UiO : University of Oslo

**IN5431 – spring 2024**

# Business case, concept selection and alternative analysis

# Agenda

- Introduction
- On making decisions
- The business case
- Generic decision making process
- Summary

# Introduction

# Planned lectures (subject to change)

| Date | Time | Topic |
|---|---|---|
| Fri. 19. Jan | 12:15–14:00 | Introduction of course and seminar |
| Fri. 26. Jan | 12:15–14:00 | Strategy, governing documents and other structural frames: what does it mean, and what is the importance of IT? |
| Fri. 2. Feb | 12:15–14:00 | Tools and frameworks 1: Introduction + projects |
| Fri. 9. Feb | 12:15–14:00 | Tools and frameworks 2: concept selection and alternative analysis with a business case |
| Fri. 16. Feb | 12:15–14:00 | Tools and frameworks 3: Business processes and IT architecture |
| Fri. 1. Mar | 12:15–14:00 | Tools and frameworks 4: IT Governance & platforms. |
| Fri. 19. Apr | 12:15–14:00 | Agile organizations |

Strategy and strategic context

Management tools and frameworks

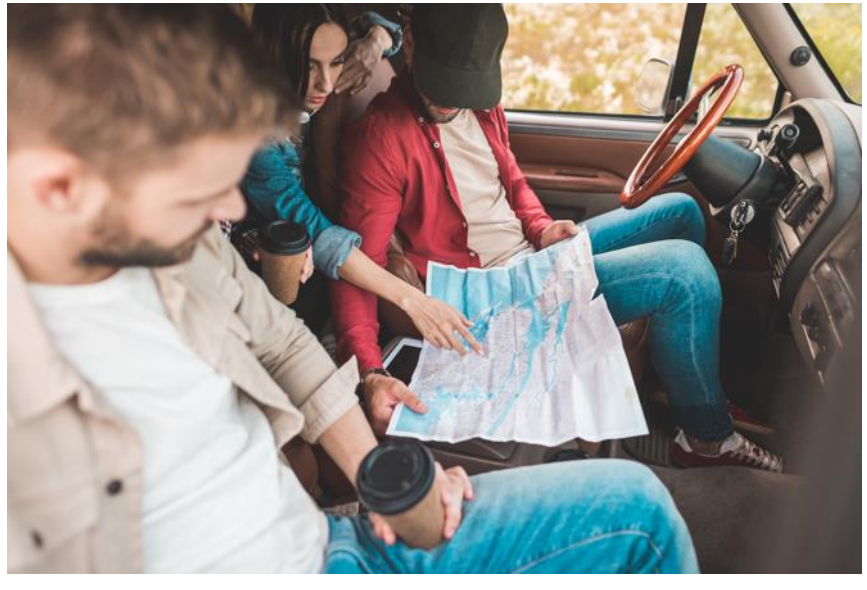
| Date | Time | Topic | What is it really about? |
|---|---|---|---|
| Fri. 26. Jan | 12:15–14:00 | Strategy, governing documents and other structural frames: what does it mean, and what is the importance of IT? | The really big decisions in an organization: what should we improve the forthcoming years? Important discussion before choosing strategy: what are we really working together for – and who are we competing with? |
| Fri. 2. Feb | 12:15–14:00 | Tools and frameworks 1: Introduction + projects | After deciding improvements, one needs to make some kind of sub-organization to coordinate the improvements. One typical sub-organization is a project. There are several frameworks to manage projects. |
| Fri. 9. Feb | 12:15–14:00 | Tools and frameworks 2: concept selection and alternative analyzis with a business case | Both while working explicitly on strategy and in the daily operation of an organization, important prioritziation decisions must be made. There are established approaches for this as well – here we discuss some of them. |
| Fri. 16. Feb | 12:15–14:00 | Tools and frameworks 3: Business processes and IT architecture | |
| Fri. 1. Mar | 12:15–14:00 | Tools and frameworks 4: IT Governance & platforms. | |
| Fri. 15. Mar | 12:15–14:00 | Agile organizations | |

# Recall from the first lecture: Prioritization is essential to all management

- In a typical organization, there is no shortage of good suggestions for improvement – both from internal and external stakeholders
- An important part of management work is to:
  - Understand the current situation: how is the organization fit for current and forthcoming challenges?
  - Categorize and analyze possible options to improve
  - Prioritize these options and then initialize concrete initiatives to achieve the desired results

