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Selecting Analytic Approaches for Decision Situations
(Revised Edition)

VOLUME III: Appendices

R.V. Brown
J.W. Ulvila

DECISIONS and DESIGNS, INC.

SELECTING ANALYTIC APPROACHES
FOR DECISION SITUATIONS
(Revised Edition)

VOLUME III: APPENDICES

by

R.V. Brown
J.W. Ulvila

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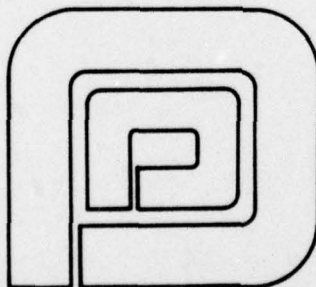
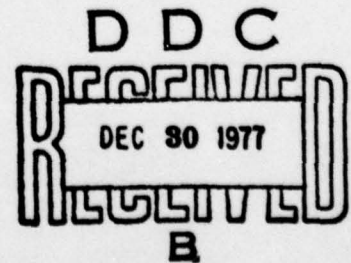| REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR-77-7-25-VOL-3	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) SELECTING ANALYTIC APPROACHES FOR DECISION SITUATIONS (Revised Edition). Volume III, appendices.		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Rex V. Brown Jacob W. Ulvila		8. CONTRACT OR GRANT NUMBER(s) N00014-75-C-0426
9. PERFORMING ORGANIZATION NAME AND ADDRESS Decisions and Designs, Inc. 8400 Westpark Drive McLean, Virginia 22101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Navy Office of Naval Research 800 N. Quincy Street, Arlington, VA 22217		12. REPORT DATE Dec 1977
		13. NUMBER OF PAGES 85
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

decision analysis   analysis techniques
situation taxonomy   elicitation techniques
analysis taxonomy
performance measure taxonomy
matching generalizations

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The three volumes of this report present a conceptual framework within which experienced decision analysts can derive generalizations that match analytic techniques to decision situations and communicate those generalizations to decision makers and inexperienced analysts. The framework consists of a three-way taxonomy: decision situations, analytic options, and performance measures.

(cont. on p. iii)

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The first component is a "situation taxonomy," listing about one hundred dimensions of a situation that might be relevant to a particular analytic choice. These dimensions include: the stakes involved in a decision; the reaction time available; and the clairty with which options, probable consequences, and values are perceived.

The second component is an "analysis taxonomy," according to which about one hundred decision-analytic choices can be located in an "analytic option space." Dimensions of the analytic taxonomy included, how much decision analysis is undertaken, how it is used, what type of model structure is involved, and what technique for probability assessment or consequence evaluation is employed.

The third component is a "performance measure taxonomy," listing about thirty measures of effectiveness which can characterize the analytic options. The same taxonomy can also be used to describe a situation by expressing the relative importance of the performance measures in the situation. Performance measure dimensions include: enhanced logical reasoning, cost, speed, convenience, and facilitated communication. This component serves as a mediating factor, implicit or explicit, in matching analysis to situation.

In this research effort, we have attempted to identify a few important and plausible matching generalizations based on the experience of practicing decision analysts. A few analytic options were selected to represent thousands of possibilities and to facilitate generalizations about when they should be exercised in the form of a taxonomy matching.

This volume contains very detailed lists of the three taxonomies and matching generalizations relating twenty-two analytic techniques to decision situations.

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INTRODUCTION

This volume presents the details of the situation taxonomy, analytic taxonomy, and performance measure taxonomy that are introduced in Volume I. The presentations in this volume are intended as a dictionary-style reference that explains the specific categories of the taxonomies. As such, the presentation of the taxonomies contained in this volume are nothing more than detailed lists of categories of situations, analytic techniques, and performance measures.

In addition to the detailed lists of taxonomies, which are contained in the first three sections, the last two sections of this volume illustrate the use of the taxonomies to derive and communicate specific matching principles. Section D explains the matching relationship between each characteristic in the situation taxonomy and the appropriate amount of decision analysis. In essence, this presentation is an expansion of that given in Section 3.1 of Volume I, which explains the most important situation characteristics for determining the amount of decision analysis. Section E explains twenty-two additional matching principles for specific analysis techniques. This section is basically an explanation of the matching principles displayed on Table 3-2 of Volume I.

We realize that some of our explanations in this volume are a bit cryptic. This was done for two main reasons. First, we made an effort to save space. Second, it is our intention in this report to indicate the form that a final definitive product might take. It does not purport to be that final product. We hope that future research will refine and build upon the ideas presented here in order to

achieve more definitive classification schemes and matching
principles. (Throughout this taxonomy, we have included
categories entitled "other" to indicate that we recognize
that other categories are required for a complete taxonomy.)

SECTION A: SITUATION TAXONOMY

This section presents a detailed description of the
situation taxonomy, which was introduced in Section 2.1 of
Volume I. This taxonomy contains dimensions that enable
decision makers to define precisely their decision situations
in such a manner that an identification of the appropriate
amount and types of decision analytic techniques is facilitated.
This taxonomy is designed as a series of multiple choice
questions coded in a numerical scheme. The final digits
under each category are the choices to answer the questions
posed by the other digits. For example, 1123 refers to the
choice "Expected number of occurrences = 2" to the question
(signified by the first three digits, 112) "How many times do
you expect tc make this same decision?"

The primary objectives in developing this taxonomy were
to produce something that is universally applicable to
decision makers (not just useful to decision makers in one
particular field of decision making) and to indicate the
form that a complete definitive classification scheme for
decision situations might take. The present development of
this taxonomy does not purport to be a complete definitive
product.

1   Decision Substance

The following dimensions describe the substance of a decision as opposed to the setting in which the decision is to be made.

11   Basic Situation

111   Current/contingent choice - does the situation demand an immediate choice, or will a choice be required only in the event of the occurrence of some future contingency?

1111 Current - e.g., mobilize NATO forces immediately.
1112 Contingent - e.g., mobilize NATO forces if and when the probability of Warsaw Pact forces mobilizing exceeds .55.

112   Expected number of occurrences - What is the probability weighted average of the number of times that the decision must be made (including the first time)?

1121 Expected number of occurrences < 1
1122 Expected number of occurrences = 1 (e.g., a current choice or a contingent choice that will occur twice if it occurs at all and has a 50% chance of occurring).
1123 Expected number of occurrences = 2
1124 Expected number of occurrences < 2

113   Operating/information act - Will the immediate decision result in taking an operating act or an act to seek more information?

1131 Operating - e.g., shooting at an unidentified plane.
1132 Information - e.g., seeking information on an unidentified plane's identity.

119   Other basic situations.

12   Options

121   Broad/Narrow - Is a commitment required at a broad or narrow level? (A narrow level is typically a subset of a broad one.)

1211 Broad - A commitment is required at a coarsely defined level, e.g., go north or go south.
1212 Narrow - A commitment is required at a finely defined level, e.g., go to Fairbanks, Alaska, or go to Miami, Florida.

122 Clear/Fuzzy - Are the options clearly and unambiguously specified or not?

    1221 Clear - e.g., selecting one of five bidding contractors.
    1222 Fuzzy - e.g., selecting criteria to use in selecting a contractor.

123 Complexity of decision options - How complex are the decision options that are under consideration?

    1231 Two discrete options (a binary choice).
    1232 Three to twelve discrete options.
    1233 More than twelve discrete options.
    1234 One scalar choice - e.g., where to set a price.
    1235 Small vector of choices - e.g., what values to assign to three design parameters.
    1236 Large vector of choices - e.g., what values to assign to ten design parameters.
    1239 Other.

124 Radical/adaptive - Will the decision result in minor changes to current operations, or will a more radical departure occur?

    1241 Radical - outside of the realm of current practice and the alternatives are very different, (e.g., a decision to drop a product).
    1242 Moderately radical.
    1243 Adaptive - involving minor changes in current practice and the alternatives are very similar (e.g., a decision to raise the price of a product).

125 Static/dynamic - Is this decision final or can it be modified over time?

    1251 Static - The decision is to be made now once and for all (e.g., a declaration of war).
    1252 Dynamic - The commitment can be modified, possibly continuously (e.g., taking an increasingly bellicose stance toward a potential enemy, maneuvering a ship).

129 Other options

13   Ease of Decision

    131   Difficulty of choice - Is the choice difficult in the sense that there is a lot of room for improvement over informal decision making methods?

        1311 Routine or obvious - Informal techniques leave little room for improvement.
        1312 Moderate difficulty.
        1313 Difficult - There is much room for improvement over informal decision-making techniques. The decision maker is perplexed about what to do and there is a high "cost of confusion."

    132   Unfamiliarity - How foreign is the choice to the decision maker's experience?

        1321 Low - familiar to the decision maker's experience.
        1322 High - foreign to the decision maker's experience.

    133   Key consideration - In this case, what is the key determinant of a good decision?

        1331 Option generation - generating a set of viable options.
        1332 Information - gathering information to support a choice.
        1333 Inference - drawing inferences from available information.
        1334 Choice - choosing from among a set of options.
        1339 Other considerations.

    139   Other decidability

14   Stakes

    This section is arranged in order of increasing importance to the determination of the appropriate amount of decision analysis to use in a situation but also in an order that is increasingly difficult for a decision maker to answer. That is, the early questions (e.g. 141 Resources Committed) are easy for a decision maker to answer but are not very relevant to the indication of the appropriate amount of decision analysis. On the other hand, the late questions (e.g. 145 expected irrationality cost) are very relevant to the indication of the appropriate amount of decision analysis but very difficult for a decision

maker to answer. The categories 143, 144 and 145 can be used to successively bound the classification of stakes. That is, answers on early questions may be sufficient to identify obviously "low stakes" or "high stakes" situations so that the later questions are unnecessary.

141 Resources committed - What total amount of resources have already been committed to the decision (e.g., the value of facilities engaged)?

1411 Low - less than $200,000.
1412 Medium - $200,000 to $2 million.
1413 High - greater than $2 million.

142 Cost swing - What is the difference in cost between the least expensive and most expensive option?

1421 Low - less than $100,000.
1422 Medium - $100,000 to $1 million.
1423 High - greater than $1 million.

143 Value swing - What is the difference in value *between the best and worst plausible outcomes* considering all reasonable decision options?

1431 - Less than $1 million.
1432 - $1 million to $40 million.
1433 - $40 million to $100 million.
1434 - Greater than $100 million.

