Lisbon School of Economics & Management
Universidade de Lisboa

Master in Innovation and Research for Sustainability

Evaluation and Management of R&I Projects

Module III: Assessing R&D and Innovation Projects

Lecture 6: Evaluating R&D+I Projects

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Summary for today

Module I: Introduction to R&D+I Management

Lecture 1: Crafting an R&D+I Strategy

- Overview of R&D + Innovation: Its importance and impact
- Exploring Innovation Types: Understanding the diversity in innovation

Lecture 2: Applying R&D+I Management

- Developing R&D+I Capabilities: Techniques to enhance innovation
- Implementing R&D+I: Strategies for effective teamwork and innovation

Module II: Project Lifecycle in R&D and Innovation

Lecture 3: R&D+I Project Fundamentals: From Conception to Market

- Project Initiation: Scope definition and scientific and technical merit
- Project Planning: Strategy development, identifying challenges, and risk assessment

Lecture 4: R&D+I Project Fundamentals: From Conception to Market

- Project Execution: Leading RD&I teams, fostering creativity, managing change, and overseeing project progress.
- Project Closure: Capturing lessons learned and assessing project impact on value creation.

Module III: Assessing R&D and Innovation Projects

Lecture 5: Evaluating R&D+I Projects

- Value proposition and value capture process
- Core definition and evaluation elements: Understanding the fundamentals in project assessment – from technology to investment appraisal criteria
- Decision making process: Approaches for project selection and handling incomplete data

Lecture 6: Evaluating R&D+I Projects

- Design a business model: phase analysis, investment phases, accounting outcomes, and impact prediction considering both financial outcomes and social impact
- Financial Metrics: Discussing profitability, cost of capital, and their roles in economic and financial assessments
- How to define a Minimum Viable Product

Lecture 7: Evaluating R&D+I Projects

- Risk Management: Techniques for analyzing and mitigating project risks
- Funding mechanisms for Academia & Corporate

Lecture 8, 9: Real-World Applications

- Analysis of a R&D+I evaluation case study to illustrate concepts

Module IV: R&D+I Portfolio Management

Lecture 10: Optimizing R&D+I Contributions to Strategic Objectives

- Aligning R&D projects with strategic goals beyond financial metrics

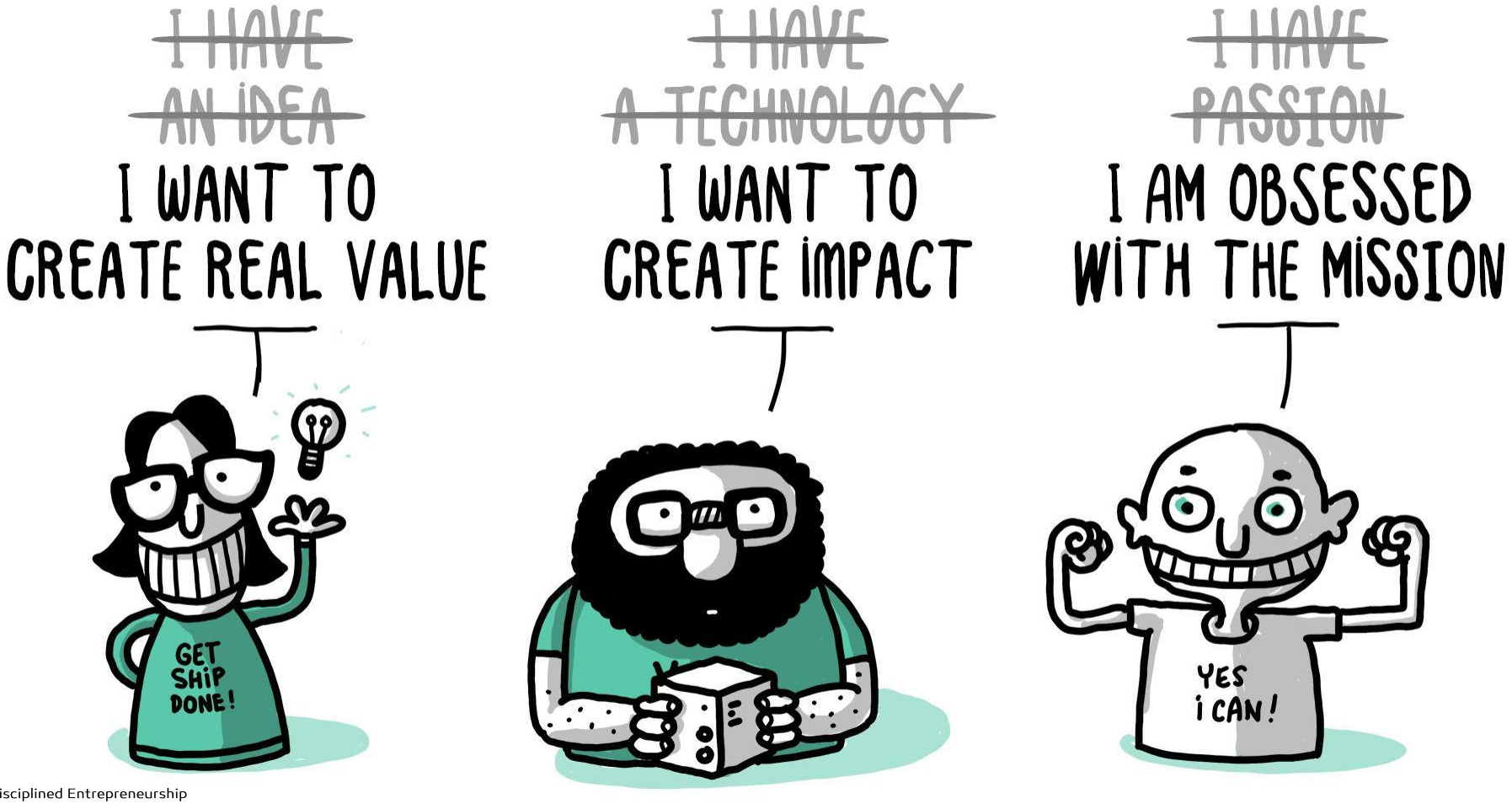
Lecture 11: Performance Metrics for R&D and Innovation

