# IMAGE/1000

# Data Base Design Kit

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# PRINTING HISTORY

The Printing History below identifies the Edition of this Manual and any Updates that are included. Periodically, Update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this Printing History page. Also, the update may contain write-in instructions.

Each reprinting of this manual will incorporate all past Updates, however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with its user-inserted update information. New editions of this manual will contain new information, as well as all Updates.

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First Edition ..... Oct 1981

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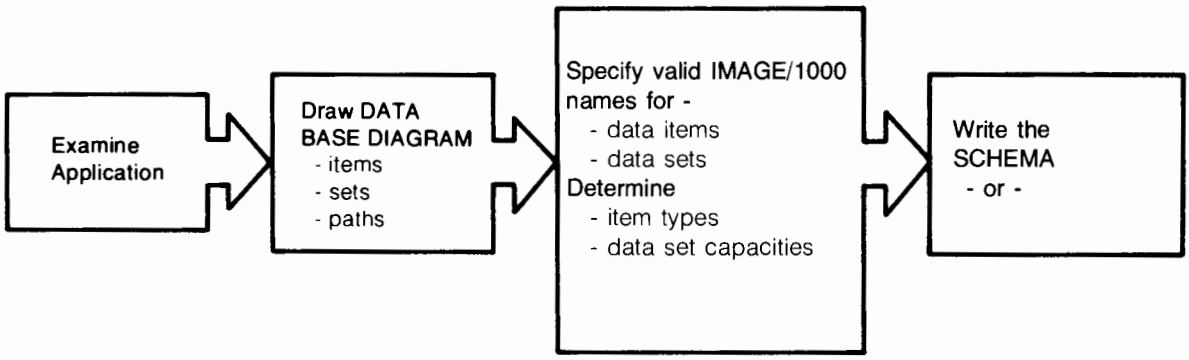
# Table of Contents

# Chapter 1
# Introduction

The process of designing a data base accomplishes the task of representing and relating the information in a data management application, putting it into terms that IMAGE/1000 can understand. This process converts the logical definition of the data into the physical design (items, sets and paths) of an IMAGE/1000 data base. The designing of a data base is a crucial step, one which must be completed before any other data base operations can take place. Looked at simply, the design process can be broken down into four steps —




Because the last two steps are quite straightforward, the Data Base Design Kit focuses on assisting you in completing the first two steps, especially drawing the data base diagram. Since any item in a data base can be accessed, a good design determines how easily the data can be accessed and related at a later time. There is no one perfect design of a data base, but one or two designs may provide the most efficient access to and usage of the data.

## Who Can Use the Design Kit?

Whether you intend to use IMAGE/1000 to write data base programs or to use QUERY/1000 to access your data bases interactively, you can use the Data Base Design Kit to convert your application into an optimum IMAGE-QUERY data base. The Design Kit provides procedures, forms and tips to assist you in translating your data base management needs into a useable structure.

# Before Using the Design Kit

Before you use the Design Kit to design a data base, you should be familiar with the terms and concepts of IMAGE/1000 data bases, such as data item, data set, key item (or search item) and data path. These concepts are covered in the IMAGE/1000 Reference Manual.

# Design Procedures

The Design Kit includes two approaches to designing a data base. The first is an **intuitive** approach, which involves determining what data is kept, how it is related and how it is to be accessed. The second approach is a **functional**, more rigorous one and can be used if the intuitive approach isn't sufficient in helping you design your data base. This approach involves examining the overall design requirements of the application as well as the data base design. The functions the data is to perform are defined in order to determine how the data sets and data paths are structured.

Both design approaches result in a **data base diagram** of the data items, data sets and how they are related. Once the diagram is drawn, you must determine valid IMAGE/1000 names for data items (and any QUERY/1000 synonyms) and data sets, the type of each data item, the capacity of each data set and, for multiple-volume data bases, the volume on which each data set is to reside.