144 Maximum option impact - What is the dollar equivalent difference in expected value between the best decision and the worst plausible decision?

1441 - Less than $100,000.
1442 - $100,000 to $5 million.
1443 - $5 million to $10 million.
1444 - Greater than $10 million.

145 Expected irrationality cost - What is the room for improvement in the user's decision making process? That is, the difference between the expected value of choosing the "best" option, as indicated by an impeccable decision analysis, and the expected value obtained by expecting over the probabilities that the decision maker would take each possible alternative if he did no analysis. (The concept of irrationality cost is explained more fully in Watson and Brown (1975).)

```
1451 Low - less than $20,000.
1452 Medium - $20,000 to $500,000.
1453 High - greater than $500,000.
```

149   Other stakes

15   Outcome Valuation

151   Difficulty of net valuation - How difficult
      is it to compare the overall attractiveness
      of possible outcomes? (Specific elements of
      this characterization are covered below in
      items 152 - 155.)

      1510 Not very - e.g., for a single criterion
           with a natural metric.
      1511 Moderately.
      1512 Very - e.g., for multiple conflicting
           intangible criteria.

152   Number of value dimensions - To what degree
      are many value criteria (measures of effec-
      tiveness) important to consider? (Note that
      setting levels by specific numbers of value
      dimensions is somewhat ambiguous because any
      value dimension can be decomposed into at
      least two components.)

      1521 Low - e.g., value can be summarized
           sufficiently by a single criterion such
           as discounted present value.
      1522 Medium.
      1523 High - many specific criteria are required
           to adequately capture value.

153   Measurable value - To what extent does a
      natural metric exist for the value dimen-
      sions?

      1530 No natural metric - e.g., for quality of
           life.
      1531 Approximate metric - e.g., GNP as a
           metric for standard of living.
      1532 Exact metric - e.g., dollars as a metric
           of income.

154   Natural combinability of value - How natural
      is it to combine the dimensions of value into
      a single index?

      1541 Low - e.g., in the case of many con-
           flicting intangible value criteria.
      1542 Moderate.

8

1543 High - e.g., for different additive
     components of a single variable such as
     cost.
1549 Other - e.g., high for some but not for
     all.

155   Timing horizon - Over what time horizon will
the effects of the decision extend?

    1551 Early - all costs and benefits associated
        with the decision will be resolved
        within one year.
    1552 Medium - resolution of all effects will
        take 1-10 years.
    1553 Late - resolution of all effects will
        take more than ten years (e.g., with the
        long-run impact of U.S. military standing).

156   Difficulty of component valuation - How
difficult is it to value outcomes on each
criterion scale?

    1561 Low
    1562 Medium
    1563 High
    1564 Varies with component.

159   Other outcome valuations.

16   Outcome Uncertainty

161   Number of uncertainties - How many uncertain
quantities influence the decision?

    1611 One - typical of personal gambling
        situations.
    1612 Few - typical of mid-level business or
        military decisions.
    1613 Many - typical of top-level business or
        government decisions.

162   Assessability - How easy is it to assess the
appropriate probability distribution(s) of
the uncertain quantities?

    1621 Low - difficult to determine the proper
        distribution.
    1622 Medium
    1623 High - easy to determine the proper
        distribution.

163 High/low uncertainty - What is the "amount"
of uncertainty in the uncertain quantities as
represented in the 90% relative credible
interval, <u>90% credible interval</u> , of the
median
probability distribution?

    1630 None
    1631 Low - Relative credible interval (RCI) <
        .10.
    1632 Medium - .10 < RCI < 1.00.
    1633 High - RCI > 1.00.

164 Subsequent acts - To what degree do subsequent
acts impact the decision outcome?

    1641 Low
    1642 Medium
    1643 High - e.g., if the immediate decision
        is to seek information that will inform
        a later operating act.

165 Type of evidence - What is the nature of
evidence available to resolve the uncertainties?

    1651 Mainly historical record.
    1652 Lends itself readily to direct judgment.
    1653 Lends itself to indirect techniques -
        e.g., conditioned assessment, decomposed
        assessment, Bayesian updating.
    1654 Lends itself to both direct and indirect
        techniques.

166 Hindsight monitoring - How accurately and
promptly can the outcomes be determined by
hindsight?

    1661 Low - e.g., having to wait years to know
        whether there were mines at the entrance
        of the Dardanelles in 1914.
    1662 Medium
    1663 High - e.g., discovering within hours
        that a bombing mission was successful.

169 Other outcome uncertainties

19 Other Decision Substance

2   Decision Process

In terms of the user's analytic options (as opposed to the technician's options), the organizational and personal setting within which a decision is to be made may be of even greater importance than the specific substance of the decision. Thus, we may be interested in the personal characteristics of the decider, the organizational setting within which he operates, or external constraints on the decision process.

21   Reaction Time - How much reaction time is available between the time that the decision is recognized and an analysis is considered and the time that a commitment is required?

211   Minutes - 0-60 minutes, e.g., in deciding to shoot an approaching unidentified plane or to arbitrate a stock.

212   Hours - 1-48 hours, e.g., in the Pueblo incident.

213   Days - 2-30 days, e.g., in a NATO mobilization decision or some decisions to enter into contract agreements.

214   Months - More than 30 days, e.g., in planning a reconnaissance system or planning a business expansion.

22   Analytic Process

221   Number of input sources - How many sources could provide relevant input data?

2211 Single for all inputs - All inputs should come from a single source.

2212 Single for each input - Several sources could provide input data, but there is only one source for each input.

2213 Several preference sources - Several sources of preferences (e.g., values) could be relevant, but only a single source of substantive input (e.g., uncertainties) is relevant.

2214 Several substantive sources - Several sources of substantive input (e.g., uncertainties) could be relevant but only a single source of preferences is relevant.

2215 Several for both - Several sources could be relevant for both substantive and preference inputs.

222   Analytic Team

    2221 Number of team members - How many people would actually perform an analysis?

        22211   Single - e.g., the decision maker himself, a member of his staff, or an outside consultant.
        22212   Multiple - e.g., a group of staff members or a horizontal task force comprised of several people of equal rank in the organization.

    2222 Type of analyst - Who would actually perform the analysis?

        22221   The decision maker himself.
        22222   A member of the decision maker's staff.
        22223   An outside consultant.

    2229 Other distinctions.

223   Constraints on analytical method - What established procedures constrain the analytic method?

    2230 None - The analysis is unconstrained.
    2231 Encouraged - Certain analysis techniques are encouraged by convention or habit.
    2232 Required - The analysis is required to conform to established procedures.
    2239 Other

224   Documentation - What procedures constrain reporting and documentation?

    2240 None
    2241 Encouraged by convention or habit.
    2242 Required - A certain form of documentation is required.
    2249 Other

225   Interest in trying new methods - How high is the decision maker's interest in trying new analytic methods?

    2251 Low
    2252 High

23 Organizational Process - These dimensions deal
with the way in which a particular decision is
articulated within the organization and the way
the decision is initiated, used, and controlled.

231 Initiation

2311 How is an analysis initiated?

23111 Spontaneously in response to
unanticipated developments.
23112 Scheduled ahead of time.
23119 Other

2312 Who initiates the decision?

23121 The decision maker
23122 His staff
23123 His superior
23124 A subordinate
23125 A peer
23129 Other

232 Responsibility - Where, in the organization,
is the responsibility for the decision?

2321 Role of decision analysis user - What
role does the decision analysis user
serve in the decision process?

23211 Firm decision - He will make
the final decision.
23212 Tentative decision - He will
make a decision that is subject
to someone else's revision.
23213 Recommendation - He will make a
recommendation.
23214 Information - He will provide
information for someone else's
decision.
23219 Other

2322 Dispersion of decision responsibility -
How is the responsibility for the decision
dispersed?

23220 Not - A single person has sole
responsibility for everything
that is involved in making the
decision.

13

23221 Low - A small group of people share responsibility for various aspects of the decision. For example, while a single person may make the decision, he may weigh the opinions of others heavily.

23222 High
23229 Other

233 Coordination - To what degree must the decision coordinate with other higher, lower, or collateral decisions?

2330 Not at all
2331 Moderately
2332 Very much

234 Justification - Will the decision and the reasons surrounding it need to be justified before or after the decision is made?

2340 No
2341 Pre-decision justification only
2342 Post-decision justification only
2343 Both pre- and post-decision justification is needed

235 Controversial - How controversial is the decision?

2350 Not
2351 Moderately
2352 Very

236 Performance control - What type of accountability, evaluation, or reward system is in operation?

2360 None - The decision maker is his own master.
2361 Loose
2362 Tight - The decision maker operates under very strict control.
2369 Other - e.g., the decision maker is controlled by more than one superior (as with the Chief of Naval Operations).

237 Rational-actor model - How well is the organizational decision process approximated

by a rational actor model (which hypothesizes a unitary decision maker who makes his decisions on the basis of reasoned judgments)?

2371 Poor approximation.
2372 Good approximation.

238 Risk attitude - Does the process require the consideration of attitude toward risk?

2380 No - the decision maker is risk-neutral
2381 Yes - and the decision maker is either risk-averse or risk-seeking
2389 Other - Some other non-linear utility function is appropriate

239 Other organizational processes

24 Decision Maker Characteristics

What are the characteristics of the person making the decision?

241 Position in organization

2411 Authority level - What authority does the decision maker command?

24111 Low - first-line manager (e.g., Lieutenant).
24112 Medium
24113 High - top management (e.g., General Officer).
24114 Staff member

2419 Other - e.g., What type of organization does the decision maker belong to?

242 Personal characteristics

2421 Familiarity with decision analysis -How familiar is the decision maker with decision-analytic techniques?

24210 None
24211 Little
24212 Much

2429 Other, e.g., management style.

249 Other characteristics

25   Resources Available

251   Computational facilities - How available are computational facilities for an analysis?

2510 Not
2511 Some - A small computer is available on a limited schedule.
2512 Much - A powerful computer is readily available.

252   Staff - What type of staff support is available to the decision maker?

2520 None
2521 Modest - a few or untrained people.
2522 Strong - many competent people.

253   Decision-analytic specialist - How available are decision-analytic specialists (either in-house or through consultants) for an analysis?

