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

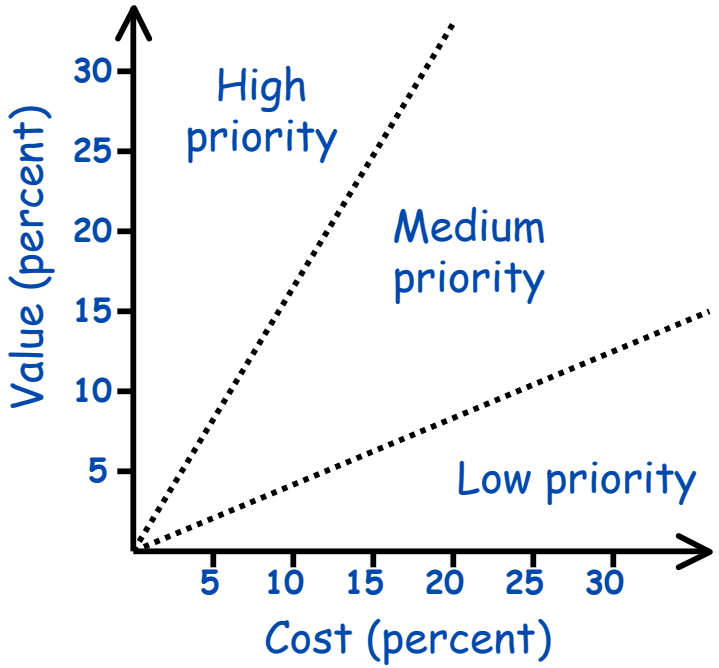
- Need to select what to implement
  - Customers (usually) ask for way too much
  - Balance time-to-market with amount of functionality
  - Decide which features go into the next release
- For each requirement/feature, ask:
  - How important is this to the customer?
  - How much will it cost to implement?
  - 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

Source: *Adapted from Karlsson & Ryan 1997*

→ 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 & 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
