

SENG 471

Software Requirements Engineering

Feasibility Study

Why, When a Feasibility Study?

- Objectives:
 - Possibilities of an system, alternatives
 - Enough information for management to know
- Early → when performing problem analysis
 - Coarse one:
 - Thorough one:

Note: A project that is feasible at one point may not be feasible at a later point.

Feasibility Study - Content

- Organization of a system → stakeholders, ...
- Problems with the present system → inconsistencies, ...
- Goals for the new system → ...
- Constraints → preliminary ???
- Possible alternatives → other solutions, ...
- Things to conclude → preferred alternative, ...

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[Whi04]

Feasibility Study - Types

- **Technical**
 - Possible with current technologies?
 - Technologies exist?
 - Compatible with others?
- **Operational**
 - Urgency of the problem
 - Acceptability of any solution
 - Human and social issues...
 - Internal issues
 - External issues
- **Schedule**
 - Possible to build a solution in time to be useful?
- **Economic**
 - Possible, given resource constraints?
 - What benefits?
 - What costs?
 - Are the benefits worth the costs?

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Technical Feasibility

- Is the proposed technology / solution practical?
 - necessary technology?
 - necessary technical expertise?
 - relevant technology mature enough?
- What kinds of technology will be needed?
 - state-of-the-art technology?
- Is the required technology available “in house”?
 - available technology → its capacity?
 - non-available technology → how to get?

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Schedule Feasibility

- How long will it take to get the technical expertise?
 - skills required to apply the technology?
- What are the schedule risks?
 - project deadlines reasonable?
 - mandatory or desirable deadlines?
 - alternatives for desired deadlines?
- What are the real constraints on project deadlines?
 - consequences for overrunning the project?
 - flexibility of delivering deadlines?

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Operational Feasibility

“PIECES” framework:

- Performance
- Information
- Economy
- Control
- Efficiency
- Services

- Whether a system will work ...
 - NOT whether a system can work ...
- How do clients/users and managers feel about?
 - identified problems?
 - alternative solutions?
- What are resistances?
 - Management?
 - clients/users?
 - who may resist (or not use) the system?
 - change of the working environment?
 - adaptation to the change?

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Economic Feasibility

- Purpose – What are the costs and benefits?
 - project justified?
 - project completion within given cost constraints?
 - minimal cost to attain a certain system?
 - alternatives for the best return on investment?
- Examples of things to consider:
 - hardware/software?
 - management support?
 - alternative financing?
- Difficulties
 - estimating benefits and costs
 - ranking multi-criteria alternatives

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Economic Feasibility - Costs

- Development costs (OTO)
 - Development and purchasing
 - team, consultant
 - software
 - hardware
 - facilities
 - Installation and conversion
 - installing
 - training
 - file conversion,....
- Operational costs (on-going)
 - System maintenance:
 - hardware
 - software
 - facilities
 - Personnel:
 - operation
 - support
 - on-going training

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[Whi04]

Example: Costs of client-server project

Personnel:		
2	System analysts (400 hours/each; \$35.00/hour)	\$28,000
4	Programmer/tester (250 hours/each; \$25.00/hour)	\$25,000
1	GUI designer (200 hours/each; \$35.00/hour)	\$7,000
1	Telecommunication specialist (50 hours/each; \$45.00/hour)	\$2,250
1	System architect (100 hours/each; \$45.00/hour)	\$4,500
1	Database specialist (15 hours/each; \$40.00/hour)	\$600
1	System librarian (250 hours/each; \$10.00/hour)	\$2,500
Expenses:		
4	Smalltalk training registration (\$3500.00/person)	\$14,000
New hardware and software:		
1	Development server (hardware)	\$18,700
1	Server software (operating system, misc.)	\$1,500
1	Database server software	\$7,500
6	Database client software (\$950.00/client)	\$6,650
Total Projected Development Costs:		\$118,200

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Example: Costs of client-server project

Personnel:		
2	Programmer/tester (125 hours/each; \$25.00/hour)	\$6,250
1	System librarian (20 hours/each; \$10.00/hour)	\$200
Expenses:		
1	Maintenance agreement for server hardware	\$995
1	Maintenance agreement for server database software	\$525
	Administration/maintenance	\$3,300
Total Projected Annual Operational Costs:		\$11,270

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Economic Feasibility - Benefits

- **Tangible Benefits**
 - Readily quantified → \$ values
 - Examples:
 - sales
 - cost/error
 - throughput/efficiency
 -
- **Intangible benefits**
 - Difficultly quantified → \$ values; but **more important**
 - Examples:
 - operational flexibility
 - product/service quality
 - customer relations
 - staff morale

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Economic Feasibility - Cost-Benefit Analysis

- Identify costs and benefits
 - Tangible and intangible
 - One-time and recurring
- Determine cash flow
 - Project costs and benefits over time
 - Calculate **Net Present Value (NPV)** for all future costs/benefits
- Analyze cost-benefit
 - **Break-Even point**
 - **Return on Investment (ROI)**

