Details for

Twelve Steps to Robust Decisions: Building Consensus and using ConsensusBuilder in Product Development and Business

David G. Ullman

Professor, Department of Mechanical Engineering
Oregon State University
Corvallis Oregon, 97331
541-737-2336
ullman@engr.orst.edu
www.engr.orst.edu/~ullman

Camas
800 NW Starker Ave
Corvallis 97330
541-738-8701
ullman@camas.org

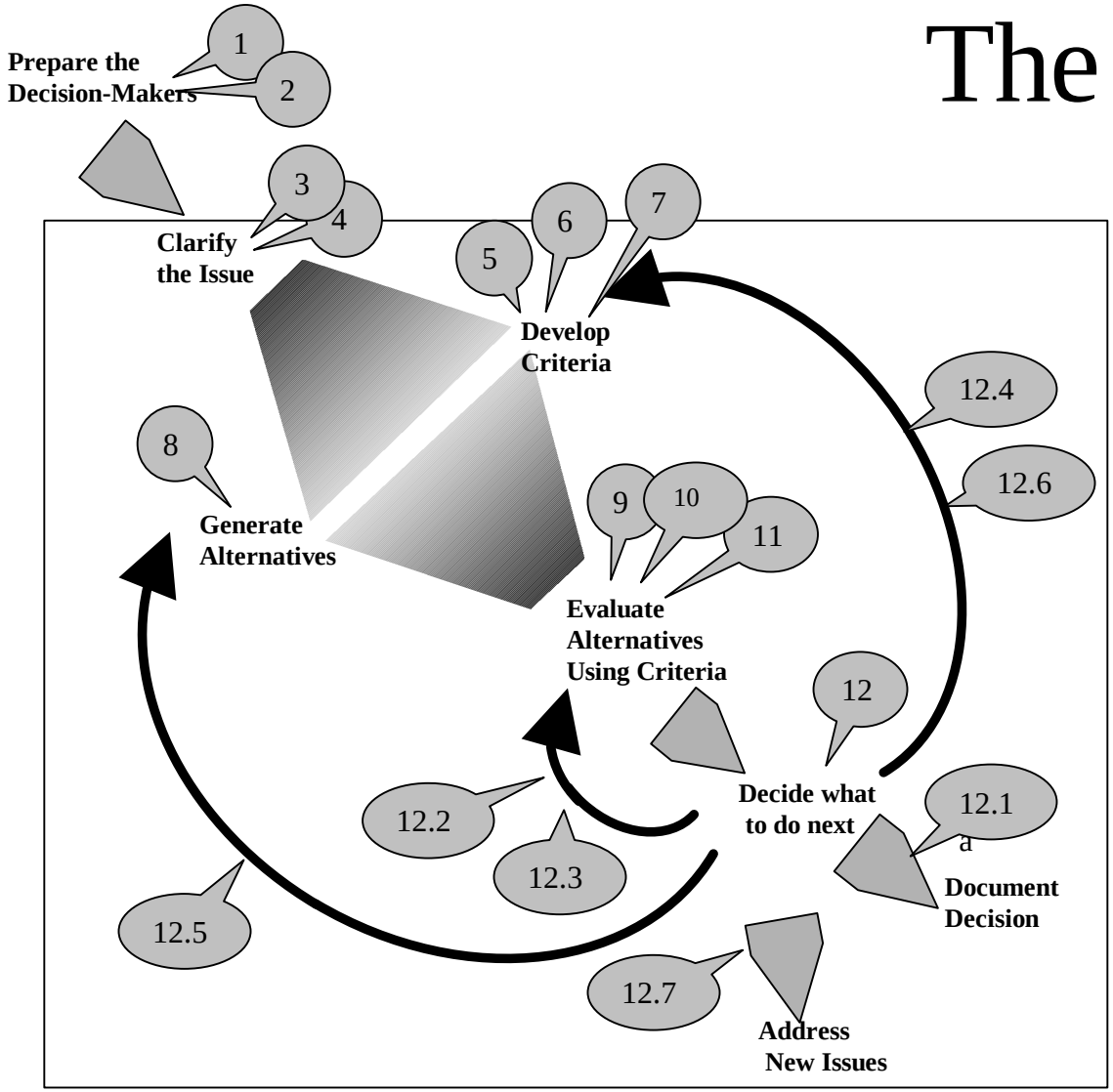
12 Steps to Robust Decisions

Step 1. Maximize personal decision-making effectiveness.
Step 2. Insure team and organization effectiveness.
Step 3. State the **issue.**
Step 4. Identify the **customers**.
Step 5. Itemize **solution features**.
Step 6. Define **targets** for the features.
Step 7. Measure feature **importance**.
Step 8. Generate **alternative solutions.**
Step 9. Measure decision-makers' **knowledge**.
Step 10. Determine **belief** in alternatives' ability to meet targets.
Step 11. Determine overall **satisfaction** in alternatives.
Step 12. **Decide what to do next.**

Robust decision-making works to minimize the risk resulting from choosing a poor alternative

1. The risk resulting from not being able to solve the problem or Decision-Maker Risk
2. The risk resulting from not getting the best from the problem solvers or Organizational Risk
3. The risk resulting from solving the wrong problem or Envisioning Risk
4. The risk resulting from not developing good alternatives or Ideation Risk
5. The risk resulting from choosing a poor alternative or Evaluation Risk
6. The risk resulting from not following a beneficial strategy or Strategic Risk
7. The risk resulting from not being able to implement the decision or Execution Risk

The 12 Steps



1: Decision-maker risk

2: Organizational risk

3-7: Envisioning risk

6: Ideation risk

9-11: Evaluation risk

1,2,12: Strategic risk

12: Realization risk

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.
Strategic Risk
The risk resulting from not following a beneficial strategy

Step 1: Maximize Personal Decision-Making Effectiveness

Individual Decision-Making Success =

Decision-Making Style +

Decision-Making Strategy +

Issue Knowledge +

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.
Strategic Risk
The risk resulting from not following a beneficial strategy

Step 1: Maximize Personal Decision-Making Effectiveness

1.1 Be aware of decision-making style.

1.2 Use sound decision-making strategy

1.3 Be aware of issue knowledge.

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.
Strategic Risk
The risk resulting from not following a beneficial strategy

1.1 Be aware of decision-making style.

Decision-Making Style =

Energy Source +

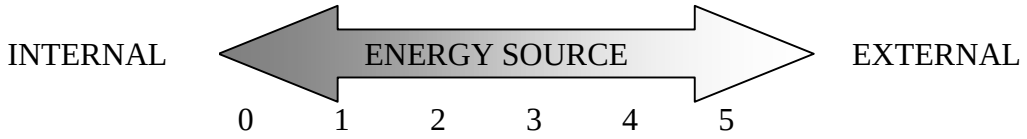
Information Management Style +

Information Language +

Deliberation Style +

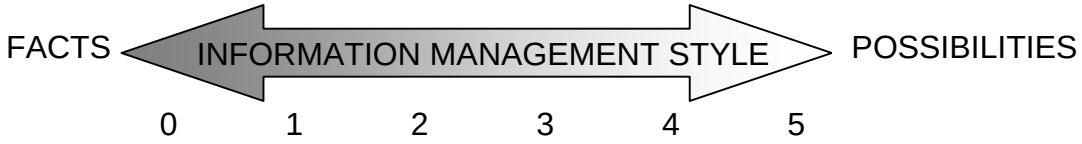
Decision Closure Style

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.



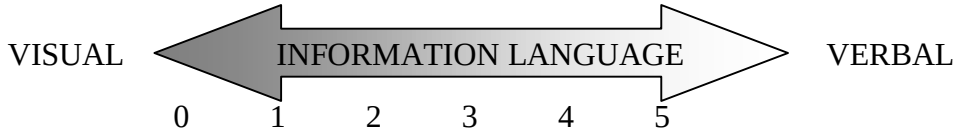
1. In a group, do you generally
   - wait to be introduced
   - introduce others
2. Does interacting with others
   - take real effort
   - energize you
3. Do you tend to
   - listen and reflect
   - say what is on your mind
4. Do you think of yourself as
   - private
   - outgoing
5. At work do you tend
   - keep more to yourself
   - be sociable with your colleagues

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.



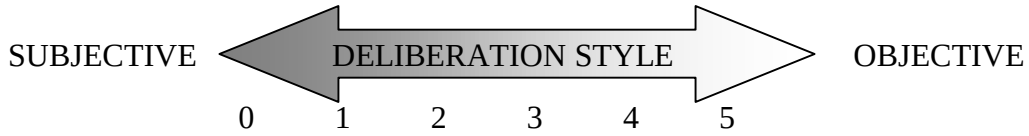
1. Which word best describes you
   - practical
   - ingenious
2. Which interest you more
   - the actual
   - the possible
3. In problem solving, do you prefer to
   - iron out the details
   - develop the ideas
4. Are you inclined to take what is said
   - literally
   - figuratively
5. Do you generally feel
   - down to earth
   - somewhat removed

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.



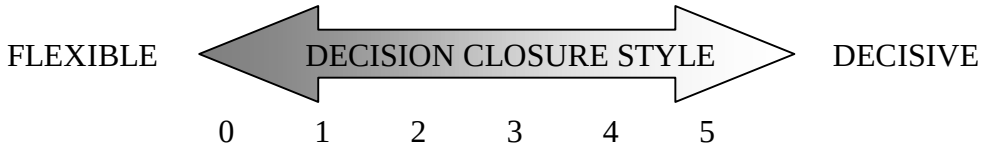
1. When you meet someone again, do you remember their
    - face
    - name
2. Do you prefer to
    - be shown how
    - read instructions how
3. In a book, if there are two descriptions of the same material, which do you look at first
    - a diagram
    - the text
4. If they both represented the same thing, would you rather study
    - a graph
    - an equation
5. If there is a possibility to touch an object
    - you do so eagerly
    - you hold back

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.



1. Do you more often let
   - your heart rule your head
   - your head rule your heart
2. Which is the worse fault
   - to be unsympathetic
   - to show too much concern
3. Which to you most value in yourself
   - your compassion
   - your reason
4. Which appeals to you more
   - harmonious relationships
   - getting the job done
5. In a heated discussion, do you
   - look for common ground
   - usually stick to your guns

Problem Solver Risk
The risk resulting from decision-maker ineffectiveness.



1. Do you prefer to
   - just let things happen
   - plan for things to happen
2. When a decision is to be made, are you more comfortable
   - before
   - after
3. Is it harder for you to adapt to
   - routine
   - Change
4. In you more satisfied with
   - work in progress
   - a finished product
5. Are more
   - impulsive
   - careful

1.2 Use sound decision-making strategy

Designers who use an effective strategy:

- Spend time understanding the issues and developing criteria
- Consider multiple alternatives during the process
- Keep options open as long as possible
- Gather sufficient information to learn as you go
- Iterate through the decision-making process
- Be skeptical of information
- Be aware of what you know and don’t know

1.3 Be aware of issue knowledge.

See Steps 9, 10 and 11.