  - Contruct a Minimal Spanning Tree
    - for each pair (Ri, Ri+1) get the distance between them
    - Requires n-1 comparisons

Some complications

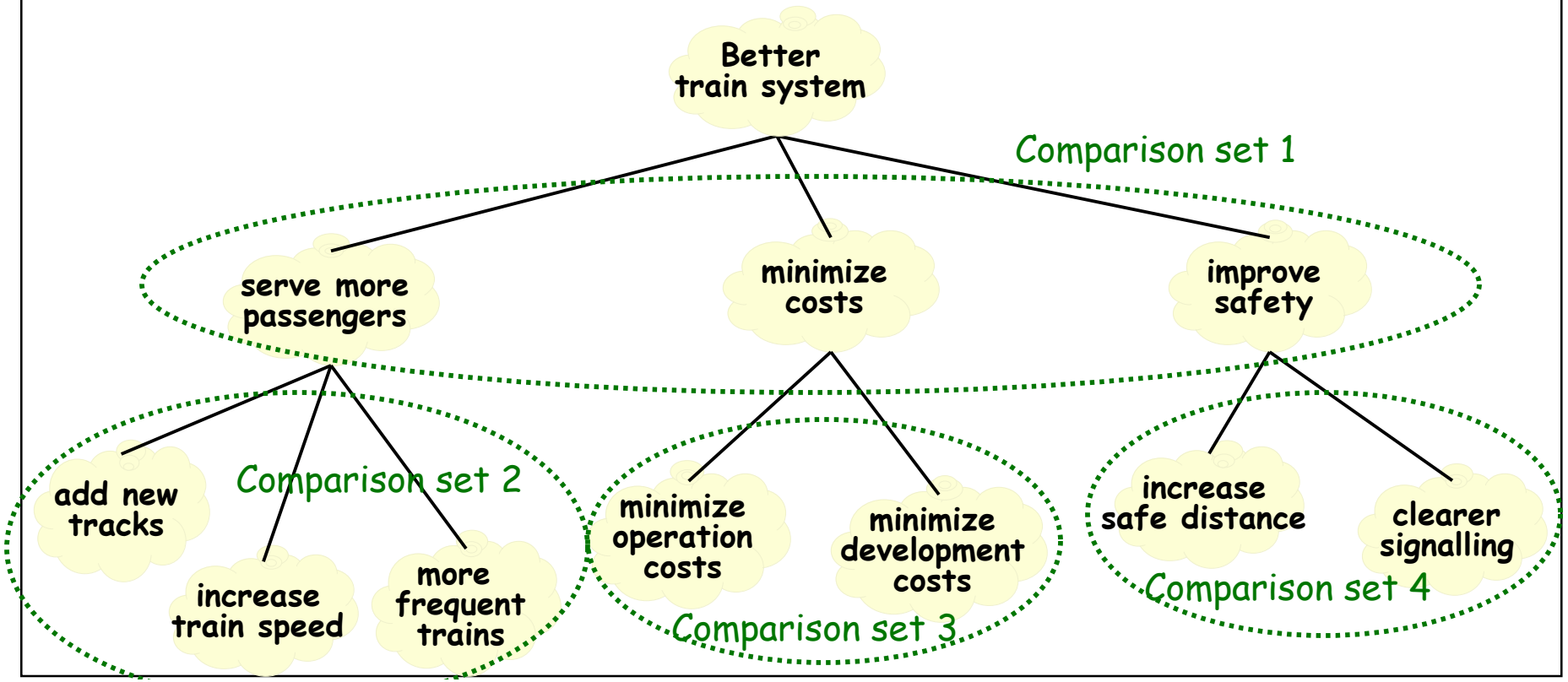
- Hard to *quantify* differences
  - easier to say "x is more important than y"…
  - …than to estimate by how much.
- Not all requirements comparable
  - E.g. different level of abstraction
  - E.g. core functionality vs. customer enhancements
- Requirements may not be independent
  - No point selecting 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)

