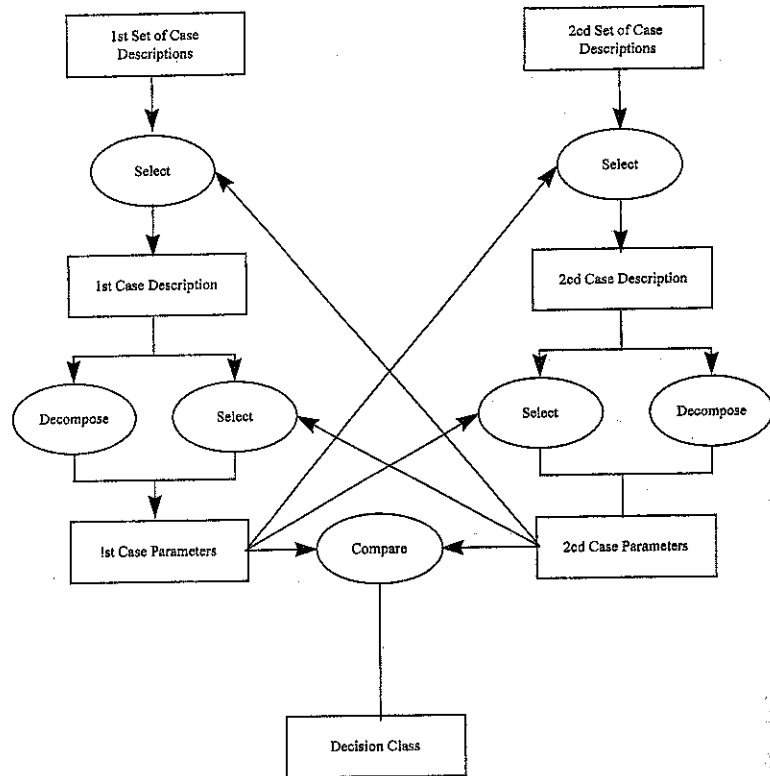|	
Name:	Mixed Mode Diagnosis: (Identification - Diagnosis)
Definition:	Identifying faults with a system, given a set of complaints, using a combination of the essence of the Localization and Causal Tracing tasks, together with Heuristic Classification.
Strategies:	Attempt to capture and separate out the different ways of operating the task.
Source:	*Tansley & Hayball, 1993*
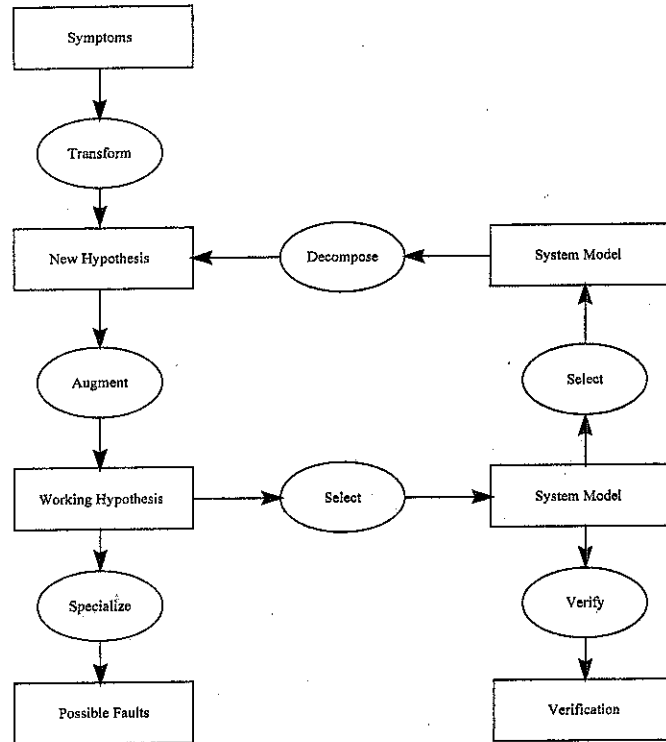
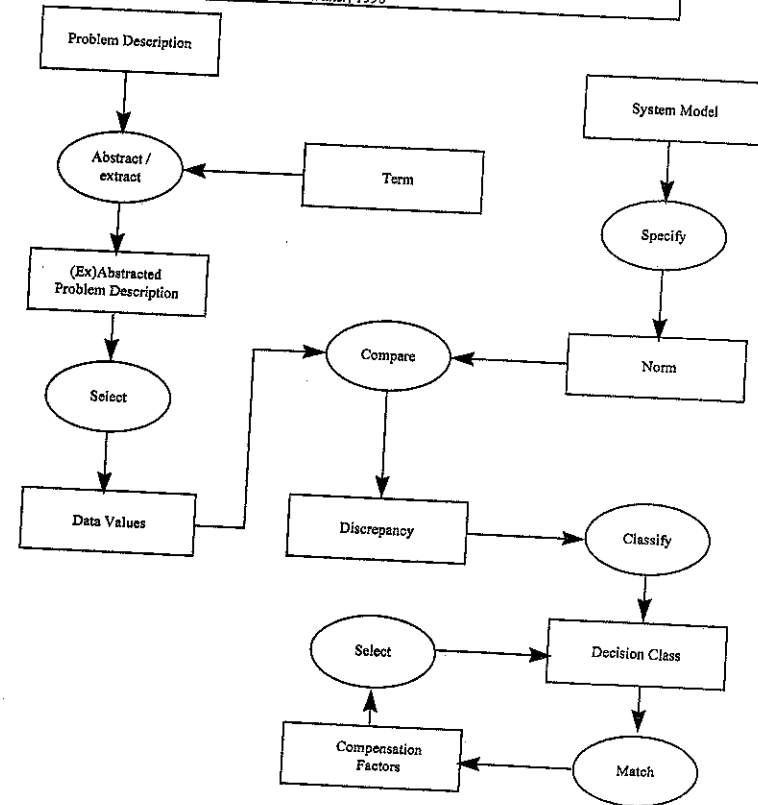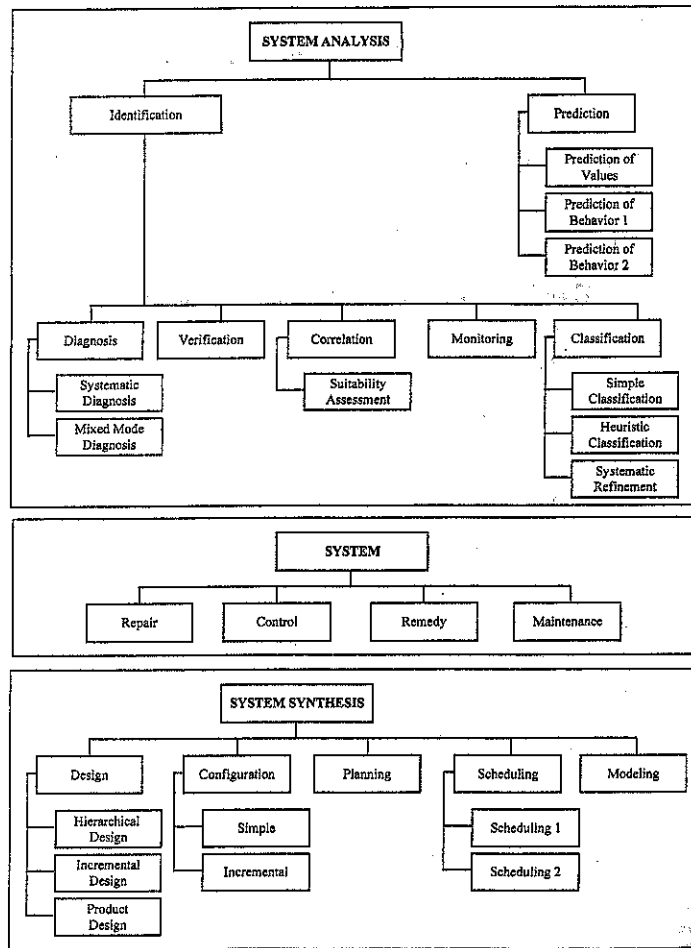|	
Name:	Verification: (Identification - Verification)
Definition:	Determining whether an assertion made about a system is consistent with (at least some of) the actual values of the observables of the system.
