Lecture 7: the Feasibility Study

- What is a feasibility study?
  - What to study and conclude?
- Types of feasibility
  - Technical
  - Economic
  - Schedule
  - Operational
- Quantifying benefits and costs
  - Payback analysis
  - Net Present Value Analysis
  - Return on Investment Analysis
- Comparing alternatives

Why a feasibility study?

→ Objectives:

- To find out if an system development project can be done:
  - ...is it possible?
  - ...is it justified?
- To suggest possible alternative solutions.
- To provide management with enough information to know:
  - Whether the project can be done
  - Whether the final product will benefit its intended users
  - What the alternatives are (so that a selection can be made in subsequent phases)
  - Whether there is a preferred alternative

→ A management-oriented activity:

- After a feasibility study, management makes a "go/no-go" decision.
- Need to examine the problem in the context of broader business strategy

Content of a feasibility study

→ Things to be studied in the feasibility study:

- The present organizational system
  - Stakeholders, users, policies, functions, objectives,...
- Problems with the present system
  - inconsistencies, inadequacies in functionality, performance,…
- Goals and other requirements for the new system
  - Which problem(s) need to be solved?
  - What would the stakeholders like to achieve?
- Constraints
  - including nonfunctional requirements on the system (preliminary pass)
- Possible alternatives
  - "Sticking with the current system" is always an alternative
  - Different business processes for solving the problems
  - Different levels/types of computerization for the solutions
- Advantages and disadvantages of the alternatives

→ Things to conclude:

- Feasibility of the project
- The preferred alternative.

Exploring Feasibility

→ The "PIECES" framework

- Useful for identifying operational problems to be solved, and their urgency
- Performance
  - Is current throughput and response time adequate?
- Information
  - Do end users and managers get timely, pertinent, accurate and usefully formatted information?
- Economy
  - Are services provided by the current system cost-effective?
  - Could there be a reduction in costs and/or an increase in benefits?
- Control
  - Are there effective controls to protect against fraud and to guarantee information accuracy and security?
- Efficiency
  - Does current system make good use of resources: people, time, flow of forms,…?
- Services
  - Are current services reliable? Are they flexible and expandable?

See the course website for a more specific list of PIECES questions

the PIECES Framework

A checklist for identifying problems with an existing information system.

- Performance
  - Throughput
  - Response Time
- Information (and Data)
  - Outputs
    - Lack of any information
    - Lack of necessary information
    - Lack of relevant information
    - Too much information – information overload
    - Information that is not in a useful format
    - Information that is not accurate
    - Information that is difficult to produce
    - Information that is not timely to its subsequent use
  - Inputs
    - Data is not captured
    - Data is not captured in time to be useful
    - Data is not accurately captured – contains errors
    - Data is difficult to capture
    - Data us captured redundantly – same data is captured more than once
    - Too much data is captured
    - Illegal data is captured
  - Stored Data
    - Data is stored redundantly in multiple files and/or databases
    - Stored data is not accurate
    - Data is not secure from accident or vandalism
    - Data is not well organized
    - Data is not flexible – not easy to meet new information needs from stored data
    - Data is not accessible
- Economics
  - Costs
    - Costs are unknown
    - Costs are untraceable
    - Costs are too high
  - Profits
    - New markets can be explored
    - Current marketing can be improved
- Control (and Security)
  - Too little security or control
    - Input data is not adequately edited
    - Crimes (e.g. fraud, embezzlement) are (or can be) committed against the data
    - Ethics are breached on data or information – refers to data or information getting to unauthorized people
    - Redundantly stored data is inconsistent in different files or databases
    - Data privacy regulations or guidelines are being (or can be) violated
    - Processing errors are occurring (either by people, machines, or software)
    - Decision- making errors are occurring
  - Too much control or security
    - Bureaucratic red tape slows the system
    - Controls inconvenience customers or employees
    - Excessive controls cause processing delays
- Efficiency
  - People, machines, or computers waste time
    - Data is redundantly input or copied
    - Data is redundantly processed
    - Information is redundantly generated
  - People, machines, or computers waste materials and suppliers
    - Effort required for tasks is excessive
    - Materials required for tasks is excessive
- Service
  - The system produces inaccurate results
  - The system produces inconsistent results
  - The system produces unreliable results
  - The system is not easy to learn
  - The system is not easy to use
  - The system is awkward to use
  - The system is inflexible to new or exceptional situations
  - The system is inflexible to change
  - The system is incompatible with other systems
  - The system is not coordinated with other systems

Four Types of feasibility

→ Technical feasibility

- Is the project possible with current technology?
- What technical risk is there?
- Availability of the technology:
  - Is it available locally?
  - Can it be obtained?
  - Will it be compatible with other systems?

