Business Case Analysis (Part 1)

CS 566 – Software Management and Economics
Lecture 7 (Reifer 2005; Chapters 1 – 4, Reifer 2002)

Ali Afzal Malik
Why Write a Book on Software Business Cases?

• Over the years, I have observed that many software engineers don’t know how to justify proposed changes or improvements using either economic analyses methods or business cases.

• In many of these cases, these engineers are trying to justify changes technically to managers who come from a non-technical background (financial, marketing, etc.).

• The book was written to serve as a textbook for teaching software engineers to win the battle of the budget.
For Software, Change is Constant

- Reuse/patterns
- Streamlined processes
- Architecture-first
- Process paradigms
- Metrics-based management
- Best engineering practices
- Extreme programming
- Agile methods
- COTS-based systems
- Experience factory
- Component-based composition
- Product-lines

Searching for ways to do the job faster, better and cheaper
Business Cases Quantify the Impact of Such Changes

• As understood by most, engineering decisions involve many options and difficult tradeoffs
  – May be several technical solutions for the problem
  – The best technical solution is determined by evaluating the tradeoffs using a variety of criteria selected for that purpose

• Software engineering provides you the methods and tools to understand the tradeoffs and select the best answer (typically under constraints)
  – Management rejects many of these recommendations because the business benefits are not quantified
Pervasive Issues When Developing Business Justifications

- Common definition of costs and benefits not widely accepted across the industry
- Productivity, cost and quality data considered highly confidential and kept secret
- Common definition of the justification processes involved lacking within the engineering community
- Difficult to attribute resulting numbers to one cause or another
- Hard to communicate results - engineers talk technical, decision-makers talk business
- Goal of the lecture is to help you communicate better
What Are we Going to Cover?

Making the Software Business Case: Improvement by the Numbers

Part I - Fundamental Concepts

- Chapter 1: Improvement is Everybody’s Business
- Chapter 2: Making a Business Case
- Chapter 3: Making the Business Case: Principles, Rules, and Analysis Tools
- Chapter 4: Business Cases that Make Sense

Part II - The Case Studies

- Chapter 5 - Playing the Game of Dungeons and Dragons: Process Improvement Case Study
- Chapter 6: Quantifying the Costs/Benefits: Capitalizing Software Case Study
- Chapter 7: Making Your Numbers Sing: Architecting Case Study
- Chapter 8: Maneuvering the Maze: Web-Based Economy Case Study
Coverage (Continued)

- **Part III - Finale**
  - Chapter 9: Overcoming Adversity: More Than a Pep Talk
- **Appendix A:**
  Recommended Readings
- **Appendix B:**
  Compound Interest Tables
- **Acronyms** ✓
- **Glossary** ✓
Understand the Software Industry is in Constant Turmoil

Collaboration via seamless networks

Systems of systems concepts

Computer as an appliance

End-user programming

Software continues to provide the edge

Global workforce

Marketplace model in transition
Justifying Improvement Initiatives to Address Change

- Reduce
  - Time to Market
  - Productivity
  - Increase
- Avoid/Cut
  - Improve Customer Satisfaction
  - Improve Quality
  - Cost

There needs to be some compelling business reason for making an improvement, else it won’t be approved.
Relationships Can Be Deceptive

Drives

Quality
- Fewer Failures
- Shorter Schedules
- Lower Support & Maintenance Costs
- Reduced Rework
- Increased Capacity

Cycle Time
- Reduced Effort

Productivity

Cost
- Lower Price
- Time-to-Market

Customer Satisfaction
- Higher Margin, Low-cost Provider
- Lower Price

Produces

Image

Business Goals
- Retention, Referrals, Bonuses, Award Fee

Market Share, Profit

Primary Indicators

Secondary Indicators

Legend
Primary Indicator
Secondary Indicator
Business Goals

Source: SSCI
ROI framework

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So Can the Process of Making the Leap Forward

Innovators

Early Adopters

Early Majority

Late Majority

Laggards

Change takes time and is hard to accomplish

Source: G. Moore, Crossing the Chasm
Example: CMMI Level 5 - Technology Innovation Seven-Step Process

1. Establish improvement objectives
2. Improvement proposal collection & analysis
3. Identify innovations
4. Perform cost/benefit analysis
5. Perform pilot
6. Select candidate improvements
7. Provide feedback

Source: Ahern, *CMMI Distilled*
<table>
<thead>
<tr>
<th>Challenges Associated with Making Organizational Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lack of incentives</td>
</tr>
<tr>
<td>• “Good of the firm” versus “Good of the project”</td>
</tr>
<tr>
<td>• Infrastructure shortfalls</td>
</tr>
<tr>
<td>• Few meaningful metrics</td>
</tr>
<tr>
<td>• Limited cash available</td>
</tr>
<tr>
<td>• Reward system must be altered</td>
</tr>
<tr>
<td>• Reward system must be altered to emphasize “good of firm”</td>
</tr>
<tr>
<td>• Policies, processes and decision making structure changes</td>
</tr>
<tr>
<td>• Must collect data to quantify impact of changes</td>
</tr>
<tr>
<td>• To get funded, must make compelling business case</td>
</tr>
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</table>
Why Change - Five Good Reasons?

