Investment calculation

Cost benefit of improvements

2016-05-20
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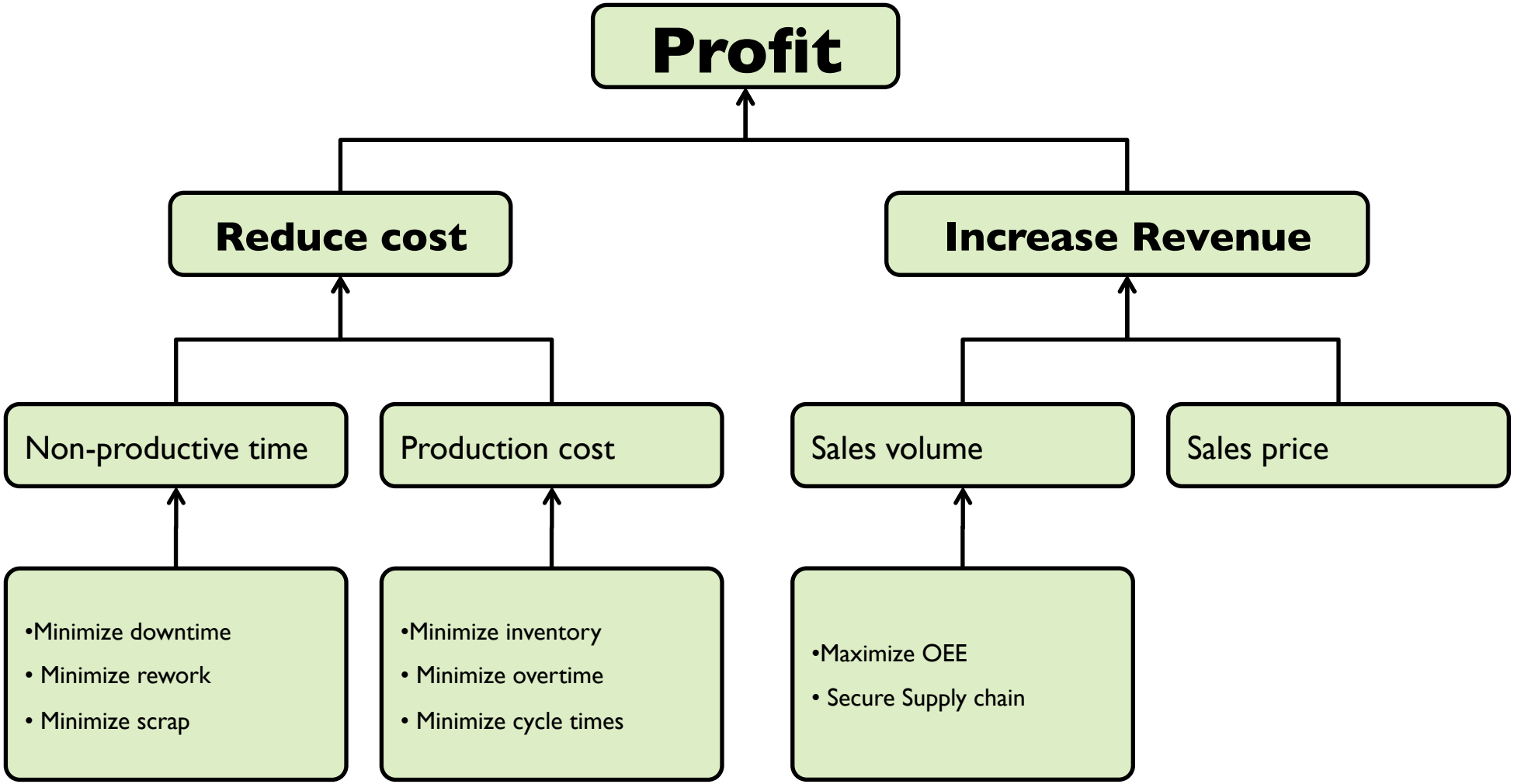
Fundamental economy

