UiO : University of Oslo

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Business case, concept selection and alternative analysis

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Introduction

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



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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 choices

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.

The Business Case

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A more detailed analysis of these four factors



Utility maximisation

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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

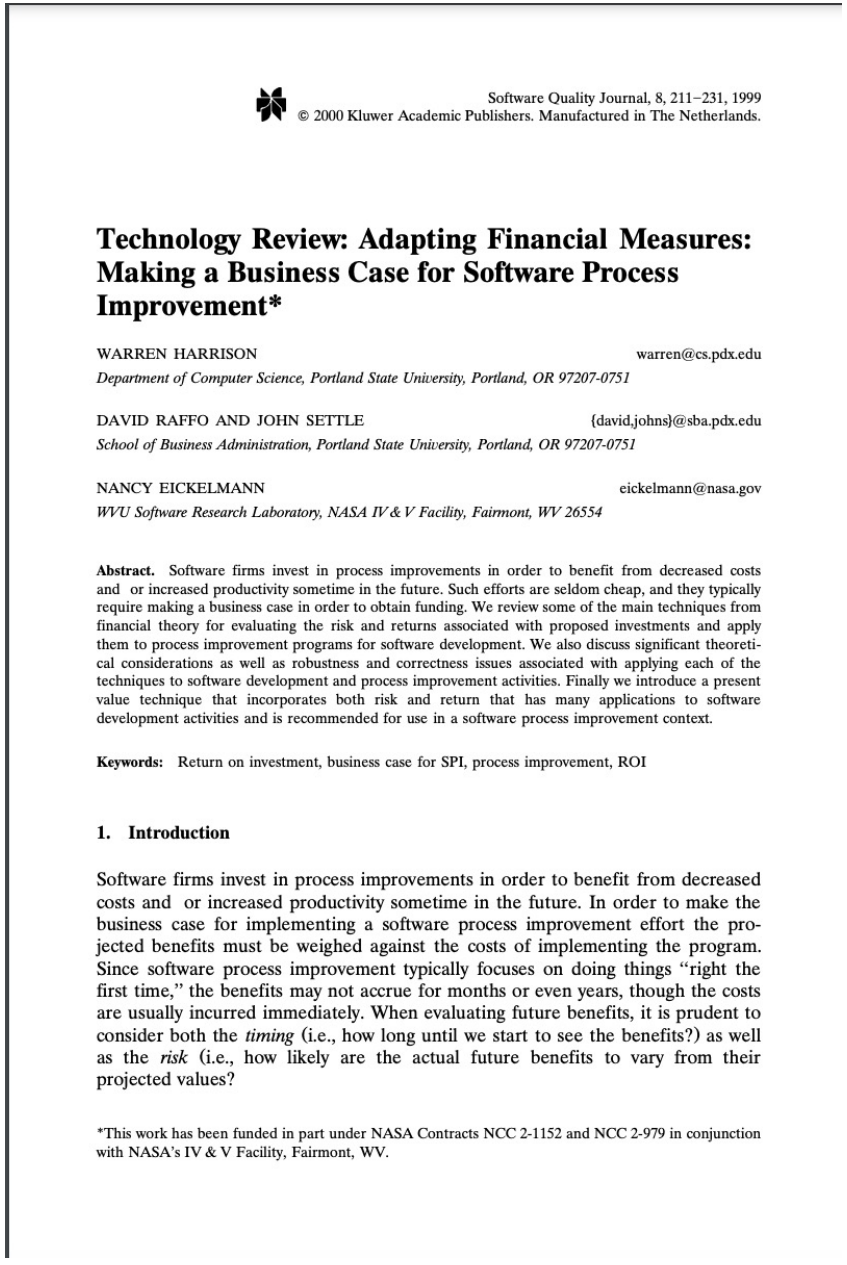
Continue efforts, and assume experience reduces risk of further challenges

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

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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

PV shorthand

Generic formula:

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

Let

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

Then

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

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 one 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?

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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.

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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?

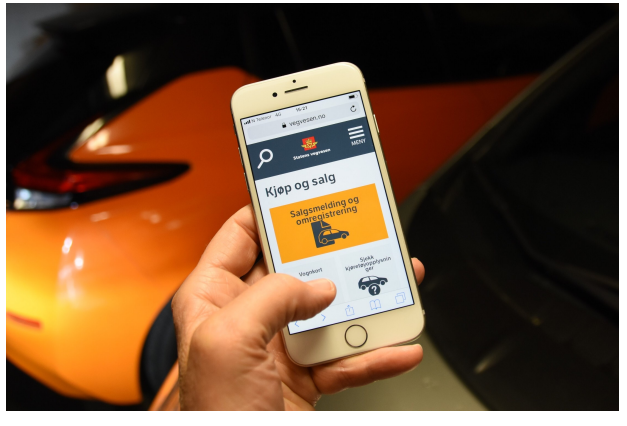
- Quantifiable
  - time saved
  - "conversion rate" (interested vs purchasing customers)
  - user satisfaction
- Non-quantifiable
  - compliance to legal requirements
  - increased safety or security



- Nå går alt digitalt, som registrering, salgsmelding og forsikring. Det er langt smidigere og mer effektivt enn før. Vi har nok spart minst to årsverk på dette, om jeg skal gi et veldig forsiktig anslag, sier Lars Erik Presterud, konsernleder for bilforhandleren Erik Arnesen.



De nytteverdien av Autosys er formidabel, ifølge Statens vegvesen. I november sendte etaten beregninger til regjeringen der de skrev at systemet «har gitt samfunnsnytte på om lag 6 milliarder kroner».



Source:
https://www.aftenposten.no/norge/i/PRPQ95/statens-vegvesens-prosjekt-ble-omtalt-som-en-skandale-i-aarevis-naa-rev

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 analyzes 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

Making your case

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

Step	Description	Note
1. Analyse the situation	Using interviews, document analysis 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

	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

Summary

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