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Economic Feasibility - Net Present Value

- Discount Rate (i) → average annual return for investment in a company or an industry
- Present Value (PV) → “current year” \$ value for costs/benefits in n years into the future

e.g.: if $i = 12\%$, then $PV(1) = 1 / (1 + 0.12)^1 = 0.893$

$PV(2) = 1 / (1 + 0.12)^2 = 0.797$

- Net Present Value (NPV) → total value of investment
 $NPV = (\text{cumulative PV of all benefits}) - (\text{cumulative PV of all costs})$

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Economic Feasibility - NPV Example

NPV = (cumulative PV of all benefits) – (cumulative PV of all costs)

Cash Flow	Year 0	Year 1	Year 2	Year 3	Year 4
Present value (PV)	1	0.893	0.797	0.712	0.636
Development costs	(\$100,000)				
Operational costs		(\$4,000)	(\$4,500)	(\$5,000)	(\$5,500)
Time-adjusted costs	(\$100,000)	(\$3,572)	(\$3,587)	(\$3,560)	(\$3,498)
Cumulative costs	(\$100,000)	(\$103,572)	(\$107,159)	(\$110,719)	(\$114,217)
Benefits	0	\$25,000	\$30,000	\$35,000	\$50,000
Time-adjusted benefits	0	\$22,325	\$23,910	\$24,920	\$31,800
Cumulative benefits	0	\$22,325	\$46,235	\$71,155	\$102,955
Net present value (NPV)	(\$100,00)	(\$81,243)	(\$60,924)	(\$39,564)	(\$11,262)

Assuming subsequent years are like Year 4, the NPV of this investment will be:

Year 5, NPV = \$13,969

Year 6, NPV = \$36,530

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Economic Feasibility - Break-Even Point

- Compute the payback period (**Break-Even point**)
 - The fraction of a year when payback starts to occur:

- Example: on Slide #17, the fraction of a Year 5 is as follows:

$$11,262 / (13,969 + 11,262) = 0.45$$

Thus, the pay back period (break-even) is 4.45 years.

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Economic Feasibility - Return on Investment

- Return on investment (ROI) → the ratio of an investment to its cost
 - Example: on Slide # 17
Year 5: $ROI = 13,969 / (114,217 + 3,119) = 11.91\%$
Year 6: $ROI = 36,530 / (117,336 + 2,789) = 30.41\%$
- ROI + Break-Even point → the full picture of investment and preferred alternatives

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Feasibility - Comparing Alternatives

- When to compare alternatives?
 - multiple selection criteria; none alternative stands out
- Use a Candidate Systems Matrix

Feasibility Criteria	Weight	Alternative 1	Alternative 2	Alternative 3
Operational Feasibility				
Technical Feasibility				
Schedule Feasibility				
Economic Feasibility				
Ranking				
- Include other criteria in the matrix
 - quality of output, ease of use, vendor support, load on system

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Candidate Systems Matrix - Example

Feasibility Criteria	Wt.	Alternative1	Alternative 2	Alternative 3	Alternative ...
Operational Feasibility Functionality: Describes to what degree the alternative would benefit the organization and how well the system would work. Political: Describes how well received this solution would be from 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	Sam as alternative 2. Score: 100	
Technical Feasibility Technology: Assessment of the maturity, availability, and desirability of the computer technology needed to support this candidate system. Expertise: Assessment to technical expertise needed to develop, operate, and maintain the candidate system.	30%	- Current production release is version 1.0 and has only been on the market for 6 weeks. Maturity of product is a risk and company charges a 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 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. - VB 5.0 is a mature technology based on version number. Score: 95	- Although current technical staff is fine with Powerbuilder, management is concerned with recent acquisition of Powerbuilder by Sybase Inc. MS SQL Server is a current company to compete with Sybase. No guarantee future Powerbuilder versions will match with our SQL server. Score: 60	

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Candidate Systems Matrix - Example

Feasibility Criteria	Wt.	Alternative 1	Alternative 2	Alternative 3	Alternative ...
Operational Feasibility	30%	Score: 60	Score: 100	Score: 100	
Technical Feasibility	30%	Score: 50	Score: 95	Score: 60	
Economic Feasibility Cost to develop: Payback period: Net present value: Detailed calculations:	30%	~ \$350,000 ~ 4.5 Years ~ \$210,000 See attachment A. Score: 60	~ \$418,000 ~ 3.5 Years ~ \$306,748 See attachment A. Score: 85	~ \$400,000 ~ 3.3 Years ~ \$325,500 See attachment A. Score: 90	
Schedule Feasibility 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	

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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 settings, 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
9. **Appendices**
 - any supporting materials

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Recap

- Feasibility study
 - Why, when, what
 - Types of feasibility study
 - Comparison of alternatives

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