Lecture 20: Requirements Prioritization

Why Prioritization is 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:

Cost (percent)  Value (percent)

5   5
10  10
15  15
20  20
25  25
30  30

Low priority
Medium priority
High priority

Estimating Cost & 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
- Comparison Process - options
  - Basic sorting - for every pair of requirements (i,j), 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

Hierarchical Prioritization

- Group Requirements into a hierarchy
  - E.g. A goal tree
  - E.g. A NFR tree
- Only make comparisons between branches of a single node:

Analytic Hierarchy Process (AHP)

- Create n x 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 very strongly more preferred than y
    - 9 - 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 it’s column
  - Calculate the sum of each row
  - Divide each row sum by the number of rows

- This gives a value for each reqt:
  - 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>

Result:

- Req1 - 26% of the cost
- Req2 - 50% of the cost
- Req3 - 9% of the cost
- Req4 - 16% of the cost
Plot ROI graph

→ Repeat AHP process twice:
  % Once to estimate relative value
  % Once to estimate relative cost
→ Use results to calculate ROI ratio:

Other selection criteria

→ ROI ratio is not the only way to group requirements

Other selection criteria

Visualizing “Value by stakeholder”

30 Stakeholders:
- M1
- M2
- M3
- M4
- M5
- M6
- M7
- M8
- M9
- A10

Visualizing stakeholder satisfaction

→ 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”
Can also weight each stakeholder

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

- Example:

  Stakeholder
  - A: 30%
  - B: 20%
  - C: 15%
  - D: 10%
  - E: 10%
  - F: 5%

  (The priorities have changed)

Resolving Stakeholder Conflict

- Weighting each stakeholder

Three broad types of resolution method can be distinguished:

- Competitive
  - Also known as: adversarial, distributive/competitive negotiation
  - Distinct from: integrative negotiation
  - Examples: cases in court

- Cooperative (or collaborative)
  - Also known as: integrative negotiation
  - Distinct from: distributive/competitive negotiation
  - Examples: negotiation

- Third Party resolution
  - Types: judicial, extrajudicial
  - Examples: mediation, arbitration

Interesting Results

- Deviant behavior & conflict are normal in small group decision making
- More aggression and less cooperation when communication is restricted
- A decrease in communication tends to intensify a conflict (contact hypothesis)
- Heterogeneous teams experience more conflicts than homogeneous teams
- The effect of personality is overshadowed by situational and perceptual factors

Conflict Resolution - basics

- Defining Conflict
  - In Social psychology, focus is on interdependence and perception:
    - The interaction of interdependent people who perceive opposition of goals, aims, and values, and who see the other party as potentially interfering with the realization of these goals (Putnam & Poole, 1987)
    - In RE, focus is on logical inconsistency:
      - E.g. conflict is a divergence between goals - there is a feasible boundary condition that makes the goals inconsistent (von Lansweerde et al., 1998)
  - Note: conflict may occur between individuals, groups, organizations, or different roles played by one person

- Resolution Method:
  - The approach used to settle a conflict:
    - Methods include negotiation, arbitration, coercion, and education
    - Not all conflicts need a resolution method: not all conflicts need to be resolved.
  - Three broad types of resolution method can be distinguished:
    - Co-operative (or collaborative) methods, which include negotiation and education:
      - Competitive methods, which include combat, coercion and competition:
      - Third Party methods, which include arbitration and appeals to authority.

Basic approaches to conflict resolution

- Negotiation
  - Is collaborative exploration:
    - Participants attempt to find a settlement that satisfies all parties as much as possible
  - Also known as:
    - Integrative behavior
    - Constructive negotiation
  - Distinct from:
    - Distributive/competitive negotiation

- Competition
  - Is maximizing your own gain:
    - Regardless 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
    - E.g. a zero-sum game

- Third Party Resolution
  - Types of third party resolution:
    - Judicial: cases presented by each participant are taken into account
    - Extrajudicial: a decision is determined by factors other than the cases presented (e.g., relative status of participants)
    - Arbitrary: e.g., toss of a coin