Profit = Revenue - Costs

Fundamental production economy



Investment calculation

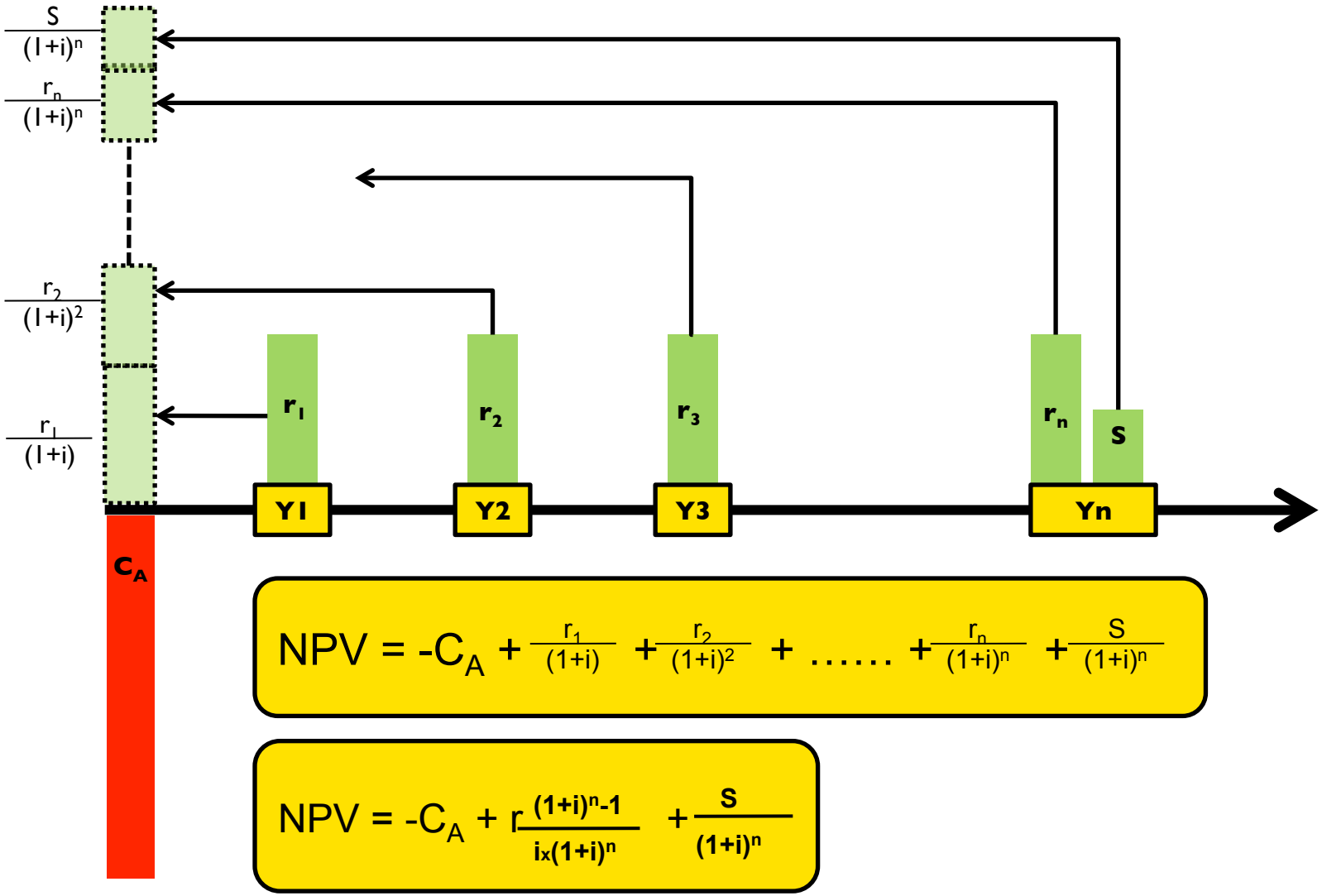
Net Present Value

(Internal Rate of Return)