# Using the Design Kit

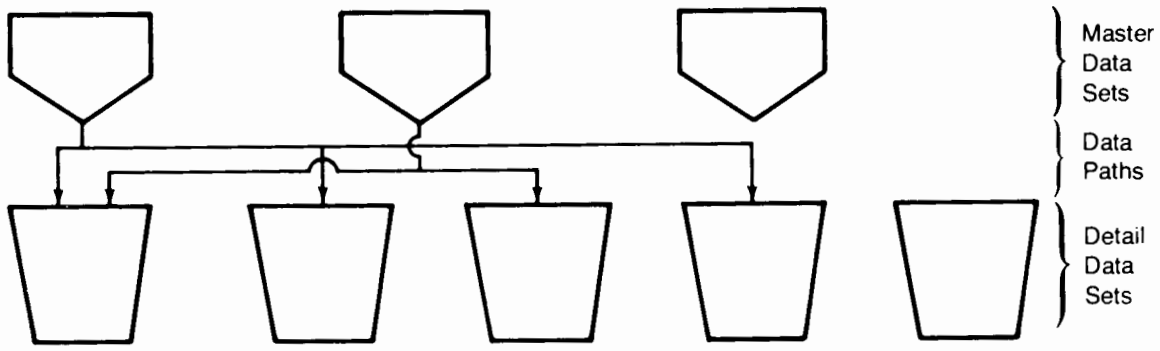
The Design Kit is divided into six chapters. They are –

- Introduction
- Intuitive Design Approach
- Functional Design Approach
- Beyond the Data Base Diagram
- Special Considerations and Design Tips
- Examples of sample data base applications and resulting data base diagrams

Whether you use the intuitive or the functional approach, the fourth, fifth and sixth chapters should be of interest to you.

# IMAGE/1000 Data Bases

IMAGE/1000 organizes data using a **simple network** structure. Basically, a simple network has two levels: master sets and detail sets, connected by data paths. The following diagram illustrates a simple network data base.




Each master data set can have up to 16 paths to detail data sets. In turn, each detail data set can have a maximum of 16 paths linking it to master data sets.

# The Sample Data Base

The first step in the design process is to examine the needs which the data base will serve. The sample data base is used by the fictitious NOP Manufacturing Company to keep track of the reference books contained in the libraries of its eight plants. The data base serves the following needs -

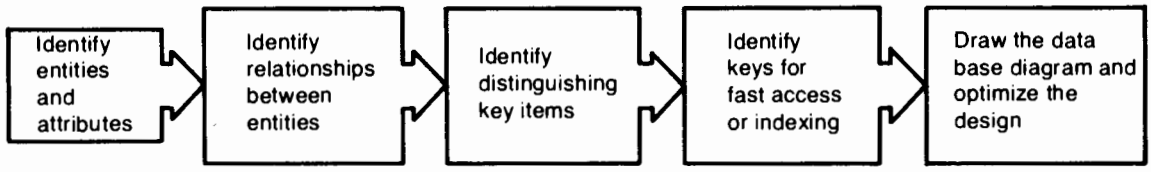
- Keep information about each book (title, author, call number, how recent it is, publisher, cost and subject).
- Keep a list of every book, identifying which plant owns it.
- Determine whether or not a book has been checked out, when and by whom.
- Identify all employees who may borrow books (including name, employee number, department and plant phone number).
- Keep general information about each library branch (plant name and address, librarian and phone number).
- Classify each book by subject.

This list is used as the basis for both the intuitive and functional design examples in Chapters 2 and 3 of the Design Kit.

# Chapter 2

# Intuitive Design Approach

The intuitive approach to designing a data base involves the following five steps -




## Identify Entities and Attributes

The first step in the intuitive design approach is to identify the **entities**, or things, about which information is being kept and the **attributes** necessary to describe those entities (based on the needs of the application). Normally, each entity becomes a data set and its attributes become data items.

Some examples of entities are Parts, Warehouses, Projects, Employees and Tests. The attributes for each entity depend on the information needs of the application. For example, for the entity Warehouse, the attributes Size, Address and Manager may be the necessary information, but the attributes Color and Age may not be needed as part of the warehouse entity.

If there is an attribute which is computed using other attributes, it need not be part of the data base. For example, if an entity called Test Results had three attributes: Total tested, Total failed, and Percentage failed, the last of these need not be included because it can be computed.

### Example

The sample data base keeps information about three entities -

Books
Borrowers
Library Branches

In accordance with the needs of the library, the entities are described by the following attributes -

| **Book** | **Borrower** | **Library Branch** |
|---|---|---|
| Title | Name | Plant name |
| Author | Employee number[2] | Plant address |
| Call number[1] | Location, Phone number[3] | Librarian |
| Subject | | Phone number |
| Publisher | | |
| Publication date | | |
| Cost | | |

Other information could be kept for each entity, but it isn't needed for the library application. For example, the library does not need to know the salary and date of employment for an employee.

# Identify Relationships Between Entities

The second step in the intuitive design approach is to identify the needs of the data base that are met by defining a relationship **between two or more entities**. A relationship between two or more entities becomes a data set; the attributes necessary to identify each of the entities involved, along with related information, become the items in the data set.

