Lecture 3, Part 2: Feasibility Study

Jennifer Campbell
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Why a feasibility study?

- **Objectives of a feasibility study:**
  - To find out if a 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

When to do Feasibility Study?

- Start examining feasibility early: when performing problem analysis.
  - Determine whether detailed study and analysis are worthwhile.
  - Thorough feasibility study is performed after software requirements specification is written, before proceeding any further with the project.
- A project that is feasible at one point, may not be feasible at a later point.
  - Feasibility should be reviewed throughout the project.

Content of a 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 non-functional requirements on the system (preliminary pass)
Content of a feasibility study [2]

- 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

Types of feasibility

- Technical feasibility
  - Is the project possible with current technology?
    - How much technical risk is there?
    - Does the technology exist at all?
      - 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 benefits will result from the system?
    - Both tangible and intangible benefits
    - 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?
    - Any constraints on the schedule?
    - Can these constraints be met?
- Operational feasibility
  - Urgency of the problem and the acceptability of any solution:
    - If the system is developed, will it be used?
    - Human and social issues...
    - Internal issues:
      - Available of human resources?
      - 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?
  - Is the 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.
- 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?

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.
- 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?
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?
  - How will the working environment of the end users change?
  - Can or will end users and management adapt to the change?

Operational Feasibility: PIECES

The "PIECES" framework is 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

Economic Feasibility

- Purpose - answer questions such as:
  - Is the project justified (i.e. will benefits outweigh costs)?
  - Can the project be done, within given cost constraints?
  - What is the minimal cost to attain a certain system?
  - Which alternative offers the best return on investment?

- 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
  - Benefits and costs can both be intangible, hidden and/or hard to estimate
  - Ranking multi-criteria alternatives

Economic Feasibility: 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: 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 $35.00/hr) $7,000
- 1 System Architect (100 hours $45.00/hr) $4,500
- 1 Database Specialist (15 hours $40.00/hr) $600
- 1 Telecommunications Specialist (50 hours $45.00/hr) $2,250
- 1 System Librarian (250 hours $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 $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

Economic Feasibility: 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

Economic Feasibility: Cost/Benefit Estimation

“Software Cost Estimation continues to be the weak link in software project management”. [Agarwal et al, 2001]

Assigning monetary values to costs and benefits
- Need to be able to compare them on the same scale
- Extremely challenging task
- Examples:
  - Increased efficiency in mail-order department
    - $125,000 (justification: 5 people at $25,000 per person)
  - Increased earnings due to web presence
    - $500,000 (justification: increasing at 50% per year)

Economic Feasibility: Cost-Benefit Analysis

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

- **Determine Cash Flow**
  - Project 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 **Break-Even point**:
    - how long will it take (in years) to pay back the accrued costs:
  - Calculate **Return on Investment**:
    - allows comparison of lifetime profitability of alternative solutions.
Economic Feasibility: 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 in 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
    - \[\text{Present Value}(1) = \frac{1}{(1 + 0.12)} = 0.893\]
    - \[\text{Present Value}(2) = \frac{1}{(1 + 0.12)^2} = 0.797\]

\[\text{[WBDF04]}\]

Economic Feasibility: Net Present Value

- Measures the total value of the investment
  - ...with all figures adjusted to present dollar values
  \[
  \text{NPV} = \text{Cumulative PV of all benefits} - \text{Cumulative PV of all costs}
  \]

<table>
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<tr>
<th>Cash Flow</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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<td>($81,243)</td>
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</table>

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

\[\text{[WBDF04]}\]

Economic Feasibility: Computing the payback period

- Compute the break-even point:
  - When does lifetime benefits overtake lifetime costs?
  - Determine the fraction of a year when payback actually occurs:
    \[
    \text{beginningYear amount} \quad \frac{\text{endYear amount} + \text{beginningYear amount}}{2}
    \]
  - For our last example, \(51,611 / (70,501 + 51,611) = 0.42\)
  - Therefore, the payback period is 3.42 years
Economic Feasibility: Return on Investment (ROI)

- 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:
  \[ \text{ROI} = \frac{\text{Estimated lifetime benefits} - \text{Estimated lifetime costs}}{\text{Estimated lifetime costs}} \]
  or:
  \[ \text{ROI} = \frac{\text{Net Present value}}{\text{Estimated lifetime costs}} \]
- 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

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 Candidate Systems 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

Candidate Systems Matrix

<table>
<thead>
<tr>
<th>Description</th>
<th>Candidate 1 Name</th>
<th>Candidate 2 Name</th>
<th>Candidate 3 Name</th>
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<tbody>
<tr>
<td>Operational Feasibility</td>
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<tr>
<td>Ranking</td>
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</table>
### Feasibility Criteria

#### Operational Feasibility

**Functionality**
- Describes to what degree the alternative would benefit the organization and how well the system would work.
- Candidate 3: Fully supports user required functionality. Score: 100
- Candidate 2: Same as candidate 2. Score: 100
- Candidate 1: Only supports Member Services requirements and current business processes would have to be modified to take advantage of software functionality. Score: 60

**Political**
- A description of how well received this solution would be from both user management, user, and organization perspectives.

**30%**
- Score: 60
- Score: 100
- Score: 100

#### Technical Feasibility

**Technology**
- An assessment of the maturity, availability (or ability to acquire), and feasibility of the computer technology needed to support this candidate.
- Candidate 3: 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 changes an additional monthly fee for technical support. Required to hire or train C++ expertise to perform modifications for integration requirements. Score: 50
- Candidate 2: Although current technical staff has only Powerbuilder experience, the senior analysts who saw the MS Visual Basic demonstration and presentation, have agreed the transition will be simple and finding experienced VH 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
- Candidate 1: 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

**30%**
- Score: 50
- Score: 95
- Score: 60

#### Economic Feasibility

**Cost to develop:**
- Candidate 3: Approximately $418,040. Score: 85
- Candidate 2: Approximately $306,748. Score: 90
- Candidate 1: Approximately $210,000. Score: 85

**Payback period (discounted):**
- Candidate 3: Approximately 3.5 years.
- Candidate 2: Approximately 3.3 years.
- Candidate 1: Approximately 4.5 years.

**Net present value:**
- Candidate 3: Approximately $325,500.
- Candidate 2: Approximately $306,748.
- Candidate 1: Approximately $418,040.

**Detailed calculations:**
- See Attachment A.

**10%**
- Score: 60
- Score: 85
- Score: 85

#### Schedule Feasibility

**An assessment of how long the solution will take to design and implement:**
- Candidate 1: Less than 3 months. Score: 95
- Candidate 2: 9-12 months. Score: 80
- Candidate 3: 9 months. Score: 85

**10%**
- Score: 95
- Score: 80
- Score: 85

### Ranking

<table>
<thead>
<tr>
<th>Feasibility Criteria</th>
<th>Wt.</th>
<th>Candidate 1</th>
<th>Candidate 2</th>
<th>Candidate 3</th>
<th>Candidate …</th>
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### References