Organizational Risk
The risk resulting form an
ineffective team or organization

Step 2: Insure Team and Organization Effectiveness

Team Decision-Making Success =

Shared Vision +

Mix of Individual Decision-making Styles +

Team Roles +

Team Structure +

Team Strategy +

Management Style

Step 2: Insure Team and Organization Effectiveness

2.1 Encourage development of a shared vision.

2.2 Encourage methods to get the best from the mix of decision-making styles.

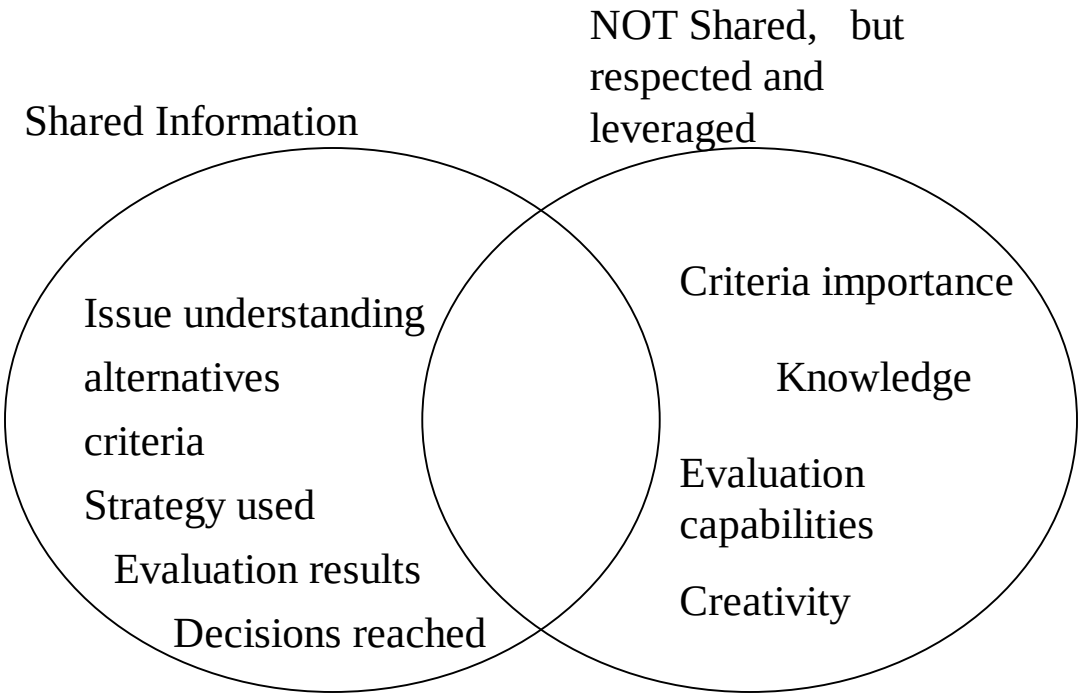
2.3 Balance team roles.

2.4 Utilize an effective team structure.

2.5 Adopt a front loaded strategy.

2.6 Adopt a collaborative organization style.

2.1 Encourage development of a shared vision.



2.2 Encourage methods to get the best from the mix of decision-making styles.

The twelve steps:

- Help team members who get their energy from within share more than their final response.
- Give internal decision-makers a more equal say in deliberations.
- Encourage external decision-makers to hear the contributions of others.

Organizational Risk

The risk resulting form an ineffective team or organization

The twelve steps:

- Encourage fact-oriented team members to allow the team to work on understanding the problem rather than diving right in and working on the details of a single, potential non-robust solution.
- Encourage possibility-oriented team members to deal with details.
- Encourage possibility-oriented team members to be specific and avoid generalities.
- Help possibility-oriented team members to stick to the issues.

Organizational Risk

The risk resulting form an ineffective team or organization

The twelve steps:

- Help identify information that needs to be communicated regardless of language.
- Help identify differences in team members' mental models encouraging extra effort by both visual and verbal people to communicate clearly with other team members.

Organizational Risk

The risk resulting form an ineffective team or organization

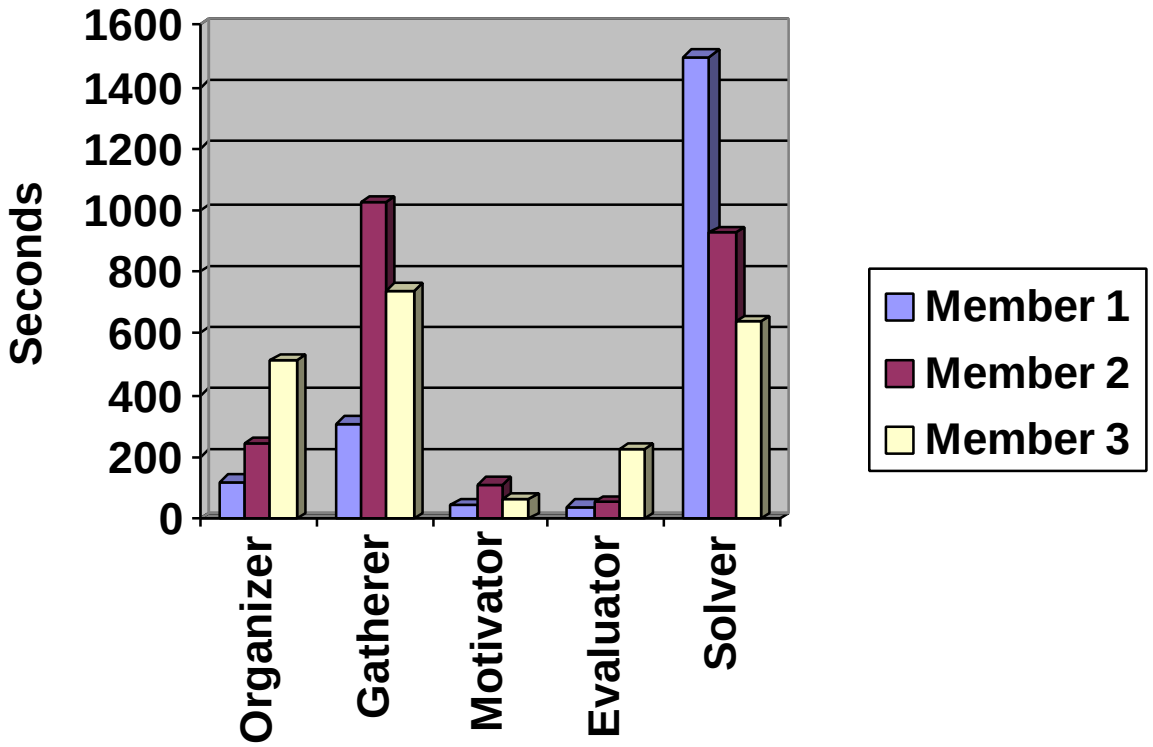
The twelve steps:

- Help subjective team members to discuss differences of opinion without feeling threatened.
- Help the team reach consensus reassuring subjective decision-makers.
- Help objective team members understand and respect how the team functions.

The twelve steps:

- Give both flexible and decisive team members a strategy so they can see that problems are solved one step at a time.
- Encourage feedback from other team members so flexible decision-makers can reflect on the decision-making process.
- Slow flexible decision-makers from changing their minds.
- Slow decisive decision-makers from jumping to conclusions without considering the details or other team members.
- Encourages decisive team members to be part of the data collection and review process.
- Remind decisive team members that they are not always right.

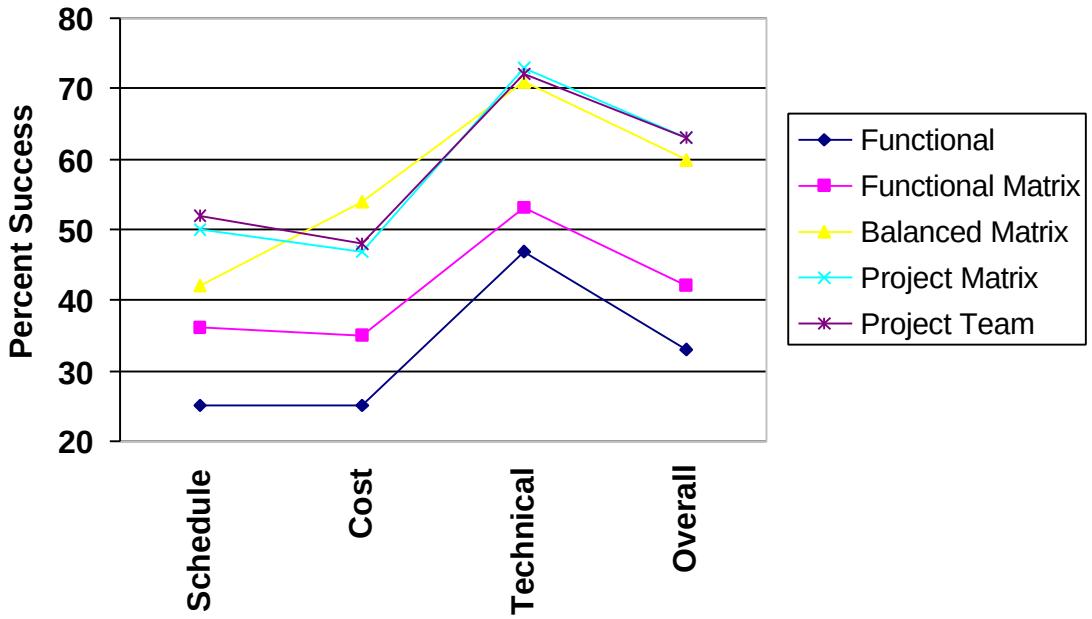
2.3 Balance team roles.



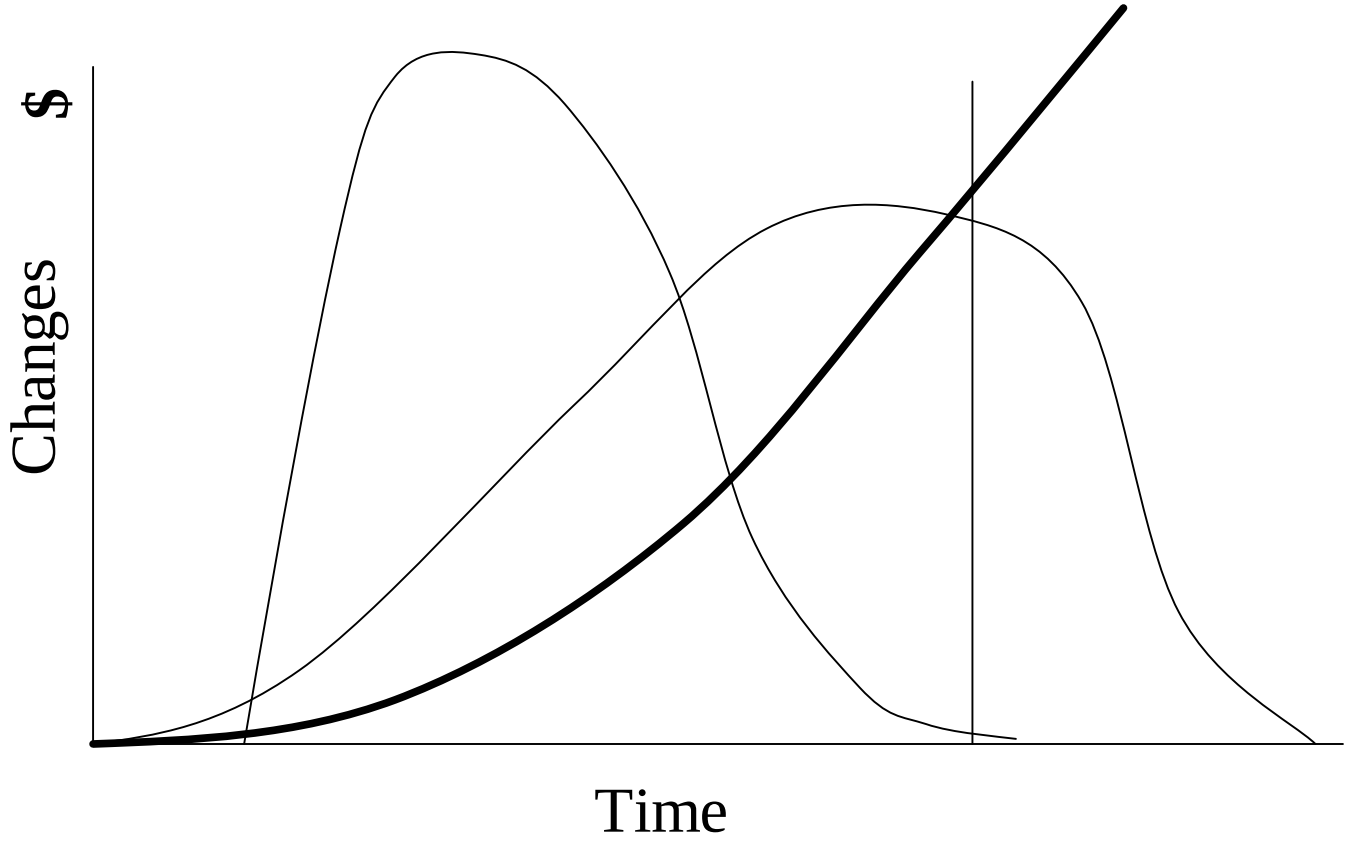
Organizational Risk

The risk resulting form an ineffective team or organization

2.4 Utilize an effective team structure.



2.5 Adopt a front loaded strategy.



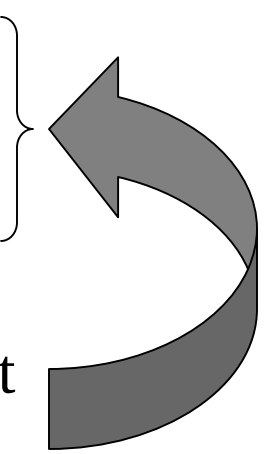
2.6 Adopt a collaborative organization style.