→ Economic feasibility

- Is the project possible, given resource constraints?
- What are the benefits?
  - Both tangible and intangible
  - Quantify them!
- What are the development and operational costs?
- Are the benefits worth the costs?

→ Schedule feasibility

- Is it possible to build a solution in time to be useful?
  - What are the consequences of delay?
  - Any constraints on the schedule?
  - Can these constraints be met?

→ Operational feasibility

- If the system is developed, will it be used?
- Human and social issues…
- internal issues:
  - Potential labour objections?
  - Manager resistance?
  - Organizational conflicts and policies?
- external issues:
  - Social acceptability?
  - legal aspects and government regulations?

Technical Feasibility

- Is the proposed technology or solution practical?
  - Do we currently possess the necessary technology?
  - Do we possess the necessary technical expertise
    - …and is the schedule reasonable for this team?
  - Is relevant technology mature enough to be easily applied to our problem?
- What kinds of technology will we need?
  - Some organizations like to use state-of-the-art technology
    - …but most prefer to use mature and proven technology.
  - A mature technology has a larger customer base for obtaining advice concerning problems and improvements.
- Is the required technology available "in house"?
  - If the technology is available:
    - …does it have the capacity to handle the solution?
  - If the technology is not available:
    - …can it be acquired?

Economic Feasibility

→ Can the bottom line be quantified yet?

- Very early in the project…
  - a judgement of whether solving the problem is worthwhile.
- Once specific requirements and solutions have been identified…
  - …the costs and benefits of each alternative can be calculated

→ Cost-benefit analysis

- Purpose - answer questions such as:
  - Is the project justified (I.e. will benefits outweigh costs)?
  - What is the minimal cost to attain a certain system?
  - How soon will the benefits accrue?
  - Which alternative offers the best return on investment?
- Examples of things to consider:
  - Hardware/software selection
  - Selection among alternative financing arrangements (rent/lease/purchase)
- Difficulties
  - benefits and costs can both be intangible, hidden and/or hard to estimate
  - ranking multi-criteria alternatives

Benefits

- Tangible Benefits
  - Readily quantified as $ values
  - Examples:
    - increased sales
    - cost/error reductions
    - increased throughput/efficiency
    - increased margin on sales
    - more effective use of staff time
- Intangible benefits
  - Difficult to quantify
    - But maybe more important!
    - business analysts help estimate $ values
  - Examples:
    - increased flexibility of operation
    - higher quality products/services
    - better customer relations
    - improved staff morale
- How will the benefits accrue?
  - When - over what timescale?
  - Where in the organization?

Costs

- Development costs (OTO)
  - Development and purchasing costs:
    - Cost of development team
    - Consultant fees
    - software used (buy or build)?
    - hardware (what to buy, buy/lease)?
    - facilities (site, communications, power,...)
  - Installation and conversion costs:
    - installing the system,
    - training personnel,
    - file conversion,....
- Operational costs (on-going)
  - System Maintenance:
    - hardware (repairs, lease, supplies,...),
    - software (licenses and contracts),
    - facilities
  - Personnel:
    - For operation (data entry, backups,…)
    - For support (user support, hardware and software maintenance, supplies,…)
    - On-going training costs

Example: costs for small Client-Server project

Personnel:

2	System Analysts (400 hours/ea $35.00/hr)	$28,000
4	Programmer/Analysts (250 hours/ea $25.00/hr)	$25,000
1	GUI Designer (200 hours/ea $35.00/hr)	$7,000
1	Telecommunications Specialist (50 hours/ea $45.00/hr)	$2,250
1	System Architect (100 hours/ea $45.00/hr)	$4,500
1	Database Specialist (15 hours/ea $40.00/hr)	$600
1	System Librarian (250 hours/ea $10.00/hr)	$2,500

Expenses:

4	Smalltalk training registration ($3500.00/student)	$14,000

New Hardware & Software:

1	Development Server (Pentium Pro class)	$18,700
1	Server Software (operating system, misc.)	$1,500
1	DBMS server software	$7,500
7	DBMS Client software ($950.00 per client)	$6,650

Total Development Costs:	**$118,200**

PROJECTED ANNUAL OPERATING COSTS

Personnel:

2	Programmer/Analysts (125 hours/ea $25.00/hr)	$6,250
1	System Librarian (20 hours/ea $10.00/hr)	$200

Expenses:

1	Maintenance Agreement for Pentium Pro Server	$995
1	Maintenance Agreement for Server DBMS software	$525
	Preprinted forms (15,000/year @ .22/form)	$3,300

Total Projected Annual Costs:	**$11,270**

Analyzing Costs vs. Benefits

→ Identify costs and benefits

- Tangible and intangible, one-time and recurring
- Assign values to costs and benefits

→ Determine Cash Flow

- Project the costs and benefits over time, e.g. 3-5 years
- Calculate Net Present Value for all future costs/benefits
  - determines future costs/benefits of the project in terms of today's dollar values
  - A dollar earned today is worth more than a potential dollar earned next year

→ Do cost/benefit analysis

- Calculate Return on Investment:
  - Allows comparison of lifetime profitability of alternative solutions.

$$ROI = \frac{\text{Total Profit}}{\text{Total Cost}} = \frac{\text{Lifetime benefits - Lifetime costs}}{\text{Lifetime costs}}$$

- Calculate Break-Even point:
  - how long will it take (in years) to pay back the accrued costs:

@T (Accrued Benefit > Accrued Cost)

Calculating Present Value

- **A dollar today is worth more than a dollar tomorrow…**
  - Your analysis should be normalized to "current year" dollar values.
- **The discount rate**
  - measures opportunity cost:
    - Money invested in this project means money not available for other things
    - Benefits expected in future years are more prone to risk
  - This number is company- and industry-specific.
    - "what is the average annual return for investments in this industry?"
- **Present Value:**
  - The "current year" dollar value for costs/benefits n years into the future
    - … for a given discount rate i

$$\text{Present\_Value}(n) = \frac{1}{(1+i)^n}$$

  - E.g. if the discount rate is 12%, then
    - $\text{Present\_Value}(1) = 1/(1 + 0.12)^1 = 0.893$
    - $\text{Present\_Value}(2) = 1/(1 + 0.12)^2 = 0.797$

Net Present Value

→ Measures the total value of the investment

- …with all figures adjusted to present dollar values

  NPV = Cumulative PV of all benefits - Cumulative PV of all costs

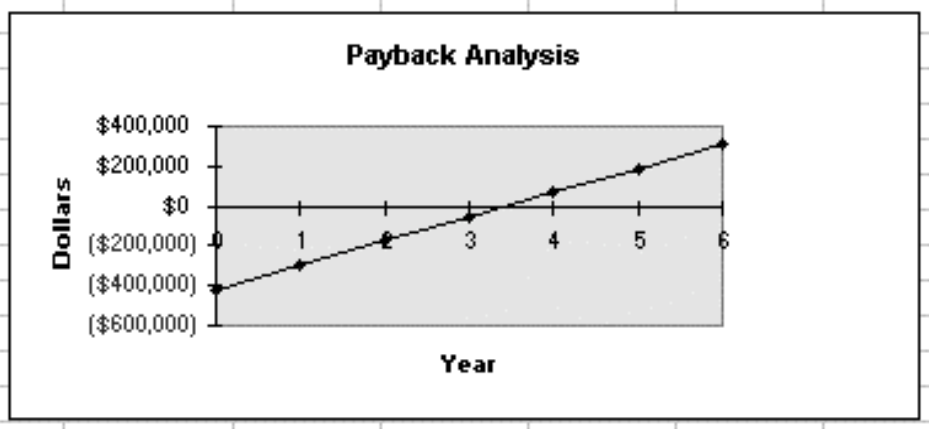
Cash Flow	Year 0	Year 1	Year 2	Year 3	Year 4
Dev. Costs	($100,000)				
Oper.Costs		($4,000)	($4,500)	($5,000)	($5,500)
Present Value	1	0.893	0.797	0.712	0.636
Time-adj Costs	($100,000)	($3,572)	($3,587)	($3,560)	($3,816)
Cumulative Costs	($100,000)	($103,572)	($107,159)	($110,719)	($114,135)
Benefits	0	$25,000	$30,000	$35,000	$50,000
T-adj Benefits	0	$22,325	$23,910	$24,920	$31,800
Cumulative Benefits	0	$22,325	$46,235	$71,155	$102,955
Net Costs+Benefits	($100,000)	($81,243)	($60,924)	($39,564)	($11,580)