Strategies:	Describe how to choose between a goal-driven, data-driven, or mixed-initiative approach to verification, if needed. Otherwise, use a fixed approach.
Source:	*Tansley & Hayball, 1993*
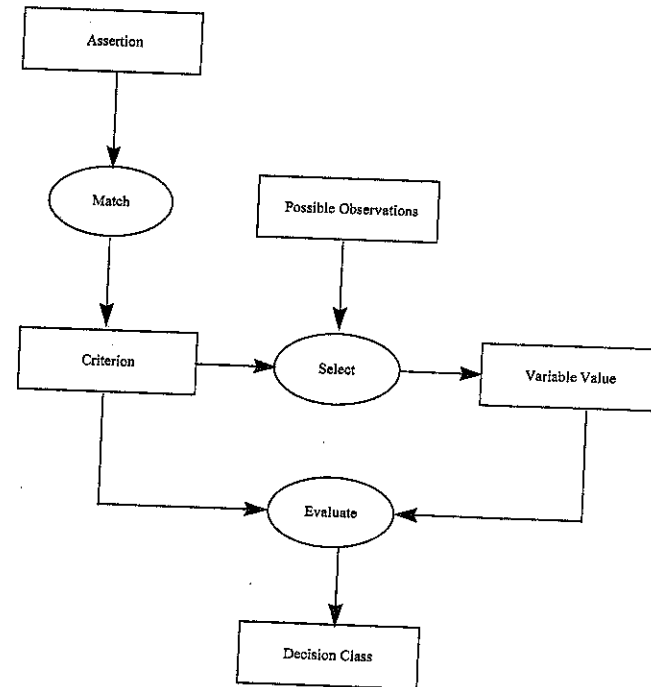
Name:	Correlation: (Identification - Correlation)
Definition:	Comparing two entities (systems) and producing some result on the basis of that comparison. *Assessment* is a specialization.
Strategies:	Correlation typically has a lot of strategic information. Base it on availability of data, format or structure of data, level of abstraction, changes over time.
Source:	*Tansley & Hayball, 1993*

