



*Finnish Defence  
Research Agency*

# ISMS 2015 MODELLING STRATEGY EFFECTIVENESS WITH RESOURCE PROFIT RATIO INTEGRALS

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# Introduction

- Strategy is often expressed in concepts, strategic papers and principles in textual or visual formats.
- We would like to propose a new perspective for considering a question of comparing strategies via investments and profits by using integral presentation closely related to Net Present Value (NPV) used in economics.
- Our purpose is to propose a mathematical formulation for strategy effectiveness.





# Complex world of strategy

- Strategy is a tool for determining future goals, preparing forthcoming changes of functioning environment and focusing them with respect to available resources.
- In the future, automation and technology will be more present and should be taken into account in strategy studies.
- On the other hand, more applications exist the harder is to select the most suitable ones. "Diversity of possibilities"
- Therefore, we propose that successful strategy should include description of cost effectiveness i.e. profits and costs.





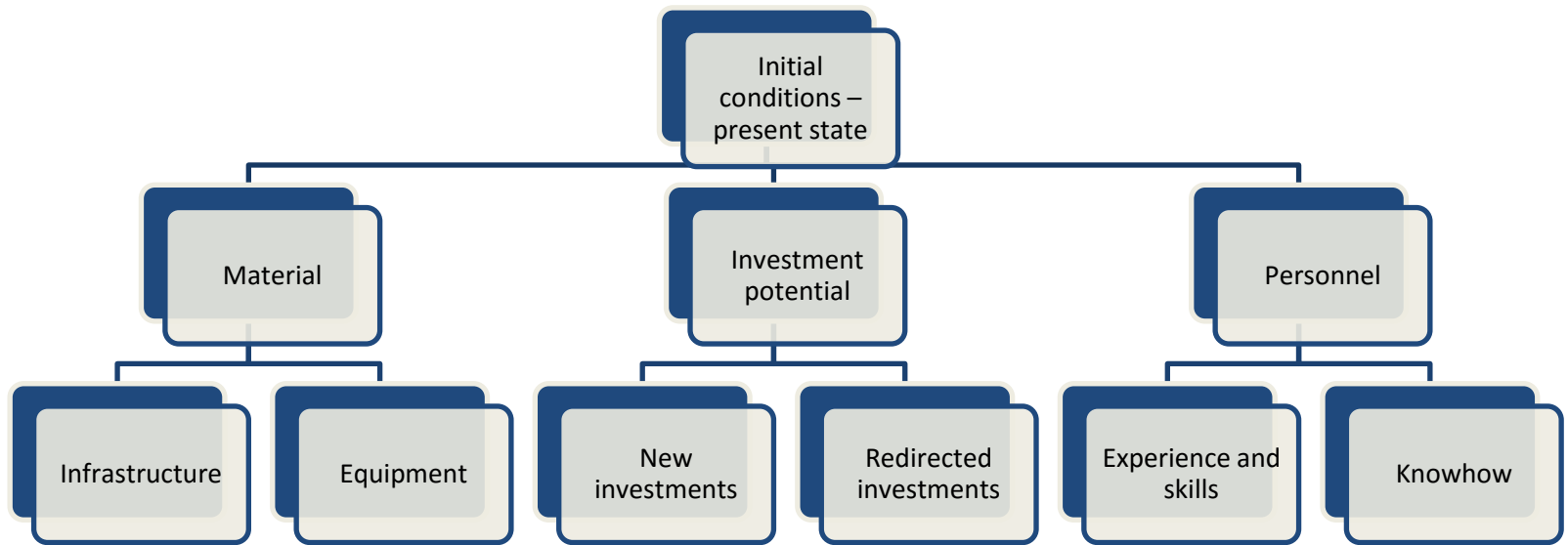
# Limitations

- Available resources
- Laws of the nature set limits for technology.
- Environmental facts should be considered.
- Laws and ethics.
- Limitations should be considered in estimating profits and needed resources in operating efficiency.
- This takes into a consideration the maximum capability of the object, machine, system or personnel invested and this should include also the effectiveness of used practises and processes.





