The Design of a Small Business Database using the Semantic Database Model

by

Jac F. Morgan

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Department of Computer Science

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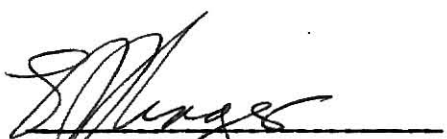
Approved by:



Major Advisor

Table of Contents

List of Figures i

Introduction - Chapter 1 1

The problem environment - Chapter 2 7

An overview of SDM - Chapter 3 12

A description of the SDM - Chapter 4 22

SDM application - Chapter 5 72

Converting an SDM model to a relational model - Chapter 6 96

Conclusion - Chapter 7 103

SDM DbDL syntax (BNF) - Appendix A 110

SDM DbDL syntax (Warnier) _ Appendix B 112

List of classes and attributes after step 3 - Appendix C 117

Final SDM schema for insurance agency - Appendix D 122

Forms used by insurance agency - Appendix E 148

References 159

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List of figures appearing in this report

Figure number and title — Page

3-1 Example of a class description 15
3-2 Example of a subclass description 15
3-3 Example of interclass connection describing a subclass 17
3-4 Example of a subclass description 17
3-5 Example of inverse attribute interrelationship 18
3-6 Example of match attribute interrelationship 19
3-7 The target class of the match in figure 3-6 20
5-1 Initial entities and events 78
5-2 The subclass approach to entity relationships 80
5-3 The grouping approach to entity relationships 80
5-4 Initial assessment of entities and events 83
5-5 Entities and events described as SDM categories 84
5-6 A class description demonstrating two methods of matching when the target is an attribute class 88
5-7 Attribute class, the target of the match 89
5-8 Base class, the target of the match 89
5-9 Diagram showing the 2 match strategies 90
5-10 Attribute class, the target of the match 89
5-11 Diagram showing matching on different attribute names 91
5-12 Base class, the target of the match 92
5-13 Attribute description requiring multiple value classes 92
5-14 Attribute description requiring multiple value classes 93
6-1 Classes and attributes remaining after eliminating derived attributes and name classes 97
6-2 Relational model of the insurance agency 100
7-1 Description using alternative match attribute interrelationships descriptions 106
7-2 Proposed modifications to the match attribute interrelationships . . 106

Chapter 1

Introduction

Database management systems were developed to bring the data resources of an enterprise into a centralized, manageable system. They were intended to bear the burden of the management of data, specifically to insure data compatibility; eliminate or reduce data duplication; create a programming environment free from considerations of the physical storage of data; centralize the management of data; and enhance programmer productivity.

The implementation of a database management system involves gathering all the data used by the enterprise and determining its use. Because a major objective of the DBMS implementation is to reduce data redundancy, thus enhancing data currency and consistency, each project's data must be integrated with data from all other projects. Even if the implementation is not that ambitious and only one section's data is to be incorporated into the DBMS, the scale of the project is diminished but not its complexity.

Database (DB) designers must understand the meaning of all the data elements and their relationships to all other data elements that will populate the DBMS. They must also keep an eye on the future and create a design that will facilitate the addition, deletion and modification of data within the DB. All of this requires an extraordinary amount of detailed knowledge of the data's organization.

Realizing the inordinate complexity and management nightmares that are associated with such an undertaking, researchers have proposed several database design methodologies.

A database design life cycle was proposed by Unger and Fisher (14) which identified six phases. They are as follows:

1. Predesign evaluation
2. Information modeling
3. Logical database design
4. Database management system selection
5. Cost/benefit analysis
6. Physical design and implementation

Predesign evaluation, the first phase, is accomplished by collecting information about the enterprise, the data it uses and how it is used. This will provide a perspective of what is needed and the expectations of the individuals who will be using the system. If after phase one it is decided that a database is the most feasible approach then phase two begins.

This report will be concerned with the second phase of the design life cycle, information modeling which is often referred to as conceptual modeling. Conceptual modeling involves using the information collected in phase one to create, on paper, a facsimile of the day to day operations of the enterprise, e.g., the data requirements and processing requirements of the users. The most common method for accomplishing this task is to view the data and processes of the enterprise as a collection of "things" that are relevant to the enterprise. An intuitive knowledge of these "things" is required to insure a successful database implementation. The concept of "things" seems so ambiguous, yet an understanding of them is of such importance that a few paragraphs concerning the nature of things is essential to the successful conceptual and logical modeling of a database.

Many authors have addressed the issue of "things", however, Hsu and Roussopoulos (5) have provided an extremely illuminating description which places things in perspective and which can be summarized in what follows:

Things in the real world can be concrete or abstract --- houses, people,

ships are concrete while time, dates, phone numbers and events are abstract. Intuitively we all recognize and understand what things are, but in order to model them we must break them into smaller "definable" parts. We thus say that "things" consist of entities, properties and relationships.

Entities

Entities and objects are often used synonymously when describing objects in an application environment. Hsu and Roussopoulos (5) put it quite well when they said,

> "Entities are a state of mind . . . Intuitively, an entity may be defined as something that is of interest in a given context and it may have properties that are of interest in the same context. A property may be thought of as something that characterizes an entity or set of entities."

The value of these properties can, at times, be used to uniquely identify an entity. It must be realized that the difference between entities and their properties depend on the context in which they are viewed. In this case context not only refers to a current state but also the perspectives of different individuals when viewing the same state. The latter is referred to as user views and will be discussed later. It is argued that an entity may exist on its own but a property can exist only if the entity it characterizes also exists. Once again we must emphasize the fact that the distinction is relative to the context in which they are used. For example, from Hsu (5)

> "This car has red color.
> Color red has wavelength X."

The entity color in the first sentence is a property of the object car. In the second sentence the entity wavelength is a property of the object color.

Relationships

Relationships describe the way in which two or more entities are connected to define an action, a state, a concept, an object, or a transaction. A list of entities and their properties by themselves would impart little meaning without some means of relating the entities one to another. A relationship may exist between different entity types, e.g., a person owns an insurance policy (a relationship between a person and an insurance policy); or a relationship may exist between the same entity types, e.g., George is Jim's client (a relationship between two people). A relationship may exist as a one to one association between two entities, e.g., John's wife is Sally; a one to many association, e.g., John's children are Sue, Mark and Tom; or a many to many association, e.g., John has many friends and each friend has many friends including John. Relationships may also have properties. For example, John owns four insurance policies the total value of which is $250,000. The four policies are not attributes which characterize John, and the sum of $250,000 does not characterize each policy, so it must characterize the association between John and his insurance policies. Because entities may be abstract things in the real world and they are characterized by properties, it can be argued that relationships may be viewed as abstract entities. Hsu and Roussopoulos defended this assertion in the following manner:

> "In our view, associations are entities. Since no two people will agree on what a real world view is, entities are a state of mind. Our view is based on the observation that an association may be a property of another object. The entity of supply association between suppliers and parts has property, the quantity; viz., suppliers supply parts in quantities. The supply association is an object in this case. The entity of birth date association among month, day and year is a property of a person. We believe our view of regarding associations as entities is a pragmatic one, because our view is consistent with the human mental process of abstractions."

The Semantic Database Model (SDM) (2,3,4,10,11) is a conceptual modeling tool which was designed not only to specify entities and relationships but also to provide a means for formally adding the meaning of entities and relationships to the model. As with other conceptual models (1,6,7,12,13) the SDM views a database as a collection of entities and relationships between entities. It diverges from the other models in the manner in which these relationships are described.

One's view of a conceptual model may range from the data section of a COBOL program to Sowa's conceptual graphs (12) The former view pertains more to a physical implementation and the latter view provides a framework extensive enough for the development of artificial intelligence in the computer. The COBOL description of an application's environment is rejected as a conceptual model because it has been more or less agreed upon that a conceptual model should be free of logical as well as physical implementation considerations. The degree of sophistication of a modeling tool then becomes a function of the application to be modeled. Sowa measures the difference between artificial intelligence systems and database systems as a ratio of data descriptors to individual data items. In a database system one descriptor may describe thousands of records whereas in an artificial intelligence application there is so little repetition that each record may have its own descriptor. Sowa's graphs were developed to provide an exhaustive description of a unique application environment. There is no argument that his graphs would fulfill the qualitative requirement of a database conceptual model, however, the model would be voluminous and too complex for the normal user to understand.

Of the conceptual models introduced to date,the SDM was chosen for study because it seemed to provide a facility for incorporating meaning into a conceptual model without placing it beyond the comprehension of the people who

are to manage and use the database.

This report will deal with the creation of an SDM schema of an insurance agency. The agency has been the subject of a database class design project and is currently being used as a pedagogical tool for teaching a graduate database course. The information and knowledge acquired to date will be used to assist in the application of the SDM database definition language (DbDL) to this problem domain. The purpose of this endeavor is two fold. First, it is written in an attempt to provide a comprehensive guide to the use of the SDM as a conceptual modeling tool in sufficient detail that it may be used as a pedagogical tool, and second, to evaluate the strengths and weaknesses of the SDM in representing the semantics of the problem domain. As a teaching tool this report will at times appear somewhat redundant, a necessary aspect of instruction.

This chapter has discussed the need for a viable conceptual modeling tool. Chapter 2 will provide the reader with a description of the enterprise to be modeled. Chapter 3 will present an overview of the SDM in general terms without exposing the reader to specifics of the model's syntax. Chapter 4 will provide a detailed description of the SDM's DbDL and demonstrate its use with examples from the insurance agency schema. If needed, situations not present within the enterprise schema will be contrived in order to demonstrate specific points. Chapter 5 will provide steps to follow when applying the SDM to a problem domain and detail their use in the development of an SDM schema for the insurance agency. Chapter 6 will demonstrate a method for converting an SDM model into a relational model. Chapter 7 will critique the SDM in light of experiences gained by its use and also provide suggestions as to the direction of future study.

Chapter 2

The problem environment

This chapter will describe the insurance agency to be modeled. It will provide the information that would have been gathered by on-site visits to the agency. From the narrative presented here and an examination of the forms used by the agency which appear in Appendix E, the reader may begin to form a conceptual image of the enterprise and the "things" that will populate the conceptual schema.

The agency has one general agent, i.e., an individual who has primary responsibility to the various insurance and investment companies for whom the agency sells products. There are agents (alias subagents) who are responsible to the general agent, and an office manager who manages the office staff.

The agency sells products for three insurance companies, annuities for two companies, and IRA's for three companies at the present time. The number of companies for which products are sold increases occasionally and presently there is consideration to expand the types of products offered to include some of the limited partnership products available.

Each agent has to be licensed to sell a type of product and then under contract to a company to sell that product type. A commission accrues for each product and the company. The commissions are always a percentage of the client payment. The general agent receives an override commission on all products sold by the agency. This override commission is determined by the product and the company and is expressed as a percentage of the client payment.

When the agency was originally visited seven documents were gathered. These documents were studied to determine the type and volume of data that was to populate the database. Close examination of the forms will reveal much

duplicate information. It is the job of the database designer to identify the types and categories of data and with the assistance of the employees of the enterprise, determine what data should go into the database. The forms collected were as follows: a) client file card (p. 148); b) insurance application (p. 149); c) client asset sheet (p. 153); d) estate settlement worksheet (p. 154); e) cash flow statement (p. 155); f) pro forma cash flow statement (p. 156); g) statement of financial position (p. 157); and policy record (p. 158).

The client file cards form the easy access role for the agent to use on a daily basis. A facsimile of this document is needed by the agents when they have to respond to phone requests by the client and for information to meet most of the daily reminder events.

The life insurance form is filled out and sent to the home office when insurance is requested. A copy is kept in the clients folder. Very few pieces of data are needed from this form for continued interaction with the client. These include the type and amount of insurance and other information required on the policy record (p. 158).

The client asset sheet is a data collection document; the data is used by the agents to run a financial analysis for the client. This form is to be stored with the client file and updated each year. Totals for the four columns of information are to be calculated.

The estate settlement worksheet is created for each spouse as part of the financial analysis that is provided by the agency as a service to its clients. This form is filled out for both husband and wife if that is appropriate.

The cash flow statement is a device to aid clients in the determination of the amount of money they can expect in investments, etc. It and the pro forma cash flow statement are always filled out by the client.

The Statement of Financial Position is a form that the agent has the

client fill out prepatory to creating a financial analysis for the client.

The policy record sheet is an often referenced document on a client. It provides the agent with information from the policies the client has in force and provides information to assist the agent in preparing the annual review. The cash values change each year and must be updated by the secretaries prior to the client's annual review.

Reports

The daily contact report is a reminder system which currently is kept on filing cards. Its purpose is to remind the agents and secretaries of events that will occur, e.g., appointments and things which must be done that day. Such things may be reminders of annual reviews for clients, policy issuance follow-up, client courtesy cards (e.g., birthday cards), bills to be paid, etc. These events may be added to the daily card up to one year prior to the day they must be processed.

Most events added to the daily contact file may be generated automatically. Annual reviews should be scheduled at one year intervals from the date of the last scheduled review. Thus a reminder to schedule this appointment should be inserted one week before a year has elapsed since the last review. The reminder for the next year should be inserted one year shy one week from the last review. For courtesy cards a reminder should be inserted into the file 3 working days before the actual birthday.

Client follow-up for insurance clients can be scheduled automatically. This procedure begins when an APS form is received by the office manager from the home office of the insurance company. After 5 working days have elapsed, the secretary should be reminded to call the home office of the insurance company to see if the doctor's follow-up to the APS form has been received. If it has been received then no additional reminders are needed; if it has not, the secretary should immediately call the doctor's office. If that office says

the form has been sent, in 2 days the secretary should again be reminded to call the home office. Also, upon receipt of a second notice APS form the secretary should call the doctor's office in 4 working days. This procedure continues until the APS is received by the home office. All calls should be recorded in the client's record for the agent's information.

Reinstatement follow-up for insurance clients can also be automated. This process is initiated when a client fails to pay an insurance premium on time and subsequently payment is sent. The agent should be notified in two weeks to check with the home office to see if the forms and the money have been received.

When an agent sells insurance to an out-of-town client, the secretary should be reminded in two weeks to check on receipt of the application by the agency.

Replacement follow-up for insurance clients is still another procedure which may be done semi-automatically. Here the goal is to minimize the payment for the client. Two weeks after the replacement policy is sold the secretary should be reminded to contact the insurance home office to see if the policy has been issued; if so, the client is to be notified immediately to stop payment on the replacement contract.

Prospect letters are sent daily. The follow-up for these should take place 3 days later by the agent.

All daily reminder items are to be automatically scrolled to the next working day if they are not accomplished.

Other Output Reports Required

Quarterly and annual reports of the state of the business are required for management purposes. These reports simply list the income and the expenses of the business. These, at the present time, are backed-up by detailed listings monthly. An entry for an expense gives the date, description, amount

and the individual to whom the expense is charged. An entry for the income gives the date, amount and the individual who brought that money into the business. All commissions have been divided by the companies at this point. Only the incomes to the general agent are considered income to the agency.

Chapter 3

An overview of the SDM

This chapter will introduce the reader to the syntax of the SDM using a minimum amount of its database definition language (DbDL) and little detail. The intent is to ease the reader into a general understanding of the SDM and how it can be used before exposing him to a detailed description of its DbDL syntax (Chapter 4). While reading this chapter the reader should keep the following facts in mind.

1. An SDM schema is a conceptual representation of the application environment. Implementation consideration should be ignored. In fact, approaching the SDM with the databases ultimate implementation in mind will hamper your understanding of the use and potential of this conceptual tool.
2. A schema is constructed entirely of class discriptions.
3. A class represents an entity or collection of entities.
4. Attributes describe the properties of the class.
5. Classes are related by interclass connections, attribute interrelationships and interattribute derivations.
6. The value of an attribute is selected from a domain of values described by a value class, or it calculated (derived) using information within the database.

These aspects will be discussed in general terms in the remainder of this chapter.

The basic building block of the SDM is the class (4). A class is an entity or meaningful collection of entities. Entities represent the objects found in the application environment. They may be concrete objects such as

agents, secretaries, or policies sold by one company; events such as contact reminders or renewal notices; or higher-level entities such as all life insurance policies sold by one company or all employees of the enterprise. You may have entities which provide representations of the values of the entities that populate the database. The syntactic identifiers used to represent values are referred to as name classes. Name classes are always described as a subset of the set of all possible strings, integers or reals. Examples of names include: all possible calendar dates, all possible first names, all possible social security numbers, etc. All of these -- concrete objects, events, higher-level entities, names -- are described relative to the user's perspective.

A database designer may view a class as a logical grouping of entities. For example, one class describing the enterprise may represent its employees. The employee class might contain such descriptors as the employees name; personal information about the employee; information about the employees spouse and children; the date the employee joined the company; something that would identify the employee's position within the enterprise, i.e., an agent, a subagent, an office worker, etc.; the employee's rate of pay; a ranking which implies the employee's seniority with respect to the other employees of the enterprise; and finally a count of the number of enterprise employees. These entities are grouped together because they constitute a reasonable description of an employee and thus form a logical grouping. The SDM representation of the employee class appears in figure 3-1. The class description in figure 3-1 probably seems ominous and confusing and rightly so, it's written in a language that most are not familiar with and which is the subject of the remainder of this report. It would be a good idea to take a few minutes to study figure 3-1 to get an impression of what a class description looks like. Don't be concerned if it appears foreign to you --- it should!

The organization and structure of the database is specified by an SDM schema which consists entirely of class descriptions. A class description contains 1) a class name including all synonyms, 2) an optional class description, 3) a description of any relationships in which the class may participate, and 4) a list of attributes. Attributes describe the class and derive their values from other classes (the attribute's value class) or from calculation performed on information contained within the database (derived attribute). Relationships between entities are both implicitly and explicitly described. To list an attribute's value class implicitly implies a relationship between the class defined by the attribute and the class providing the value for the attribute. The attribute Status_of in the class EMPLOYEE has as its value class EMPLOYEE_TYPES (figure 3-2). This says that the value of Status_of is selected from the domain of values described by the class EMPLOYEE_TYPES (the implicit relationship). (The SDM syntax requires that class names appear in full capital letters and attribute names appear with their first letter capitalized.) EMPLOYEE_TYPES, in turn, is defined as a subclass (interclass connection) of the built-in class STRINGS and is further restricted to values that are specified by the user. This condition is denoted by the "where specified" within the description of EMPLOYEE_TYPES. The class STRINGS is included within the SDM by its authors and is defined as the basic set of alphanumeric characters (1). The occurrence of several member attributes in the definition of EMPLOYEE implies that the entities PERSON_NAMES, PERSONAL_INFO, SPOUSE_INFO, DEPENDENT_INFO, etc., form a relationship with the entity EMPLOYEE and also a relationship with one another (they form the set of entities from whose domains the attributes defining EMPLOYEE acquire their values).

Explicit relationships are described by interclass connections,attribute

```
EMPLOYEE
  description: all people who work for the enterprise.
  member attributes:
     Employee_name
        value class: PERSON_NAMES
     Employee_personal_info
        value class: PERSONAL_INFO
     Employee_spouse_info
        value class: SPOUSE_INFO
     Employee_dependent_info
        value class: DEPENDENT_INFO
        multivalued
     Date_joined_company
        value class: DATES
     Status_of
        value class: EMPLOYEE_TYPES
     Pay
        value class: PAY
     Seniority
        value class: INTEGERS
        derivation: order by increasing Date_joined_company
  class attributes:
     Number_of_employees
        value class: INTEGERS
        derivation: number of members in this class.
  identifiers: Employee_name
```

Figure 3-1: An example of a class description using the SDM DbDL.

```
EMPLOYEE_TYPES
 description: The types of employees at the agency, values may be
    "agent", "subagent" and "office staff".
 interclass connection: subclass of STRINGS where specified
```

Figure: 3-2: An example of a subclass description.

interrelationships and interattribute derivations. An example of the first is found in the definition of EMPLOYEE_TYPES. EMPLOYEE_TYPES is defined as a subset of the built-in class STRINGS. Once again the class STRINGS is a built-in class of the SDM and it represents the domain of all possible strings. Another example of an interclass connection is found in the definition of AGENT (figure 3-3). AGENT is a subset of EMPLOYEE where the value of the attribute Status_of = agent. By virtue of attribute inheritance from parent class to subclass the attributes of the class EMPLOYEE aid in the description of AGENT if the employee in question is an agent. If the employee in question is an office worker then those attributes describing EMPLOYEE aid in the description of OFFICE_STAFF (figure 3-4). A second type of interclass connection allows the grouping of classes into aggregates based on common values of one or more attributes, on enumerated groups or a user-controllable grouping.

Attribute interrelationships are provided by SDM to accommodate multiple views of the data. Binary associations can be established between entities of a class by defining each to be the inverse of the other. For example, the attribute Agent_of_record of the class CLIENT is specified as the inverse of attribute Client_of of the class AGENT_INFO (figure 3-5) Both then provide a perspective as to a clients agent and an agent's clients. Binary and higher degree association are accomplished by matching the value of an attribute with an attribute of an entity that also possesses data desired. The insurance agency conceptually requires a high degree of redundant data. This semantic redundancy is supported in SDM in a conceptual manner. SDM allows the database designer to reference data which already occurs within the database by matching. For example, the values of the attributes of the class CLIENT_FILE_CARD_POLICY_INFO (figure 3-6) are obtained from a particular instance of the class POLICY_RECORD (figure 3-7) by matching on the value of

```
AGENT
  description: The owner and primary agent of the enterprise.
  interclass connection: subclass of EMPLOYEE where Status_of="Agent"
  member attributes:
     Agent_particulars
        value class: AGENT_INFO
     Agent_commission
        description: The agent receives a commission on all products sold
           by the agency. The rate varies with type and age of policy,
           the details of which are beyond the scope of this report.
        value class: DOLLARS
```

Figure 3-3: An example of an interclass connection which describes a class as a subclass of another class.

```
OFFICE_STAFF
  description: The class that identifies the office staff and the office
     manager.
  interclass connection: subclass of EMPLOYEE where Status_of =
     "office worker"
  member attributes:
     Is_office_manager
        description: "yes" if the instance is the office manager, "no"
           otherwise.
        value class: BOOLEAN
```

Figure 3-4: Example of a subclass description.

```
CLIENT
  description: Individuals who purchase products from the enterprise.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_personal_info
        value class: PERSONAL_INFO
     Client_spouse_info
        value class: SPOUSE_INFO
     Client_dependent_info
        value class: DEPENDENT_INFO
        mulitvalued
     Client_business_info
        value class: CLIENT_BUSINESS_INFO
     Miscellaneous_information
        value class: MISC_INFO
     Annuities_owned
        value class: ANNUITIES_INFO
        mulitvalued
     IRA's_owned
        value class: IRA_INFO
        multivalued
     Agent_of_record
        value class: AGENT_INFO
        inverse: Client_of
  identifiers: Client_name
```

```
AGENT_INFO
  description: Attributes that the agent and subagents have in common.
     Used as a value class for Agent_particulars of AGENT and
     Subagent_particulars of SUBAGENT.
  member attributes:
     Clients_of
        value class: CLIENT
        inverse: Agent_of_record
        multivalued
        exhausts value class
        no overlap in values
     Licensed_with
        value class: COMPANIES
        multivalued
     Number_of_clients
        value class: INTEGERS
        derivation: number of unique members in Client_of
```

Figure 3-5: An example of two classes which utilizes the attribute interrelationship, inverse.

```
CLIENT_FILE_CARD_POLICY_INFO
  description: A summary of the policies a client owns.
  member attributes:
     Policy_number
        description: client will have 1 instance of POLICY_RECORD for
           each policy owned. The policy numbers of the policies owned by
           each client can be derived from POLICY_RECORD. A match on the
           clients name will result in several policy numbers each of
           which should be used in turn to provide multiple instances of
           Client_policy_info, an attribute of CLIENT_FILE_CARD whose
           value class is CLIENT_FILE_CARD_POLICY_INFO.
        value class: POLICY_NUMBERS
        match: Policy_number of POLICY_RECORD on Client_name (of
           CLIENT_FILE_CARD)
     Plan
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Mode_of_premium_payment
        value class: MODE_OF_PAYMENT
     Premium_amount
        value class: DOLLARS
        match: Premium_amount of POLICY_RECORD on Policy_number
     Date_premium_due
        value class: DATES
        match: Date_premium_due of POLICY_RECORD on Policy_number
     Face_amount
        value class: DOLLARS
        match: Face_amount of POLICY_RECORD on Policy_number
     Date_of_issue
        value class: DATES
        match: Date_of_issue of POLICY_RECORD on Policy_number
     Age_of_issue
        value class: AGE
        match: Age_of_issue of POLICY_RECORD on Policy_number
     Primary_beneficiary
        value class: PERSON_NAMES
        match: Primary_beneficiary of POLICY_RECORD on Policy_number
     WP_rider
        value class: BOOLEAN
        match: WP_rider of POLICY_RECORD on Policy_number
     Dividend_option
        value class: BOOLEAN
        match: Dividend_option of POLICY_RECORD on Policy_number
```

Figure 3-6: An example of a class which derives attribute values from attributes of another class (POLICY_RECORD, figure 3-7).

```
POLICY_RECORD
  description: a collection of specifications about insurance policies
     owned by each client. The POLICY_RECORD class will act as the master
     record of each policy sold.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Policy_number
        value class: POLICY_NUMBERS
     Type
        value class: POLICY_TYPES
     Company
        value class: COMPANY_NAMES
     Face_amount
        value class: DOLLARS
     Date_of_issue
        value class: DATES
     Age_of_issue
        value class: AGE
     Primary_beneficiary
        value class: PERSON_NAMES
     WP_rider
        value class: BOOLEAN
     Dividend_option
        value class: BOOLEAN
     Gross_yearly_premium
        value class: DOLLARS
     Add_rider
        value class: BOOLEAN
     Cpd_rider
        value class: BOOLEAN
     Apl_rider
        value class: BOOLEAN
     Loans
        value class: LOAN_INFO
     Cash_value_record
        value class: CASH_VALUE_SCHEDULE
     Contingent_beneficiary
        value class: PERSON_NAMES
     Total_insurance_owned
        value class: DOLLARS
        derivation: sum of Face_amount
     Total_gross_yearly_premium
        value class: DOLLARS
        derivation: sum of Gross_yearly_premium
  identifiers: Client_name + Policy_number
```

Figure 3-7: A class from which attribute values are derived by other classes.

Policy_number.

Derived attributes provide a method for describing a value that is algorithmically derived from the information in the database. Derived values are common within application programs but are not normally included within a conceptual model. The addition of derived attributes within the SDM adds another layer of meaning to the relationships and use of the data. The attribute Seniority within the class EMPLOYEE describes a method for deriving the seniority status of an employee based on the date the employee joined the company.

The intent of this section was to prepare the reader for a more formal description of the SDM DbDL presented in Chapter 4. The reader is encouraged to review the six points mentioned at the beginning of this chapter and to study the figures presented. Some of them will appear again in Chapter 4.

Chapter 4

A description of the Semantic Database Model

The organization and structure of the database is specified by an SDM schema, which identifies the classes in the database and explicitly defines the relationships between them. The authors of the SDM have provided a detailed syntax of the Database Definition Language (DbDL) used by the SDM. The DbDL is presented in Appendix A in Backus-Naur form and in Appendix B in Warnier diagrams (15). This chapter will step through the DbDL, presented in Appendix A, explaining the various syntactic forms and providing examples in an effort to familiarize the user with the SDM and its application. This chapter is organized differently from the other chapters in that it is intended to be used as a student handout. For this reason the chapter was written in the form of a manual. The major topics covered will appear double underlined and in bold type at the top left of each page that deals with its description. It's syntax will then be presented followed by a description of the syntax and how it is used. Finally examples demonstrating the topic will be presented. Most may be found in Appendix D. This general format will be followed throughout this chapter, however, the presentation format will be altered from time to time to accommodate specific situations. A table of contents of this student manual appears on the following page.