- **Running out of time**
- **Fiat**
- **Coercion**
- **Competition**
- **Voting**
- **Inertia**
- **Compromise**
- **Collaboration**

Envisioning =Understanding the Problem

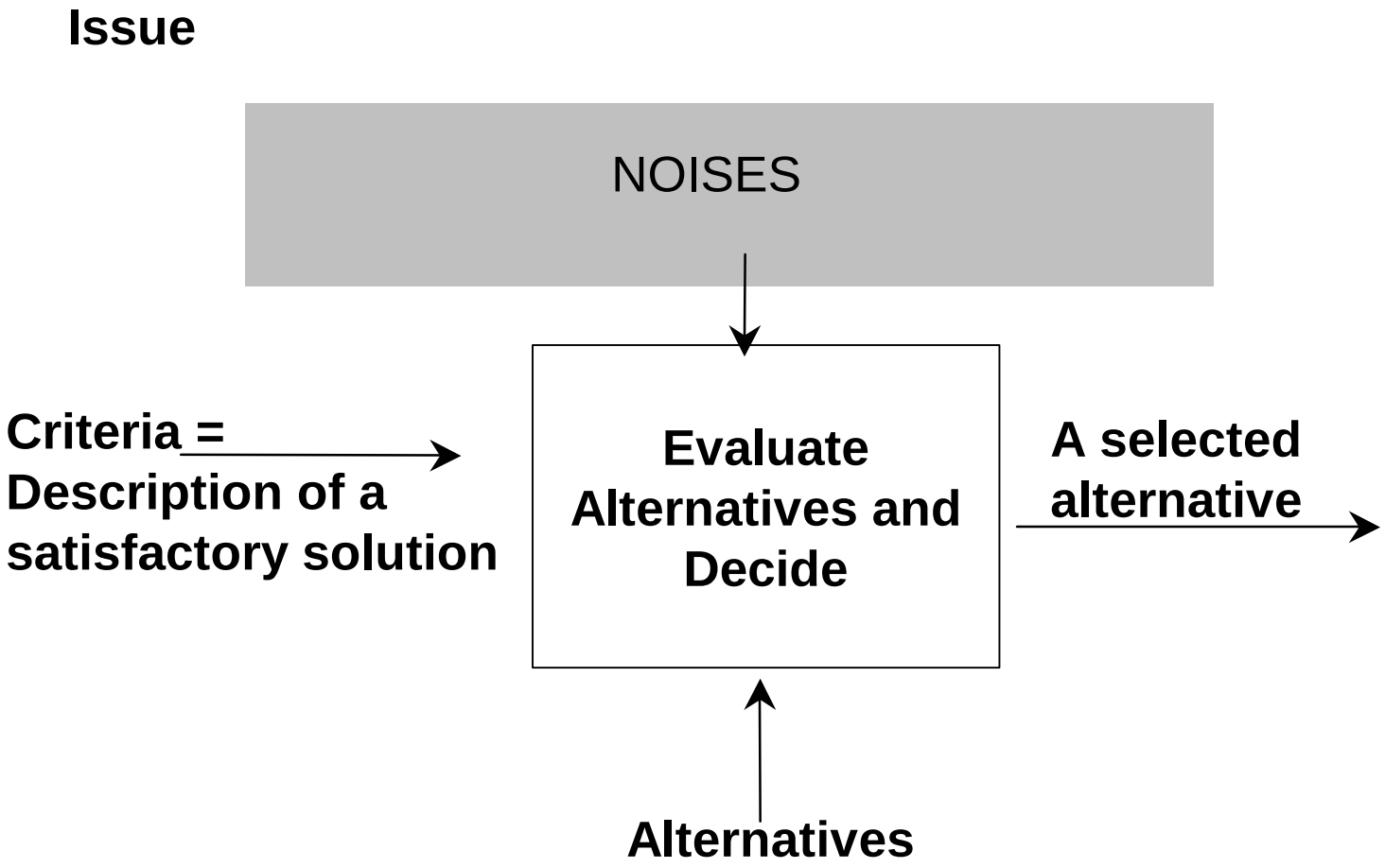
Step 3. State the **issue.**
Step 4. Identify the **customers**.

Step 5. Itemize **solution features**.
Step 6. Define **targets**.
Step 7. Measure **importance**.



The Development of Criteria

Must know issue and criteria for a robust decision



Step 3: Identify the Issue.

An issue is the current focus of problem solving requiring the development of new information. A decision made about an issue is generally a call for action dependent on the selection of an option or activity to satisfy some criteria associated with the issue.

Some issues are:

- Design a front suspension system for a bicycle.
- What car should I buy? I want to go fast, in comfort.
- What should I do next on this project?
- How can we keep the brakes from squealing and still have good deceleration?
- What are we going to do about Bob? He seems so disruptive.
- Find the best employee from the local talent pool for the new marketing position.
- Where is the best place for our new factory?
- What is the best Java applet to change the cursor color?

Issue =
- Object or process +
- Characteristic +
- Action +
- Initial Criteria +
- Initial Alternatives +
- Source

3.1 Identify the **object, or process** of interest.

3.2 Identify the specific **characteristic** of the object or process on which action is needed.

3.3 Identify desired **action**.

Envisioning Risk

The risk resulting from solving the wrong problem

- Bicycle front suspension system + design
- Car + choose
- Project next step + choose
- Brakes + change
- Bob + change situation
- New marketing employee +find
- New plant location + find
- Cursor color Java applet +find

3.4 Itemize the **initial criteria**.

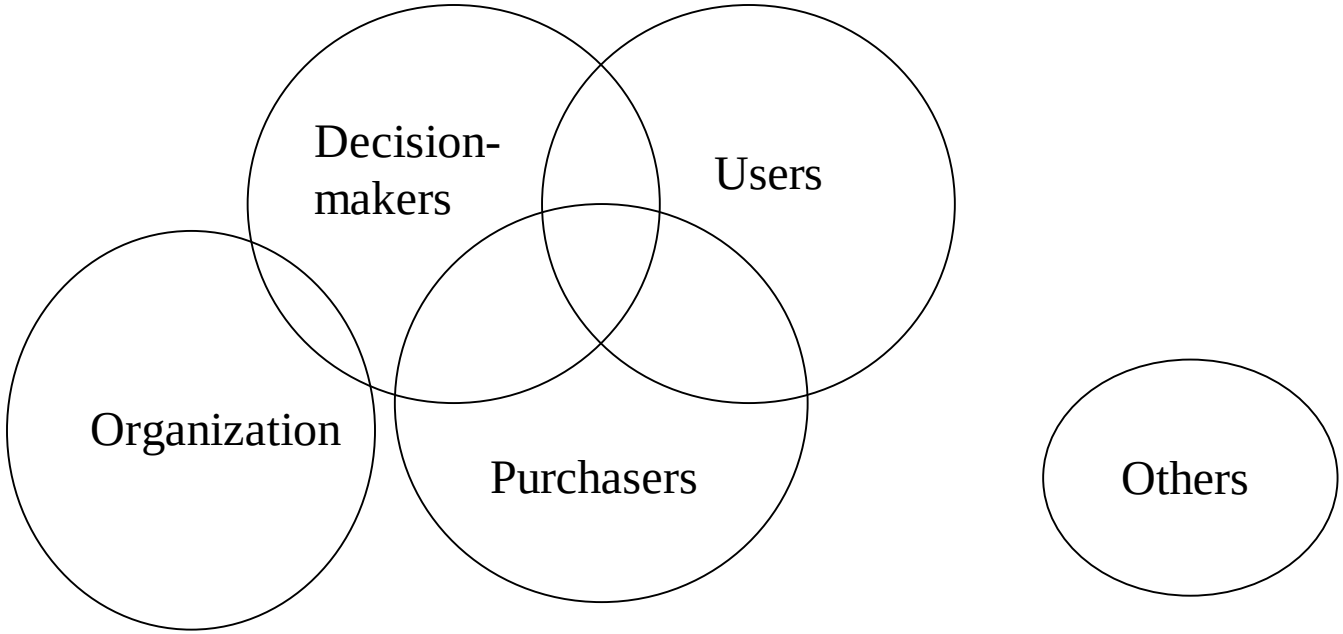
3.5 Capture **initial alternative solutions**.

3.6 Identify the **source** of the issue.

- Direct Issue decomposition
- Alternative generated issues
- Criteria generated issue

3.7 Write a single sentence that describes the issue, question, task, problem statement or area of concern.

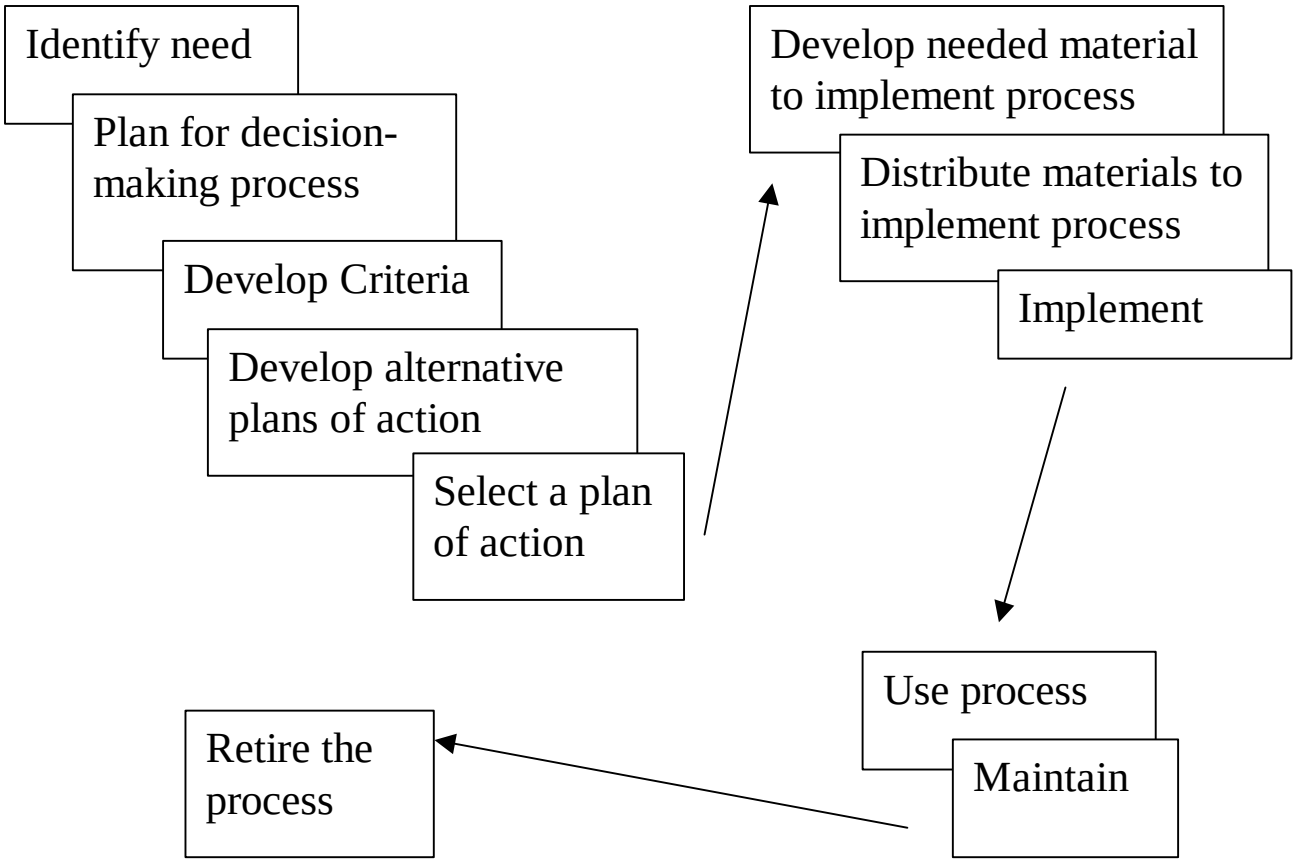
Step 4: Identify the customers for the decision.



