The Economics of Innovation Procurement

2nd SEREN3 Training for stakeholders on PCP/PPI in Secure Societies

30th of May 2017, Warsaw, Poland

Dr. Anne Rainville
Management Consultant, Vtrek

Vtrek
Empowering procurement economics

Julianaplein 21, 5211 BB 's-Hertogenbosch
The Netherlands
+31 (0)6 - 1090 4079
info@vtrek.eu

Outline

- Introduction to procurement economics
- Innovation procurement
  - Pre-commercial Procurement (PCP)
  - Public Procurement of Innovative Solutions (PPI)
- Introduction to the Business Case Methodology
- Economic evaluation – theory and practice
  - Uncertainty - Justifying PCP
  - Time - Discounting, Net Present Value, Returns
  - The stand-alone PPI
  - Reaping rewards – Royalty Schemes
- Discussion

Vtrek

What is Procurement Economics

- Public Procurement is ~18% of European GDP
- To support demand-side innovation
  - Demand-pull vs supply-push
- To help procurers achieve:
  - Primary goals – service improvement, cost reduction
  - Secondary goals – innovation, sustainability
- To support rational and transparent decision-making
  - Building a business case
  - Gaining internal project support

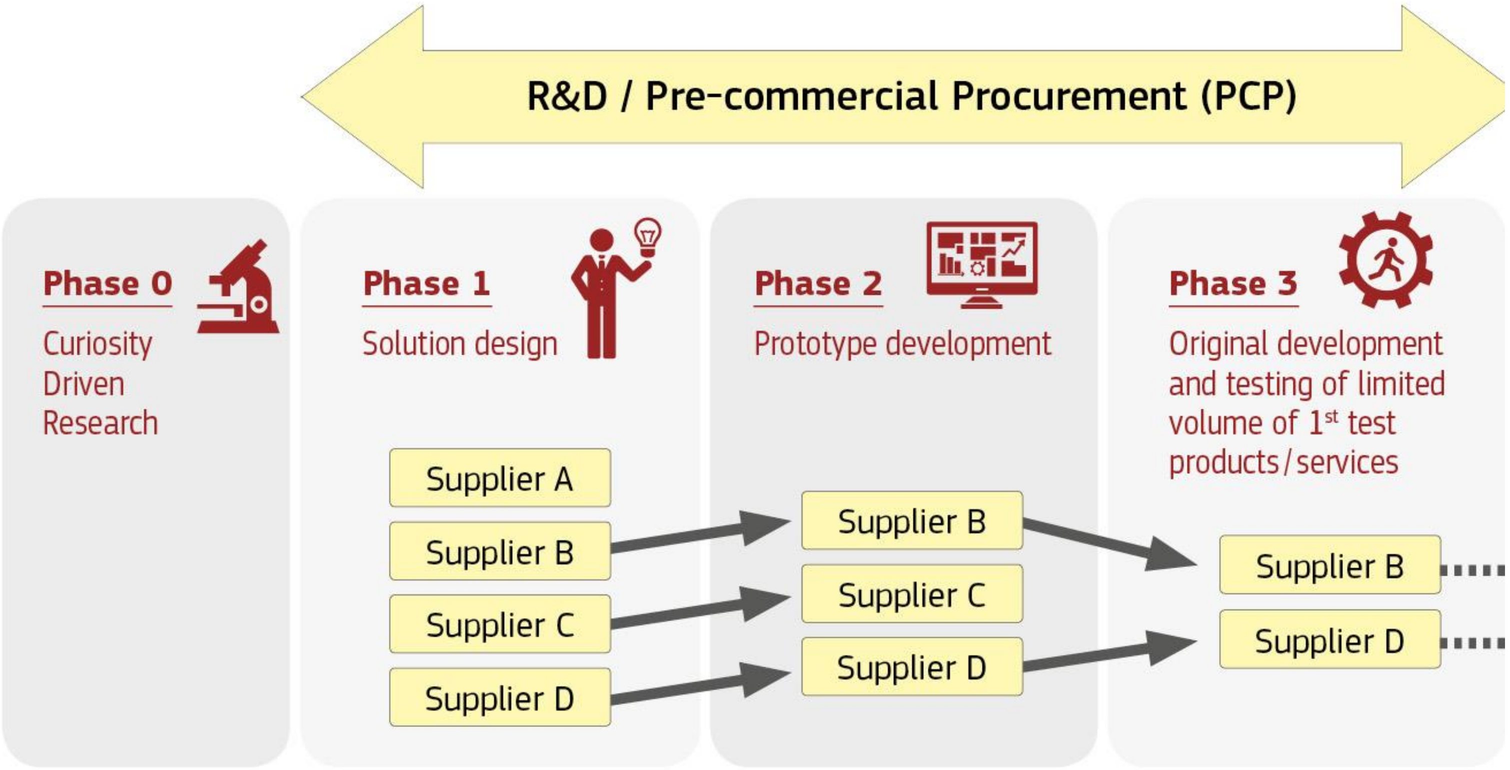
Vtrek

Pre-Commercial Procurement (PCP)

- Develop and test new solutions through R&D to meet the challenge identified
- Purchase R&D to
  - Steer the development of solutions to procurers' needs
  - Gather knowledge on pros/cons of alternative solutions
  - Support a competitive supply base (avoid later lock-in)
- Purchase R&D from several suppliers in parallel (comparing alternative solution approaches)
- Closed competition and evaluating progress after critical milestones (design, prototyping, testing)
- (IPR-related) Risks and benefits of R&D are shared between procurer and suppliers - Maximizes incentives for wide commercialization