# Analysis of the resources





# Vision of future the aimed state – recognized uncertainties

- What kind of future shall be – non-exact study.
- Ability to learn new things, ability to develop new technology
- Uncertainty of the development of markets and changes in functioning environment
- Changing prices and customer needs
- Political changes
- Trends in society





# Comparison, competition and connections of strategies

- In order to compare strategies they should represent comparable phenomena like
  - strategies of small companies
  - military strategies (possible candidates for supporting decision making)
  - wide scale of the strategy like global environmental strategy
- "Levels of strategy"
- Competition appears e.g. in markets where competitive companies try to get advantages or there are several candidates i.e. when selecting new investments or market areas.
- Connections appear between different level strategies where e.g. main strategy directs large guidelines but smaller sub-strategies provide more detailed description for smaller units.





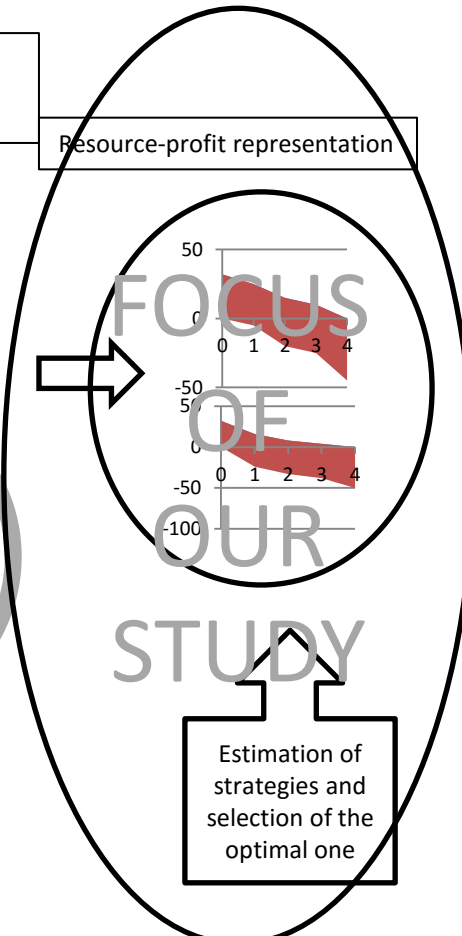
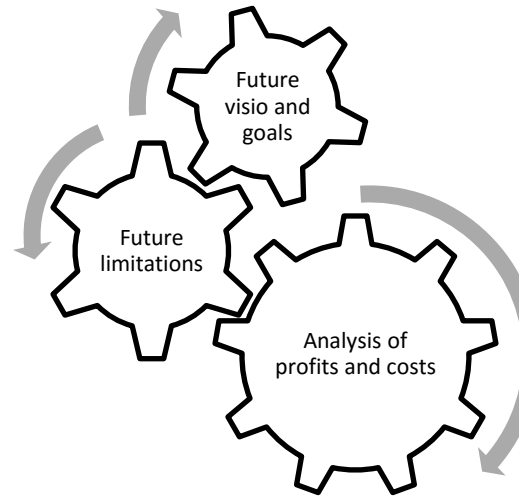
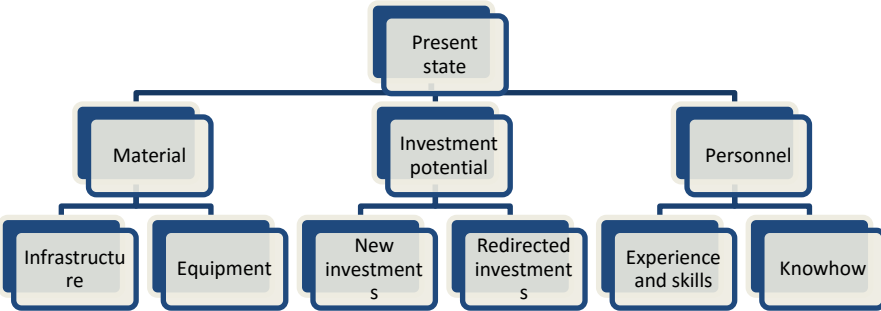
# Focus of our study