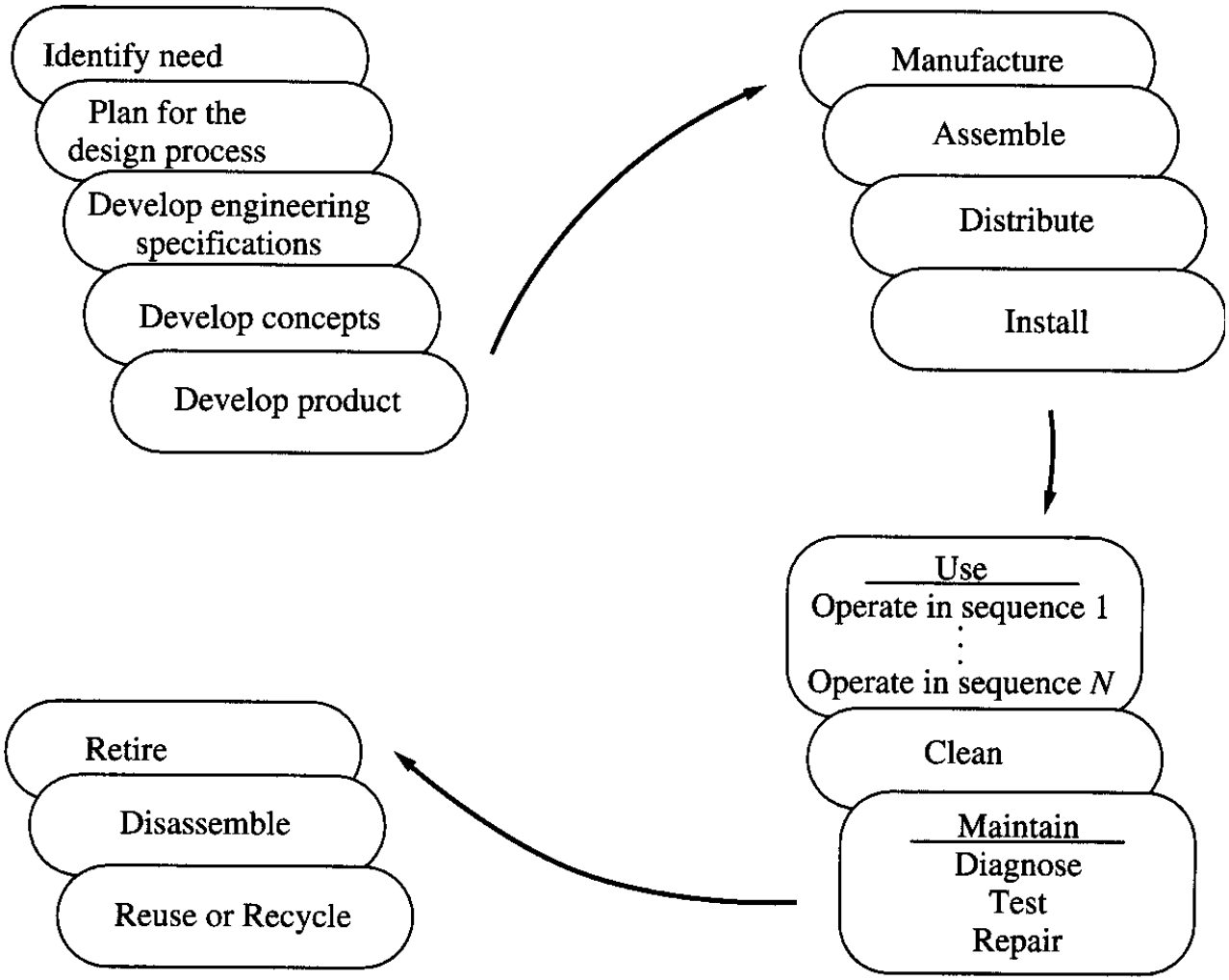
4.1 Itemize **everyone** who is included in the description of the problem.

4.2 Itemize everyone who **comes in contact** with the object, function or process during **each phase of its life-cycle**.

Business Life Cycle Phases



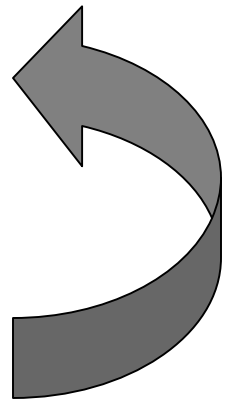
Mechanical Product life Cycle Phases



Envisioning =Understanding the Problem

Step 3. State the **issue.**
Step 4. Identify the **customers**.

Step 5. Itemize **solution features**.
Step 6. Define **targets**.
Step 7. Measure **importance**.



The Development of Criteria

Truths about Criteria

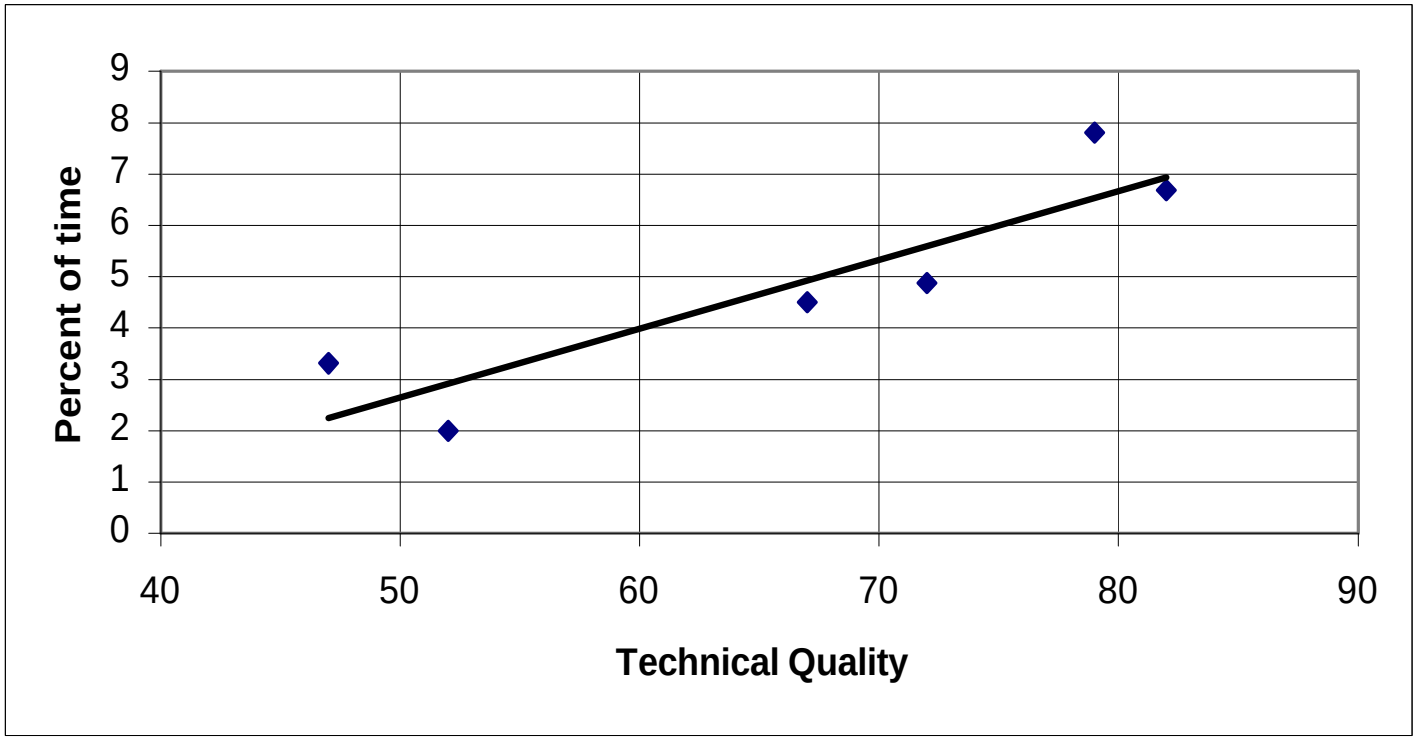
If you don't write down the criteria, they will change during problem solving – in product development this is commonly called "feature creep."

If you don't know what defines a satisfactory solution, the only way you know you are done is when you run out of time.

If you don't articulate the criteria, different team members will be working toward different goals (trying to meet different criteria) while believing they are working together on the same issue.

If you are not careful, you will not make good use of the fact that no two problem-solvers on a team believe the same criteria are important.

Some experimental results



Step 5: Itemize the important features of a solution.

Criteria are used to measure features of alternatives. As such they define goals for the features, and relate the importance of meeting these goals.

Criteria = Feature + Target + Importance

5.1 List the features included in the issue statement.

5.2 Add features based on those of previous and competitive solutions to similar problems.

5.3 Refine feature list by listening to voice of the customers

- Observing
- Surveys
- Focus Groups
- Complaint histories

5.4 Develop and use feature checklists to aid in completeness.

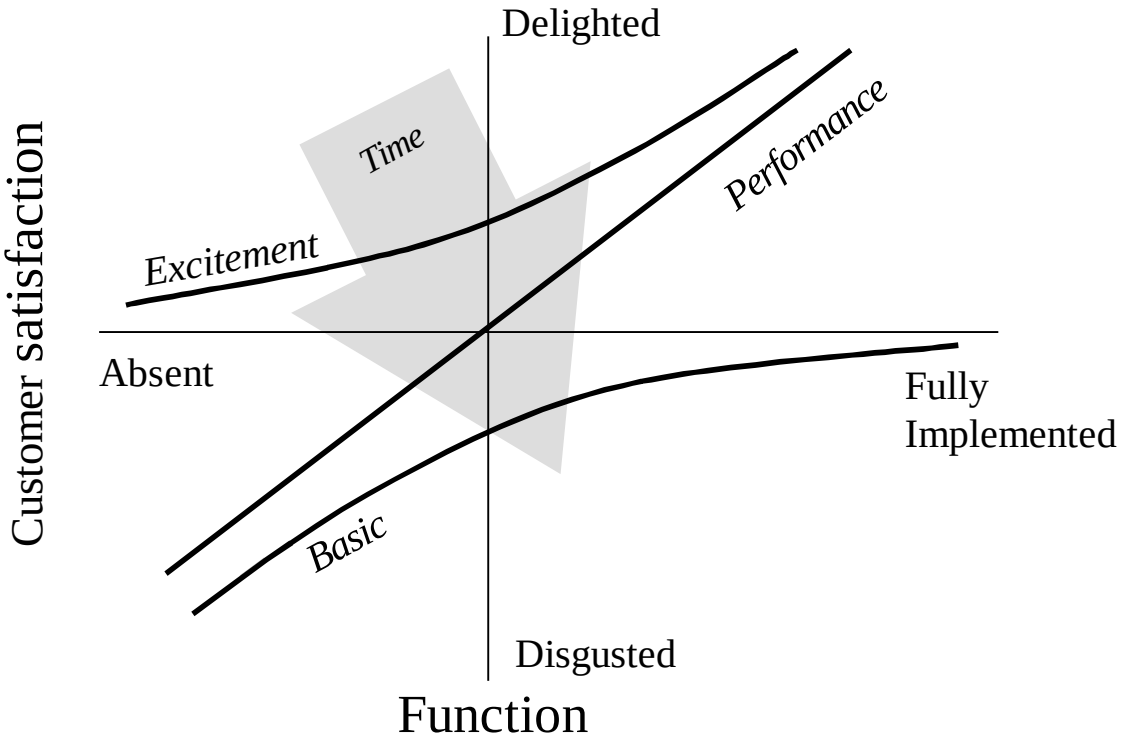
Business project checklist

- Functional performance
  - flow of information
  - operational steps
  - operational sequence
- Human factors
  - Ease of sensing state
- Reliability
  - Operation under various conditions
- Lifecycle concerns
  - Development of material
  - Distribution of material
  - Maintainability
- Retirement
- Resource concerns
  - ROI
  - Capital needed
  - time
  - Unit costs
  - equipment
  - Standards