1st Set of Case Descriptions

2cd Set of Case Descriptions

Select

Select

1st Case Description

2cd Case Description

Decompose

Select

Select

Decompose

1st Case Parameters

Compare

2cd Case Parameters

Decision Class

Name:	Suitability Assessment: (Identification - Correlation)
Definition:	The process of comparing an expected value with an abstracted or extracted data value, resulting in a (usually) binary decision, and where the decision may be subject to compensating factors.
Strategies:	Need for pre-assessment abstraction of data, top-down vs. bottom-down approach to working through the system model. How long to continue in the Compensation Loop.
Source:	*Gardner, 1996*

Problem Description

System Model

Abstract / extract

Term

Abstract / extract

Specify

(Ex)Abstracted Problem Description

Compare

Norm

Select

Data Values

Discrepancy

Classify

Select

Decision Class

Compensation Factors

Match

KADS Object
Problem Solving Template Taxonomy

```
                    SYSTEM ANALYSIS

       Identification                    Prediction

                                   Prediction of
                                      Values

                                   Prediction of
                                     Behavior 1

                                   Prediction of
                                     Behavior 2

  Diagnosis    Verification    Correlation    Monitoring    Classification

  Systematic                   Suitability                  Simple
  Diagnosis                    Assessment                   Classification

  Mixed Mode                                                Heuristic
  Diagnosis                                                 Classification

                                                            Systematic
                                                            Refinement
```

```
                        SYSTEM

      Repair        Control        Remedy        Maintenance
```

```
                   SYSTEM SYNTHESIS

  Design     Configuration    Planning    Scheduling    Modeling

  Hierarchical      Simple                 Scheduling 1
  Design