- Assuming subsequent years are like year 4…
  - the net present value of this investment in the project will be:
  - after 5 years, $13,652
  - after 6 years, $36,168

Payback Analysis for Client-Server System Alternative

(Numbers rounded to nearest $1)

Cash flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Development cost:	($418,040)						
Operation & maintenance cost:		($15,045)	($16,000)	($17,000)	($18,000)	($19,000)	($20,000)
Discount factors for 12%:	1.000	0.893	0.797	0.712	0.636	0.567	0.507
Time-adjusted costs (adjusted to present	($418,040)	($13,435)	($12,752)	($12,104)	($11,448)	($10,773)	($10,140)
Cumulative time-adjusted costs over	($418,040)	($431,475)	($444,227)	($456,331)	($467,779)	($478,552)	($488,692)
Benefits derived from operation of new	$0	$150,000	$170,000	$190,000	$210,000	$230,000	$250,000
Discount factors for 12%:	1.000	$0.89	$0.80	$0.71	$0.64	$0.57	$0.51
Time-adjusted benefits (current of present	$0	$133,950	$135,490	$135,280	$133,560	$130,410	$126,750
Cumulative time-adjusted benefits over	$0	$133,950	$269,440	$404,720	$538,280	$668,690	$795,440
	0	1	2	3	4	5	6
Cumulative lifetime time-adjusted costs +	($418,040)	($297,525)	($174,787)	($51,611)	$70,501	$190,138	$306,748



Computing the payback period

→ Can compute the break-even point:

- when does lifetime benefits overtake lifetime costs?
- Determine the fraction of a year when payback actually occurs:

$$\frac{|\text{beginningYear amount}|}{\text{endYear amount} + |\text{beginningYear amount}|}$$

- For our last example, 51,611 / (70,501 + 51,611) = 0.42
- Therefore, the payback period is approx 3.4 years

Return on Investment (ROI) analysis

→ For comparing overall profitability

- Which alternative is the best investment?
- ROI measures the ratio of the value of an investment to its cost.

→ ROI is calculated as follows:

$$ROI = \frac{\text{Estimated lifetime benefits - Estimated lifetime costs}}{\text{Estimated lifetime costs}}$$

or:

$$ROI = \text{Net Present value / Estimated lifetime costs}$$

- For our example
  - ROI = (795,440 - 488,692) / 488,692 ≈ 63%,
  - or ROI = 306,748 / 488,692 ≈ 63%

→ Solution with the highest ROI is the best alternative

- But need to know payback period too to get the full picture
  - E.g. A lower ROI with earlier payback may be preferable in some circumstances

Schedule Feasibility

- How long will it take to get the technical expertise?
  - We may have the technology, but that doesn't mean we have the skills required to properly apply that technology.
    - May need to hire new people
    - Or re-train existing systems staff
    - Whether hiring or training, it will impact the schedule.
- Assess the schedule risk:
  - Given our technical expertise, are the project deadlines reasonable?
  - If there are specific deadlines, are they mandatory or desirable?
    - If the deadlines are not mandatory, the analyst can propose several alternative schedules.
- What are the real constraints on project deadlines?
  - If the project overruns, what are the consequences?
    - Deliver a properly functioning information system two months late…
    - …or deliver an error-prone, useless information system on time?
  - Missed schedules are bad, but inadequate systems are worse!

Operational Feasibility

- How do end-users and managers feel about…
  - …the problem you identified?
  - …the alternative solutions you are exploring?
- You must evaluate:
  - Not just whether a system *can* work…
  - … but also whether a system *will* work.
- Any solution might meet with resistance:
  - Does management support the project?
  - How do the end users feel about their role in the new system?
  - Which users or managers may resist (or not use) the system?
    - People tend to resist change.
    - Can this problem be overcome? If so, how?
  - How will the working environment of the end users change?
  - Can or will end users and management adapt to the change?