ME Criteria checklist

- Functional performance
  - flow of energy
  - flow of information
  - flow of materials
  - operational steps
  - operation sequence
- Human factors
  - appearance
  - force and motion to control
  - ease of controling and sensing state
- Physical Requirements
  - available spatial envelope
  - physical properties
- Reliability
  - mean time between failures
  - safety (hazard assessment)
- Life cycle concerns
  - distribution (shipping)
  - maintainability
  - diagnosability
  - testability
  - repairability
  - cleanability
  - installability
  - retirement
- Resource concerns
  - time
  - cost: capital and unit
  - equipment
  - Standards
  - Environmental
- Manufacture/assembly Requirements
  - materials
  - quantity
  - company capabilities

5.5 Refine the list of features to insure that the criteria are discriminatory.



5.6 Refine the list of features to insure that the criteria are measurable.

5.7 Refine the list of features to insure that the criteria are orthognal.

5.8 Refine the list of features to insure that the criteria are universal.

5.9 Refine the list of features to insure that the criteria are external.

.

Step 6: Define targets for features. Identify the basis for evaluation.

Criteria = Characteristic + Target + Importance

(basis + goal (value + units + type + realizability + volatility + sensitivity) + condition)

6.1 Identify the basis for evaluation.

Absolute targets

- The front suspension should weigh less than 220 grams

Relative targets

- The front suspension should weigh less than the Stoneshok 220.

Implied targets

- The front suspension should be the lightest possible.

6.2. Identify the target goal value and units.
6.3 Identify the target goal type.

	Absolute	Relative	Implied
Goal value	Set	Set by baseline	Unstated
Type	Y/N Equals Exact About Less than More than	Y/N Equals Exact About Less than More than Function of	Less the better More the better

Weak criteria

6.4. Identify the target goal realizability.

6.5. Identify the target goal volatility.

6.6. Identify the target goal value sensitivity.

6.7. Identify conditions on the criterion.

Step 7: Measure characteristic importance for each customer.

7.1 Plan methods to honor various customer viewpoints.

7.2 Measure importance from each customer viewpoint using the fixed sum or ranking method.

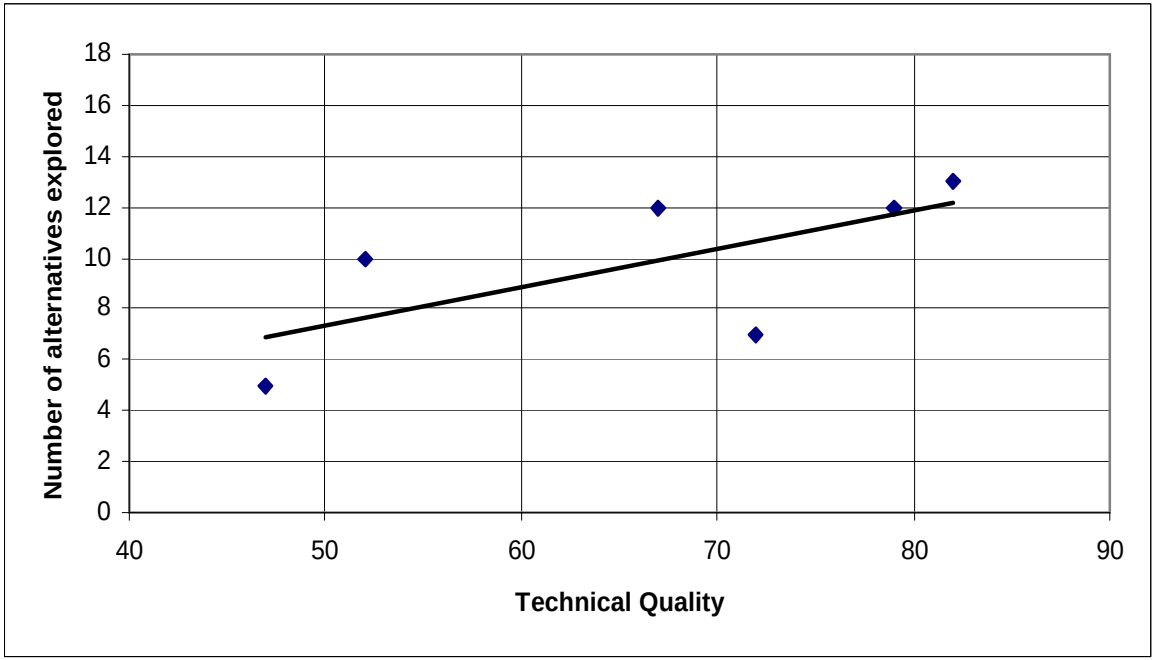
Fixed Sum Method

- the sum of all the weights must equal a fixed number.
- 3 -5 times the number of criteria.

Ideation Risk
The risk resulting from not developing good alternatives

Step 8. Generate Alternative Solutions.

Experimental results show:



Ideation Risk
The risk resulting from not developing good alternatives

8.1 Build management structures to encourage the development of many alternative solutions.

8.2 Build working environment to encourage creativity.

Ideation Risk
The risk resulting from not developing good alternatives

8.3 Utilize structured methods to aid in generating alternatives.

- Morphology, organizing to help generation
- Brainstorming as a Source of Ideas
- Using the 6-3-5 Method as a Source of Ideas
- Using Existing Products and Concepts as Idea Sources, Benchmarking

Ideation Risk
The risk resulting from not developing good alternatives

8.4 Refine alternatives to insure distinctness and variability.

- Distinct alternatives are readily distinguishable from each other.
- Variability implies that the alternatives cover the range of potential solutions

Ideation Risk
The risk resulting from not developing good alternatives

8.5 Monitor the characteristics of new alternatives to provide an alternative filter or criteria amendment.

8.6 Note new issues generated by alternatives

Evaluation risk

The risk resulting from choosing a poor alternative

Step 9: Measure decision-makers' **knowledge**.

Step 10. Determine **belief** in alternatives' ability to meet targets.

Step 11. Determine overall **satisfaction** in alternatives.

Evaluation risk

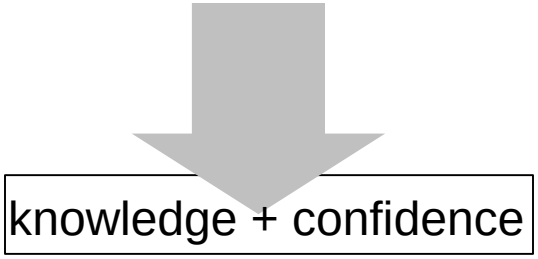
The risk resulting from choosing a poor alternative

Step 9: Measure the decision-makers' knowledge of the alternatives.

9.1 Assess decision-maker's knowledge about the alternatives' features.

Satisfaction with Alternative

= belief that an alternative meets its targets



Evaluation risk

The risk resulting from choosing a poor alternative

Each decision-maker has
unique knowledge
about each feature
of each alternative.

Evaluation risk

The risk resulting from choosing a poor alternative

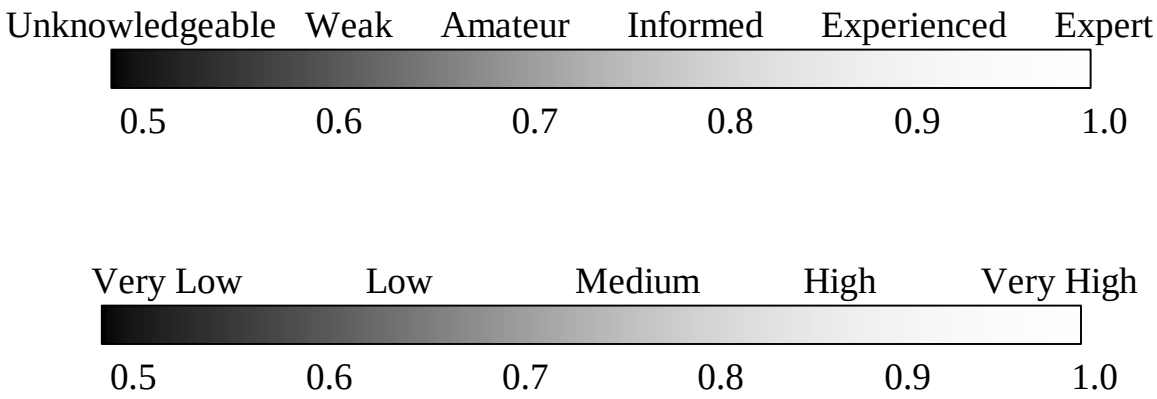
A Proverb about knowledge

He who knows not and knows he knows not,
he is a child, teach him;
He who knows not and knows not he knows not,
he is a fool, avoid him;
He who knows and knows not he knows,
he is asleep, awaken him;
He who knows and knows he knows,
he is wise, follow him.

Evaluation risk

The risk resulting from choosing a poor alternative

Knowledge scales



Evaluation risk

The risk resulting from choosing a poor alternative

9.2 Assess technology readiness.

1. Can the alternative be used with known resources?
2. Are the critical features that control the alternative identified?
3. Is the sensitivity of the features known?
4. Have the failure modes been identified?
5. Do examples exist that demonstrates positive answers to the above four questions?
6. Is the method controllable throughout its life?

Evaluation risk

The risk resulting from choosing a poor alternative

Original technology readiness questions.