- Evolution of Performance Measurement Systems: Historical perspective and current trends
- Comparative Analysis of R&D Measurement Approaches

Lecture 12: Real-World Applications and Case Studies

- In-depth discussion & analysis of R&D+I case studies to how to manage a R&D+I portfolio

Design a Business Model



Remember this?

Business Opportunity Idea (BOI) Form

Title/ Headline			Submitted by/ Date
Target customer	Target customer unmet need / Job-to-be-done		Target (attainable) market
Potential offering / USP	Fit with the company	Intellectual property	Preliminary size of opportunity
Regulatory framework	Possible partners		Main competitors
Project management considerations			

Design a Business Model

Phase Analysis

1 - Mobilize

During this phase, primary tasks involve defining the objectives to achieve, forming the team, and initiating discussions on initial ideas.

The Kill/Thrill approach can be applied for idea testing. In the first 20 minutes, the team critically examines reasons why the idea might fail (Kill phase), followed by brainstorming for the next 20 minutes on reasons why it could succeed (Thrill phase).

2 - Understand

During this phase, the design team conducts thorough research to gather essential elements for the design process. Key activities include studying the business environment, identifying potential customers and their needs, interviewing domain experts, analyzing competitors, and questioning industry assumptions. It's important to avoid disconnects in research objectives, excessive analysis, and bias. Teams should also prototype multiple options and explore beyond existing business models to ensure success.

3 - Design

In the design phase, prototypes from the understanding phase are refined based on research. Teams explore multiple options, seeking innovative solutions and embracing feedback. Challenges include balancing bold ideas with organizational norms and creating risk profiles for each model. Participatory design, maintaining model separation, and avoiding short-term focus are also key considerations.

Design a Business Model

Phase Analysis

4 - Implement

After finalizing the business model, it is translated into an implementation design. This involves defining related projects, setting milestones, establishing legal structures, creating a detailed budget and project roadmap, and more. Mechanisms for adjusting the business model based on market feedback are also developed.

Key concerns in this phase involve proactively addressing roadblocks, securing investor support, maintaining separation between old and new business models, and crafting an effective communication strategy.

5 - Manage

During this phase, the business consistently monitors the environment, assesses, evaluates, validates, and updates the business model, ensuring alignment across the enterprise and managing synergies or conflicts between new and old models. Critical success factors include maintaining a long-term perspective, embracing big-picture thinking, and proactively governing business models. Failure to adapt and becoming complacent in one's success are significant risks.

Successful organizations exhibit the ability to manage their business models beyond implementation. New ideas for business models frequently originate from unexpected sources within the organization.