2531 Low
2532 Medium
2533 High - a specialist is readily available in-house

254   Decision-maker availability - How available will the decision maker be throughout the course of an analysis?

2540 Not
2541 Little
2542 Much

255   Availability and technical sophistication of assessors

2551 Availability - How available will the assessors be throughout the course of an analysis?

25510   Not
25511   Low
25512   High

2552 Technical sophistication - How sophisticated are the assessors in the techniques of decision analysis?

25520 Not
25521 Low
25522 High

256 Dollars available - How much money is available for the analysis?

2561 Less than $15,000.
2562 $15,000 to $50,000.
2563 Greater than $50,000.

259 Other resources

29 Other Decision Processes

291 Negotiation - Are there two or more actors with conflicting interests?

2910 No - single actor
2911 Two
2912 More

SECTION B: ANALYTIC TAXONOMY

This section presents a detailed description of the
analytic taxonomy, which was introduced in Section 2.2 of
Volume I. This taxonomy contains categories for clas-
sifying many of the decision-analytic techniques that can be
used to solve decision problems. Although it may be appropriate
for a decision maker to be concerned with only the first few
analytic choices (those listed under the heading "USER'S
OPTIONS"), our present development of the analytic taxonomy
is meant to suggest the entire range of analytic choices
that might concern an analyst.

In its final form, which the present effort only suggests,
the analytic taxonomy should allow decision analysts to
define precisely the possible analytic techniques that may
be brought to bear on decision problems. Within such a
framework, experienced decision analysts can communicate
their guidelines on the appropriate application of decision
analysis to less experienced decision analysts and possibly
even to decision makers.

The coding scheme of the analytic taxonomy is similar
to that of the situation taxonomy; categories are designed
as multiple choice questions with the last digit signifying
the answer. For example, A12 refers to the question, "What
amount of money is devoted to the analysis?" (dollar amount
of analysis); A121 refers to the answer, "Low--less than
$15,000." Any particular complete analysis will be characterized
along many dimensions of the taxonomy.

The categories of the analytic taxonomy are presently
developed only partially. In this development, we have
attempted to cover, at a broad level, the wide range of
analytic choices that a decision analyst will typically make

during the course of an analysis. However, this broad
framework is not developed uniformly. In particular, only a
few categories have been developed to a very fine level of
detail. This uneven development was done purposefully to
suggest the form of analytic taxonomy that might ultimately
be developed without attempting such a development. We
hope that this presentation might stimulate other decision
analysts to develop other categories to finer levels and
thus "fill out" the taxonomy.

1   User's Options - those options that should be con-
        sidered by the decision maker rather than the analyst.

    11   Use decision analysis at all? - Should any decision
            analysis techniques be used or should intuitive
            decision-making techniques be used?

        111   Intuitive - Use intuitive decision-making
                devices rather than decision analysis.
        112   Decision analysis - Use decision analysis.
        119   Other - Use another decision-making technique.

    12   Dollar amount of analysis - What amount of money
            should be devoted to the decision analysis effort?

        121   Low - less than $15,000.
        122   Medium - $15,000 to $50,000.
        123   High - greater than $50,000.

    13   Role of decision analysis - What role should the
            analysis serve in the decision-making process?

        131   Private/public aid - Should the decision
                analysis serve as a personal aid for the
                decision maker, or should the analysis serve
                a more public function?

            1311 Private - The analysis is performed for
                 the benefit of people inside the decision
                 process.
            1312 Public - The analysis is performed for
                 the benefit of an institution (e.g., the
                 U.S. government).

        132   Prescribed/optional - Should the decision
                indicated by the analysis be prescribed, as
                in an automatic control system, or should the
                indicated decision be optional?

            1321 Prescribed
            1322 Optional

        133   Contingent/current analysis - Should decisions
                that are anticipated in the future be analyzed
                in advance, or should they be analyzed only
                when the decision situation has materialized?

            1331 Contingent - analyzed in advance.
            1332 Current - analyzed when the decision is
                 current.

134   Optimization/display only - Should a closed
       optimization model be used (See chapter 18 of
       Brown, et. al. (1974/1)), regardless of what
       display options are used? (Display options
       are presented in A51 below.)

       1341 Optimization
       1342 Display only
       1343 Both optimization and display

135   Communication - Should the analyses serve to
       communicate the reasons for a choice?

       1350 No
       1351 Yes

14   Organization - How should this analysis effort be
     organized?

     141   Analysis source - Who should take responsibility
            for performing the analytic work?

            1411 Decision maker
            1412 Staff member
            1419 Someone else

     142   Input source - Who should be responsible for
            providing the model inputs?

            1421 Decision maker
            1422 Analyst
            1423 Expert

     143   "Vest pocket" relation to decision maker -
            Should the analyst work in a close, "vest
            pocket" relation to the decision maker or the
            group of people affecting the decision process
            (see S2322).

            1430 No
            1431 Yes

15   Resources - What special resources should be
     devoted to the analysis?

     151   Use a decision-analytic specialist? - Should
            a decision analysis specialist be used to
            provide assistance in the analytic effort?

            1510 No
            1511 Yes

     152   Use a computer? - Should a computer be used
            in the analysis?

21

          1520 No
          1521 Yes

               15211 Use pre-canned programs such
                      as those described in Ulvila
                      (1975) (e.g., MANECON or CTREE).
               15212 Write special-purpose programs.

2   Model Approach Options - These options concern the
     types of decision-analytic modeling techniques to use.

     21   Complexity of analysis - On the whole, how complex
           should the analysis effort be?

           211 Simple
           212 Moderately complex - e.g., on a par with a
                100-node decision tree.
           213 Very complex

     22   Comprehensive/Partial analysis - Regardless of its
           complexity, should the analysis encompass only a
           part of the complete problem or should it purport
           to reflect all relevant considerations?

           221 Comprehensive - reflect all relevant con-
                siderations.
           222 Partial - encompass only a part of the
                complete problem.

                2221 Inference only - perform an analysis to
                      draw inferences from the data.
                2222 Some value dimensions - consider only
                      some of the relevant dimensions of
                      value.
                2223 Partial list of options - analyze only
                      some of the relevant decision options.
                2229 Other - perform some other part of the
                      complete analysis.

     23   Degree of Approximation - How closely should the
           model attempt to represent the real decision
           situation?

           231 Low exactness
           232 Medium exactness
           233 High exactness

     24   Balance of Effort - How should the total analysis
           effort be divided among the different parts of
           the analysis?

           241 Option definition - How much effort should be
                spent on defining the decision options?

        2411 Negligible
        2412 Appreciable
        2413 Substantial

242   Option valuation

    2421 Modeling uncertainty - What amount of
        effort should be spent modeling un-
        certain events?

        24211 Low
        24212 Medium
        24213 High

    2422 Modeling value - What amount of effort
        should be spent modeling the dimensions
        of value?

        24221 Low
        24222 Medium
        24223 High

3   Input Structure - those alternative ways of structuring
the inputs to the analysis.

   31   Uncertainty - How should uncertain events be
      structured for the analysis?

     311 Explicit modeling - Is uncertainty encoded
         explicitly?

       3110 No - certainty equivalents only.
       3111 Simple measures of uncertainty - e.g.,
           credible intervals.
       3112 Complete probability distributions.

     312 Time horizon - Over what period of time
         should events be modeled explicitly?

       3121 Short
       3122 Medium
       3123 Long

     313 Subsequent acts - How should acts subsequent
         to the initial choice (e.g., an act based
         upon the outcome of a test marketing effort)
         be treated in the analysis?

       3130 Not modeled explicitly.
       3131 Modeled as acts, in preposterior format.
       3132 Modeled as events.
       3139 Other

314 Detail level - What degree of detail should be included in structuring the inputs?

    3141 Low - e.g., binary grouping of variables.
    3142 Medium - e.g., grouping by 10 bracket medians.
    3143 High

315 Degree of grouping - To what degree should uncertain quantities be grouped?

    3151 Low
    3152 High

32 Value - How should valuation be structured in the analysis?

321 Comprehensiveness - How comprehensive a value measure should be needed?

    3211 Low - consider a small percentage of the items of concern to the decision maker.
    3212 Medium
    3213 High - consider nearly all items of concern to the decision maker.

322 Decomposed - To what degree should the overall value dimension be decomposed into its constituent parts (e.g., decomposing profit into units, price, and profit margin)?

    3220 None
    3221 Modest
    3222 Substantial

323 Aggregation - How much should the value dimensions be aggregated?

    3230 Not - Do not attempt to aggregate the value dimensions into a single measure (or a few measures).
    3231 Yes - Do some aggregation of the value dimensions.

        32311 Adjustment - Treat subsidiary value criteria by making trade-off adjustments to the main criterion.
        32312 Utility - Combine all value criteria into a single utility measure.
        32319 Other - Use another method to arrive at a single valuation index.

24

324 Function - If 32312, should multi-attributed value be expressed in the form of a mathematical function? If so, what function?

3240 No
3241 Yes

  32411 Linear - combine the value dimensions linearly.
  32419 Other function

33 Special forms - Should any special analytical paradigms or techniques be used? (Note that this category of analytic options is meant only to be suggestive of some of the special forms that might be used. We have not, in any manner, attempted to be comprehensive in our list of these special forms.)

331 Markov - Should a sequence of events be treated as a Markov Process?

3310 No
3311 Yes

332 Pareto - Should the concept of Pareto optimality be used in considering decision options?

3320 No
3321 Yes

333 Linear programming - Should linear programming techniques be used to optimize the choice?

3330 No
3331 Yes

339 Other special forms - Should other special forms of analysis be used?

3390 No
3391 Yes

4 Input Specification - This category considers how inputs should be specified once they have been structured.

41 Decision options - How should the decision option space be explored?

411 Specificity of definition - How do the analyzed decision options compare in specificity to the real decision options?

25

          4111 Real option - Evaluate the real actions
               under consideration, e.g., whether to
               set out for Alaska (with the exact
               location determined later).
          4112 Narrower variant of real option - e.g.,
               go to Fairbanks, Alaska.
          4113 Broader class - e.g., go north.

     419 Other

42   Events - How should uncertain events be specified
in the analysis?

     421 Scenarios - Incorporate events by specifying
          scenarios.
     422 Specific - Use specific events.
     429 Other - Use another method of specifying
          events.

43   Value criteria - How should the valuation be
specified?

     431 Units - What should the units of value be?

          4311 Natural - such as dollars, hours, etc.
          4319 Other - such as utiles.

     432 Base - What kind of reference base should be
          used for valuation? (The "reference base"
          concept is clarified on pages 363-4 and 96 of
          Brown, et al. (1974/1.