Annuity Method

Pay-back Method

Net Present Value



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

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

Net Present Value

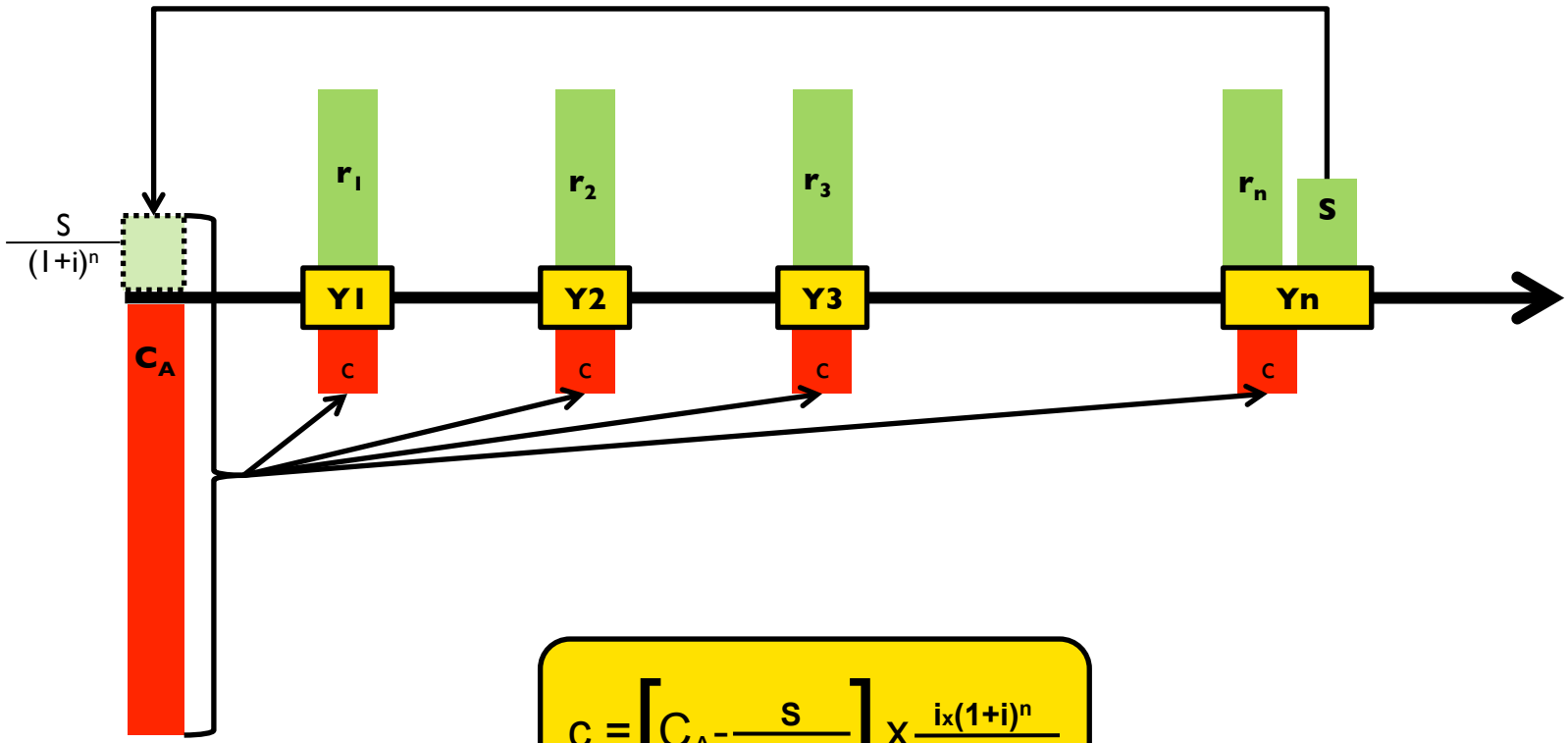
Example:
Machine cost: 500 000:-
Capacity: 16 000 details/year
Selling price: 30:-/detail
Operator salary: 100 000:-/year
Operating costs: 150 000:-/year
Economic life: 5 years
Rest value: 50 000:-
Interest rate: 10%

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

C_A = 500 000:-
S = 50 000:-
Rev = 16 000 x 30 = 480 000:-/year
Cost = 250 000:-/year
r = 480 – 250 = 230 000:-/year
i = 10%