Vtrek

Phases of PCP

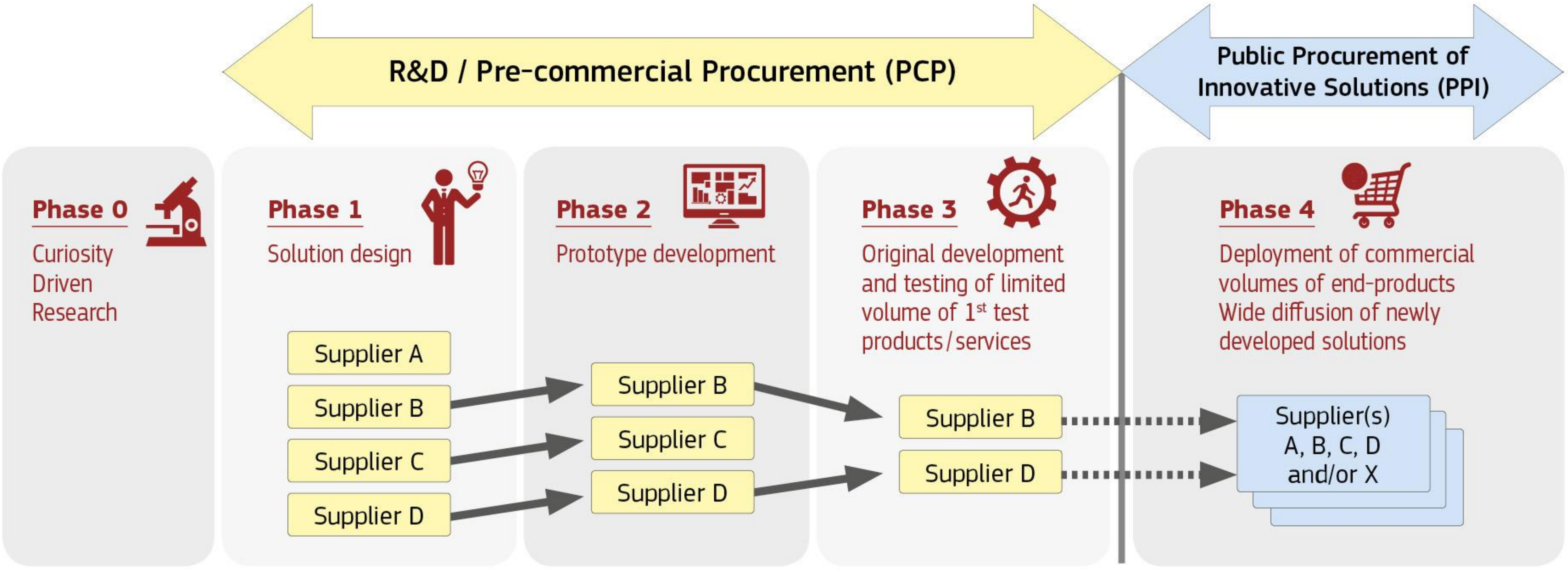


Public Procurement of Innovative Solutions (PPI)

- Incremental innovation or scaling up to meet the identified challenge
  - No R&D takes place – is already completed, or not required to solve the challenge
- When a solution is
  - Near to the market
  - Already on the market, but in small quantities
- Procurer acts as launching customer / early adopter / first buyer

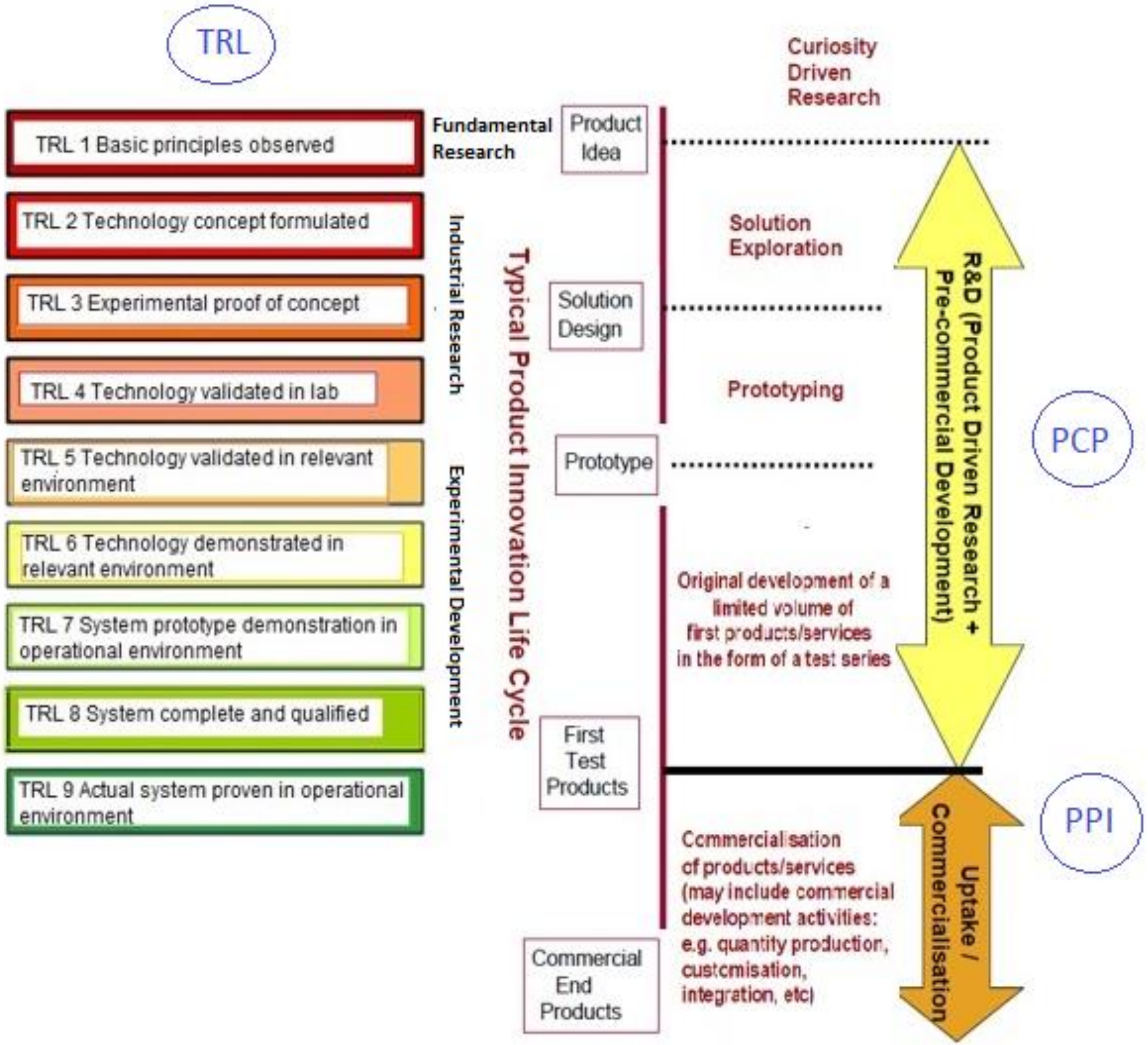
Vtrek

Innovation procurement



Phases of a PPI

1. Announce intention to buy a critical mass of innovative solutions triggers industry to bring products to the market
   - With a desired price : quality ratio
   - Within a specific time
2. Verify whether what market delivers the desired quality/price – e.g. via a test and/or certification
3. Purchase a significant volume of innovative solutions.