  Incremental      Incremental             Scheduling 2
  Design

  Product
  Design
```
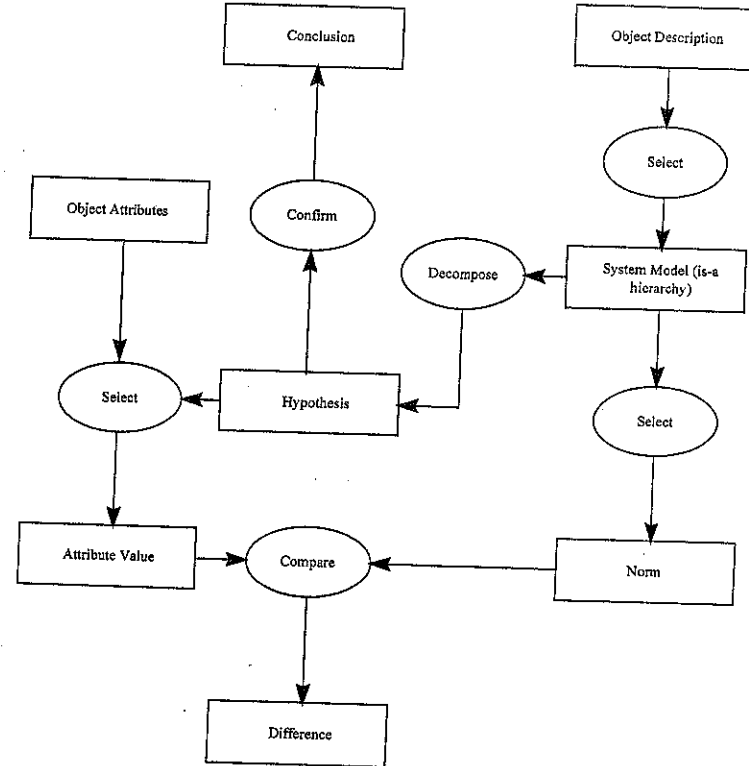
Name:	Systematic Diagnosis: (Identification - Diagnosis)
Definition:	Determining the cause and location of a problem by the use of hypothesis and tests.
Strategies:	Traverse a *consists-of* or *causes* knowledge structure.
Source:	*Tansley & Hayball, 1993*

```
                           System Model

                                 |
      Complaint  -------->     Select

                                 |
                            Subsystem Model

                                 |
  Possible                   Decompose
  Observables  <--------

      |                           |
    Select                    Hypothesis  -------->   Select

      |                           |                      |
  Data Values  ------>        Compare   <------        Norm

                                 |                       |
                            Difference  ------>   Specify /
                                                  Heuristic Match
                                                  / Confirm

                                                         |
                                                    Conclusion
```
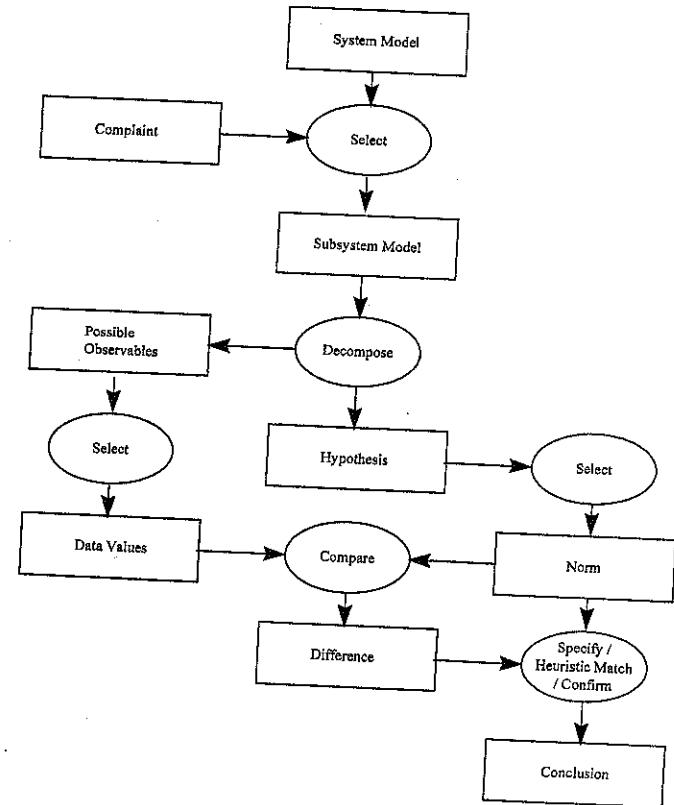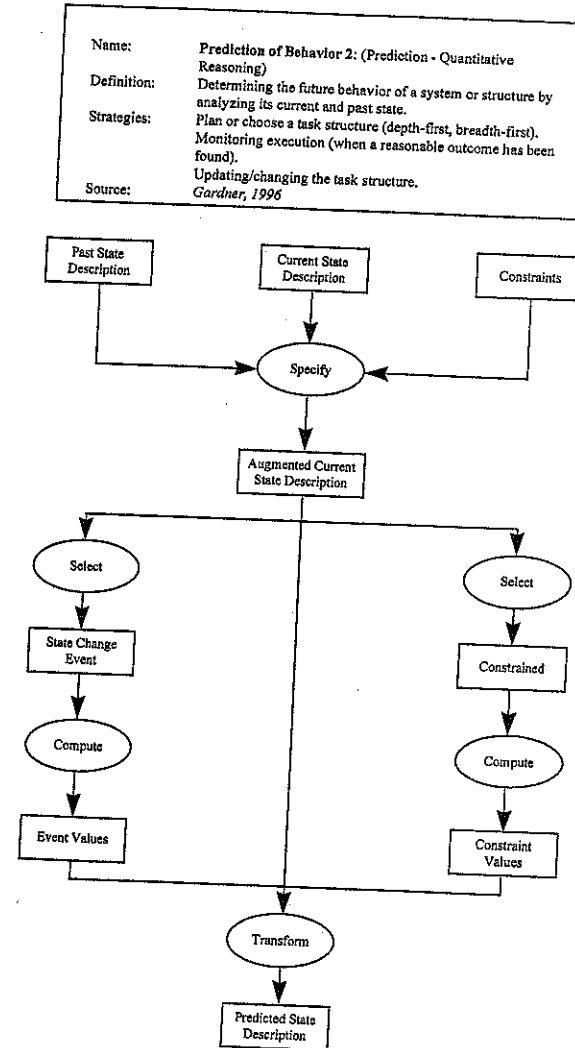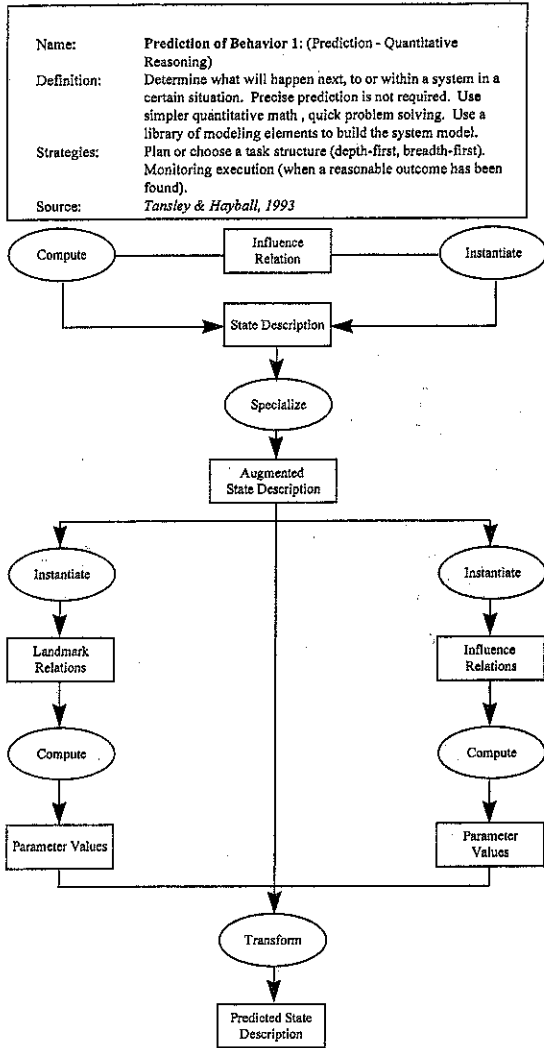
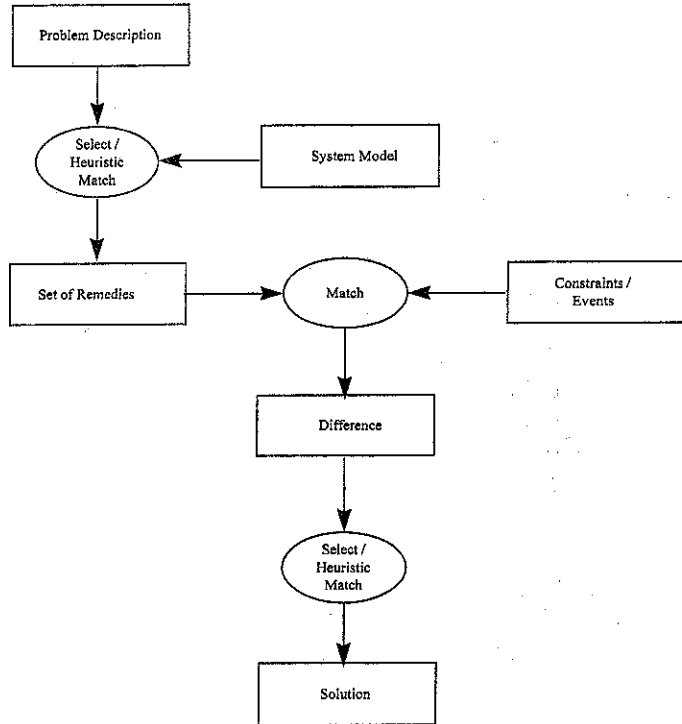| Name:	**Heuristic Classification:** (Identification - Classification)
Definition:	The process of hypothesizing and reaching a conclusion using heuristic knowledge.
Strategies:	If cost of obtaining data is high, choose backward-reasoning approach; else use a more forward-reasoning approach. How accurate must the solution be, to what level of classification? Which level of "specialize" is needed?
Source:	*Tansley & Hayball, 1993; Gardner, 1996*
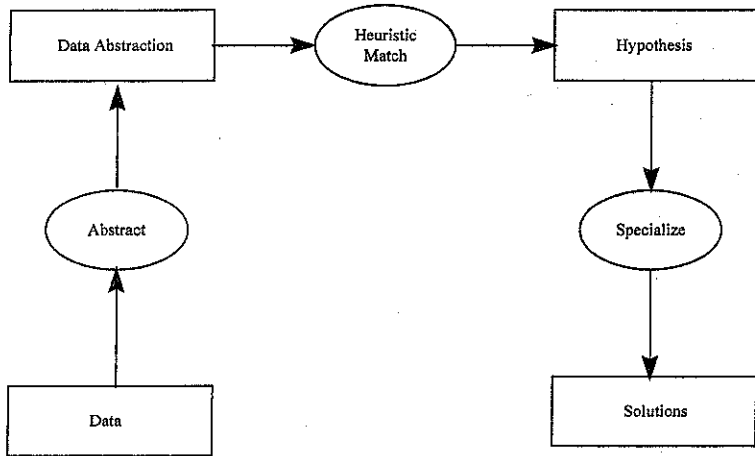
Name:	**Systematic Refinement:** (Identification -Classification)
Definition:	Traversal of a is-a knowledge structure in order to determine a refinement of an existing system.
Source:	*Tansley & Hayball, 1993*