For example, a hospital might need to keep track of a relationship, called Skill, for determining which doctors can perform which operations. The entities involved are Doctor and Operation. A related item of information could be Total, specifying how many times a specific doctor has performed a specific operation.

## Example

The library data base keeps track of which employees have checked out which book and which plant owns the book; multiple copies of books make Copy Number a necessary related item. This is a relationship between Book, Borrower and Library branch. The relationship is described by the following attributes -

**Inventory**
Call number
Copy number
Plant
Employee number (0 is used if the book is not checked out)
Date borrowed

1 needed to identify unique Title-Author combinations
2 needed to distinguish employees having the same name
3 needed to contact the employee

# Identify Key Items for Distinguishing Entities and Relationships

Each entity should have one attribute which can distinguish a particular occurrence of that entity. Each relationship between entities normally has one attribute for each of the entities involved which combine to distinguish a particular occurrence of the relationship. Each distinguishing attribute becomes a **key item** for that entity.

## Example

The sample data base keeps information about three entities and one relationship. They are distinguished by the following key items -

| **Book** | **Borrower** | **Library Branch** | **Inventory** |
|---|---|---|---|
| Call number | Employee number | Plant name | Call number |
| | | | Employee number |
| | | | Plant name |

# Identify Key Items for Fast Access

The fourth step is to identify **additional** key items by which the entities and relationships will be accessed routinely. In this case, subjective judgement must be used. Key items provide easier access, but also cause the data base to require more space on a disc. If access to an entity via a particular attribute will be made only on rare occasions, it is probably best not to make that attribute a key item.

When determining whether or not an attribute should be a key item, keep these three questions, which pertain to accessing of the entity through a particular item, in mind -

- How much?
- How fast?
- How often?

## Example

For the sample data base, the following key items are added for easier accessing and indexing –

**Book**
Title
Author
Subject

Suppose that an additional function of the library data base is to list the books in chronological order based on publication date in an effort to get rid of out-of-date books. However, this operation is only performed once a year. In this case, it is best not to make Publication date a key item.

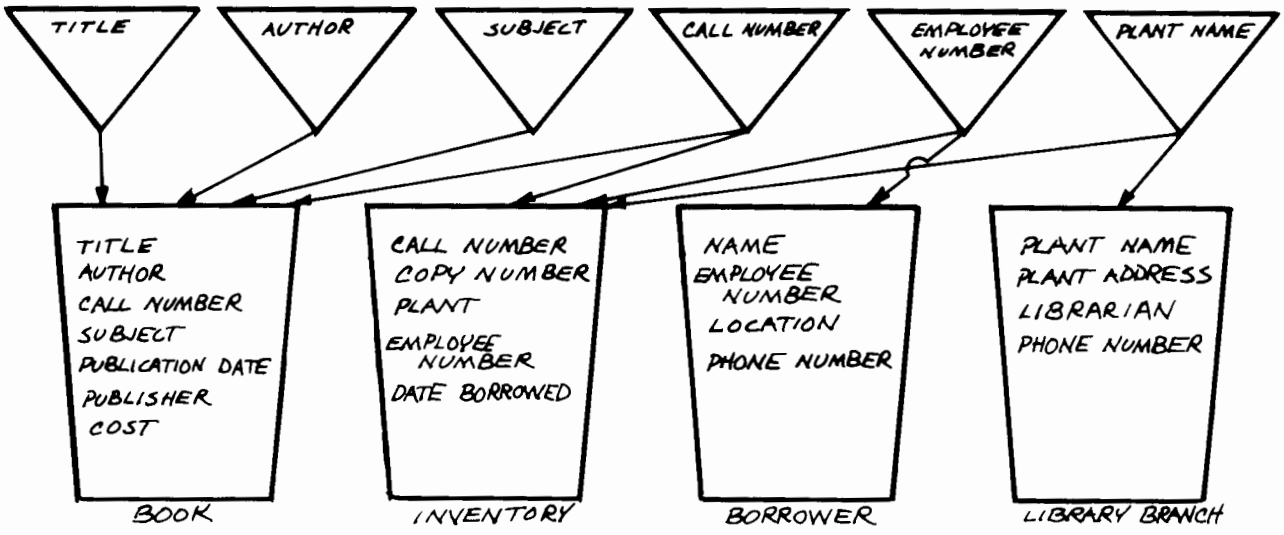
# Draw and Optimize the Data Base Diagram

The result of the design process is the data base diagram. An initial diagram can be drawn from the entities, attributes and relationships as they are defined at this point. The initial diagram is then examined and can be modified as necessary to optimize it.