• Keeping up with the competition
  – *Playing catch-up is always a motivation for change*

• Achieving economic benefits
  – *Having a compelling business reason also works*

• Supporting new product needs
  – *Tying change to a product need justifies investment*

• Avoiding legal entanglements
  – *Sometimes changes are needed to comply with the law*

• Achieving efficiencies
  – *Streamlining/simplifying process also justifies change*
Overcoming Resistance to Change

- Organizations fight changes for many reasons

**Middle Management Barriers**
- Customer incentives
- Ignorance is bliss
- Never enough time

**Island Culture**
- Why change—We're successful
- Hacker mentality
- Never enough $$

**Middle Management Barriers**
- Not invented here (NIH)

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Are You Ready for Change?

• Examine the following:
  – Consistency with business goals/cycle
  – Compatibility with level of process maturity
  – Consistency with corporate culture
  – Compatibility with investment strategies
  – Achievability within desired timetable

• If warranted, be willing to take the risk
  – The opportunity should be justifiable in terms of the risk/returns
## Changing Corporate Cultures

<table>
<thead>
<tr>
<th>Entrepreneurial Culture</th>
<th>Old-Fashioned Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Seeks opportunity for improvement</td>
<td>• Prefers the status quo</td>
</tr>
<tr>
<td>• Action-oriented and willing to take risks</td>
<td>• Avoids change and risk</td>
</tr>
<tr>
<td>• Team-oriented</td>
<td>• Territorial by nature</td>
</tr>
<tr>
<td>• Rewards innovation</td>
<td>• Rewards followers, not innovators</td>
</tr>
<tr>
<td>• Learns from failure</td>
<td>• Penalizes failure</td>
</tr>
<tr>
<td>• Creative, imaginative, pliant and flexible</td>
<td>• Persistent, authoritative and rigid</td>
</tr>
</tbody>
</table>
Making Changes: Eight Lessons Learned the Hard Way

1. Tie improvement to organizational goals
2. Emphasize making product-oriented improvements
3. Demonstrate value that justifies improvements
4. Make your new processes the way you do business
5. Recognize major barriers to change are primarily political and psychological
6. Change your culture to one that rewards risk-taking
7. If you don’t have the talent, buy it
8. Use numbers to overcome post-decision dissonance
Business Goal Alignment Techniques

- Five forces analysis
- 7-S framework analysis
- Value chain analysis
- Normative forecasting
- Scenario writing
- Critical success factor analysis
- Customer satisfaction surveys
- Process benchmarking
Success is a Numbers Game

Answer Basic Business-Related Questions

• Will this proposal save money, cut costs, increase productivity, speed development or improve quality?
• Have you looked at the financial and tax implications of the proposal?
• What’s the impact of the proposal on the bottom line?
• Are our competitors doing this? If so, what are the results they are achieving?
• Who are the stakeholders and are they supportive of the proposal? + Many more tough questions

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Business Cases Supply You with the Winning Numbers

- **Business Case** = the materials prepared for decision-makers to show that the proposed idea is a good one and that the numbers that surround it make sound financial sense
  - Most software engineers prepare detailed technical rather than business justifications
  - Many of their worthwhile proposals are rejected by management as a consequence
  - Use of business cases to complement the technical case can greatly increase their chances of success
## Business Versus Technical Cases

<table>
<thead>
<tr>
<th>Factors (5 is best)</th>
<th>Java</th>
<th>C/C++</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Core language features</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>- Degree of standardization &amp; portability</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>- Object-oriented support</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>- Reuse facilities (library, browser, etc.)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>- Web programming support</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>- Optimizing compilers available</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>- Bindings available</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>- Rich libraries available</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>- Compiler support tools available</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>- Inexpensive visual tools available</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>- Oriented toward your products</td>
<td>5</td>
<td>3</td>
</tr>
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**Score**

- Java: **43**
- C/C++: **44**
## Business Versus Technical Cases

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<tr>
<th>Factors (5 is best)</th>
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<tr>
<td>- Popularity - improve resumes</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>- Training opportunities available</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>- Literature and books available</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>- Consultants &amp; subcontractors available</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>with language skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Staff maintains competency in language/tools</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>- Retooling and retraining costs</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>- Transition costs associated with learning</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>curve (bring staff up to speed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>Combined Score</td>
<td>67</td>
<td>77</td>
</tr>
</tbody>
</table>
The Business Planning Process