          4321 Fixed zero - Use an absolute scale.
          4322 Floating zero - Use a relative or
               incremental scale (i.e., a scale that
               relates all values to that of a single,
               possibly hypothetical, alternative).

     433 Evaluation date(s) for time stream - What
          evaluation date or dates should be specified
          in the analysis?

          4331 Present value - Reduce all values to the
               present date.
          4332 Future value - Project all values to a
               specified future date.
          4333 Time flow - Present the values as a flow
               over some specified time period.
          4339 Other

44   Indirect assessments - What indirect assessment
techniques should be used to specify inputs?

441 Conditioned assessment - the number of conditioning tiers (treating uncertainty explicitly by considering, for each decision option, a probability distribution on the events that condition the likelihood of other events and the valuation).

    4410 None
    4411 Few
    4412 Several
    4413 Many

442 Bayesian updating - Should Bayes' Theorem be utilized to process information bearing on some model inputs?

    4420 No
    4421 Yes

443 Decomposed assessment model - Should any inputs be specified by using a decomposed assessment model that breaks the inputs into their constituent parts?

    4430 No
    4431 Yes

444 Regression - Should any of the inputs be determined by using regression analysis?

    4440 No
    4441 Yes

449 Other - Should other indirect assessment techniques be used?

    4490 No
    4491 Yes

45 Elicitation technique - What elicitation techniques should be used?

451 For discrete probabilities

    4511 Odds - Elicit relative likelihoods.
    4512 Probabilities - Elicit probabilities.
    4519 Other

452 For continuous variables

    4521 Fixed probability - e.g., elicit fractiles or credible intervals.

4522 Fixed interval - elicit the probabilities of each of several fixed intervals on the variable scale (e.g., the probabilities of a price being between $10-$12, $12-$14, $14-$16, etc.).

4529 Other

453 For values

4531 Reference gamble - See pages 57-74 of Raiffa (1968) for a description of the reference gamble technique.

4532 Direct rating

4539 Other

454 Use group elicitation - Should group elicitation be used for probabilities or values?

4540 No
4541 Yes

45411   Informal
45412   Delphi - see Fischer (1975), p. 5 for a description
45413   Delbecq - see Fischer (1975), p. 5 for a description
45419   Other

5   Output

51   Specification - What results should be presented?

511   Preferred decision - Should the preferred decision be presented?

5110 No
5111 Yes

512   Single value for each option - Should a single value (e.g., an expected value) be presented for each option?

5120 No
5121 Yes

513   Value distributions - Should a distribution of value be presented for each option?

5130 No
5131 Yes

519   Other

52   Display Format - How should the specified output be displayed?

28

521 Graphic - Should a graphic display of the analytic results be prepared?

    5210 No
    5211 Yes

522 Computer - Should a computer supply the display?

    5220 No
    5221 Yes

529 Other

53 Analytic Devices

531 Use simulation - Should the analysis of uncertainty be addressed using Monte Carlo simulation?

    5310 No
    5311 Yes

        53111 Use step-through? - Should the analytical device of step-through simulation be used (See Ulvila et al., 1976)?

            531110 No - Use regular simulation.
            531111 Yes

        53112 Number of trials - How many simulation trials should be used?

            531121 Few
            531122 Many

539 Other analytic devices - What other analytic devices should be used?

5391 Grouping - Should grouping devices such as bracket medians be used?

    53910 No
    53911 Yes

5392 Pruning - Should pruning devices such as dominance be used?

    53920 No
    53921 Yes

6   Model Management

61   Model Dynamics

611   Combining - Should several models be linked
together in series?

6110 No
6111 Yes

612   Pooling - Should several simultaneous models
be linked together in parallel?

6120 No
6121 Yes

613   Sequential modeling - Should the problem be
modeled sequentially?

6130 No
6131 Yes

614   Decision option scanning - How should the
decision option space be scanned?

6141 Complete enumeration - by examining all
possible decision options.
6142 Sequential
6149 Other

615   Input iteration - How much should inputs be
modified within the same model structure
(e.g., by performing sensitivity analyses)?

6151 Values

61511   Low
61512   Medium
61513   High

6152 Probabilities

61521   Low
61522   Medium
61523   High

6153 Both values and probabilities

61531   Low
61532   Medium
61533   High

62   Contingent analysis input sequence - When should
      the various inputs be entered into a contingent
      analysis (A1331 above)?

      621   Values - When should values be entered?

            6211 Early - contingently, before the de-
                 cision is made.
            6212 Late - when the decision is made.

      622   Prior probabilities

            6221 Early
            6222 Late

      623   Likelihoods - Likelihoods for indicators

            6231 Early
            6232 Late

      624   Data

            6241 Early
            6242 Late

SECTION C: PERFORMANCE MEASURE TAXONOMY

This section presents a detailed description of the performance measure taxonomy, which was introduced in Section 2.3 of Volume I. This taxonomy contains categories that can be useful to decision analysts who seek to develop matching principles that state the analytic approaches that are best for different decision situations. An analyst can use this taxonomy to specify the performance properties of the various analytic techniques. An analyst or decision maker can also use this taxonomy to specify the performance needs of different decision situations. Then, by searching these specifications, an analyst can identify the various analytic techniques that meet the needs of different decision situations and thus match the analytic techniques to the situation.

This taxonomy is used differently from the other two. To use this taxonomy, one does not answer a series of multiple choice questions. Rather, one prioritizes the categories to specify the needs of a decision situation, and one rates the degree to which each category is met to specify the properties of an analytic technique.

As with the other taxonomies, the performance measure taxonomy presented here is only an initial tentative development of what might be ultimately desired.

1   Quality of decision - the quality of the reasoning or
     logic and the quality of the inputs.

    11   Logic of choice - making choices that are in
          logical agreement with the available information.

        111   Conceptual completeness - taking all im-
               portant considerations into account, and
               avoiding serious errors of approximation.

        112   Effective disaggregation - dividing the
               problem into manageable subproblems.

        113   Sound predictions - making sound inferences
               from the available data.

        114   Good overall logic - a summary measure of
               making choices that are in logical agreement
               with available information. This includes
               performing a technically competent analysis.

        115   Scope - addressing the complete problem (as
               opposed to addressing only the probability or
               utility part of the problem).

        119   Other logic considerations

    12   Quality of input - obtaining complete, accurate,
          and timely data and judgments.

        121   Good data gathering - obtaining complete,
               accurate, and timely data.

        122   Good management of staff/expertise - making
               staff assignments in a manner that makes best
               use of the available expertise and facili-
               tates accurate and timely data processing.

        123   Posing meaningful questions - requesting the
               appropriate data and judgments.

        124   Good overall input quality - a summary
               measure of obtaining appropriate, complete,
               accurate, and timely data and judgments.

        129   Other input quality considerations

2   Time and cost - the amount of time and cost devoted to
     the analysis.

   21   Elapsed time - the time from the instant that a
         decision is recognized to the time that a decision
         is made.

      211   Short elapsed modeling time - keeping the
             time spent on structuring a model of the
             decision problem low.

         2111 First pass - the first time that the
              model is used.
         2112 Additional passes - repeated uses of the
              model.

      212   Fast input assignment - quickly attaching
             values to input parameters (e.g., values and
             probabilities).

         2121 First pass
         2122 Additional passes

      213   Fast calculation - quick performance of the
             calculations needed to determine a recommended
             decision.

         2131 First pass
         2132 Additional passes

      214   Fast interpretation - ability to quickly
             interpret the analysis output.

         2141 First pass
         2142 Additional passes

      215   Short overall net elapsed time - fast per-
             formance of items P211-P214 above.

         2151 First pass
         2152 Additional passes
         2153 Total - all passes

      219   Other time considerations

   22   Costs - The amount of executive time and anguish
         and cash expenses involved in making the decision.

      221   Low-cost analysis - performing an analysis
             cheaply.

         2211 First pass
         2212 Additional passes

222 Low-cost input assignment - making all required input assignments cheaply.

    2221 First pass
    2222 Additional passes

223 Low-cost calculation - performing the required calculations cheaply.

    2231 First pass
    2232 Additional passes

224 Low-cost overall - a low level of overall costs.

    2241 First pass
    2242 Additional passes
    2243 Total - all passes

229 Other costs.

3 Other considerations

    31 Activity preceding choice processes - activities that take place prior to considering a decision.

        311 Good environment monitoring - monitoring the environment for indications that a problem exists or gathering information to resolve the problem.

        312 Good decision identification - recognizing when a decision must be made and what decision is needed.

        313 Good option generation - generating the options for choice.

        314 Good pre-analysis of anticipated decisions - thinking through and analyzing future decisions in advance.

        319 Other

    32 Activity following choice processes.

        321 Good decision communication - communicating the decision and any supporting arguments (e.g., to facilitate justifying the decision).

        322 Good hindsight evaluation of decision - facilitating an after-the-fact evaluation of the quality of decision.

323 Effective implementation - effectively implementing the choice.

329 Other.

33 Organizational and other non-"choice specific" impacts - impacts that are not concerned with making a decision choice, but that affect more permanent or organizational properties.

331 Improved information processing - improving the recall, correlation, and presentation of relevant data.

332 Improving the command, control, and communication properties of the organization - e.g., making managers behave more responsibly.

333 Improving body of applied precepts - improving doctrinal guidelines.

339 Other.

SECTION D: SITUATIONS FAVORING THE USE OF
DECISION ANALYSIS

This section presents a more detailed statement of the
matching generalizations summarized in Section 3.1.2 of
Volume I.   In particular, this section examines how each
situation category shown in Table 2-1 (Vol. I) impacts the decision
to use decision analysis when compared with the alternative
of using informal intuitive decision making methods.   The
statements made in this section assume that the reader is
familiar with the performance measure characterization of
decision analysis that is presented in Section 3.1.1 of
Volume I.   Thus, the matching generalizations here are
explained in terms of what performance needs of the situation
can or cannot be fulfilled by decision analysis without
enumerating all of the performance properties that decision
analysis can provide.

The order of the presentation that follows is that of
the situation taxonomy of Section A of this volume.   In
particular there is no prioritization of situation charac-
terizations and some rather obvious statements are scattered
among the more important ones.   The reason for this section
is to demonstrate the use of the taxonomies in a more complete
manner than that in Section 3.1.2 of Volume I, which presents
matching generalizations based on only the most important
situation characteristics and is probably more useful than
this presentation.

In searching for matching principles, we had the option
of searching for those decision situations with performance
needs that argued for decision analysis or for those with
performance needs that argued against decision analysis.