Feasibility Study Contents

1. **Purpose & scope of *the study***
   - Objectives (of the study)
   - who commissioned it & who did it,
   - sources of information,
   - process used for the study,
   - how long did it take,…
2. **Description of present situation**
   - organizational setting, current system(s).
   - Related factors and constraints.
3. **Problems and requirements**
   - What's wrong with the present situation?
   - What changes are needed?
4. **Objectives of the new system.**
   - Goals and relationships between them
5. **Possible alternatives**
   - …including 'do nothing'.
6. **Criteria for comparison**
   - definition of the criteria
7. **Analysis of alternatives**
   - description of each alternative
   - evaluation with respect to criteria
   - cost/benefit analysis and special implications.
8. **Recommendations**
   - what is recommended and implications
   - what to do next;
     - E.g. may recommend an interim solution and a permanent solution
9. **Appendices**
   - to include any supporting material.

Comparing Alternatives

- How do we compare alternatives?
  - When there are multiple selection criteria?
  - When none of the alternatives is superior across the board?
- Use a Feasibility Analysis Matrix!
  - The columns correspond to the candidate solutions;
  - The rows correspond to the feasibility criteria;
  - The cells contain the feasibility assessment notes for each candidate;
  - Each row can be assigned a rank or score for each criterion
    - e.g., for operational feasibility, candidates can be ranked 1, 2, 3, etc.
  - A final ranking or score is recorded in the last row.
- Other evaluation criteria to include in the matrix
  - quality of output
  - ease of use
  - vendor support
  - cost of maintenance
  - load on system

Example matrix

	Candidate 1 Name	Candidate 2 Name	Candidate 3 Name
Description			
Operational Feasibility			
Technical Feasibility			
Schedule Feasibility			
Economic Feasibility			
Ranking			

Feasibility Criteria	Wt.	Candidate 1	Candidate 2	Candidate 3	Candidate …
Operational Feasibility **Functionality**. Describes to what degree the alternative would benefit the organization and how well the system would work. **Political**. A description of how well received this solution would be from both user management, user, and organization perspective.	**30%**	Only supports Member Services requirements and current business processes would have to be modified to take advantage of software functionality **Score: 60**	Fully supports user required functionality. **Score: 100**	Same as candidate 2. **Score: 100**	
Technical Feasibility **Technology**. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. **Expertise**. An assessment to the technical expertise needed to develop, operate, and maintain the candidate system.	**30%**	Current production release of Platinum Plus package is version 1.0 and has only been on the market for 6 weeks. Maturity of product is a risk and company charges an additional monthly fee for technical support. Required to hire or train C++ expertise to perform modifications for integration requirements. **Score: 50**	Although current technical staff has only Powerbuilder experience, the senior analysts who saw the MS Visual Basic demonstration and presentation, has agreed the transition will be simple and finding experienced VB programmers will be easier than finding Powerbuilder programmers and at a much cheaper cost. MS Visual Basic 5.0 is a mature technology based on version number. **Score: 95**	Although current technical staff is comfortable with Powerbuilder, management is concerned with recent acquisition of Powerbuilder by Sybase Inc. MS SQL Server is a current company standard and competes with SYBASE in the Client/Server DBMS market. Because of this we have no guarantee future versions of Powerbuilder will "play well" with our current version SQL Server. **Score: 60**	

Feasibility Criteria	Wt.	Candidate 1	Candidate 2	Candidate 3	Candidate …
Operational Feasibility	**30%**	**Score: 60**	**Score: 100**	**Score: 100**	
Technical Feasibility	**30%**	**Score: 50**	**Score: 95**	**Score: 100**	
Economic Feasibility **Cost to develop:** **Payback period (discounted):** **Net present value:** **Detailed calculations:**	**30%**	 Approximately $350,000. Approximately 4.5 years. Approximately $210,000. See Attachment A. **Score: 60**	 Approximately $418,040. Approximately 3.5 years. Approximately $306,748. See Attachment A. **Score: 85**	 Approximately $400,000. Approximately 3.3 years. Approximately $325,500. See Attachment A. **Score: 90**	
Schedule Feasibility An assessment of how long the solution will take to design and implement.	**10%**	Less than 3 months. **Score: 95**	9-12 months **Score: 80**	9 months **Score: 85**	
Ranking	**100%**	**60.5**	**92**	**83.5**	