TRL
TRL 1 Basic principles observed
TRL 2 Technology concept formulated
TRL 3 Experimental proof of concept
TRL 4 Technology validated in lab
TRL 5 Technology validated in relevant environment
TRL 6 Technology demonstrated in relevant environment
TRL 7 System prototype demonstration in operational environment
TRL 8 System complete and qualified
TRL 9 Actual system proven in operational environment
Fundamental Research
Industrial Research
Experimental Development
Typical Product Innovation Life Cycle
Product Idea
Solution Design
Prototype
First Test Products
Commercial End Products
Curiosity Driven Research
Solution Exploration
Prototyping
Original development of a limited volume of first products/services in the form of a test series
Commercialisation of products/services (may include commercial development activities: e.g. quantity production, customisation, integration, etc)
R&D (Product Driven Research + Pre-commercial Development)
Uptake / Commercialisation
PCP
PPI

Vtrek

Business Case Methodology

- To help public procurers engage in innovation procurement by reducing risks and identifying incentives
- … By identifying the procurer's need for innovation and private actors' abilities to meet this need
- Six steps:
  1. Needs identification and assessment;
  2. Prior art analysis and intellectual property rights (IPR) search;
  3. Analysis of the standards' landscape;
  4. Economic calculations; and
  5. Open market consultation
- Procurers can directly apply the methodology during the preparatory phase

An ICT hardware solution? - The Case Study

- There are currently 100 units of an ICT technology
- The technology is non-functioning 5% of the time
- Repair costs are € 27,50/hour, and repair takes 9 hours
  - Total monthly cost: €27,50/hour x 9 hours x 100 units = €99.000/month
- A procurer wants to reduce the down-time by half
  - Potential monthly savings: € 99.000/month ÷ 2 = € 49.500/month
- The procurer estimates the price of the solution (all units) at € 100.000

Vtrek

What the procurer needs to decide

- Whether to purchase **R&D services**, or conduct a **PCP**?
- Would a PCP+PPI be **profitable**?
- How long do we have to implement the new technology before we **break even**?
- What royalty rate should we offer as **a profit-sharing agreement**?

Uncertainty and the PCP

Uncertainty – Probabilities

- No future is certain
- Uncertainty can come from
  - Technology unknowns – costs, performance, reliability
  - Market unknowns – prices, economies of scale, openness
- We introduce probability to account for uncertainty
  - Is always a factor between 0 (will never happen) and 1 (will always happen)

$$0 < q < 1$$

- Values with uncertainty are *expected*, not *real*

Every day I walk my dog in the morning. Twice a week, we see joggers.

- Throughout the entire week, you have a 29% (2 days / 7 days) chance of seeing joggers.

$$q = .29$$

Justifying a 3-phase PCP - Overview

- The probability that the full R&D budget has to be paid even if the benefits don't occur is always lower in a PCP (3-phase vs 1-phase)
- Based on a market consultation, the procurer estimates the following probabilities of success at each phase:
  - S1 $q1 = 0{,}70$
  - S2 $q2 = 0{,}75$
  - S3 $q3 = 0{,}80$

Project Phase	Expense	Probability	Variable
PCP phase 1	200,000	0.70	q1
PCP phase 2	300,000	0.75	q2
PCP phase 3	500,000	0.80	q3
Purchase	100,000	0.42	q=q1*q2*q3

- Then the R&D success rate is q1*q2*q3 = ,7*,75*,8=,42. Therefore q=0,42

Vtrek

Justifying a 3-phase PCP - Costs

- Costs for the public procurer in an all-in-one R&D services contract

$$C1 = \begin{cases} (1.000.000 + P) & with\ probability\ q \\ 1.000.000 & with\ probability\ 1 - q \end{cases}$$

$$\mathrm{EC1} = (1.000.000 + \mathrm{P})\mathrm{q} + 1.000.000(1 - \mathrm{q})$$

$$\mathrm{EC1} = €1.042.000$$

  - The probability of complete loss is $1 - q$ =1-,42=58%

- Costs for the public procurer in a PCP contract with 3 phases

$$C3 = \begin{cases} (1.000.000 + P) & with\ probability\ q \\ 200.000 & with\ probability\ 1 - q1 \\ 200.000 + 300.000 & with\ probability\ q1 * (1 - q2) \\ 200.000 + 300.000 + 500.000 & with\ probability\ q1 * q2 - q1 * q2 * q3 \end{cases}$$

$$EC3 = (1.000.000 + P)q + 200.000(1 - q1) + 500.000\big(q1(1 - q2)\big) + 1.000.000(q1q2 - q1q2q3)$$

$$EC3 = €714.500$$

  - The probability of complete loss is $q1 * q2 - q1 * q2 * q3$ =10,5%

Vtrek

Justifying a 3-phase PCP - Benefits

- Benefits for each are the same, where t is the number of months the solution is implemented

$$B = \begin{cases} 49.500 * t & \textit{with probability } q \\ 0 & \textit{with probability } 1 - q \end{cases}$$

$$\mathrm{EB} = 49.500\mathrm{tq} + 0(1 - \mathrm{q})$$

- If the procurer estimates implementation of the resulting PPI over 48 months, then

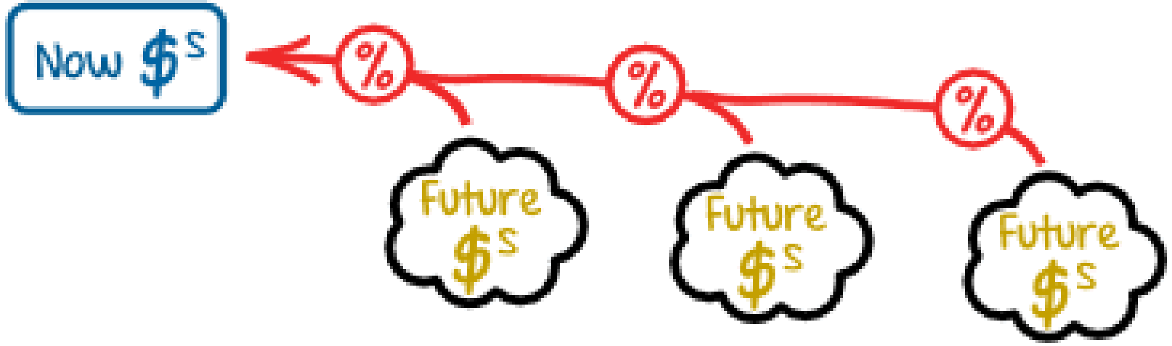
$$\mathrm{EB} = 49.500 * 48 *, 42 = €997.290$$

- We can now calculate the **Return on Investment (ROI)**

$$ROI = \frac{EB - EC}{EC}$$

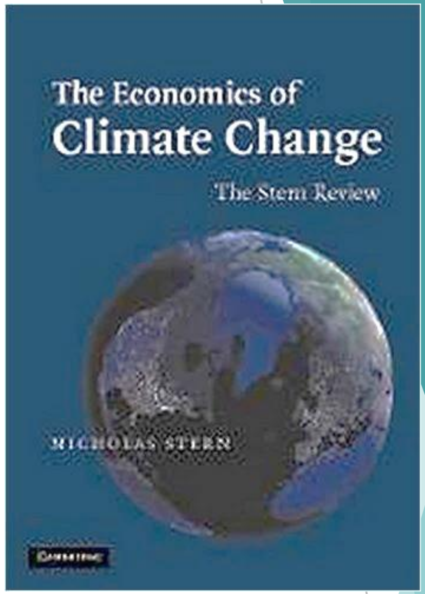
- For the 3-phase PCP, the ROI is 37.4%, compared with the single stage of -4.2%