In the discussion below, we take a positive attitude and
explore mainly situations with needs favoring decision analysis.
For this reason, the discussion below may begin to sound
like a "more is better" argument. It will sound this way
because we have generally chosen to discuss those situation
characteristics that point in this direction, we could have
easily chosen the opposite ends of the situation scales and
argued consistently that "less is better."

Because this is our initial attempt at generating such
matching principles, we do not argue that they are ready for
adoption as they stand as tenets of recommended decision
analytic practice. Rather, these matching principles are
presented as hypotheses that can later be refined by ourselves
and others and as guidelines that might be of some immediate
use to decision makers and inexperienced decision analysts.

Throughout this section, references to the situation
taxonomy of Section A are preceded by the letter "S" and
references to the performance measure taxonomy of Section C
are preceded by the letter "P."

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Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
DECISION SUBSTANCE (S1)	
Basic Situation (S11)	
Current/Contingent Choice (S111)	Current choice situations (S1111) favor the use of decision analysis because these situations guarantee that the analysis could be used. Since decision analysis is a tool to aid in decision making, its value as an aid is reduced in contingent situations (S1112), where it is uncertain that the decision will ever occur.
Expected Number of Occurrences (S112)	A decision that is expected to recur (S1123, S1124) supports the use of decision analysis because the cost (P22) per analysis is reduced. The amount of advantage gained by recurrence, of course, depends upon both the expected frequency of occurrence and the similarity of the recurring situations because the similarity will determine the amount of modification needed.
	The expected number of occurrences is, in general, closely related to the current/contingent classification, and the two categories should be considered simultaneously. For instance, a current decision that will occur only once should be considered the same as a contingent decision that has a 50% chance of occurring twice. Both of these situations have an expected occurrence rate of one. (The advantages of a recurring situation may be somewhat reduced if the situation is also characterized by hindsight monitoring, (S166) below.)

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Operating/Information Act (S113)	This classification is unimportant, in itself, for determining the appropriate amount of analysis, but it is indirectly important because of its impact on other situational dimensions. For example, the maximum option impact (S144) is typically smaller and the assessability of uncertainty (S162) is typically lower for an informational act because the impact of the informational act is felt through a subsequent operating act. This impact relationship obscures the relationship between the situation category and the analytic taxonomy.

Options (S12)

Broad/Narrow (S121)	Unimportant
Clear/Fuzzy (S122)	Decision analysis can facilitate conceptual completeness (P111) most when the decision options are clearly specified.
Complexity of Decision Options (S123)	Unimportant
Radical/Adaptive (S124)	A situation involving a radical decision (S1241) supports the use of decision analysis because decision analysis can improve the logic of choice (P11) in situations that are outside of the decision maker's experience. Radical decisions also tend to be difficult decisions. This feature is discussed for (S131) below.

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Static/Dynamic (S125)	Static situations (S1251), those that are not subject to later modification, favor the use of decision analysis. However, when decision analysis is indicated, for other reasons, in a dynamic situation (S1252), the dynamic feature supports the use of a large amount of analysis. Since decision analysis is not particularly good at providing conceptual completeness (P111) in dynamic situations, a good analysis requires a large effort.

Ease of Decision (S13)

Difficulty of Choice (S131)	Difficult choices (S1312) support the use of decision analysis. A basic argument for the use of decision analysis is that it improves the decision quality (P1). In the case of a difficult decision, there is much room for improvement because informal decision techniques are not very good at addressing difficult decisions.
Unfamiliarity (S132)	Very unfamiliar decision situations (S1322) support the use of decision analysis mainly because of logic-of-choice considerations (P11).
Key Considerations (S133)	If the key consideration is option generation (S1331), decision analysis should not be used. Decision analysis is not good at generating decision options.
	If the key consideration is information (S1332), no strong case can be made either in favor of or against decision analysis.

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
	If inference (S1333) is the key consideration, use of decision analysis is slightly favored because decision analysis can help produce sound predictions (P113).
	If choice (S1334) is the key consideration, decision analysis is strongly indicated because of its ability to improve choice logic (P11).
Stakes (S14)	The stakes involved in the decision are the single most important classification for determining the appropriate amount of decision analysis. Since larger stakes support more decision analysis, only the minimum stakes needed to justify any analysis will be discussed. Alternative definitions of stakes itemized below are in decreasing order of accessibility but in increasing order of relevance. In use, classifying the situation along some of the more accessible measures of stakes may be sufficient to bound the appropriate amount of decision analysis by identifying obviously "high stakes" or "low stakes" situations thus making later classification along less accessible measures unnecessary. In general, the higher the stakes, the less important is cost (P22) and the stronger the case for decision analysis.
Resources Committed (S141)	R.A. Howard's dictum is that 1% of the amount of resources committed to the decision should be devoted to the decision analysis effort.

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Cost Swing (S142)	The cost swing is typically about one half of the resources committed. Accordingly, about 2% of the cost swing should be devoted to the decision analysis effort.
Value Swing (S143)	We would usually recommend decision analysis only if the value swing (the difference in value between the best and worst plausible outcomes considering all reasonable decision options) is at least $1 million (S1432).
Maximum Option Impact (S144)	The maximum option impact is a more relevant but less accessible measure of stakes. As a rough rule of thumb, we recommend that the maximum option impact (the dollar equivalent difference in expected value between the best decision and the worst plausible decision), should be on the order of $100,000 (S1442) in order to justify any decision analysis.
Expected Irrationality Cost (S145)	The most relevant and least accessible measure of stakes is the expected irrationality cost, the room for improvement in the decision. We would usually recommend decision analysis only if the expected irrationality cost is at least $20,000 (S1452).
Difficulty of Net Valuation (S151)	Difficult valuation (S1512) supports the use of decision analysis because of the improved logic of choice (P11) which decision analysis allows.
The Rest of the Outcome Valuation Dimensions (S151) to (S156)	Unimportant.

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Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Outcome Uncertainty (S16)	
Number of Uncertainties (S161)	More uncertainties support the use of more decision analysis because of the ability of decision analysis to improve the logic of choice (P11) in the face of uncertainty.
Assessability (S162)	Decision analysis can improve choice logic (P11) in situations in which uncertainties are difficult to assess.
High/Low Uncertainty (S163)	A high degree of uncertainty (as represented by the 90% relative credible interval) supports the use of decision analysis because of the improved logic of choice (P11) that should result.
Subsequent Acts (S164)	The existence of important subsequent acts supports the use of decision analysis because it can enhance conceptual completeness (P11) in that situation.
Type of Evidence (S165)	Unimportant.
Hindsight Monitoring (S166)	A situation that is characterized by a high degree of hindsight monitoring (S1663) promotes improvements in informal decision making through the development of an improved body of applied precepts (P333). Thus, hindsight monitoring reduces the need to use decision analysis.
DECISION PROCESS (S2)	
Reaction Time (S21)	In general, a longer reaction time will support more decision analysis because of the time necessary to perform an analysis (P21). However, a contingent choice analysis (A1331) is

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Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
	supported by a short reaction time combined with a long anticipation time.

Analytic Processes (S22)

Number of Input Sources (S221)

Since conventional, intuitive decision practice has difficulty organizing input from a variety of sources, and decision analysis provides a method for organizing a diverse set of inputs, use of decision analysis can improve the quality of input (P12), especially through the management of staff and expertise (P122); and the logic of choice (P11), especially through effective disaggregation (P112). Thus, a large number of input sources (S2213, 4, 5) supports the use of a large amount of decision analysis.

Analytic Team (S222)

Decision analysis is favored when a group of people are available to perform the analysis (S22212) mainly because of its capacity for effective disaggregation (P112) and good management of staff and expertise (P122).

Constraints on Analytic Method (S223)

Obviously, if an analytic method is prescribed (S2232) and the prescribed method is decision analysis, these prescriptions support using decision analysis. On the other hand, if a method of analysis other than decision analysis is prescribed, this argues against using decision analysis. If no constraints are in force (S2230), this distinction has no effect on the amount of decision analysis to use.

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Documentation (S224)	Required documentation favors the use of decision analysis because decision analysis promotes improved communication (P332).
Interest in Trying New Techniques (S225)	An interest in trying new analysis techniques favors the use of decision analysis because such an interest may encourage "trial-run" analyses which pave the way for more important ones.

Organizational Processes (S23)

Initiation (S231)	Unimportant.
Responsibility (S232)	Decision analysis is favored in situations in which a tentative decision (S23212) is to be made or where a recommendation is to be made (S23213) because decision analysis can provide good decision communication (P321), effective disaggregation (P112), and good management of staff and expertise (P122).
Coordination (S233)	Unimportant.
Justification (S234)	A need to justify the decision (S2341, S2342, or S2343) supports the use of decision analysis because of the need for good decision communication (P321).
Controversial (S235)	Controversial decisions (S2352) support the use of decision analysis because of the need for good decision communication (P321).
Performance Control (S236)	Tight performance control (S2362) supports the use of decision analysis because of a need for improved command, control, and communication (P332).

Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Rational-Actor Model (S237)	Since decision analysis assumes a "rational-actor model" (which hypothesizes a unitary decision maker who makes his decisions on the basis of reasoned judgments), a situation that is a good approximation of the model (S2372) supports the use of decision analysis.
Risk Attitude (S238)	Decision analysis provides the necessary effective disaggregation (P112) in situations in which risk attitude needs to be considered (S2381, S2389).

Decision Maker Characteristics (S24)

Position in Organization (S241)	A situation with a high-level decision maker (S24113) supports the use of decision analysis mainly because he is in a position that commands more resources (S25); accordingly, time and cost (P2) are less important considerations.
Personal Characteristics (S242)	Decision analysis is favored by a situation where the decision maker has a familiarity with decision analysis (S24212 or S24213) because, in this situation, decision analysis will promote effective decision implementation (P323), good management of expertise (P122), and good overall logic (P114) (since familiarity will increase the chances of doing the analysis correctly).

Resources Available (S25)

Computational Facilities (S251)	The use of decision analysis is supported by better computational facilities (S2512) because they enable less expensive calculation (P223).