Name:	**Prediction of Behavior 1: (Prediction - Quantitative Reasoning)**
Definition:	Determine what will happen next, to or within a system in a certain situation. Precise prediction is not required. Use simpler quantitative math, quick problem solving. Use a library of modeling elements to build the system model.
Strategies:	Plan or choose a task structure (depth-first, breadth-first). Monitoring execution (when a reasonable outcome has been found).
Source:	*Tansley & Hayball, 1993*

Compute → Influence Relation ← Instantiate

→ State Description ←

↓ Specialize

Augmented State Description

Instantiate → Landmark Relations → Compute → Parameter Values

Instantiate → Influence Relations → Compute → Parameter Values

→ Transform

Predicted State Description

Name:	**Prediction of Behavior 2: (Prediction - Quantitative Reasoning)**
Definition:	Determining the future behavior of a system or structure by analyzing its current and past state.
Strategies:	Plan or choose a task structure (depth-first, breadth-first). Monitoring execution (when a reasonable outcome has been found). Updating/changing the task structure.
Source:	*Gardner, 1996*

Past State Description   Current State Description   Constraints

→ Specify ←

↓

Augmented Current State Description

Select → State Change Event → Compute → Event Values

Select → Constrained → Compute → Constraint Values

→ Transform
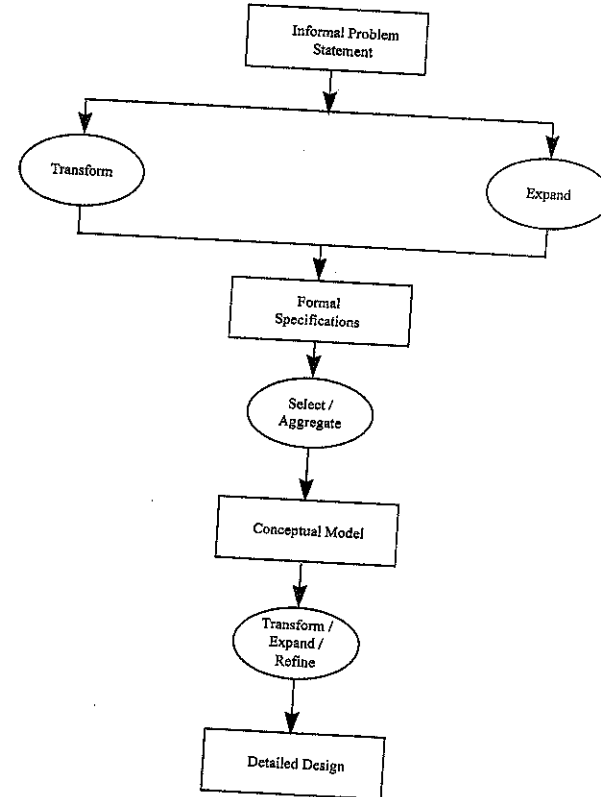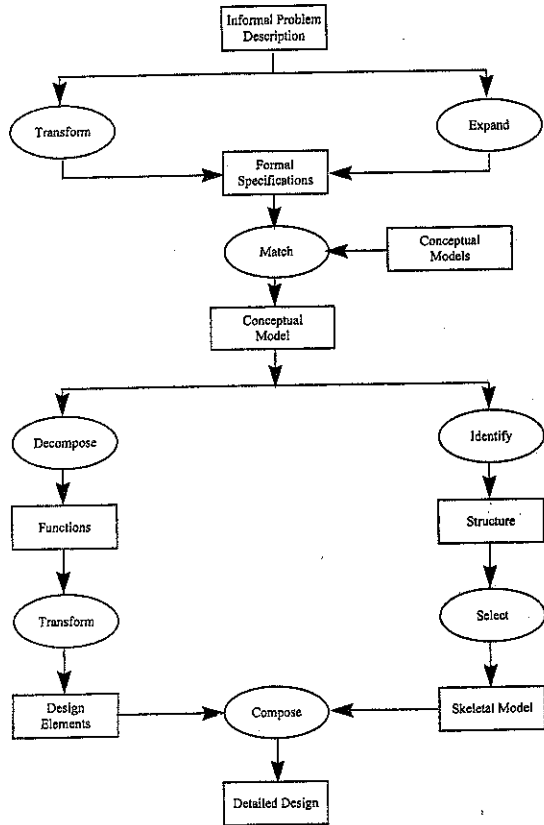
Predicted State Description