1. Prepare white paper
2. Demonstrate technical feasibility
3. Conduct market survey
4. Develop business plan
5. Prepare business case
6. Sell the idea and develop support base
7. Get ready to execute

GQM Results
Idea or proposal

Proof of Concept

Approval to go-ahead
Aligning with Goals - Your First Step

**Goal** - successful technology transition

- **Q1** - ready for use?
  - **M1** - availability of tools
  - **M2** - availability of training
  - **M3** - availability of methods
  - **M4** - availability of infrastructure

- **Q2** - benefits quantified?
  - **M1** - cost avoidance in $
  - **M2** - time-to-market delta
  - **M3** - quality delta

- **Q3** - costs of use understood?
  - **M1** - startup costs
  - **M2** - operational costs
  - **M3** - opportunity costs

Use the G-Q-M Paradigm
Stepping Through the Process

1. Prepare white paper
   - State what you are trying to do crisply

2. Demonstrate technical feasibility
   - Let’s you prove the idea’s value
   - Provide management with early evidence that you can deliver what you promised them

3. Conduct market survey
   - Determine the market need for your idea
   - Understand what the competition is doing and what your customers want
   - Focus on market creation, not sharing
   - Get to market first, be agile and take risks that allow you to seize the opportunity
4. Develop business plan
   – Needed before idea will be funded
   – Such plans summarize how you will make or save money, not how you’ll get the job done

5. Prepare business case
   – Convince sponsor idea makes both good technical and business sense and provides value

6. Sell the idea
   – Package for sales/champion

7. Get ready to execute
   – Plan the project thoroughly (your project plan)
   – Start recruiting key staff
   – Work communications and outreach up front
   – Search out facilities to co-locate team and for conducting demos
   – Prepare your operational concepts (support, etc.)
Business Process Framework

The business planning process proceeds in parallel and interfaces with the software development process.

Business Planning Process

Tradeoff and Analysis Processes

Software Development Process

Analytical Methods

Models

Guidelines for Decision-Making

“Principles, Rules and Tools for Business Case Development”
Nine Business Case Principles

1. Decisions should be made relative to alternatives
2. If possible, use money as the common denominator
3. Sunk costs are irrelevant (Engineering Econ 101)
4. Investment decisions should recognize the time value of money
5. Separable decisions must be considered separately
6. Decisions should consider both quantitative and qualitative factors
7. The risks associated with the decision should be quantified if possible
8. The timing associated with making decisions is critical
9. Decision processes should be periodically assessed and continuously improved
Success Tactics

- Address the cultural issues first - they’re the hardest
- Keep senior management informed of your progress
- Build alliances with both projects and people
- Publicize successes and spread the word widely
- Mix it with the middle managers and critics
- Don’t be afraid to change horses in mid-stream
- Deliver something that you can brag about
- Be perceived as successful by others (perception is reality)
- Work continuously to improve the infrastructure you’ve set up to manage the initiative and transfer the technology
Use Engineering Economics as its Analytical Basis

**Future Worth**
- Takes cost of money into account
  - A $$ today is worth more than tomorrow due to inflation
- Takes compounding into account

**Present Value**
- Normalizes future expenditures using current year dollars as a basis for comparison
- Lets you establish a minimum attractive rate of return

\[
FW = P (1 + i)^N \\
PV = FW/(1 + i)^N
\]
Use Other Available Techniques

Analysis Techniques

- Balanced scorecard
- Break-even analysis
- Cause and effect analysis
- Cost/benefit analysis
- Opportunity tress
- Pareto analysis
- Payback analysis
- Portfolio analysis
- Real options theory
- Return-on-Investment/Capital
- Risk analysis (exposure)
- Sensitivity analysis
- Trend analysis
- Value chains

Source: Boehm, *Software Engineering Economics*
Example – Cost/Benefit Analysis

• Want to bring in training to support PSP/TSP initiative
• How would you justify the investment?
  – Should you use cost/benefits, quality improvement or some other approach?
• How would you pay for the training?
  – Is this a capital, project or customer expense?
• What are the windows of opportunity and how would you take advantage of them?
  – Can you influence next year’s training budget?
  – Is there State funds available? Can we partner? Is there mid-year or year-end funds available?
Doing a Cost/Benefit Analysis

Cost/Benefit Ratio = PV (Total costs ($) / Total Benefits ($))

- Non-recurring costs
  - Course acquisition $$\_\_\_$$
  - Course conduct $$\_\_\_$$
    Total $$\_\_\_$$

- Recurring costs
  - Course maintenance $$\_\_\_$$
  - Continuing education $$\_\_\_$$
    Total $$\_\_\_$$
    Total Costs $$\_\_\_$$