# Recall from the first lecture: Prioritization is essential to all management

- In a typical organization, there is no shortage of good suggestions for improvement – both from internal and external stakeholders
- An important part of management work is to:
  - Understand the current situation: how is the organization fit for current and forthcoming challenges?
  - Categorize and analyze possible options to improve
  - Prioritize these options and then initialize concrete initiatives to achieve the desired results



Focus of today

# Utility maximisation

1. Consider your options of investing (money, time, ...)
2. For each option, analyse:
   a. the expected benefit ("return on investment")
   b. the expected cost
   c. the timing - when do I get the benefits?
   d. the estimated risk – usually focusing on the probability that either benefits turn out lower than expected, or costs turn out higher than expected
3. Choose the most attractive option, considering both the expected benefit, the expected cost, the timing, and the risk

# Notes on utility maximisation

- Benefits are not always monetarian
- The hard part is:
  - Estimating benefit, cost and risk
- Anyone with managerial responsiblity are expected to prioritize resources to maximize utility for her organization

# On making decisions

# Rational choices

Economists have been debating the "rationality" of choice for centuries.

It is clear: there are no completely rational actors.

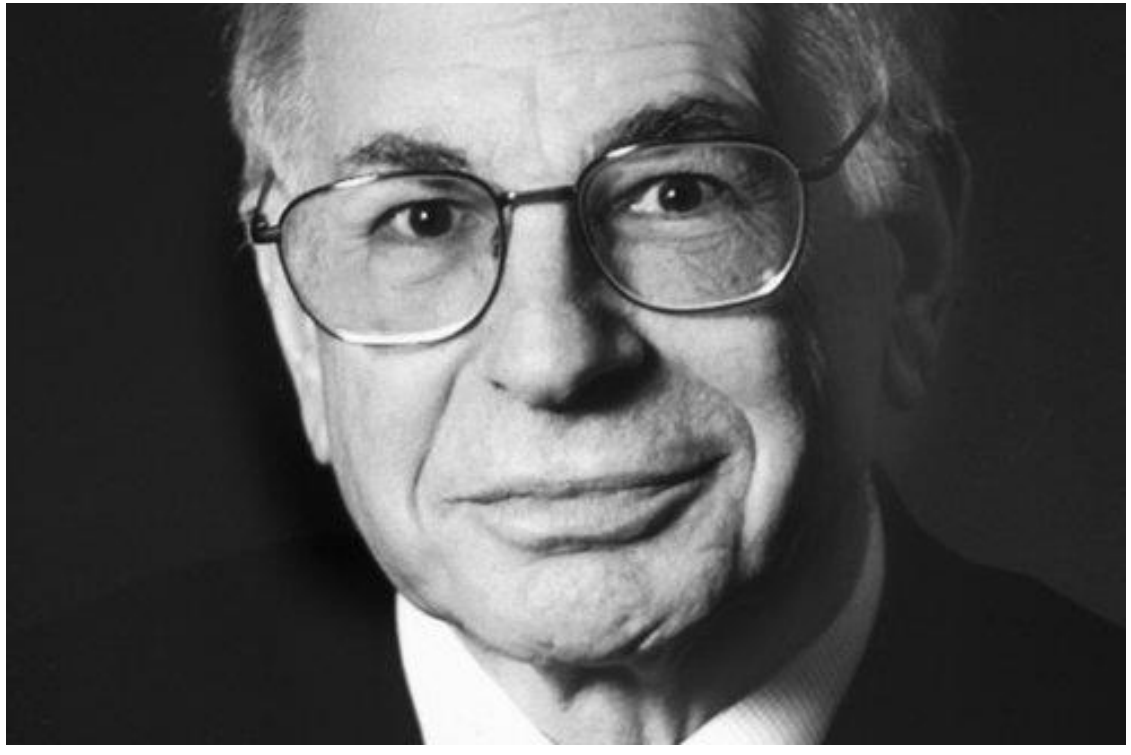
This means any attempt of utility maximisation is, in practice, blurred by both individual's emotions and the cultural context of the organization

Unfortunately, professionals' intuitions do not all arise from true expertise. Many years ago I visited the chief investment officer of a large financial firm, who told me that he had just invested some tens of millions of dollars in the stock of Ford Motor Company.

When I asked how he had made that decision, he replied that he had recently attended an automobile show and had been impressed. "Boy, do they know how to make a car!" was his explanation. He made it very clear that he trusted his gut feeling and was satisfied with himself and with his decision.

