Software Project Management

Week 14

Today's Lecture

- Project Selection and Criteria
- Project Selection Models
- Uncertainty and Risk
- Information for Project Selection
- Project Portfolio Process (PPP)
- Project Proposals
- Financial Analysis of a Project as a project selection criteria

Slides from Ken Schwaber's book on Agile Project Management with SCRUM

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Project Maturity and Reality

- Many projects fall outside company mission
- Projects without organizational goal/objective "fit"
- Project budgets not tied to cost-benefit analysis

Multiple Project Management Issues

- Delays in one project impacting others
  - Resource conflicts
  - Technology dependencies
- Lack of resource "smoothing"
  - Peaks and valleys of resource utilization
- Bottlenecks with scarce resources
  - Lack of workarounds

Project Selection

- Evaluation process -- individual projects or groups of projects
- Choosing some set of project options
- Organizational objectives achieved
- Managers use *decision-aiding models*
- Models represent the problem's structure
- Aid in evaluating risks and options

Criteria for Project Selection Models

- **Realism** - reality of manager's decision
- **Capability**- able to simulate different scenarios and optimize the decision
- **Flexibility** - provide valid results within the range of conditions
- **Ease of Use** - reasonably convenient, easy execution, and easily understood
- **Cost** - Data gathering and modeling costs should be low relative to the cost of the project
- **Easy Computerization** - must be easy and convenient to gather, store and manipulate data in the model

Nature of Project Selection Models

– 2 Basic Types of Models
  - Numeric
  - Nonnumeric

– Two Critical Facts:
  - Models do not make decisions - People do!
  - All models are only partial representations of reality

Nonnumeric Models

- ***Sacred Cow*** - project is suggested by a senior and powerful official in the organization
- ***Operating Necessity*** - the project is required to keep the system running
- ***Competitive Necessity*** - project is necessary to sustain a competitive position
- ***Product Line Extension*** - projects are judged on how they fit with current product line, fill a gap, strengthen a weak link, or extend the line in a new desirable way.
- ***Comparative Benefit Model*** - several projects are considered and the one with the most benefit to the firm is selected

Numeric Models: Profit/Profitability

- ***Payback period*** - initial fixed investment/estimated annual cash inflows from the project
- ***Average Rate of Return*** - average annual profit/average investment
- ***Discounted Cash Flow -*** Present Value Method
- ***Internal Rate of Return -*** Finds rate of return that equates present value of inflows and outflows
- ***Profitability Index*** - NPV of all future expected cash flows/initial cash investment

Financial Selection Criteria

- Payback Model
  - Time to recover project investment
    - Investment $/Annual Net Savings = PB
  - Widely used
  - Emphasis on Cash Flow
- Net Present Value (NPV)
  - Desired rate of return
    - (Est. Annual Cash Flow/Project Cost) X 100 = RoR
  - Compare “RoR” of project(s) to “target”

Numeric Models: Scoring

- Unweighted Factor Scoring Model
- Weighted Factor Scoring Model
- Goal Programming with Objectives Evaluation

Risk Versus Uncertainty

- Analysis Under Uncertainty - The Management of Risk
  - The difference between risk and uncertainty
    - **Risk** - when the decision maker knows the probability of each and every state of nature and thus each and every outcome. An expected value of each alternative action can be determined
    - **Uncertainty** - when a decision maker has information that is not complete and therefore cannot determine the expected value of each alternative

Risk Analysis

- Principal contribution of risk analysis is to focus the attention on understanding the nature and extent of the uncertainty associated with some variables used in a decision making process
- Usually understood to use financial measures in determining the desirability of an investment project

Risk Analysis

- Probability distributions are determined or subjectively estimated for each of the “uncertain” variables
- The probability distribution for the rate of return (or net present value) is then found by simulation
- Both the expectation and its variability are important criteria in the evaluation of a project

Project Portfolio Process - Purpose

- Identify Projects that Meet Strategic Needs
  - Support Multiple Goals
  - Direct Organizational Improvement
  - Enhance/Enable Key Areas
- Prioritize Potential Projects
  - Limit Active Projects to Manageable Level
  - Identify Risk-intensive Efforts
  - Balance Short, Medium, Long-term Returns
- Reduce Projects from Getting in via "Backdoor"

Project Portfolio Process - Steps

1. Establish a Project Management "Governance" Structure
   - Senior Leaders and Technical Experts
2. Identify (Common) Project Selection Criteria
   - Tied to Strategic Vision, Mission, Goals, Objectives
3. Collect Project-specific Data
   - Project Attributes Tied to Selection Criteria
4. Assess Available Resources
   - Internal and External
   - Financial and Other