Table of Contents

page

25 SDM formalisms
26 Class
28 Class name and class description
29 Attributes
33 Base class feature
    33 Identifier
    33 Attribute name
35 Interclass connection
36 Subclass
    36 Attribute predicate
    37 Specified
    38 Set-operator-defined subclasses
        38 Intersect (is in CLASS_NAME and is in CLASS_NAME)
        39 Union (is in CLASS_NAME or is in CLASS_NAME)
        40 Difference (is not in CLASS_NAME)
    40 Is a value of ATTRIBUTE_NAME of CLASS_NAME
    41 Format is FORMAT
42 Attribute predicate
    42 Simple predicate
        42 MAPPING SCALAR_COMPARATOR [CONSTANT,MAPPING],
        42 MAPPING SET_COMPARATOR [CONSTANT; CLASS_NAME; MAPPING]
46 Grouping
    46 Expression_defined grouping class (GROUPING of CLASS_NAME on common value of <ATTRIBUTE_NAME> {groups defined as classes are <CLASS_NAME>)
    48 Enumerated grouping class (GROUPING of CLASS_NAME consists of classes <CLASS_NAME>)
    48 User-controllable grouping class (GROUPING of CLASS_NAME as specified)
50 MEMBER_ATTRIBUTES
    50 ATTRIBUTE_NAME and ATTRIBUTE_DESCRIPTION
    51 Value class: CLASS_NAME
    51 Inverse - Match
       Attribute derivations
    51 Single valued; multivalued {with size between CONSTANT and CONSTANT}
    53 May not be null
    53 Not changeable
    53 Exhausts value class
    54 No overlap in values
55 INVERSE
57 MATCH
59 ATTRIBUTE_DERIVATIONS
60 INTERATTRIBUTE_DERIVATIONS
    60 Same as MAPPING
    61 Subvalue of MAPPING where is in [CLASS_NAME; ATTRIBUTE_PREDICATE]
    61 Where is in MAPPING and is in MAPPING; is in MAPPING or is in MAPPING; is in MAPPING and is not in MAPPING
    62 = MAPPING_EXPRESSION
    63 [Maximum; minimum; average; sum] of MAPPING
    64 Number of {unique} members in MAPPING

page

66 MEMBER-SPECIFIED_DERIVATIONS
66 Order by [increasing; decreasing] <MAPPING> {within <MAPPING>}
67 If in CLASS_NAME
67 [up to CONSTANT; all} levels of values of ATTRIBUTE_NAME
68 Contents
70 CLASS_ATTRIBUTES
71 CLASS-SPECIFIED_DERIVATIONS

SDM FORMALISMS

Before proceeding with a description of the SDM, the reader must be aware of the items and terms used within the SDM syntax. A list of the formalisms and symbols used within the DbDL has been offered by Hammer and McLeod (4) and appear in the following:

1. The left side of a production is separated from the right by a "<-".
2. The first level of indention in the syntax description is used to help separate the left and right sides of a production; all other indentation is in the SDM data definition language.
3. Syntactic categories are capitalized while all literals are in lowercase.
4. {} means optional.
5. [] means one of the enclosed choices must appear; choices are separated by a ";" , when used with "{}" one of the choices may optionally appear.
6. <> means one or more of the enclosed can appear, separated by spaces with optional "and" at the end.
7. <<>> means one or more of the enclosed can appear, vertically appended.
8. * * encloses a "meta"-description of a syntactic category, to informally explain it.

CLASS

Syntax

```
CLASS <-
     <CLASS_NAME>
     {description: CLASS_DESCRIPTION}
     {[BASE_CLASS_FEATURES;INTERCLASS_CONNECTION]}
     {MEMBER_ATTRIBUTE}
     {CLASS_ATTRIBUTE}
```

Description

The syntax diagram for a Class is read to mean that: 1) a class is constructed of one or more identifiers called CLASS_NAME (synonyms are defined by including more than one CLASS_NAME); 2) a class may have an optional description of category CLASS_DESCRIPTION; 3) a class may have an optional BASE_CLASS_FEATURE category or an INTERCLASS_CONNECTION category but not both; 4) a class may have MEMBER_ATTRIBUTES; and 5) a class may have CLASS_ATTRIBUTES.

Examples

```
EMPLOYEE
  description: all people who work for the enterprise.
  member attributes:
     Employee_name
        value class: PERSON_NAMES
     Employee_personal_info
        value class: PERSONAL_INFO
     Employee_spouse_info
        value class: SPOUSE_INFO
     Employee_dependent_info
        value class: DEPENDENT_INFO
        multivalued
     Date_joined_company
        value class: DATES
     Status_of
        value class: EMPLOYEE_TYPES
     Pay
        value class: PAY
     Seniority
        value class: INTEGERS
        derivation: order by increasing Date_joined_company
  class attributes:
     Number_of_employees
        value class: INTEGERS
        derivation: number of members in this class.
  identifiers: Employee_name
```

CLASS
=====

```
OFFICE_STAFF
  description: The class that identifies the office staff and
     the office manager.
  interclass connection: subclass of EMPLOYEE where
     Status_of="office worker"
  member attributes:
     Is_office_manager
        description: "yes" if the instance is the office manager
           "no" otherwise.
        value class: BOOLEAN
```

CLASS_NAME and CLASS_DESCRIPTION

Syntax

CLASS_NAMES <- *string of capitals including special characters.*

CLASS_DESCRIPTION <- *STRING*

Description

The CLASS_NAME definition thus says that a Class must have a class name made up of uppercase letters and special characters; the designer may also include multiple names for the same class. This then provides a method for dealing with synonyms directly within the conceptual model. EMPLOYEE and OFFICE_STAFF (see example under CLASS) are examples of class names. As the DbDL specifies, the names appear in capital letters and include special characters. The underscore character is used extensively in an SDM schema.

A class description should give a brief description of the class, the entities making up the class (if appropriate) and the role they have in the enterprise. The class description provides a means and a place for internal documentation within the semantic model.

Example

```
ANNUAL_REVIEW_SCHEDULE
   description: An annual review is conducted for each client
      once a year. The next review is scheduled 1 year from the
      last review. A notice is posted in the event schedule one
      week prior to the review date. Some of the attribute
      values may be derived from attributes of CLIENT ( match on
      client name).
                :
                :
```

ATTRIBUTES

Description

In order to discuss BASE_CLASS_FEATURES and INTERCLASS_CONNECTIONS you must understand the nature of attributes and the role they play in the SDM. The next few paragraphs are intended to provide you with a basic understanding of attributes.

Classes have distinctive features called attributes that set them apart from other classes. The term attribute in its simplest form implies an association between a value from a domain of possible values to an entity. The SDM has expanded the meaning of an attribute value to include the class, thus, an attribute value is either a class in the database, a collection of logically related classes, or is derived. The domain of values from which an attribute's value may be selected is called its value class. Any class within the SDM schema may be referenced as the value class of an attribute. For the insurance agency, EMPLOYEE is a class with several attributes, one of which is Employee_name. Employee_name has a value class of PERSON_NAMES which associates a value from the domain of PERSON_NAMES to individuals within the class EMPLOYEE. However, PERSON_NAMES is a class with the attributes Title, First, Middle and Last. These attributes in turn associate values from the domain of titles, e.g., Mr., Ms., Dr., etc., to the attribute Title, and values from the domain of first names, middle names and last names to their respective attribute names. Thus it is natural to have a class as the value of an attribute.

These domains are described in more detail by the value classes from which the attribute's value is drawn. This example introduces the concept of a name class. The values populating a database represents actual values encountered in the application environment. These values are denoted by strings of symbols taken from the set of alphanumeric characters. A name

class is described as a subset of the built-in SDM class STRINGS. For convenience the name classes NUMBERS, INTEGERS, REALS and YES/NO (Boolean) are also recognized as built-in SDM classes. Name classes can be described in the following manners:

1. The class can be described as the intersect, union or difference of two other name classes.
2. The class can be described as a subset of some other name class with the predicate "where specified".
3. Constraints on the acceptable data values a class can have are specified by the predicate "format is FORMAT".
4. If constraints as in 1,2 and 3 are not placed on the name class then all strings are valid values.

SDM recognizes two types of attributes, member attributes and class attributes. A member attribute describes a property of each member of a class and thus has a value for each member. Each member of EMPLOYEE has the attributes Name, Employee_personal_info, Employee_spouse_info, Employee_dependent_info, Date_joined_company, Status_of, Pay, Seniority and Number_of_employees. Number_of_employees, a class attribute, does not pertain to each member of the class, rather it describes a property of the class EMPLOYEE as a whole and has only one value for the class, i.e., the number of employees employed by the agency.

ATTRIBUTES
==========

Examples

```
EMPLOYEE
  description: all people who work for the enterprise.
  member attributes:
     Employee_name
        value class: PERSON_NAMES
     Employee_personal_info
        value class: PERSONAL_INFO
     Employee_spouse_info
        value class: SPOUSE_INFO
     Employee_dependent_info
        value class: DEPENDENT_INFO
        multivalued
     Date_joined_company
        value class: DATES
     Status_of
        value class: EMPLOYEE_TYPES
     Pay
        value class: PAY
     Seniority
        value class: INTEGERS
        derivation: order by increasing Date_joined_company
  class attributes:
     Number_of_employees
        value class: INTEGERS
        derivation: number of members in this class
  identifiers: Employee_name


PERSON_NAMES
  description: The form a person's name may take.
  member attributes:
     Title
        value class: TITLES
     First
        value class: FIRST_NAMES
     Middle
        value class: MIDDLE_NAMES
     Last
        value class: LAST_NAMES


TITLES
  description: The title a person may have preceeding his name
     e.g., Dr., Mr., Ms., Mrs.
  interclass connection: subclass of STRINGS where specified



FIRST_NAMES
  description: The first name of a person.
    interclass connection: subclass of STRINGS where specified
```

ATTRIBUTES
==========

MIDDLE_NAMES
  description: The middle name identifiers a person may have. It may be one or more initials or one or more names.
  interclass connection: subclass of STRINGS where specified

LAST_NAMES
  description: The last name of a person, it may be one or more names or hyphenated.
  interclass connection: subclass of STRINGS where specified

BASE_CLASS_FEATURE

Syntax

```
BASE_CLASS_FEATURE <- ([duplicates allowed;duplicates not allowed])
                      (<<IDENTIFIERS>>)

    IDENTIFIER <- [ATTRIBUTE_NAME;ATTRIBUTE_NAME+IDENTIFIER]

    ATTRIBUTE_NAME <- *string of lowercase letters beginning with a capital
        and may include special characters.*
```

Description

SDM recognizes a class as being either a base class or a nonbase class (interclass connection, discussed later). A base class is considered a primitive entity in that it cannot be defined in terms of one or more classes, although it may be made up of one or more entities. EMPLOYEE is a base class. The database designer can specify that a base class may contain duplicate instances of its members. The default, by definition (4) is "duplicates allowed". If it is required that all of the member attributes taken together comprise a unique identifier then "duplicates not allowed" must be specified.

Although the DbDL syntax implies an order to the components of a class description, the base class features are placed at the bottom of the examples. This is done to be consistent with the examples provided by the authors of the SDM (4). Each member of a base class is identified by its identifier. An identifier is constructed of an attribute name or an attribute name plus ("+") another identifier. The latter method for describing an identifier is used in the class CLIENT_COURTESY_CARD.

BASE_CLASS_FEATURE
==========

Example

```
CLIENT_COURTESY_CARD
  description: Courtesy cards are send to clients on special
     occasions, e.g., birthdays.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Address of CLIENT on
           Client_name
     Client_birthday
        value class: DATES
        match: Client_personal_info.Date_of_birth of PERSONAL
           on Client_name
     Date_to_send_card
        Value class: DATES
        derivation: Client_birthday - 3 working days
  identifiers: Client_name + Date_to_send_card
```

INTERCLASS_CONNECTION

Syntax

```
INTERCLASS_CONNECTION <- [SUBCLASS;GROUPING_CLASS]
```

Description

A nonbase class does not enjoy an independent existence but must be defined in terms of one or more classes. The syntactic argument used to define a nonbase class is referred to as an interclass connection.

Classes may be partitioned into subclasses inheriting attributes from their parent class. The subclass must be of type nonbase because it is defined in terms of its parent class. OFFICE_STAFF is an example of a subclass and it also offers a very good demonstration of attribute inheritance. The subclass OFFICE_STAFF has only one attribute description which is used to identify the office manager. It inherits all of the attributes from its parent class EMPLOYEE (see Examples of ATTRIBUTES).

Classes may also be aggregated into groups based on one or more common attribute values. They differ from a class in that the grouping is not necessarily permanent; in this case the grouping is based upon the values of attributes. The group class provides a convenient interclass connection for aggregates with changing member classes.

Example

```
OFFICE_STAFF
  description: The class that identifies the office staff and
     the office manager.
  interclass connection: subclass of EMPLOYEE where
     Status_of="office worker"
  member attributes:
     Is_office_manager
        description: "yes" if the instance is the office manager
           "no" otherwise.
        value class: BOOLEAN
```

SUBCLASS
========

Syntax

```
SUBCLASS <- subclass of CLASS_NAME where SUBCLASS_PREDICATE

  SUBCLASS_PREDICATE <-
      [ATTRIBUTE_PREDICATE;
      specified;
      is in CLASS_NAME and is in CLASS_NAME;
      is not in CLASS_NAME;
      is in CLASS_NAME or is in CLASS_NAME;
      is a value of ATTRIBUTE_NAME of CLASS_NAME;
      format is FORMAT]
```

Description

A subclass contains some but not all of the members of the parent class. The factor that determines the entities that belong to the subclass is the subclass predicate. An entity can thus be a member of any subclass for which the subclass predicate is satisfied. This is one of the SDM features which provides for multiple views of the same data. A subagent who specializes in annuities may be interested in only those clients who own annuities. An appropriate subclass of clients from his viewpoint would be one containing only those clients. Another subagent whose speciality is IRA's may choose a viewpoint which includes only those clients who own IRA's. This subclass may include some or all of those included in the annuity subclass. Thus, different perspectives on the same data are provided.

ATTRIBUTE_PREDICATE

Description

The discussion of attribute_predicates (attribute defined subclasses) will require additional syntax diagrams and thus will occur as a major topic.

SUBCLASS
==========

Specified

Description

The term "specified" defines a user-controllable subclass. Users of the database manually specify the entities which belong to this subclass. If a group of clients was selected for some type of preferential treatment (the agent's in-laws perhaps) a subclass of CLIENT called SPECIAL_CLIENTS could be defined that would contain only the members of CLIENT that were manually placed into it.

Examples

```
CLIENT
    definition: individuals who purchase products from the
        enterprise.
    member attributes:
        Client_name
            value class: PERSON_NAMES
        Client_personal_info
            value class: PERSONAL_INFO
        Client_spouse_info
            value class: SPOUSE_INFO
        Client_dependent_info
            value class: DEPENDENT_INFO
            multivalued
        Client_business_info
            value class: CLIENT_BUSINESS_INFO
        Miscellaneous_information
            value class: MISC_INFO
        Annuities_owned
            value class: ANNUITIES_INFO
            mulitvalued
        IRA's_owned
            value class: IRA_INFO
            multivalued
        Agent_of_record
            value class: AGENT_INFO
            inverse: Client_of
    identifiers: Client_name


SPECIAL_CLIENTS
    description: Those clients selected to receive
        preferential treatment.
    interclass connection: subclass of CLIENT where specified
```

Set-operator-defined subclasses

Description

The next three subclass types to be discussed, are referred to as set-operator-defined subclasses. Membership into subclasses defined using these predicates is based upon the attribute's membership within two other classes. An intersect relationship (is in CLASS_NAME and is in CLASS_NAME) specifies that the members of the subclass are just those members that belong to Class 1 (C_1) and Class 2 (C_2). Set union (is in CLASS_NAME or is in CLASS_NAME) requires that the members of the subclass be members of C_1 or C_2. Set difference (is not CLASS_NAME) limits the members of a subclass to those members of C but not in C_1. To insure that C_1 and C_2 are of the same data type, C_1 and C_2 must both be subclasses of the same parent class either directly or through a series of subclass relationships.

Examples of the set_operator_defined subclasses were not readily available in the insurance agency SDM schema, because the schema is to reflect the actual working environment of the agency. For demonstration purposes artificial classes will be created when specific examples are needed to demonstrate a concept

Intersect

Description

The schema might contain a subclass of CLIENT which contains only those clients who are 55 years of age or older. This type of subclass is called an attribute defined subclass and will be

discussed later. Its description is necessary to demonstrate the intersect relationship. If the database designer then wished to define a subclass which contained only those clients who were preferred clients and also over 55 years of age, the class Special_Clients_over_55 would be defined. This class would then include the members who belong to both classes.

Examples

```
SENIOR_CLIENTS
     description:  Those clients 55 years of age or older.
     interclass connection: subclass of CLIENT where AGE=>55.
                    :


SPECIAL_CLIENTS_OVER_55
     description: Special clients who are 55 years of age or
         older.
     interclass connection: subclass of CLIENT where is in
         SPECIAL_CLIENTS and is in SENIOR_CLIENTS
                    :
```

Union

Description

If the database designer desired a subclass of all clients who are preferred clients and all those who are 55 years of age or older the class SPECIAL_CLIENTS_OR_SENIOR_CLIENTS would be defined. This subclass would contain the members of both classes.

Example

```
SPECIAL_CLIENTS_OR_SENIOR_CLIENTS
     description: All special clients and all clients 55 years of
         age and older.
     interclass connections: subclass of CLIENT where is in
         SPECIAL_CLIENTS or is in SENIOR CLIENTS
                    :
```

Difference

Description

The agency's clients who are not yet 55 years old can be collected into their own subclass. YOUNGER_CLIENTS would contain those members of the class CLIENT that are not members of the subclass SENIOR_CLIENTS.

Example

YOUNGER_CLIENTS
description: Those clients who are not yet 55 years old.
interclass connection: subclass of CLIENT where in not in SENIOR_CLIENTS.
:
:

is a value of ATTRIBUTE NAME of CLASS NAME

Description

This is a predicate that identifies the members of the subclass as being those that are already values of an attribute defining another class. This is referred to as an existence subclass. For example, a subclass of CLIENT which would contain those clients who are also employees (EMPLOYEE_PATRONS) is described as an existence subclass.

Example

EMPLOYEE_PATRONS
description: Those employees who are also clients of the agency.
interclass connection: subclass of CLIENTS where is a value of Employee_name of EMPLOYEE.

SUBCLASS
========

Format is FORMAT

Syntax

FORMAT <- *a name class definition pattern*

Description

This is a clause that allows the database designer to explicitly specify the format of values which the subclass may contain (9). SOCIAL_SECURITY_NUMBER is described as a subclass of STRINGS where format is a 3 digit number between 000 and 999 followed by a hyphen then a 2 digit number between 00 and 99 followed by a hyphen then a 4 digit number between 0000 and 9999. Format is used primarilyin the description of name classes.

Example

```
SOCIAL_SECURITY_NUMBER
    interclass connection: subclass of STRINGS where format is
        000<=number<=999
        "-"
        00<=number<=99
        "-"
        0000<=number<=9999
```

ATTRIBUTE_PREDICATE
==========

Syntax

```
ATTRIBUTE_PREDICATE <-
    [SIMPLE_PREDICATE; {ATTRIBUTE_PREDICATE};
    not ATTRIBUTE_PREDICATE;
    ATTRIBUTE_PREDICATE and ATTRIBUTE_PREDICATE;
    ATTRIBUTE_PREDICATE or ATTRIBUTE_PREDICATE]

    SIMPLE_PREDICATE <- [MAPPING SCALAR_COMPARATOR [CONSTANT;MAPPING];
                MAPPING SET_COMPARATOR [CONSTANT; CLASS_NAME: MAPPING]]

        MAPPING <- [ATTRIBUTE_NAME; MAPPING.ATTRIBUTE_NAME]

        SCALAR_COMPARATOR  <- [EQUAL_COMPARATOR; >; >=; <; <= ]

        EQUAL_COMPARATOR <- [ =, <> ]

        CONSTANT <- *a string of number constants*

        Set_Comparator <- [is {properly} contained in; {properly} contains]
```

Description

The attribute predicate is used to delimit the members of a subclass by specifying the assertions which must be true for each member of the subclass. The attribute predicate thus is defined as a simple predicate or combination of simple predicates joined by one of the following Boolean operators: "not" , "and" and "or".

Mapping is a means of referring to specific values of an attribute. In the examples both attribute names and mappings are used to reference specific values. Example 1 demonstrates the use of the first option of the mapping syntax (Attribute_name). The value being referenced is a specific value of the attribute Status_of. A mapping may also represent a concatenation of attribute names in order to allow direct reference to the value of an attribute. In example 2 the first attribute being referenced is Client_name·Last. A period is used to separate the attribute names which comprise the mapping. Mappings occurring within the narrative will be elevated to the middle of the printed line to distinguish it from the

period ending the sentence. The attribute Last is found in the class PERSON_NAMES (example 6). PERSON_NAMES is the value class of the attribute Client_name of the class CLIENT (example 7), thus the notation Client_name·Last. The second value being referenced (Client_spouse_info·Name·Last) is the attribute Last of the class PERSON_NAMES which is a value class of the attribute Name of the class SPOUSE_INFO (example 8). SPOUSE_NAME is the value class of Clients_spouse_info of the class CLIENT.

By applying a simple predicate or a combination of simple predicates we are able to select from the members of a class, specific members that form a meaningful subclass of the original parent class. More complex stipulations can be formed by combinations of simple predicates joined by one or a combination of the boolean operators "and", "or" and "not".

Examples

1) Mapping scalar_comparator constant;

```
AGENT
    interclass connection: subclass of EMPLOYEE where
        Status_of = 'agent'
```

2) Mapping scalar_comparator mapping;

```
CLIENT_WHOSE_SPOUSE_HAS_A_DIFFERENT_NAME
    interclass connection: subclass of CLIENT where
        Client_name.Last <> Client_spouse_info.Name.Last
```

3) Mapping set_comparator Constant;

```
INSURANCE_COMPANIES
    interclass connection: subclass of COMPANIES where
        Company_type contains "insurance"
```

4) Mapping Set_Comparator Class_Name;

```
AGENT'S_SENIOR_CLIENTS
    interclass connection: subclass of CLIENT where Client_of
        is in SENIOR_CLIENTS
```

5) Mapping Set_Comparator Mapping;

AGENT'S_PREFERRED_CLIENTS_OVER_55
interclass connection: subclass of CLIENT where Preferred_client
is in Client_over_55

6) PERSON_NAMES
description: The form a person's name may take
member attributes:
Title
value class: TITLES
First
value class: FIRST_NAMES
Middle
value class: MIDDLE_NAMES
Last
value class: LAST_NAMES

7) CLIENT
definition: individuals who purchase products from the enterprise.
member attributes:
Client_name
value class: PERSON_NAMES
Client_personal_info
value class: PERSONAL_INFO
Client_spouse_info
value class: SPOUSE_INFO
Client_dependent_info
value class: DEPENDENT_INFO
multivalued
Client_business_info
value class: CLIENT_BUSINESS_INFO
Miscellaneous_information
value class: MISC_INFO
Annuities_owned
value class: ANNUITIES_INFO
mulitvalued
IRA's_owned
value class: IRA_INFO
multivalued
Agent_of_record
value class: AGENT_INFO
inverse: Client_of
identifiers: Client_name

ATTRIBUTE_PREDICATE
==========

8) SPOUSE_INFO
description: That information relevant to a clients or employee's spouse.
member attributes:
Name
value class: PERSON_NAMES
Home_address
value class: ADDRESSES
Phone_number
value class: PHONE_NUMBERS
Date_of_birth
value class: DATES

GROUPING
==========

Syntax

```
GROUPING <-
    [GROUPING of CLASS_NAME on common value of < ATTRIBUTE_NAME >
        {groups defined as classes are < CLASS_NAME >};
    GROUPING of CLASS_NAME consists of classes <CLASS_NAME>;
    GROUPING of CLASS_NAME as specified]
```

Description

The second type of interclass connection used to describe a nonbase class is the grouping interclass connection. Grouping provides a means for describing higher level, abstract entities which are constructed out of basic entities.

Expression-defined grouping class

The first predicate defines a grouping class made up of members having a common value for one or more designated member attributes . For example, a class TYPES_OF_COMPANIES can be defined as a grouping class of COMPANIES based on common values of Company_type. Company_type thus represents a collection of types of companies whose instances are the members of the various types of companies represented by the agency. The contents of TYPES_OF_COMPANIES represent subsets of the class COMPANIES and thus correspond to a collection of attribute defined subclass definitions. For example, the subclass TYPES_OF_COMPANIES represents the grouping of subclasses which may be defined as Company_type = "insurance", Company_type = "IRA", etc. Because some of these subclasses may already be defined as subclasses within the SDM schema, it is recommended that these subclasses be referenced within the grouping class definition by naming the subclasses defined within the schema. INSURANCE_COMPANIES is described

as a subclass of COMPANIES where Company_type = "insurance".

This type of grouping is intended to focus attention on the shared properties of the entities that are its contents, rather than to the collection of entities itself. Although the name would infer an aggregation of classes, a grouping class still represents an abstract subclass of some underlying parent class.

Examples

```
TYPES_OF_COMPANIES
    description:  Types of Companies represented by the agency.
    interclass connection:  grouping of COMPANIES on common
        value of Company_type groups defined as classes are
        INSURANCE_COMPANIES, ANNUITY_COMPANIES
                        :
                        :


INSURANCE_COMPANIES
    description:  All insurance companies represented by the
        agency.
    interclass connection:  subclass of COMPANIES where
        Company_type = "Insurance"
                    :

ANNUITY_COMPANIES
    description: Companies which offer annuities through the
        agency.
    interclass connection:  subclass of COMPANIES where
        Company_type = "Annuities"
                    :

COMPANIES
    description: the companies whose products are sold by the
        enterprise.
    member attributes:
        Company_type
            value class: COMPANY_TYPES
        Company_name
            value class: COMPANY_NAMES
        Company_address
            value class: ADDRESSES
        Company_phone
            value class: PHONE_NUMBERS
        Products_offered
            value class: PRODUCT_TYPE
    identifiers: Company_name
```

Enumerated grouping class

Description

The second grouping predicate of allows the database designer to specify the classes that will belong to the grouping class. However, the specific classes must all have been previously defined as a subclass of some underlying parent class. The class SPECIAL_CLIENT_GROUPS is described in such a manner. This grouping class description is useful when there is no appropriate attribute value which can be used to distinguish the various groups.

Example

```
SPECIAL_CLIENT_GROUPS
    description: Those clients that are special to the agency
        at present are special clients and are those over 55
        years of age.
    interclass connection: grouping of CLIENTS consisting of
        classes SPECIAL_CLIENTS and SENIOR_CLIENTS.
                :
                :
```

User-controllable grouping class

This last grouping predicate consists of a collection of user_controllable subclasses of some underlying parent class. It is a vehicle to use when the database designer wishes to define a class of clients considered "special cases", i.e., individual clients who require special attention which is not based on some common attribute value. The class would not contain groups of clients as in the first two cases. Each member of this class would be an individual client. Such a class would thus represent an aggregate of individual members which were chosen by the users.

GROUPING
========

Example

SPECIAL_ATTENTION

description: Those clients requiring special attention.

interclass connection: grouping of CLIENTS as specified

:

:

MEMBER_ATTRIBUTES

Syntax

```
MEMBER_ATTRIBUTE <-
        <ATTRIBUTE_NAME>
        {ATTRIBUTE_DESCRIPTION}
        value class: CLASS_NAME
        {inverse: ATTRIBUTE_NAME}
        {[match: ATTRIBUTE_NAME of CLASS_NAME on ATTRIBUTE_NAME};
         derivation: MEMBER_ATTRIBUTE_DERIVATION]}
        {single valued; multivalued {with size between CONSTANT
         and CONSTANT}}
        {may not be null}
        {not changeable}
        {exhausts value class}
        {no overlap in values}
```

Description

SDM recognizes two types of attributes, member attributes and class attributes. Member attributes describe properties belonging to each member of the class and class attributes describe properties about the class in general. The syntactic clauses shared by the two attribute types (attribute name, attribute description, single valued-multivalued, may not be null, not changeable) will be addressed during the discussion of member attributes.