Source: *Adapted from Karlsson & Ryan 1997*

- → 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

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

	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

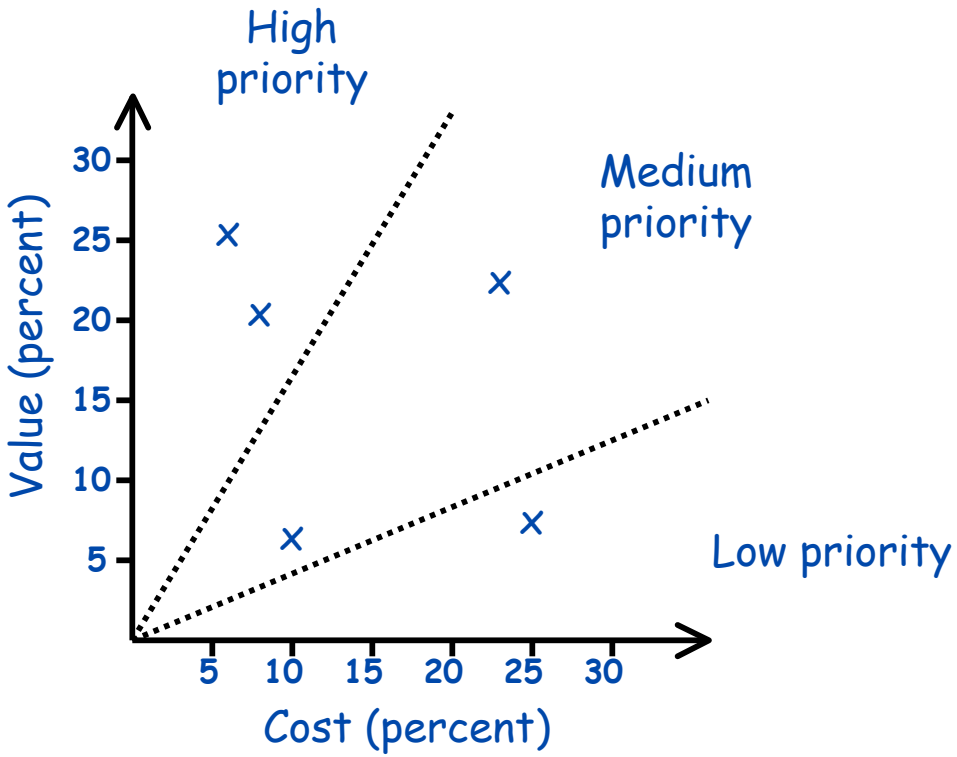
Result

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

Plot ROI graph

Source: *Adapted from Karlsson & Ryan 1997*

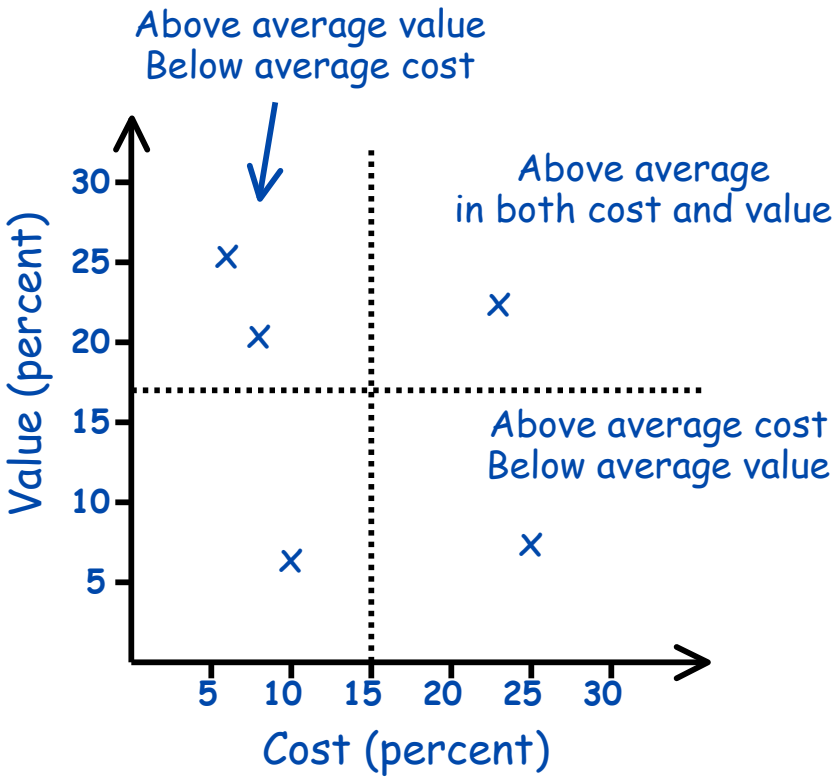
- Do AHP process twice:
  - Once to estimate relative value
  - Once to estimate relative cost
- Use results to calculate ROI ratio:

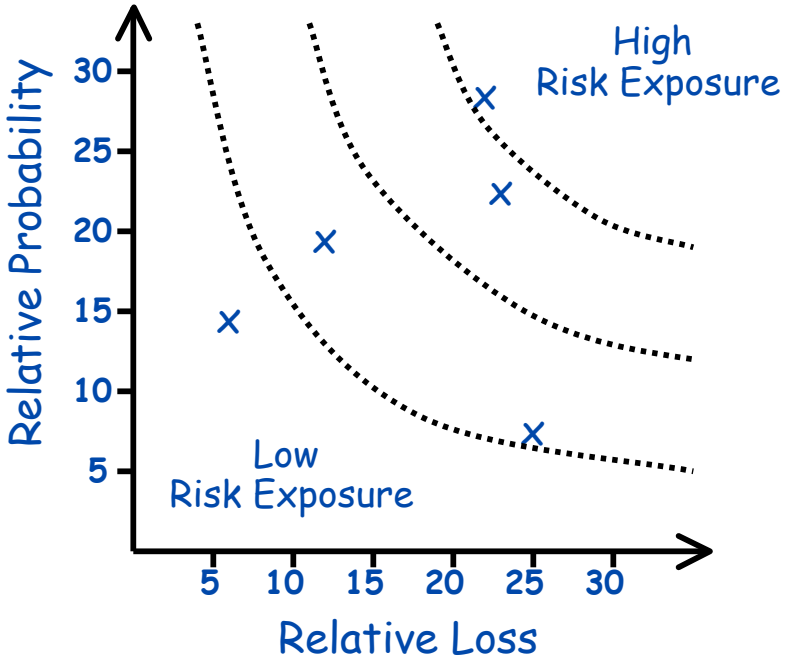


Other selection criteria

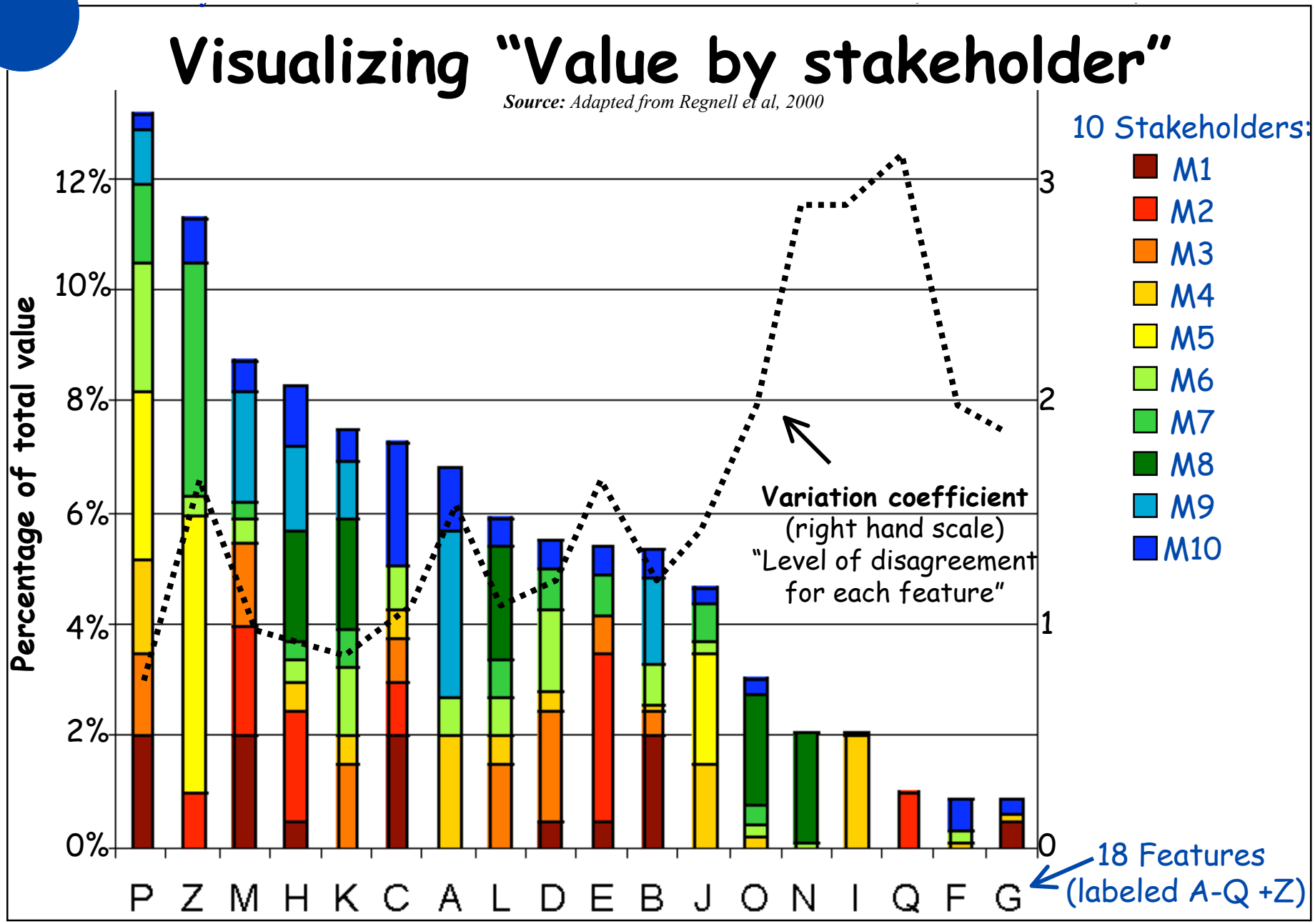
Source: *Adapted from Park et al, 1999*

→ **ROI ratio is not the only way to group requirements**





Visualizing "Value by stakeholder"