Project Portfolio Process - Steps

5. Reduce Project List
   - Screen for Potential "Differntiators"
6. Prioritize within Categories
   - Assuring Balance of Portfolio
   - Avoid Overabundance of Similar Projects
7. Select Primary and "Reserve" Projects
   - Leave Budget for "Surprise" Opportunities
8. Implement the Project Process
   - Communicate Results to Selectees and Non-selectees
   - Fund Projects to Promised Levels

Project Proposals

- Which projects should be bid on?
- How should the proposal-preparation process be organized and staffed?
- How much should be spent on preparing proposals for bids?
- How should the bid prices be set?
- What is the bidding strategy? Is it ethical?

Project Proposal - Outline

- Executive Summary
- Cover Letter
- Nature of the technical problem
- Plan for Implementation of Project
- Plan for Logistic Support & Administration of the project
- Description of group proposing to do the work
- Any relevant past experience that can be applied

Project Selection Evaluation Factors

- Production
  - Interruptions, learning, process
- Marketing
  - Customer management issues
- Financial
  - Return on investment
- Personnel
  - Skills and training, working conditions Project Selection
- Administrative
  - Regulatory standards, strategic fit

We have…

- Let us consider an example
  - Your FYP
  - You have to prepare cost
  - Question arises, how?
  - Activities ->
    - SRS Dev, Design, Imp, Testing
      - (Hardware req, Inputs (M/S), Controller conf, Wifi Modules req, Sensors requirements, overall system, application, external req, …)
      - Screen scrapping req, best buy option module, …
- Up to now…
  - Net project cost

We have…

- Up to now…
  - Net project cost
- Price has component of Cost and a component of profit = P = C +Profit
- Cost has several heads
- One of the dimensions for project selection is financial aspect
- This means you are clear about the expense side of the project

Financial Analysis of Projects

- Financial considerations are often an important consideration in selecting projects
- Three primary methods for determining the projected financial value of projects:
  - Net present value (NPV) analysis
  - Return on investment (ROI)
  - Payback analysis

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Net Present Value Analysis: NPV

- NPV: a method of calculating the expected net monetary gain or loss from a project by discounting all expected future cash inflows and outflows to the present point in time
- Projects with a positive NPV should be considered if financial value is a key criterion
- The higher the NPV, the better

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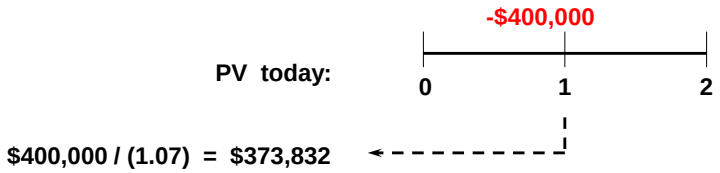
Net Present Value

- Capital Budgeting Decision
  - Suppose you had the opportunity to buy a Tbill (Treasury Bill) which would be worth $400,000 one year from today.
    - Interest rates on Tbills are a **risk free** 7%.
  - What would you be willing to pay for this investment?



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Net Present Value

- Capital Budgeting Decision
  - You would be willing to pay $373,382 for a risk free $400,000 a year from today.
  - Suppose this were, instead, an opportunity to construct a building, which you could sell in a year for $400,000 with certainty (That means the project is risk free.)
  - Since this investment has the same risk and promises the same cash flows as the Tbill, it is also worth the same amount to you:

$373,282

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Net Present Value

- Capital Budgeting Decision
  - Now, assume you could buy the land for $50,000 and construct the building for $300,000. Is this a good deal?
  - Sure! If you would be willing to pay $373,382 for this investment and can acquire it for only $350,000, you have found a very good deal!
  - You are better off by:

    $373,382 - $350,000 = $23,832

Net Present Value

- Capital Budgeting Decision
  - We have just developed a way of evaluating an investment decision which is known as **Net Present Value (NPV)**.
  - NPV is defined as the PV of the cash flows from an investment minus the initial investment.

    NPV = PV – Required Investment (C0)
    = [$400,000/(1+.07)] - $350,000
    = $23,832

Net Present Value

- Capital Budgeting Decision
  - This discount rate is known as the **opportunity cost of capital**.
    - It is called this because it is the return you give up by investing in the project.
    - In this case, you give up the money you could have used to buy a 7% tbill so that you can construct a building.
  - But, a Tbill is risk free! A construction project is not!
  - We should use a higher opportunity cost of capital.