ATTRIBUTE NAME and ATTRIBUTE DESCRIPTION

Syntax

```
ATTRIBUTE_NAME <- *string of lowercase letters beginning with a capital
    and possibly including special characters*

ATTRIBUTE_DESCRIPTION <-  * string *
```

Description

For the purpose of standardization, attribute names will begin with a capital letter with the remainder lowercase and may contain special characters. An attribute name must be unique with respect to all

attribute names used in the class; it cannot have been used in its parent class if the class being defined is a subclass, and it cannot be used in any subclasses that may be defined from it. Synonyms are permitted. An attribute description may also be included and is encouraged to aid in the documentation of the schema.

Example

```
Spouse_amount_insurance
    description: If it is assumed that if the spouse is also a
        client then a record of total insurance owned should also
        be present for the spouse. This value is derivable by
        matching Spouse_name to Client_name in POLICY_RECORD.
    value class: DOLLARS
                 :
                 :
```

Value class: CLASS NAME

Description

The value class of an attribute is the class which describes the domain of values an attribute may have. The attribute described in the above example has a value class of DOLLARS.

Inverse-Match

Inverse and match will be discussed as separate major topics.

Attribute derivations

Attribute derivations will be discussed as a major topic.

Single valued; multivalued {with size between CONSTANT and CONSTANT}

Description

The Agent_of_record attribute in the class CLIENT is an example of an attribute that may have only one value. Each agent sells to only his

own clients, they do not share clients. The Annuities_owned attribute in the class CLIENT is an example of a multivalued attribute. This attribute is a list of information pertaining to all annuities sold to the client by the agent. If we think of a multivalued attribute as being a subset of a value class, the number of values this set may contain can be controlled by specifying the set size ("with size between CONSTANT and CONSTANT"). For example, if for some reason we wished to limit the number of clients an agent may have, we could specify it in the manner displayed in a modified version of the class AGENT_INFO.

Examples

```
CLIENT
    definition: individuals who purchase products from the
        enterprise.
    member attributes:
        Client_name
            value class: PERSON_NAMES
        Client_personal_info
            value class: PERSONAL_INFO
        Client_spouse_info
            value class: SPOUSE_INFO
        Client_dependent_info
            value class: DEPENDENT_INFO
            mulitvalued
        Client_business_info
            value class: CLIENT_BUSINESS_INFO
        Miscellaneous_information
            value class: MISC_INFO
        Annuities_owned
            value class: ANNUITIES_INFO
            mulitvalued
        IRA's_owned
            value class: IRA_INFO
            multivalued
        Agent_of_record
            value class:AGENT_INFO
            inverse: Client_of
    identifiers: Client_name
```

MEMBER_ATTRIBUTES

```
AGENT_INFO
      :
    member attributes:
        Clients_of
            value class: CLIENT
            multivalued with size between 1 and 150
                  :
                  :
```

May not be null

Description

Attributes may be specified as mandatory. This means that a null value is not a valid value for this attribute.

Not changeable

Description

Specifying that the attribute value is not changeable implies that it cannot be updated. It may however be changed to correct erroneous information.

Exhausts value class

Description

This feature allows the database designer to specify that every member of the value set must be the value of some attribute. The attribute Clients_of class AGENT_INFO "exhausts value class" because every client must be the client of some agent.

MEMBER_ATTRIBUTES
==========

Example

```
AGENT_INFO
    description: Attributes that the agent and subagents have in
        common. Used as a value class for Agent_particulars of AGENT
        and Subagent_particulars of SUBAGENT.
    member attributes:
        Clients_of
            value class: CLIENT
            inverse: Agent_of_record
            multivalued
            exhausts value class
            no overlap in values
        Licensed_with
            value class: COMPANIES
            multivalued
        Number_of_clients
            value class: INTEGERS
            derivation: number of unique members in Client_of
```

No overlap in values

Description

This feature can be used to specify exclusive ownership of avalue by an attribute. The attribute Clients_of, in the above example, is also declared as having "no overlap in value, which means that no two Agents can have the same Client.

INVERSE
=======

Syntax

inverse: ATTRIBUTE_NAME

Description

The matching and inverse clauses allow the occurrence of data redundancy within the database. They were created intentionally to support the incorporation of user views into the SDM schema. In the design of a database it sometimes becomes convenient and meaningful to think of an attribute and entities switching places to accommodate different user perspectives. Inverse is used to accommodate such a situation. The attribute Client_of in AGENT_INFO has a value class of CLIENT and its inverse is the attribute Agent_of_record in the class CLIENT which has a value class of AGENT_INFO. Kroenke (6) points out that the inverse clause allows us to describe two entities which are contained within each other. Thus if we know a client, his agent can be determined by the attribute agent_of_record. A different view of the data might present us with an agent whose clients may be determined by the attribute, Client_of.

Examples

```
AGENT_INFO
    description: Attributes that the agent and subagents have in
       common. Used as a value class for Agent_particulars of AGENT
       and Subagent_particulars of SUBAGENT.
    member attributes:
       Clients_of
          value class: CLIENT
          inverse: Agent_of_record
          multivalued
          exhausts value class
          no overlap in values
       Licensed_with
          value class: COMPANIES
          multivalued
       Number_of_clients
          value class: INTEGERS
          derivation: number of unique members in Client_of
```

INVERSE
=======

```
CLIENT
    definition: individuals who purchase products from the
        enterprise.
    member attributes:
        Client_name
            value class: PERSON_NAMES
        Client_personal_info
            value class: PERSONAL_INFO
        Client_spouse_info
            value class: SPOUSE_INFO
        Client_dependent_info
            value class: DEPENDENT_INFO
            mulitvalued
        Client_business_info
            value class: CLIENT_BUSINESS_INFO
        Miscellaneous_information
            value class: MISC_INFO
        Annuities_owned
            value class: ANNUITIES_INFO
            mulitvalued
        IRA's_owned
            value class: IRA_INFO
            multivalued
        Agent_of_record
            value class:AGENT_INFO
            inverse: Client_of
    identifiers: Client_name
```

MATCH

Syntax

match: ATTRIBUTE_NAME OF CLASS_NAME on ATTRIBUTE_NAME

Description

Where inversion allows the description of binary associations between attributes, matching supports binary and higher degree associations. Matching provides a means of deriving an attribute's value from information within the database by matching common values of attributes from different classes. There is some disagreement as to the interpretation of the match derivation. In this text, match will be used as a method for deriving a single attribute value. The other interpretation is a more powerful join in which a match derives an entire class instance. An example of matching is found in the class PRO_FORMA_CASH_FLOW_STATEMENT. In this example the total insurance premiums paid by a client is derived from the value of the attribute Total_gross_yearly_premiums of the class POLICY_RECORD by a match on the client's name. Matching can be thought of as a high level join. It is used extensively in the insurance agency schema because of the highly redundant nature of the application environment. In this application environment example CLIENT and POLICY_RECORD serve as the primary sources of information. Attribute values of most of the other classes may be derived from these primary classes by matching on the client's name or on a specific policy number. Additional examples may be seen in CLIENT_FILE_CARD, CLIENT_FILE_CARD_POLICY_INFO, and the FOLLOW-UPs (Appendix D).

MATCH
=====

Example

```
PRO_FORMA_CASH_FLOW_STATEMENT
    description: That data stored in the database that would be
        of use when filling out a client's pro forma cash flow
        statement.
    member attributes:
        Client_name
            value class: PERSON_NAMES
        Client_address
            value class: ADDRESSES
        Client's_total_yearly_insurance_premiums
            value class: DOLLARS
            match: Total_gross_yearly_premiums of POLICY_RECORD
                on Client_name
    identifiers: Client_name
```

ATTRIBUTE DERIVATIONS

Syntax

```
MEMBER_ATTRIBUTE_DERIVATION <-
    [INTERATTRIBUTE_DERIVATION; MEMBER-SPECIFIED_DERIVATION]

CLASS_ATTRIBUTE_DERIVATION <-
    [INTERATTRIBUTE_DERIVATION; CLASS-SPECIFIED_DERIVATION]
```

Description

Attribute values may be derived from other information stored within the database or in fact may take the form of statistics about the data within the database, e.g., maximum, minimum, average and sum. Values for member attributes and class attributes may be derived, and they share common interattribute derivations. They differ in member specified derivations and class-specified derivations as seen in the syntax diagrams.

As a brief review, the diagrams specify that a MEMBER_ATTRIBUTE_DERIVATION may take the form of an INTERATTRIBUTE_DERIVATION or a MEMBER-SPECIFIED_DERIVATION and a CLASS_ATTRIBUTE_DERIVATION may take the form of an INTERATTRIBUTE_DERIVATION or a CLASS-SPECIFIED_DERIVATION.

INTERATTRIBUTE_DERIVATION

Syntax

```
INTERATTRIBUTE_DERIVATION <-
    [same as MAPPING;
    subvalue of MAPPING where [is in CLASS_NAME; ATTRIBUTE_PREDICATE];
    where [is in MAPPING and is in MAPPING; is in MAPPING or is
        in MAPPING; is in MAPPING and is not in MAPPING];
    = MAPPING_EXPRESSION
    [maximum; minimum; average; sum] of MAPPING;
    number of {unique} members in MAPPING]
```

Description

Interattribute derivations allow the database designer extreme flexibility in specifying the values a derived attribute may have.

Same as MAPPING

Description

This clause allows the database designer to derive the value of an attribute by stating that it is the same as that for another attribute.

Example

```
OTHER_APPOINTMENTS
    description: Appointments other then those that are normally
        scheduled.
    member attributes:
                :
            Date_of_appointment
                value class: DATES
            Next_date_of_action
                description: This attribute must be present if
                   OTHER_APPOINTMENTS is to be included in
                   DAILY_SCHEDULE. Membership in DAILY_SCHEDULE is
                   based on a match with Next_date_of_action. Rather
                   than change the name of the attribute
                   Date_of_appointment, which is familiar to all
                   employees, Next_date_of_action was coined as a
                   synonym.
                value class: DATES
                derivation: same as Date_of_appointment
                        :
```

Subvalue of MAPPING where is in [CLASS NAME; ATTRIBUTE PREDICATE

Description

We can define an attribute or mapping to be a subset of the values of a multivalued attribute requiring that they be members of some other class or by specifying some predicate which must be satisfied. This derivation could be used to describe a new attribute of AGENT_INFO whose members would include all clients who are members of the class SPECIAL_CLIENT described in the discussion of subclass predicates.

Example

```
Agent's_special_clients
    description: all of the agent's clients who are members of
        the class SPECIAL_CLIENT
    value class: CLIENT
    derivation: subvalue of Client_of where is in SPECIAL_CLIENT
```

Where is in MAPPING and is in MAPPING; is in MAPPING or is in MAPPING; is in MAPPING and is not in MAPPING

Description

The database designer could use this predicate to define an attribute whose value represents the intersect, union or difference of two other member attributes or mappings. To demonstrate this predicate two additional member attributes of AGENT_INFO must be defined.

Examples

Agent's_clients_55_and_over
description: All of the agent's clients who are members of the class SENIOR_CLIENTS.
value class: CLIENT
derivation: subclass of Client_of where is SENIOR_CLIENTS

Agent's_special_clients_55_and_over
description: An agent's clients who are members of both Agent's_special_clients and Agent's_clients_55_and_over
value class: CLIENT
derivation: subvalue of Clients_of where is in Agent's_special_clients and Agent's_clients_55_and_over

= MAPPING EXPRESSION

Description

An attribute's value can be derived by applying an arithmetic expression to the values of other member attributes or mappings. This type of derivation can be seen in the Date_of_next_action definitions of the "FOLLOW-UP"'s (Appendix D). The example demonstrates its use in the description of the class REINSTATEMENT_FOLLOW-UP. Although it is specified that the involved attributes or mappings must have numeric values the SDM syntax has been expanded by the database designer to include the arithmetic manipulation of dates. The various symbols and their meanings are as follows: (+) addition; (-) subtraction; (*) multiplication; (/) division; and (!) exponentiation.

INTERATTRIBUTE_DERIVATION

Example

```
REINSTATEMENT_FOLLOW-UP
    description: Calls to insurance company to ascertain whether a
        client has paid his premium.
    member attributes:
                  :
        Date_of_next_action
            value class: DATES
            derivation: = Date_notified_of_delinquency + 14
                if this is the first attempt
             or Date_of_next_action + 1
                if client was not notified on the initial date,
                denoted by a "no" value of Contact_completed of class
                DAILY_SCHEDULE for this instance
              **** Note: This is not part of the SDM syntax. ****
                    :
```

[Maximum; minimum; average; sum] of MAPPING

Description

"The operators 'maximum', 'minimum', 'average', and 'sum' can be applied to a member attribute or mapping that is multivalued; the value class of the attributes involved must be an eventual subclass NUMBERS. The maximum, minimum, average, or sum is taken over the collection of entities that comprise the current value of the attribute or mapping."(1) The SDM syntax was modified by the database designer to allow these operators to be applied to the name class DOLLARS.

Examples

Total_gross_yearly_premium
value class: DOLLARS
derivation: sum of Gross_yearly_premium

DOLLARS
description: The form a reference to money may take.
interclass connection: subclass of STRINGS where format is
"$"
000 < number <= 999
","
000 <= number <= 999
","
000 <= number <= 999
"."
00 <= number <=99
where leading zeros are omitted

Number of {unique} members in MAPPING

Description

The value of an attribute may be defined as being equal to the number of members in a multivalued attribute or mapping. This derivation may count all members or only unique members of a multivalued attribute. The member attribute Number_of_clients of AGENT_INFO is used to represent the number of unique clients an agent has.

Example

```
AGENT_INFO
    description: Attributes that the agent and subagents have in
        common. Used as a value class for Agent_particulars of AGENT
        and Subagent_particulars of SUBAGENT.
    member attributes:
        Clients_of
            value class: CLIENT
            inverse: Agent_of_record
            multivalued
            exhausts value class
            no overlap in values
        Licensed_with
            value class: COMPANIES
            multivalued
        Number_of_clients
            value class: INTEGERS
            derivation: number of unique members in Client_of
```

MEMBER-SPECIFIED-DERIVATIONS

Syntax

```
MEMBER-SPECIFIED_DERIVATIONS <-
     [order by [increasing;decreasing] <MAPPING> {within <MAPPING>};
     if in CLASS_NAME;
     [up to CONSTANT; all] levels of values of ATTRIBUTE_NAME;
     contents]
```

Description

Member attributes and class attributes can be defined using interattribute derivations or derivations unique to each attribute type (member attributes or class attributes).

Order by [increasing; decreasing] <MAPPING> {within <MAPPING>}

Description

The ordering derivation allows the definition of an attribute which denotes the sequential position of each specific member of the class with respect to some other attribute or mapping within the class. The member attribute Seniority of the class EMPLOYEE is described as being the sequential position of each employee with respect to the date he began working for the agency. Ordering can be either increasing or decreasing with respect to the attribute value; the default is increasing. Ordering can also take place within a subset of the members of a class by specifying "within MAPPING". This causes the ordering of a subset of the members of the class whose values are the same for the mapping referenced to in the above mentioned predicate. For example, the database designers could have described a seniority attribute that would specify each employee's seniority within his employee type. This would have the affect of assigning a sequential ordering value to each office worker based on his seniority among the office staff, assign a

subagents seniority with respect to other subagents, etc.

Examples

```
Seniority
   value class: INTEGERS
   derivation: order by decreasing Date_joined_company


Seniority_within_type
     value class: INTEGERS
     derivation: order by decreasing Date_joined_company within
        Status_of.
```

If in CLASS_NAME

Description

An existence attribute is provided that allows the assignment of a boolean value to a member attribute based on the presence of the member in some other specified class. If the database designer wished to signify for each client whether he was considered a special client (described earlier in the discussion of subclasses) a new member attribute of class CLIENT could be described that would assign the boolean value "yes" if the member in question was also a member of the class SPECIAL_CLIENTS or "no" otherwise.

Example

```
Is_special
    value class: YES/NO
    derivation: if in SPECIAL_CLIENTS
```

[up to CONSTANT; all] levels of values of ATTRIBUTE_NAME

Description

To describe the next clause "up to [CONSTANT;ALL] levels of value of ATTRIBUTE_NAME" a new attribute of CLIENT must be defined.

Relatives_who_are_clients will allow us to combine all the entities obtained by recursively tracing the values of Client_dependent_info·Name. This will provide a list of a client's children, the children's children, etc. The recursive process can be repeated a specified number of times (up to CONSTANT levels) or for all occurences (all levels). Although the syntax does not specify that a mapping can be used, a mapping is necessary to impart the proper meaning, thus the ".Name" enclosed in parentheses in the description of the attribute Relatives_who_are_clients. This then tells us that we must trace relatives by identifying those dependents that are also listed as clients. We must use the dependent's name as an identifier for CLIENT.

Example

```
Relatives_who_are_clients
    description: a recursive descent through Client_dependent_info
        that will produce a list of relatives who are also clients.
    value class: CLIENT
    derivation: all levels of values of Client_dependent_info (.Name)
```

Contents

Description

The last member-specified_derivation clause, "contents", is stated by Hammer and McLeod (4) to automatically exist when a grouping class is defined. "The value of this attribute is the collection of members (of the class underlying the grouping) that form the contents of that member"(4). To demonstrate the use and significance of "contents" we will have to add a member attribute to our definition of the class TYPE_OF_COMPANIES. The attribute Instances has as its members all

instances of companies which have the same value for Company_type.

Example

```
TYPE_OF_COMPANIES
    description: Type of companies represented by the agency.
    interclass connection: grouping of COMPANIES on  common
        value of Company_type groups defined as classes are . .
    member attributes:
        Instances
            description: the instances of the type of companies.
            value class: COMPANIES
            derivation: same as contents
            multivalued
```

CLASS_ATTRIBUTE

Syntax

```
CLASS_ATTRIBUTE <-
     <ATTRIBUTE_NAME>
       {ATTRIBUTE_DESCRIPTION}
       value class: CLASS_NAME
       derivation: CLASS_ATTRIBUTE_DERIVATION]}
       {single valued; multivalued {with size between CONSTANT
        and CONSTANT}}
       {may not be null}
       {not changeable}
```

Description

SDM recognizes two attribute types, member attributes (discussed previously) and class attributes. Member attributes describe properties belonging to each member of the class and class attributes describe properties of the class as a whole. Class attributes and member attributes share most of their formal description in common. The major difference is in the description of CLASS_SPECIFIED_DERIVATIONS and the lack of the follow two clauses in the class attribute description, "exhausts value class" and "no overlap in value".

Descriptions of those clauses shared in common can be found in the section discussing member attributes. The class-specified derivations will appear as a major topic and follows next.

CLASS-SPECIFIED_DERIVATION

Syntax

```
CLASS-SPECIFIED_DERIVATIONS
    [number of {unique} members in this class;
    [maximum;minimum;average;sum] of ATTRIBUTE_NAME over members of this
        class]
```

Description

The class-specified_derivations allow the database designer to maintain statistical information about the members of the class and attributes of the class. An example of the derivation "number of {unique} members in this class" appears in the description of the attribute Number_of_employees. The second derivation, "[maximum; minimum; average; sum] of ATTRIBUTE_NAME over members of this class" would be applied in the same fashion as its member-specified derivation counterpart. The statistical derivations maximum, minimum, average and sum in the original SDM syntax applied only to attributes with the value class NUMBERS. This restriction has been relaxed in this paper to allow for the summation of of attributes with the value class of DOLLARS.

Examples

```
Number_of_employees
    value class: INTEGERS
    derivation: number of members in this class
```

Chapter 5

SDM Application

Now that the reader has been introduced to the SDM DbDL, it is time to consider how to apply the SDM to an application domain. The first part of this chapter will provide a list of several steps that in the schema design process a database designer may follow. The designer follows these steps with repeated iteration of some steps to complete the schema.

The second part of this chapter will trace the use of these steps to develop the insurance agency schema. An exhaustive description of these steps would be cumbersome and inappropriate for this report. The steps will be presented in sufficient detail as to provide the reader with an understanding of what they involve.

Design steps

No definitive algorithm exists for the design of an SDM schema. McLeod (10) summarizes the design process by describing 3 principle tasks which must be accomplished. They are:

> "1. A core of classes containing basic things must be defined.
>
> 2. Families of related classes must be formed, using subclasses and grouping primitives . .
>
> 3. Associations among things must be expressed, using attribute inversion, attribute matching and classes."

Iteration of these tasks is necessary. These tasks have been further refined byMcLeod (11). A summarized list of the steps he suggests is given here:

1. Prepare an initial list of the classes, i.e., entities, events, that are to be present in the SDM database. The list should contain the objects and events (things of interest) that occur in the application environment. A brief description of each class should also be included with the list.
2. Examine the class list to determine subclasses and grouping-classes that exist or are implied by the list. This is accomplished by considering each class in the list and determining if there are any entities that are subclasses of the class in question or if the class in question suggests any abstract or aggregate classes whether as a class or as a member of such a class.

While perusing the class list, the database designer should look for similarities in classes which would suggest that they be collected into a common class. McLeod and King (11) refer to such a collection as a family and define a family in the following manner:

> "A family is a set of classes that all have, at some level of abstraction, a common type of member; that is , the members of each component of a family of classes belong to some common class."

The classes agent, subagent, office manager and office personnel, by virtue of common attributes would seem to form a meaningful family called Employee. Employee would thus become the parent class and agent, subagent, office manager and office personnel would be defined as subclasses of Employee. The primary consideration when looking for families of classes is to determine at what level of abstraction parent classes should be defined. Classes which describe fundamentally different things should not be defined as subclasses of the same class. Those classes which share common attributes become likely candidates as subclasses of a common parent class.

The degree of subclass differentiation must also be considered when defining classes and subclasses. For example, defining subagent as a subclass of agent which in turn is a subclass of Employee was considered inappropriate for our model. The database designer found it more appropriate and meaningful to define both as subclasses of the parent Employee. Such decisions are arbitrary and at some point can only be based onthe designer's intuition. However, McLeod and King (11) have provided the following suggestion:

> "A useful heuristic for determining the appropriate degree of specificity (i.e., differentiation) is that a subclass be defined if and only if one or both of the following are true:
>
> --- the members of the subclass have attributes that are not possessed by all of the members of its parent class.
>
> --- the subclass will often be manipulated as a meaningful unit."

New classes recognized at this point should be described as in step 1.

3. Produce a list of the aspects (attributes) of interest for each class in the class list. Each aspect must be identified as being an aspect of each member (member attributes) or as an aspect of the class as a whole (class attributes). The designer should provide as a minimum, a name for the attribute, a description of its meaning and should specify if the attribute is multi-valued (default is single-valued). Additional descriptors which may be specified at this time include: whether the attribute may have a null value; whether the value of the attribute is changeable; and in the case of a member attribute, whether every member of the underlying value class must be the value of some attribute (exhausts value class); and/or whether a specific value may be shared by other instances of the attribute (no overlap in values). These optional descriptors may be added later as additional insight into the nature of

the application environment is gained.

4. Assign a value class to each attribute identified in step 3. The designer should examine the class list established in step 1 to select the appropriate value class. If no such value class exists, a new class is added to the list and steps 1 through 3 are repeated for it.

5. Determine the interclass connections for the subclasses and groups defined in step 2. Subclass connections may be defined by applying a predicate on the other member attributes of the parent class (attribute-defined subclass), by the predicate "where specified" (user-controllable subclass), by a predicate on members of two other specified database classes (set-operator-defined subclasses) or by a predicate on current values of some attribute of another database class (existence subclass). The database designer must also guard against circular definitions when defining grouping classes. McLeod (11) provides the following recommendations when defining subclasses: 1) guard against circular definitions, e.g., defining a subclass, C1, of class C2 then later defining C2 as a subclass of C1; 2) it is desirable to define a subclass via a multiset operator using other classes that are of interest, this allows the subclass to inherit attributes from all of the classes involved; 3) multiple levels of subclasses should only be defined when the class at each level is of interest.

Grouping connections may be defined as all those classes having a common value for one or more designated member attributes (expression-defined grouping class); by explicitly specifying the classes which are members of the grouping class (enumerated grouping class) or by defining a grouping class that consists of user-controllable subclasses of some underlying class (a user-controllable grouping class). The last two methods differ in that in the enumerated grouping class all members of

those classes which constitute the grouping class are members of the grouping class. Members of a user-controllable grouping are those specific instances of a class which have been specified as being members of the grouping class.

6. Determine whether each attribute of every class is either primitive or derived. The value of a primitive attribute is directly modifiable by users. The value of a derived attribute can not be directly modified by a user. However, the value of only one attribute in an inverse interrelationship is modifiable and no attribute described with a match interrelationship is modifiable.

   Primitive member attributes may be further defined by the optional descriptors discussed in step 3 (e.g., may not be null, not changeable, exhaust value class, no overlap in values). Class attributes may be further defined by the optional descriptors "may not be null" and " not changeable".

   Derived attributes are assigned a derivation specification. Knowledge of the attribute's value class gained in step 4 will assist in selecting the appropriate derivation specification (see INTERATTRIBUTE_DERIVATION, MEMBER-SPECIFIED_DERIVATION AND CLASS-SPECIFIED_DERIVATION of Appendix A and B).If no appropriate derivation type can be found, auxiliary attributes may be defined. The database designer must repeat step 4 for each new attribute defined.

7. Select one or more member attribute to serve as a unique identifier for each base class if appropriate.

8. Identify all name classes, define each as subclass of either STRINGS or NUMBERS and apply derivation specifications if desired to further describe the class.

In brief, the steps described above can be summarized as follows:

1. Prepare an initial list of the entities (class list).
2. From the class list determine the subclasses and grouping classes of interest.
3. Identify member attributes and class attributes.
4. Assign a value class to each attribute.
5. Determine the interclass connection for subclasses and grouping classes.
6. Add descriptive options to primitive attributes, assign attribute interrelationship specifications if appropriate or and assign derivation specifications to derived attributes.
7. Select member attributes to serve as unique identifiers of appropriate base class.
8. Identify name classes, define them as subclasses of either STRING, INTEGER or NUMBERS, and apply derivation specifications as desired.

As new classes and attributes emerge, repeat the appropriate steps for each.

Application of the design steps

The remainder of this chapter will follow the evolution of the SDM schema for the insurance agency described in Chapter 3. The resulting schema appears in Appendix D. An exhaustive review of the design phase is impossible thus the following discussion will focus on the problems encountered. The reader is encouraged to examine Appendix D, refer to Appendix A and B, and study the discussion of the SDM syntax in Chapter 3 for a more thorough understanding of SDM.

Step 1

| 1. Prepare an initial list of classes of interest. |

On-site interviews and examination of the forms used by the enterprise revealed an initial set of entities and events which appear in figure 5-1.

Entities

Agent	Client
Subagents	Payment
Office manager	Client asset sheet
Office staff	Client file card
	Estate settlement worksheet
Insurance	Client courtesy cards
Annuities	
IRA's	Quarterly state of business report
Companies	Annual state of business report
Product license	Monthly cash-flow
Commission, subagent	
Commission, agent	

Events

Appointments	Client follow-up
Reinstatement follow-up	Replacement follow-up
Prospect letter follow-up	Annual reviews
Daily contacts	

Figure 5-1. A list of initial entities and events collected from on-site interviews and examination of forms used by the insurance agency.

Step 2

| 2. From the class list determine the subclasses, grouping classes and class families of interest. |

An interesting phenomenon which is obvious but often overlooked is the fact that as we discuss objects and events, we naturally tend to group like "things" together. We can use this phenomenon to our advantage during the on-site visit and while perusing the forms the enterprise uses. While compiling

the entity-event list (figure 5-1) the designer found that related "things" seemed to be grouped and such groups can be used when proceeding with step 2.

The first four entities (agent, subagent, office manager and office staff) suggested a family of classes which represent the Employees of the enterprise. This appears to be a convenient, natural grouping both intuitively and because they are likely to share common attributes. The designer must now decide the most appropriate level of abstraction in which to model this relationship.

One method of representing this relationship would be to define a new class that we shall call EMPLOYEE and define agent, subagent, office manager and office staff as subclasses of EMPLOYEE. We could then differentiate the various members of each subclass by specifying a unique value of some classification attribute (figure 5-2).