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

Annuity Method



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

Annuity method

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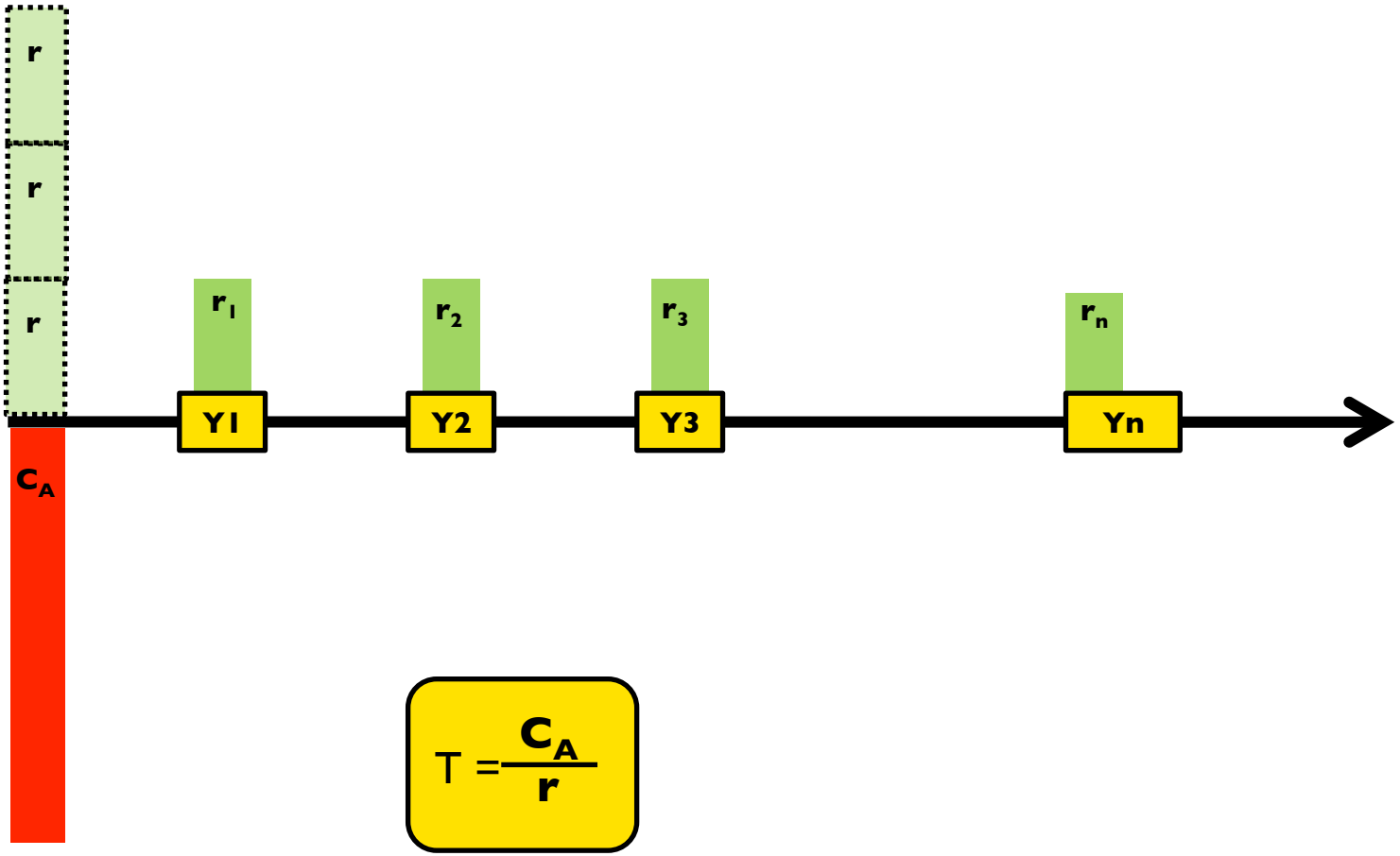
Economic life: 5 years
Rest value: 50 000:-
Interest rate: 10%

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

C_A = 500 000:-
S = 50 000:-
Rev = 16 000 x 30 = 480 000:-/year
Cost = 250 000:-/year
r = 480 – 250 = 230 000:-/year
i = 10%

$$c = \left[500 - \frac{50}{(1+0,1)^5} \right] \times \frac{0,1 \times 1,1^5}{1,1^5 - 1} = 124 < 230 \Rightarrow \text{Profit} = 106\ 000\text{:-/year}$$

Pay-back Method



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

Pay-back Method

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

C_A = 500 000:-
S = 50 000:-
Rev = 16 000 x 30 = 480 000:-/year
Cost = 250 000:-/year
r = 480 – 250 = 230 000:-/year
i = 10%

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

Pay-back Method

Even though the pay-back method is rather simplified, most companies use it at least as a method for a first assessement of the profitability of an investment.

Also, the Pay-back method is a rapid method for assessement of feasability in pre-studies such as you are performing now.