Business Model Canvas

Business Opportunity Idea (BOI) Form – Remember?

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Exercise 7

Evaluate your idea from Exercise 1 using the canvas and consider:

The 5 phases previously described – make a brief description of it

What are the main expected outcomes? Consider both financial and social impact

BUSINESS MODEL DESIGN PROCESS

MOBILIZE	UNDERSTAND	DESIGN	IMPLEMENT	MANAGE
Prepare for a successful business model design project	Research & analyze elements needed for the business model design effort	Generate & test viable business model options & select the best	Implement the business model prototype in the field	Adapt & modify the business model in response to market reaction

Accounting Outcomes

The Economic and Financial Assessment of a Project

Project valuation has three main perspectives:

- Economic: Costs and Benefits (Income Statement) – P&L on activity
- Financial Commitments: Revenues and Expenses (Balance Sheet) – Assets and Liabilities
- Cash Flows – The basis for project valuation

Cash Flows:

- Past cash flows are irrelevant – sunk costs
- Consider the incremental base
  - CF with the project Vs CF without the project
  - Not before Vs after the project
- Include opportunity costs
  - Value the alternatives individually

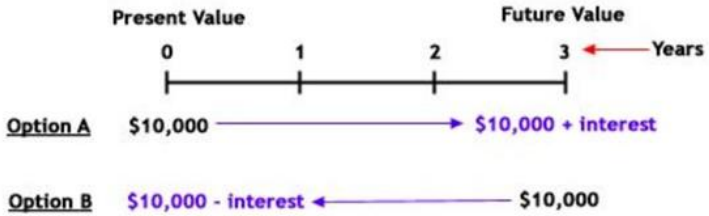
- Include taxes and investment in working capital Include overhead costs (general expenses, rent, administration, wages, etc)
- Don't include interest payment – separate investment decision from financing decision
- Include project's terminal value of equipment's (depreciation)

Financial Math

Project valuation and metrics

Project Valuation based on:

- NPV – Net Present Value
- IRR – Internal Rate of Return
- Payback period and Return on Investment
- Return on Marketing and others non-tangible



Time Value of Money:

- 1€ today is worth more than 1€ in one year
- 1€ in one year is worth more that 1€ in 5 years
- Consider present values and future values
- It is only possible to compare or combine values at the same point in time

Rule 1	Only values at the same point in time can be compared or combined.	
Rule 2	To move a cash flow forward in time, you must compound it.	$FV_T = CF_t \times (1+r)^{T-t}$
Rule 3	To move a cash flow backward in time, you must discount it.	$V_t = \frac{CF_T}{(1+r)^{T-t}}$

1st Rule of Time Travel:

It is only possible to compare or combine values at the same point in time

Which would you prefer, assuming an interest rate of 10%:
A gift of $1,000 today or $1,200 in two years?

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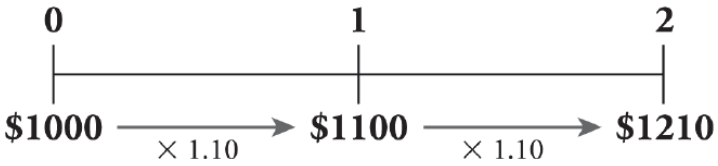
2nd Rule of Time Travel:

To move a cash flow forward in time, you must capitalize it. To capitalize a cash flow you need to apply compound interest.

$$FV_T = CF_t \times (1 + r)^{T-t}$$



$$FV_{2y} = 1{,}000 \times (1.1)^{2-0} = \$1{,}210$$

or

$$CF_{2y} = \$1{,}200$$

3rd Rule of Time Travel:

To move a cash flow backward in time, we must discount it

Which would you prefer, assuming an interest rate of 10%: a gift of $1,000 today or $1,200 in two years?

$$V_t = \frac{CF_T}{(1+r)^{T-t}}$$

$CF_0 = \$1{,}000$

or

$$PV = V_0 = \frac{1{,}200}{(1.1)^{2-0}} = \$991.74$$

Financial Math

Exercise 7

Consider that your bank gives you access to annual deposits with an interest rate of 5%.

1 - How much should you deposit today in order have $10,000 in your bank account in 15 years time?

Financial Math

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$$PV = V_0 = \frac{CF_{15y}}{(1.05)^{15-0}} = \frac{10{,}000}{(1.05)^{15}} = \$4{,}810.17$$

In order to have $10,000 in 15 years time you need to deposit $4,810.17 today

Financial Math

Exercise 7

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2 - Assume that you will deposit $5,000 in three years time. How much money will be in your bank account 9 years after the deposit is made?