Vtrek



Time & Value

Time – discounting



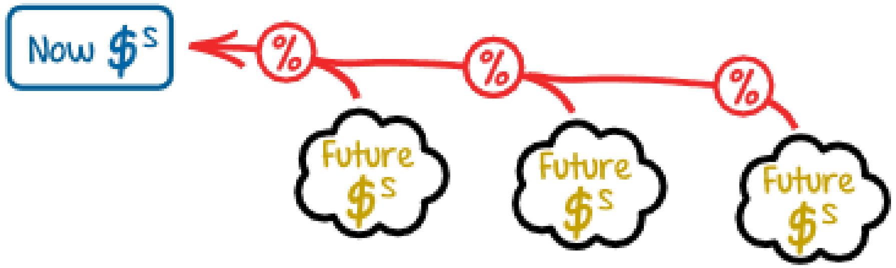
- For a more accurate estimates, we need to introduce time
- To do this, we use a discount factor δ, based on a discount rate i

$$\delta = \frac{1}{(1+i)^t}$$

  - Every month t, the discount factor decreases
  - The further in the future a cost or benefit is incurred, the less it affects our present value of the situation
- In our example, the procurer uses a financial interest rate of i=0,12% per month (1,44%/year) to calculate their discount factor
- Discounting choices
  - The lower the discount rate, the greater value placed on the future
    - e.g. social policy vs private investment in capital (7-12%)

Time – Flowsheet for Valuing Future Costs and Benefits

Months from Present	Value	1	2	3		4	5	6	7	8	9
Costs (R&D)	1,000,000	-	-	200,000	-	-	-	-	-	-	300,000
Costs (Price)	100,000	-	-	-	-	-	-	-	-	-	-
Benefit (Savings - cost reduction)	2,425,500	-	-	-	-	-	-	-	-	-	-
Discount factor	Present Value	0.99880	0.99760	0.99641		0.99521	0.99402	0.99283	0.99164	0.99045	0.98926
Costs (R&D discounted)	985,383	-	-	199,282		-	-	-	-	-	296,779
Costs (Price discounted)	97,163	-	-	-		-	-	-	-	-	-
Benefit (Savings - cost reduction discounted)	2,290,147	-	-	-		-	-	-	-	-	-



Calculating Net Present Value

- **Present value** – the sum of discounted cash flows
  - PV(Costs) and PV(Benefits)
- Since we are using expected (vs real) benefits and costs, we use PV(EC) and PV (EB)

$$NPV = PV(EB) - PV(EC)$$

- The procurer wants to know if the project is worth considering – if its NPV is positive (>0)

$$NPV = PV(EB) - PV(EC) > 0$$

- This is equivalent to the benefits being greater than the costs (hence, Cost-Benefit Analysis)

$$PV(EB) > PV(EC)$$

Vtrek

Calculating Present Value of Expected Benefits

- Compared with costs, benefits are received over a number of months
- We need to add up the discounted expected benefits over each month

$$PV(B) = \begin{cases} B * (\delta^{V1} + \delta^{V1+1} + \delta^{V1+2} \dots \delta^{V2}) = \sum_{t=V1}^{V2} \frac{B}{(1+i)^t} & \text{with probability } q \\ 0 & \text{with probability } 1-q \end{cases}$$

$$PV\ (EB) = q * \sum_{t=V1}^{V2} \frac{B}{(1+i)^t}$$

- Where B are the benefits, V1 is the first month that the solution is implemented, and V2 is the last
- In our example, the solution is implemented from month 24 until month 72 from the beginning of the PCP. The PV(EB) is therefore € 941.662.

$$PV\ (EB) = 0{,}42 * \left(\sum_{t=1}^{72} \frac{49.500}{(1+{,}0012)^{72}} - \sum_{t=1}^{24} \frac{49.500}{(1+{,}0012)^{24}}\right)$$

$$= 0{,}42 * (\ 3.412.415 - \ 1.170.364\ )$$

$$= \ 941.662$$

Vtrek

Calculating Present Value of Expected Costs

- While the PV(EB) occur over a period of time, PV(EC) occur at discreet points in time
- We calculate PV(EB) by inputting values for
  - costs of phase S (1, 2, and 3)
  - month M (1, 2, and 3) when the phase ends
  - probabilities of success (q1, q2, q3) at each phase

$$PV(C) = \begin{cases} \frac{s_1}{(1+i)^{M_1}} & \text{with probability } (1 - q1) \\ \frac{s_1}{(1+i)^{M_1}} + \frac{s_2}{(1+i)^{M_2}} & \text{with probability } q1 * (1 - q2) \\ \frac{s_1}{(1+i)^{M_1}} + \frac{s_2}{(1+i)^{M_2}} + \frac{s_3}{(1+i)^{M_3}} & \text{with probability } (q1 * q2) - (q1 * q2 * q3) \\ \frac{s_1}{(1+i)^{M_1}} + \frac{s_2}{(1+i)^{M_2}} + \frac{s_3}{(1+i)^{M_3}} + P & \text{with probability } q \end{cases}$$

Vtrek

Calculating Present Value of Expected Costs

- The PV(EC) is a long calculation:

$$PV\ (EC) =$$

$$\frac{200.000}{(1+,0012)^3}(1-,7)$$

$$+\left(\frac{200.000}{(1+,0012)^3}+\frac{300.000}{(1+,0012)^6}\right)(,7\ *\ (1-,75))$$

$$+\left(\frac{200.000}{(1+,0012)^3}+\frac{300.000}{(1+,0012)^6}+\frac{500.000}{(1+,0012)^9}\right)((,7*,75)-(,7*,75*\ ,8))$$

$$+\left(\frac{200.000}{(1+,0012)^3}+\frac{300.000}{(1+,0012)^6}+\frac{500.000}{(1+,0012)^9}+100.000\right)(,42)$$

- That is made easier by the use of Excel
- In our example, the PV(EC) of the PCP is € 722.092

Vtrek

Net Present Value
– comparing PV(EC) and PV(EB)

- The procurer should invest in the PCP and PPI if the NPV is positive, that is, $PV(EB) > PV(EC)$

$$q * \sum_{t=V1}^{V2} \frac{B}{(1+i)^t}$$

$$>$$

$$\frac{s_1}{(1+i)^{M1}}(1-q1)$$

$$+\left(\frac{s_1}{(1+i)^{M_1}}+\frac{s_2}{(1+i)^{M_2}}\right)(q1 * (1-q2))$$

$$+(\frac{s_1}{(1+i)^{M_1}}+\frac{s_2}{(1+i)^{M_2}}+\frac{s_3}{(1+i)^{M_3}})((q1 * q2)-(q1 * q2 * q3))$$

$$+(\frac{s_1}{(1+i)^{M_1}}+\frac{s_2}{(1+i)^{M_2}}+\frac{s_3}{(1+i)^{M_3}}+P)(q)$$

Vtrek

Calculating break-even time

- Knowing the equation where PV(EB)>PV(EC), we can solve for different values that help us to better understand the potential project
- You can only solve for one unknown at a time
  - This means choosing which value to find a minimum or maximum for, and making it the dependent variable. Your input values are the independent variables
- In this example, we will solve for the time it takes for the investment to break even - The number of months in the future where the costs=benefits
- Using the spreadsheet, we find that this is just over 39 months from project inception, equaling a minimum implementation time of 15 months.