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Situation Classification	Relationship to the Appropriate Amount of Decision Analysis
Staff (S252)	The use of decision analysis is supported by the availability of a strong staff (S2522) because such a staff is more apt to perform an analysis correctly and improve the overall logic of choice (P114).
Decision Analysis Specialist (S253)	The use of decision analysis is supported by the availability of a decision-analytic specialist (S2533) because such a specialist is more apt to perform an analysis correctly and improve the overall logic of choice (P114).
Decision Maker Availability (S254)	A high availability of the decision maker (S2542) supports the use of decision analysis because, without it, logic of choice (P11) and quality of input (P12) are seriously impaired.
Assessors Available (S255)	Unimportant.
Dollars Available (S256)	Since decision analyses are fairly costly (P22), the analysis budget that is available can constrain the size of the decision analysis. Naturally, a large analysis is supported by a large budget (S2563).
Other Decision Processes (S29)	
Negotiation (S291)	Negotiation situations (S2911-2) support the use of decision analysis for reasons of improved choice logic (P11), especially through conceptual completeness (P11) and effective disaggregation (P112). Decision analysis provides a methodology for simultaneously accounting for elements of the problem that otherwise might be handled individually (especially for examining the value structures of competing parties simultaneously).

SECTION E

MATCHING PRINCIPLES FOR ANALYSIS TECHNIQUES

This section presents statements of matching principles that we have derived for twenty-two specific analytic choices, those displayed on Table E-1. This section is a more complete presentation of the ideas introduced in Section 3.2 of Volume I.

The guidelines presented here are meant to illustrate how experienced decision analysts might eventually use the taxonomies to codify matching principles that could guide inexperienced analysts. In addition, the specific guidelines presented here are meant to be useful in their present form and are also meant to stimulate debate among experienced analysts that will eventually produce more definitive guidelines for the applied practice of decision analysis. We do not expect these matching principles to be guidelines that a decision maker can use on his own, without the additional guidance of a decision analyst.

In the presentations that follow, each analytic choice is characterized in terms of the performance measure taxonomy and then situational matching principles are developed. In all cases, the discussion of the situations are taken in the order of the situation taxonomy, which is not necessarily the order of importance. Since the generalizations are intended to illustrate the range and depth of the analytic taxonomy, matchings at several levels of analytic choice are presented. For example, at a broad level, the choice of the amount of approximation is discussed (A237), and at a fine level, the choice of whether to use the Delphi group elicitation technique for probabilities is discussed (A4541).

Throughout this section, the situation taxonomy of Section A is referenced by the letter "S," the analytic taxonomy of Section B is referenced by the letter "A," and the performance measure taxonomy of Section C is referenced by the letter "P."

Table E-1
MATCHING SUMMARY -- TYPE OF ANALYSIS

Column group headers: SITUATION CHARACTERISTICS | DECISION SUBSTANCE (Best Selection, Optimize, Time of Decision, Scales, Outcome Valuation, Outcome Uncertainty, Reaction Time, As Much) | DECISION PROCESS (Organizational Pro Consm., Decision Maker Char. Actor Views, Resources Available) | OTHER

Situation characteristic column codes:
S1111 CURRENT CHOICE; S1112 CONTINGENT CHOICE; S1121 MORE THAN TWO EXPECTED NO. OF OCCURRENCES; S1131 MORE THAN TWO CHOICE; S1221 FUZZY OPTIONS; S1231 CLEAR OPTION; S1311 EASY CHOICE; S1321 DIFFICULT CHOICE; S1333 KEY CONSIDERATION CHOICE; S1334 KEY CONSIDERATION INFERENCE; S1421 MAXIMUM OPTION CHOICE; S1510 EASY NET VALUATION; S1511 VERY DIFFICULT NET VALUATION; S1531 EARLY DIFFICULT NET VALUATION; S1553 LATE TIMING; S1811 LATE TIMING; S1821 UNCERTAINTIES THAT ARE EASY TO ASSESS; S1822 UNCERTAINTIES THAT ARE DIFFICULT TO ASSESS; S1841 IMPORTANT SUBSEQUENT ACTS; S211 MINUTES OF REACTION TIME; S214 SEVERAL PREFERENCE SOURCES; S2340 BOTH ONE AND POST JUSTIFICATION; S2352 VERY SUBSTANTIVE SOURCES; S2412 NATIONAL ACTON MORE CONTROVERSIAL DECISION; S2512 POWERFUL COMPUTER WITH DECISION ANALYSIS; S2520 NO STRONG STAFF AVAILABLE; S2540 STRONG STAFF AVAILABLE; S2541 LOW ASSESSOR AVAILABILITY; S2563 GREATER THAN $50,000 AVAILABLE

Type of Analysis	SITUATION	DECISION SUBSTANCE	DECISION PROCESS	OTHER
A123 LARGE DOLLAR AMOUNT OF DECISION ANALYSIS				PREDICTABLE ANALYSIS
A1331 CONTINGENT CHOICE				COMPREHENSIVE ANALYSIS (A221)
A1341 OPTIMIZATION				CLEAR COMPLEX STRUCTURE (A213), HIGH INPUT ITERATION (A61533)
A1521 USE A COMPUTER				
A213 VERY COMPLEX ANALYSIS				
A2221 PARTIAL ANALYSIS—INFERENCE ONLY				MANUAL COMPUTATION
A231 APPROXIMATE ANALYSIS				LOW UNCERTAINTY (S1631), LOW COMPLEXITY (A211)
A3121 SHORT TIME HORIZON				INFORMATION & SUBSEQUENT ANALYSIS DIFFICULT TO MODEL
A3132 SUBSEQUENT ACTS AS EVENTS				
A3222 DECOMPOSE VALUES				NATURE OF VALUE
A32311 ADJUSTED VALUE INDEX				
A32411 LINEAR VALUE FUNCTION				OPTIMIZING MODE (A13411)
A3311 MARKOV MODEL				
A3321 PARETO MODEL				SPECIAL STRUCTURE
A3221 LINEAR PROGRAMMING MODEL				NEGOTIATION (S2911)
A4322 FLOATING VALUE BASE				LARGE OPTION VECTOR (S12361), CERTAIN (S16320), LINEAR STRUCTURED
A4413 MANY CONDITIONING TIERS				NO JUSTIFICATION NEEDED (S23240)
A4421 BAYESIAN PROBABILITY MODEL				EACH TIER ACCOUNTS FOR 10%–70% OF TOTAL VARIANCE
A4631 REFERENCE GAMBLE ELICITATION				SPECIAL PERCEPTUAL STRUCTURE
A45412 DELPHI ASSESSMENT				RISK AVERSE OR RISK SEEKING DECISION MAKER (S23811)
A53111 SIMULATION				STATUS HETEROGENEOUS, DATA HOMOGENEOUS
A53111 STEP THROUGH SIMULATION				COMPLEX STRUCTURE (A213) CONDITIONED ASSESSMENT (A44132)

X Indicates a situation/analysis match   ☐ Indicates a key matching characteristic

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E.1   CONTINGENT ANALYSIS (A1331)[1]

(An analysis performed in advance of a decision that is
expected to arise in the future)

Performance Characterization

Contingent choice analysis requires a large amount of
time initially (P2151)[2]. However, it provides a fast response
on subsequent uses (P2152). In addition, when reaction time
is short (S211), performing a contingent choice analysis in
advance can improve the choice logic (P11), input quality
(P12), and the decision maker's ability to control his
organization (P332).

Situation Classification	Relationship to Contingent Choice Analysis
Current/Contingent Choice (S111)[3]	By definition, contingent analysis requires a contingent choice situation (S1112).
Expected Number of Occurrences (S112) and Maximum Option Impact (S144)	These two situational characteristics need to be considered together. In general, contingent choice analysis is indicated in situations where its cost (P22) is justified by either a large number of occurrences (S1124) or by a large maximum option impact (S1444).
	As a rule of thumb, a contingent analysis should not be performed unless the expected number of occurrences is at least one (S1122) (e.g., occurring once with certainty or occurring twice with a 50% probability.) It is also necessary to consider

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[1]Analytic options are described in Section B.

[2]Performance measures are described in Section C.

[3]Situation characteristics are described in Section A.

the similarity of the occurrences, the more similar the situations are, the more the contingent analysis is justified. (As a rule of thumb, three similar recurrences are roughly equivalent to a single identical recurrence.) For a good pre-analysis (P314), it is critical that the actual decision is predictable, that is, involves the same considerations that are modeled.

As a guideline, the expected option impact (considering number of occurrences) should exceed $10 million (S1444) to justify the cost (P22) of a contingent analysis. See page 3-3 of Brown, et.al. (1975) for an illustration of this guideline in a Navy task force commander's decision situation.

Clear/Fuzzy Options (S122)

Clear options (S1221) allow a contingent analysis to provide a good pre-analysis of anticipated decision (P314). Clear options also enhance predictability (see above).

Reaction Time (S21)

A contingent analysis is recommended where reaction time is short (S211) (but the time available to perform the pre-analysis is long). In this situation, the analysis can improve the decision quality (P1) by providing a logical framework that considers all available data.

Number of Input Sources (S221)

Contingent choice analyses can improve command, control, and communication (P332) in situations that require several preference (e.g., value) sources to be considered (S2213).

E.2 OPTIMIZATION (A1341)

Using a closed-form optimization model (See chapter 18 of Brown et.al. (1974)).

Performance Characteristics

An optimization analysis is characterized by poor decision quality (P1), especially with regard to conceptual completeness (P111), unless the analysis is comprehensive (A221). However, optimization promotes a short interpretation time (P214).

Situation Classification	Relationship to Optimization
Reaction Time (S21)	If reaction time is short (S211), then the time savings (P214) provided by optimization are more important than the loss in decision quality (P1).
Other	If a comprehensive analysis is performed (A221), then optimization is difficult, leading to lower logic quality (P114), and an expensive analysis (P22) if the options are unclear (S1222).
	A controversial decision (S2352) may favor display (A1342), but not to the exclusion of optimization (A1341).

E.3 USE A COMPUTER (A1521)

Performance Characterization

A computerized analysis tends to involve high first-pass calculation cost (P2231) and long first-pass calculation time (P2131), except for a complex analysis (A213). However, a computer analysis generally involves a low level of subsequent-pass calculation cost (P2232) and short subsequent-pass calculation time (P2132).

Situation Classification	Relationship to Computer Use
Expected Number of Occurrences (S112)	Since a computer offers cheaper and faster performance on subsequent passes, use of a computer is supported by a large expected number of occurrences (S1124).
Maximum Option Impact (S144)	A large maximum option impact (S1444) justifies a large cost (P22) and indicates a complex model (A213). Both of these conditions support a computerized analysis.
Reaction Time (S21)	Since a computer analysis takes a long time to build, days of anticipatory reaction time (S213) are needed. However, since a computerized analysis runs quickly, only minutes of execution reaction time (S211) are needed.
Staff Available (S252)	Some staff support (S2521) is needed to program a computerized analysis.
Other	The costs (P22) and time (P21) of a computerized analysis are not significantly worse than the alternative of a non-computerized analysis if the situation has clear, complex options (S1221, S1236); many assessable uncertainties

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(S1613, S1623); and many
measurable values (S1523,
S1532).

