VI. The Feasibility Study

What is a feasibility study?
What to study and conclude?
Benefits and costs
Cost/Benefit analysis
Accounting methods
Comparing alternatives

Do it!

The Feasibility Study Phase

- The objectives of a feasibility study are to find out if an information system project can be done (...is it possible?...is it justified?) and to suggest possible alternative solutions.

- A feasibility study should provide management with enough information to decide:
  - whether the project can be done
  - whether the final product will benefit its intended users
  - what are the alternatives among which a solution will be chosen (during subsequent phases)
  - is there a preferred alternative

- After a feasibility study, management makes a go/no go decision

  The feasibility study is a management-oriented activity

What to Study? ...What to Conclude?

- Things to be studied during the feasibility study phase:
  - ✓ The present organizational system, including users, policies, functions, objectives,...
  - ✓ Problems with the present system (inconsistencies, inadequacies in functionality, performance,...,
  - ✓ Objectives and other requirements for the new system (what needs to change?)
  - ✓ Constraints, including nonfunctional requirements on the system (preliminary pass)
  - ✓ Possible alternatives (the current system is always one of those)
  - ✓ Advantages and disadvantages of the alternatives

- Things to conclude: Feasibility of the project and the preferred alternative.

Types of Feasibility

- **Operational** -- Define the urgency of the problem and the acceptability of any solution; If the system is developed, will it be used? Includes people-oriented and social issues: internal issues, such as manpower problems, labour objections, manager resistance, organizational conflicts and policies; also external issues, including social acceptability, legal aspects and government regulations.
- **Technical** -- Is the project feasibility within the limits of current technology? Does the technology exist at all? Is it available within given resource constraints (i.e., budget, schedule,...)?
- **Economic** (**Cost/Benefits Analysis**) -- Is the project possible, given resource constraints? Are the benefits that will accrue from the new system worth the costs? What are the savings that will result from the system, including tangible and intangible ones? What are the development and operational costs?
- **Schedule** -- Constraints on the project schedule and whether they could be reasonably met

  Constraints may be hard or soft

Operational Feasibility:
The PIECES Framework

The PIECES framework can help in identifying problems to be solved, and their urgency:

Performance -- Does current mode of operation provide adequate throughput and response time?

Information -- Does current mode provide end users and managers with timely, pertinent, accurate and usefully formatted information?

Economy -- Does current mode of operation provide cost-effective information services to the business? Could there be a reduction in costs and/or an increase in benefits?

Control -- Does current mode of operation offer effective controls to protect against fraud and to guarantee accuracy and security of data and information?

Efficiency -- Does current mode of operation make maximum use of available resources, including people, time, flow of forms,...?

Services -- Does current mode of operation provide reliable service? Is it flexible and expandable?

More on Operational Feasibility:
Acceptability of Potential Solutions

- How do end-users and managers feel about the problem (solution)?
- It's not only important to evaluate whether a system *can* work but also evaluate whether a system *will* work.
- A workable solution might fail because of end-user or management resistance.
  - ✓ Does management support the project?
  - ✓ How do the end-users feel about their role in the new system?
  - ✓ What end-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?

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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?
- The technology for any defined solution is usually available; however, the question is whether that technology is mature enough to be easily applied to our problem.
- Some firms like to use state-of-the-art technology, but most firms prefer to use mature and proven technology.
- A mature technology has a larger customer base for obtaining advice concerning problems and improvements.
- Assuming that required technology is practical, is it available in the information systems shop? If the technology is available, does it have the capacity to handle the solution.
- If the technology is not available, can it be acquired?

Schedule Feasibility

- We may have the technology, but that doesn't mean we have the skills required to properly apply that technology; True, all information systems professionals can learn new technologies; However, that learning curve will impact the technical feasibility of the project; specifically, it will impact the schedule.
- Given our technical expertise, are the project deadlines reasonable? Some projects are initiated with specific deadlines;   You need to determine whether the deadlines are mandatory or desirable. If the deadlines are desirable rather than mandatory, the analyst can propose alternative schedules.
- It is preferable (unless the deadline is absolutely mandatory) to deliver a properly functioning information system two months late than to deliver an error-prone, useless information system on time! Missed schedules are bad, but inadequate systems are worse!