PV expected cash flows	
Costs PCP	€ 722,092
Costs PPI	€ 40,808
Benefits Savings	€ 722,107
Net	€ 15
Enter number of months in cell B83 that make cell B80 is just greater than 0. This is the break-even point in months from project inception	
t (number of months from beginning)	39.16

Vtrek

Calculating Return on Investment (ROI)

- The **Return On Investment (ROI)** expresses how many additional euros are generated by a single euro invested in the PCP project.
- If $ROI > i$ then, from a purely financial point of view, investing the money in a PCP would be more profitable than in market activities.
- $ROI = \frac{PV(EB)-PV(EC)}{PV(EC)} = \frac{NPV}{PV(EC)}$
- $ROI = \frac{941{,}662-722.092}{722.092} = \frac{219.570}{722.092} = 30{,}41\%$

Calculating Internal Rate of Return (IRR)

- The **Internal Rate of Return (IRR)** is the minimum rate i needed to make the NPV positive
- Using Excel makes this task much simpler
- In this example, the IRR is 0,5172%/month, or 6,2%/year.
- Supports that PCP can be profitable even for costly R&D with uncertainties

PV expected cash flows	Solving for IRR
Costs PCP	€ 690,650
Costs PPI	€ 88,355
Benefits Savings	€ 779,015
Net	€ 10
Enter the interest rate in cell B65 that makes cell B61 just greater than 0. This the interest rate that makes PV(EC)=PV(EB), and is equal to the Internal Rate of Return (IRR)	
Alternative interest rate (%)	0.5172
IRR is this many times greater than market interest rate in cell B27	

Vtrek

The Stand-Alone PPI

Calculating NPV of only a Public Procurement of Innovation (PPI)

- A PPI is simpler to calculate, since there is much less uncertainty without R&D
- At this point, we assume the risk of failing to develop the product is eliminated
  - Future benefits are no longer termed *expected*, but *real*
- The cost for the procurer in a PPI is the purchasing price
  - Now, costs are given now only by the purchasing price, such that $C = P$.
- The present value (PV) of all future benefits would now be

$$PV(B) = B(\delta^t + \delta^{t+1} + \delta^{t+2} \ldots \delta^X) = \sum_{t=1}^{X} \frac{B}{(1+i)^t}$$

- Where X is the last month in which the solution is implemented, B is the monthly benefit, and t is the month

$$NPV = \left(\sum_{t=1}^{X} \frac{B}{(1+i)^t} \right) - C$$

Vtrek

Calculating NPV of only a Public Procurement of Innovation (PPI) (cont.)

- The formula for NPV is given by

$$NPV = \left(\sum_{t=1}^{X} \frac{B}{(1+i)^t} \right) - C$$

- Using the values from our example, with timespan of the PPI project $t = X = 48$, we get calculate the NPV of our project as

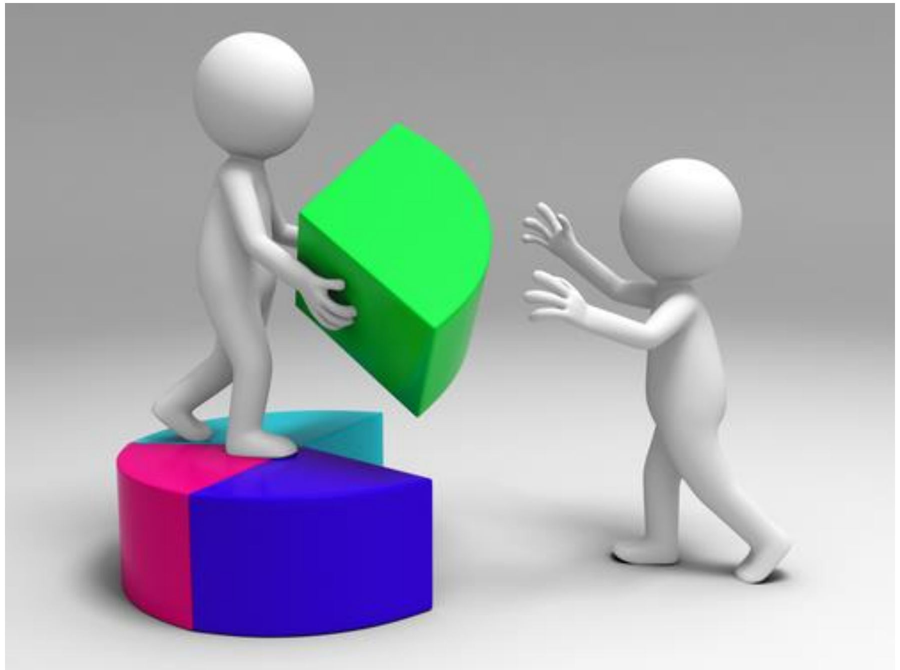
$$NPV = \left(\sum_{t=1}^{48} \frac{49.500}{(1+,0012)^{48}} \right) - 100.000 = 679.015€$$

- If we want to find the maximum price to pay for the product, we can set the NPV to 0 and solving for P instead of setting the price at 100.000€.