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Net Present Value

- Risk and Net Present Value
  - Suppose instead you believe the building project is as risky as a stock which is yielding 12%.
  - Now your opportunity cost of capital would be 12% and the NPV of the project would be:

NPV = PV – IC0
= [$400,000/(1+.12)] - $350,000
= $357,143 - $350,000 = $7,142.86

  - The project is significantly less attractive once you take account of risk.
  - This leads to a basic financial principal: **A risky dollar is worth less than a safe one.**
  - **10,000,000 yields 14,000,000 -> 2,500,000 yield 3,500,000**
  - **3,500,000 / (1+0.11) = 3,153,153**

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Net Present Value

- Valuing long lived projects
  - The NPV rule works for projects of any duration:
    - Simply discount the cash flows at the appropriate opportunity cost of capital and then subtract the cost of the initial investment.

$$NPV = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \ldots + \frac{C_n}{(1+r)^n}$$

Initial Investment negative cash flow

Discounted expected future cash flows

  - The critical problems in any NPV problem are to determine:
    - The amount and timing of the cash flows.
    - The appropriate discount rate.

NPV Rule: Accept Projects with Positive NPVs

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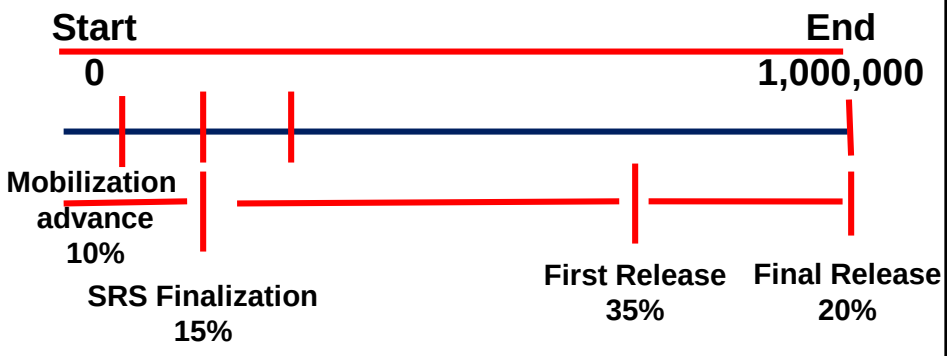
Example

Project Execution

This is a 10 months project with expense of Rs. 85,000 / m



Remaining 20% shall be given upon expiry of maintenance period, usually 6 months to 1 year after final acceptable delivery is made

What should I calculate…

Month	Details	Transaction amount Inward	Expense	Balance
1	M/Adv	1,000,000*10%=100,000	85,000	15,000
2	Nil		85,000	(70,000)
3	SRS	1,000,000*15%=150,000	85,000	(5,000)
4			85,000	(90,000)
5			85,000	(175,000)
6			85,000	(260,000)
7	R1	1,000,000*35%=350,000	85,000	5,000
8			85,000	(80,000)
9			85,000	(165,000)
10	F R	1,000,000*20%=200,000	85,000	(50,000)
11	M (6M)	1,000,000*20%=200,000	35,000	115,000
Total			885,000	

What should I calculate…

Month	Details	Transaction amount Inward	Expense	Balance
1	M/Adv	12000+12000/1	-	15,000
2	Nil		70000	(70,000)
3	SRS	1,000,000*15%=150,000	5000	(5,000)
4				(90,000)
5				(175,000)
6				(260,000)
7	R1	1,000,000*35%=350,000		5,000
8				(80,000)
9				(165,000)
10	F R	1,000,000*20%=200,000		(50,000)
		1,000,000*20%=200,000	12,000	115,000
Total				

My analysis

- Investment from company = 800,000
- Profit = 115,000
- Total inward cash flow = 1,000,000
- Time to profit = 1 years
- I went to National Bank of Pakistan (NBP)
- NPV
  - Let bank rate of return is 15%
  - 1,000,000/1.15 = 869,565
  - Current situation = 869,565 – 800,000 = 69,565
- We invested 69,565 less to earn equivalent amount against a risk free $ from bank

We have not considered…

Month	Details	Transaction amount Inward	Expense	Balance
1	M/Adv	1,000,000*10%=100,000	85,000	15,000
2	Nil		85,000	(70,000)
3	SRS	1,000,000*15%=150,000	85,000	(5,000)
4			85,000	(90,000)
5			85,000	(175,000)
6			85,000	(260,000)
7	R1	1,000,000*35%=350,000	85,000	5,000
8			85,000	(80,000)
9			85,000	(165,000)
10	F R	1,000,000*20%=200,000	85,000	(50,000)
		1,000,000*20%=200,000	35,000	115,000
Total				