Name:	Repair: (Modification)
Definition:	Changing the characteristics of a "system" or structure with the goal of changing its behavior. This is an area of growth in KADS.
Source:	*Gardner, 1996*

```
┌──────────────────────┐
│ Problem Description   │
└──────────┬───────────┘
           │
           ▼
      ╭─────────╮      ┌──────────────────┐
      │ Select / │◄─────│  System Model    │
      │ Heuristic│      └──────────────────┘
      │  Match   │
      ╰────┬────╯
           │
           ▼
┌──────────────┐   ╭────────╮   ┌──────────────────┐
│ Set of Remedies│─►│ Match │◄──│  Constraints /   │
└──────────────┘   ╰───┬───╯    │      Events       │
                       │        └──────────────────┘
                       ▼
                 ┌───────────┐
                 │ Difference │
                 └─────┬─────┘
                       │
                       ▼
                  ╭─────────╮
                  │ Select / │
                  │ Heuristic│
                  │  Match   │
                  ╰────┬────╯
                       │
                       ▼
                 ┌───────────┐
                 │ Solution  │
                 └───────────┘
```
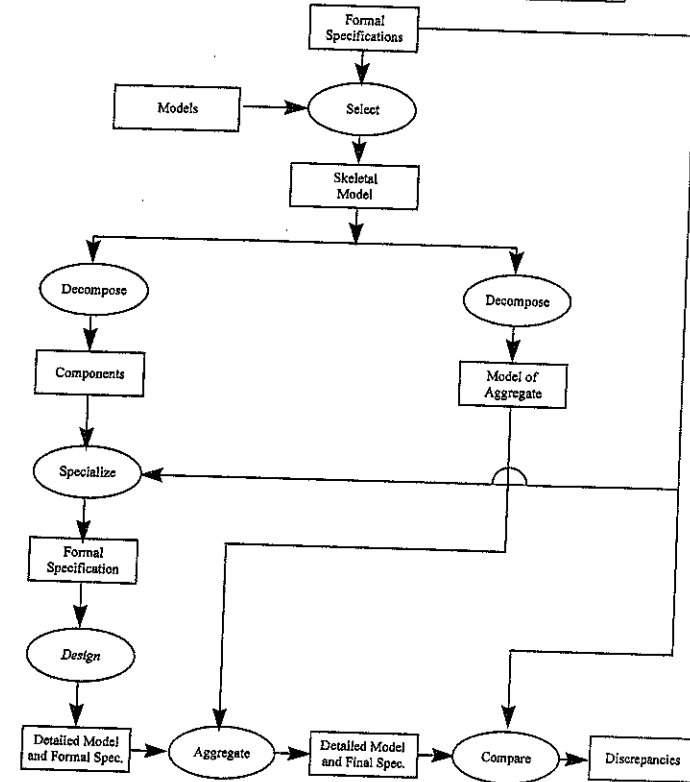
Name:	Generic Design: (Synthesis - Design)
Definition:	Specifying the components and architecture of some artifact, given a statement of the role that that artifact must fulfill.
Strategies:	Control of degree of overlap between inference. Could be based on externally arising constraints and/or constraints from design guidelines or paradigms.
Source:	*Tansley & Hayball, 1993*

```
┌──────────────────────┐
│  Informal Problem     │
│     Statement         │
└──────────┬───────────┘
      ┌─────┴───────────────────┐
      ▼                         ▼
  ╭─────────╮              ╭─────────╮
  │Transform│              │ Expand  │
  ╰────┬────╯              ╰────┬────╯
      └───────────┬─────────────┘
                  ▼
           ┌─────────────┐
           │   Formal     │
           │Specifications│
           └──────┬──────┘
                  ▼
             ╭─────────╮
             │ Select / │
             │Aggregate │
             ╰────┬────╯
                  ▼
          ┌────────────────┐
          │Conceptual Model │
          └───────┬────────┘
                  ▼
             ╭───────────╮
             │Transform / │
             │ Expand /   │
             │  Refine    │
             ╰─────┬─────╯
                   ▼
           ┌────────────────┐
           │ Detailed Design │
           └────────────────┘
```
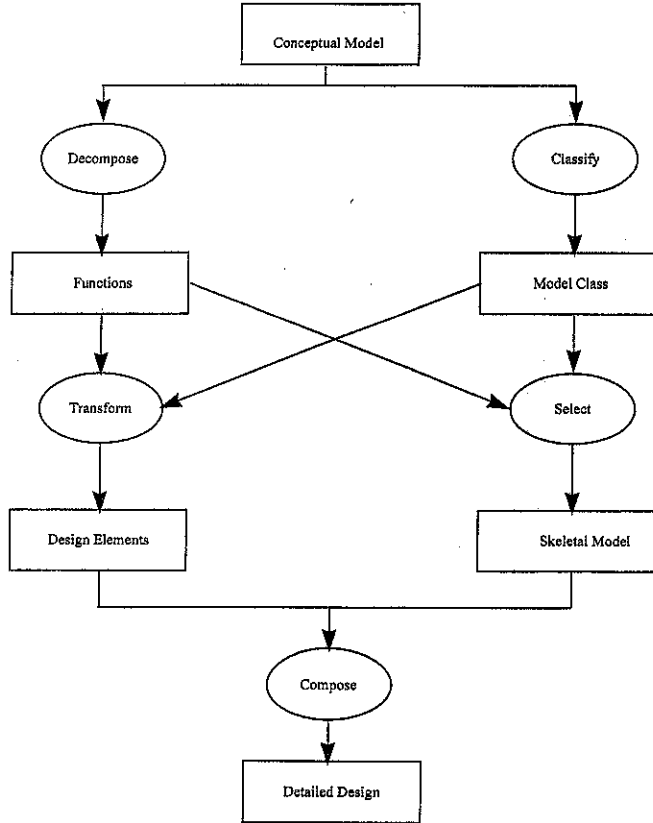
Name: Product Design: (Synthesis - Design)
Definition: Specifying the components, the structure and the function of a
             product, given a statement of the problem the product will
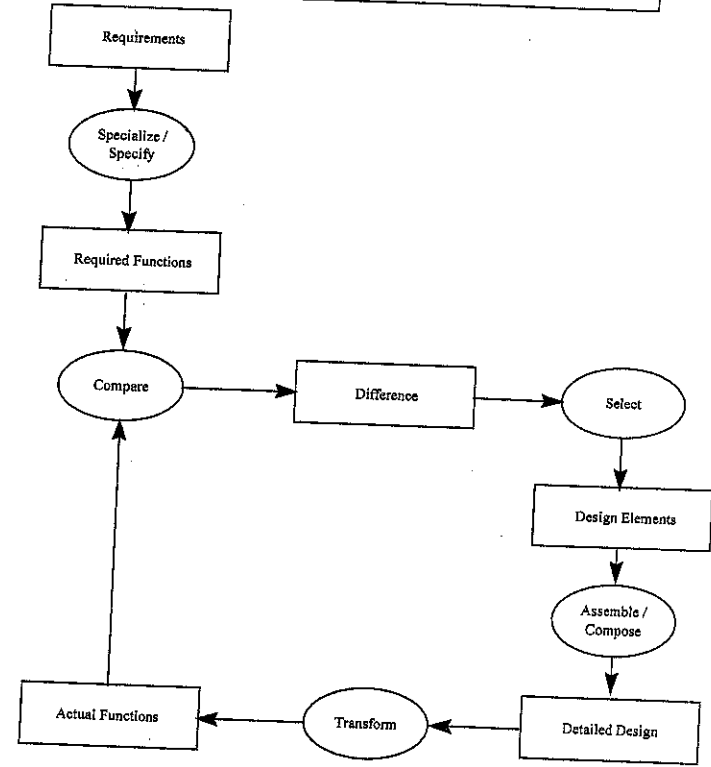   solve.
Source: *Gardner, 1996*