$$P \leq \sum_{t=1}^{48} \frac{49.500}{(1+,0012)^{48}} = 779.015€$$

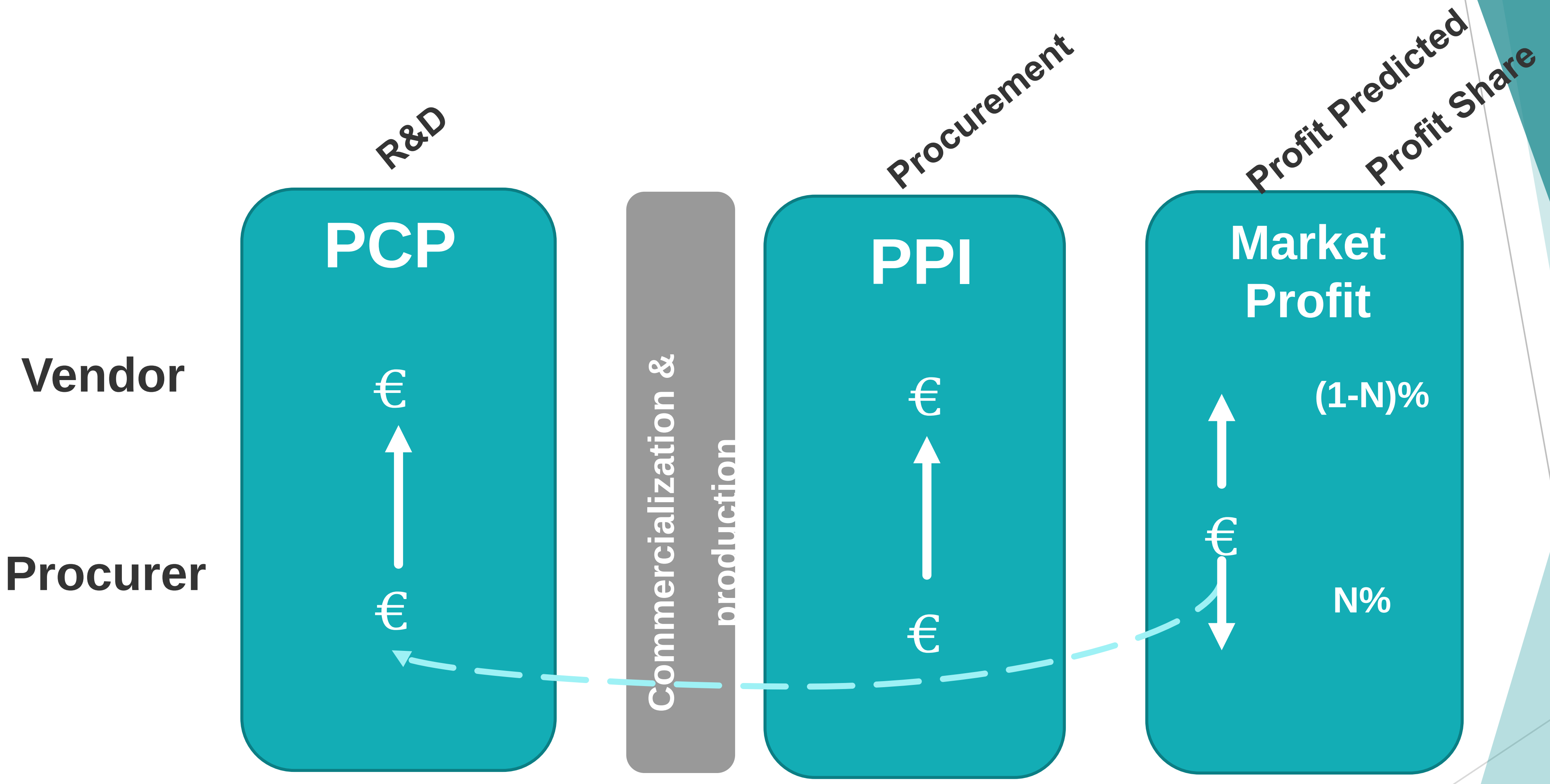
- Remember that this price is includes discounting. To bring it back to current euro, as what we would invest at the present time, we can use the PV function in excel. This is equal to 735.437€.

Vtrek



Sharing Profits: Royalty Schemes

Vtrek



R&D
Procurement
Profit Predicted
Profit Share
Vendor
Procurer
PCP
€
€
Commercialization & production
PPI
€
€
Market Profit
(1-N)%
€
N%

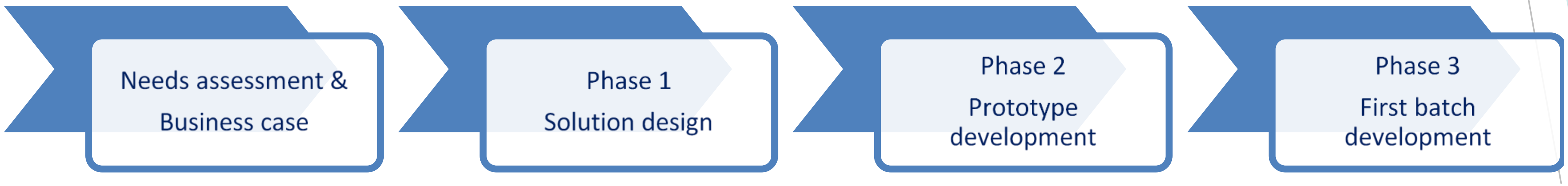
Reducing Costs of R&D Investments

- Procurers have two options to reduce the costs of their PCP investments
  - Ex-ante: setting maximum costs and awarding based on submitted R&D prices
  - Ex-post: creating profit sharing agreements as royalty schemes
- Intellectual Property Rights (IPR) can be generated during any PCP phase
- Not all suppliers who create IPR will
  - Commercialize their solutions
  - Win the PPI
  - Generate profits in wider markets
- If the IPR is left with the supplier, a procurer pays pay for part of this IPR without being certain of receiving benefits from the investment

Vtrek

Profit Sharing Agreements

- Assumption: IPR stays with the supplier, grants free license; Supplier is responsible for commercializing PCP outcomes
- To capture benefits from IPR generated during the PCP, when IPR is left with the supplier, a procurer can use a **profit sharing agreement**.
- Procurer takes a % of profits (royalties) post-commercialization
- Agreements made prior to beginning each phase with each R&D supplier
  - Procurer can benefit from their investment regardless of *which* supplier is dropped from the competition and *when*
- Two areas for the business case:
  - For each PCP stage: Contributions of the procurer and supplier to R&D
  - After the completion of the PCP: Break-even time


Needs assessment &
Business case
Phase 1
Solution design
Phase 2
Prototype development
Phase 3
First batch development

Vtrek

Choosing & Using Royalty Rates

- Royalties: a **percentage of the profit** based on investment in IPR
- Royalties should be taken only when the supplier begins to make a profit
- Which royalty rate the procurer should set for each supplier within each stage of a given PCP?
  - $G_{i,j}$ - cost of PCP to the procurer in PCP phase i to supplier j
  - $H_{i,j}$ - contribution of supplier j during PCP phase i
  - $N_{i,j}$ - percent of profit (royalties) requested by per month from supplier j
- The royalty rate for supplier j who participates in PCP phase i is then

$$N_{i,j} = \frac{G_{i,j}}{(G_{i,j} + H_{i,j})}$$

Vtrek

Calculating a Royalty Rate – Example

- A procurer has a budget of €100,000 for phase 1, for four suppliers
- Each supplier receives €25,000
  - For supplier 1 we write $G_{1,1} = €25{,}000$
- Assume that this is 20% of the total R&D costs, so that contribution by each supplier in phase 1 will be €125,000 (€25,000/.2)
  - For supplier 1, we write $H_{1,1} = €125{,}000$
- This means that royalty rate for supplier number 1 for PCP phase 1 are

$$N_{1,1} = \frac{G_{1,1}}{(G_{1,1}+H_{1,1})} = \frac{25{,}000}{25{,}000+125{,}000} = .17 = 17\%.$$

- Repeat for each phase and supplier

Vtrek

Calculating Royalty Rates for Each Supplier & Phase – Example

- Royalty rate for supplier 1 would increase to 23% for IPR from phase 2, and to 29% for IPR from phase 3.