For the initial representation, each entity or relationship becomes a detail data set and each key item is also put into a master data set. Data paths are then drawn from each master set to related detail sets.

## Example

Here is the initial diagram for the library data base.




## Optimizing the Design

Optimizing the design of a data base involves saving memory and taking advantage of the characteristics of manual master data sets. Manual master sets allow other items in addition to the key item to be in the master set, which saves memory and helps ensure data integrity.

The optimization process may be used any time the following conditions are met.

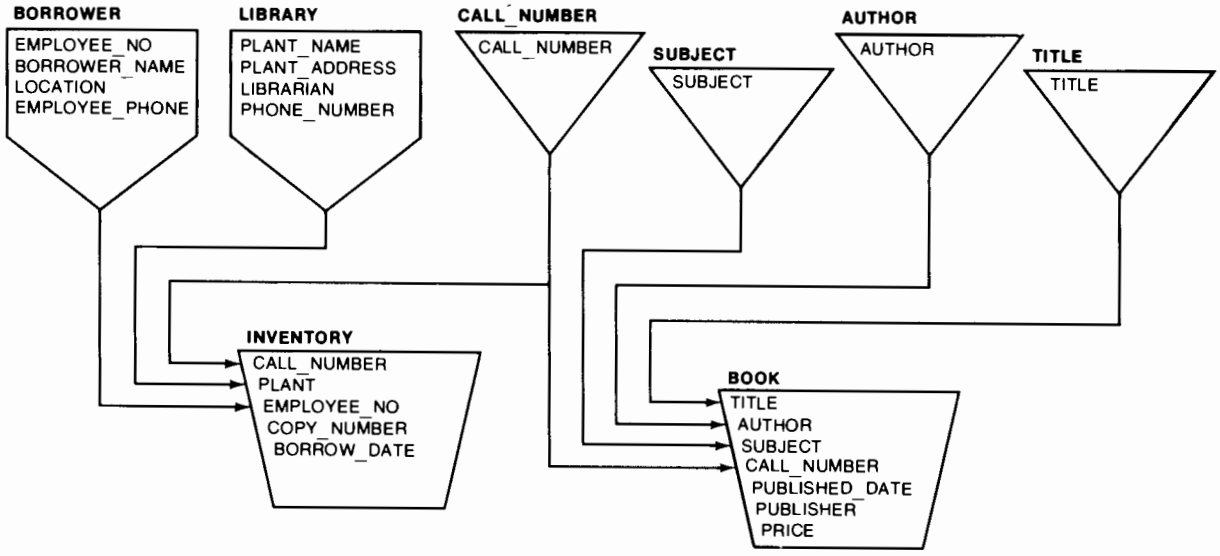
- there is a detail data set which describes a particular entity
- there is only one master set which has a path to that detail set
- the key item in the master set is the indentifying attribute (key item) for the entity described in the detail set

When all of these conditions are met, the information in the detail data set can be moved into the master set. This changes the master set to a manual master data set and permits the corresponding detail data set to be removed, along with the data path.

## Example

In the initial diagram of the sample data base, both the Borrower and Library Branch detail data sets meet the criteria specified above. Specifically, the Borrower detail set (which describes one entity) has only one related master set, Employee number. The key item Employee number is the identifying attribute for the Borrower.

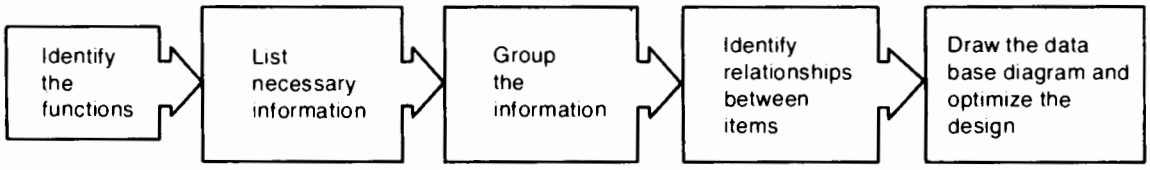
Both the Borrower and Library Branch detail sets can be combined with their corresponding master sets. This produces the final diagram of the sample data base.



# Chapter 3

# Functional Design Approach

The functional approach to data base design is more rigorous than the intuitive approach discussed in Chapter Two. It can be used when the entities and relationships you want to keep information about cannot be determined in the straightforward manner used in the intuitive approach. The functional approach to designing a data base involves the following five steps -




## Identify the Functions

The first step in the functional design approach is to identify the functions which the application must perform. Begin with the primary purpose, then break it down into one or more secondary functions, which are more specific than the primary function. In turn, secondary functions may be broken down further. This process continues until the functions are the most fundamental, unable to be broken down into supporting functions.