Informal Problem Description

Transform

Expand

Formal Specifications

Match

Conceptual Models

Conceptual Model

Decompose

Identify

Functions

Structure

Transform

Select

Design Elements

Compose

Skeletal Model

Detailed Design

Name: Hierarchical Design: (Synthesis - Design)
Definition: A design task in which a model of the artifact is first built and
             then modified: the design works at different levels of
             abstraction by recursion. *This is a special case of the Generic
             Design and is not fully refined.*
Strategies: If well understood, follow a structured task approach.
             Otherwise, fill in skeletal models.
             How long to recurse. *Note: recursive steps shown in italics.*
Source: *Tansley & Hayball, 1993*

Formal Specifications

Models

Select

Skeletal Model

Decompose

Decompose

Components

Model of Aggregate

Specialize

Formal Specification

Design

Detailed Model and Formal Spec.

Aggregate

Detailed Model and Final Spec.

Compare

Discrepancies

| Name:	Incremental Design: (Synthesis Design)
Definition:	Expansion of the Transform/Expand/Refine inference found in generic design. *Special case of Generic Design and not fully refined.*
Strategies:	Describe if and how to combine functional decomposition-driven vs. conceptual model class-driven approaches.
	Are inferences carried out in parallel.
Source:	*Tansley & Hayball, 1993*

Conceptual Model

Decompose   Classify

Functions   Model Class

Transform   Select

Design Elements   Skeletal Model

Compose

Detailed Design

Name:	Simple Configuration: (Synthesis - Configuration)
Definition:	Assembling elements of a system together such that spatial or logical constraints are not violated in the case when there are no common resources that can help satisfy several types of functions.
Strategies:	Use pure nominate, pure verify, or mixture of the two.
	Control of overlap between inferences in nominate and verify.
Source:	*Tansley & Hayball, 1993*