Financial Math

Exercise 7

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2 - Assume that you will deposit $5,000 in three years time. How much money will be in your bank account 9 years after the deposit is made?

$$FV_{12y} = CF_{3y} \times (1.05)^{12-3} = 5{,}000 \times (1.05)^{9} = \$7{,}756.64$$

In 12 years from now (9 years from the point on which the deposit was made) you will have $7,756.64 in your bank account.

Project Valuation based on four main criteria :

- NPV – Net Present Value
  - Present value of future cash flows minus the initial investment
  - Analyse the profitability of a project
  - NPV > 0 – Create value = Proceed with project
  - NPV < 0 – Negative outcome = stop project

$$NPV = -I_0 + PV = -I_0 + \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t} = -I_0 + \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \ldots + \frac{CF_t}{(1+r)^t} + \ldots$$

I = Initial Investment

PV = Present Value

CF = Cash Flow

r = Discount rate

Project Valuation based on four main criteria :

- IRR – Internal Rate of Return
  - Expected return form the project
  - Discount rate that creates a zero NPV
  - Estimate the profitability of potential investment
  - The higher the better
  - Metric for the company to choose which capital project to invest

$$0 = -I_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \ldots + \frac{CF_t}{(1+IRR)^t} + \ldots$$

I = Initial Investment

CF = Cash Flow

Financial Decision

Exercise 8

Assuming a discount rate of 10% for all investments, calculate NPV and IRR:

	I_0	CF_1
A	5	5
B	5	6
C	5	5,2
D	5	8

$$NPV = -I_0 + \frac{CF_1}{1+r} \qquad 0 = -I_0 + \frac{CF_1}{1+IRR} \qquad IRR = \frac{CF_1}{I_0} - 1$$

Financial Decision

Exercise 8

Assuming a discount rate of 10% for all investments, calculate NPV and IRR:

	I_0	CF_1	NPV	IRR
A	5	5	-0,45	+0%
B	5	6	+0,45	+20%
C	5	5,2	-0,27	+4%
D	5	8	+2,27	+60%

$$NPV = -I_0 + \frac{CF_1}{1+r} \qquad 0 = -I_0 + \frac{CF_1}{1+IRR} \qquad IRR = \frac{CF_1}{I_0} - 1$$

Financial Decision
Project Valuation

- Payback Period
  - Number of years required to recover the initial investment
  - Does not discount cash-flows (longer projects can request this)
  - No risk adjustment
  - Ignores subsequent cash flows

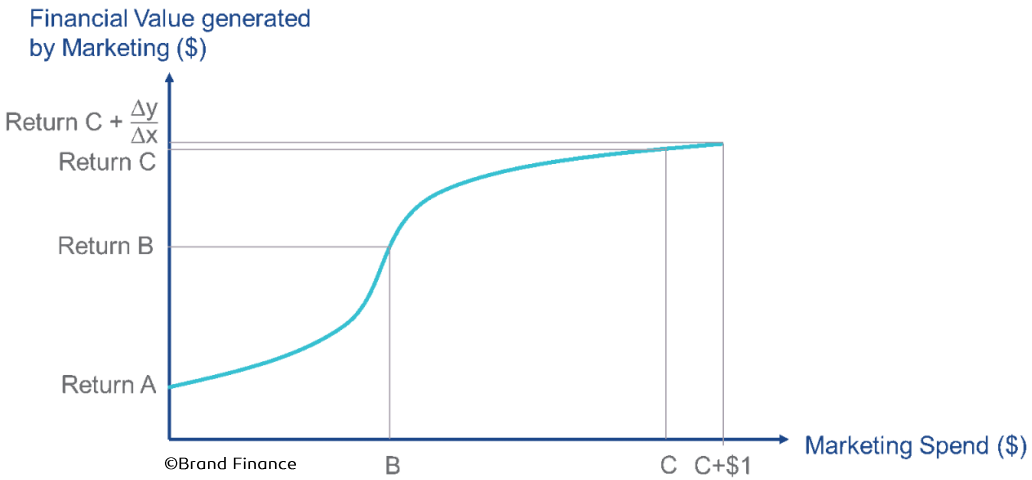
Project	C_0	C_1	C_2	C_3	Payback Period
A	-2000	500	500	5000	3
B	-2000	500	1800	0	2
C	-2000	1800	500	0	2