A second method of representing this relationship would be to treat each type of employee as members of a common class and assert their relationship, one to another, by describing them as members of an overlaying grouping class. Such an approach would provide the alternative represented in figure 5-3.

```
EMPLOYEE
   description all people who work for the agency.
   member attributes:
              :
     Status_of
        value class EMPLOYEE_TYPES
              :


AGENT
   description: The owner and primary agent of the
      enterprise.
   interclass connection: subset of EMPLOYEE where
      Status_of = "Agent"
              :
              :


SUBAGENT
   description:  people licensed to sell products and work
      for the primary agent.
   interclass connection:  subset of EMPLOYEE where Status_of =
     "subagent"
   member attributes:
              :
              :
```

Figure 5-2. Agent, subagents, office manager and office_staff described as subclasses of EMPLOYEE (attribute-defined subclasses).

```
EMPLOYEE
   description:  all people who work for the agency.
   member attributes
              :
     Status_of
         value class EMPLOYEE_TYPES
              :
              :

 EMPLOYEE_TYPES
    description:  groups of employees by type.
    interclass connection:  grouping of EMPLOYEE on common
       value of Status_of.
    member attributes:
              :
              :
```

Figure 5-3. Agent, subagents, office manager and office_staff implicitly described as groups of employees whose instances are the members of the groups that make up EMPLOYEE_TYPES (expression-defined grouping).

EMPLOYEE_TYPES could be defined as an expression-defined grouping class which would group the various employee types of the base class EMPLOYEE with respect to common values of a specific attribute of EMPLOYEE, e.g. Status_of. In this case the addition of a new employee type to the schema would require no further definition. All employees would then belong to the base class EMPLOYEE and nothing would distinguish one type from another except the value of the Status_of attitude.

A second example involving levels of abstraction is seen in the consideration of the entity Subagent. Should subagent be included within the base class EMPLOYEE as in figure 5-3? Should it be defined as a subclass of EMPLOYEE as in figure 5-2, or would it be more appropriate to define Subagent as a subclass of the subclass Agent? Is office manager a subclass of office staff? Because of the number of attributes each employee type have in common, it seems more natural for at least some of them to be modeled as subclasses of the parent class EMPLOYEE (figure 5-2). If we apply the heuristics mentioned in step 2 we might conclude that based on the difference in the way commissions are calculated Agent and Subagent should be treated as separate subclasses of the parent class EMPLOYEE. Because the attributes which describe office staff and office manager are the same, these two subclasses will be consolidated under office staff and the office manager will be distinguished in some other manner.

The next group of classes on the list --- insurance, annuities, IRA's --- are sufficiently different that they should be treated as separate base classes. However, they suggest a higher level grouping class that would be convenient if one wishes to treat all products offered by the enterprise as a single unit, e.g., total value of products sold. Collecting these classes into a grouping class would seem appropriate, however, none of the clauses available to use for defining a grouping class seem to fit. All grouping

predicates require that the classes constituting its description be defined as subclasses of some parent class. So if we wish to treat these three classes as a single unit, we cannot define them as separate base classes. It was decided that the agency desired information about these products only with respect to what individual clients owned and general information about products as a whole was not needed. Thus they were treated as value classes for attributes describing CLIENT.

A first assessment of the remaining classes on our list appears in figure 5-4. The results of applying step 2 to the initial list of classes appears in figure 5-5.

Step 3

| 3. Identify member attributes and class attributes. |

The database designer must now produce a list of the attributes for the classes listed above. Attributes of interest for the forms and reports can be determined directly from these articles. Most of the clients attributes can be ascertained from the client file card. Additional attributes of interest will have been obtained from those interviewed during the on-site visit. From these resources an initial list of attributes for each class can be produced. After this step a second visit to the enterprise should be planned to determine the validity of assumptions made up to this point and to discuss other issues which may have arisen.

Appendix C contains the results of step 3. Class descriptions have been included but attribute descriptions were intentionally omitted to elucidate each class and its attributes. It is important to include class and attribute descriptions as you proceed with the SDM schema. The designers soon realized that the descriptions offered in this Appendix C were inadequate when attempting to continue with the next steps in the design process. As we

proceed with the construction of the SDM schema the absolute necessity of comprehensive class descriptions (and attribute descriptions when appropriate) was realized. The grand design that the designers had in mind when the classes were identified was no longer self evident when it became time to piece the puzzle together. It was only after time was taken to regroup and, for all practical purposes, start again beginning with the list prepared in step 1 (figure 5-1) were the designers able to progress toward the completion of the schema.

Company -- base class

Product license -- value class of an attribute describing the products an agent is licensed to sell

Commission, agent and Commission subagent -- probably derived attributes of agent and subagent respectively.

Client -- base class

Payment -- subclass of events

Client asset sheet, client file card, cash flow statement, pro forma cash flow statement, policy record, statement of financial position, life insurance form and estate settlement worksheet -- forms used by the enterprise. Much of the data gathered on these forms are redundant and much is not needed within the database. The decision as to how much should be stored is a function of memory storage available and the frequency of use of each data item (data field). It was decided that the Policy record form and the Client file card are the only forms to be incorporated into the database. Data stored within the database which could be used by individuals when completing the other forms will be modeled within the database as summaries of each form.

Daily contact report -- this report is the event scheduler of the enterprise. All events listed have a close relationship to this report. (The name was later changed to DAILY_SCHEDULE.)

Appointments, Client follow-up, reinstatement follow-up, replacement follow-up, Prospect letter, Prospect letter follow-up, Annual review, Daily contacts -- subclasses of the base class event.

Quarterly state of business, Annual state of business, monthly cash flow -- subclasses of the base class event.

Figure 5-4: An initial assessment of the entities and events appearing in figure 5-1.

Base classes	Subclasses
Employee	Appointment
Products	Client follow-up
Companies	Reinstatement follow-up
Product license	Prospect letter
Client	Annual review
Policy record	Daily contacts
Client file card	Agent
Client asset sheet	Subagent
Client file card	Office staff
Cash flow statement	Insurance
Pro forma cash flow statement	Annuities
Policy record	IRA's
Statement of financial position	Payment
Life insurance form	Client asset sheet summary
Estate settlement worksheet	Cash flow statement summary
	Pro forma cash flow statement statement
	Statementoffinancial position summary
	Life insurance summary
	Estate settlement worksheet summary

Attributes	Grouping Classes
Commission, agent	none identified
Commission, subagent	

Figure 5-5. A list of entities and events described in terms of SDM categories.

Steps 4-6

4. Assign a value class to each attribute.
5. Determine the interclass connection for subclasses and grouping classes.
6. Add descriptive options to primitive attributes, assign attribute interrelationship specifications if appropriate or and assign derivation specifications to derived attributes.

The assignment of value classes, determining interclass connections and assigning derivation specifications claimed the bulk of the time required to design the SDM schema. All three steps resulted in the discovery of additional classes, the realization that some were not needed and the need to restructure others. Steps 2 through 6 were repeated numerous times as new avenues of expression were explored. In addition to the insight gained by creating the enhanced class and attribute descriptions, "clutter" was removed from the model by the decision to place commonly referenced groups of attributes into their own classes.

An examination of Appendix C will reveal a number of classes that share common groups of attributes (at least they have the same attribute names). The SDM model allows the use of non-unique attribute names as long as they occur in different class hierarchy. In other words, attributes with the same names cannot be related by grouping classes or subclasses. We have not determined the interclass connections for our model as yet but having just compiled a list of classes and their associated attributes we have an idea of the attributes that are identical within different class definitions. It is both cumbersome and somewhat ambiguous to repeatedly reference each individual attribute within these groups when we describe a class. The group of attributes consisting of Name_of_agent, Client_name, Policy_name and Policy_type is used in the description of five different classes (APS_FOLLOW-UP, CLIENT_FOLLOW-UP, OUT_OF_TOWN_FOLLOW-UP, REINSTATEMENT_FOLLOW-UP, and REPLACEMENT_FOLLOW-Up). It is obvious to those currently involved with the construction of this conceptual model that the attributes are the same in all

five descriptions, this is not to say that they represent the same instances in all five classes, but rather, they share the same value class. However, a new applications programmer or a new employee wishing to understand the function and relationships of "things" within the enterprise will not share such insight. Recognizing that these groups of attributes appear frequently and wishing to exploit SDM's capabilities to impart meaning into a conceptual schema the database designers decided to place commonly referenced groups of attributes into their own classes. Now when a reference is made to the four attributes, Name_of_agent, Clients_name, Policy_type, and Company, a new attribute description is used with a value class of POLICY_INFO_FOR_FOLLOW-UP which will contain the above mentioned attributes. As a result of collecting commonly used attributes into their own class six "attribute" classes were added to our schema. The new classes are described at the bottom of Appendix C and are proceeded by a number. The number corresponds to the number enclosed in parentheses behind attributes which were initially defined in other classes and are now part of the new class definitions.

It is important to remember that the "attribute" class was introduced to conceptually "save space" in the schema and to enhance the understanding of these attributes and the role they play in the schema. We save space by placing attributes which are commonly referenced together into a single class. We enhance understanding by emphasizing the fact that they are indeed the same attributes that are being referenced in several class definitions. The designers and users of the model must be comfortable with the fact that attributes which were partitioned into "attribute" classes are still part of the original class description in which they now appear as a value class. If this detracts from the understanding of the model then the members of the "attribute" class should be moved back into the original class descriptions.

Although the addition of attribute classes clarified some aspects of the

schema it complicated the match derivation. The syntax for the match derivation is as follows:

match: ATTRIBUTE_NAME of CLASS_NAME on ATTRIBUTE_NAME

Mapping and a type of reverse mapping were needed to accommodate matching on attributes that are members of an attribute class. A portion of the description of the class INSURANCE_APPLICATION_INFO_SUMMARY demonstrates the extended matching derivation (figure 5-6).

The client's home address (Client_address) is contained within the database and is derivable by assuming the value of the attribute Home_address which is a member of the attribute class PERSONAL_INFO (figure 5-7). PERSONAL_INFO is the value class of Client_personal_info which is an attribute of CLIENT (figure 5-8). The description of CLIENT also contains Client_name as an attribute. Thus by matching Client_name of INSURANCE_APPLICATION_INFO_SUMMARY with Client_name of CLIENT the attribute Client_address may be obtained. This match description is also represented in a diagram in figure 5-9. In this match example the class CLIENT is specified as the source of the information and a mapping is used to specify the attribute containing the information ("match: Client_personal_info.Home_address of CLIENT on Client_name").

The description of Spouse_name (figure 5-7) demonstrates another match approach. This value also resides within the database and may be obtained by knowing the name of the client whose spouse's name we seek. The same attribute class as above is being queried, however, it is named explicitly as the source of the information in a reverse manner. The phrase "Client_name (of CLIENT)" is a form of reverse mapping that tells us where to find Client_name

```
INSURANCE_APPLICATION_INFO_SUMMARY
  description: That data stored in the database that would be of
     use when filling out an insurance application form for a
     current client.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Home_address of CLIENT on
           Client_name
     Spouse_name
        value class: PERSON_NAMES
        match: Name_of_spouse of SPOUSE_INFO on Client_name (of
           CLIENT)
     Spouse_date_of_birth
        value class: DATES
        match: Client_spouse_info.Date_of_birth of CLIENT on
           Client_name
     Dependents_name
        value class: PERSON_NAMES
        match: Name_of_dependent of DEPENDENT_INFO on Client_name
           (of CLIENT)
     Dependents_date_of_birth
        value class: DATES
        match: Client_dependent_info.Date_of_birth of CLIENT on
           Client_name
     Spouse_amount_insurance
        description: If it is assumed that if the spouse is also
           a client then a record of total insurance owned should
           also be present for the spouse. This value is
           derivable by matching Spouse_name to Client_name in
           CLIENT_FILE_CARD.
        value class: DOLLARS
        match: Total_insurance_owned of POLICY_RECORD on Spouse_name
                    :
                    :
```

Figure 5-6. Partial description of the class INSURANCE_APPLICATION_INFO_SUMMARY excerpt from Appendix D.

```
PERSONAL_INFO
  description: The personal information relevant to each person,
     both client and employee.
  member attributes:
     Home_address
        value class: ADDRESSES
     SSN
        value class: SOCIAL_SECURITY_NUMBER
     Phone_number
        value class: PHONE_NUMBERS
     Date_of_birth
        value class: DATES
```

Figure 5-7. Description of the class PERSONAL_INFO excerpt from Appendix D.

```
CLIENT
  definition: individuals who purchase products from the
     enterprise.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_personal_info
        value class: PERSONAL_INFO
     Client_spouse_info
        value class: SPOUSE_INFO
     Client_dependent_info
        value class: DEPENDENT_INFO
                  :
                  :
```

Figure 5-8. Partial description of the class CLIENT excerpt form Appendix D.

```
SPOUSE_INFO
  description: That information relevant to a client's or
     employee's spouse.
  member attributes:
     Name
        value class: PERSON_NAMES
     Home_address
        value class: ADDRESSES
     Phone_number
        value class: PHONE_NUMBERS
     Date_of_birth
        value class: DATES
```

Figure 5-10. Description of the class SPOUSE_INFO excerpt from Appendix D.

because it is not an attribute of the class SPOUSE_INFO (figure5-10). This match description is also represented in the diagram in figure 5-9. The above examples of the match derivation were adapted for use with attribute classes and were thus extensions to the SDM syntax offered by Hammer and McLeod (4).

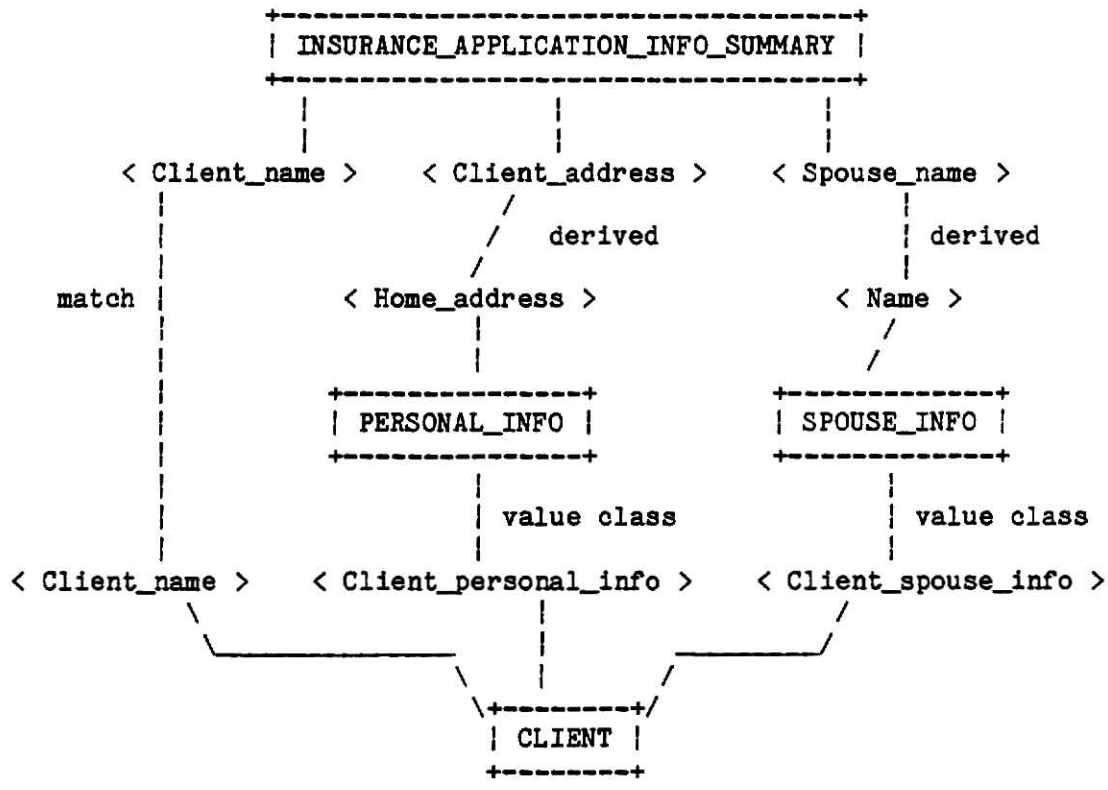


Figure 5-9: Illustration of a match attribute interrelationship, attributes are enclosed in "< >" and classes are enclosed in boxes. The values of the attributes Home_address and Spouse_name in the class INSURANCE_APPLICATION_INFO_SUMMARY are derived by matching the values of Client_name. The derivation path leads from an attribute through its value class to a specific attribute of the value class.

Another peculiarity was encountered in the description of Spouse_amount_insurance (figure 5-6), however, this was not due to the use of attribute classes. If the spouse is also a client then the amount of insurance owned by the spouse which was sold by this agency should also be derivable. A match is specified which would obtain the value of the attribute

Total_insurance_owned of the class POLICY_RECORD (figure 5-12) by matching the value of Spouse_name with its representation (the attribute Client_name) within POLICY_RECORD. This match description is represented in the diagram in figure 5-11. One must be well versed in the syntax of the match derivation to fully understand the intended match.

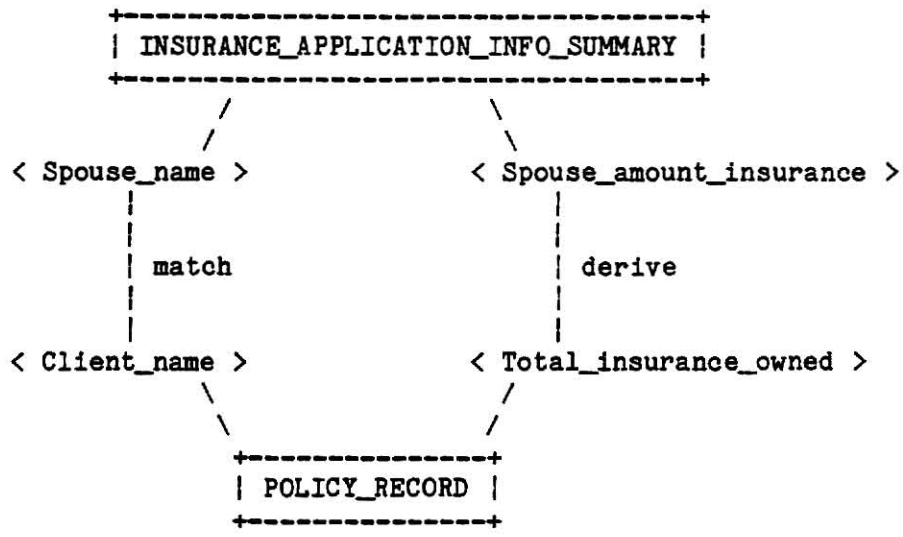


Figure 5-11: Illustration of a match attribute interrelationship, attributes are enclosed in "< >" and classes are enclosed in boxes. The value of the attribute Spouse_amount_insurance in the class INSURANCE_APPLICATION_INFO_SUMMARY is derived by matching the value of Spouse_name to a value of Client_name of the class POLICY_RECORD. This particular approach to deriving an attribute's value is unusual because of the match of dissimilar attribute names.

The database designers were also unable to develop a meaningful description of DAILY_SCHEDULE (figure5-13) and Contact_record of CLIENT_FILE_CARD(figure 5-14) using the SDM syntax provided by Hammer and McLeod (4). The daily schedule was to contain a reference to all events, e.g., appointments, follow-ups, etc., for each day. To do this, values from the above mentioned classes had to be collected based on the current day's

```
POLICY_RECORD
  description: a collection of specifications about insurance policies
     owned by each client. The POLICY_RECORD class will act as the master
     record of each policy sold.
  member attributes:
     Client_name
        value class: PERSON_NAMES
                  :
                  :
     Total_insurance_owned
        value class: DOLLARS
        derivation: sum of Face_amount
                  :
                  :
```

Figure 5-12. Partial description of the class POLICY_RECORD excerpt from Appendix D.

```
DAILY_SCHEDULE
   description: A schedule of events (follow-ups, appointments, etc.) that
      are to occur on the current day.
   member attributes:
      Event
         value class: APS_FOLLOW-UP, REINSTATEMENT_FOLLOW-UP,
            PROSPECT_FOLLOW-UP, REPLACEMENT_FOLLOW-UP, OUT_OF_TOWN_FOLLOW-UP,
            ANNUAL_REVIEW, CLIENT_COURTESY_CARD, OTHER_APPOINTMENTS
         derivation: where Date_of_next_action = Today's_date
         **** Note: This is not part of the SDM syntax. ****
      Today's_date
         value class: SYSTEM_DATE
                  :
                  :
```

Figure 5-13. Partial description of the class DAILY_SCHEDULE, excerpt from Appendix D.

date. Originally these classes were to be described as subclasses of some overlaying parent class. However, this approach became extremely complicated when it came to describing various scheduling criteria and dealing with different attribute names which essentially described the same attributes, e.g., Date_of_next_action. It was more meaningful to describe each event as a separate base class thus allowing the use of similar attribute names. Subsequently, one can specify multiple value classes for the attributes Event of DAILY_SCHEDULE and finally gather all events scheduled for the current day by the derivation "where Date_of_next_action = Today's_date". A similar procedure is used in the description of Client_record of CLIENT_FILE_CARD where all events involving a single client are collected by the derivation "where Client_name = Client_name (of the appropriate class)".

```
CLIENT_FILE_CARD
  description: a summary of the client attributes, history of
     client contacts and a summary of POLICY_RECORD. Most
     attributes pertaining to insurance will be derived from
     attributes of POLICY_RECORD based on a match with
     Policy_number of CLIENT_FILE_CARD_POLICY_INFO. Those
     attributes pertaining to the client will be derived from
     attributes of CLIENT based on a match with Client_name.
  member attributes:
     Client_name
        value class: PERSON_NAMES
                     :
                     :
     Contact_record
        value class: APS_FOLLOW-UP, REINSTATEMENT_FOLLOW-UP,
           PROSPECT_FOLLOW-UP, REPLACEMENT_FOLLOW-UP,
           OUT_OF_TOWN_FOLLOW-UP, ANNUAL_REVIEW,
           CLIENT_COURTESY_CARD, OTHER_APPOINTMENTS
        match: Event of DAILY_SCHEDULE on Client_name (of
           appropriate class)
        **** Note: This is not part of the SDM syntax. ****
```

Figure 5-14. Partial description of the classes DAILY_SCHEDULE and CLIENT_FILE_CARD excerpt from Appendix D.

Steps 7-8

| 7. Select member attributes to serve as unique identifiers of appropriate base class.
| 8. Identify name classes, define them as subclasses of either STRING, INTEGER or NUMBERS, and apply derivation specifications as desired.

The selection of identifiers for base Classes is mostly straight forward, however the use of attribute classes did cause a problem. The use of an attribute class (class 6 of Appendix C) to gather common attributes of events resulted in the identifier, Client_name, for the events being placed in the attribute class POLICY_INFO_FOR_FOLLOW-UP. At some later date, it may be desirable to collect all events scheduled for a specific agent on a given day, thus Name_of_agent is another potentially useful attribute which was also placed into POLICY_INFO_FOR_FOLLOW-UP. Rather than introduce a mapping as an identifier, it was decided that the class POLICY_INFO_FOR_FOLLOW_UP be deleted and its 5 attributes would be returned to the event descriptions from which they came. These classes appear in Appendix C and have certain attribute names which are followed by the number 6.

Identifiers are optional and it was thus decided that identifiers for the "attributes" classes discussed previously were not appropriate. The description of name classes is also straight forward and will not be elaborated upon. However, the description of name classes and the selection of identifiers should not be necessarily postponed until last.

Summary

The design steps provide some guidelines for applying the DbDL to the application domain. It was immediately recognized that exhaustive descriptions were essential to the schema's successful completion. Attribute classes provided a convenient and conceptually sound means of representing commonly referenced groups of attributes. Discovered shortcomings include:

1) The SDM's lack of facilities for manipulating times and dates; 2) The lack of a convenient means for grouping dissimilar entities; and 3) A need for some type of automated tool to assist the designer in the application process.

Chapter 6

Converting an SDM model into a relational model

This chapter will briefly outline the steps that were taken to convert the insurance agency schema into a relational model. Because the focus of the report is on the development of a conceptual model, only a few paragraphs will be spent discussing this conversion.

We assume that the system will be implemented on a microcomputer. With this as a guide our ultimate objective will be to minimize data storage requirements. Our initial implementation will minimize the amount of data redundancy within the database. At a later date if it is determined that certain redundancy is necessary to improve efficiency, the implementation will be modified. With this criteria in mind we will proceed with the conversion.

In order to reduce the bewilderment fostered by 26 pages of SDM schema (Appendix D) we will eliminate consideration of all derived attributes. They will be calculated or otherwise retrieved from the database by the applications programs which will access the database. If you are interested in achieving domain/key normal form (8), the name classes may be rewritten as domain definitions. We will not attempt a domain/key representation of this application environment, thus the name classes may be set aside as external documentation. They will not be directly represented within the model.

Having eliminated all derived attributes and name classes, we find that the number of classes and attributes with which we must deal is greatly reduced. A list of the remaining classes appears in figure 6-1.

All base classes which were not attribute classes (those classes containing groups of commonly referenced attributes) become relations. All single valued attributes that are not derived become tuples within the relation (figure 6-2).

```
ADDRESS
  House#_Apt#
  Street_Route
  State
  Zip_code

AGENT_INFO
     Clients_of
     Licensed_with

ANNUAL_REVIEW_SCHEDULE
     Client_name
     Date_of_last_review
     Date_of_appointment
     Time_of_appointment
  identifiers:
      Client_name
        + Date_of_appointment

ANNUITY_INFO
     Company
     Annuity_identification
     Annuity_value

APS_FOLLOW-UP
     Policy_number
     Policy_type
     Name_of_doctor
     Doctors_phone
     Date_of_next_action
     Date_of_last_action
     Last_action
  identifiers: Client_name
               + Policy_number

CASH_VALUE_AT_AGE
     Age
     Guaranteed_value
     Total_value

CASH_VALUE_FIRST_DATE
     Date
     Guaranteed_value
     Total_value

CASH_VALUE_SCHEDULE
     Value_first_date
     Value_second_date
     Value_at_specific_age

CASH_VALUE_SECOND_DATE
     Date
     Guaranteed_value
     Total_value

CLIENT
     Client_name
     Client_personal_info
     Client_spouse_info
     Client_dependent_info
     Client_business_info
     Miscellaneous_information
     Annuities_owned
     IRA's_owned
     Agent_of_record
  identifiers: Client_name

CLIENT_BUSINESS_INFO
     Occupation
     Phone_number
     Address

CLIENT_FILE_CARD
     Client_name
     Referred_to_agency_by
     Reference_phone
     Miscellaneous_information
     Approximate_income
     Best_time_to_contact_at_home
     Best_time_to_contact_at_work
     Contact_record
  identifiers: Client_name

CLIENT_FILE_CARD_POLICY_INFO
     Policy_number
     Mode_of_premium_payment

COMPANIES
     Company_type
     Company_name
     Company_address
     Company_phone
     Products_offered
  identifiers: Company_name

DEBITS
     Debit_date
     Debit_amount
     Description_of_expenditure
     To_whom_charged
```

Figure 6-1:Classes remaining after eliminating derived attributes.

```
DEPENDENT_INFO
     Name
     Date_of_birth

EMPLOYEE
     Employee_name
     Employee_personal_info
     Employee_spouse_info
     Employee_dependent_info
     Date_joined_company
     Status_of
     Pay
  identifiers: Employee_name

IRA_INFO
     Company
     IRA_identification
     IRA_value

LOAN_INFO
     Loan_amount
     Loan_interest

OTHER_APPOINTMENTS
     Name_of_agent
     Client_name
     Date_of_appointment
     Time_of_appointment
     Description_of_appointment
     Next_date_of_action
   identifiers:
       Client_name
         + Date_of_appointment

OUT_OF_TOWN_FOLLOW-UP
     Client_name
     Policy_number
     Date_of_next_action
     Date_policy_sold
  identifiers:
      Client_name
        + Date_policy_sold

PERSON_NAMES
     Title
     First
     Middle
     Last

PERSONAL_INFO
     Home_address
     SSN
     Phone_number
     Date_of_birth

POLICY_RECORD
     Client_name
     Policy_number
     Type
     Company
     Face_amount
     Date_of_issue
     Age_of_issue
     Primary_beneficiary
     WP_rider
     Dividend_option
     Gross_yearly_premium
     Add_rider
     Cpd_rider
     Apl_rider
     Contingent_beneficiary
  identifiers:
      Client_name
        + Policy_number

PROSPECT_FOLLOW-UP
     Name_of_prospect
     Prospect_phone
     Contact_made
     Date_of_contact
  identifiers: Name_of_prospect

PROSPECT_LETTER
     Name_of_agent
     Name_of_prospect
     Address_of_prospect
     Type_of_product
     Date_mailed
  identifiers: Name_of_prospect

REINSTATEMENT_FOLLOW-UP
     Client_name
     Policy_number
     Date_of_next_action
     Date_notified_of_delinquency
   identifiers: Client_name
```

Figure 6-1 continued

REPLACEMENT_FOLLOW-UP
Client_name
Policy_number
Date_of_next_action
identifiers: Client_name

SPOUSE_INFO
Name
Home_address
Phone_number
Date_of_birth

Figure 6-1 continued

Next we will consider the best representation of the attribute classes. We may 1) move all attributes described with an attribute class back into their original parent class; 2) represent the value class of a multivalued attribute as a separate relation; 3) represent multivalued attributes within an attribute class as their own relations and return the remaining attributes to their parent class; represent the attribute class as a separate relation even though it is not the value of a multivalued attribute.