I found it remarkable that he had apparently not considered the one question that an economist would call relevant: Is Ford stock currently underpriced? Instead, he had listened to his intuition;

*Kahneman, Daniel. Thinking, Fast and Slow (p. 12). Penguin Books Ltd., Kindle Edition.*



# The first step of choice: consider your options

- No standardized process, depending on situation

- Simple example:
  - Individual training budget
  - Planning the summer party
- Complex examples:
  - A consulting company considering to grow through purcase
  - A startup struggling for funding
  - Government agency planning a project

# A spectrum of decision making effort

**Little effort**
intuitive
response/"gut feeling"

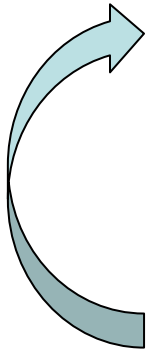
**Significant effort**
detailed alternative
analysis

No absolute recommendation – and this is heavily debated. What is the appropriate level of analysis in a given situation, in particular with a high level of uncertainty?

General guideline: high impact decisions, little prior experience, less trust and/or shared perspective among decision makers mandate higher level of analysis.

# Generic decision making process

# What are the key steps of problem solving/ identifying opportunities?



Iterate
as needed

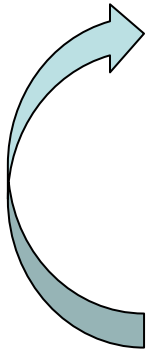
| Step | Description | Note |
|---|---|---|
| 1. Understand the situation | Using available methods (could be interviews, document analysis, expert observation and external information sources), aim to achieve a clear picture of the current situation within the organization. – preferably including root cause-analysis | Try to understand the "whys" – including both internal competency, technical assets, and cultural factors |
| 2. Synthesize options | Based on analysis, present alternative actions. These can often be "concepts", e.g. an internally consistent set of work items | Strive to ensure the recipient feel that all the relevant options are considered |
| 3. Evaluate and propose | For each of the alternative actions/concepts (see step 2), present advantages , disadvantages. Then present a recommendation | The level of detail in the evaluation is adapted according to situation |

**Little effort**
intuitive
response/"gut feeling"

**Significant effort**
detailed alternative
analysis

# What are the key steps of problem solving/ identifying opportunities?

| Step | Description | Note |
|---|---|---|
| 1. Understand the situation | Using available methods (could be interviews, document analysis, expert observation and external information sources), aim to achieve a clear picture of the current situation within the organization. – preferably including root cause-analysis | Try to understand the "whys" – including both internal competency, technical assets, and cultural factors |
| 2. Synthesize options | Based on analysis, present alternative actions. These can often be "concepts", e.g. an internally consistent set of work items | Strive to ensure the recipient feel that all the relevant options are considered |
| 3. Evaluate and propose | For each of the alternative actions/concepts (see step 2), present advantages , disadvantages. Then present a recommendation | The level of detail in the evaluation is adapted according to situation |



Iterate as needed

**Little effort**
intuitive response/"gut feeling"

**Significant effort**
detailed alternative analysis

**In organizations: How can the alternatives / concepts evaluated in a transparent way?**

# Two common approaches

- ***Quantify*** the expected cost and benefit for each alternativ using money: which alternative is the most profitable?
- ***Qualitatively*** evaluate important properties for each alternative

# Quantitatively comparing alternatives: The Business Case

UiO : University of Oslo

A more detailed analysis of these four factors

## Utility maximisation

1. Consider your options of investing (money, time, ...)
2. For each option, analyse:
   a. the expected benefit ("return on investment")
   b. the expected cost
   c. the timing - when do I get the benefits?
   d. the estimated risk – usually focusing on the probability that either benefits turn out lower than expected, or costs turn out higher than expected
3. Choose the most attractive option, considering both the expected benefit, the expected cost, the timing, and the risk

# Comparing alternatives

- Goodumbrellas Inc has been struggling to get Umbrella Heaven up and running
- After spending $2 million without any real results, they are now considering their options
- The board has asked the management to come up with three alternative actions

# Comparing alternatives

- After working day and night, the middle-managers of Goodumbrellas and their subordinates can finally present three alternative directions:

## A: Halt

Accept losses, and cancel the plan to establish a consumer market channel

## B: Continue

Continue efforts, and assume experience reduces risk of further challenges

## C: Outsource

Outsource the initiative – find a provider with proven success to give Umbrella Heaven the love it deserves