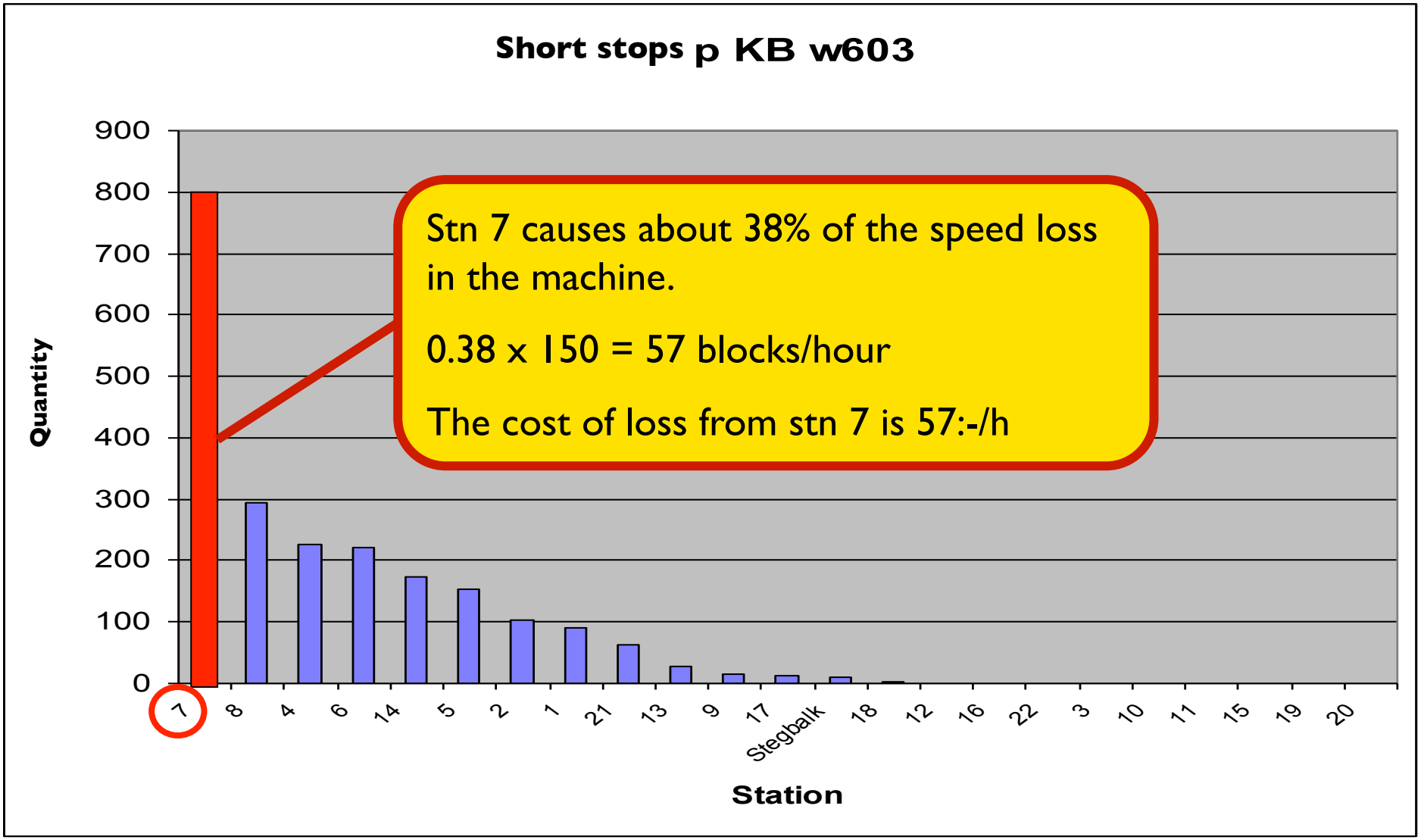
An example

A machine that have a theoretical speed of 650 components/hour.