Expectations and analysis of operational environment

Existing operational environment

Constructing alternative strategies

Resource-profit representation







# Cost effectiveness -> proposed measures

- The ratio of incoming profit and the value of investment.
- A continuous version is called to Net Present Value (NPV).
- We introduced a set of measures which take into account time dependent values of resources  $R(t)$  and profits  $P(t)$ , which can be visualized by resource-profit curves.
- When resources and profits can be expressed and determined in a similar manner (e.g. in money), our measures could be applied.





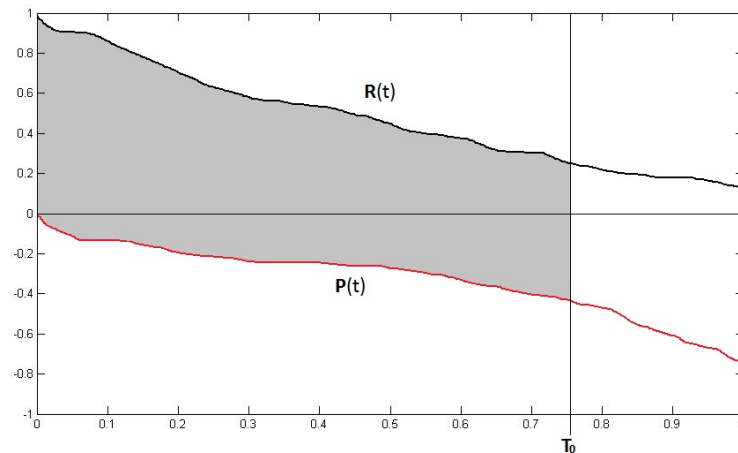
# Proposition for strategy effectiveness measures $S$

The simplest form defined over time period  $T_0$  is

$$\|S\| = 1/T_0 \int (R(t) - (-P(t)))dt.$$

which maximum  $\max\|S\| = \max \frac{1}{T_0} \int_{t=0}^{T_0} (R(t) - (-P(t)))dt$  would be of interest.

Geometrically this estimate is the area between two curves (normalized by  $T_0$ ) and does not include the possible benefits obtained earlier or later and the maximum is over the curves.





# Proposition for strategy effectiveness measures $S$

- Other propositions are for weighting by  $v$  and  $w$  resource and profits given by

$$\max \|S\| = \max \frac{1}{T_0} \int_{t=0}^{T_0} (v(t)R(t) - w(t)(-P(t)))dt,$$

- for specific interest rates familiar with economics

$$\max \|S\| = \max \frac{1}{T_0} \int_{t=0}^{T_0} (R(t)\exp(-\rho_1 t) - (-P(t)\exp(-\rho_2 t)))dt,$$

where  $\rho_1$  and  $\rho_2$  give the interest rates of the resource and the profit.

- Final estimate is NPV in continuous manner and can be expressed as

$$\max \|S\| = \max \int_{t=0}^{T_0} (\dot{R}(t)\exp(-\rho_1 t) - (-\dot{P}(t)\exp(-\rho_2 t)))dt.$$