The attributes of attribute classes which are single valued will be placed back into their parent class. These attributes are denoted by having the attribute class name from which they came as part of their name, e.g., PERSONAL_INFO.PERSON_NAMES.First, LOAN_INFO.Loan_amount. The class PERSON_NAME, ADDRESS, LOAN_INFO, CASH_VALUE_AT_AGE, CASH_VALUE_FIRST_DATE and CASH_VALUE_SECOND_DATE exemplify this type of attribute class. Examples of value classes that became separate relations include ANNUITY_INFO, IRA_INFO and DEPENDENT_INFO. Individual multivalued attributes that were placed into their own relations include: Licensed_with (of AGENT_LICENSED_WITH), Client_name (of AGENT'S_CLIENTS) and Products_offered (of COMPANY_PRODUCTS_OFFERED). Other single valued attribute classes which were left as separate relations were SPOUSE_INFO, CLIENT_BUSINESS_INFO, and PERSONAL_INFO. You will notice that in all situations when relations other than the major base classes were constructed, identifiers had to be included within the tuples.

It can be seen from this example that converting the SDM schema to a

relational model was not that complicated. If we had been concerned about normal forms the procedure would have required additional attention. (Second normal form was achieved in this demonstration.)

ANNUAL_REVIEW_SCHEDULE(Client name,Date of appointment,
Date_of_last_review,Time_of_appointment)

APS_FOLLOW-UP(Policy number,Name_of_doctor,Doctor's_phone,
Date_of_next_action,Date_of_last_action,Last_action,APS_number)

CLIENT(Client name,Miscellaneous_information,Agent_of_record)

CLIENT_FILE_CARD(Client name,Referred_to_agency_by,Reference_phone,
Miscellaneous_information,Approximate_income,
Best_time_to_contact_at_home,Best_time_to_contact_at_work)

COMPANIES(Company name,Company_type,ADDRESSES.House#_Apt#,
ADDRESSES.Street_Route,ADDRESSES.State,ADDRESSES.Zip_code,
Company_phone)

COMPANY_PRODUCTS_OFFERED(Company name,Products_offered)

CREDITS(Credit date,Credit amount,Source of credit,
Person responsible)

DEBITS(Debit date,Debit amount,Description of expenditure,
To whom charged)

EMPLOYEE(Employee name,PERSONAL_INFO.PERSON_NAMES.Name_title
PERSONAL_INFO.PERSON_NAMES.Name_First,
PERSONAL_INFO.PERSON_NAMES.PERSONAL_INFO.Name_Middle
PERSONAL_INFO.PERSON_NAMES.PERSONAL_INFO.Name_Last
Date_joined_company,Status_of,Pay)

OTHER_APPOINTMENTS(Name of agent,Date of appointment,Client name,
Time_of_appointment,Description_of_appointment,Next_date_of_action)

Figure 6-2: Insurance agency relational model.

OUT_OF_TOWN_FOLLOW-UP(Client name,Date policy sold,Name_of_agent,
Policy_number,Date_of_next_action,)

POLICY_RECORD(Policy number,Client_name,Type,Company,Face_amount,
Date_of_issue,Age_of_issue,Primary_beneficiary,WP_rider,
Dividend_option,Gross_yearly_premium,Add_rider,Cpd_rider,Apl_rider,
LOAN_INFO.Loan_amount,LOAN_INFO.Loan_interest,CASH_VALUE_AT_AGE.Age,
CASH_VALUE_AT_AGE.Guaranteed_value,CASH_VALUE_AT_AGE.Total_value,
CASH_VALUE_FIRST_DATE.Date,CASH_VALUE_FIRST_DATE.Guaranteed_value,
CASH_VALUE_FIRST_DATE.Total_value,CASH_VALUE_SECOND_DATE.Date,
CASH_VALUE_SECOND_DATE.Guaranteed_value,
CASH_VALUE_SECOND_DATE.Total_value,Contingent_beneficiary,
CLIENT_FILE_CARD_POLICY_INFO.Mode_of_premium_payment)

PROSPECT_FOLLOW-UP(Name of prospect,Date of contact,Prospect_phone,
Type_of_product,Contact_made,)

PROSPECT_LETTER(Name of prospect,Date_mailed,Name_of_agent,
PERSON_NAMES.Title,
PERSON_NAMES.Name_First,PERSON_NAMES.Name_Middle,
PERSON_NAMES.Name_Last,ADDRESSES.House#_Apt#,
ADDRESSES.Street_Route,ADDRESSES.State,ADDRESSES.Zip_code,
Type_of_product,)

REINSTATEMENT_FOLLOW-UP(Client name,Policy_number,
Date_of_next_action,Date_notified_of_delinquency)

REPLACEMENT_FOLLOW-UP(Client name,Policy_number,Date_of_next_action)

AGENT'S_CLIENTS(Agent name,Client_name)

AGENT_LICENSED_WITH(Agent name,Licensed_with)

ANNUITY_INFO(Name of owner,Company,Annuity_identification,
Annuity_value)

CLIENT_BUSINESS_INFO(Client name,Occupation,Phone_number,
ADDRESSES.House#_Apt#,ADDRESSES.Street_Route,ADDRESSES.State,
ADDRESSES.Zip_code)

Figure 6-2 continued

```
DEPENDENT_INFO(Parent_name,PERSON_NAMES.title,PERSON_NAMES.First,
     PERSON_NAMES.Dependent_Middle,PERSON_NAMES.Dependent_Last,
     Date_of_birth)


IRA_INFO(Owner_name,Company,IRA_identification,IRA_value)


PERSONAL_INFO(Name,PERSON_NAMES.Title,PERSON_NAMES.Name_First,
     PERSON_NAMES.Name_Middle,PERSON_NAMES.Name_Last,
     ADDRESSES.House#_Apt#,ADDRESSES.Street_Route,ADDRESSES.State,
     ADDRESSES.Zip_code,SSN,Phone_number,Date_of_birth)


SPOUSE_INFO(Client_name,Name,PERSON_NAMES.Title,
     PERSON_NAMES.Spouse_First,PERSON_NAMES.Spouse_Middle,
     PERSON_NAMES.Spouse_Last,ADDRESSES.House#_Apt#,
     ADDRESSES.Street_Route,ADDRESSES.State,ADDRESSES.Zip_code,
     Phone_number,Date_of_birth)
```

Figure 6-2 continued

Chapter 7

Conclusion

This final chapter will review several of the ideas discussed in previous chapters as well as present suggestions for an automated SDM design tool. The SDM DbDL proved to be an adequate tool for modeling most of the situations encountered within this application domain. However, several shortcomings were discovered that are worthy of further discussion.

The SDM does not support the manipulation of dates. In order to increment a date by a constant, the date must be stored as a number which implies Julian dates. Julian dates are not natural in a business environment. This then would require the description of a function that would convert Gregorian dates to Julian dates, add the appropriate time increment and convert back to Gregorian dates. The aforementioned function would have to be modified to allow for applications which dealt with update increments of less than 24 hours. Another problem arises when one wishes to model the incremental updates in working days rather than simply n days in the future.

SDM does not provide adequate constructs for the aggregation of dissimilar time and date attributes into a sequence of events. The various follow-ups, the client annual review, and appointments could not be collected together as a simple multivalued attribute. Grouping predicates were inadequate in that they required all members of the aggregation to be defined as subclasses of an underlying class. This stipulation then required that unique names be given to the various follow-up attributes which denoted the date of next action. With different attribute names no derivation could be found within the syntax defined that would allow the integration of the dates into a common list. If all follow-ups were defined in one class and thus being differentiated from one another by the value of a member attribute, the

date of next action for each follow-up could thus be defined as another member attribute. A class attribute could then be defined as a derivation of the date of next action ordered by date or equal to a specified date but there is no way to selectively update the date of next action with the appropriate time increment.

When a situation is encountered that cannot be adequately modeled by strictly following the DbDL syntax, there are two courses of action that can be taken: 1) Construct the model up to the point of conflict, define the attributes and/or classes involved, and describe the circumstances or actions that must be applied to the attributes within the description clause; 2) Define an extension to the DbDL syntax. In most cases the unusual situations which cannot be modeled by SDM will be an application's consideration, not a database consideration.

The present DbDL syntax forces the db designer to use the same name in both classes for the matching attribute. In several instances within the insurance agency schema, attribute values were derived by matching on the client's name. In step 3 of the application of the SDM (chapter 5) the designer is instructed to list the attributes for each class. Finally, in step 6, the designer is asked to identify attribute interrelationships (inverse or match) and at this time it is realized that attributes that are the subject of a match must have the same attribute name. This discovery required several name changes within the insurance agency schema. Specifically, it was found that a client's name had been represented as Client_name and Name_of_Client in almost equal proportions. Because the name of the client is used extensively for matching, its identifier was standardized as Client_name.

Arguments can be made in favor of standardization if for no other reason than it enhances understanding. However, the designer should be allowed the

freedom of assigning attribute names based upon their role or based upon what is familiar to the end user. No practical solution to this dilemma is suggested other than perhaps including a step 0 to the design steps which would read:

0. Read all of the steps before continuing.

The addition of this new step provides a perfect lead into the discussion of the topic concerning iterative use of the design steps. It is unfortunate but often true that new concepts or procedures are not fully understood until they have been put to use. It was necessary for me to blunder through the design steps several times before fully appreciating what they implied. The most useful lesson learned was to keep subsequent steps in mind while performing each other step. Knowledge of what comes next helps in avoiding certain pit falls such as the attribute naming problem just discussed. However, knowing the steps that follow at times led to being sidetracked into describing a class in its finest detail which included describing supporting classes in their finest detail. This soon led to utter chaos. The chaos resulted from forgetting plans for the other classes.

In (11) it is suggested that related attributes be grouped together in some type of hierarchy. The example is one of the attribute Size of class SHIP which in turn has attributes Length and Draft. In this highly redundant insurance environment, there are many classes which share common attributes. This was pointed out in Chapter 5. The designers chose to group these common attributes into classes of their own and reference them as a value class. A problem arises when one wishes to reference one of the attributes that is tucked away as an attribute of a value class. To one unfamiliar with SDM or to a casual user a reference to one of these attributes is unclear and confusing. Such a situation prompted the modifications to the match

derivation discussed in Chapter 5 and demonstrated in figure 5-6. Two modifications were suggested to remedy the situation. One would apply the use of mapping, and the second would provide a means for identifying the class to which the match attribute belonged (figure 7-1). Suggested DbDL changes appear in figure 7-2.

```
Spouse_name
   value class: PERSON_NAME
   match: Client_spouse_info.Name of CLIENT on Client_name
```

or

```
Spouse_name
   value class:  PERSON_NAMES
   match:  Name SPOUSE_INFO on Client_name of CLIENT
```

Figure 7-1: Alternative descriptions of a match descriptor using proposed syntax extensions illustrated in Figure 7-1.

```
match:  Mapping of CLASS_NAME on ATTRIBUTE_NAME
```

or

```
match: ATTRIBUTE_NAME of CLASS_ NAME on ATTRIBUTE_NAME of CLASS_NAME.
```

Figure 7-2 Proposed modifications to SDM DbDL to accommodate matching within attribute classes.

The reader will notice that the class targetted as containing the desired information is different depending upon the method of representation chosen. The class CLIENT is the target in the first example which uses mapping to ultimately identify the attribute containing the value desired. The class SPOUSE_INFO is the target in the second example which requires that the location (class containing the attribute) of the match attribute be specified.

Although the introduction of attribute classes has caused some DbDL

problems, it is not without precedent (5). Attribute classes are extremely useful conceptual descriptors. How would the notion of multiple dependents (Client_dependent_info of CLIENT Appendix D), all with their own unique attribute values, be modeled without the use of the attribute class DEPENDENT_INFO? Or, how would all the information pertaining to each insurance policy, annuity or IRA owned by each client be represented conceptually without the use of their corresponding attribute classes? Other examples include Client_annuities of INSURANCE_APPLICATION_INFO_SUMMARY; Loan_info of POLICY_RECORD; Client_policy_info of CLIENT_FILE_CARD; Client_dependent_info of Client; Employee_dependent_info of EMPLOYEE; etc.

In summary, the SDM is an extremely useful and semantically rich modeling tool. However, even though its designers attempted to keep it as simple as possible with a minimum amount of syntax, the SDM isunwieldy and complicated. The lack of strictly enforceable design steps allows a designer to become easily sidetracked and muddled in detail. The only recourse one has is to justify the creation of each class and attribute and detail their intended use within the description of each. For those who have already been concerned with implementation details in other projects, casual use of the SDM can lead to confusion between conceptual modeling and implementation considerations. It is very easy to project past conceptual considerations and allow implementation issues to restrict and limit the semantic potential of the SDM.

It is already apparent that extensions to the SDM will be necessary to accommodate unique situations. The addition of new constructs should be closely scrutinized. It is easy to envision adding DbDL extensions ad infinitum in lieu of solving complicated problems or special case descriptions with the established DbDL.

Future work

Although the SDM is by comparison simpler to understand and use than Sowa's conceptual graphs, it is apparent from the schema developed in this report that a thorough description of an application environment can become quite complicated. If the SDM is to blossom as a usable conceptual modeling tool, it must be incorporated into an interactive computer program. Arguments supporting this premise have already been presented in this chapter. Ideally an interactive SDM system would contain the following features:

--- A menu driven mode of operation which would provide each alternative available at each stage of a class description. As information is gathered it will be added to a growing knowledge base which will be used to enforce the DbDL syntax.

--- The system would not require that a class be described in its entirety at any one time. The designer may choose to simply enter all class names; or may choose to describe each class in its entirety or any level in between. The system would keep track of the stage of development of each class and could be queried as to the status of each class description or provide detailed reports similar to the "who references what" reports available from some data dictionary systems.

--- The system should provide some form of graphic representation of the developing schema. A hierarchical or network representation might be the most appropriate.

--- For inexperienced users or students the system could provide examples from an existing SDM schema to illustrate the use of specific parts of the DbDL syntax.

--- It should provide a means for defining and incorporating extensions to the DbDL.

--- An option that would allow generation of logical schema of your choice

from the SDM schema would be nice, but realistically the break down of the SDM schema into the beginnings of a relational model would be most likely within the scope of such a system.

Appendix A

Syntax of the SDM Data Definition Language [1/]

1. The left side of a production is separated from the right by a "<-".
2. The first level of indention in the syntax description is used to help separate the left and right sides of a production; all other indentation is in the SDM data definition language.
3. Syntactic categories are capitalized while all literals are in lowercase.
4. {} means optional.
5. [] means one of the enclosed choices must appear; choices are separated by a ";" , when used with "{}" one of the choices may optionally appear.
6. <> means one or more of the enclosed can appear, separated by spaces with optional "and" at the end.
7. <<>> means one or more of the enclosed can appear, vertically appended.
8. * * encloses a "meta"-description of a syntactic category , to informally explain it.

```
SCHEMA <-
   <<CLASS>>

CLASS <-
   <CLASS_NAME>
     {description: CLASS_DESCRIPTION}
     {[BASE_CLASS_FEATURE;INTERCLASS_CONNECTION]}
     {MEMBER_ATTRIBUTE}
     {CLASS_ATTRIBUTE}

CLASS_NAME <-
   *string of capitals possibly including special characters*

CLASS_DESCRIPTION <-
   *string*

BASE_CLASS_FEATURE <-
   {[duplicates allowed; duplicates not allowed]}
   {<<IDENTIFIERS>>}
```

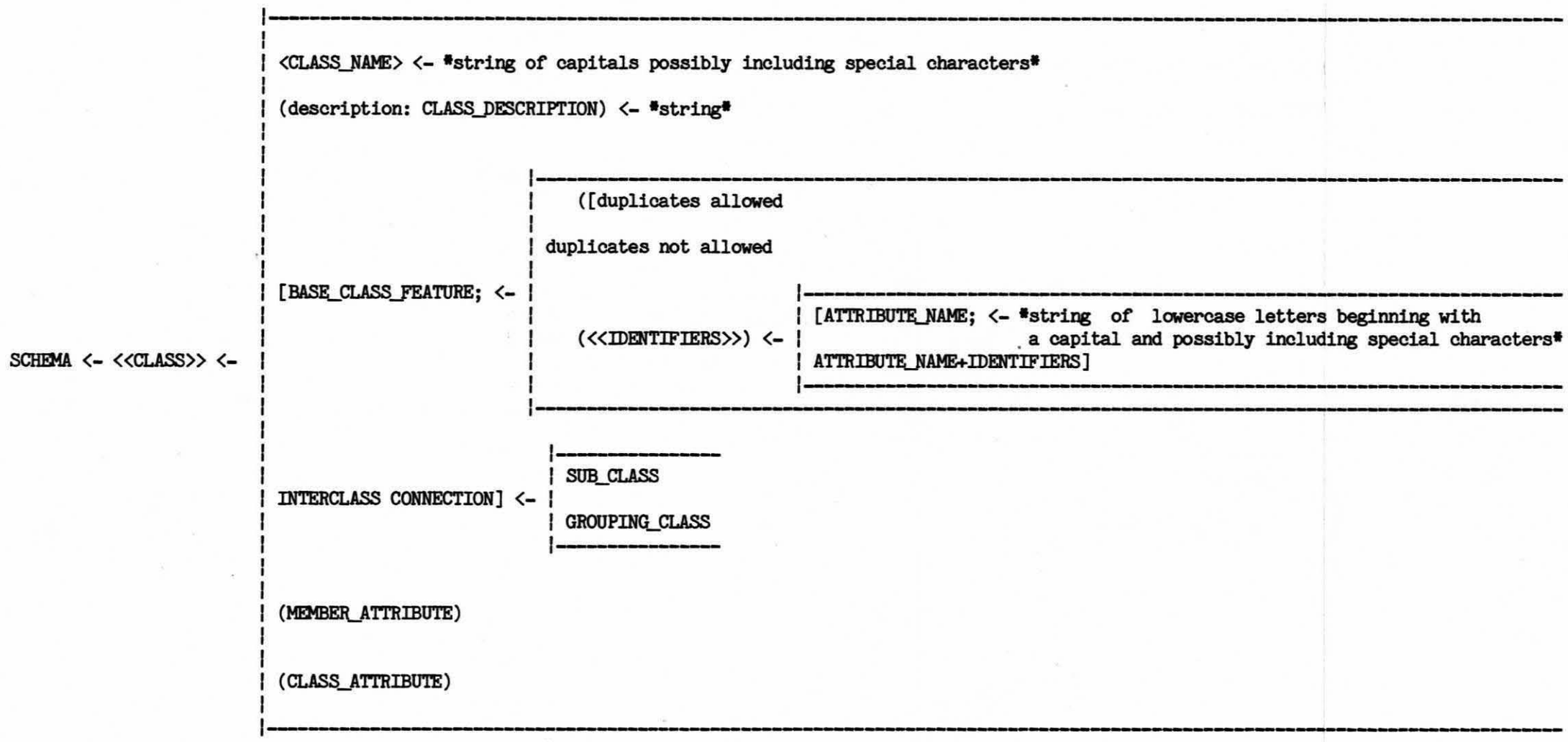
1/ Hammer,M. and D. McLeod."Database description with SDM: a Semantic Database Model", ACM Trans. Database Syst., Vol.6, No. 3, Sept. 1981

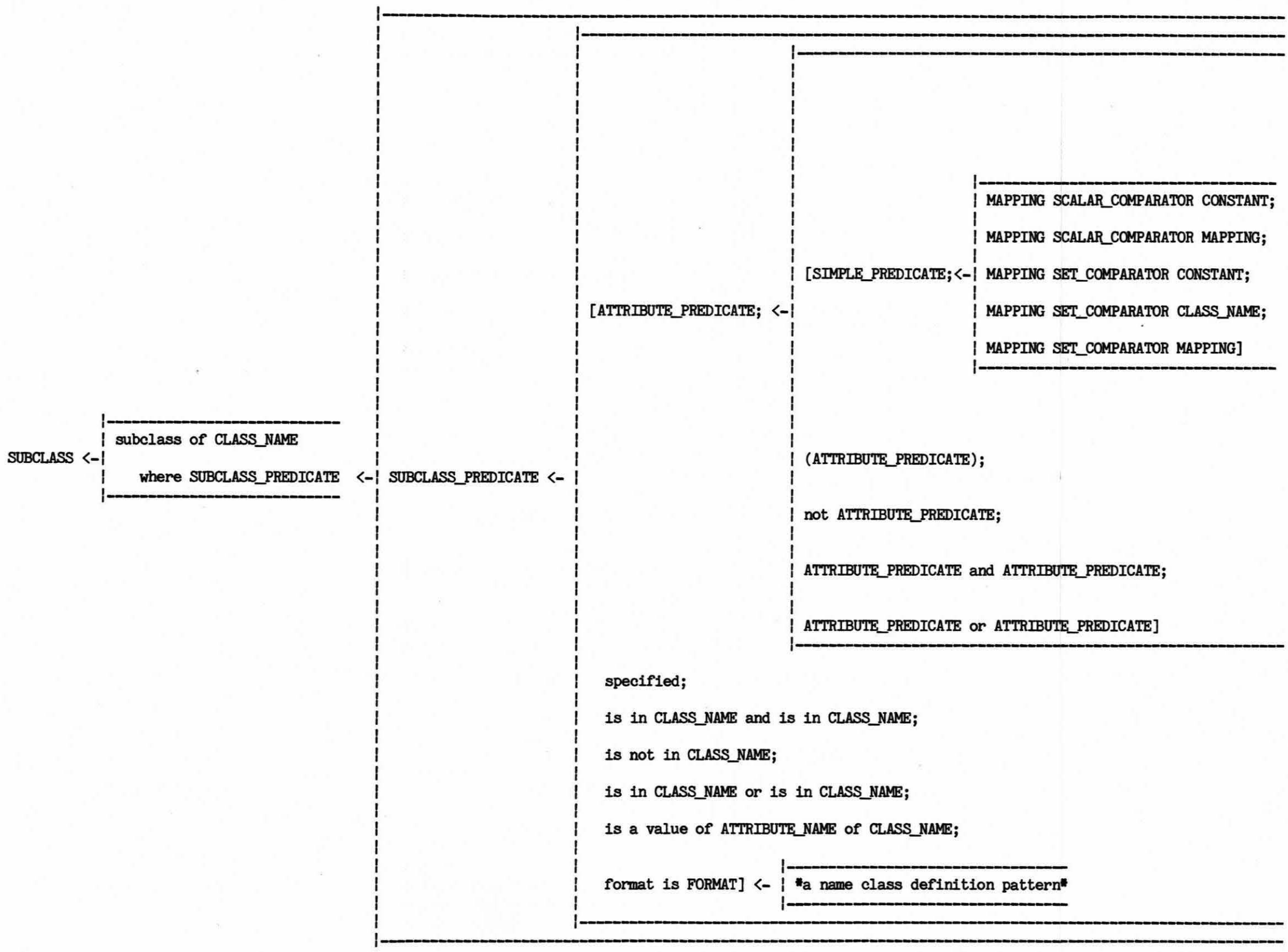
```
IDENTIFIERS <-
   [ATTRIBUTE_NAME;ATTRIBUTE_NAME+IDENTIFIERS]

MEMBER_ATTRIBUTES <-
   member attributes:
     <<MEMBER_ATTRIBUTE>>

CLASS_ATTRIBUTES
   class attributes:
     <<CLASS_ATTRIBUTES>>

INTERCLASS CONNECTION <-
   [SUB_CLASS; GROUPING_CLASS]

SUBCLASS <-
   subclass of CLASS_NAME where SUBCLASS_PREDICATE

GROUPING <-
   [grouping of CLASS_NAME on common value of <ATTRIBUTE_NAME>
     {groups defined as classes are <CLASS_NAME>};
   grouping of CLASS_NAME consisting of classes <CLASS_NAME>;
   grouping of CLASS_NAME as specified]

SUBCLASS_PREDICATE <-
   [ATTRIBUTE_PREDICATE;
   specified;
   is in CLASS_NAME and is in CLASS_NAME;
   is not in CLASS_NAME;
   is in CLASS_NAME or is in CLASS_NAME;
   is a value of ATTRIBUTE_NAME of CLASS_NAME;
   format is FORMAT]

ATTRIBUTE_PREDICATE <-
   [SIMPLE_PREDICATE; (ATTRIBUTE_PREDICATE);
   not ATTRIBUTE_PREDICATE;
   ATTRIBUTE_PREDICATE and ATTRIBUTE_PREDICATE;
   ATTRIBUTE_PREDICATE or ATTRIBUTE_PREDICATE]

SIMPLE_PREDICATE <-
   [MAPPING SCALAR_COMPARATOR [CONSTANT;MAPPING];
   MAPPING SET_COMPARATOR [CONSTANT; CLASS_NAME; MAPPING]]

MAPPING <-
   [ATTRIBUTE_NAME;MAPPING.ATTRIBUTE_NAME]

   [EQUAL_COMPARATOR; > ; >= ; < ; <= ]
```

```
EQUAL_COMPARATOR <-
   [ - ; <> ]

SET_COMPARATOR <-
   [is {properly} contained in; {properly} contains]

CONSTANT <-
   *a string or number constant*

FORMAT <-
   *a name class definition pattern*

MEMBER_ATTRIBUTE <-
   <ATTRIBUTE_DESCRIPTION>
     {ATTRIBUTE_DESCRIPTION}
     value class: CLASS_NAME
     {inverse:ATTRIBUTE_NAME}
     {[match:ATTRIBUTE_NAME of CLASS_NAME on ATTRIBUTE_NAME};
     derivation:MEMBER_ATTRIBUTE_DERIVATION]}
     {single valued;  multivalued {with size between CONSTANT and
       CONSTANT
     {may not be null}
     {not changeable}
     {exhausts value class}
     {no overlap in values}

CLASS_ATTRIBUTE <-
   <ATTRIBUTE_DESCRIPTION>
     {ATTRIBUTE_DESCRIPTION}
     value class: CLASS_NAME
     derivation:MEMBER_ATTRIBUTE_DERIVATION]}
     {single valued;  multivalued {with size between CONSTANT and
       CONSTANT
     {may not be null}
     {not changeable}

ATTRIBUTE_NAME <-
   *string  of  lowercase letters beginning with  a  capital  and
      possibly including special characters*

ATTRIBUTE_DESCRIPTION <-
   "*string*"

MEMBER_ATTRIBUTE_DERIVATION <-
   [INTERATTRIBUTE_DERIVATION; MEMBER-SPECIFIED_DERIVATION]

CLASS_ATTRIBUTE_DERIVATION <-
   [INTERATTRIBUTE_DERIVATION; CLASS-SPECIFIED_DERIVATION]

INTERATTRIBUTE_DERIVATION <-
   [same as MAPPING;
   subvalue of MAPPING where [is in CLASS_NAME;
       ATTRIBUTE_PREDICATE]
   where [is in MAPPING and is in MAPPING;
   is in MAPPING or is in MAPPING;
   is in MAPPING and is not in MAPPING];
   =MAPPING _ EXPRESSION;
   [maximum; minimum; average; sum] of MAPPING;
   number of {unique} members in MAPPING]

MEMBER-SPECIFIC_DERIVATION <-
   [order by {increasing; decreasing} <MAPPING>
   {within <MAPPING>};
   if in CLASS_NAME;
   [up to CONSTANT; all] levels of values of ATTRIBUTE_NAME;
   contents]

CLASS-SPECIFIC_DERIVATION <-
   [number of {unique} members in this class;
   [maximum; minimum; average; sum] of ATTRIBUTE_NAME over
   members of this class]

MAPPING EXPRESSION <-
   [MAPPING; (MAPPING); MAPPING NUMBER_OPERATOR MAPPING]

NUMBER_OPERATOR <-
   [ + ; - ; * ; / ; ! ]
```

Appendix B

The Semantic Database Model DbDL Syntax represented in Warnier like diagrams.