A computer is also recommended
in conjunction with a complex
analysis (A213) and with
simulation (A5311).

E.4 COMPLEXITY OF ANALYSIS (A21)

Performance Characterization

A complex analysis can sometimes (for instance, see below) provide a good choice logic (P11) and input quality (P12). However, a complex analysis takes a long time (P21) and is expensive (P22). In addition, a complex analysis provides for good decision communication (P321) by explicitly modeling a large number of important factors.

Situation Classification	Relationship to Complexity of Analysis
Difficulty of Choice (S131)	Choice logic (P11) and input quality (P12) are important in a difficult choice situation (S1313). If the situation is also one in which a complex analysis contributes to choice logic and input quality, a complex analysis is recommended.
Maximum Option Impact (S144)	A large maximum option impact (S1444) justifies a high cost (P22) to improve choice logic (P11). A complex analysis is supported if it contributes to improved choice logic.
Outcome Timing Horizon (S155)	A complex analysis can improve choice logic (P11) and input quality (P12) if the timing horizon is long (S1553).
Subsequent Acts (S164)	A complex analysis can improve choice logic (P11) and input quality (P12) if subsequent acts have a high impact on the decision outcome (S1643).
Reaction Time (S21)	A complex analysis requires much time (S213 or S214).
Number of Input Sources (S221)	A complex analysis can improve choice logic (P11) and input quality (P12) if there are several input sources (S2213, S2214 or S2215).

Justification (S234)

A situation that requires justification (S2341, S2342, S2343) requires good decision communication (P321) and thus supports a complex analysis.

Controversial (S235)

Controversial decisions (S2352) require good decision communication (P321) and thus support complex analyses.

Decision Maker's Familiarity with Decision Analysis (S2421)

A decision maker who is very familiar with decision analysis (S24212) can improve choice logic (P11) and input quality (P12) by using a complex analysis.

Computational Facilities Availability (S251)

A powerful computer (2512) can reduce the computational cost (P223) of a complex analysis and thus favors its use.

Staff Available (S252)

A strong staff (S2522) is needed to perform a complex analysis in order to minimize the risk of an erroneous analysis and increase the overall choice logic (P114).

Decision Maker Availability (S254)

A complex analysis can improve input quality (P12) when a decision maker is unavailable (S2540). The complex analysis can perform the disaggregation that the decision maker might otherwise do informally.

Assessor Availability (S255)

Assessors must be very available (S25512) in order for a complex analysis to provide good overall input quality (P124).

Dollars Available (S256)

Because of its cost (P22), a complex analysis requires a large dollar availability (S2563).

E.5 PARTIAL ANALYSIS - INFERENCE ONLY (A2221)

Performance Characterization

An inference analysis is limited in scope (P115) to addressing uncertainty (not values or options). Consequently, an inference analysis costs less (P22) than a full analysis.

Situation Classification	Relation to Inference Only
Clear/Fuzzy Options (S122)	An inference model can improve conceptual completeness (P111) with fuzzy options (S1221).
Key Consideration (S133)	An "inference only" analysis can provide the conceptual completeness (P111), effective disaggregation (P112), and sound predictions (P113) that are necessary when the key consideration is inference (S1333).
Maximum Option Impact (S144)	An "inference only" analysis is a reduced scope (P115) consistent with reduced cost (P22) and thus requires a low threshold of maximum option impact (S1442).
Difficulty of Net Valuation (S151)	Since an "inference only" analysis does not model valuation, conceptual completeness (P111) will be poor unless the valuation is easy (S1510).
Uncertainty Assessability (S162)	An inference model can improve choice logic (P11) when uncertainties are difficult to assess (S1621).

E.6   APPROXIMATE ANALYSIS (A231)

Performance Characterization

An approximate analysis, one that does not represent the real decision situation with a high degree of exactness, can be done quickly (P21) and cheaply (P22), but it does not provide as high a level of choice logic (P11) or input quality (P12) as a more exact analysis.

Situation Classification	Relationship to Approximate Analysis
Difficulty of Choice (S131)	An easy choice (S1311) does not require much improvement in decision quality (P1) and thus supports the use of an approximate analysis.
Maximum Option Impact (S144)	Since an approximate analysis can be cheap (P22), only a low maximum option impact (S1442) is necessary to justify an approximate analysis.
Computational Facilities Available (S251)	An approximate analysis is not complex and is recommended when no computer is available (S2510).
Staff Available (S252)	An approximate analysis is more difficult than a complete one and thus an approximate analysis requires a strong staff (S2522) in order to control the approximation error and effect good overall choice logic (P114).
Assessor Availability (S255)	Unavailability of assessors (S2551) may force an approximate analysis.

E.7   SHORT TIME HORIZON (A3121)

Performance Characterization

A short time horizon switches attention from modeling uncertainty to modeling value in that the value model subsumes uncertainties that are beyond the modeled time horizon.

Situation Classification	Relationship to Short Time Horizon
Difficulty of Net Valuation (S151)	Difficult valuation (S1512) supports the use of a short time horizon, since a short horizon focuses attention on valuation.
Timing Horizon (S155)	By definition, a short time horizon should be used in an early timing situation (S1551). (But a short horizon may also be used, if indicated for other reasons, in a situation with a long time horizon.)

Uncertainty Accessability
  (S162) and
High/Low Uncertainty
  (S163)
	Events with low amounts of uncertainty (S1631) that are easy to assess (S1623) support the use of a short time horizon, since a short horizon focuses attention away from uncertainty.

Availability of Assessors
  (S255) and
  Dollars (S256)
	Low assessor availability (S2551) and a small analysis budget (S2561) will tend to indicate a simple analysis (A211), which can often usefully incorporate a short time horizon.

E.8 MODEL SUBSEQUENT ACTS IN STANDARD PREPOSTERIOR FORMAT AS ACTS (A3131)

Subsequent acts should be modeled in the preposterior format, as acts in a decision tree, when the rational actor model is a good approximation of the decision making process (S2372) and the structure of possible outcomes for all uncertain events can be predicted with great accuracy before the analysis. In such situations, the standard preposterior format offers its greatest benefits, especially in terms of the logic of choice (P11) and communication of the decision (P321).

E.9   ACTS AS EVENTS (A3132)

Performance Characterization

Modeling acts as events reduces cost (P22) and promotes conceptual completeness (P111) but may make posing meaningful questions (P123) difficult, compared with preposterior modeling (A3131).   However, omitting an explicit modeling of subsequent acts (A3130) reduces cost even more.

Situation Classification	Relationship to Acts as Events
Impact of Subsequent Acts on Outcome (S164)	A high impact of subsequent acts (S1642 or S1643) supports at least some modeling of subsequent acts (but preposterior even more than acts-as-events).
Other	Modeling subsequent acts as events promotes conceptual completeness (P111) when it is difficult to model informational events or the subsequent analysis needed for preposterior modeling [see Brown (1975)].

E.10 DECOMPOSED VALUATION (A3222)

Performance Characterization

Sometimes decomposed valuation can improve choice logic (P11), especially through effective disaggregation (P112), and input quality (P12). However, decomposed valuation is slow (P21) and expensive (P22). Also, decomposed valuation is limited in scope (P115) to valuation.

Situation Classification	Relationship to Decomposed Valuation
Maximum Option Impact (S144)	As a rule of thumb, a decomposed valuation analysis does not require high stakes (S1442), but for larger stakes (e.g., (S1444), costs (P22) are less important and decomposed valuation is even more strongly indicated.
Difficulty of Net Outcome Valuation (S151)	Decomposed valuation can help provide conceptual completeness (P111) and effective disaggregation (P112) when outcome valuation is difficult (S1512).
Reaction Time (S21)	Decomposed valuation requires at least hours of reaction time (S212), but longer reaction time is desirable.
Number of Input Sources (S221)	Decomposed valuation can help effective disaggregation (P112) in a situation with multiple preference sources (S2213 or S2215).
Controversy (S235)	Decomposed valuation can aid communication (P321) for controversial decisions (S2352).
Computational Facilities (S251)	A computer (S2511 or S2512) is useful, but not necessary, for decomposed valuation.

Availability of Staff (S252)   A decomposed assessment will
                                typically require more assessments
                                than an aggregated assessment.
                                Thus, a decomposed assessment
                                requires a high degree of
                                assessor availability (S25512).

Other   Decomposed assessment is
                                indicated only if the nature
                                of the value is such that it
                                can be decomposed into constituent
                                parts.

E.11   SINGLE ADJUSTED INDEX (A32311)

<u>Performance Characterization</u>

A single adjusted value index promotes good decision communication (P321) because the number is understood easily by nontechnical users, and a single index may have more information content than a dimensionless utility. If value cannot be reduced to a single index, then insufficient conditions exist for a choice (the situation lacks conceptual completeness, P111). An adjusted index is limited in scope (P115) to valuation.

Situation Classification	Relationship to Single, Adjusted Index
Decision Justification (S234)	An adjusted index can provide the communication (P321) needed to justify a decision (S2341, S2342 or S2343).
Controversy (S235)	An adjusted index can help provide the communication (P321) needed for a controversial decision (S2352).

E.12 LINEAR VALUE FUNCTION (A32411)

Performance Characterization

A linear value function promotes good decision communication (P321) because it is commonly used and readily understood. However, a linear value function lacks conceptual completeness unless certain utility conditions are met. Specifically, total value should be a linear additive combination of its components. A linear value function is limited in scope (P115) to valuation.

Situation Classification	Relationship to Linear Value Function
Decision Justification (S234)	A linear value function can help provide the communication (P321) needed to justify a decision (S2341, S2342, or S2343).
Staff Available (S252)	Since a linear value function requires no specialized skills, it is indicated when no staff is available (S2520).
Assessor Availability (S255)	Since a linear value function requires no unusually difficult assessments, only a low level of assessor availability (S25511) is needed.

E.13 MARKOV (SPECIAL FORM) (A3311)

Performance Characteristics

A Markov analysis is a compact analysis, which enables inexpensive input assignment (P222) and inexpensive calculation (P223). However, since a Markov analysis is restricted, it may impair conceptual completeness (P111), and, because it requires special skill, a Markov analysis is an expensive analysis (P221). A Markov analysis is also restricted in scope (P115) to uncertainty.