## A: Halt

Accept losses, and cancel the plan to establish a consumer market channel

## B: Continue

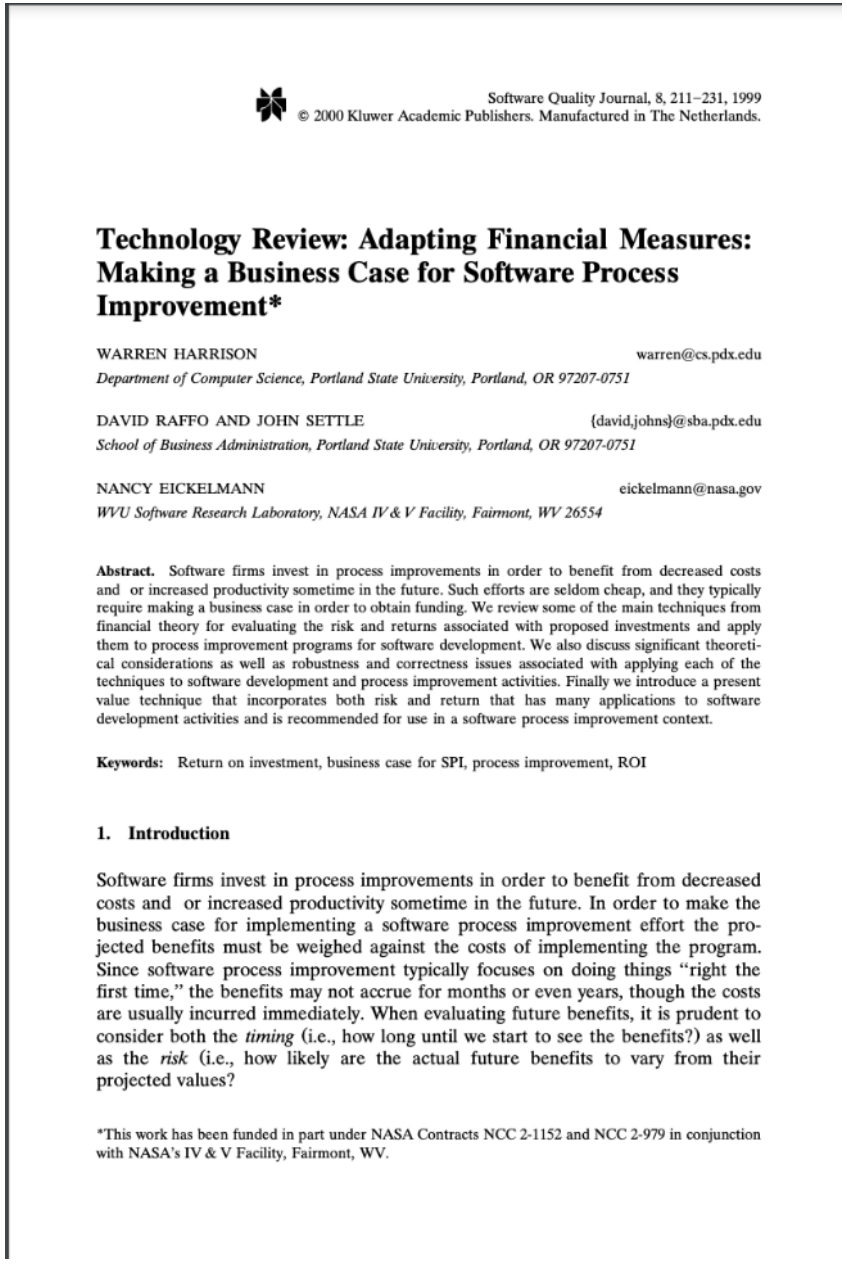
Continue efforts, and assume experience reduces risk of further challenges

## C: Outsource

Outsource the initiative – find a provider with proven success to give Umbrella Heaven the love it deserves

# What should they choose?

# The business case



Software Quality Journal, 8, 211–231, 1999


# Technology Review: Adapting Financial Measures: Making a Business Case for Software Process Improvement*

WARREN HARRISON warren@cs.pdx.edu
*Department of Computer Science, Portland State University, Portland, OR 97207-0751*

DAVID RAFFO AND JOHN SETTLE {david,johns}@sba.pdx.edu
*School of Business Administration, Portland State University, Portland, OR 97207-0751*