Project Stage	Phase Duration (months)	PCP budget, per phase	Number of Suppliers, per phase	Budget per Supplier, per phase	% of Total Costs Contributed by Procurer, per phase	Contibution by Supplier (Supplier R&D Costs), per phase	Royalty rate, per supplier and phase
PCP phase 1	3	€ 100,000	4	€ 25,000	20%	€ 125,000	17%
PCP phase 2	6	€ 200,000	3	€ 66,667	30%	€ 222,222	23%
PCP phase 3	9	€ 300,000	2	€ 150,000	40%	€ 375,000	29%
Total	18	€ 600,000		€ 241,667		€ 722,222	

Vtrek

Calculating Break-even Time for Royalty Agreements

- After each phase of the PCP is complete, a royalty agreement can come into effect
- Now we are examining the situation **after** the completion of the PCP
  - Costs are not R&D costs contributed by suppliers in the PCP, but *all other* costs: costs of commercialization, production, marketing, offices, staff…
- Introducing
  - p - probability of successful commercialization– **of any supplier involved at any stage of the PCP** – that includes any IPR generated under the PCP
  - $P_{i,j}$ - monthly profit of **supplier** j who has successfully commercialized using IPR from PCP phase i
    - $P_{i,j} = R_{i,j} - C_{i,j}$, (profits are revenues minus costs)
  - $Q_{i,j}$ - total royalties received **by the procurer** by time t from supplier j based on their successful commercialization using IPR from PCP phase i

Vtrek

Calculating Break-even Time for Royalty Agreements

- **Expected benefits to the procurer**, given the probability of successful commercialization p
- For **each** supplier j at PCP phase i , the expected benefits $EB_{i,j}$ can be expressed as:

$$PV(EB_{i,j}) = Q_{i,j} = \begin{cases} p * N_{i,j} * \left(\delta^{M_i} + \delta^{M_i+1} + \delta^{M_i+2} \dots \delta^{Y_{i,j}}\right) = p * N_{i,j} \sum_{t=M_i}^{Y_{i,j}} \frac{R_{i,j} - C_{i,j}}{(1+r)^t} & when\ R_{i,j} > C_{i,j} \\ 0 & when\ R_{i,j} \le C_{i,j} \end{cases}$$

- M_i - the first time t where $R_{i,j} > C_{i,j}$,
- $Y_{i,j}$ - the time t where $Q_{i,j} = G_{i,j}$ (wheretotal royalties received from supplier j in PCP phase i are equal to the procurer’s investment to supplier j in PCP phase i

Vtrek

Calculating Break-even Time for Royalty Agreements

- Royalties are only at a given time t when $R_{i,j} > C_{i,j}$
- **Break-even time** for each investment $C_{i,j}$ to each is the point in time after which $Q_{i,j} = C_{i,j}$
- Present Value of **total** Expected Benefits

$$PV(EB) = p * \sum Q_{i,j} \ \forall\, i,j$$

- Note: Procurers do not make a profit themselves
  - Benefit from the results of the solution which followed the PCP in a successful PPI
  - Stop at the break-even time

Vtrek

Calculating Break Even Time – Example

- One supplier who reached the end of PCP phase 3 takes 6 months to commercialize the results of the IPR they generated
- Commercialization and production costs €450,000, with a 70% likelihood of success
- Firm operates at a loss for 8 months
- Profit begins from month 9, at €20,000 every month (for at least 40 months into the future)

Project Stage	Phase Duration (months)	Revenue or Expense (to the supplier)	Frequency	Commercialization Success probability (general)
Commercialization/Production	6	€ 450,000	(one-time)	70%
Months of Loss	8	N/A		
Months of Profit	40	€ 20,000	(monthly)	
Month when profit begins	32			
Interest Rate (Monthly)	0.12%			