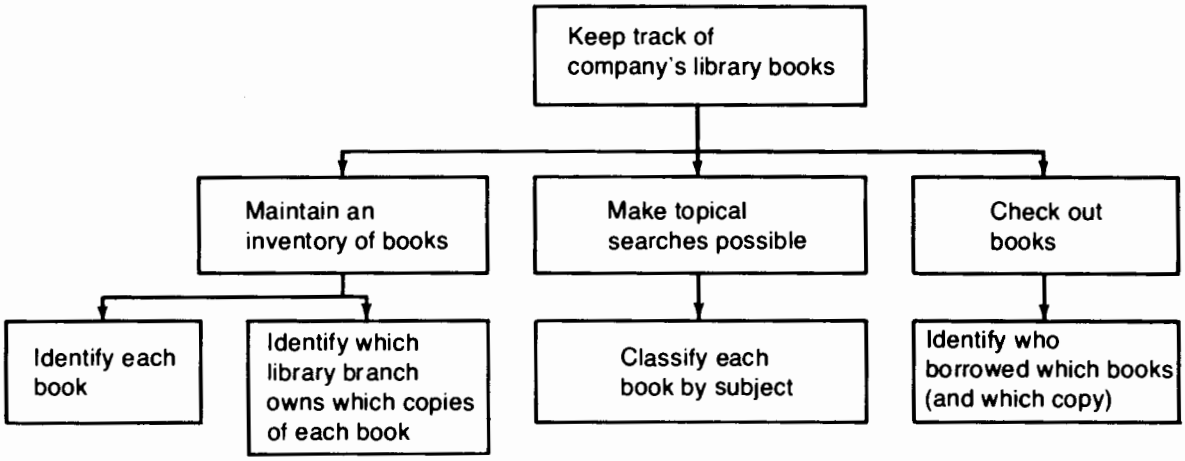
There are three factors to keep in mind as you identify the functions of your application. They are -

- the objectives of your application
- how to accomplish those objectives
- what information is needed to accomplish the objectives.

Make sure that all functions are included and, if possible, look ahead to future needs of the data base.

## Example

The needs of the library in using the sample data base were discussed in Chapter 1. Here is the functional breakdown of the functions -

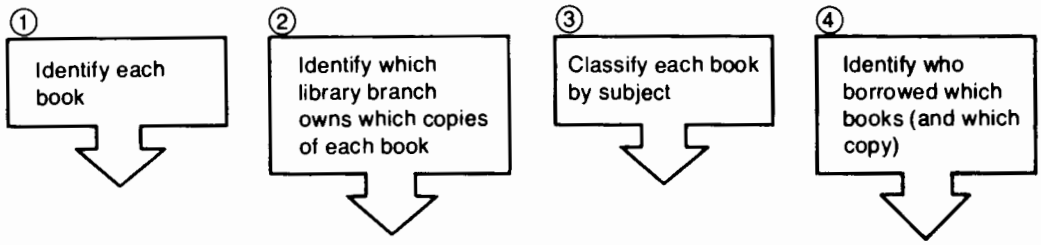



# List Necessary Information

The second step in the functional design of a data base is to list the information needed to perform the bottom-line functions determined in step 1. Each item of information needed to perform a particular function should be included. This step also includes numbering of each function for later use.

## Example

The information needed for each of the bottom-line functions of the sample data base is listed below.




| | | | |
|---|---|---|---|
| Author | Call Number | Call Number | Call Number |
| Title | Copy Number | Subject | Copy number |
| Call number | Plant name | | Borrower |
| Publisher | Plant address | | Employee number |
| Publication date | Librarian | | Location |
| Cost | Phone number of plant | | Phone number |
| | | | Date borrowed |

# Group the Information

Once all of the information needed for the functions is specified, the next step is to identify groups of items which are used together. This is simplified using a **Function Matrix**. This Function Matrix contains all the functions and data items and is the first step in identifying data sets. Additional blank copies of the Function Matrix can be found in the back of the Design Kit.

The first step in filling out the Function Matrix is to list all the data items from step 2 in the first column and to fill in the function descriptions under the appropriate functiong numbers. If the form is not large enough to contain all the functions or items for your data base, an additional form can be used.

The second step in filling out the Function Matrix is, for each data item, to put an X in the appropriate function columns, indicating each function in which the data item is used.