Economic Feasibility

- The bottom line in many projects is economic feasibility.
- During the early phases of the project, economic feasibility analysis amounts to little more than judging whether the possible benefits of solving the problem are worthwhile.
- As soon as specific requirements and solutions have been identified, the analyst can weigh the costs and benefits of each alternative.
- This is called a *cost-benefit analysis*.

Cost/Benefit Analysis

- The purpose of a cost/benefit analysis is to answer questions such as:
  - ✓ Is the project justified (because benefits outweigh costs)?
  - ✓ Can the project be done, within given cost constraints?
  - ✓ What is the minimal cost to attain a certain system?
  - ✓ What is the preferred alternative, among candidate solutions?
- Examples of things to consider:
  - ✓ Hardware/software selection
  - ✓ How to convince management to develop the new system
  - ✓ Selection among alternative financing arrangements (rent/lease/purchase)
- Difficulties -- discovering and assessing benefits and costs; they can both be intangible, hidden and/or hard to estimate, it's also hard to rank multi-criteria alternatives

Types of Benefits

- Examples of particular benefits: cost reductions, error reductions, increased throughput, increased flexibility of operation, improved operation, better (e.g., more accurate) and more timely information
- Benefits may be classified into one of the following categories:
  - **Monetary** -- when $-values can be calculated
  - **Tangible** (Quantified) -- when benefits can be quantified, but $-values can't be calculated
  - **Intangible** -- when neither of the above applies
- How to identify benefits? By organizational level (operational, lower/middle/higher management) or by department (production, purchasing, sales,...)

Types of Costs

- Project-related costs
  - ✓ Development and purchasing costs: who builds the system (internally or contracted out)? software used (buy or build)? hardware (what to buy, buy/lease)? facilities (site, communications, power,...)
  - ✓ Installation and conversion costs: installing the system, training of personnel, file conversion,....
- Operational costs (on-going)
  - ✓ Maintenance: hardware (maintenance, lease, materials,...), software (maintenance fees and contracts), facilities
  - ✓ Personnel: operation, maintenance
- For a small business that wants to introduce a PC-based information system, these cost categories translate to the following:
  - ✓ Project costs: purchasing (hardware, software, office furniture), customizing software, training, system installation and file conversion
  - ✓ On-going costs: operating the system (data entry, backups, helping users, vendors etc.), maintenance (software) and user support, hardware and software maintenance, supplies

Sample Costs for a Client-Server Devel/nt 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**

Accounting Methods

Assuming that both benefits and costs can be identified and evaluated, how do we compare them to determine project feasibility? Typical cases include comparing costs of alternatives (assuming equal benefits) or comparing various payment options:

- **Payback Analysis:** how long will it take (usually, in years) to pay back the project, and accrued costs:
  Total costs (initial + incremental) - Yearly return (or savings)
- **Return on Investment Analysis**: compares the lifetime profitability of alternative solutions.
  $$\frac{\text{Lifetime benefits - Lifetime costs}}{\text{Lifetime costs}}$$
- **Net Present Value Analysis:** determines the profitability of the new project in terms of today's dollar values. Will tell you that if you invest in the proposed project, after n years you will have $XXX profit/loss on your investment

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Discount Rates

- A dollar today is worth more than a dollar tomorrow…
- The dollar values used in this type of analysis should be normalized to refer to current year dollar values.
- For this, we need a number, the **discount rate**, which measures the opportunity cost of investing money in other projects, rather than the information system development one. This number is company- and industry-specific.
- To calculate the **present value,** i.e., the real dollar value given the discount rate i, n years from now, we use the formula
  $$\text{Present Value}(n) = \frac{1}{(1 + i)^n}$$
- For example, if the discount rate is 12%, then