1. Can the technology be manufactured with known processes?

2. Are the critical characteristics that control the function identified?

3. Are the safe operating latitude and sensitivity of the characteristics known?

4. Have the failure modes been identified?

5. Does hardware exist that demonstrates positive answers to the above four questions?

6. Is the technology controllable throughout the product's life cycle?

Evaluation risk

The risk resulting from choosing a poor alternative

9.3 Identify methods to increase knowledge and their costs.

- Analysis either formal or informal
- Experiments
- Consultants
- Vendor representatives
- Referencing prior documented work
- Leveraging team knowledge off the knowledge of the individual team members

Evaluation risk

The risk resulting from choosing a poor alternative

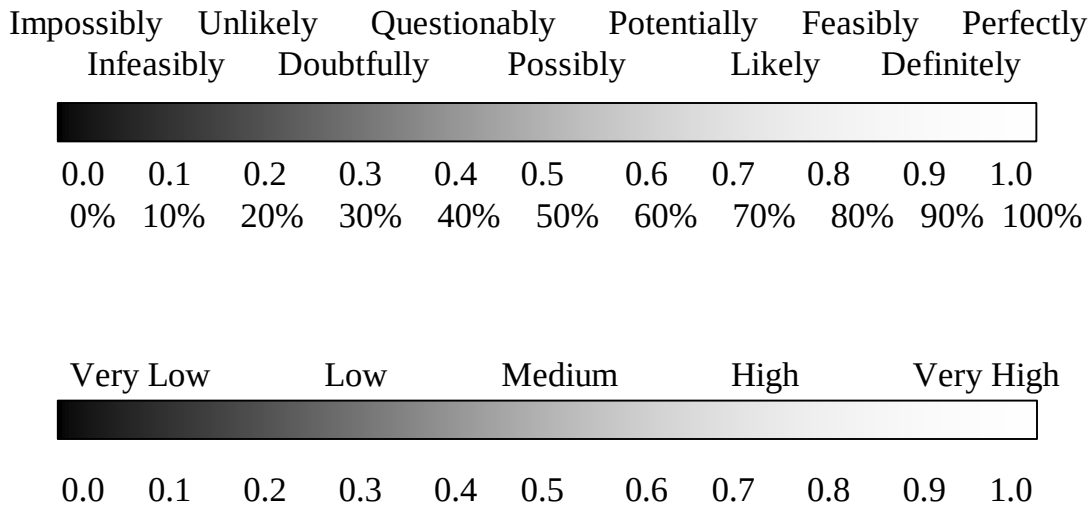
Step 10: Determine **belief** in alternatives' ability to meet targets.

10.1 Assess the decision-makers' confidence in the alternatives' ability to meet the criterion target.

Evaluation risk

The risk resulting from choosing a poor alternative

Confidence scales



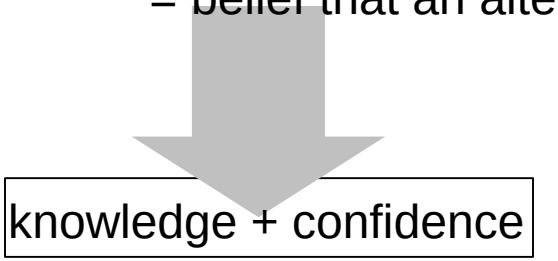
Evaluation risk

The risk resulting from choosing a poor alternative

10.2 Determine the decision-makers' belief in the alternatives' ability to meet the criterion target.

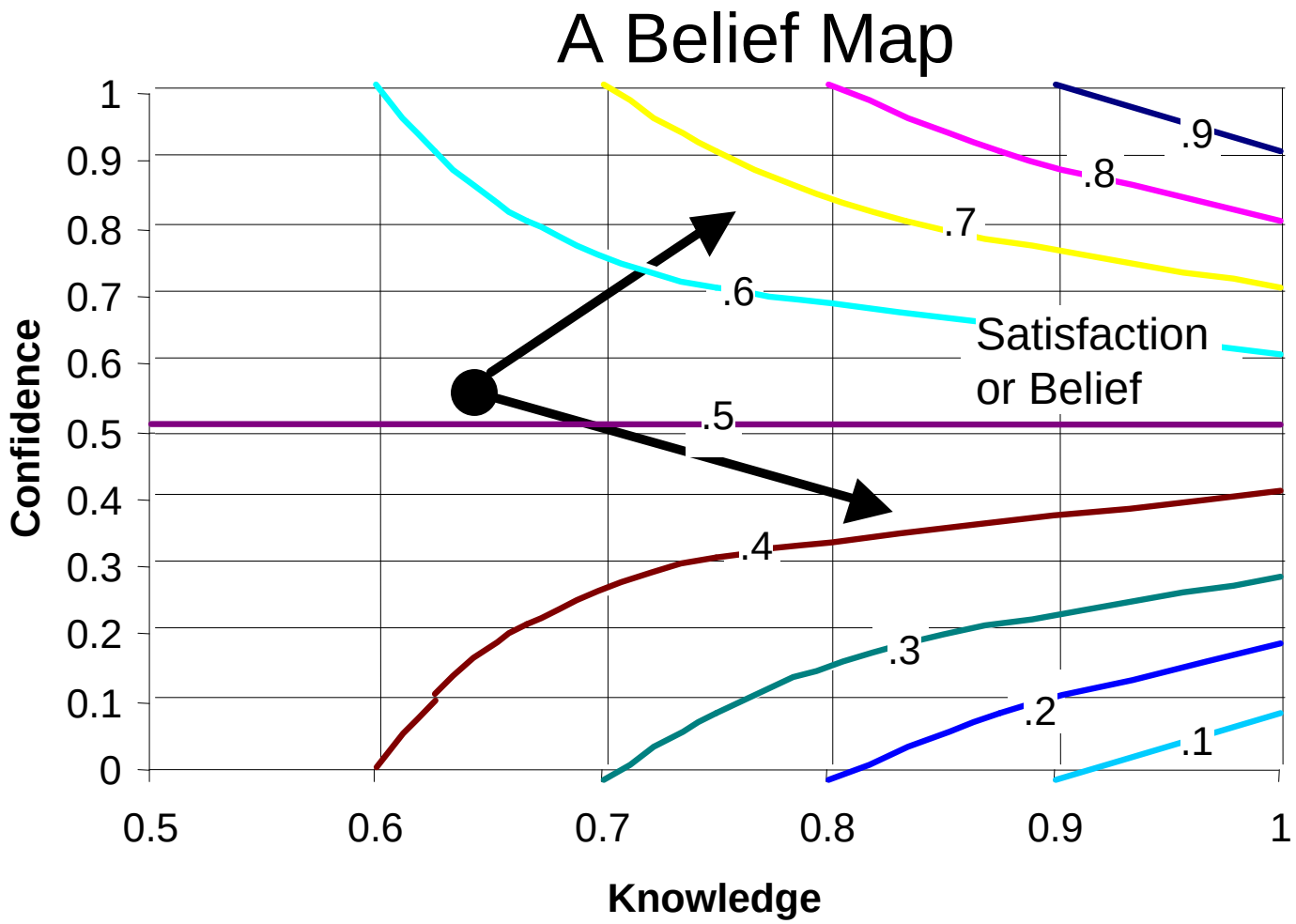
Satisfaction with Alternative

= belief that an alternative meets its targets



Evaluation risk

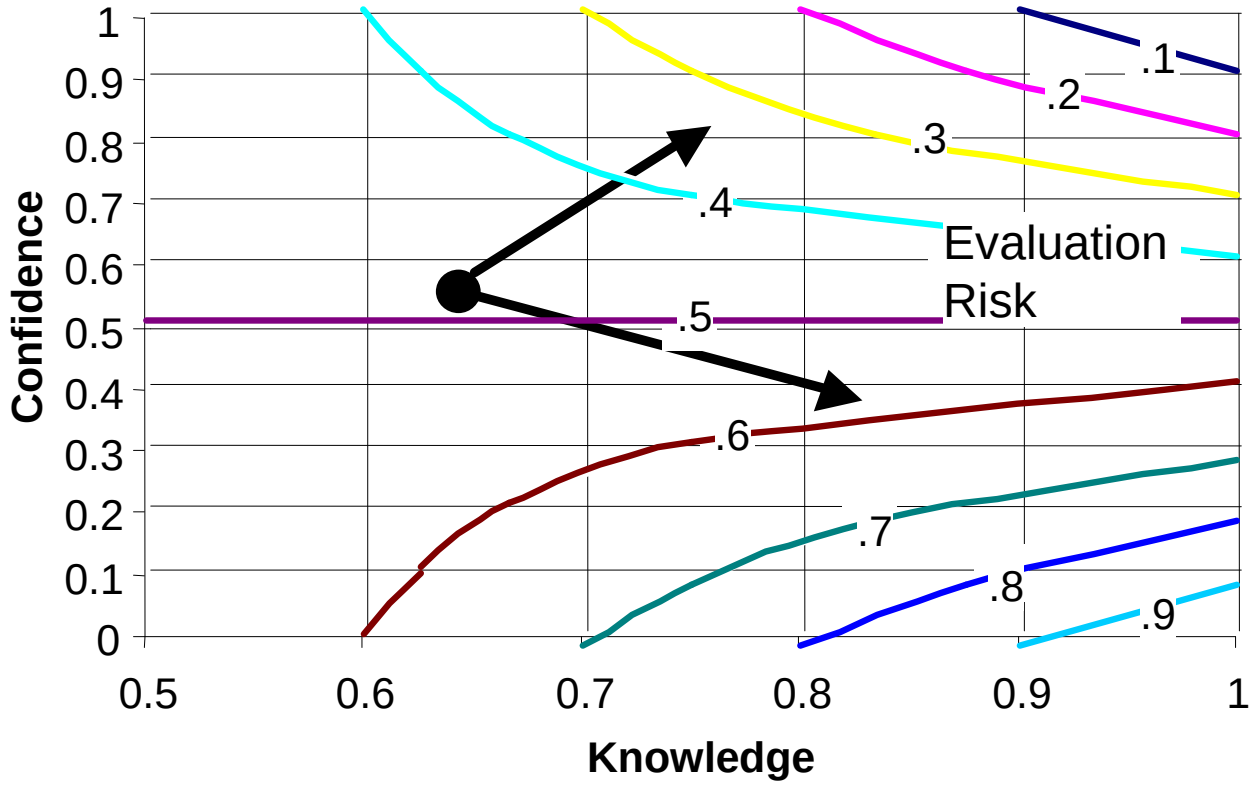
The risk resulting from choosing a poor alternative



Evaluation risk

The risk resulting from choosing a poor alternative

10.3 Note the evaluation risk in this level of belief.



Evaluation risk

The risk resulting from choosing a poor alternative

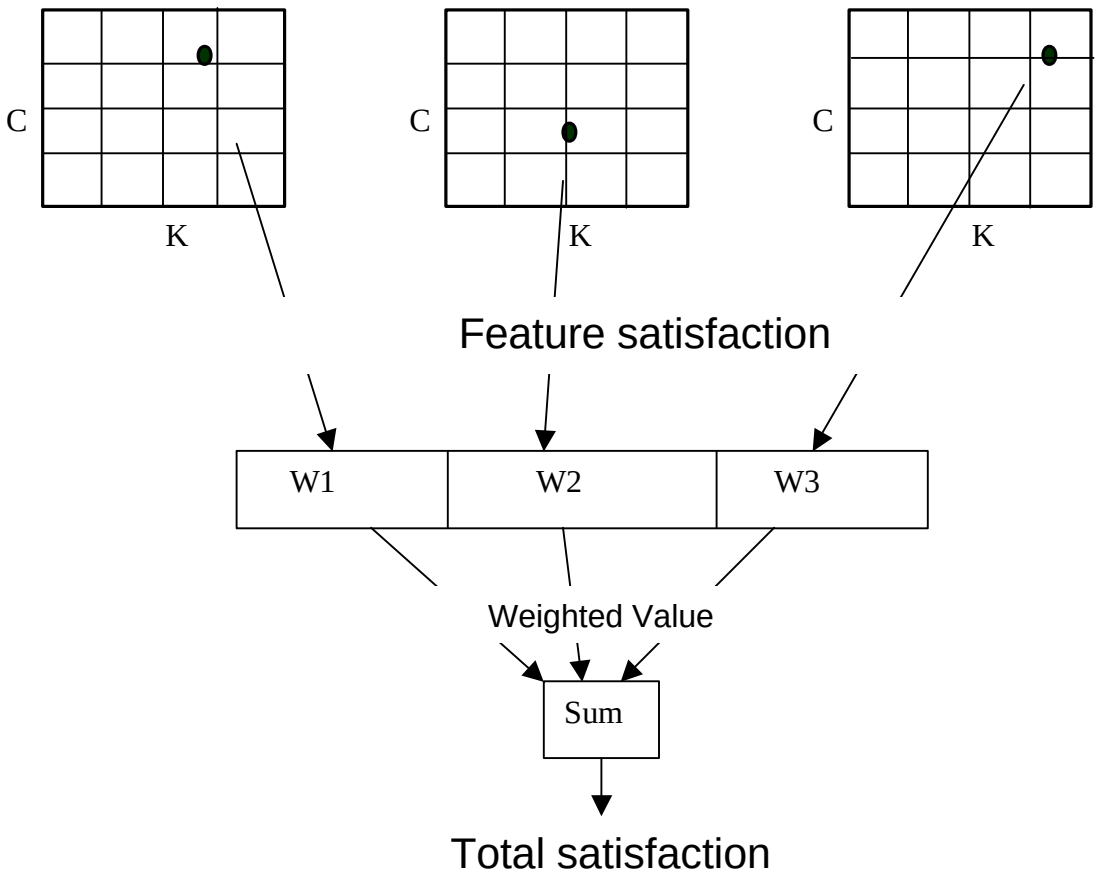
Step 11. Determine the decision-makers' overall satisfaction in the alternatives.