## Example

Following is the completed Function Matrix for the sample data base.

FUNCTION MATRIX

| Function Number: | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Function Description: | | IDENTIFY EACH BOOK | IDENTIFY WHICH LIBRARY BRANCH OWNS WHICH COPIES OF EACH BOOK | CLASSIFY EACH BOOK BY SUBJECT | IDENTIFY WHO BORROWED WHICH BOOKS (AND WHICH COPY) | | | | |
| Data Item | Item Number | DATA ITEM FUNCTIONS | | | | | | | |
| AUTHOR | 1 | X | | | | | | | |
| TITLE | 2 | X | | | | | | | |
| CALL NUMBER | 3 | X | X | X | X | | | | |
| PUBLISHER | 4 | X | | | | | | | |
| PUBLICATION DATE | 5 | X | | | | | | | |
| COST | 6 | X | | | | | | | |
| COPY NUMBER | 7 | | X | | X | | | | |
| PLANT NAME | 8 | | X | | | | | | |
| PLANT ADDRESS | 9 | | X | | | | | | |
| LIBRARIAN | 10 | | X | | | | | | |
| PLANT PHONE # | 11 | | X | | | | | | |
| SUBJECT | 12 | | | X | | | | | |
| BORROWER | 13 | | | | X | | | | |
| EMPLOYEE NUMBER | 14 | | | | X | | | | |
| LOCATION | 15 | | | | X | | | | |
| PHONE NUMBER | 16 | | | | X | | | | |
| DATE BORROWED | 17 | | | | X | | | | |
| | 18 | | | | | | | | |
| | 19 | | | | | | | | |
| | 20 | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

## Identify Entities and Key Items

After the Function Matrix is filled out, the next step is to identify the **entities**, or things, about which data is being kept. Certain items will be used together in one or more of the functions; these 'related items' describe some entity. The identification of entities is an intuitive step in the functional design process. Generally, each entity becomes a detail or manual master data set.

Each entity should have one data item that identifies a particular occurrence of the entity. This is called the **key item**. Additionally, items which are used to access entities can be key items. For example, books can also be accessed by title, author and subject.

Once you have identified the entities and their key items, you may want to write these down at the bottom of the Function Matrix.

## Example

The sample data base keeps information about three entities. They are itemized below, with the key items indicated by an asterisk.

| **Book** | **Borrower** | **Library Branch** |
|---|---|---|
| Title* | Borrower name | Plant name* |
| Author* | Employee number* | Plant address |
| Call number* | Location | Librarian |
| Publisher | Phone number | Plant phone number |
| Publication date | | |
| Subject* | | |
| Cost | | |

# Identify Relationships Between Data Items

The next step in the functional design of a data base brings you even closer to identifying the data sets. This step is to determine how each data item is related to every other data item. Each pair of data items is related in one of four possible ways. When two items both have an 'X' in the same column of the Function Matrix, they may be related in any of the four ways. If two items never have an 'X' in the same column, they must be related in the fourth way, which is 'no relationship'. The four possible relationships are -

1. **1 to 1 (1:1) – occurs between two items that describe the same entity. One value for one of the items always occurs with one value for the other.** For example, each Call Number has one Title. In some cases, the reversal of the relationship is not 1-to-1; two different books having the same title would have different call numbers. In this case, the relationship remains 1-to-1.
2. **1 to many (1→N) – one value for a key item can occur with more than one value for the other item**. The two items need not describe the same entity. For example, an Author can be associated with more than one Title.
3. **Many to many (N⇔M) – multiple values for one key item occur with multiple values for another key item**. For example, many Authors write about one Subject and one Author can write about many Subjects.
4. **No relationship – none of the three previous conditions is met**. This also occurs when the two items are never used together in the same column of the Function Matrix.

To determine the relationships between the data items, a **Relation Matrix** can be used, as shown on the next page. Blank copies of this form can be found in the back of the Design Kit. Notice that half of the matrix has been crossed out. This is because each pair of items needs to occur only once; pairing 1 with 2 means you need not pair 2 with 1.

Begin filling out the Relation Matrix by filling in the item names next to the appropriate numbers. Next, cross out each box where there is no relationship between two items because they are never used in the same column of the Function Matrix. For the remaining boxes, examine each relationship, determining whether it is 1-to-1, 1-to-many, many-to-many or no relationship, as described above.

## Example

Following is the completed Relation Matrix for the sample data base.