Requirements

Specialize / Specify

Required Functions

Compare → Difference → Select

Design Elements

Assemble / Compose

Actual Functions ← Transform ← Detailed Design

Name:	Incremental Configuration: (Synthesis - Configuration)
Definition:	Assembling elements of a system together such that spatial or logical constraints are not violated in the case when common resources can help satisfy several types of functions.
Strategies:	How to iterate over the "grouping contexts" and increase the coverage of the configuration. Ordering of the matches and decompositions.
Source:	*Tansley & Hayball, 1993*
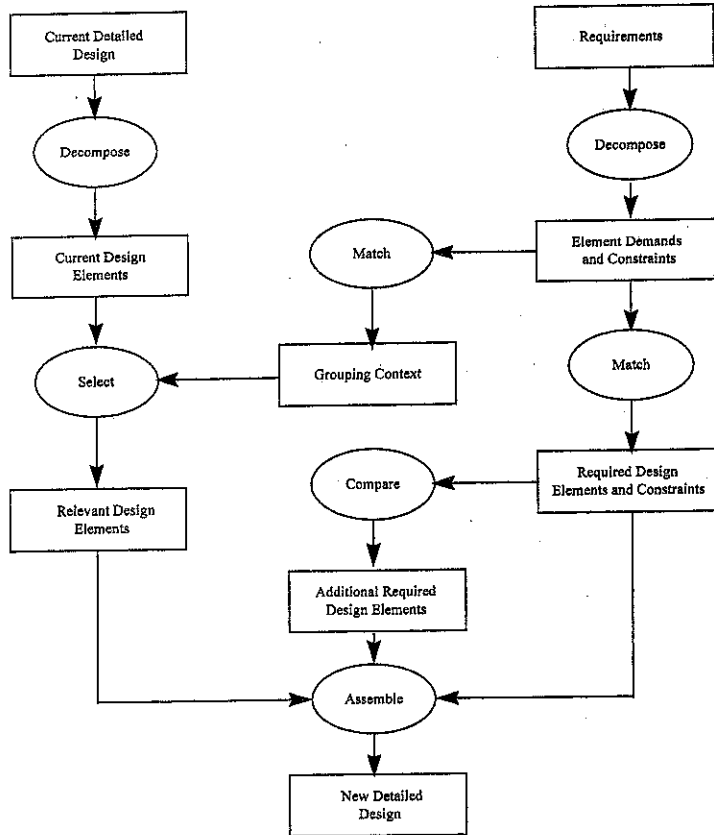
Name:	Planning: (Synthesis - Planning)
Definition:	Taking an initial state and determining the actions required to meet a final goal (and sub-goal) within a set of constraints. Output is a refined version of the original plan with some or all of its actions decomposed. Optionally, a resource allocation can be output.
Strategies:	Identification of and resolution of conflict between goals. Importance of meta-goals.
Source:	*Tansley & Hayball, 1993*
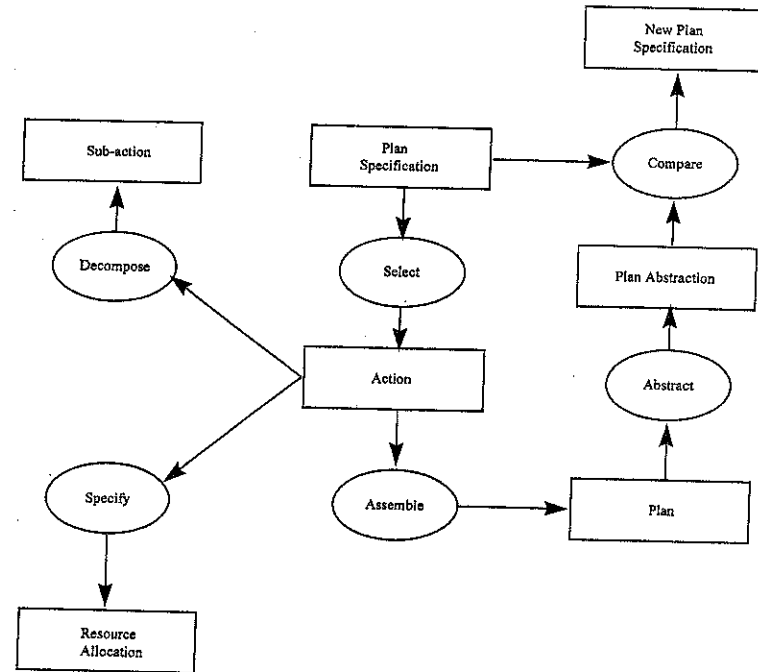
Name:	Scheduling 1: (Synthesis – Planning)
Definition:	Take a plan and determine the temporal ordering of groups of actions within that plan according to a set of minimizing constraints.
Strategies:	Take into account a data-driven or constraint-driven approach or mixture of the two.
Source:	*Tansley & Hayball, 1993*
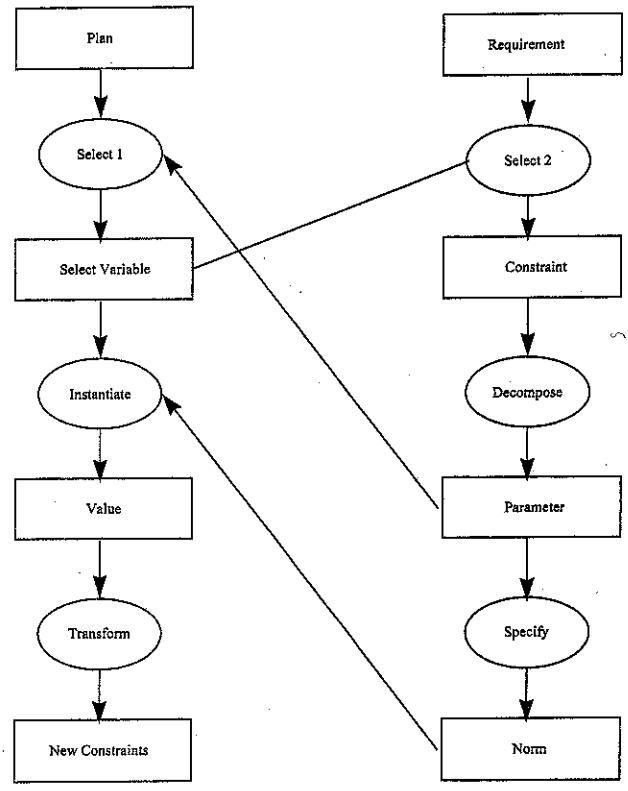
Name:	Scheduling 2: (Synthesis – Planning)
Definition:	Arriving at a schedule, given resources, planning steps, and planning periods.
Source:	*Gardner, 1996*