- Return on Investment
  - Measures the complete profitability of an investment
  - Approximate measure of an investment profitability
  - Presented in a percentage
  - Relevant and nice to have

$$\text{ROI} = \frac{\text{Net Return on Investment}}{\text{Cost of Investment}} \times 100\%$$

Financial Decision
Project Valuation

- ROMI – Return on Marketing Investment
  - Calculates the return from marketing initiatives
  - Compares the value generated after the initiatives where done, versus without it
  - Should include the opportunity costs (e.g., the value saved if it did not happen)
  - Provides an additional level of control and prediction of future cash flows
  - Assists the improvement of marketing effectiveness
  - Based on the company's Marketing Mix model



Identifying Return on Marketing Investment (ROMI)

Risk Analysis
From analysis to mitigation

What is Risk?

- Likelihood of occurring something adverse that affects the proposed outcomes of a given project,
- Project risks affect deliverables, timelines, and budgets,
- Can lead to a project's failure if not managed properly,

External Risks

- Risks can be caused by political, environmental, economic, social, technological, or legal factors beyond the scope of the project,
- Can be mitigated in a proactive and/or reactive way but there is no complete control over it,

Internal Risks

- Poor management, bad planning, inefficient PM system, planning and/or preparation,
- Higher degree of control over process.

Risk Analysis
From analysis to mitigation

Technical or performance risk

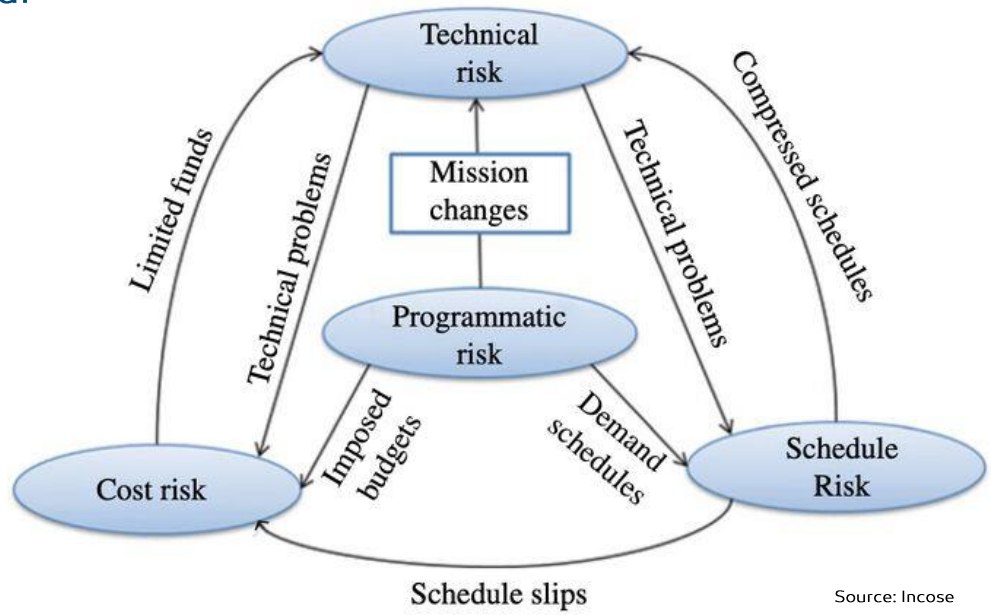
- Potential failure to meet specified technical or performance requirements or outcomes of a project,

Cost risk

- Likelihood of surpassing the allocated budget or funds for a project,

Schedule risk

- Possibility of a project falling short of meeting its predetermined milestones and duration,



Source: Incose

Programmatic risk

- Arises from external events beyond the control of the project manager, often stemming from decisions made by individuals with higher authority. Examples include a reduction in project priority, delays in authorizations and funding, among others. Consequently, programmatic risks can contribute to risks in any of the other three categories.