NANCY EICKELMANN eickelmann@nasa.gov
*WVU Software Research Laboratory, NASA IV & V Facility, Fairmont, WV 26554*

**Abstract.** Software firms invest in process improvements in order to benefit from decreased costs and or increased productivity sometime in the future. Such efforts are seldom cheap, and they typically require making a business case in order to obtain funding. We review some of the main techniques from financial theory for evaluating the risk and returns associated with proposed investments and apply them to process improvement programs for software development. We also discuss significant theoretical considerations as well as robustness and correctness issues associated with applying each of the techniques to software development and process improvement activities. Finally we introduce a present value technique that incorporates both risk and return that has many applications to software development activities and is recommended for use in a software process improvement context.

**Keywords:** Return on investment, business case for SPI, process improvement, ROI

## 1. Introduction

Software firms invest in process improvements in order to benefit from decreased costs and or increased productivity sometime in the future. In order to make the business case for implementing a software process improvement effort the projected benefits must be weighed against the costs of implementing the program. Since software process improvement typically focuses on doing things "right the first time," the benefits may not accrue for months or even years, though the costs are usually incurred immediately. When evaluating future benefits, it is prudent to consider both the *timing* (i.e., how long until we start to see the benefits?) as well as the *risk* (i.e., how likely are the actual future benefits to vary from their projected values?

*This work has been funded in part under NASA Contracts NCC 2-1152 and NCC 2-979 in conjunction with NASA's IV & V Facility, Fairmont, WV.

Harrison, Warren, et al. "Technology review: adapting financial measures: making a business case for software process improvement." *Software Quality Journal* 8.3 (1999): 211-231

# Present value

- When considering the benefits of an investment, the actual value is insufficient – the timing of the yield must also be considered.
- Minimal example: earning 100,000 this year is better than earning 100,000 in 10 years.

$$PV = FV \frac{1}{(1+r)^n}$$

| | | |
|---|---|---|
| PV | = | present value |
| FV | = | future value |
| r | = | annual discount rate (Norwegian: "diskonteringsrenten") |
| n | = | the number of years |

# Why present value?

- Assume your company has 10 000 000 NOK to invest. Oslo Børs (the stock exchange) has given an average return of investment on 10% the last 5 years.
- Assuming the same trend:
  - Five years from now, we will have ca 16 105 000 NOK
  - 10 years from now, we will have ca. 25 940 000 NOK
- For a company, any way to invest the 10 000 000 must have an expected future value exceeding these numbers (assuming the investment has similar risk as the stock market)

# PV shorthand

Generic formula:

$$PV = FV\frac{1}{(1+r)^n}$$

Let

$FV = \$10{,}000$
$r = 10\%$
$n = 2$

Then

$$PV = \$10{,}000\,\frac{1}{(1+10\%)^2} = \frac{\$10{,}000}{\left(1+\frac{10}{100}\right)^2} = \frac{\$10{,}000}{(1.10)^2} = \$8{,}264.463$$

# More complete example

A project manager has the option of either purchasing a new testing tool for $250,000 or using the same resources to hire and train additional Test Engineers. It has been projected that the new testing tool would provide $600,000 in cost savings within a year by automating several aspects of the testing effort.

The effort savings would allow fewer testers to be assigned to the project. Thus, it is not expected that any defects would be found that would not be found with the current testing staff.

However if the manager chose instead to hire additional Test Engineers, at the end of three years, it is expected that the additional staffing will be responsible for $750,000 in rework cost savings by finding additional defects prior to release. Assuming an annual discount rate of 15%.

Testing Tool - $600,000 in one year

$PV_{tool}$ $600,000 / $(1.15)^1 = \$521,739$

Hire Testers - $750,000 in three year

$PV_{hire}$ $750,000 / $(1.15)^3 = \$439,421$

Despite the higher final yield, the "Testing Tool" alternative is the most valuable under these assumptions, as the cost savings are available within one year compared to three for the "Hire Testers" alternative

# Dealing with periodic returns

In practice, an investment rarely yields all returns at once.