RELATION MATRIX

| Data Item | Item Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUTHOR | 1 | | | | | | | | | | | | | | | | | | | | |
| TITLE | 2 | 1→N | | | | | | | | | | | | | | | | | | | |
| CALL NUMBER | 3 | 1→N | 1-1 | | | | | | | | | | | | | | | | | | |
| PUBLISHER | 4 | 1→N | 1:1 | 1:1 | | | | | | | | | | | | | | | | | |
| PUBLICATION DATE | 5 | 1→N | 1:1 | 1:1 | – | | | | | | | | | | | | | | | | |
| COST | 6 | 1→N | 1:1 | 1:1 | – | – | | | | | | | | | | | | | | | |
| COPY NUMBER | 7 | X | X | 1→N | X | X | X | | | | | | | | | | | | | | |
| PLANT NAME | 8 | X | X | N↔M | X | X | X | – | | | | | | | | | | | | | |
| PLANT ADDRESS | 9 | X | X | – | X | X | X | – | 1:1 | | | | | | | | | | | | |
| LIBRARIAN | 10 | X | X | – | X | X | X | – | 1:1 | 1:1 | | | | | | | | | | | |
| PLANT PHONE NUMBER | 11 | X | X | – | X | X | X | – | 1:1 | 1:1 | 1:1 | | | | | | | | | | |
| SUBJECT | 12 | X | X | 1→N | X | X | X | X | X | X | X | X | | | | | | | | | |
| BORROWER | 13 | X | X | – | X | X | X | – | X | X | X | X | – | | | | | | | | |
| EMPLOYEE NUMBER | 14 | X | X | N↔M | X | X | X | – | X | X | X | X | – | 1:1 | | | | | | | |
| LOCATION | 15 | X | X | – | X | X | X | – | X | X | X | X | – | 1:1 | 1:1 | | | | | | |
| PHONE NUMBER | 16 | X | X | – | X | X | X | – | X | X | X | X | – | 1:1 | 1:1 | – | | | | | |
| DATE BORROWED | 17 | X | X | 1→N | X | X | X | – | X | X | X | X | – | – | 1→N | – | – | | | | |
| | 18 | | | | | | | | | | | | | | | | | | | | |
| | 19 | | | | | | | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | | | | | | | | |

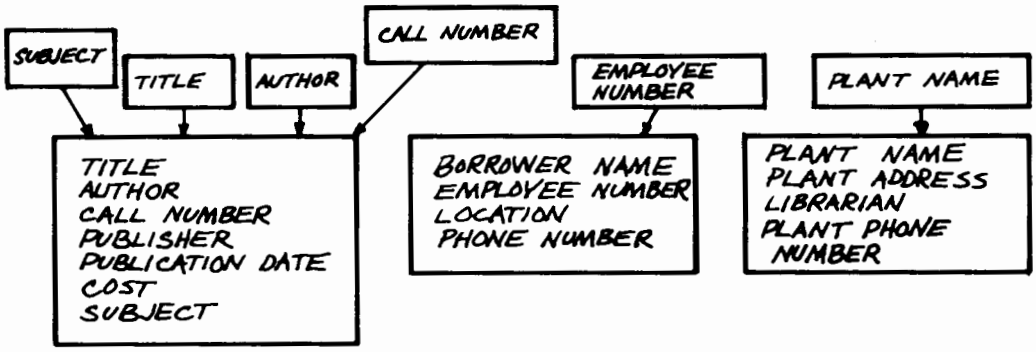
# Draw and Optimize the Data Base Diagram

As in the intuitive design process, the result of the functional design process is the data base diagram. An initial diagram can be drawn from the Relation Matrix. This initial diagram is not nearly as final as the initial diagram produced by the intuitive process; more modifications are necessary.

## Fulfilling the Relationships

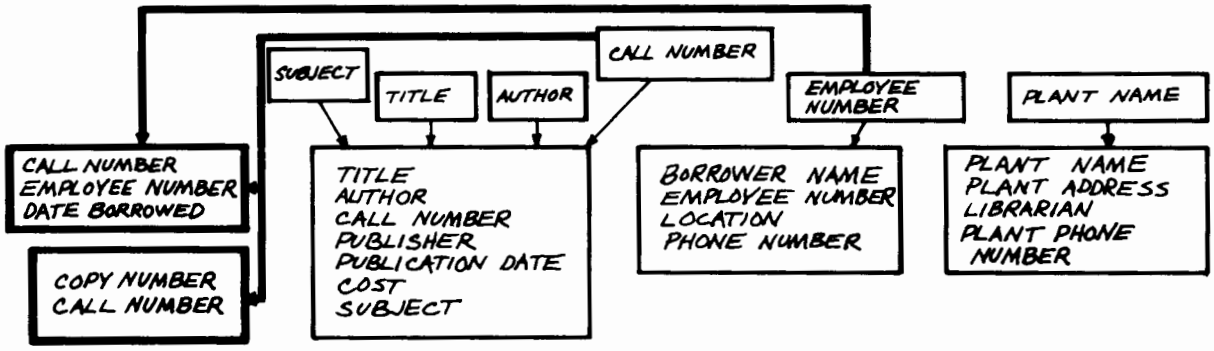
To begin the data base diagram, place items with 1-to-1 relationships together in a box. Typically, these are entities. Next, using the key items determined in the previous step, place the key item outside the appropriate box and draw an arrow to the box. If the key item is not in the box, add it. Either item names or item numbers can be used.