  Present Value (1) = $1/(1 + 0.12)^1 = 0.893$
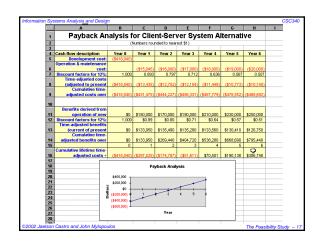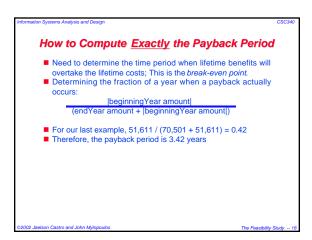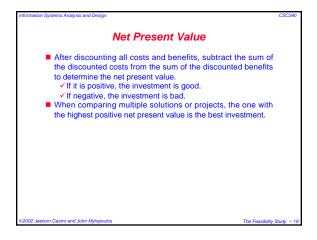 Present Value (2) = $1/(1 + 0.12)^2 = 0.797$
  ...

Payback Analysis

Basically, we need to compute
  Total costs (initial + incremental) - Yearly return (or savings)
but it must be done with present dollar values.

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)	

The **net present value** of the investment in the project after 5 years is $13,652, and after 6 years is $36,168, assuming the same figure as for year 4.

Payback Analysis for Client-Server System Alternative

(Numbers rounded to nearest $1)

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

Payback Analysis

How to Compute _Exactly_ the Payback Period

- Need to determine the time period when lifetime benefits will overtake the lifetime costs; This is the _break-even point_.
- Determining the fraction of a year when a 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 3.42 years

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Net Present Value

- After discounting all costs and benefits, subtract the sum of the discounted costs from the sum of the discounted benefits to determine the net present value.
  - ✓ If it is positive, the investment is good.
  - ✓ If negative, the investment is bad.
- When comparing multiple solutions or projects, the one with the highest positive net present value is the best investment.

	A	B	C	D	E	F	G	H	I	J
1	Net Present Value Analysis for Client-Server System Alternative									
2		(Numbers rounded to nearest $1)								
3										
4	Cash flow description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total	
5	Development cost:	($418,040)								
6	Operation & maintenance cost:		($15,045)	($16,000)	($17,000)	($18,000)	($19,000)	($20,000)		
7	Discount factors for 12%:	1.000	0.893	0.797	0.712	0.636	0.567	0.507		
8	Present value of annual costs:	($418,040)	($13,435)	($12,752)	($12,104)	($11,448)	($10,773)	($10,140)		
9	Total present value of lifetime costs:								($488,692)	
10										
11	Benefits derived from operation of new	$0	$150,000	$170,000	$190,000	$210,000	$230,000	$250,000		
12	Discount factors for 12%:	1.000	$0.89	$0.80	$0.71	$0.64	$0.57	$0.51		
13	Present value of annual benefits:	$0	$133,950	$135,490	$135,280	$133,560	$130,410	$126,750		
14	Total present value of lifetime benefits:								$795,440	
15										
16	NET PRESENT VALUE OF THIS ALTERNATIVE:								$306,748	
17										

Return on Investment (ROI) Analysis

- The ROI analysis technique compares the lifetime profitability of alternative solutions or projects.
- The ROI for a solution or project is a percentage rate that measures the relationship between the amount the business gets back from an investment and the amount invested.
- The ROI for a potential solution or project is calculated as follows:

ROI = (Estimated lifetime benefits - Estimated lifetime costs) / Estimated lifetime costs

or,

ROI = Net Present value / Estimated lifetime costs

- For our example, ROI = (795,440-488,692)/ 488,692= 62.76%, or ROI = 306,748 / 488,692 = 62.76%
- The solution offering the highest ROI is the best alternative.