For an investment expected to yield the following returns at the end of each year:

$Return_1$: $10,000
$Return_2$: $20,000
$Return_3$: $30,000

Given a discount rate of 10%, the overall present value – PV(total) - is:

PV(total) =
PV(Y1) + PV(Y2) + PV(Y3) =
$\$10,000/1.10^1 + \$20,000/1.10^2 + \$30,000/1.10^3$ =
$9,091 + $16,529 + $22,539 = $48,159

Generic formula:

$$PV_{total} = \sum_{i=1}^{n} \frac{Return_i}{(1+r)^i}$$

# Net present value (NPV)

The "Net present value" (Norwegian: "netto nåverdi") is simply the periodic result of the investment, i.e. profit – cost, subtracted any initial investment (I)

$$NPV = \sum_{i=1}^{n} \frac{Result_i}{(1+r)^i} - I$$

# NPV-example (in NOK)

| Period | Result | PV (discount rate = 10%) |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 100 000 | 82 645 |
| 3 | 150 000 | 112 697 |
| 4 | 500 000 | 341 507 |
| 5 | 500 000 | 310 461 |
| **Sum** | | **847 309** |

Initial investment: 600 000

$$NPV = \sum_{i=1}^{n} \frac{Result_i}{(1+r)^i} - I$$

which means *NPV* = 847 309 – 600 000 = 247 309

# Example: comparing alternatives

Assume you develop and sell a custom CMS. You have decided to improve quality control.

Should you:

A: Hire manual testers. This will cost 100 000/year, and is expected to give an increased profit of 200 000/year

B: Invest in automated tests. This will require an initial investment of 350 000, also with an expected profit of 200 000/year

With discount rate = 10%, we get

$$NPV_A = \sum_{i=1}^{5} \frac{100\,000}{(1{,}10)^i} - 0 = 379\,079$$

$$NPV_B = \sum_{i=1}^{5} \frac{200\,000}{(1{,}10)^i} - 350\,000 = 408\,157$$

# What about risk?

Assume you develop and sell a custom CMS. You have decided to improve quality control.

Should you:

A: Hire manual testers. This will cost 100 000/year, and is expected to give an increased profit of 200 000/year

B: Invest in automated tests. This will require an initial investment of 350 000, also with an expected profit of 200 000/year

With discount rate = 10%, we get

$$NPV_A = \sum_{i=1}^{5} \frac{100\,000}{(1{,}10)^i} - 0 = 379\,079$$

$$NPV_B = \sum_{i=1}^{5} \frac{200\,000}{(1{,}10)^i} - 350\,000 = 408\,157$$

Experience has shown you that the cost of automatic tests might be more unpredictable.

How to represent this in the calculation?

# What about risk? Add a risk premium to the discount rate.

A: Hire manual testers. This will cost 100 000/year (500 000 total), and is expected to gain 200 000/year

B: Invest in automated tests. This will require an initial investment of 350 000, also with an expected gain of 200 000/year

For Alternative A , risk premium is 2%

$$NPV_A = \sum_{i=1}^{5} \frac{100\,000}{(1{,}12)^i} - 0 = 360\,478$$

For Alternative B , risk premium is 10%

$$NPV_B = \sum_{i=1}^{5} \frac{200\,000}{(1{,}20)^i} - 350\,000 = 248\,122$$

# With and without risk adjustment

| | NPV without risk | NPV with risk |
|---|---|---|
| Alternative A | 379 079 | **360 478** |
| Alternative B | **408 157** | 248 122 |

Clearly, how you determine the risk adjustment has a huge impact on the result

# On applying NPV

To calculate the NPV for a set of options, you must be able to:

- Predict the cost of implementation
- Predict quantitative return
- Predict the timing of the return
- Assess the risk of each option

For any non-trivial development initiative, setting these values correctly is impossible – they are estimates. In addition, benefits might be hard or impossible to estimate numerically – in particular if they are related to safety or security.

# On applying NPV

To calculate the NPV for a set of options, you must be able to:

- Predict the cost of implementation
- Predict quantitative return
- Predict the timing of the return
- Assess the risk of each option