Risk Analysis
Risk Management

- Risk management planning

Outlining the procedures for managing risks in a project, ensuring that the risk management process is transparent, sufficient time and resources are allocated, and there is a mutually agreed-upon approach for assessing risks,

- Risk identification

Identifying and documenting potential risks that could impact the project. This is an ongoing process as new risks may emerge or become apparent during the project's execution,

- Qualitative risk analysis

Prioritize risks for further examination or action based on their likelihood of occurrence and their impact on project objectives,

- Quantitative risk analysis

Involves numerically evaluating the impact of identified risks on overall project performance and objectives. It employs a quantitative approach to decision-making amidst uncertainty,

- Risk response planning

Plan strategies and actions to capitalize on opportunities and mitigate threats to project objectives,

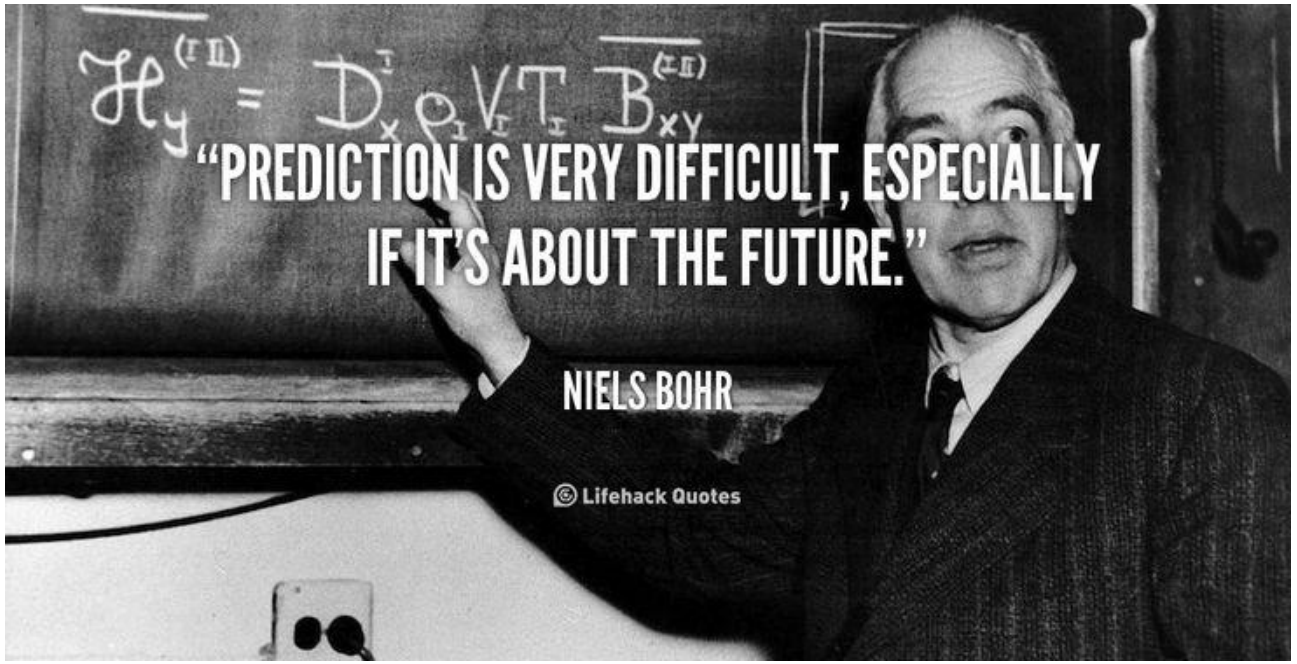
- Monitoring and controlling risks

Executing risk response plans, overseeing identified risks, tracking residual risks, identifying new risks, and assessing the effectiveness of the risk management process throughout the project lifecycle.

Risk Analysis
Qualitative Analysis methods

- Stand Alone Methods (Total Risk)
  - Break Even Analysis
  - Sensitivity Analysis
  - Scenario Analysis
  - Simulation (Monte Carlo) Analysis

- Market Risk Methods (Systematic Risk)
  - CAPM – Capital Asset Pricing Model
  - APT – Arbitrage Pricing Theory



Risk Analysis
Qualitative Analysis methods

Break Even Analysis

- Point where generated revenue equals total costs applied to the project, resulting in zero profit or loss
- It indicates when a business and/or product covers all the costs of the project that developed it and begins to make a profit
- Different from payback – this last one focuses on the time taken to recover investment
- Allows to determine the value that a specific variable needs to take to bring NPV=0

$$\text{Break Even Point} = \frac{\text{Fixed Cost}}{\text{Selling price per unit - Variable cost per unit}}$$

$$\text{Break Even Point} = \frac{\text{Fixed Cost}}{\text{Contribution Margin per unit}}$$

Considers:
Investment only in Year 0
Cash flows are constant

Sensitivity Analysis

- Sensitivity analysis determines how different values of an independent variable affect a particular dependent variable under a given set of assumptions,
- Determine the impact of variations in the conditions of a specific project,
- Allows:
  - To identify the most sensitive variables that, with a small change, result in a significant impact on project outcomes,
  - To understand the limits - critical points - of variation of variables to maintain a minimum viable product,
  - To draw conclusions and to determine whether an investment in time and money can mitigate risk or not;
- Pros and Cons
  - It is limited to key variables leading to results that can be ambiguous,
  - It requires the ability to identify relevant variables and need for additional information,
  - Interdependence of variables - variables under study must be independent.