Situation Classification	Relationship to Markov Analysis
Key Consideration (S133)	Markov analysis only addresses probabilities; therefore, it is indicated most strongly when inference is the key consideration (S1333).
Difficulty of Net Outcome Valuation (S151)	Since a Markov analysis does not contribute to valuation, it is recommended when valuation is easy (S1510).
Other	A Markov analysis requires a special environmental structure. Specifically, it requires that a time series of stochastically changing discrete variables, and their associated transition probabilities, follow some systematic pattern.

E.14 PARETO (SPECIAL FORM) (A3321)

Performance Characterization

A Pareto analysis can improve conceptual completeness (P111) by allowing a simultaneous analysis of the joint utility function of the parties involved. On the other hand, a Pareto analysis may reduce conceptual completeness (P111) because it does not accommodate the dynamic social aspects of negotiation.

Situation Classification	Relationship to Pareto Analysis
Negotiation (S291)	Pareto analysis addresses the negotiation problem and thus requires a negotiation situation (S2911 or S2912).

E.15 LINEAR PROGRAMMING (SPECIAL FORM) (A3331)

Performance Characterization

When a computer is available (S2511 or S2512), linear programming can provide a low-cost overall analysis (P224) and low-cost calculation (P223), especially in subsequent passes (P2242 and P2232), and can enable fast calculation (P213) and short elapsed modelling time (P211). However, linear programming is slow (P21) and expensive (P22) without a computer (S2510). In addition, linear programming will reduce conceptual completeness (P111) unless restrictive conditions are met. Specifically, the objective function that is to be maximized or minimized and the constraints must be linear. Also, linear programming can enable low-cost input assignment (P222) because it requires little involvement of the decision maker, but it is poor at posing meaningful questions (P123) and does not permit disaggregation (P112) of value or uncertainties.

Situation Classification	Relationship to Linear Programming
Clear/Fuzzy Options (S122)	Linear programming requires clear options (S1221).
Option Complexity (S123)	Linear programming addresses vector options (S1235 and S1236) and is most useful in large vector (S1236) situations.
Difficulty of Net Outcome Valuation (S151)	Linear programming does not contribute anything to determining valuation and does not permit disaggregation (P112). Thus, the situation must be characterized by easy outcome valuation (S1510).
Amount of Uncertainty (S163)	Linear programming assumes certainty and thus requires a low amount of uncertainty (S1630 or S1631).

Computational Facilities Available (S251)	Linear programming requires a computer (S2512) because it is slow (P21) and expensive (P22) without one.
Staff Available (S252)	Linear programming requires a modest staff (S2521), but a strong staff is better (S2522), to ensure an accurate analysis and good overall logic (P114).
Decision Maker Availability (S254)	Linear programming does not require much decision maker availability (S2540) for interaction. This keeps the input assignment costs low (P222).
Other	Linear programming assumes a structured, linear environment.

E.16   FLOATING ZERO BASE (A4322)

Performance Characterization

A floating zero base, which relates all values to that of a single alternative, provides a compact analysis. This allows for low-cost input assignment (P222) (because fewer inputs are required), cheap calculation (P223) and an inexpensive overall analysis (P224). However, a floating zero analysis is less conceptually complete (P111) if utility is non-linear, and is difficult to communicate (P321). In addition, a floating zero analysis requires more assessment skill, which may produce an expensive analysis (P221). Also a floating zero base is limited in scope (P115) to valuation.

Situation Classification	Relationship to Floating Zero Base
Maximum Option Input (S144)	Because floating zero is inexpensive (P22), it requires only a modest maximum option impact (S1442).
Difficulty of Net Outcome Valuation (S151)	Floating zero requires easy valuation (S1510) because it is difficult, and hence expensive (P22), to apply unless valuation is easy.
Decision Justification (S234)	Floating zero is recommended when decision justification is not needed (S2340) because floating zero is not good at providing the communication (P321) needed for justification.
Staff Available (S252)	Floating zero is difficult and thus it requires a strong staff (S2522) to ensure good overall logic (P114).

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E.17   CONDITIONED ASSESSMENT (A441)

Performance Characterization

Conditioned assessment sometimes promotes logical choice (P11), especially through effective disaggregation (P112), and quality input (P12) (see below). However, conditioned assessment is time consuming (P21) and costly (P22).

Situation Classification	Relationship to Conditioned Assessment
Maximum Option Impact (S144)	The stakes threshold for performing conditioned assessment is low (S1442) but, because of the cost of a conditioned assessment (P22), the larger the stakes (S144), the stronger the case for using conditioned assessment.
Assessability of Uncertainty (S162)	Conditioned assessment promotes logical choice (P11), especially through effective disaggregation (P112), and input quality (P12) when outcome uncertainty is difficult to assess (S1621).
Reaction Time (S21)	At least hours of reaction time (S212) are needed for conditioned assessment but a longer reaction time is desirable (S213 or S214) because elapsed analysis time (P21) is of less concern with a long reaction time.
Number of Input Sources (S221)	Conditioned assessment can improve input quality (P12), especially through good management of staff/expertise (P122) when there are several substantive sources (S2214 or S2215).
Computational Facility Available (S251)	A computer (S2511, S2512) is useful for conditioned assessment.

Staff Available (S252)

A modest staff (S2521) is necessary but a strong staff is preferred (S2522) in order to ensure good overall logic (P114).

Other

The proper number of conditioning tiers is closely related to the amount of total variance that is accounted for by each tier. As a rough guideline, to be included in the model, a tier should account for at least 10%-20% of the total variance.

E.18 BAYESIAN PROBABILITY UPDATING (A4421)

Performance Characterization
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A Bayesian probability updating model promotes effective disaggregation (P112) and a low-cost overall analysis (P224). However, a Bayesian updating model may lead to poor input quality (P124) because it is often difficult to elicit the necessary prior probabilities and likelihood functions. Also, Bayesian updating is limited in scope (P115) to inference.

Situation Classification	Relationship to Bayesian Probability Updating
Key Consideration (S133)	Bayesian probability updating is recommended when the key consideration is inference (S1333) because Bayesian updating addresses inference. (Bayesian analyses may also be indicated for the probability portion of a model when choice is the key consideration (S1334).)
Staff Available (S252)	Bayesian updating is difficult. Therefore, a strong staff (S2522) is needed.
Other	Bayesian updating assumes a perceptual structure that includes prior probabilities and likelihood functions.

E.19   REFERENCE GAMBLE (A4531)
(ELICITATION TECHNIQUE FOR VALUES)

Performance Characterization

The reference gamble elicitation technique can provide conceptual completeness (P111), but the technique makes it difficult for an analyst to pose meaningful questions (P123). In addition, the reference gamble technique rates low on decision communication (P321), and data gathering (P121), and it involves high input assignment cost (P222). Also, the reference gamble technique is limited in scope (P115) to valuation.

Situation Classification	Relationship to Reference Gamble Technique
Decision Justification (S234)	Although the reference gamble technique scores low on decision communication (P321), an important performance measure for decision justification, its ability to supply demonstrably superior conceptual completeness (P111) makes the reference gamble technique good for decision situations requiring justification (S2341, S2342, and S2343).
Risk Attitude of the Decision Maker (S238)	The reference gamble technique is a technique for assessing risk sensitive utility functions. Therefore it improves conceptual completeness (P111) only if the decision maker is either risk-averse or risk-seeking (S2381).
Staff Available (S252)	Reference gamble elicitation is difficult. Therefore, a strong staff (S2522) is required to ensure good overall logic (P114).
Assessor Availability (S255)	The reference gamble technique requires a high degree of assessor availability (S25512).

E.20 DELPHI (A45412)
(GROUP ELICITATION TECHNIQUE FOR PROBABILITIES)

Performance Characteristics

The Delphi technique involves pooling the opinions of several probability assessors with limited interaction.

Situation Classification	Relationship to Delphi Technique
Number of Input Sources (S221)	The Delphi technique addresses the problem of several substantive sources (S2214).
Other	The Delphi technique limits interaction among assessors and provides the assessors with anonymity. Thus, the Delphi technique removes inhibition and allows better use of staff expertise (P122) where the status of the assessors is heterogeneous. However, if data is heterogeneous, then the Delphi technique reduces input quality (P12) by inhibiting useful interactions. See Fischer (1975) for further information on the Delphi technique.

E.21 SIMULATION (ANALYTIC DEVICE) (A5311)

Performance Characterization

Simulation is expensive when compared with doing nothing, but it provides cheaper analysis (P221) and cheaper calculation (P223) than an identically structured extensive form analysis. On the other hand, simulation communicates less effectively (P321) than extensive form. In addition, simulation lacks conceptual completeness (P111) due to errors of approximation, and simulation is restricted in scope (P115) to probabilities.

Situation Classification	Relationship to Simulation
Maximum Option Impact (S144)	Since simulation is expensive, it is indicated in situations with large stakes (S1444).
Other	Simulation may be indicated in conjunction with a complex structure (A213) or a conditioned assessment model (A441).

E.22   STEP-THROUGH SIMULATION (A531111)
(ANALYTIC DEVICE)

Performance Characteristics

Compared with regular simulation (A531110), step-through simulation provides:

o   greater conceptual completeness (P111),

o   lower-cost overall modeling (P224) and
input assignment (P222), but places greater demands
on the decision maker (for the same level of
conceptual completeness), and

o   better decision communication (P321) (because
step-through requires the decision maker to
get involved in the analysis).

Situation Classification	Relationship to Step-Through Simulation
Outcome Valuation Timing (S155)	Step-through simulation is adapted to improving conceptual completeness (P111) for chronological sequences, and chronological sequences are significant only in situations with late evaluation dates (S1552).
Assessability of Uncertainty (S162)	Step-through simulation improves conceptual completeness (P111) most when uncertainties are difficult to assess (S1621).
Decision Justification (S234)	Because step-through simulation involves the decision maker in the analysis, it improves the communication (P321) needed for justification (S2341, S2342, S2343).
Staff Available (S252)	Step-through simulation is a difficult technique, and it requires a strong staff (S2522) to ensure good overall logic (P114).

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Assessor Availability
(S255)

Step-through simulation can improve conceptual completeness (P111) only if the assessor is available (S25512). (Step-through shifts the weight of effort from the analyst to the assessors.)

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