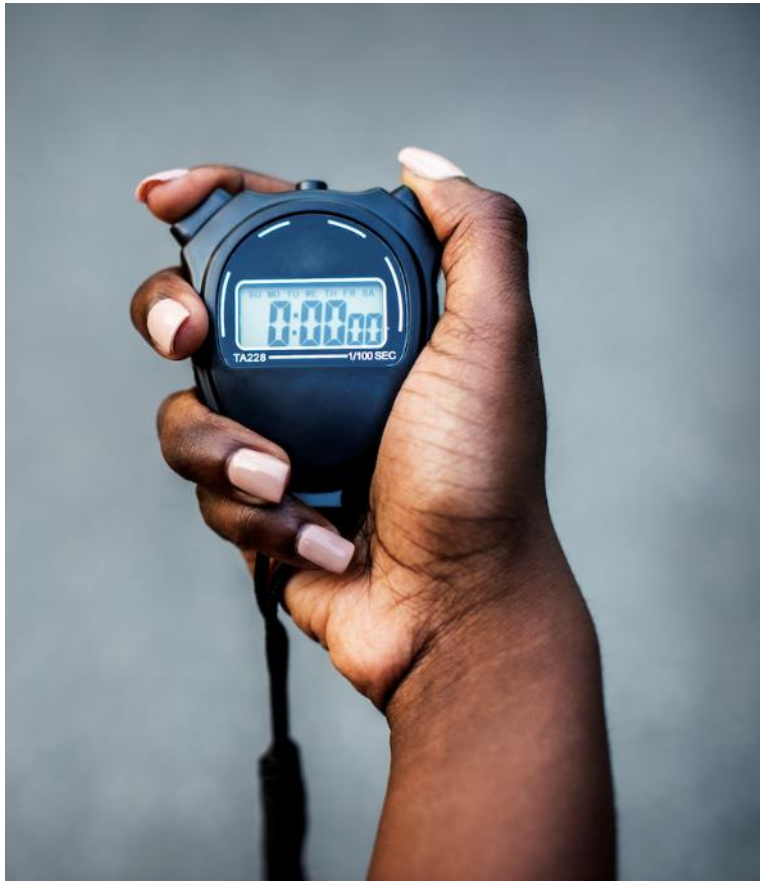
For any non-trivial development initiative, setting these values correctly is impossible – they are estimates. In addition, benefits might be hard or impossible to estimate numerically – in particular if they are related to safety or security.

On the other hand, NPV has a strong communicative effect.

In a decision process, NPV is often presented together with a set of "non-quantatifiable" benefits for each of the options.

# Estimating benefits: what are typical benefits?

- Quantifiable
  - time saved
  - "conversion rate" (interested vs purchasing customers)
  - user satisfaction
- Non-quantifiable
  - compliance to legal requirements
  - increased safety or security



| Alternative | Description | Investment | NPV compared to «alternative sero» |
|---|---|---|---|
| «Alternative zero» | Proceed with the same system as today for 5 more years | 1 961 MNOK | 0 |
| Basic modernization | Minimal level of modernization to be able to extend the lifetime significantly | 1 961 MNOK | 224 MNOK |
| Modern system portfolio | Includes basic modernization, but also a new self-service portal, more automization and further modernization | 2 394 MNOK | 1 245 MNOK |
| Transformative change | An extension of both basic modernization and modern system portolio – with higher levels of self-service and automization | 3 136 MNOK | 1 369 MNOK |

Source: https://www.ntnu.no/documents/1261860271/1261975586/KS1+Modernisering+av+IKT+i+utlendingsforvaltningen+-+uten+vedlegg+150722.pdf (slightly adapted)

# Bias

In a business case-analysis of a given set of options, it is surprisingly common to find that both the NPV and the non-quantifiable benefits are highest for the alternative most desired by the group analysing the options.

" For 22 billion, one can build three new hospitals the size of Østfold Kalnes Hospital. You can run Ahus for 5 years. With 22 billion, you can cover the salary costs of all GPs in Norway for over five years and there is no doubt that we need more GPs. One would think that before embarking on such a project, a thorough socio-economic analysis will be carried out to map the benefits of such a gigantic measure. Then one unfortunately has to think again.

In fact, two such analyses have been carried out by the Directorate for e-Health. I will take as my starting point the updated analysis, which is more pessimistic than the first, but which, somewhat depending on which calculation one looks at, still believes that this measure will generate 3–4 billion in socio-economic profits. In addition, there are non-quantified gains that are considered substantial. These are the quantified gains I am most critical of. "

Source: https://www.dn.no/innlegg/eric-navdal/helse/direktoratet-for-e-helse/samfunnsokonomien-i-den-nye-journallosningen/2-1-847344