Return on Investment (ROI)

- ROI: income divided by investment

  ROI = (total discounted benefits - total discounted costs) / discounted costs
- The higher the ROI, the better
- Many organizations have a required rate of return or minimum acceptable rate of return on investment for projects
- As a software house, we are working on what license costs we should consider to remain business viable

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Understanding ROI

$$\text{ROI} = \frac{\text{Net operating income}}{\text{Average operating assets}}$$

$$\text{Margin} = \frac{\text{Net operating income}}{\text{Sales}}$$

$$\text{Turnover} = \frac{\text{Sales}}{\text{Average operating assets}}$$

$$\text{ROI} = \text{Margin} \times \text{Turnover}$$

An ROI Example

	ABC Div	XYZ Div
•Year 1:		
•Sales	$30,000,000	$117,000,000
•Operating income	1,800,000	3,510,000
•Average operating assets	10,000,000	19,500,000
•Year 2:		
•Sales	$40,000,000	$117,000,000
•Operating income	2,000,000	2,925,000
•Average operating assets	10,000,000	19,500,000
•Minimum return of 10%		

Margin and Turnover Comparisons

	ABC Div		XYZ Div	
	Year 1	Year 2	Year 1	Year 2
Margin	6.0%	5.0%	3.0%	2.5%
Turnover	x 3.0	x 4.0	x 6.0	x 6.0
ROI	18.0%	20.0%	18.0%	15.0%
	===	===	===	===

Increasing ROI – An Example

Ahmed Bilal's Company reports the following:

Net operating income	$ 30,000
Average operating assets	$ 200,000
Sales	$ 500,000
Operating expenses	$ 470,000

What is ABC Company's ROI?

$$\text{ROI} = \text{Margin} \times \text{Turnover}$$

$$\text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}}$$

Increasing ROI – An Example

ROI = Margin × Turnover

$$\text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}}$$

$$\text{ROI} = \frac{\$30{,}000}{\$500{,}000} \times \frac{\$500{,}000}{\$200{,}000}$$

ROI = 6% × 2.5 = 15%

Let Bank rate of return be = 12%
Decision = ?

Investing in Operating Assets to Increase Sales

Suppose that Regal's manager invests in a $30,000 piece of equipment that increases sales by $35,000, while increasing operating expenses by $15,000.

Regal Company reports the following:

Net operating income	$ 50,000
Average operating assets	$ 230,000
Sales	$ 535,000
Operating expenses	$ 485,000

Let's calculate the new ROI.

Investing in Operating Assets to Increase Sales

$$\text{ROI} = \text{Margin} \times \text{Turnover}$$

$$\text{ROI} = \frac{\text{Net operating income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Average operating assets}}$$

$$\text{ROI} = \frac{\$50{,}000}{\$535{,}000} \times \frac{\$535{,}000}{\$230{,}000}$$

$$\text{ROI} = 9.35\% \times 2.33 = 21.8\%$$

ROI increased from 15% to 21.8%.

Payback Analysis

- Another important financial consideration is payback analysis
- The "payback period" is the amount of time it will take to recoup, in the form of net cash inflows, the net dollars invested in a project
- Payback occurs when the cumulative discounted benefits and costs are greater than zero
- Many organizations want IT projects to have a fairly short payback period

Payback Period

- How long does it take to recover the initial cost of a project?
- Computation
  - Estimate the cash flows
  - Subtract the future cash flows from the initial cost until initial investment is recovered
  - A "break-even" type measure
- Decision Rule – ***Accept if the payback period is <u>less</u> than some preset limit***

Calculate Payback Period

- If investment cost $100 and receive $50 a year for 3 years, what is payback period?
- What if investment cost $75?
- Same project as before
  - Year 0: CF = -165,000
  - Year 1: CF = 63,120
  - Year 2: CF = 70,800
  - Year 3: CF = 91,080

Computing Payback for the Project

Capital Budgeting Project

Year	CF	Cum. CFs
0	$ (165,000)	$ (165,000)
1	$ 63,120	$ (101,880)
2	$ 70,800	$ (31,080)
3	$ 91,080	$ 60,000

Payback = year 2 +
+ (31080/91080)