11.1 Estimate each alternative's total satisfaction.

- Can be found using iDecision
- Can be estimated by hand
- Can be found using the equation programmed in iDecision

Evaluation risk

The risk resulting from choosing a poor alternative



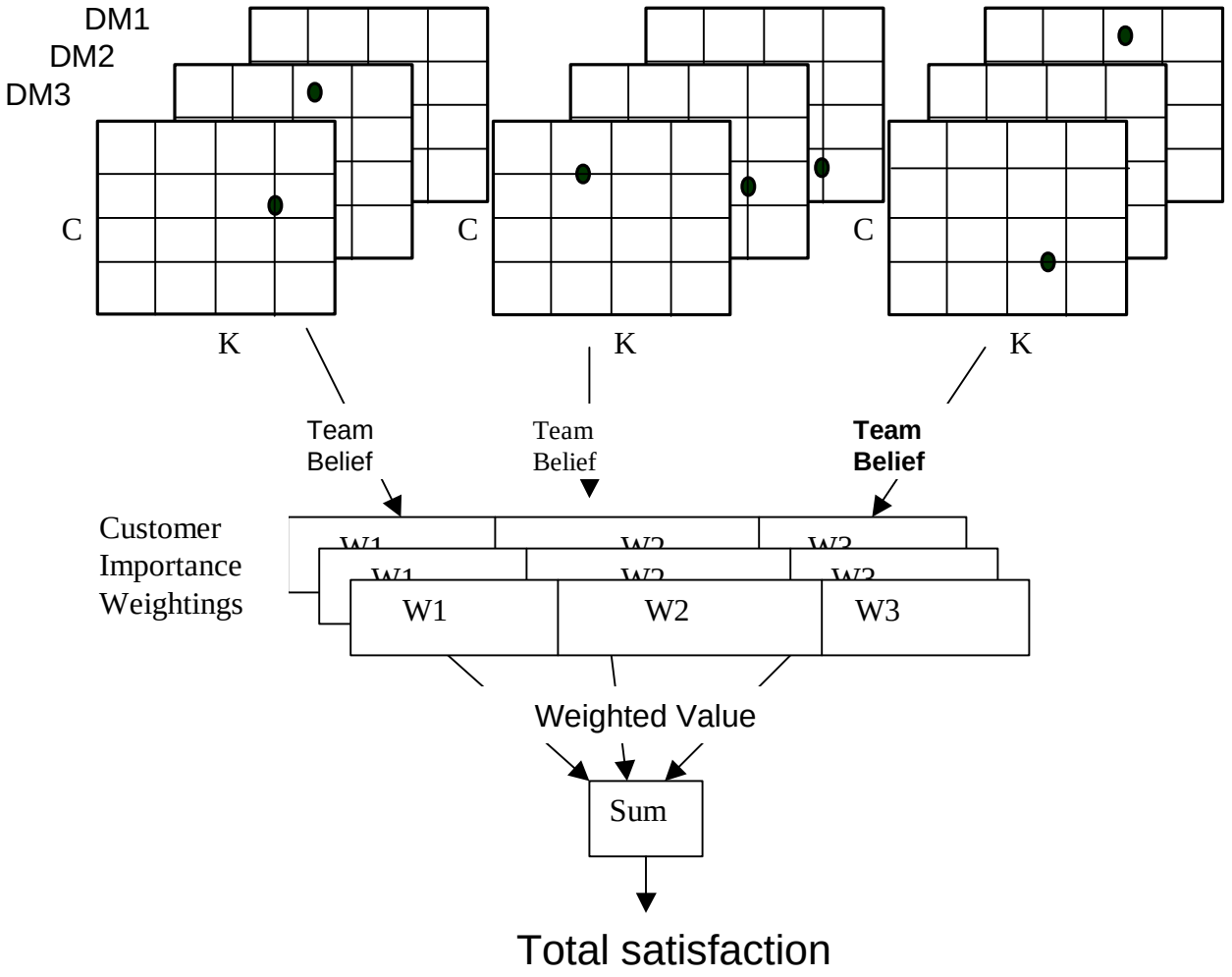
Evaluation risk

The risk resulting from choosing a poor alternative

11.2 Calculate each alternative's total satisfaction based on all decision-makers evaluation.

Evaluation risk

The risk resulting from choosing a poor alternative



Evaluation risk

The risk resulting from choosing a poor alternative

11.3 Compare the alternative's expected values from various customer viewpoints.

Strategic risk

The risk resulting from not following a beneficial strategy

Step 12: Decide what to do next.

1. *What is the best alternative?*
2. *Do <u>we</u> know enough to make a good decision yet?*
3. *What do <u>we</u> need to do next to feel confident about our* decision?
4. Is there team consensus about the decision?

Strategic risk

The risk resulting from not following a beneficial strategy

Information to help determine what to do next

- Results of expert knowledge analysis
- Belief maps
- Importance weightings
- Quality and number of alternatives
- Strength, completeness, orthogonality, clarity, universality, discrimination, and measurability of criteria

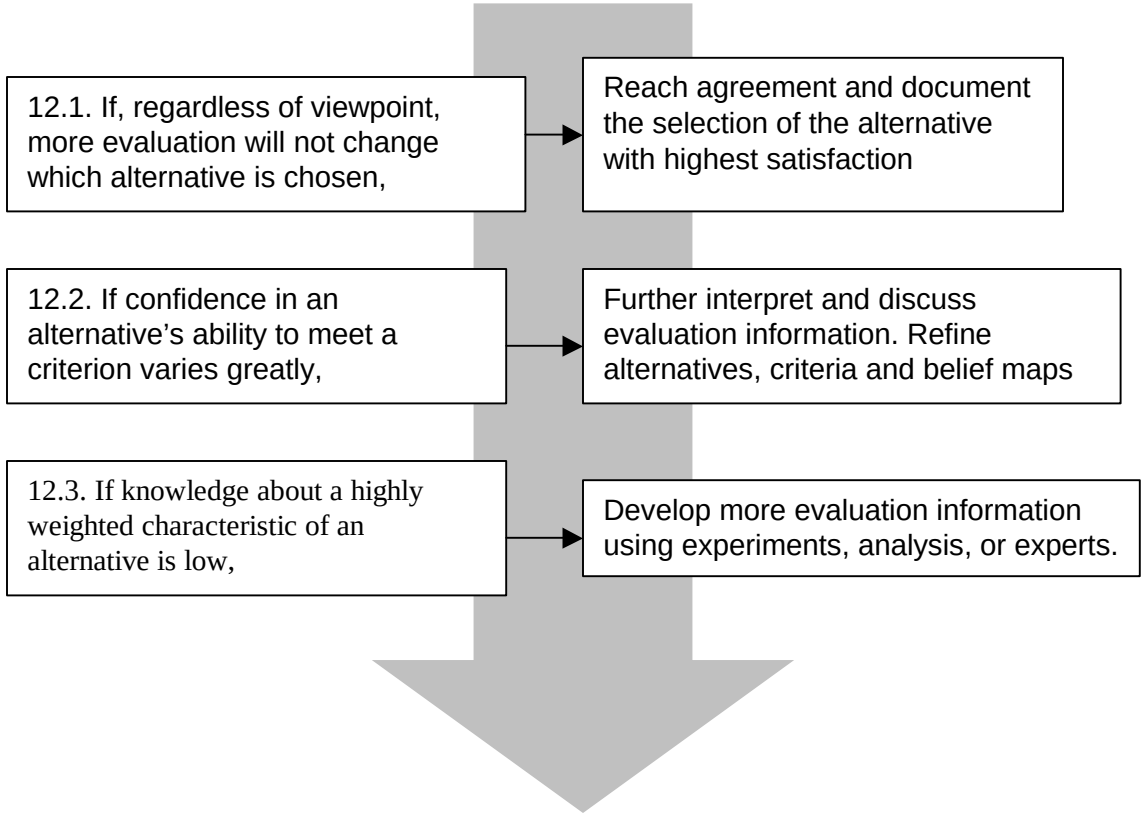
Strategic risk

The risk resulting from not following a beneficial strategy

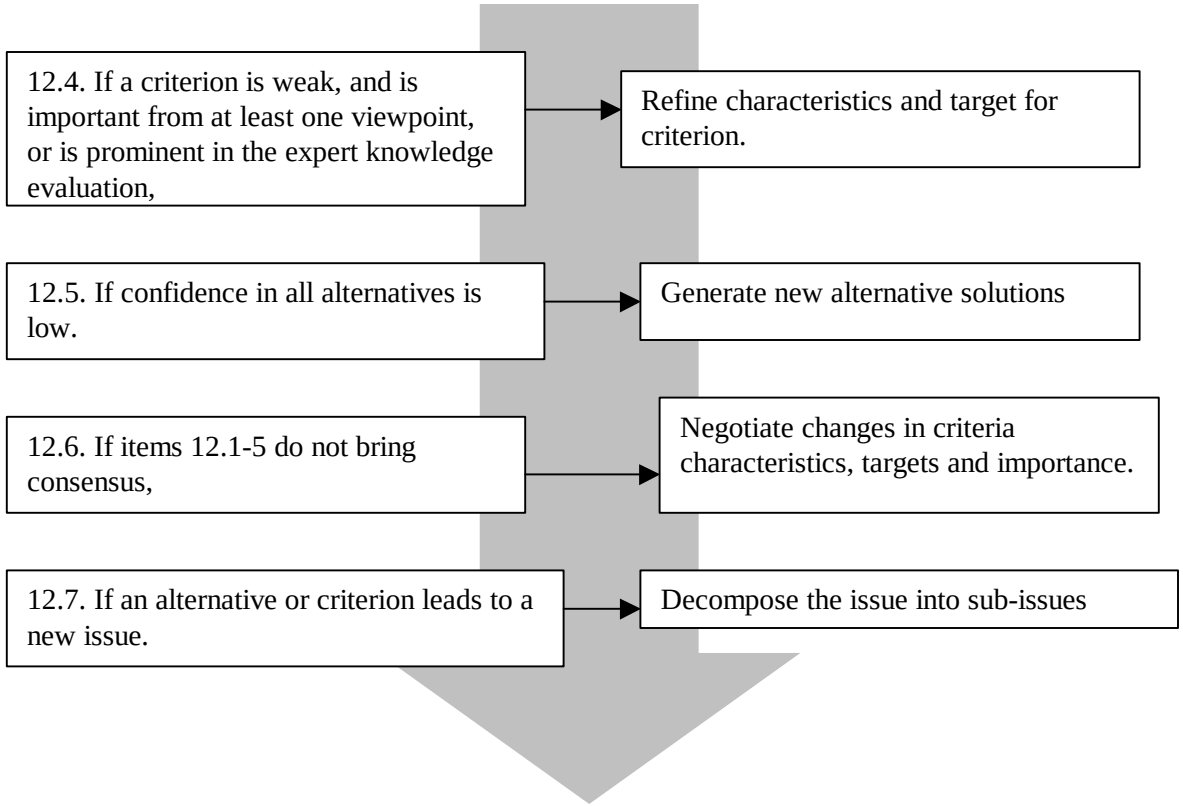
The results of the expert knowledge analysis are:

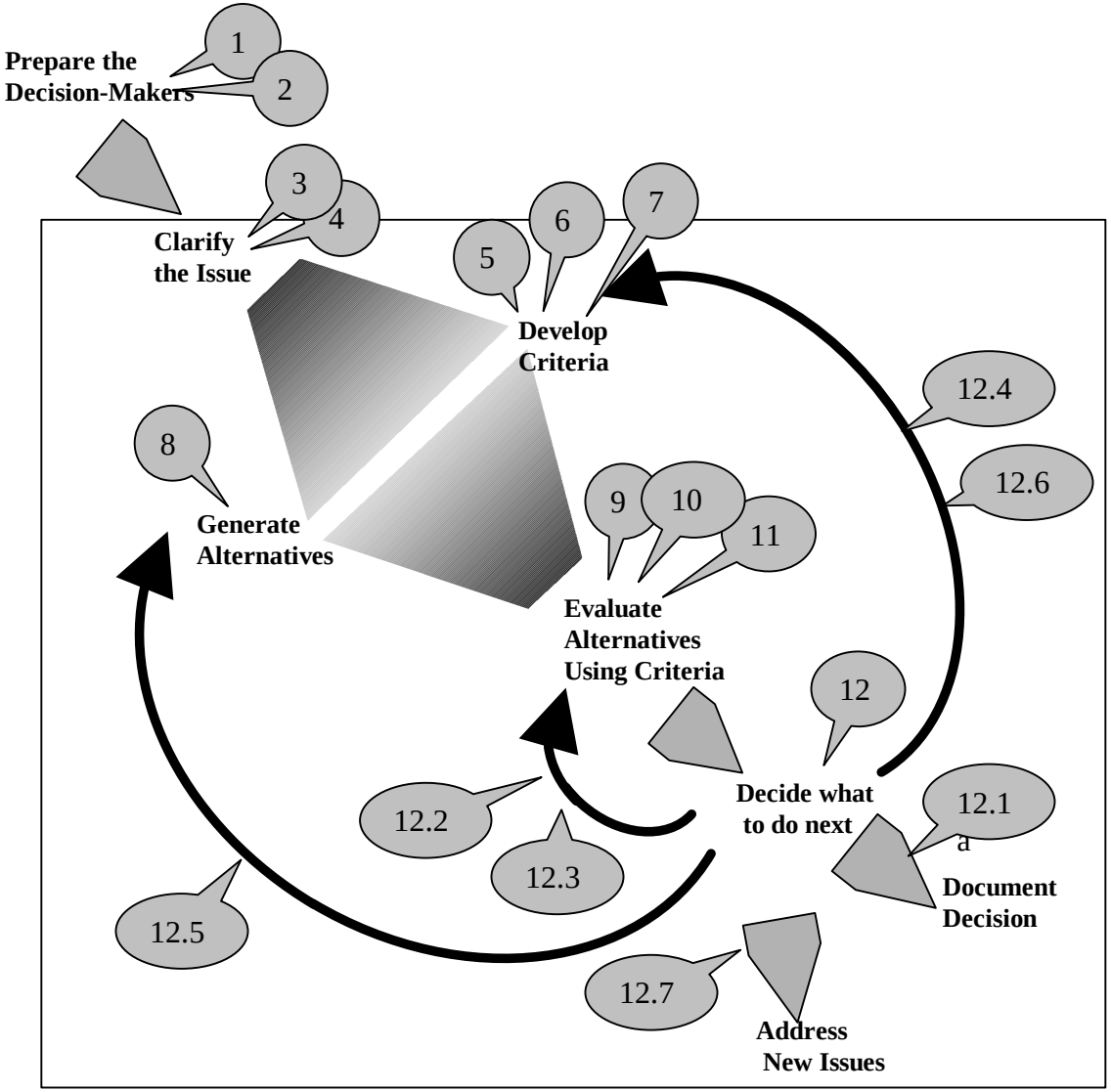
- a function of the current customer's importance weighting.
- a function of the current knowledge indicated by the team.
- a function of the current confidence indicated by the team.
- for reevaluation of one criterion at a time.

Strategy for what to do next 1/2



Strategy for what to do next 2/2




1
Prepare the
Decision-Makers
2
3
4
Clarify
the Issue
5
6
7
Develop
Criteria
12.4
12.6
8
Generate
Alternatives
9
10
11
Evaluate
Alternatives
Using Criteria
12
Decide what
to do next
12.1
a
Document
Decision
12.2
12.3
12.5
12.7
Address
New Issues

Strategic risk

The risk resulting from not following a beneficial strategy

12.1 Reach agreement and document the result

12.2 Further interpret and discuss evaluation information.

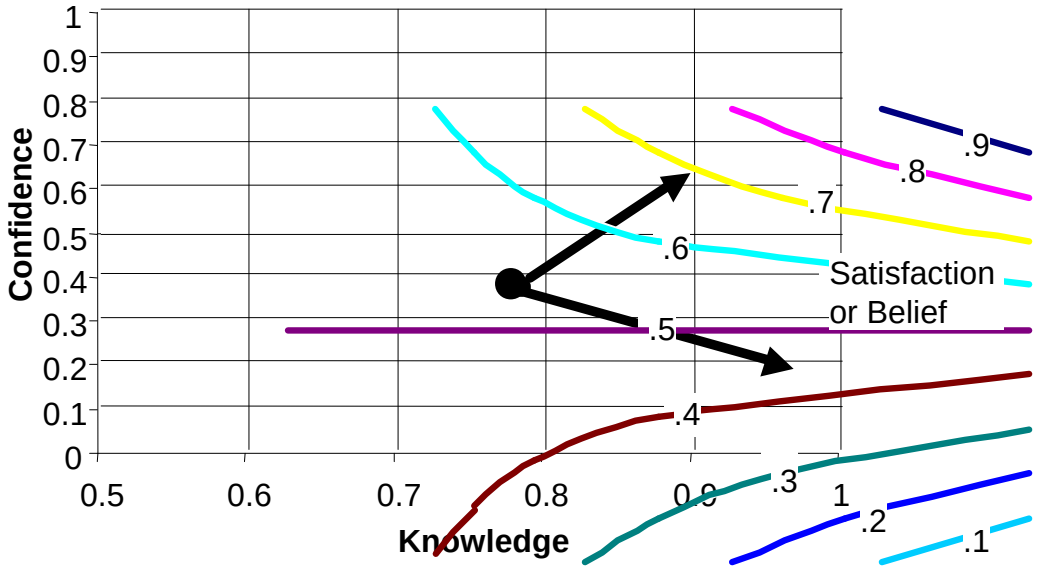
- Based on belief maps.
- Compare interpretation of information.

Strategic risk

The risk resulting from not following a beneficial strategy

12.3 Develop more evaluation information.

- Goal is to refine knowledge and then update belief maps.



Strategic risk

The risk resulting from not following a beneficial strategy

12.4: Refine solution features and targets.

- Return to Steps 5 and 6.

12.5: Generate new alternative solutions.

- Return to Step 8

12.6: Negotiate new features, targets or importance weightings.

- Return to Steps 5 and 6, but with the intent of modifying the criteria and/or opinions about what is important.

12.7 :Decompose the issue into sub issues.

Benefits of using the methods 1/4

- Encourage **sound decision-making skills**
- **Organize** decision-making to be most effective. Most decisions are ad hoc; fashioned from whatever is immediately available. Often this just isn't good enough.
- Make **robust decisions**, decisions that are insensitive to things you can not control.
- **Communicate** what is important to other team members. The largest single problem in teamwork is poor communication. The methods presented give a framework for decision-making communication.

Benefits of using the methods 2/4

- Help the team **develop a common understanding** of the issue and its alternative solutions.
- Make **meetings more effective**. The methods help structure meetings by developing a strategy and organizing information for easy review.
- Understand why a decision is not being reached and develop a **strategy to resolve the issue**. Often a problem is not being resolved and the only action is frustration. The methods help get problems unstuck.

Benefits of using the methods 3/4

- Understand how to **get the best out of the people** on the team. Teams are often dominated by a few. The methods help even the playing field.
- **Analytically support decision-making** regardless of completeness of the problem, the qualitative nature of the evaluation or inconsistency of team member opinions about what is important.
- **Rationally decide what to do next** to reach a robust decision.

Benefits of using the methods 4/4

- **Convince managers** that the team has carefully studied the problem and which solution should be implemented.
- Easily **develop documentation** of the decision.
- Reveal the process of decision making for **review and reuse**. Understanding and refining the process is important and more easily done if it is structured as developed in this book.
- Reduce the need to rework the results of non-robust decisions. In industry this is often referred to as "**fire fighting**." Fire-fighting takes valuable time from working on new issues.

I have decided to stop now!

Step 1: State the Issue

- Write a single sentence that describes the issue, question, task, problem statement or area of concern.
- Identify the object, function or process on which activity is focused.
- Identify the desired action on the object, function or process.
- Itemize the initial criteria.
- Capture initial alternative solutions.
- Identify the source of the issue.

Step 2: Identify the customers for the decision.

- Itemize everyone who is included in the description of the problem.
- Itemize everyone who comes in contact with the object, function or process during each phase of its life-cycle.

Step 3: Itemize the important characteristics of a solution.

- List the characteristics included in the issue statement.
- Add characteristics based on those of previous and competitive solutions to similar problems.
- Refine by listening to voice of the customers.
- Develop and use characteristic checklists to aid in completeness.
- Refine the list of characteristics to insure that the criteria are complete, orthogonal, clear, universal, discriminatory, and measurable.
- Categorize all characteristics as basic, performance or excitement.
- Insure all characteristics are external.

Step 4: Define targets for characteristics.

- Identify the basis for evaluation.
- Identify the target goal value, units, and type.
- Insure criterion conditions are known.
- Refine weak criteria by identifying ways of measuring characteristic and transforming to strong criteria.

Step 5: Measure characteristic importance for each customer

- Plan methods to honor various customer viewpoints
- Measure importance from each customer viewpoint using the fixed sum or ranking method.

Ideation Risk
The risk resulting from not developing good alternatives

Step 6. Generate Alternative Solutions.

- Build management structures to encourage the development of many alternative solutions.
- Build working environment to encourage creativity.
- Utilize structured methods to aid in generating alternatives.
- Refine alternatives to insure distinctness and variability.
- Monitor the characteristics of new alternatives to provide an alternative filter or criteria amendment.
- Note new issues generated by alternatives.

Evaluation risk

The risk resulting from choosing a poor alternative

Step 7: Measure the decision-makers' knowledge of the alternatives.

- Assess decision-maker's knowledge about the alternatives' characteristics.
- Assess technology readiness.
- Identify methods to increase knowledge and their costs.

Step 8: Determine decision-maker's belief.

- Assess the decision-makers' confidence in the alternatives' ability to meet the criterion target.
- Determine the decision-makers' belief in the alternatives' ability to meet the criterion target.
- Note the risk in this level of belief.

Evaluation risk

The risk resulting from choosing a poor alternative

Step 9. Determine the decision-makers' overall evaluation of the alternatives.

- Estimate each alternative’s expected value.
- Calculate each alternative’s expected value based on all decision-makers evaluation.
- Compare the alternative’s expected values from various customer viewpoints.

Strategic risk

The risk resulting from not following a beneficial strategy

Step 12: Decide what to do next.

- Reach agreement and document the result.
- Further interpret and discuss evaluation information.
- Develop more evaluation information.
- Refine solution characteristics and targets.
- Generate new alternative solutions.
- Negotiate new characteristics, targets or importance weightings.
- Decompose the issue into sub issues.