# Back to Goodumbrellas

## A: Halt

Accept losses, and cancel the plan to establish a consumer market channel

## B: Continue

Continue efforts, and assume experience reduces risk of further challenges

## C: Outsource

Outsource the initiative – find a provider with proven success to give Umbrella Heaven the love it deserves

| | A: Halt | B: Continue | C: Outsource |
|---|---|---|---|
| Estimated yearly result | | | |
| Year 1 | 0 | -$1,000,0000 | -$3,000,000 |
| Year 2 | 0 | - $500,000 | -$500,000 |
| Year 3 | 0 | $1,000,000 | $1,000,000 |
| Year 4 | 0 | $1,500,000 | $1,500,000 |
| Year 5 | 0 | $3,000,000 | $3,000,000 |
| Risk adjustment and discounting rate – base rate 4% | | | |
| Risk adjustment | 0 | 30% | 10% |
| Discounting rate | 4% | 4% + 30% = 34% | 4% + 10% = 14% |

| | A: Halt | B: Continue | C: Outsource |
|---|---|---|---|
| **Estimated yearly result** | | | |
| Year 1 | 0 | -$1,000,0000 | -$3,000,000 |
| Year 2 | 0 | - $500,000 | -$500,000 |
| Year 3 | 0 | $1,000,000 | $1,000,000 |
| Year 4 | 0 | $1,500,000 | $1,500,000 |
| Year 5 | 0 | $3,000,000 | $3,000,000 |
| **Risk adjustment and discounting rate – base rate 4%** | | | |
| Risk adjustment | 0 | 30% | 10% |
| Discounting rate | 4% | 4% + 30% = 34% | 4% + 10% = 14% |
| **Net Present Value** | | | |
| | $0 | $550,497 | $104,885 |

# Brief example: Qualitative comparision

# The «plus/minus»-method

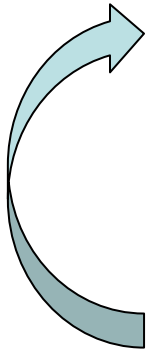
| | K2 Order in own house | K10 Coordinated regional centers | K12 Order in the educational sector | K14 The knowledge center |
|---|---|---|---|---|
| Initial phase | 5 | 10 | 10 | 15 |
| Investment | 50 | 100 | 70 | 125 |
| Tax financial cost | 10 | 20 | 15 | 30 |
| Sum | 65 | 130 | 95 | 170 |
| Yearly mainenance | 9 | 8 | 12 | 10 |
| **Rank cost** | **1** | **3** | **2** | **4** |
| Reduced effort, consumers | + | ++ | ++ | +++ |
| Reduced effort, data producers | 0 | ++ | + | ++ |
| Increased use of data | ++ | +++ | +++ | +++ |
| Correct use of data | ++ | +++ | +++ | ++++ |
| Improved data protection | ++ | +++ | +++ | ++++ |
| **Rank benefits** | **4** | **2** | **3** | **1** |
| Risk | Low | Medium /high | Medium | High |
| Real options | High | Medium | High | Low |
| **Overall evaluation** | **3** | **2** | **1** | **4** |

Adapted from https://www.regjeringen.no/contentassets/0ff78b4f861b43e8a7e52d5f02dbbd34/sluttrapport-fremtidig-deling-av-data-1.1.pdf (in Norwegian)
See also https://dfo.no/sites/default/files/Fagomr%C3%A5der/Utredninger/Veileder-i-samfunnsokonomiske-analyser.pdf (in Norwegian), section 3.4.8

# Summary

# What are the key steps of problem solving/ identifying opportunities?

| Step | Description | Note |
|---|---|---|
| 1. Understand the situation | Using available methods (could be interviews, document analysis, expert observation and external information sources), aim to achieve a clear picture of the current situation within the organization. – preferably including root cause-analysis | Try to understand the "whys" – including both internal competency, technical assets, and cultural factors |
| 2. Synthesize options | Based on analysis, present alternative actions. These can often be "concepts", e.g. an internally consistent set of work items | Strive to ensure the recipient feel that all the relevant options are considered |
| 3. Evaluate and propose | For each of the alternative actions/concepts (see step 2), present advantages , disadvantages. Then present a recommendation | The level of detail in the evaluation is adapted according to situation |



Iterate as needed

**Little effort**
intuitive response/"gut feeling"

**Significant effort**
detailed alternative analysis

**Examples of methods to evaluate:**
- Business case
- The «plus/minus»-method

# Summary

- No standard way of making choices
- For high impact decisions, little prior experience, less trust and/or shared perspective among decision makers: spending time to make a business case is often worthwile
- Business case is no exact science – bias, experience and sometimes politics affects the result
- Pay sufficient attention to presenting your results