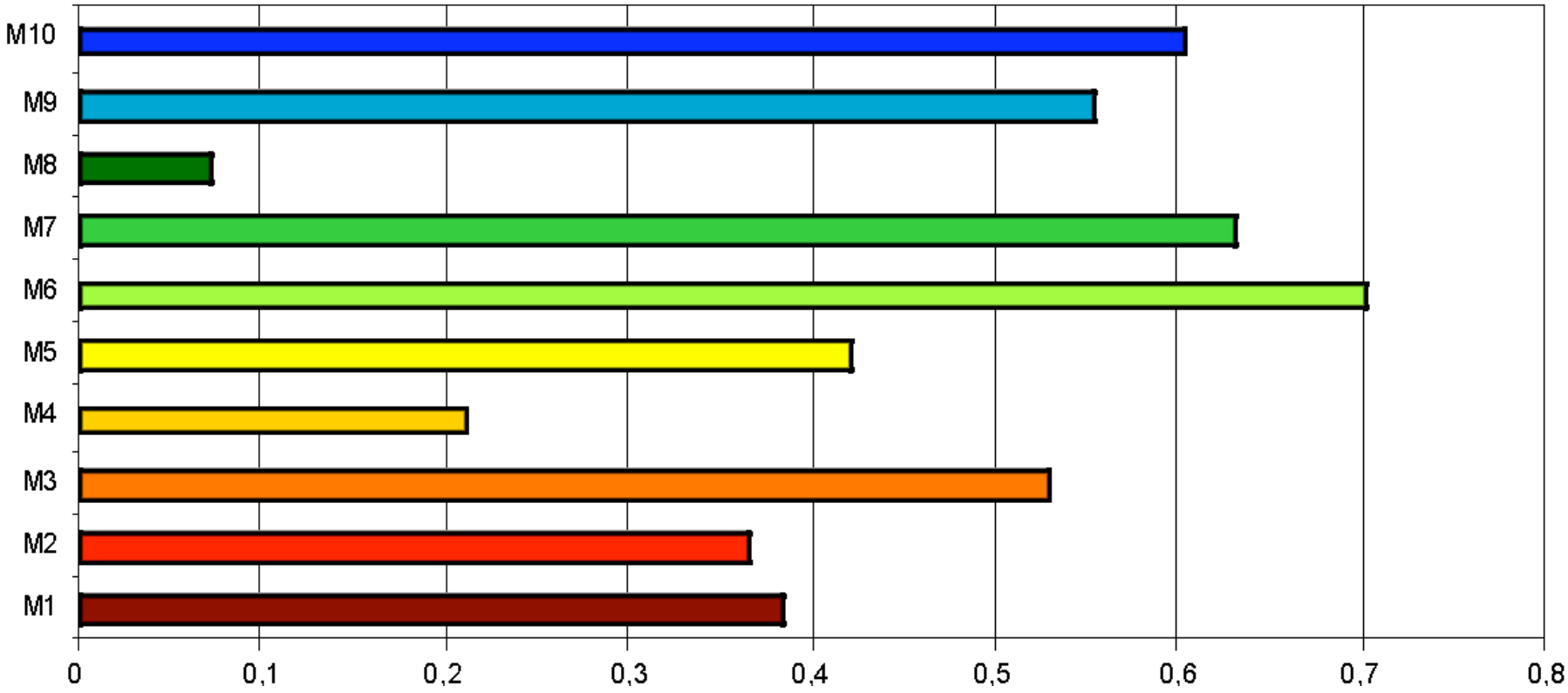


Visualizing stakeholder satisfaction

Source: *Adapted from Regnell et al, 2000*

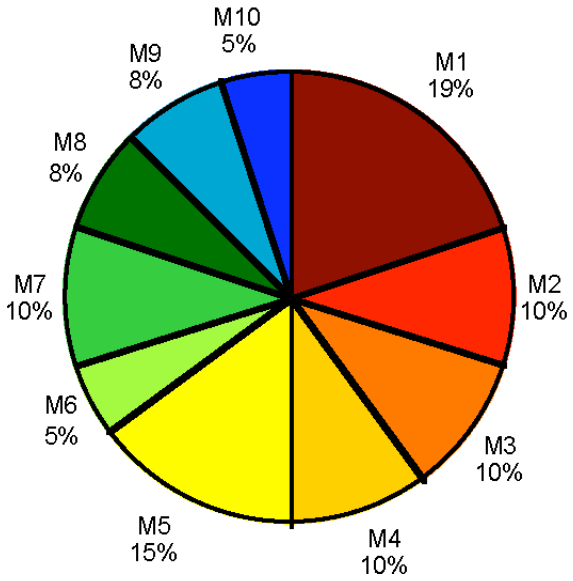
→ Graph showing correlation between stakeholder's priorities and the group's priorities