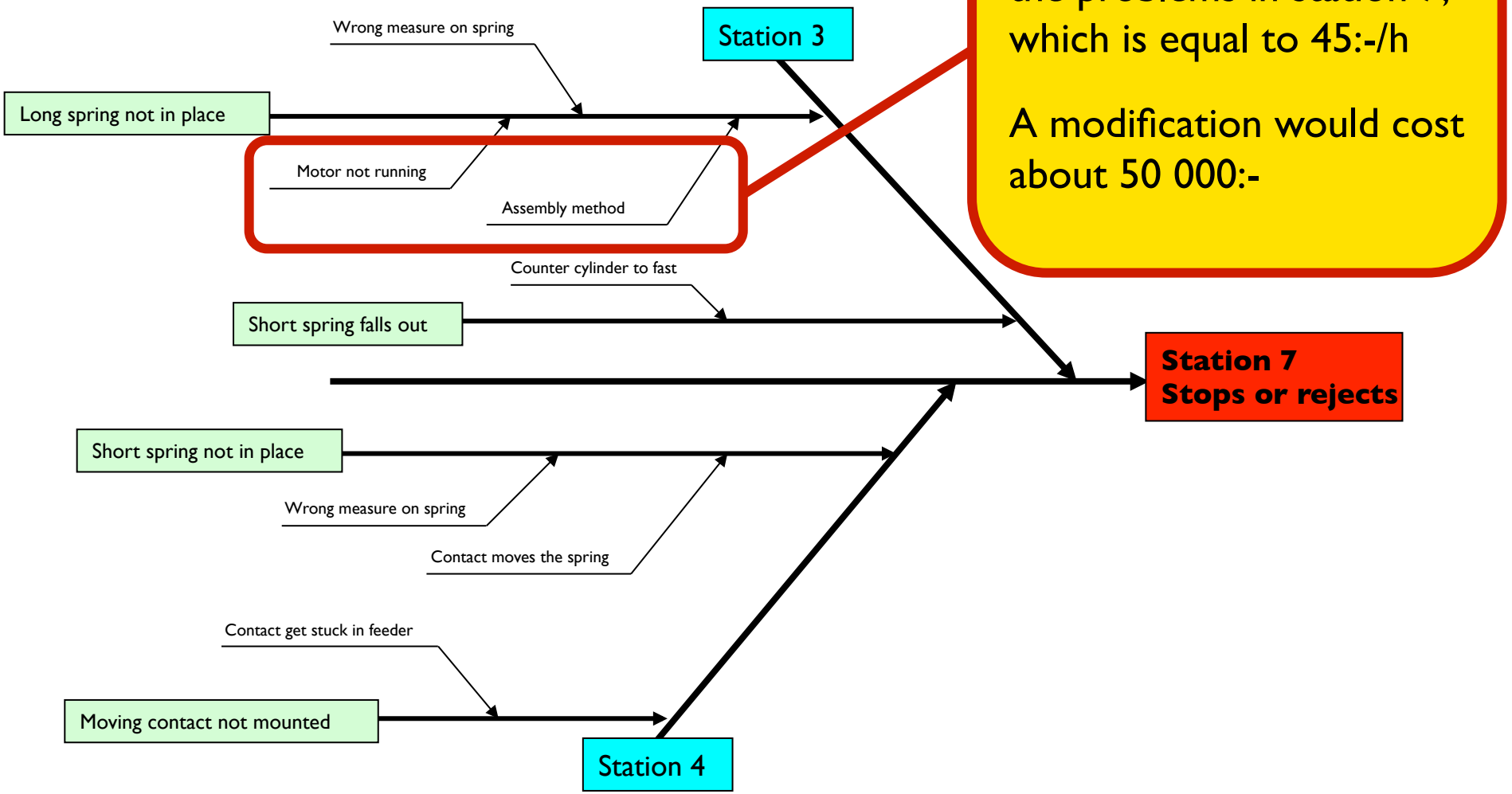
Actual output is 500 components/hour

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

An example


Short stops p KB w603
Quantity
900
800
700
600
500
400
300
200
100
0
7
8
4
6
14
5
2
1
21
13
9
17
Stegbalk
18
12
16
22
3
10
11
15
19
20
Station
Stn 7 causes about 38% of the speed loss in the machine.
0.38 x 150 = 57 blocks/hour
The cost of loss from stn 7 is 57:-/h

An example



These two causes are assessed to cause 80% of the problems in station 7, which is equal to 45:-/h