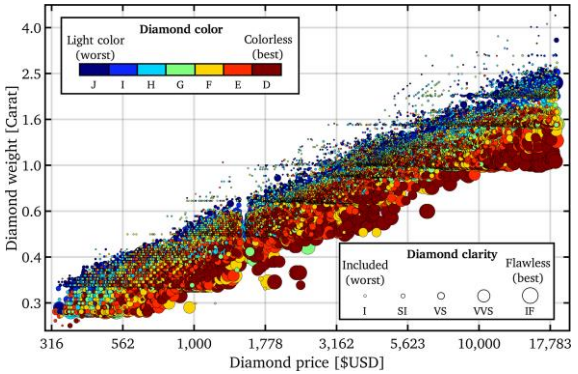
Risk Analysis
Qualitative Analysis methods

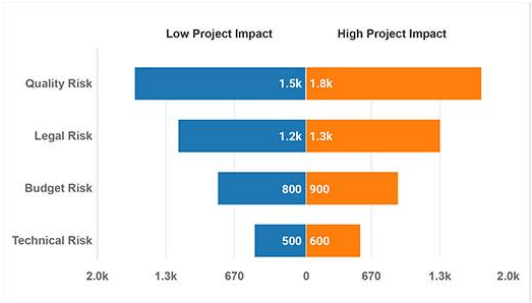
Sensitivity Analysis Process:

1. Identify the critical variables (example):
   - Project investment,
   - Estimated cost of final product,
   - Quantity sold,
   - Cost of raw materials,
   - Personnel costs,
   - Discount rate,

2. Assign a new value to that variable,
3. Recalculate the value of the evaluation criteria,
4. Analyze the impact of the change in the value of the evaluation criteria,

The bigger the change, the riskier that parameter is – mitigation focus





Risk Analysis
Qualitative Analysis methods

Scenario Analysis:

- Complex form of multivariate sensitivity analysis in which each scenario reflects a consistent combination of variables, envisioning relevant impacts on the project results,
- The challenge is to evaluate the project under hypotheses of events that lead to simultaneous changes in its critical variables,
- Three main scenarios are considered including the most likely or base scenario, worst case and the best case,
- When probabilities of occurrence can be assigned to different scenarios, and an evaluation indicator (usually NPV or IRR) has been calculated for each of them, average values and standard deviation can be calculated,

Example – Changes in cost of materials and discount rate due to macro economic conditions

Risk Analysis
Mitigation Process

Define Objectives and Scope:

- Clearly outline the goals and boundaries of the project to establish a focused direction and minimize scope creep,

Identify and Prioritize Risks:

- Conduct thorough risk assessments to identify potential risks and prioritize them based on their impact and likelihood of occurrence,

Implement Risk Management Measures:

- Develop strategies to mitigate identified risks to minimize their impact on project outcomes based on:
    - Risk avoidance,
    - Risk transfer,
    - Risk reduction,

Continuous Monitoring and Evaluation:

- Regularly monitor the project's progress, reassess risks, and adjust risk management strategies accordingly throughout the project lifecycle to ensure timely intervention and effective risk mitigation,

Evaluating R&D+I Projects

Key Takeaways

- Design a Business Model
  - Phase analysis – 5 phases focused on understanding and implementing your objectives
- Economic and Financial Assessment
  - Three main perspectives on project valuation
  - How to handle cash flows
  - Basis of project valuation – NPV, IRR, Pauback period and non-tangible approach
  - Time value for money
- Risk analysis
  - Risk management processes
  - Qualitative analysis
  - Mitigation processes

Read

- Araújo Monteiro dos Santos, C. (2013). R&D project selection incorporating risk management [Doctoral dissertation, University of Minho]
- Yu, P. (2021). R&D project risk management research. E3S Web of Conferences, 251, 01100

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