SUBCLASS <-
subclass of CLASS_NAME
where SUBCLASS_PREDICATE <-
SUBCLASS_PREDICATE <-
[ATTRIBUTE_PREDICATE; <-
[SIMPLE_PREDICATE;<-
MAPPING SCALAR_COMPARATOR CONSTANT;
MAPPING SCALAR_COMPARATOR MAPPING;
MAPPING SET_COMPARATOR CONSTANT;
MAPPING SET_COMPARATOR CLASS_NAME;
MAPPING SET_COMPARATOR MAPPING]
(ATTRIBUTE_PREDICATE);
not ATTRIBUTE_PREDICATE;
ATTRIBUTE_PREDICATE and ATTRIBUTE_PREDICATE;
ATTRIBUTE_PREDICATE or ATTRIBUTE_PREDICATE]
specified;
is in CLASS_NAME and is in CLASS_NAME;
is not in CLASS_NAME;
is in CLASS_NAME or is in CLASS_NAME;
is a value of ATTRIBUTE_NAME of CLASS_NAME;
format is FORMAT] <-
a name class definition pattern

```
                |----------------------
                | [ATTRIBUTE_NAME;
MAPPING <-      |
                | MAPPING.ATTRIBUTE_NAME]
                |----------------------
```

```
                        |-------------------------
                        |                        |----
                        | [EQUAL_COMPARATOR; <-  | [-;
                        | > ;                    | <>]
SCALAR_COMPARATOR <-    | >= ;                   |----
                        | < ;
                        | <= ]
                        |-------------------------
```

```
                |----------------------------
CONSTANT <-     | *a string or number constant*
                |----------------------------
```

```
                      |--------------------------
                      | [is (properly) contained in;
SET_COMPARATOR <-     |    (properly) contains]
                      |--------------------------
```

```
                |-------------------------------------------------------
                | [grouping of CLASS_NAME on common value of <ATTRIBUTE_NAME>
                |
                |    (groups defined as classes are <CLASS_NAME>);
GROUPING <-     |
                |  grouping of CLASS_NAME consisting of classes <CLASS_NAME>;
                |
                |  grouping of CLASS_NAME as specified]
                |-------------------------------------------------------
```

MEMBER_ATTRIBUTE <-

<ATTRIBUTE_NAME> <- See SUBCLASS

{ATTRIBUTE_DESCRIPTION} <- "*string*"

value class: CLASS_NAME

{inverse:ATTRIBUTE_NAME}

{[match:ATTRIBUTE_NAME of
CLASS_NAME on ATTRIBUTE_NAME};

derivation:MEMBER_ATTRIBUTE_DERIVATION]} <-

{single valued;

multivalued {with size between
CONSTANT and CONSTANT}}

{may not be null}

{not changeable}

{exhausts value class}

{no overlap in values}

[INTERATTRIBUTE_DERIVATION; <-

=MAPPING _ EXPRESSION; <-

[same as MAPPING; <- See SUBCLASS for MAPPING

subvalue of MAPPING where is in CLASS_NAME;

subvalue of MAPPING where is in ATTRIBUTE_PREDICATE;

where [is in MAPPING and is in MAPPING;

where is in MAPPING or is in MAPPING;

where is in MAPPING and is not in MAPPING]

[MAPPING;

{MAPPING}; [+; -; *; /; !]

MAPPING NUMBER_OPERATOR <- MAPPING]

maximum of MAPPING;

minimum of MAPPING;

average of MAPPING;

sum of MAPPING]

number of {unique} members in MAPPING;

MEMBER-SPECIFIED_DERIVATION] <-

[order by increasing <MAPPING> {within <MAPPING>};

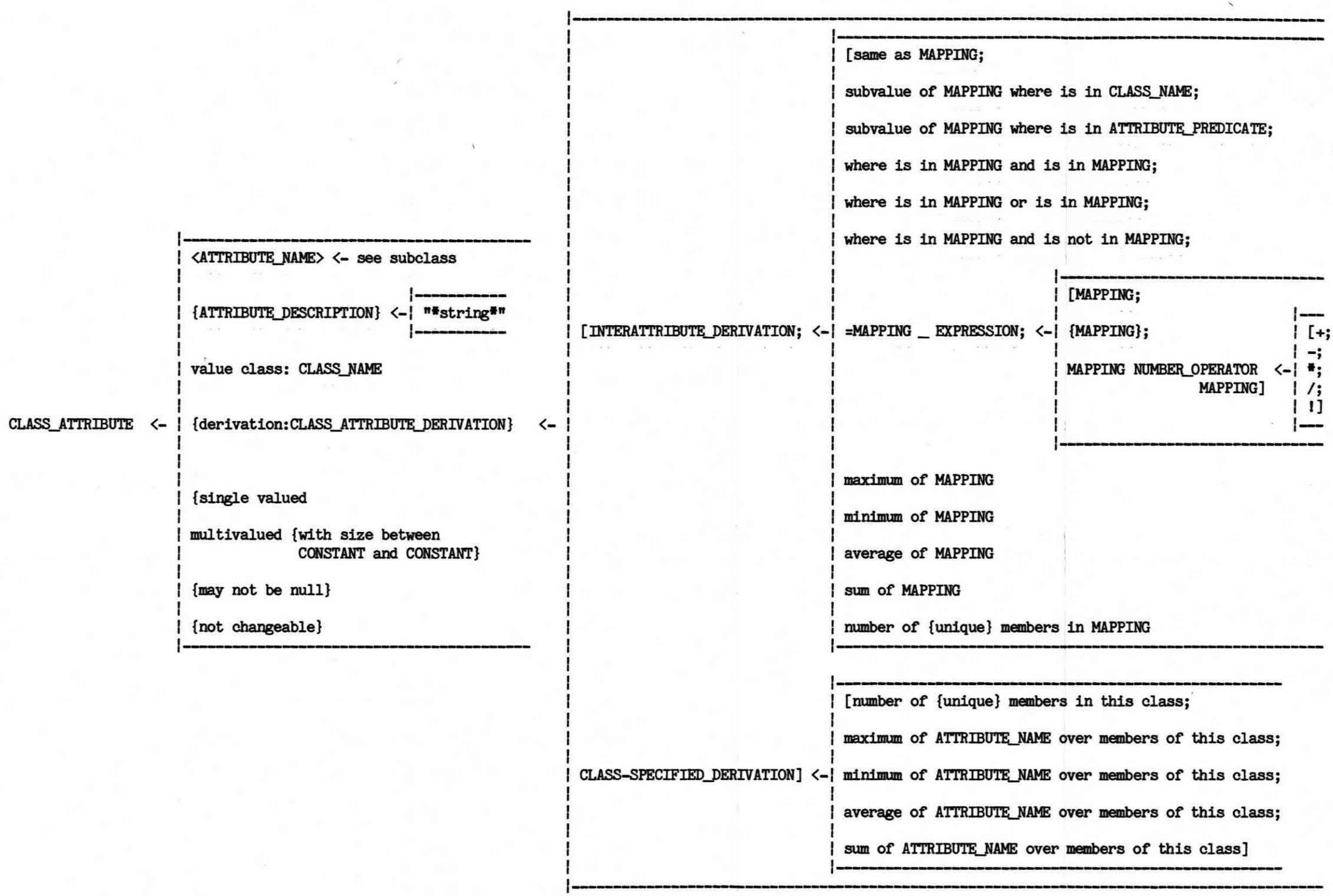
order by decreasing <MAPPING> {within <MAPPING>};

if in CLASS_NAME;

up to CONSTANT levels of value of ATTRIBUTE_NAME]

all levels of value of ATTRIBUTE_NAME;

contents]


CLASS_ATTRIBUTE <-
<ATTRIBUTE_NAME> <- see subclass
{ATTRIBUTE_DESCRIPTION} <- "*string*"
value class: CLASS_NAME
{derivation:CLASS_ATTRIBUTE_DERIVATION} <-
{single valued
multivalued {with size between CONSTANT and CONSTANT}
{may not be null}
{not changeable}
[INTERATTRIBUTE_DERIVATION; <-
[same as MAPPING;
subvalue of MAPPING where is in CLASS_NAME;
subvalue of MAPPING where is in ATTRIBUTE_PREDICATE;
where is in MAPPING and is in MAPPING;
where is in MAPPING or is in MAPPING;
where is in MAPPING and is not in MAPPING;
=MAPPING _ EXPRESSION; <-
[MAPPING;
{MAPPING};
MAPPING NUMBER_OPERATOR <- MAPPING]
[+; -; *; /; !]
maximum of MAPPING
minimum of MAPPING
average of MAPPING
sum of MAPPING
number of {unique} members in MAPPING
CLASS-SPECIFIED_DERIVATION] <-
[number of {unique} members in this class;
maximum of ATTRIBUTE_NAME over members of this class;
minimum of ATTRIBUTE_NAME over members of this class;
average of ATTRIBUTE_NAME over members of this class;
sum of ATTRIBUTE_NAME over members of this class]

Appendix C

SDM schema after step 3 Chapter 5.

ANNUAL_REVIEW_SCHEDULE
  description: An annual review is conducted for each client once a year. The next review is scheduled 1 year from the last review. A notice is posted in the schedular one week prior to the review date.
  member attributes:
    Name_of_agent
    Client's_name
    Date_of_appointment
    Time_of_appointment

ANNUAL_STATE_OF_BUSINESS
  description: An annual report of all debits and credits.

APS_FOLLOW-UP
  description: A follow-up to insure that a client's medical papers are received by the appropriate insurance company when new policies are purchased.
  member attributes:
    Name_of_agent (6)
    Client_name (6)
    Policy_number (6)
    Policy_type (6)
    Company_name (6)
    Name_of_doctor
    Doctors_phone
    Date_of_call
    Time_of_call
  class attributes:
    Call_number

CASH_FLOW
  description: That data stored in the database that would be of use when filling out a client's cash flow statement.
  member attributes:
    Client_name
    Client_address
    Client's_total_yearly_insurance _premiums

CLIENT
  description: individuals who purchase products from the enterprise.
  member attributes:
    Name
    Home_address (1)
    Social_security_number (1)
    Phone_number (1)
    Date_of_birth (1)
    Spouse's_name (2)
    Spouse's_address (2)
    Spouse's_data_of_birth (2)
    Spouse's_phone_number (2)
    Dependent's_name (3)
    Depentent's_date_of_birth (3)
    Occupation (4)
    Business_phone (4)
    Business_address (4)
    Miscellaneous_information
    Insurance_purchased
    Annuities_owned
    IRA's_owned

CLIENT_ASSET_SHEET
  description: That data stored in the database that would be of use when filling out a client's asset sheet.
  member attributes:
    Client_name
    Client_address
    Spouse_name
    Client's_total_life_insurance
    Spouse's_total_life_insurance

CLIENT_COURTESY_CARD
  description: Courtesy cards are send to clients on special occasions, e.g., birthdays.
  member attributes:
    Name_of_agent
    Client_name
    Client_address
    Occasion

CLIENT_FILE_CARD
  description: a summary of the client attributes, history of client contacts and a summary of POLICY_RECORD.
  member attributes:
    Name
    Occupation (4)
    Home_address (1)
    Home_phone (1)
    Business_address (4)
    Business_phone (4)
    Referred_to_agency_by
    Reference_phone
    Miscellaneous_information
    Approximate_income
    Spouse's_name (2)
    Spouse's_date_of_birth (2)
    Children[_names (3)
    Client's_date_of_birth (1)
    Children's_dates_of_birth (3)
    Insurance_owned,_dollar_value
    Best_time_to_contact_at_home
    Best_time_to_contact_at_work
    Contact_record
    Company_name (5)
    Policy_number (5)
    Face_amount (5)
    Type (5)
    Date_of_issue (5)
    Age_of_issue (5)
    Gross_yearly_premium
    WP_rider (5)
    Dividend_option (5)
    Primary_beneficiary (5)
    Mode_of_premium_payment
    Premium_amount
    Date_premium_due

CLIENT_FOLLOW-UP
  description: an event, required to insure that all materials necessary for the purchase of insurance have been received by the insurance company.
  member attribute:
    Name_of_agent (6)
    Client_name (6)
    Policy_number (6)
    Policy_type (6)
    Company_name (6)
    Time_of_call
    Date_of_call
    Next_action_required
    Date_of_next_action

CLIENT'S_INSURANCE_AND_ANNUITIES_IN_FORCE
  description: A summary of all insurance and annuities that a client has with the agency.
  member attributes:
    Company_name
    Amount
    Year_issued
    Accidental_death

COMPANIES
  description: the companies whose products are sold by the enterprise.
  member attributes:
    Company_type
    Company_name
    Company_address
    Company_phone

CREDITS
  description: All funds coming into the agency.
  member attributes:
    Date
    Amount
    Source
    Person_responsible

DEBITS
  description: All funds going out of the agency.
  member attributes:
    Date
    Amount
    Description_of_expenditure
    To_whom_charged

```
EMPLOYEE
  description: all people who work
    for the enterprise.
  member attributes:
    Name
    Home_address (1)
    Social_security_number (1)
    Phone_number (1)
    Date_of_birth (1)
    Spouse's_name (2)
    Spouse's_address (2)
    Spouse's_phone_number (2)
    Spouse's_date_of_birth (2)
    Dependents_name (3)
    Dependents_data_of_birth (3)
    Date_joined_company
    Status_of
    Pay
    Seniority
  class attributes:
    Number_of_employees

EVENT
  description: a base class needed in
    order to define the various
    events that must be scheduled.
  member attributes:
    Event_type

INSURANCE_APPLICATION_INFO_SUMMARY
  description: That data stored in
    the database that would be of
    use when filling out an
    insurance application form for a
    current client.
  member attributes:
    Client_name
    Client_address
    Spouse's_name
    Spouse's_date_of_birth
    Dependent's_name
    Dependent's_dates_of_birth
    Spouse's_amount_insurance
    Client's_insurance_and_annuities
       _in_force

FORM_SUMMARIES
  description: a base class needed in
    order to define the various form
    summaries as subclasses.
  member attributes:
    Form_number

MONTHLY_CASH_FLOW
  description: A monthly report of
    debits and credits.
  member attributes:
    Debits
    Credits

OTHER_APPOINTMENTS
  description: Appointments other
     then those that are normally
     scheduled.
   member attributes:
     Name_of_agent
    Client_name
    Date_of_appointment
    Time_of_appointment
    Description_of_appointment

OUT_OF_TOWN_FOLLOW-UP
 description: The agent is required
    to check with the insurance
    company about the receipt of
    initial premium payments by new
    out of town clients.
  member attributes:
    Name_of_agent (6)
    Client_name (6)
    Policy_number (6)
    Policy_type (6)
    Company_name (6)
    Date_of_call


POLICY_RECORD
  description: a collection of
    specifications about insurance
    policies  owned by each client.
  member attributes:
    Company (5)
    Policy_number (5)
    Face_amount (5)
    Type (5)
    Date_of_issue (5)
    Age_of_issue (5)
    Gross_yearly_premium
    WP_rider (5)
    Add_rider
    Cpd_rider
    Apl_rider
    Dividend_option (5)
    Loans
    Loan_interest
    Cash_value
    Primary_beneficiary (5)
    Contingent_beneficiary
```

```
PRO_FORMA_CASH_FLOW_STATEMENT
  description: That data stored in
    the database that would be of
    use when filling out a client's
    pro forma cash flow statement.
  member attributes:
    Client_name
    Client_address
    Client's_total_yearly_insurance
      _premiums

PRODUCT_LICENSE
  description: agents must be possess
    a license for each product he
    sells.
  member attributes:
    License_type

PRODUCTS
  description: the products sold by
    the enterprise.
  member attributes:
    Product_type

PROSPECT_FOLLOW-UP
  description: A follow-up to the
    prospect letter is scheduled 3
    days after the prospect letter
    is mailed.
  member attributes:
    Name_of_agent
    Name_of_prospect
    Address_of_prospect
    Prospect_phone
    Contact_made

PROSPECT_LETTER
  description: Information concerning
    contact with a prospective
    client.
  member attributes:
    Name_of_agent
    Name_of_prospect
    Address_of_prospect
    Type_of_product
    Date_mailed

REINSTATEMENT_FOLLOW-UP
  description: Calls to insurance
    company to ascertain whether a
    client has paid his premium.
  member attributes:
    Name_of_agent (6)
    Client_name (6)
    Policy_number (6)
    Policy_type (6)
    Company_name (6)
    Date_of_call
  class attributes
    Number-of-call

REPLACEMENT_FOLLOW-UP
  description: In the event that a
    policy must be replaced the
    agent is to check with the
    insurance company concerning
    issuance of the new policy.
  member attributes:
    Name_of_agent (6)
    Client_name (6)
    Policy_number (6)
    Policy_type (6)
    Company_name (6)
    Date_of_call

STATEMENT_OF_FINANCIAL_POSITION
  description: That data stored in
    the database that would be of
    use when filling out a client's
    statement of financial position.
  member attributes:
    Client_name
    Client_address
    Total_life_insurance_cash_value
    Address
```

```
1
PERSONAL_INFO
  description: The personal
    information relevant to each
    person, both client and
    employee.
  member attributes:
    Home_address
    Social_security_number
    Phone_number
    Date_of_birth

2
SPOUSE_INFO
  description: That information
    relevant to a client's or
    employees spouse.
  member attributes:
    Name
    Home_address
    Phone_number
    Date_of_birth

3
DEPENDENT_INFO
  description: That information
    relevant to a client's or
    employee's dependents.
  member attributes:
    Name
    Date_of_birth

4
CLIENT_BUSINESS_INFO
   description: That inforamtio[
     relevant to a client's job.
   member attributes:
     Occupation
     Phone_number

5
POLICY_INFO
  description: That information
    reference most as a group when
    dealing with client insurance
    policies.
  member attributes:
    Company
    Policy_number
    Type
    Face_amount
    Date_of_issue
    Age_of_issue
    Primary_beneficiary
    WP_rider
    Dividend_option

6
POLICY_INFO_FOR_FOLLOW-UP
  description: That information
    referenced most as a group when
    performing follow-ups.
  member attributes:
    Name_of_agent
    Name_of_client
    Policy_number
    Policy_type
    Company
```

Appendix D

SDM Schema of Insurance Agency

```
ADDRESS
  description: Person's home address.
     House#_Apt#
        value class: HOUSE_APT
     Street_Route
        value class: STREET_ROUTE
     State
        value class: STATES
     Zip_code
        value class: ZIP_CODES

AGE
  description: The values which may be used to describe a person's age.
  member attributes:
     Months
        value class: MONTH_VALUES
     Years
        value class: YEAR_VALUES

AGENT
  description: The owner and primary agent of the enterprise.
  interclass connection: subclass of EMPLOYEE where Status_of="Agent"
  member attributes:
     Agent_particulars
        value class: AGENT_INFO
     Agent_commission
        description: The agent receives a commission on all products sold by
           the agency. The rate varies with type and age of policy. The
           details of which are beyond  the scope of this report.
        value class: DOLLARS

AGENT_INFO
  description: Attributes that the agent and subagents have in common. Used as
     a value class for Agent_particulars of AGENT and Subagent_particulars of
     SUBAGENT.
  member attributes:
     Clients_of
        value class: CLIENT
        inverse: Agent_of_record
        multivalued
        exhausts value class
        no overlap in values
     Licensed_with
        value class: COMPANIES
        multivalued
     Number_of_clients
        value class: INTEGERS
        derivation: number of unique members in Client_of
```

```
ANNUAL_REVIEW_SCHEDULE
  description: An annual review is conducted for each client once a year. The
     next review is scheduled 1 year from the last review. A notice is posted
     in the schedular one week prior to the review date. Some of the attribute
     values may be derived from attributes of CLIENT ( match on client name).
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Agent_of_record of CLIENT on Client_name
     Client_name
        value class: PERSON_NAMES
     Date_to_schedule_review_appointment
        value class: DATES
        derivation: Date_of_last_review + 51 weeks
        **** Note: This is not part of the SDM syntax. ****
     Date_of_last_review
        value class: DATES
        derivation: Date client purchased first policy
           if new client
         or Date_of_appointment
           if client has already had at least 1 annual review
              and SYSTEM_DATE > Date_of_appointment
        **** Note: This is not part of the SDM syntax. ****
     Date_of_appointment
        value class: DATES
     Time_of_appointment
        value class: TIME
   identifiers: Client_name + Date_of_appointment

ANNUAL_STATE_OF_BUSINESS
  description: An annual report of all debits and credits. The "where
     specified" clause would identify the subset of the members of
     DEBITS_CREDITS that would belong to this class, e.g., those from the last
     year.
  interclass connection: grouping of DEBITS_CREDITS where specified
  member attributes:
     Last_year's_debits
        value class: DOLLARS
        derivation: sum of Debit_amount
     Last_year's_credits
        value class: DOLLARS
        derivation: sum of Credit_amount
     Annual_report_date
        value class: DATES
  identifiers: Annual_report_date

ANNUITIES_REGISTRATION
  description: The values an annuity identifier may have.
  interclass connection: subclass of STRINGS where specified
```

```
ANNUITY_INFO
  description: Information about the annuities owned by a client.
  member attributes:
     Company
        value class: COMPANY_NAMES
     Annuity_identification
        value class: ANNUITY_REGISTRATION
     Annuity_value
        value class: DOLLARS
   class attributes:
     Total_value_of_annuities
        value class: DOLLARS
        derivation: sum of Annuity_value

APPOINTMENT_DESCRIPTION
  description: A description of an appointment that is not covered under
     one the other appointment categories.
  interclass connection: subclass of STRINGS where specified

APS_ACTIONS
   description: The actions that may be taken when dealing with an APS
      follow-up.
   interclass connection: subclass of STRINGS where specified
```

```
APS_FOLLOW-UP
  description: A follow-up to insure that a client's medical papers are
     received by the appropriate insurance company when new policies are
     purchased. Several attribute values may be derived from attribute
     values of POLICY_RECORD (match on Client_name or Policy_number).
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Agent_of_record of CLIENT on Client_name
     Client_name
        value class: PERSON_NAMES
        match: Client_name of POLICY_RECORD on Policy_number
     Policy_number
        value class: NUMBERS
     Policy_type
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Name_of_doctor
        value class: PERSON_NAMES
     Doctors_phone
        value class: PHONE_NUMBERS
  Date_of_next_action
        value class: DATES
        derivation: = Date_of_last_action + 5 working days
           if Last_action="received APS" and APS_number < 2
         or = Date_of_last_action + 2 working days
           if Last_action="called doctor's office"
         or = Date_of_last_action + 4 working days
           if Last_action="received APS and APS_number > 1
         or = Date_of_last_action + 1
           if Contact_completed of DAILY_SCHEDULE="no"
        **** Note: This is not part of the SDM syntax. ****
     Date_of_last_action
        value class: DATES
        derivation: =Date_of_next_action
           if Date_of_next_action >= SYSTEM_DATE
         or =Date_of_next_action
           if APS_number = "1"
        **** Note: This is not part of the SDM syntax. ****
     Last_action
        description: The action taken on last date of contact.
        value class: APS_ACTIONS
  class attributes:
     APS_number
        description: the number of APS forms received by the agency.
        value class: NUMBERS
  identifiers: Client_name + Policy_number

BOOLEAN
  description: The values "yes" or "no".
  interclass connection: subclass STRINGS where format is "yes"
    or "no"
```

```
CASH_FLOW
  description: That data stored in the database that would be of use when
     filling out a client's cash flow statement. Attribute values may be
     derived from attribute values of CLIENT and POLICY_RECORD, match on
     client name.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Address of CLIENT on Client_name
     Client's_total_yearly_insurance_premiums
        value class: DOLLARS
        match: Total_gross_yearly_premium of POLICY_RECORD on Client_name
  identifiers: Client_name

CASH_VALUE_AT_AGE
  description: Cash value of policy at specified age.
  member attributes:
     Age
        value class: YEAR_VALUE
     Guaranteed_value
        value class: DOLLARS
     Total_value
        value class: DOLLARS

CASH_VALUE_FIRST_DATE
  description: Cash value of policy at first specified date.
  member attributes:
     Date
        value class: DATES
     Guaranteed_value
        value class: DOLLARS
     Total_value
        value class: DOLLARS

CASH_VALUE_SCHEDULE
  description: A record of the cash value of a policy at specific times.
  member attributes:
     Value_first_date
        value class: CASH_VALUE_FIRST_DATE
     Value_second_date
        value class: CASH_VALUE_SECOND_DATE
     Value_at_specific_age
        value class: CASH_VALUE_AT_AGE

CASH_VALUE_SECOND_DATE
  description: Cash value of policy at second specified date.
  member attributes:
     Date
        value class: DATES
     Guaranteed_value
        value class: DOLLARS
     Total_value
        value class: DOLLARS
```

```
CLIENT
  definition: Individuals who purchase products from the enterprise.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_personal_info
        value class: PERSONAL_INFO
     Client_spouse_info
        value class: SPOUSE_INFO
     Client_dependent_info
        value class: DEPENDENT_INFO
        multivalued
     Client_business_info
        value class: CLIENT_BUSINESS_INFO
     Miscellaneous_information
        value class: MISC_INFO
     Annuities_owned
        value class: ANNUITIES_INFO
        mulitvalued
     IRA's_owned
        value class: IRA_INFO
        multivalued
     Agent_of_record
        value class: AGENT_INFO
        inverse: Client_of
  identifiers: Client_name
```

```
CLIENT_ASSET_SHEET
  description: That data stored in the database that would be of use when
     filling out a client's asset sheet.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Address of CLIENT on Client_name
    Spouse_name
        value class: PERSON_NAMES
        match: Client_spouse_info.Spouse_name of CLIENT Client_name
    Client's_total_life_insurance
        value class: DOLLARS
        match: Insurance_owned,_dollar_value of CLIENT_FILE_CARD
               on Client_name
     Spouse_total_life_insurance
        value class: DOLLARS
        match: Total_insurance_owned of POLICY_RECORD on Spouse_name
        **** Note: The intent was to derive the amount of insurance owned by
        the spouse by matching her name (Spouse_name) on a Client_name of
        POLICY_RECORD. This is assuming that the only knowledge of insurance
        that the agency should be expected to have is that which they have
        sold. If the spouse has any insurance with the agency, he/she should
        also be considered a client and thus he/she would have a value for
        Total_insuracne_owned It is not clear as to the values that are
        actually being matched. The intent was to match Spouse_name with a
        Client_name in the class POLICY_RECORD.  ****
  identifiers: Client_name

CLIENT_BUSINESS_INFO
  description: That information relevant to a client's job.
  member attributes:
     Occupation
        value class: OCCUPATIONS
     Phone_number
        value class: PHONE_NUMBERS
     Address
        value class: ADDRESSES
```

```
CLIENT_COURTESY_CARD
  description: Courtesy cards are sent to clients on special
     occasions, e.g., birthdays. Attribute values may be
     derived from attribute values of CLIENT, match on client name.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
     Clients_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Address of CLIENT on Client_name
     Client_birthday
        value class: DATES
        match: Client_personal_info.Date_of_birth of PERSONAL on
           Client_name
     Date_to_send_card
        Value class: DATES
        derivation: Client_birthday - 3 working days
  identifiers: Client_name + Date_to_send_card
```

```
CLIENT_FILE_CARD
  description: A summary of the client attributes, history of client
     contacts and a summary of POLICY_RECORD. Most attributes pertaining
     to insurance will be derived from attributes of POLICY_RECORD based
     on a match with Policy_number of CLIENT_FILE_CARD_POLICY_INFO. Those
     attributes pertaining to the client will be derived from attributes
     of CLIENT based on a match with Client_name.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_personal_info
        value class: PERSONAL_INFO
        match: Client_personal_info of CLIENT on Client_name
     Client_spouse_info
        value class: SPOUSE_INFO
        match: Client_spouse_info of CLIENT on Client_name
     Client_dependent_info
        value class: DEPENDENT_INFO
        match: Client_dependent_info of CLIENT on Client_name
     Client_business_info
        value class: CLIENT_BUSINESS_INFO
        match: Client_business_info of CLIENT on Client_name
     Referred_to_agency_by
        value class: PERSON_NAMES
     Reference_phone
        value class: PHONE_NUMBERS
     Miscellaneous_information
        value class: MISC_INFO
     Approximate_income
        value class: DOLLARS
     Insurance_owned,_dollar_value
        value class: DOLLARS
        match: Total_insurance_owned of POLICY_RECORD on Client_name
     Best_time_to_contact_at_home
        value class: TIMES
     Best_time_to_contact_at_work
        value class: TIMES
     Client_policy_info
        description: a summary of each policy owned by the client.
        value class: CLIENT_FILE_CARD_POLICY_INFO
        multivalued
     Contact_record
        value class: APS_FOLLOW-UP, REINSTATEMENT_FOLLOW-UP,
           PROSPECT_FOLLOW-UP, REPLACEMENT_FOLLOW-UP, OTHER_APPOINTMENTS
           OUT_OF_TOWN_FOLLOW-UP, ANNUAL_REVIEW, CLIENT_COURTESY_CARD
        match: Event of DAILY_SCHEDULE on Client_name (of appropriate
           class)
        **** Note: This is not part of the SDM syntax. ****
  identifiers: Client_name
```

```
CLIENT_FILE_CARD_POLICY_INFO
  description: A summary of the policies a client owns. Attribute values
     may be derived from attribute values of POLICY_RECORD, match on
     Policy_number.
  member attributes:
     Policy_number
        description: A client will have 1 instance of POLICY_RECORD for
           each policy owned. The policy numbers of the policies owned by
           each client can be derived from POLICY_RECORD. A match on the
           client's name will result in several policy numbers each of which
           should be used in turn to provide multiple instances of
           Client_policy_info, an attribute of CLIENT_FILE_CARD whose value
           class is CLIENT_FILE_CARD_POLICY_INFO.
        value class: POLICY_NUMBERS
        match: Policy_number of POLICY_RECORD on Client_name
               (of CLIENT_FILE_CARD)
     Plan
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Mode_of_premium_payment
        value class: MODE_OF_PAYMENT
     Premium_amount
        value class: DOLLARS
        match: Premium_amount of POLICY_RECORD on Policy_number
     Date_premium_due
        value class: DATES
        match: Date_premium_due of POLICY_RECORD on Policy_number
     Face_amount
        value class: DOLLARS
        match: Face_amount of POLICY_RECORD on Policy_number
     Date_of_issue
        value class: DATES
        match: Date_of_issue of POLICY_RECORD on Policy_number
     Age_of_issue
        value class: AGE
        match: Age_of_issue of POLICY_RECORD on Policy_number
     Primary_beneficiary
        value class: PERSON_NAMES
        match: Primary_beneficiary of POLICY_RECORD on Policy_number
     WP_rider
        value class: BOOLEAN
        match: WP_rider of POLICY_RECORD on Policy_number
     Dividend_option
        value class: BOOLEAN
        match: Dividend_option of POLICY_RECORD on Policy_number
```

```
CLIENT'S_INSURANCE_IN_FORCE
  description: A summary of all insurance and annuities that a client has
     with the agency. This information is needed for item 15 of form 1459
     (insurance application ).
  member attributes:
     Company_name
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Client_name (of
           INSURANCE_APPLICATION_INFO_SUMMARY)
     Amount
        value class: DOLLARS
        match: Face_amount of POLICY_RECORD on Client_name (of
           INSURANCE_APPLICATION_INFO_SUMMARY)
     Date_issued
        value class: DATES
        match: Date_of_issue of POLICY_RECORD on Client_name (of
           INSURANCE_APPLICATION_INFO_SUMMARY)
     Accidental_death
        description: If the policy has an accidental death rider then
           Accidental_death = "yes"
        value class: BOOLEAN
        match: Add_rider of POLICY_RECORD on Client_name (of
           INSURANCE_APPLICATION_INFO_SUMMARY)

COMPANIES
  description: The companies whose products are sold by the enterprise.
  member attributes:
     Company_type
        value class: COMPANY_TYPES
     Company_name
        value class: COMPANY_NAMES
     Company_address
        value class: ADDRESSES
     Company_phone
        value class: PHONE_NUMBERS
     Products_offered
        value class: PRODUCT_TYPE
  identifiers: Company_name

COMPANY_NAMES
  description: The companies represented by the agency.
  interclass connection: subclass of STRINGS where specified

COMPANY_TYPES
  description: The companies whose products are sold by the agency.
  interclass connection: subclass of STRINGS where specified
derivation: order by Debit_date
```

```
DAILY_SCHEDULE
   description: A schedule of events (follow-ups, appointments, etc.) that
     are to occur on the current day.
   member attributes:
      Event
         value class: APS_FOLLOW-UP, REINSTATEMENT_FOLLOW-UP,
            PROSPECT_FOLLOW-UP, REPLACEMENT_FOLLOW-UP, OTHER_APPOINTMENTS
            OUT_OF_TOWN_FOLLOW-UP, ANNUAL_REVIEW, CLIENT_COURTESY_CARD
         derivation: where Date_of_next_action = Today's_date
         **** Note: This is not part of the SDM syntax. ****
      Today's_date
         value class: SYSTEM_DATE
      Contact_completed
         description: After action has been completed Contact_completed =
            "yes" otherwise Contact_completed="no"
         value class: BOOLEAN
  identifiers: Client_name (of appropriate value class) + Today's_date

DATES
  description: calender dates in the range "1/1/50" to "12/31/99"
  interclass connection: subclass of STRINGS where format is
     month: number where  > 1 and  < 12
     "/"
     day: number where integer and  > 1 and  < 31
     "/"
     year: number where integer and  > 1950 and  < 1999
     where (if (month=4 or =5 or =9 or =11) then day  < 30
        and (if month=2 then day  < 29)
     ordering by year, month, day

DEBITS
  description: All funds going out of the agency.
  interclass connection: subclass of DEBITS_CREDITS where
     Transaction_type = "debits"
  member attributes:
     Debit_date
        value class: DATES
     Debit_amount
        value class: DOLLARS
     Description_of_expenditure
        value class: EXPENDITURE_DESCRIPTION
     To_whom_charged
        value class: PERSON_NAMES
     Order_of_debit
        description: The chronological order of the debits.
        value class: INTEGERS

DEBITS_CREDITS
   description: A parent class needed in order to accumulate both debits
     and credits for monthly, quarterly and annual cash flow reports.
   member attributes:
      Transaction_type
         value class: TRANSACTION_TYPES
```

```
DEPENDENT_INFO
  description: Information relevant to a client's or employee's dependents.
  member attributes:
     Name
        value class: PERSON_NAMES
     Date_of_birth
        value class: DATES

DOLLARS
  description: The form a reference to money may take.
  interclass connection: subclass of STRINGS where format is
     "$"
     000 < number <= 999
     ","
     000 <= number <= 999
     ","
     000 <= number <= 999
     "."
     00 <= number <=99
     where leading zeros are omitted

EMPLOYEE
  description: all people who work for the enterprise.
  member attributes:
     Employee_name
        value class: PERSON_NAMES
     Employee_personal_info
        value class: PERSONAL_INFO
     Employee_spouse_info
        value class: SPOUSE_INFO
     Employee_dependent_info
        value class: DEPENDENT_INFO
        multivalued
     Date_joined_company
        value class: DATES
     Status_of
        value class: EMPLOYEE_TYPES
     Pay
        value class: PAY
     Seniority
        value class: INTEGERS
        derivation: order by increasing Date_joined_company
  class attributes:
     Number_of_employees
        value class: INTEGERS
        derivation: number of members in this class.
  identifiers: Employee_name

EMPLOYEE_TYPES
  description: The types of employees at the agency, values may be "agent",
     "subagent" and "office staff".
  interclass connection: subclass of STRINGS where specified
```