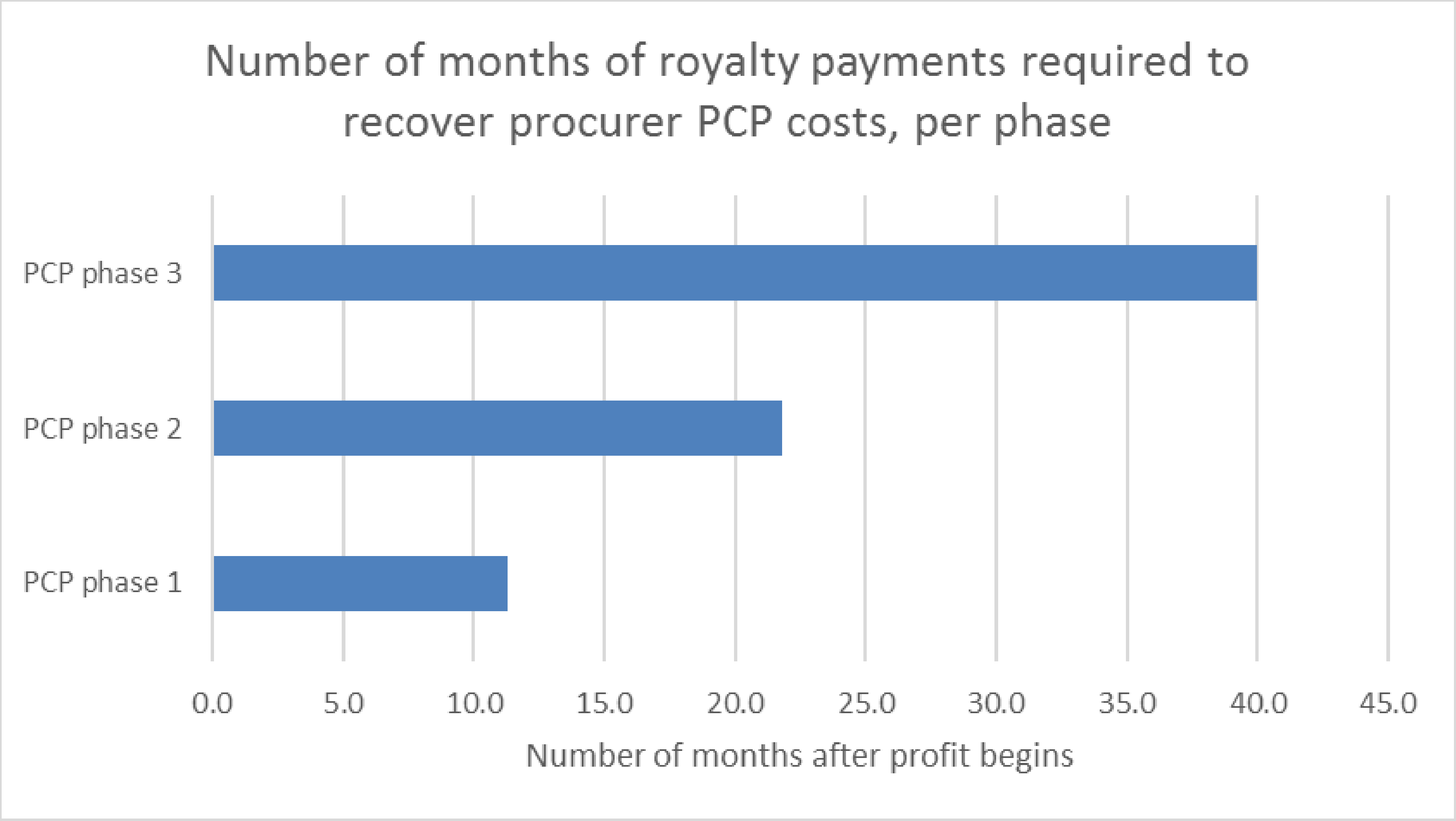
Vtrek

Calculating Break Even Time – Example

Calculating Break-even Time for Royalty Agreements			
PCP Phase 1			
Present Value of Expected Benefits	€ 25,188	€	25,000
Enter number of months below that makes the above cell just greater than the procurer's investment to the supplier in phase 1. This is the number of months in which royalties will be received from this supplier for IPR generated in phase 1.			
Months to collect royalties	11.3		

- Repeat for each phase completed by the supplier

Break Even Time – Example



Summary

Summary - Uncertainty

- Uncertainty is introduced as a probability – a factor between 0 and 1 that reflects the likelihood that something will occur
  - Success of each PCP phase
  - Successful commercialization
  - Receiving expected market revenues
- More information = better estimates
  - Importance of market consultation
- Due to uncertainty, a 3-phase PCP is always better than all in one stage
  - Probability of complete loss is lower
  - Return on Investment (ROI) is higher
    - $ROI = \frac{Benefits - Costs}{Costs}$

Vtrek

Summary – Time & Returns

- Valuing costs and benefits in the future is done by using a (carefully selected) discount rate
  - Calculate cash flows over multiple months by using indefinite summation (Σ)
  - Cash flows at one time are more suited to examining probability
- Measures of project profitability
  - Net Present Value (NPV) – to predict project profitability

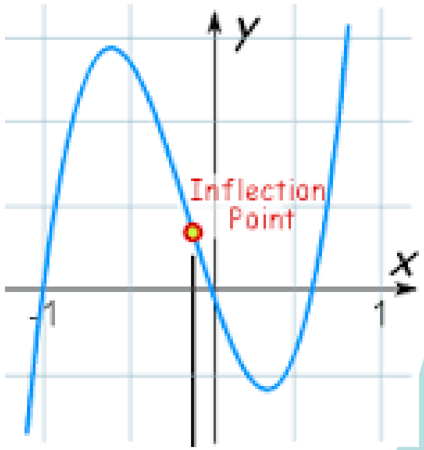
    $$NPV = Present\ Value\ (Expected\ Benefits) - Present\ Value\ (Expected\ Costs)$$
  - Internal Rate of Return (IRR) – rate of return from an investment
    - Alternative discount rate i that makes the NPV=0
  - Return on Investment (ROI) – investment gains compared with investmetn costs

    $$ROI = \frac{Benefits - Costs}{Costs}$$

Vtrek

Summary – Finding Max's & Min's

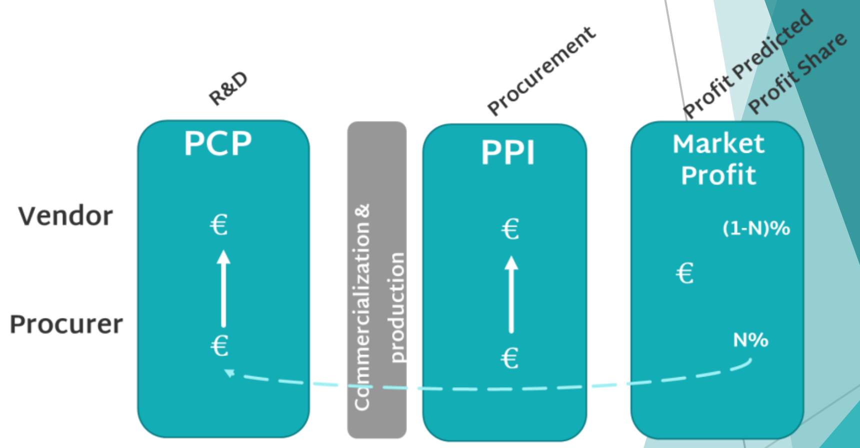
- Once you have the basic formula
  - $NPV = Present\ Value\ (Expected\ Benefits) - Present\ Value\ (Expected\ Costs)$
- You can calculate maximum/minimums for any value by finding what makes $Benefits = Costs$
  1. Choose one variable to be dependent
  2. Set values for the other independent variables
  3. Solve using a program like Excel



- This can tell the procurer
  - The minimum time over which they should implement a PPI solution
  - Minimum success probabilities, minimum R&D revenues, etc. etc.
- We solved for the break-even time t

Summary – Profit Sharing

- Profit sharing can make PCP a more attractive investment for procurers
- Helps compensate for high up-front costs
- A procurer can calculate revenue sharing based on predictions of wider market revenues
- Influence of commercialization risk / probability of commercial success
- Investment risk and potential rewards (royalties) are spread over suppliers and phases



Summary

- Introduction to procurement economics
- Innovation procurement
  - Pre-commercial Procurement (PCP)
  - Public Procurement of Innovative Solutions (PPI)
- Introduction to the Business Case Methodology
- Economic evaluation – theory and practice
  - Uncertainty - Justifying PCP
  - Time - Discounting, Net Present Value, Returns
  - The stand-alone PPI
  - Reaping rewards – Royalty Schemes
- Discussion

Vtrek

Thank you!

Vtrek

Discussion

Annex

PCP vs PPI

	PCP	PPI
When	Challenges requires R&D No commitment to PPI	Challenge requires (near-to-market) solution; No R&D
What	Purchase of R&D to steer development, inform alternatives, & avoid lock-in	Procurer is launching customer / early adopter / first buyer
How	Purchase of R&D from several suppliers in parallel	Buy critical mass of innovative solutions to trigger industry

Vtrek