# Lecture 9: Agreeing Requirements

**Last Week:**
**Validating Requirements**
Validation basics
Reviews and Inspections
Prototyping

**This Week:**
**Agreeing Requirements**
Negotiation and Conflict Resolution
Requirements Prioritization

**Next Week:**
**Evolving Requirements**
Change management
Inconsistency management
Feature Interaction
Product Families






# Outline

- Prioritization
  - Cost-value approach
  - Analytic Hierarchy Process (AHP)
- Ideas from Economics
  - Game Theory
  - Bounded Rationality
- Ideas from Social Psychology
  - Types of social conflict
  - Analysis of task types
- Resolving Requirements Conflicts
  - Definitions
  - Argumentation approaches
  - Using existing domain models to evaluate positions

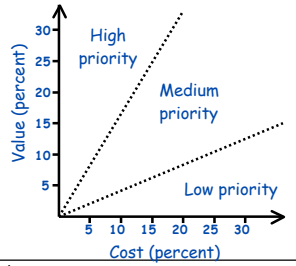





# Requirements Prioritization

*Source: Adapted from Karlsson & Ryan 1997*

- Usually there are too many requirements
  - Decide which to include in the first release
    - Balancing quality, cost and time-to-market
  - Assess each requirement's importance to the project as a whole
  - Assess the relative cost of each requirement
  - Compute the cost-value trade-off:









# Analytic Hierarchy Process (AHP)

*Source: Adapted from Karlsson & Ryan 1997*

- Create n x n matrix (for n requirements)
- Compare each pair of 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
  - …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:
  - …based on estimated percentage of total value of the project

# AHP example

*Source: Adapted from Karlsson & Ryan 1997*

| | Req1 | Req2 | Req3 | Req4 |
|---|---|---|---|---|
| Req1 | 1 | 1/3 | 2 | 4 |
| Req2 | 3 | 1 | 5 | 3 |
| Req3 | 1/2 | 1/5 | 1 | 1/3 |
| Req4 | 1/4 | 1/3 | 3 | 1 |

Normalise columns

…Also: should compute the consistency index (because the pairwise comparisons may not be consistent)

| | Req1 | Req2 | Req3 | Req4 |
|---|---|---|---|---|
| Req1 | 0.21 | 0.18 | 0.18 | 0.48 |
| Req2 | 0.63 | 0.54 | 0.45 | 0.36 |
| Req3 | 0.11 | 0.11 | 0.09 | 0.04 |
| Req4 | 0.05 | 0.18 | 0.27 | 0.12 |

Sum the rows

| sum | sum/4 |
|---|---|
| 1.05 | 0.26 |
| 1.98 | 0.50 |
| 0.34 | 0.09 |
| 0.62 | 0.16 |



# Game Theory

→ Game Theory for conflict resolution

- Given:
  - 2 or more players
  - known utilities for each outcome for each player
- Can Calculate:
  - what strategy results in the better outcome
  - how strategies by different players interact
- E.g. Prisoner's dilemma:

| | | Prisoner B: *Not Confess* | Prisoner B: *Confess* |
|---|---|---|---|
| Prisoner A | *Not Confess* | 1 year each | 10 years for A and 3 months for B |
| Prisoner A | *Confess* | 3 months for A and 10 years for B | 8 years each |

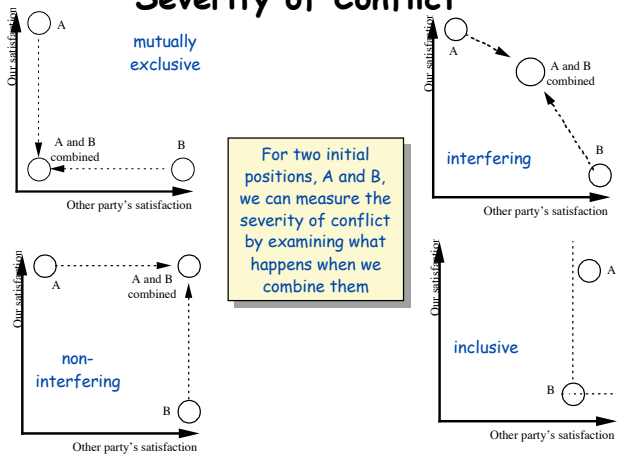
→ But:

- In RE, we often don't know what the utilities are
- Often can resolve conflicts by getting participants to change their utilities
- Often we don't know even what moves are possible!