EVENT_TYPES
  description: Each event, i.e., appointments follow-ups, etc., is specified as a specific event type.
  interclass connection: subclass of STRINGS where specified.

EXPENDITURE_DESCRIPTION
  description: A description of the type of expenditure list as a debit.
  interclass connection: subclass of STRINGS where specified

FIRST_NAMES
  description: The first name of a person.
    interclass connection: subclass of STRINGS where specified

FORM_NUMBERS
  description: Each summary form has a unique number that is used to reference the form.
  interclass connection: subclass of STRINGS where specified

HOUSE_APT
  description: The house number, apartment number, suite number or office number in an address.
  interclass connection: subclass of STRINGS where specified

```
INSURANCE_APPLICATION_INFO_SUMMARY
  description: That data stored in the database that would be of use when
     filling out an insurance application form for a current client.
     Attribute values may be derived from attribute values of
     CLIENT, SPOUSE_INFO, DEPENDENT_INFO, and CLIENT_FILE_CARD, match on
     Client_name.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
        match: Client_personal_info.Home_address of CLIENT on Client_name
     Spouse_name
        value class: PERSON_NAMES
        match: Name_of_spouse of SPOUSE_INFO on Client_name (of CLIENT)
     Spouse_date_of_birth
        value class: DATES
        match: Client_spouse_info.Date_of_birth of CLIENT on Client_name
     Dependent's_name
        value class: PERSON_NAMES
        match: Name_of_dependent of DEPENDENT_INFO on Client_name
           (of CLIENT)
     Dependent's_date_of_birth
        value class: DATES
        match: Client_dependent_info.Date_of_birth of CLIENT on Client_name
     Spouse_amount_insurance
        description: If it is assumed that if the spouse is also a client
           then a record of total insurance owned should also be present
           for the spouse. This value is derivable by matching Spouse_name
           to Client_name in POLICY_RECORD.
        value class: DOLLARS
        match: Total_insurance_owned of POLICY_RECORD on
           Spouse_name
     Client's_insurance
        value class: CLIENT'S_INSURANCE_IN_FORCE
     Client_annuities
        value class: ANNUITY_INFO
        match: Annuities_owned of CLIENT on Client_name (of CLIENT)
  identifiers: Client_name

INTEREST
  description: The value a interest reference may have.
  interclass connection: subclass of STRINGS where format is
     00<=number<=99
     "."
     00,=number<=99
     "%"
```

```
IRA_INFO
  description: Information about the IRA's owned by a client.
  member attributes:
     Company
        value class: COMPANY_NAMES
     IRA_identification
        value class: IRA_REGISTRATION
     IRA_value
        value class: DOLLARS
   class attributes:
     Total_value_of_IRA's
        value class: DOLLARS
        derivation: sum of IRA_value

IRA_REGISTRATION
  description: The values an IRA identifier may have.
  interclass connection: subclass of STRINGS where specified

LAST_NAMES
  description: The last name of a person, it may be one or more names or
     hyphenated.
  interclass connection: subclass of STRINGS where specified

LOAN_INFO
  description: Information about individual insurance loans a client has.
     Loan_amount
        value class: DOLLARS
     Loan_interest
        value class: INTEREST

MIDDLE_NAMES
  description: The middle name identifiers a person may have. It may be one
     or more initials or one or more names.
  interclass connection: subclass of STRINGS where specified

MISC_INFO
  description: Miscellaneous information.
  interclass connection: subclass of STRINGS where specified

MODE_OF_PAYMENT
  description: The various payment schedules available.
  interclass connection: subclass of STRINGS where specified

MONTH_VALUES
  description: The values a month may have.
  interclass connection: subclass of INTEGERS where format is
     1<=number<=12
```

```
MONTHLY_CASH_FLOW
  description: A monthly report of all debits and credits. The "where
     specified" clause would identify the subset of the members of
     DEBITS_CREDITS that would belong to this class, e.g., those from the
     last month.
  interclass connection: grouping of DEBITS_CREDITS where specified
  member attributes:
     Last_month's_debits
        value class: DOLLARS
        derivation: sum of Debit_amount
     Last_month's_credits
        value class: DOLLARS
        derivation: sum of Credit_amount
     Monthly_report_date
        value class: DATES
  identifiers: Monthly_report_date

NEXT_ACTION
  description: The next action required for a follow-up.
  interclass connection: subclass of STRINGS where specified

OCCASIONS
  description: A description of the occasion for a client courtesy card.
  interclass connection: subclass of STRINGS where specified

OCCUPATIONS
  description: Occupations a client may have.
  interclass connection: subclass of STRINGS where specified

OFFICE_STAFF
  description: The class that identifies the office staff and the office
     manager.
  interclass connection: subclass of EMPLOYEE where
     Status_of = "office worker"
  member attributes:
     Is_office_manager
        description: "yes" if the instance is the office manager
           "no" otherwise.
        value class: BOOLEAN
```

```
OUT_OF_TOWN_FOLLOW-UP
  description: The agent is required to check with the insurance company
     about the receipt of initial premium payments by new out of town
     clients.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Agent_of_record of CLIENT on Client_name
     Client_name
        value class: PERSON_NAMES
        match: Client_name of POLICY_RECORD on Policy_number
     Policy_number
        value class: NUMBERS
     Policy_type
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Date_of_next_action
        value class: DATES
        derivation: = Date_policy_sold + 14 days
           if this is the initial contact
         or =Date_of_next_action + 1
           if the person was not contacted on the Date_of_next_action
           this is denoted by a "no" value of Contact_completed of class
           DAILY_SCHEDULE for this instance
         **** Note: This is not part of the SDM syntax. ****
     Date_policy_sold
        value class: DATES
  identifiers: Client_name + Date_policy_sold

OTHER_APPOINTMENTS
  description: Appointments other than those that are normally
     scheduled, i.e., the follow-ups and annual review.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
     Client_name
        value class: PERSON_NAMES
     Date_of_appointment
        value class: DATES
     Time_of_appointment
        value class: TIMES
     Description_of_appointment
        value class: APPOINTMENT_DESCRIPTION
     Next_date_of_action
        description: This attribute must be present if OTHER_APPOINTMENTS is
           to be included in DAILY_SCHEDULE. Membership in DAILY_SCHEDULE is
           based on a match with Next_date_of_action. Rather than change the
           name of the attribute Date_of_appointment, which is familiar to all
           employees, Next_date_of_action was coined as a synonym.
        value class: DATES
        derivation: same as Date_of_appointment
   identifiers: Client_name + Date_of_appointment
```

```
PAY
  description: The monthly pay for each employee. Pay is based on a base
     salary plus a commission depending on the value Status_of. In general
     office staff will receive only a base salary and the agent and
     subagents will receive only a commission. The details of pay are
     beyond the scope of this report.

PERSON_NAMES
  description: The form a person's name may take.
  member attributes:
     Title
        value class: TITLES
     First
        value class: FIRST_NAMES
     Middle
        value class: MIDDLE_NAMES
     Last
        value class: LAST_NAMES

PERSONAL_INFO
  description: The personal information relevant to each person, both
     client and employee.
  member attributes:
     Home_address
        value class: ADDRESSES
     SSN
        value class: SOCIAL_SECURITY_NUMBER
     Phone_number
        value class: PHONE_NUMBERS
     Date_of_birth
        value class: DATES

PHONE_NUMBERS
  description: The form a phone number may take, area code, prefix, number.
  interclass connection: subclass of STRINGS where format is
     000<number<=999
     "-"
     00<number<=999
     "-"
     0000<=number<=9999

POLICY_NUMBERS
  description: The values a policy number may have.
  interclass connection: subclass of STRINGS where specified
```

```
POLICY_RECORD
  description: a collection of specifications about insurance policies owned
     by each client. The POLICY_RECORD class will act as the master record
     of each policy sold.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Policy_number
        value class: POLICY_NUMBERS
     Type
        value class: POLICY_TYPES
     Company
        value class: COMPANY_NAMES
     Face_amount
        value class: DOLLARS
     Date_of_issue
        value class: DATES
     Age_of_issue
        value class: AGE
     Primary_beneficiary
        value class: PERSON_NAMES
     WP_rider
        value class: BOOLEAN
     Dividend_option
        value class: BOOLEAN
     Gross_yearly_premium
        value class: DOLLARS
     Add_rider
        value class: BOOLEAN
     Cpd_rider
        value class: BOOLEAN
     Apl_rider
        value class: BOOLEAN
     Loans
        value class: LOAN_INFO
     Cash_value_record
        value class: CASH_VALUE_SCHEDULE
     Contingent_beneficiary
        value class: PERSON_NAMES
     Total_insurance_owned
        value class: DOLLARS
        derivation: sum of Face_amount
     Total_gross_yearly_premiums
        value class: DOLLARS
        derivation: sum of Gross_yearly_premium
  identifiers: Client_name + Policy_number

POLICY_TYPES
  description: The types of policies sold by the agency.
  interclass connection: subclass of STRINGS where specified.
```

```
PRO_FORMA_CASH_FLOW_STATEMENT
  description: That data stored in the database that would be of use when
     filling out a client's pro forma cash flow statement. Attribute values
     may be derived from attribute values of POLICY_RECORD, match on
     client_name.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
     Client's_total_yearly_insurance_premiums
        value class: DOLLARS
        match: Total_gross_yearly_premiums of POLICY_RECORD on Client_name
  identifiers: Client_name

PRODUCT_LICENSE
  description: An agent must possess a license for each product he sells.
  member attributes:
     License_type
        value class: PRODUCT_TYPES

PRODUCT_TYPES
  description: The product types sold by the agency.
  interclass connection: subclass STRINGS where specified

PRODUCTS
  description: the products sold by the enterprise.
  member attributes:
     Product_type
        value class: PRODUCT_TYPES
```

```
PROSPECT_FOLLOW-UP
  description: A follow-up to the prospect letter is scheduled 3 days after
     the prospect letter is mailed.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Name_of_agent of PROSPECT_LETTER on Name_of_prospect
     Name_of_prospect
        value class: PERSON_NAMES
     Address_of_prospect
        value class: ADDRESSES
        match: Address_of_prospect of PROSPECT_LETTER on Name_of_prospect
     Prospect_phone
        value class: PHONE_NUMBERS
     Type_of_product
        value class: PRODUCT_TYPES
        match: Type_of_product of PROSPECT_LETTER on Name_of_prospect
     Contact_made
        description: If contact was not made on the scheduled
           date then value="no".
        value class: BOOLEAN
     Date_of_contact
        description: An agent is to contact the prospect 3 working days
           after the prospect letter has been mailed.
        value class: DATES
        derivation: = Date_letter_mailed + 3 working days
           if this is the initial contact
         or = Date_of_contact + 1
           if Contact_completed of DAILY_SCHEDULE="no"
         **** Note: This is not part of the SDM syntax. ****
  identifiers: Name_of_prospect

PROSPECT_LETTER
  description: Information concerning contact with a prospective client.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
     Name_of_prospect
        value class: PERSON_NAMES
     Address_of_prospect
        value class: ADDRESSES
     Type_of_product
        value class: PRODUCT_TYPES
     Date_mailed
        value class: DATES
  identifiers: Name_of_prospect
```

```
QUARTERLY_REPORT
  description: A 3 month report of all debits and credits. The "where
     specified" clause would identify the subset of the members of
     DEBITS_CREDITS that would belong to this class e.g., those from the
     last 3 months.
  interclass connection: grouping of DEBITS_CREDITS where specified
  member attributes:
     Last_3_months_debits
        value class: DOLLARS
        derivation: sum of Debit_amount
     Last_3_months_credits
        value class: DOLLARS
        derivation: sum of Credit_amount
     Quarterly_report_date
        value class: DATES
  identifiers: Quarterly_report_date

REINSTATEMENT_FOLLOW-UP
  description: The agency is to call the insurance company to ascertain
     whether a client has paid his premium.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Agent_of_record of CLIENT on Client_name
     Client_name
        value class: PERSON_NAMES
        match: Client_name of POLICY_RECORD on Policy_number
     Policy_number
        value class: NUMBERS
     Policy_type
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Date_of_next_action
        value class: DATES
        derivation: = Date_notified_of_delinquency + 14
           if this is the first attempt
         or Date_of_next_action + 1
           if client was not notified on the initial date, denoted
           by a "no" value of Contact_completed of class DAILY_SCHEDULE
           for this instance
         **** Note: This is not part of the SDM syntax. ****
     Date_notified_of_delinquency
        value class: Dates
   identifiers: Client_name
```

```
REPLACEMENT_FOLLOW-UP
  description: In the event that a policy must be replaced, the agent is to
     check with the insurance company concerning issuance of the new
     policy.
  member attributes:
     Name_of_agent
        value class: PERSON_NAMES
        match: Agent_of_record of CLIENT on Client_name
     Client_name
        value class: PERSON_NAMES
        match: Client_name of POLICY_RECORD on Policy_number
     Policy_number
        value class: NUMBERS
     Policy_type
        value class: POLICY_TYPES
        match: Type of POLICY_RECORD on Policy_number
     Company
        value class: COMPANY_NAMES
        match: Company of POLICY_RECORD on Policy_number
     Date_of_next_action
        value class: DATES
        derivation: =Date_replacement_policy_sold + 14
           if this is the initial date scheduled
         or Date_of_next_action + 1
           if action was not completed on date specified this is denoted
           by a "no" value of Contact_completed of class DAILY_SCHEDULE
           for this instance
          **** Note: This is not part of the SDM syntax. ****
  identifiers: Client_name

SOCIAL_SECURITY_NUMBER
  interclass connection: subclass of STRINGS where format is
     000<=number<=999
     "-"
     00<=number<=99
     "-"
     0000<=number<=9999

SOURCE
  description: A description of the source of a credit.
  interclass connection: subclass of STRINGS where specified

SPOUSE_INFO
  description: That information relevant to a client's or employee's spouse.
  member attributes:
     Name
        value class: PERSON_NAMES
     Home_address
        value class: ADDRESSES
     Phone_number
        value class: PHONE_NUMBERS
     Date_of_birth
        value class: DATES
```

```
STATEMENT_OF_FINANCIAL_POSITION
  description: That data stored in the database that would be of use when
     filling out a client's statement of financial position.
  member attributes:
     Client_name
        value class: PERSON_NAMES
     Client_address
        value class: ADDRESSES
     Total_life_insurance_cash_value
        value class: DOLLARS
  identifiers: Client_name

STATES
  description: Postal service accepted state identifiers.
  interclass connection: subclass of STRINGS where specified

STREET_ROUTE
  description: The Street or route in an address.
  interclass connection: subclass of STRINGS where specified

SUBAGENT
  description: The persons who work for the agency and are supervised by
     the Agent.
  interclass connection: subclass of EMPLOYEE where Status_of="Subagent"
  member attributes:
     Subagent_particulars
        value class: AGENT_INFO
     Subagent_commission
        description: Subagents receive an initial commission and residual
           commission based on the type and age of the product and the
           company that sells the product. The residual commission is based
           on the client's payment. The model of this procedure is beyond
           the scope of this report.
        value class: DOLLARS

SYSTEM_DATE
   description: A new primative which refers to the current date.
   **** Note: This is not part of the SDM syntax. ****

TIME
  description: The time record using A.M.-P.M. designators.
  interclass connection: subclass STRINGS where format is
     hour: number where  >  1 and  <  12
     ":"
     minutes: number where >= 00  and < 60
     " "
     "A.M." or "P.M."

TITLES
  description: The title a person may have preceding his name, e.g., Dr.,
     Mr., Ms., Mrs.
  interclass connection: subclass of STRINGS where specified
```

```
TRANSACTION_TYPES
   description: Transaction types are debits or credits.
   interclass connection: subclass of STRINGS where specified

YEAR_VALUE
  description: The value a year may have.
  interclass connection: subclass of INTEGER where format is
     1 <= number <= 130

ZIP_CODES
  description: The accepted postal service zip codes.
  interclass connection: subclass of STRINGS where specified
```

Appendix E

Insurance Company Business Forms

Client File Card

NAME			BIRTHDAYS			INSURANCE
			Month	Day	Year	Owned
Residence		PHONE				$
OCCUPATION		WIFE'S NAME				$
FIRM ADDRESS	PHONE	CHILDREN				$
REFERRED BY	PHONE					$
Club, Church, Frat., Hobbies	Approx. Income $					$
BEST TIME TO SEE: Day At Work_____ Daytime_____						$
At Home Evening						$

CALL DATE	NEED	RESULTS	CALL DATE	NEED	RESULTS

OTHER INFORMATION

PRESENT LIFE INSURANCE

Company	Date Issued	Plan	Amount	Benefits WP	Inc.	DI	Beneficiary	Premium Mode	Amt.	Due

The Lafayette Life Insurance Company Form 1144

Insurance Application

☐ The Lafayette Life Insurance Company ☐ Lafayete National Life Assurance Company

This application is made to the Company checked above. That Company is hereinafter called Lafayette Life Company. This is an application for life insurance unless item 11 is checked.

FOR HOME OFFICE USE ONLY
☐ CWA-ORD DATE/Initial _____
☐ CWA-UL AMT. _____

Part 1

PROPOSED INSURED First Middle Last

1. PRINT FULL NAME _____
☐ Male ☐ Married ☐ Widowed ☐ Separated
☐ Female ☐ Single ☐ Divorced

2. State and Date of Birth:	State	Month	Day	Year	AGE last birthday

3. Proposed Insured's Social Security No. _____

4. **ADDRESS for Premium Notices:**
Street, Number _____
City _____ State _____
Zip _____
c/o (if needed) _____

5. **POLICYOWNER to be:**
☐ Proposed Insured
☐ Other _____
Name of Owner Age
Relationship to Proposed Insured _____
Social Security or Tax I.D. No. _____
Contingent Owner (if any) _____
(Name and Relationship to Proposed Insured) _____
☐ Ownership: (Check if Proposed Insured under 18) Until the Insured attains the age of 18, the owner shall be the Owner named above, while living, otherwise the Contingent Owner, while living, otherwise the Insured. Ownership shall automatically transfer to the Insured on his 18th birthday.
☐ Permanent in the Owner while living, then the Contingent Owner, unless changed.

Each owner, during this period of ownership, shall have the power to exercise all the existing policy rights of an owner, including the right to alter the succession of owners and their interests. A "contingent owner" is the person designated to succeed to the rights of the owner should the owner die during the Insured's lifetime. If there is no Contingent Owner, the Owner's rights upon his death may be exercised by his executors, administrator or assigns.

6. Will any existing life or annuity contract be lapsed, surrendered, borrowed against, or changed if the proposed policy is issued or have any of these transactions been completed recently? (If "Yes" furnish name of company being replaced) ☐ Yes ☐ No

7. **OCCUPATIONS:** (include Spouse's if benefit applied for)

	How long so Employed?	
	Years	Months

Home Office Corrections and Additions (Do not write in this space.)
"NOT for use in Pa., Md., or W.V.

