Prioritization - Overview

- Why is prioritization needed?
  - Basic trade-offs
- Cost-Value approach
  - Sorting requirements by cost/value
  - Estimating relative costs/values using AHP
- What if stakeholders disagree?
  - Visualizing differences in priority
  - Resolving disagreements

Basics of prioritization

- Need to select what to implement
  - Customers (usually) ask for way too much
  - Balance time-to-market with amount of functionality
  - Decide which features go into the next release

- For each requirement/feature, ask:
  - How important is this to the customer?
  - How much will it cost to implement?
  - How risky will it be to attempt to build it?

- Perform Triage:
  - Some requirements must be included
  - Some requirements should definitely be excluded
  - That leaves a pool of “nice-to-haves”, which we must select from.

A Cost-Value Approach

- Calculate return on investment
  - Assess each requirement’s importance to the project as a whole
  - Assess the relative cost of each requirement
  - Compute the cost-value trade-off:
Estimating Cost and Value

- Two approaches:
  - Absolute scale (e.g. dollar values)
    - Requires much domain experience
  - Relative values (e.g. less/more; a little, somewhat, very)
    - Much easier to elicit
    - Prioritization becomes a sorting problem

- Ensure that estimates come from proper sources
  - Cost is best estimated by developers
  - Value is best estimated by customers

Comparison Process - options
- Basic sorting - for every pair of requirements \((ij)\), ask if \(i > j\)
  - E.g. bubblesort - start in random order, and swap each pair if out of order
  - Requires \(n(n-1)/2\) comparisons
- Construct a Binary Sort Tree
  - Requires \(O(n \log n)\) comparisons
- Construct a Minimal Spanning Tree
  - for each pair \((R_i, R_{i+1})\) get the distance between them
  - Requires \(n-1\) comparisons

Some complications
- Hard to quantify differences
  - easier to say "x is more important than y"...
  - …than to estimate by how much.
- Not all requirements comparable
  - E.g. different level of abstraction
  - E.g. core functionality vs. customer enhancements
- Requirements may not be independent
  - No point selecting between \(X\) and \(Y\) if they are mutually dependent
- Stakeholders may not be consistent
  - E.g. if \(X > Y\) and \(Y > Z\), then presumably \(X > Z\)?
- Stakeholders might not agree
  - Different cost/value assessments for different types of stakeholder

Analytic Hierarchy Process (AHP)

- Create \(n \times n\) matrix (for \(n\) requirements)
  - For element \((x,y)\) in the matrix enter:
    1 - if \(x\) and \(y\) are of equal value
    3 - if \(x\) is slightly more preferred than \(y\)
    5 - if \(x\) is strongly more preferred than \(y\)
    7 - if \(x\) is extremely more preferred than \(y\)
    (use the intermediate values, 2, 4, 6, 8 if compromise needed)
  - ...and for \((y,x)\) enter the reciprocal.

- Estimate the eigenvalues:
  - E.g. "averaging over normalized columns"
    - Calculate the sum of each column
    - Divide each element in the matrix by the sum of its column
    - Calculate the sum of each row
    - Divide each row sum by the number of rows

- This gives a value for each requirement:
  - ...giving the estimated percentage of total value of the project

AHP Example – Estimating costs

<table>
<thead>
<tr>
<th></th>
<th>Req1</th>
<th>Req2</th>
<th>Req3</th>
<th>Req4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Req1</td>
<td>1</td>
<td>1/3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Req2</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Req3</td>
<td>1/2</td>
<td>1/5</td>
<td>1</td>
<td>1/3</td>
</tr>
<tr>
<td>Req4</td>
<td>1/4</td>
<td>1/3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Normalize columns
Sum the rows
Sum

<table>
<thead>
<tr>
<th></th>
<th>Req1</th>
<th>Req2</th>
<th>Req3</th>
<th>Req4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Req1</td>
<td>0.21</td>
<td>0.18</td>
<td>0.18</td>
<td>0.48</td>
</tr>
<tr>
<td>Req2</td>
<td>0.63</td>
<td>0.54</td>
<td>0.45</td>
<td>0.36</td>
</tr>
<tr>
<td>Req3</td>
<td>0.11</td>
<td>0.11</td>
<td>0.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Req4</td>
<td>0.05</td>
<td>0.18</td>
<td>0.27</td>
<td>0.12</td>
</tr>
</tbody>
</table>

1.05 0.26
1.98 0.50
0.34 0.09
0.62 0.16

Result
Plot ROI graph

- Do AHP process twice:
  - Once to estimate relative value
  - Once to estimate relative cost
- Use results to calculate ROI ratio:

<table>
<thead>
<tr>
<th>Cost (percent)</th>
<th>Value (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low priority</td>
<td>5</td>
</tr>
<tr>
<td>Medium priority</td>
<td>10</td>
</tr>
<tr>
<td>High priority</td>
<td>15</td>
</tr>
</tbody>
</table>

Other selection criteria

- ROI ratio is not the only way to group requirements

Visualizing “Value by Stakeholder”

Source: Adapted from Regnell et al., 2000

- Graph showing correlation between stakeholder’s priorities and the group’s priorities
  - Can also be thought of as “influence of each stakeholder on the group”

Visualizing stakeholder satisfaction

Source: Adapted from Regnell et al., 2000

- Graph showing correlation between stakeholder’s priorities and the group’s priorities
  - Can also be thought of as “influence of each stakeholder on the group”
Assigning weight to stakeholders

- Weight each stakeholder
  - E.g. to reflect credibility?
  - E.g. to reflect size of constituency represented?
- Example:

![Weighted Stakeholder Diagram]

Result:
(The priorities have changed)

Resolving stakeholder conflict

- Causes of Conflict
  - Deutsch (1973):
    - control over resources
    - preferences and nuisances (tastes or activities of one party impinge upon another)
    - values (a claim that a value or set of values should dominate)
    - beliefs (dispute over facts, information, reality, etc.)
    - the nature of the relationship between the parties.
  - Robbins (1989):
    - communicational (insufficient exchange of information, noise, selective perception)
    - structural (goal compatibility, jurisdictional clarity, leadership style)
    - personal factors, (individual value systems, personality characteristics).
- Interesting Results
  - deviant behaviour & conflict are normal in small group decision making
  - more aggression and less co-operation when communication is restricted
  - a decrease in communication tends to intensify a conflict (the contact hypothesis)
  - heterogeneous teams experience more conflict;
  - homogeneous groups are more likely to make high risk decisions (groupthink)
  - effect of personality is overshadowed by situational and perceptual factors

Basic approaches to conflict resolution

- Negotiation
  - as collaborative exploration:
    - participants seek a settlement that satisfies all parties as much as possible;
  - also known as:
    - integrative behaviour
    - constructive negotiation
  - distinct from:
    - distributive/competitive negotiation
- Competition
  - is maximizing your own gain:
    - no regard for the degree of satisfaction of other parties.
    - but not necessarily hostile!
  - Extreme form:
    - when all gains by one party are at the expense of others
    - i.e. a zero-sum game.
- Third Party Resolution
  - participants appeal to outside source
    - the rule-book, a figure of authority, or the toss of a coin
    - can occur with the breakdown of either negotiation or competition as resolution methods.
  - judicial: cases presented by each participant are taken into account
  - extra-judicial: a decision is determined by factors other than the cases presented
    - (e.g. relative status of participants)
    - arbitrary: e.g. toss of a coin