- Tangible savings
  - Cost avoidance $$\_\_\_$$
  - Cost savings $$\_\_\_$$
    Total $$\_\_\_$$

- Intangible savings
  - Reduced turnover $$\_\_\_$$
  - Less risk exposure $$\_\_\_$$
    Total $$\_\_\_$$
    Total Benefits $$\_\_\_$$
Quantifying Avoidance: Software Dependability Opportunity Tree

- Decrease Defect Risk Exposure
  - Decrease Defect Prob (Loss)
  - Decrease Defect Impact, Size (Loss)
  - Continuous Improvement

- Defect Prevention
- Defect Detection and Removal
- Value/Risk - Based Defect Reduction
- Graceful Degradation
- CI Methods and Metrics
- Process, Product, People
- Technology

Source: Boehm

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Quantifying Risk Exposure (RE) via a Profile: Time to Ship

- Loss due to unacceptable dependability

Source: Boehm
Example RE Profile: Time to Ship

- Loss due to unacceptable dependability
- Loss due to market share erosion

Time to Ship (Amount of Testing)

Source: Boehm
Example RE Profile: Time to Ship

- Sum of Risk Exposures

Source: Boehm
Getting Management Approval

• Why should they invest in training instead of other alternatives?
  – There needs to be a compelling business reason, else why make the effort
  – This must be the most attractive option examined

• Why invest now instead of some later time?
  – Need to show opportunity is knocking & funds are available

• What do I have to do if I say “yes” to the proposal?
  – Must show them that their efforts will be minimal; you’ve done all of the leg work and all they have to do is sign
Many Supportive Tools

Software packages

• Decision support systems
  – Tax planning and schedules
  – Trade studies and analysis

• Spreadsheets
  – Comparative analysis
  – Trade studies and analysis

• Software cost models
  – Parametric analysis
  – Trade studies and analysis
Including Estimating Models like COCOMO II - Of Course

- Benchmark analysis
- Comparative analysis
- Life cycle cost analysis

- Parametric analysis
- Trade studies
- “What-if” analysis
Business Case Information Needs

- Business cases
  - Recurring costs
  - Non-recurring costs
  - Tangible benefits
  - Intangible benefits

- Benchmarks
  - Competitive comparisons
  - Industry norms

- Metrics
  - Management measures

- Financial data
  - Inflated labor costs
  - Labor categories/rates
  - Overhead/G&A rates
  - Past costs/performance
  - Tax rates/legalities

- Marketing information
  - Demographic data
  - Market position
  - Sales forecast
## Emphasize Cost Avoidance

<table>
<thead>
<tr>
<th>Things to Do</th>
<th>Things Not to Do</th>
</tr>
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<tbody>
<tr>
<td>• Justify using cost avoidance not reduction</td>
<td>• Don’t assume the numbers won’t be scrutinized</td>
</tr>
<tr>
<td>• Keep cost &amp; productivity considerations separate</td>
<td>• Don’t assume you know what your current costs are and how they are allocated to cost centers</td>
</tr>
<tr>
<td>• Tap money when it becomes available</td>
<td>• Don’t confuse management by combining cost and profit in same proposal</td>
</tr>
<tr>
<td>• Know what cost you can control and who controls the others</td>
<td>• Don’t mix cost accounts when justifying ideas</td>
</tr>
<tr>
<td>• Package numbers for consumption by seniors</td>
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Packaging Business Cases for Management Consumption

- Convincingly summarize the numbers at the start
- Define your terms precisely - communicate meaning using examples
- Be conservative with your numbers
- Quantify tangible benefits in monetary terms
- Don’t mix capital expenditures with project budgets
- Use ranges for cost/benefits whenever possible
- Portray the PV of your benefits in this year’s dollars
- Focus attention on the business, not technical issues
Different Ways of Presenting the Data: Balanced Scorecard

**Financial**
To succeed financially, how should we appear to our stakeholders?

**Customer**
To achieve our vision, how do we appear to our stakeholders?

**Internal Process**
To satisfy our goals, what processes must we excel?

**Vision and Strategy**
Objectives Measures Targets Initiatives

**Learning & Growth**
To achieve our vision, how do we sustain our ability to change and improve?

Objectives Measures Targets Initiatives
When Communicating with Senior Managers, Remember

- They are like elephants, they never forget a number once uttered.
- They will hear only what they want to hear.
- Simple is better - package charts with at most five bullets.
Final Points Before We Adjourn

- Numbers can be your ally when asking for money
- When talking money, speak your management’s language not your own
- Don’t be casual about numbers, be precise
- To be successful, be perceived as successful
References


• Donald J. Reifer, Making the Software Business Case – Improvement by the Numbers, Addison-Wesley, 2002.