8. **Plan** (See Rate Book B-5) **8a. Amount of Insurance**
Policy _____ $_____
Rider _____ $_____
for Universal life policies, select plan and option below.
☐ Adj. Whole Life - Key UL-83 ☐ Level Benefit C.V. - Included
☐ Value Life - RX-83 ☐ Increasing Benefit C.V. - Excluded

9. **ADDITIONAL BENEFITS** (Check each benefit desired)
$_____ Spouse Insurance (Complete 15, Page 2)
☐ Waiver of Premium ☐ GPO $ _____
☐ Accidental Death $ _____ ☐ Payor Benefit
☐ Children's Rider $ _____ ☐ _____
BENEFITS AVAILABLE ONLY WITH UNIVERSAL LIFE
☐ Waiver of Monthly Deductions ☐ Cost of Living Adjustment Rider
☐ $ _____ ☐ GIO $ _____

9a. **DIVIDEND OPTION** ☐ Add to Cash Value (Un. Life only)
☐ Paid-Up Additions ☐ Accumulated at Interest
☐ Paid in Cash ☐ Reduce Premiums

10. **PREMIUM PAYMENT**
Cash with Application $ _____
(The amount of CASH Must agree with Conditional Receipt)
Planned Periodic Premium $ _____
☐ Annual ☐ Semi. ☐ Quarterly ☐ PAC ☐ GA ☐ SD

10a. Premium Loan provision will be in effect in all ordinary life policies unless "No" is checked. No ☐

11. **ANNUITIES:**
☐ Flex Prem Annuity at Retirement Age _____
☐ Single Premium Deferred
☐ _____

12. **LIFE INSURANCE & ANNUITIES IN FORCE:**

Company	Amount	Year Issued	Accidental Death

13. **BENEFICIARY**

Print full given names	Age	Relationship
Primary: _____		
Contingent _____		

☐ Lawful children of the Insured (including any named above)
☐ Children born of or legally adopted to the marriage of the Insured and primary beneficiary (including any named above). Check **only** if spouse of Insured is named as primary beneficiary.

14. **Additional Information and Special Requests**

Form 1459 - A (Continued on Reverse Side) 5/84

PART A — AVIATION ACTIVITIES — COMPLETE IF NO. 16c, ANSWERED YES Page 2

1. Indicate your current, past or intended flying status:
   ☐ Pilot ☐ Student Pilot ☐ Crew member or observer
   ☐ Other

2. Do you fly in any military or military reserve capacity or intend to do so? ☐ Yes ☐ No
   If so, state capacity:

3. Total hours flown as pilot?

4. Date of last flight?

5. Types of certificates held and issue dates?

6. Do you have an Instrument Flying Rating?
   ☐ Yes ☐ No

7. Have you ever been in an aircraft accident or been grounded for violation of regulations ☐ Yes ☐ No
   If "Yes," explain.

8. Types of flying you do or intend to do
   ☐ Pleasure, personal business ☐ Scheduled airline
   ☐ Nonscheduled carrier ☐ Business planes
   ☐ Charter ☐ Flight Instruction ☐ Test-production
   ☐ Test-experimental ☐ Dusting, seeding, spraying
   ☐ Other:

9. Extent of past or anticipated flying by type of flying indicated in Question 8.

Hours of Flying Time

Type of Flying	Last 12 Mo.	1 to 2 Yrs. Ago	Next 12 Mo.
Military Pilot or Crew			

10. Principal types of aircraft flown?

11. Should aviation coverage be issued for extra premium, if required? ☐ Yes ☐ No

PART B — MILITARY STATUS — COMPLETE IF NO. 16e, ANSWERED YES

1. Are you in the Armed Forces, National Guard or any Reserve Unit? ☐ Yes ☐ No
   If "Yes," complete the following:
   a. Branch_____ ☐ Active ☐ Reserve
   b. Pay Grade:_____ ETS Date_____
   c. Job classifications: _____

2. Current address if different from face of application.

3. Have you volunteered for (or intend to), or received orders for, or have reason to believe that you will be assigned to hazardous overseas duty? ☐ Yes ☐ No
   If "Yes," give details in Remarks.

4. REMARKS:

OTHER PERSONS PROPOSED FOR INSURANCE

15. Names of Others to be Insured (Spouse or Children)	Relationship to Proposed Insured	Date of Birth	State	Age	Height	Weight	Amount of Life Insurance in Force

QUESTIONS 16 - 22. **MUST BE COMPLETED IN ALL CASES**

16. Has any person proposed for insurance: (Give DETAILS IN No. 25 to any "Yes" answer.)

	Yes	No
a. ever been declined, postponed, excluded or rated for Life or Health insurance or had reinstatement refused?	☐	☐
b. applied for other Life insurance within past six months?	☐	☐
c. made or contemplate making any flight as a pilot or crew member of any aircraft? (If "Yes" complete A, above)	☐	☐
d. engaged in, or contemplate engaging in, parachuting, hang gliding, vehicle racing, skin or scuba diving? (Complete special questionnaire)	☐	☐
e. joined any Armed Forces or Advanced ROTC? (If "Yes" complete B, above)	☐	☐

17. Does any person proposed for insurance now have, or has he ever had:

a. Disease or disorder of lungs, asthma, emphysema, bronchitis or tuberculosis?	☐	☐
b. Disease or disorder of the heart or blood vessels, pain or discomfort in chest, high blood pressure, shortness of breath or heart murmur?	☐	☐
c. Disease or disorder of the stomach, intestines, bowel, rectum, liver or gall bladder?	☐	☐
d. Disease or disorder of the brain or nervous system, fainting spells, epilepsy, convulsions or paralysis?	☐	☐
e. Disease of the urinary system including nephritis, kidney stone, disease of the kidneys, bladder, or prostate?	☐	☐
f. Sugar, albumin, or blood in the urine?	☐	☐
g. Disease or disorder of bone, joints, muscle, back, spine; rheumatism, arthritis, gout, loss of limb or deformity?	☐	☐
h. Any disease or disorder of the eyes, ears, nose or throat?	☐	☐
i Cancer, tumor, venereal disease, diabetes, leukemia, disorder of glands, blood, breast, or reproductive organs?	☐	☐

18. In the past 5 years has any person proposed for insurance:

a. Had or been advised to have a surgical operation?	☐	☐
b. Had an electrocardiogram, X-ray, blood study, or other diagnostic study?	☐	☐
c. Been a patient in any hospital, institution, or sanitarium?	☐	☐

Insurance Application

	Yes	No
19. Proposed Insured's Height and Weight (In shoes) ___ft.___inches _____lbs. (Explain difference in weight, over 10 lbs., in past year)		
20. Has any person proposed for insurance been under treatment or taken medication in past 2 years?	☐	☐
21. Has any person proposed for insurance smoked one or more cigarettes within the last 12 months?	☐	☐
22. How much time has the proposed insured lost from work during the last two years because of illness or injuries? ☐ None _____ Weeks		
23. Has any person proposed for insurance ever:		
a. Applied for, or received pension or disability benefits?	☐	☐
b. Been rejected for or received a medical discharge from Military Service?	☐	☐
c. Sought or received advice for, or treatment of, or been arrested for the use of alcohol, marijuana, or drugs?	☐	☐
d. Used amphetamines, barbiturates, hallucinogenics, narcotics, or marijuana unless administered on the advice of a physician?	☐	☐
e. Had any parents, brothers or sisters who had heart disease, diabetes, stroke or high blood pressure?	☐	☐
24. Driving Record Within the past 3 years has any person to be covered been convicted of or pleaded guilty to:		
a. Three or more moving traffic violations?	☐	☐
b. Driving under the influence of alcohol and/or drugs?	☐	☐
c. Or had a driver's license revoked or suspended? (If yes, give license number and state where license was revoked)	☐	☐

25. DETAILS OF "YES" answers. (List name and address of all doctors or hospitals plus date of attacks and recoveries.)

26. FAMILY RECORD - of Proposed Insured

	Age If Living	Health - Reason if Not Good	Age at Death	Cause of Death
Father				
Mother				
Brothers and Sisters				

I (we) represent that all statements and answers in this application, any supplements, additional forms or medical examinations required by the Company are to the best of our knowledge and belief true, complete and correctly recorded, and it is agreed (1) Such statements and answers are a part of the application and constitute the sole basis for issuance of any insurance hereunder; (2) No information known to any agent or employee of the Company shall be binding upon the Company unless written on and made a part of this Application; (3) **EXCEPT AS STATED IN A DULY EXECUTED CONDITIONAL RECEIPT BEARING THE SAME PRINTED NUMBER AS THIS APPLICATION, A DULY EXECUTED GOVERNMENT ALLOTMENT CONDITIONAL INSURANCE CERTIFICATE BEARING THE SAME PRINTED NUMBER AS THIS APPLICATION, OR A CONDITIONAL SALARY DEDUCTION AGREEMENT RELATING TO THE PROPOSED INSURANCE AND DELIVERED TO THE APPLICANT, THE COMPANY GRANTS NO INSURANCE UNDER THIS APPLICATION UNLESS AND UNTIL, DURING THE CONTINUED INSURABILITY OF THE PROPOSED INSURED, AND ALL OTHERS PROPOSED FOR INSURANCE HEREIN, A POLICY ISSUED ON THIS APPLICATION IS DELIVERED TO THE APPLICANT, AND THE FULL FIRST PREMIUM IS PAID;** and (4) Acceptance of the issued policy will constitute ratification of changes made by the Company as Home Office Corrections or Additions except where written acceptance of non-administrative changes is required by law.

$_____
(Must Always Be Answered)

has been paid to the agent named below. This payment can in no way obligate Lafayette Life Company unless and until all terms and conditions of the corresponding conditional receipt below are met.

Signed at_____ State of_____ this_____ day of_____, 19____

№ 28322

I HAVE READ THE COMPLETED APPLICATION BEFORE SIGNING

_____
Signature of Proposed Insured (if over age 14)

_____
Signature of Policyowner named in No. 5, if other than Proposed Insured

_____
Signature of Proposed Insured Spouse

Witness_____
Signature of Agent

_____
Signature of Parent (Juvenile Policy Only)

Insurance Application

AGENT'S REPORT

A (This information must be completed with EVERY application)

1. Was Inspection or Telecom ordered?_____ Date_____ Attach Carbon Copies of Tickets
2. Residence Address of Proposed Insured: Street and No. _____
   TELEPHONE NUMBER
   HOME: Area Code____ Number____ BUSINESS: Area Code____ Number____
3. Former Address (last 3 years) _____
4. Employer and Address _____
5. Maiden name of any woman to be insured if marriage occurred within five years. _____
6. How much insurance does spouse have? $_____

How long	
Yrs.	Mos.

B EXAMINATION ARRANGEMENTS BY:

	Yes	No
1. Is a medical examination being arranged for?	☐	☐
2. ON _____ (Date)		
3. Name of Doctor _____ or Paramed?		
4. Is he one of our approved examiners?	☐	☐
5. If rules require, did you arrange for:		
Second Medical exam?	☐	☐
EKG?	☐	☐
Chest X-ray?	☐	☐
Sending specimen to Home Office Reference Lab?	☐	☐
SMA-12 Blood Test?	☐	☐
_____	☐	☐

C Will any existing life or annuity contracts be lapsed, surrendered, borrowed against, or changed if the proposed policy is issued?

☐ No

☐ Yes - Complete comparison/disclosure statement if required by state of application.

D

1. How long have you known Proposed Insured (Applicant if Proposed Insured is under age 15)? _____
   Are you related? _____
2. Are you aware of anything about the health, habits, hobbies, environment, or mode of life which might affect insurability of Proposed Insured? ☐ Yes ☐ No
3. What is the source of income (other than income from occupation)? _____
4. Will premiums be paid from personal funds? ☐ Yes ☐ No
5. Your estimate of Proposed Insured's annual income $_____

E IF PROPOSED INSURED IS UNDER AGE 15:

1. Did you see the child proposed for insurance? ☐ Yes ☐ No
2. Does the child appear in good health? ☐ Yes ☐ No
3. How long have you known the child? _____
4. How many brothers and sisters has the child?
   Brothers____ Sisters____
5. Are all brothers and sisters insured? ☐ Yes ☐ No
   If "No" give reasons _____
6. Amount of insurance in force on supporting parents? $_____
7. Remarks: _____

F TO BE COMPLETED IF INSURANCE IS FOR BUSINESS PURPOSES OR FOR ESTATE CONSERVATION

____ Business Insurance (Include copy of Business Financial Report ____ Estate Conservation

1. Value of Business $____ Proposed Insured's Interest____% 5. Approximate Value of Gross Estate $_____
2. Proposed Insured's Compensation: Salary $____, Bonus $____, Other $____ (Include Copy of Estate or Capital Need Analysis)
3. Purpose of Insurance.
   ☐ Key Person ☐ Split Dollar
   ☐ Fund Buy and Sell ☐ Executive Bonus
   ☐ Deferred Compensation ☐ Estate Liquidity
6. Type of Business.
   ☐ Sole Proprietorship ☐ Partnership
   ☐ Corporation State of Incorporation____
7. Name of Officer Signing for Corporation _____
4. Names of Other Stockholders, Officers and Partners and Amount of Business Insurance Carried on Their Lives.

Name and Title	Value of business interest	Percent owned	Amount Now Carried	Amount now applied for

(If any not insured, give explanation _____

G Details to any of above questions (state question number) _____

SOURCE OF PROSPECT ☐ 1 Policyowner ☐ 3 Cold Canvass ☐ 5 Policyowner Service lead ☐ 2 Referred lead ☐ 4 Direct Mail ☐ 6 Other _____

Credit this application to _____ (Please Print) ____% Code No.____

(If split-credit) _____ (Other Agent) ____% Code No.____

THIS REPORT MUST BE SIGNED _____ Signature of Writing Agent

H ANNUAL PREMIUM CALCULATION

	Premium		Units		Total
Basic Ins.	$____	X	____	=	$____
WP on Basic	$____	X	____	=	$____
Term Riders	$____	X	____	=	$____
WP on Riders	$____	X	____	=	$____
ADB	$____	X	____	=	$____
GPO/GIO	$____	X	____	=	$____
CIR	$____	X	____	=	$____
SIR	$____	X	____	=	$____
Subtotal	$____	X	____	=	$____
WP% of Prem. (Un. Life)				=	$____
Q.D.F. (Not Un. Life)					$____
Total Annual Premium					$____
Times (X)____ Mode Factor (Not Un. Life)					$____

I CONFIRM THAT I HAVE DELIVERED TO THE PROPOSED INSURED The Fair Credit Reporting Act and Medical Information Bureau Notices, Form 1453.

Client Asset Sheet

Name:_____ Date of Birth:____/____/____

Name:_____ Date of Birth:____/____/____

Children:_____ Date of Birth:____/____/____

_____ Date of Birth:____/____/____

_____ Date of Birth:____/____/____

ASSETS

	His	Hers	Joint	Indebt.
Market Value of Home	$_____	$_____	$_____	$_____
Other Real Estate	_____	_____	_____	_____
Personal Property	_____	_____	_____	_____
Checking Accounts_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
Savings Accounts_____ %	_____	_____	_____	_____
_____ %	_____	_____	_____	_____
C.D.'s, Money Market _____ %	_____	_____	_____	_____
Stock, Securities	_____	_____	_____	_____
Life Insurance_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
Retirement Plan Death Benefit	_____	_____	_____	_____
IRA _____ %	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

OTHER INFORMATION

His Salary_____ Her Salary_____

Other Income_____ Rental Income_____

Consulting Income_____ Self Employ. Income_____

Disability Insurance:_____

Health Insurance:_____

Income need in the event of a premature death:_____

Do you have a Will:_____

Inheritance potential:_____

OBJECTIVES

_____

_____

_____

Estate Settlement Worksheet

	Estimate of Cash Needed to Settle Your Estate	
	With Full Marital Deduction (a)	Without Marital Deduction
1. Gross Estate		
2. Less Debts, Outstanding Taxes, etc.		
3. Less Probate and Administration Costs		
4. Adjusted Gross Estate		
5. Less Marital Deduction (b)		XXXXXXXXX
6. Less Charitable Contributions (c)		
7. Taxable Estate		
8. Tentative Federal Estate Tax		
9. Less Federal Tax Credit (d)		
10. Approximate Federal Estate Tax (e)		
11. Total Cash Required (f)		

(a) The marital deduction does not apply if there is no surviving spouse.

(b) This amount can be either (1) the amount from line 4; (2) the amount necessary to bring estate taxes to zero — Line 4 less $225,000 for 1982; $275,000 for 1983; $325,000 for 1984; $400,000 for 1985; $500,000 for 1986 and $600,000 for 1987 and later years or (3) any other amount.

(c) The estate must have sufficient funds to make the bequest.

(d) Use $62,800 for 1982; $79,300 for 1983; $96,300 for 1984; $121,800 for 1985; $155,800 for 1986 and $192,800 for 1987 and later years.

(e) Including maximum credit for state inheritance taxes. The state taxes may exceed this credit so the total federal and state taxes may exceed this estimate.

(f) Sum of lines 2, 3 and 10.

Federal Estate Tax

	Taxable Estate	Estate Tax	% Tax in next Bracket
	$ 10,000	$ 1,800	20%
	20,000	3,800	22
	40,000	8,200	24
	60,000	13,000	26
	80,000	18,200	28
	100,000	23,800	30
	150,000	38,800	32
	250,000	70,800	34
	500,000	155,800	37
	750,000	248,300	39
	1,000,000	345,800	41
	1,250,000	448,300	43
	1,500,000	555,800	45
	2,000,000	780,800	49
1985	2,500,000	1,025,800	53 (50)
1984	3,000,000	1,290,800	57 (55)
1983	3,500,000	1,575,800	61 (60)
1982	4,000,000	1,880,800	65

Average Probate and Administration Costs
(on property passing under the will or by the laws of intestacy)

Probatable Estate	Probate and Adm. Costs
$ 25,000	$ 2,500
50,000	3,500
100,000	5,500
200,000	9,750
300,000	14,500
400,000	19,500
500,000	25,000
600,000	30,000
700,000	35,000
800,000	40,000
900,000	45,000
1,000,000	50,000

Not applicable to property passing by survivorship nor to property passing by contract to a named beneficiary, nor to property held in trust passing by terms of the trust.

Upper limits of estate tax brackets will be reduced in years 1982-1985. Do not refer to tax brackets below the current year. The tax brackets in parentheses will become effective when the year indexed is reached. For example, in 1982 a taxable estate of $3,600,000 will be in a 61% marginal tax bracket. In 1983, the same size taxable estate will be in a 60% marginal bracket. In 1985, a taxable estate of this size or any taxable estate in excess of $2,500,000 will be in a maximum tax bracket of 50%.

Complete the reverse side to show Estate Settlement costs if the order of death is reversed.

Cash Flow Statement

Cash Flow Statement
For the Year Ending _____

Cash Balance at Beginning of the Year		$_____
INFLOWS		
Salaries after taxes		_____
Dividends in cash		_____
Interest received		_____
TOTAL INFLOWS		$_____
OUTFLOWS		
Savings and Investment		$_____
Fixed Outflows		
Mortgage note payments	$_____	
Automobile note payments	_____	
Insurance premiums	_____	
Total Fixed Outflows		_____
Variable Outflows		
Food	$_____	
Transportation	_____	
Utilities/household exp.	_____	
Clothes and personal care	_____	
Recreation and vacations	_____	
Medical and dental care	_____	
Taxes	_____	
Miscellaneous	_____	
Total Variable Outflows		_____
TOTAL OUTFLOWS		$_____
Cash Balance at End of the Year		$_____

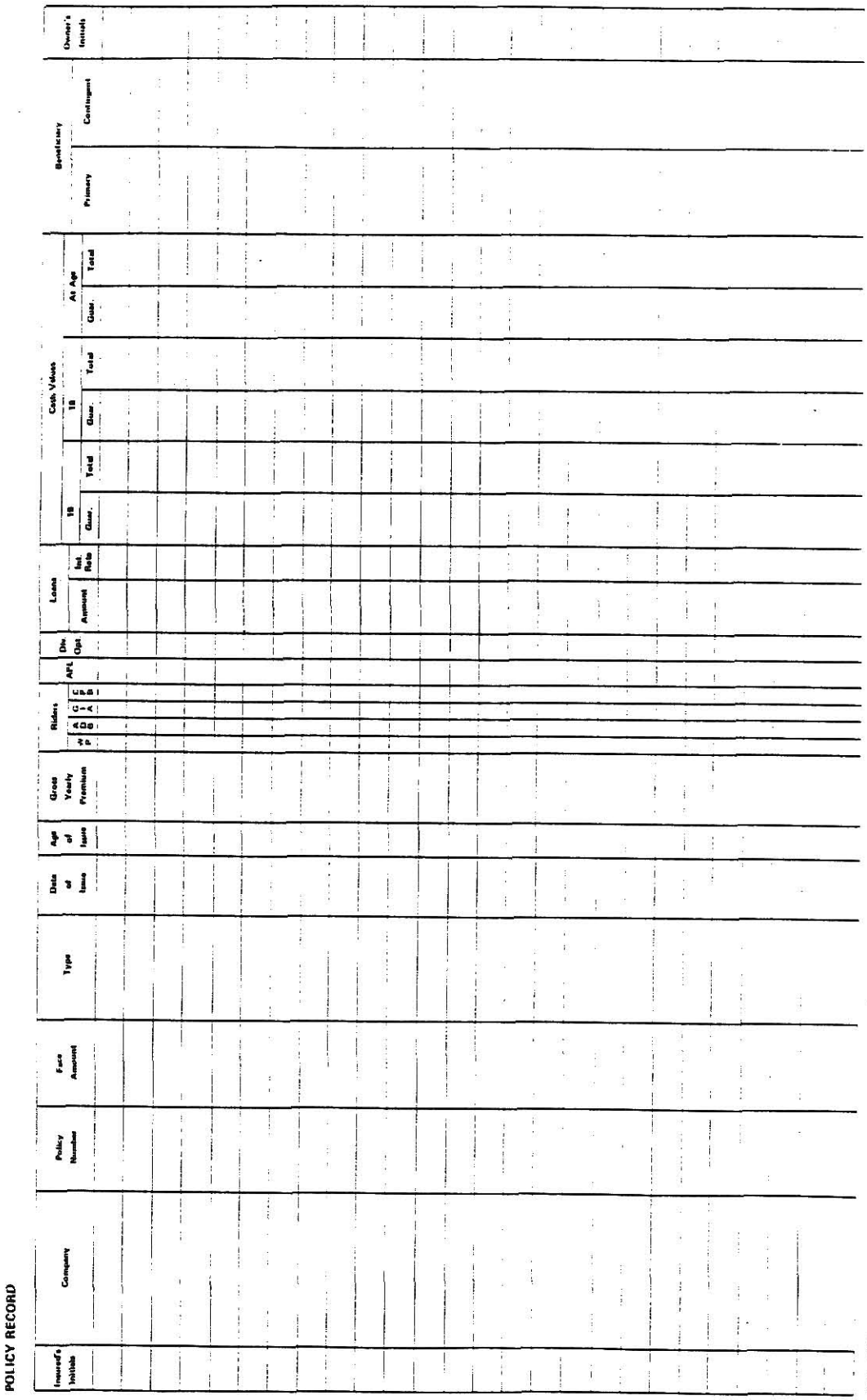
Pro Forma Cash Flow Statement
For the Quarter Ending _____

Cash balance at beginning of month	$	$	$
INFLOWS			
Salaries after taxes			
Dividends in cash			
Interest income			
Borrowed Funds			
_____			
_____			
TOTAL INFLOWS	$	$	$
OUTFLOWS			
Savings and Investments			
Fixed Outflows			
Mortgage note payment			
Automobile note payment			
Insurance premiums			
_____			
Variable Outflows			
Food			
Transportation			
Household Expenses (inc. util.)			
Clothes/personal care			
Recreation and vacations			
Medical and dental care			
Credit card payments			
Miscellaneous			
TOTAL OUTFLOWS	$	$	$
NET CASH POSITION	$	$	$
Additional funds needed			
Cash Balance at End of Month	$	$	$

Statement of Financial Position

Statement of Financial Position
As of _____

ASSETS		LIABILITIES AND NET WORTH	
Cash and Cash Equivalents		**Liabilities**	
Cash and checking account	_____	Credit card balance	_____
All-savers Certificate	_____	Automobile note bal.	_____
Money Market Fund	_____	Mortgage note bal.	_____
_____	_____	_____	_____
_____	_____	_____	_____
Total Cash/Cash Equiv.	_____	Total Liabilities	_____
Invested Assets		**Net Worth**	_____
Stocks and bonds	_____		
Life insurance cash value	_____		
Vested portion of pension	_____		
_____	_____		
_____	_____		
Total Invested Assets	_____		
Use Assets			
Residence	_____		
Automobiles	_____		
Household furnishings	_____		
Clothing, jewelry, etc.	_____		
_____	_____		
_____	_____		
Total Use Assets	_____		
TOTAL ASSETS	_____	TOTAL LIABILITIES AND NET WORTH	_____


POLICY RECORD
Insured's Initials
Company
Policy Number
Face Amount
Type
Date of Issue
Age of Issue
Gross Yearly Premium
Riders
W P
A D B
G I A
C P R
APL
Div Opt
Loans
Amount
Int. Rate
Cash Values
18
Guar.
Total
Guar.
Total
At Age
Guar.
Total
Beneficiary
Primary
Contingent
Owner's Initials
*FOR DETAILED INFORMATION ON SETTLEMENT OPTION SEE POLICY SUMMARY FORM
1065A 11/80

References

1. Chen, P.P.-S. "The entity-relationship model -- Toward a more unified view of data." ACM Trans Database Syst. 1:1.1976

2. Hammer, M. and D. McLeod. "The semantic data model: A modelling mechanism for data base applications." SIGMOD (ACM) Int. Conf. on Management of Data. Austin, TX. May 31, June 1-2, 1978

3. Hammer, M. and D. McLeod. "The semantic data model: A conceptual data modelling mechanism." In Advances in data base management. Ed. T. Rullo. Heyden. Philadelphia, PN. 1980

4. Hammer, M. and D. McLeod. "Database description with SDM: A Semantic Database Model." ACM Trans Database Syst. 6:3. 1981

5. Hsu, J. and N. Roussopoulas. "Database conceptual modelling." In Proc. Int. Conf. Entity-Relationship Approach to Systems Analysis and Design, (Los Angeles, Calif., Dec.). Elsevier-North Holland, New York. 1979.

6. Hull, R. and C. Yap. "The format model: A theory of database organization." J. Assoc. Comput. Machinery. 31:3. 1984

7. Kreps, P. "Relativism and views in a conceptual data base model." Proc. Workshop on Data Abstraction; Databases and Conceptual Models ACM Pingree Park, CO, June 23-26, 1980

8. Kroenke, D. Database Processing: Fundamentals, Design, Implementation. Second Edition. Science Research Associates, Inc. Chicago, IL. 1983

9. McLeod, D. "High level definition of abstract domains in a relational database system." J. Comput. Languages. 2:3. 1977

10. McLeod, D. "A semantic database model and its associated structured user interface." Tech. Rep., M.I.T. Lab. Computer Science. Cambridge, Mass. 1979

11. McLeod, D. and R. King. "Applying a semantic database model." In Proc. Int. Conf. Entity-Relationship Approach to Systems Analysis and Design, (Los Angeles, Calif., Dec.). Elsevier-North Holland, New York. 1979.

12. Sowa, J. Conceptual Structures. Addison-Wesley. Reading, Mass. 1984

13. Teorey, T. and J. Fry. "The logical record access approach to database design." Comput. Surveys. 12:2. 1980

14. Unger, B. and P. Fisher. Personal communication. 1983

15. Warnier, D. and K. Orr. "Part 1: Design methodology." In Structured programming with Warnier-Orr diagrams. Byte Publications, Inc., Peterborough, NH. 1978

The Design of a Small Business Database using the Semantic Database Model.

by

Jac F. Morgan

B.S., Kansas State University, 1975
M.S., Kansas State University, 1978

AN ABSTRACT OF A MASTER'S REPORT

Submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Computer Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1985

The implementation of a database management system requires a comprehensive understanding of the data used by an enterprise and of how the data is used. The first step in database design is to gather information about the data. The second step is to arrange this information into some kind of meaningful representation of the enterprise which will guide the logical and physical design of the database.

This report describes the Semantic Database Model (SDM), a tool for creating a conceptual model (meaningful representation) of the application environment. The SDM will model the information requirements of a small business, an insurance agency. The authors of the SDM have provided a database definition language (DbDL) which is to be used to describe the application environment. This report is written with the specific intent of providing a tool to teach undergraduate and graduate students how to use the SDM. Thus the DbDL is presented in the form of a user's manual. Suggested steps in the application of the SDM are provided and the use of these steps is demonstrated. The result of the application of these steps is an SDM schema which describes most of the insurance agency. A brief section will describe a method for converting the SDM model into a relation model of the enterprise. A discussion of the problems encountered when applying the SDM is provided.