Payback = 2.34 years

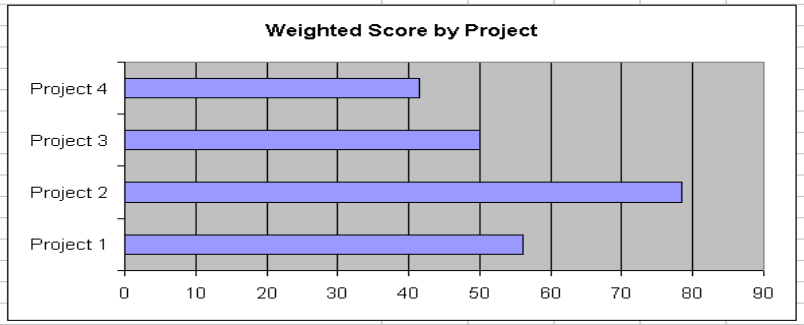
- ***Do we accept or reject the project?***

Advantages and Disadvantages of Payback

- Advantages
  - Easy to understand
  - Biased towards liquidity
- Disadvantages
  - Ignores the time value of money
  - Requires an arbitrary cutoff point
  - Ignores cash flows beyond the cutoff date

Sample Weighted Scoring Model

	A	B	C	D	E	F
1	**Criteria**	**Weight**	**Project 1**	**Project 2**	**Project 3**	**Project 4**
2	Supports key business objectives	25%	90	90	50	20
3	Has strong internal sponsor	15%	70	90	50	20
4	Has strong customer support	15%	50	90	50	20
5	Realistic level of technology	10%	25	90	50	70
6	Can be implemented in one year or less	5%	20	20	50	90
7	Provides positive NPV	20%	50	70	50	50
8	Has low risk in meeting scope, time, and cost goals	10%	20	50	50	90
9	**Weighted Project Scores**	**100%**	**56**	**78.5**	**50**	**41.5**



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Weighted Scoring Model

- A weighted scoring model is a tool that provides a systematic process for selecting projects based on many criteria
  - First identify criteria important to the project selection process
  - Then assign weights (percentages) to each criterion so they add up to 100%
  - Then assign scores to each criterion for each project
  - Multiply scores * weights = total weighted scores
- The higher the weighted score, the better

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Internal Rate of Return Method

- The internal rate of return is the rate of return promised by an investment project over its useful life. It is computed by finding the discount rate that will cause the net present value of a project to be zero.
- It works very well if a project's cash flows are identical every year. If the annual cash flows are not identical, a trial and error process must be used to find the internal rate of return.

Internal Rate of Return Method

General decision rule . . .

If the Internal Rate of Return is . . .	Then the Project is . . .
Equal to or greater than the minimum required rate of return . . .	Acceptable.
Less than the minimum required rate of return . . .	Rejected.

When using the internal rate of return, the cost of capital acts as a hurdle rate that a project must clear for acceptance.

Internal Rate of Return Method

- Decker Company can purchase a new machine at a cost of $104,320 that will save $20,000 per year in cash operating costs.
- The machine has a 10-year life.

Internal Rate of Return Method

Future cash flows are the same every year in this example, so we can calculate the internal rate of return as follows:

$$\text{PV factor for the internal rate of return} = \frac{\text{Investment required}}{\text{Annual net cash flows}}$$

$$\frac{\$104,320}{\$20,000} = 5.216$$

Internal Rate of Return Method

Using the present value of an annuity of $1 table . . .

Find the 10-period row, move across until you find the factor 5.216. Look at the top of the column and you find a rate of 14%.

Periods	10%	12%	14%
1	0.909	0.893	0.877
2	1.736	1.690	1.647
. . .	. . .	. . .	. . .
9	5.759	5.328	4.946
10	6.145	5.650	5.216

Internal Rate of Return Method

- Decker Company can purchase a new machine at a cost of $104,320 that will save $20,000 per year in cash operating costs.
- The machine has a 10-year life.

The internal rate of return on this project is 14%.

If the internal rate of return is equal to or greater than the company's required rate of return, the project is acceptable.

Quick Check ✓

The expected annual net cash inflow from a project is $22,000 over the next 5 years. The required investment now in the project is $79,310. What is the internal rate of return on the project?

a. 10%
b. 12%
c. 14%
d. Cannot be determined

Quick Check ✓

The expected annual net cash inflow from a project is $22,000 over the next 5 years. The required investment now in the project is $79,310. What is the internal rate of return on the project?

a. 10%
b. 12%
c. 14%
d. Cannot be

$79,310/$22,000 = 3.605, which is the present value factor for an annuity over five years when the interest rate is 12%.

Conclusion