↳ Can also be thought of as "influence of each stakeholder on the group"

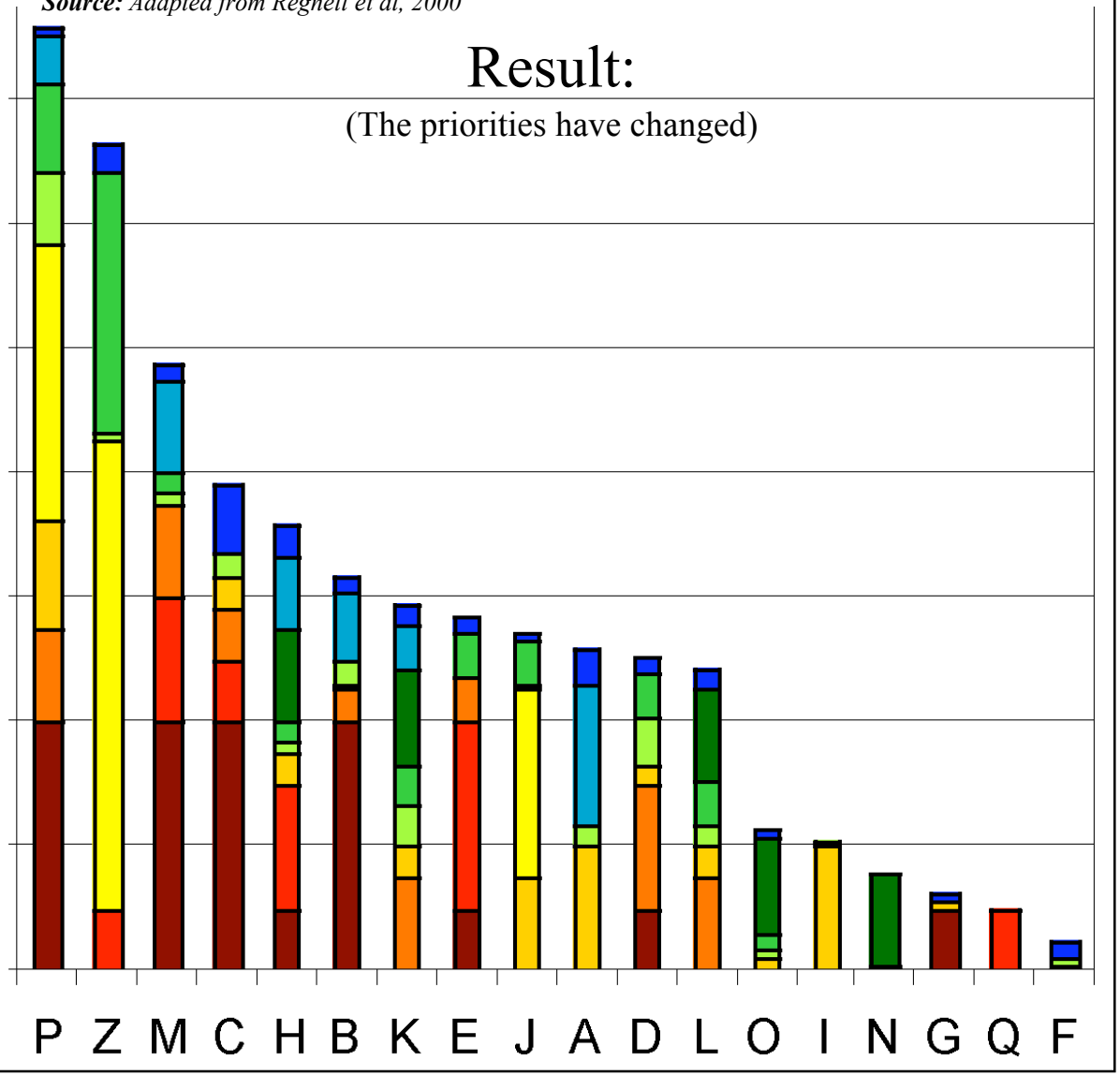


Can also weight each stakeholder

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



Source: *Adapted from Regnell et al, 2000*



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

- …is 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