A modification would cost about 50 000:-

An example

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

Resulting production time: 82 h

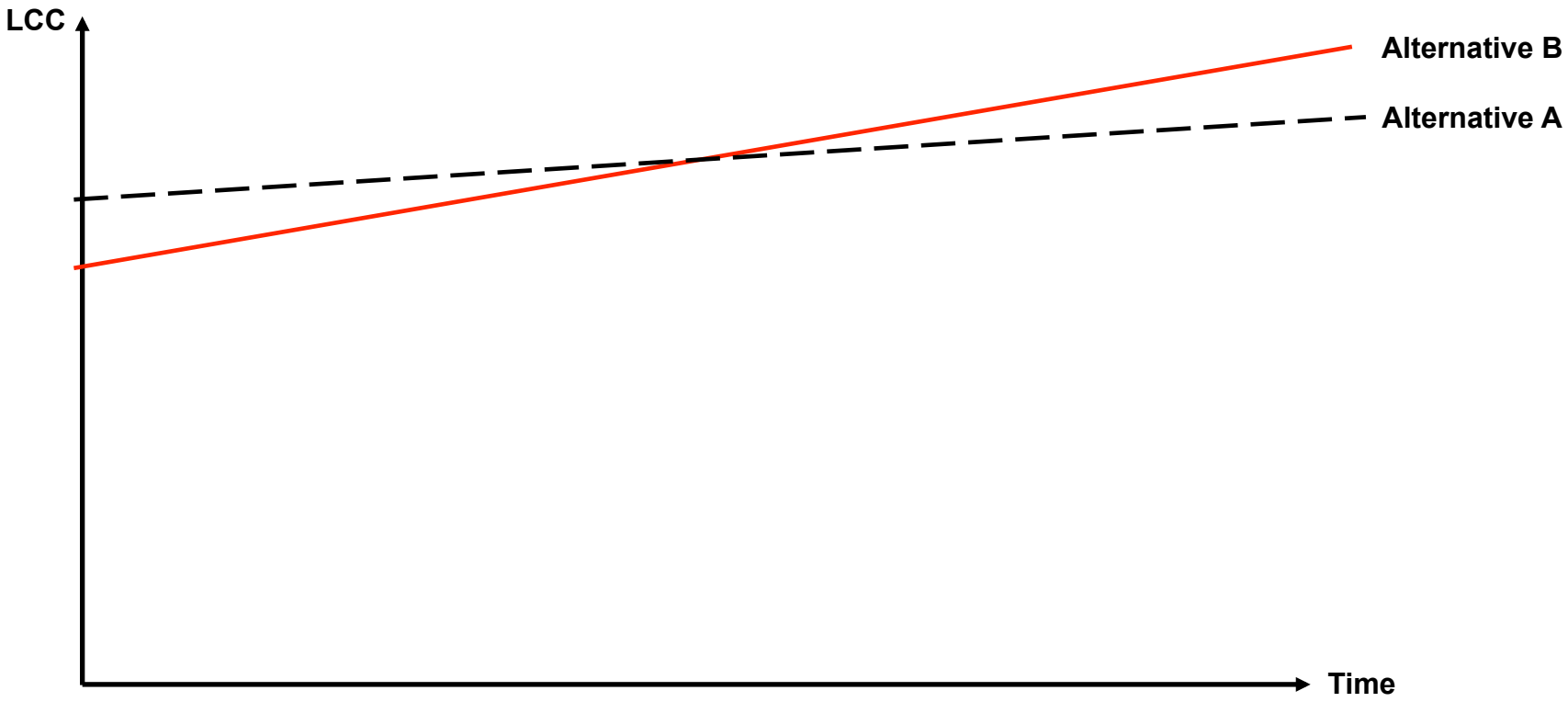
Assessed improvement potential: 45:-/h

Potential savings: 3700:-/week

Investment cost: 50 000:-

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

Using LCC for comparison



Example

	Machine X	***Machine Y***
Aquisition cost	*98500 €*	*66000 €*
Maintenance cost	*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	*12500 €/y*	*14500 €/y*
Operating hours	*4300h/y*	*4300h/y*

Time span for comparison: 20 years

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

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

Example

	Machine X	***Machine Y***
Aquisition cost	*98500 €*	*66000 €*
Maintenance cost	*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	*12500 €/y*	*14500 €/y*

$$C_{DT(X)} = 3x500x4300/420 = 15357\ €/y$$

$$LCC_X = 98500 + 20(12500 + 12500 + 15357) = 905640€$$

Example

	Machine X	***Machine Y***
Aquisition cost	*98500 €*	*66000 €*
Maintenance cost	*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	*12500 €/y*	*14500 €/y*

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

$$LCC_Y = 66000 + 20(14500 + C_M + 25083) = 905640€$$

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

Thank You!

Are there any questions?