Comparing Alternatives with the Feasibility Analysis Matrix
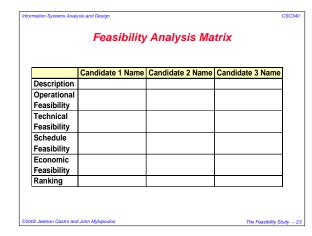
- How do we compare alternatives when there are multiple selection criteria and none of the alternatives is superior across the board?
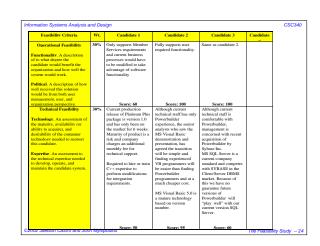- Use a Feasibility Analysis Matrix!
- In a feasibility analysis matrix,
  - ✓ The columns correspond to the candidate solutions
  - ✓ Some rows correspond to the feasibility criteria
  - ✓ The cells contain the feasibility assessment notes for each candidate.
  - ✓ Each row can be assigned a rank or score for each criterion (e.g., for operational feasibility, candidates can be ranked 1, 2, 3, etc.).
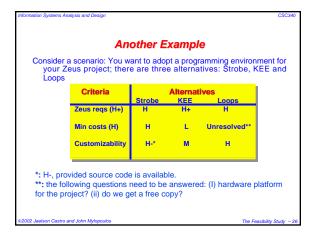 - ✓ After ranking or scoring all candidates on each criterion, a final ranking or score is recorded in the last row.
- Examples of other evaluation criteria: quality of output, ease of use, vendor support, cost of maintenance, load on system

Feasibility Analysis 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**. A description of to what degree the candidate 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 of 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	

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

Another Example

Consider a scenario: You want to adopt a programming environment for your Zeus project; there are three alternatives: Strobe, KEE and Loops

Criteria	Alternatives		
	Strobe	KEE	Loops
Zeus reqs (H+)	H	H+	H
Min costs (H)	H	L	Unresolved**
Customizability	H-*	M	H

*: H-, provided source code is available.

**: the following questions need to be answered: (I) hardware platform for the project? (ii) do we get a free copy?

Comparing Alternatives with Multiple Criteria

Methods
- Assign a weight to each criterion; evaluate each criterion for each alternative in absolute or relative terms.
- Use dominating criteria: compare on the most important criterion and eliminate all inferior alternatives; compare on next important criterion etc.
- Eliminate unsatisfactory alternatives by setting "acceptability" threshold levels, only consider alternatives that exceed these thresholds.

Feasibility Study Contents

- Purpose and scope of the study -- objectives, who commissioned it, who did it, sources of information, process used for the study, how long did it take,...
- Description of present situation -- organizational setting, current system(s).
- Related factors and constraints.
- Problems and requirements.
- Objectives of the new system.
- Possible alternatives -- including, possibly, the present situation.
- Criteria for comparison -- definition of the criteria
- Analysis of alternatives -- includes description of each alternative, evaluation with respect to criteria, including cost/benefit analysis and special implications.
- Recommendations -- what is recommended, implications, what to do next; sometimes it makes sense to recommend an interim solution and a permanent solution.
- Appendices which include supporting material.

An Example

- Your friendly campus bookstore wants to improve handling of textbook orders. Right now, the orders come in on a paper form from instructors, the information is copied on cards for a card file, purchase orders are generated for publishers. A clerk keeps track of incoming shipments. All information is thrown away at the end of the year, so instructors can't say "same as last year".
- Can you (as systems analyst) help?

- Here are the steps you may want to follow:
- Talk to the manager, convince her that a feasibility study is a good idea, generate a proposal, sign a contract and get started;
- Find out how other kinds of information are handled (payroll, scheduling of employees,...); it turns out that they are not problems, so the new system need not deal with such information (**scoping**)
- Talk to the people who handle orders; what do they do? where is the problem, if any? what would they like to see? (**information acquisition**)

An Example (cont'd)

- As you begin to understand the setup, you begin to form an idea of how different processes are done: **HandleOrder**, **AnswerQuery**, **PurchaseBooks**, **GetUsedBooks**,...
- You confirm your understanding with the manager and assistant manager.
- Next you consider alternatives: (a) improve the manual system with redesigned cards, new card-filing system; (b) install a personal computer with a database where you keep all book orders; (c) install a network of PCs to handle orders, purchase orders, inventory.
- You confirm with the manager that his criteria for evaluating alternative solutions are: (1) cost -- no more than $30K; (2) improved service; (3) ease of use.
- Next, you evaluate each alternative with respect to each criterion. To do this, you talk to your technical people who help you with advice on the size of programming tasks etc. Once you are done, you show the results to the manager. You don't show him any conclusions yet.
- Finally, you prepare your report and you hand it in.