# Severity of Conflict





# Bounded Rationality

*Source: Adapted from Simon 1969 and 1996*

→ Satisficing participants

- Outcome in complex situations depends on unpredictable events
- People look for 'satisfaction' rather than 'maximal utility'

→ Market Mechanisms

- Conditions:
  - Prices drop in the face of excess supply
  - Rate of supply drops when prices drop or when inventories mount
- Under these conditions, markets 'clear':
  - Equilibrium is reached even under bounded rationality
  - i.e. even when participants cannot predict their best option
- But they don't reach Pareto Optimality
  - Unless the participants act fully rationally
  - i.e. they all can *optimize* rather than *satisfice*.
  - But requires participants to have an unlimited ability to predict the future

→ Application to RE?

- Need a pricing mechanism that satisfies the appropriate conditions
- Offers stability but not optimality

# Conflict in Social Psychology

## → 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

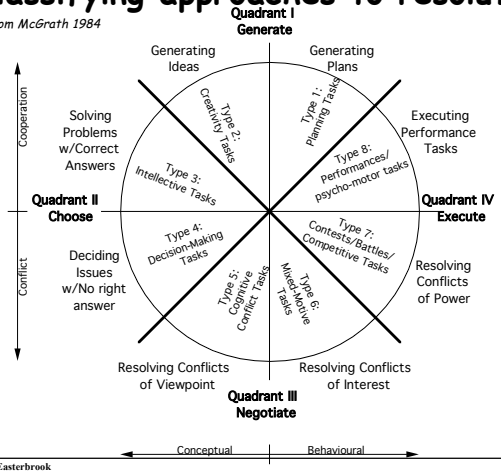
- deviant behaviour & conflict are normal in small group decision making
- more aggression and less co-operation when communication is restricted
  - a decrease in communication tends to intensify a conflict (the contact hypothesis)
- heterogeneous teams experience more conflict;
- homogeneous groups are more likely to make high risk decisions (groupthink)
- effect of personality is overshadowed by situational and perceptual factors






# Classifying approaches to resolution

*Adapted from McGrath 1984*









# 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 typically is on logical inconsistency:
  - E.g. conflict is a divergence between goals - there is a feasible boundary condition that makes the goals inconsistent [van Lamsweerde 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, competition, 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 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.
- types of third party resolution
  - 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

## → Bidding and Bargaining

- Bidding:
  - participants state their desired terms
- Bargaining:
  - participants search for a satisfactory integration of bids.

## Using Argumentation Structuring…

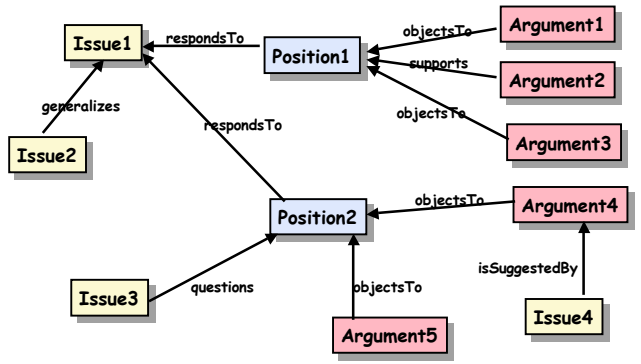
→ **gIBIS**
- developed by Conklin [1989]
- Represents argumentatation process as a hypertextual graph
- Basic Process
  - Identify issues
  - Identify positions that one can adopt with respect to the positions
  - link arguments that support or refute positions

→ **Synoptic**
- Developed by Easterbrook [1991]
- Tool support for collaborative task-focussed negotiation
- Basic Process:
  - Get each participant to externalise their conceptual model(s)
  - Find correspondences between the models
  - Classify mismatches
  - Generate options for resolving each mismatch






## gIBIS argumentation structure









## Using Pre-existing Domain Models…

→ **Oz**
- developed by Robinson [1992]
- Uses pre-existing domain model to compare conflicting perspectives
- Basic process:
  - Identify perspectives (collections of beliefs)
  - Record perspectives by annotating a domain model of goals and objectives
  - Domain model links product attributes to goals
  - Choose combinations of product attributes to maximise participants' satisfaction

→ **WinWin**
- developed by Boehm & colleagues [mid 1990s]
- explicitly identifies win-conditions for each participant
- Incorporates domain knowledge-base of quality requirements and product attribute links
- Basic Process:
  - Enter win conditions for each participant
  - identify attribute strategies for win conditions
  - determine negative effects for each strategy on each win condition
  - resolve disagreements manually