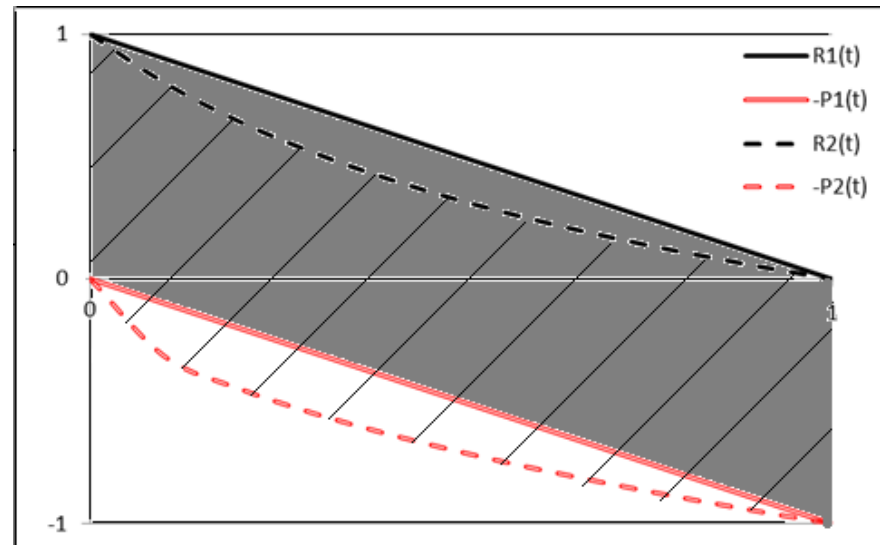
where dotted  $R$  and  $P$  are their rate of changes (derivatives).





# Comparing two strategies with introduced measures – an example

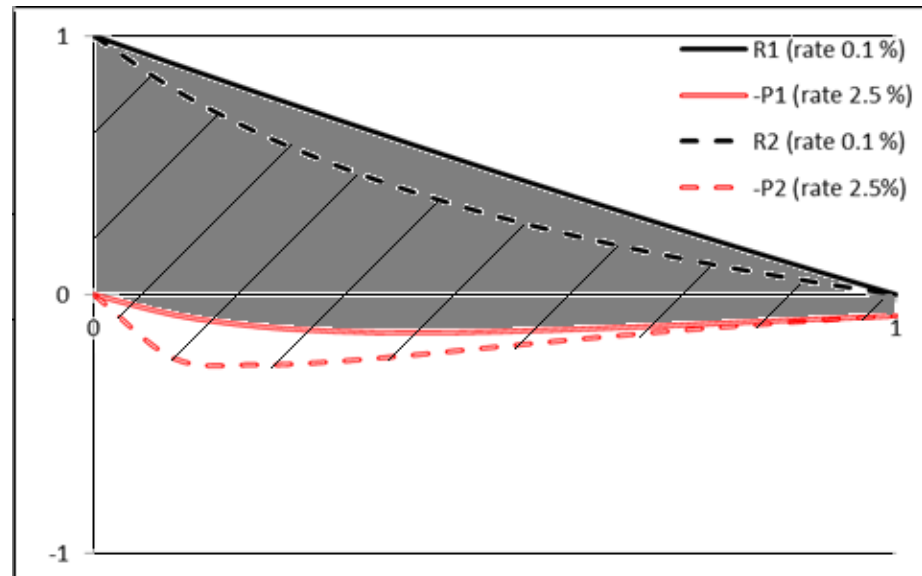
- In principle, the best choice can be impossible to determine since it would represent the maximization over all possible R-P curves.
- Let us consider a case, where in the resources are used linearly and the profits behave likely compared with a case where resources are consumed faster at the beginning producing more profits at the early stages.





# Example continues

- Let us now consider the example with two interest rates ( $\rho_1$  and  $\rho_2$ ) for the resource and the profit separately.
- We use  $\rho_1 = 0.1\%$  interest rate for the resource and  $\rho_2 = 2.5\%$  rate for the profit. This means that the strategy is that generating profit is more important than saving the resources and geometrically this looks like





# Conclusions

- We have introduced several defined integral form estimates for strategy evaluation.
- It is very difficult to observe, identify and take into account all cost-like matters for a specific strategy as well as to estimate all achieved profits.
- According to our best knowledge general time dependent strategy estimates have not been introduced earlier and our goal was to quantify strategy study.
- We concentrated in the outcome reached by the usage of resources and it is understood that the profit has to be commensurate with the resource.
- Another option is to consider both the resource and the profits as relative numbers.
- The presented example is schematic and numerical values are not considered.
- In future, more detailed considerations could be studied for testing and developing the introduced methods.





Thank You