Here is the diagram of the sample data base when this step is done.

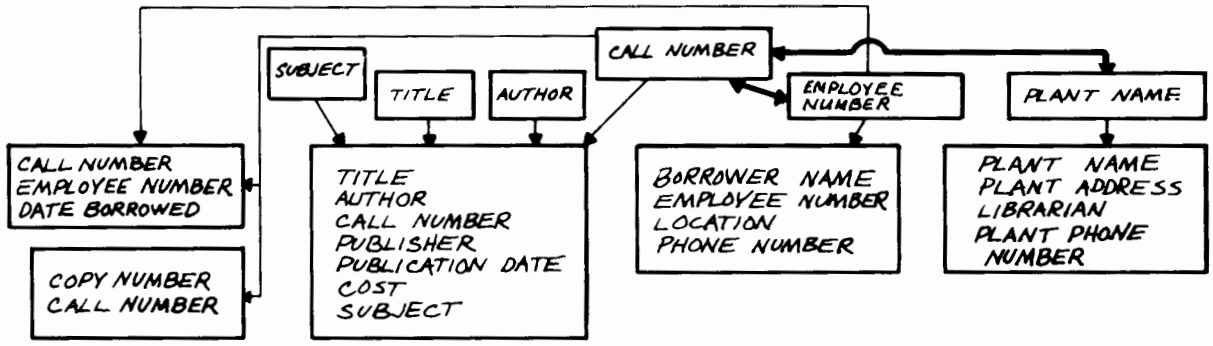



To fulfill the 1-to-N relationships identified in the Relation Matrix, an arrow should be drawn from the item which is the '1' (a key item) to the item which is the 'N'. If any of these items is not already in the drawing, it should be added.

Additionally, the key item should be added to the box that contains the 'N' item. Here is the diagram of the sample data base when this step is done.

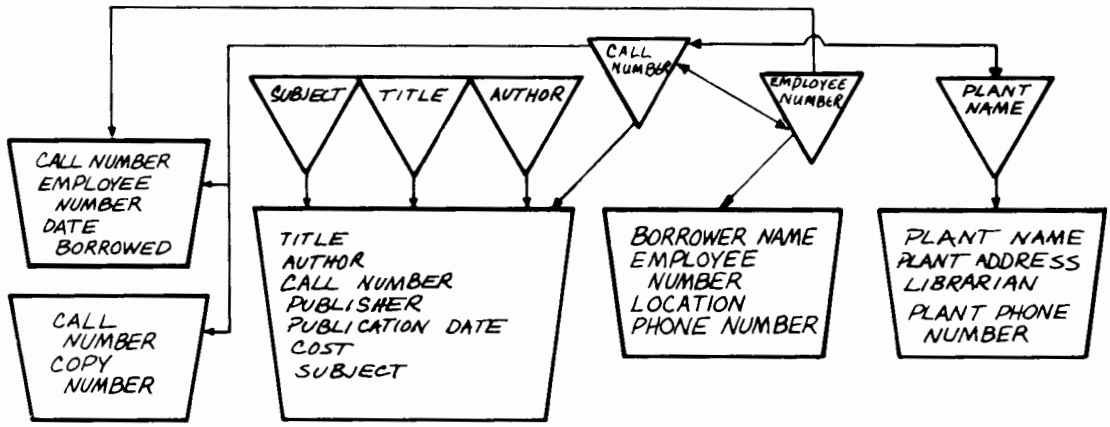


The next step is to fulfill the N-to-M relationships identified in the Relation Matrix. To do this, draw a double-headed arrow between the appropriate items. Here is the diagram of the sample data base when this step is done.




Now, a first-pass identification of the data sets can be made. The key items already determined can be placed into separate automatic master sets. Boxes that contain many items and have arrows pointing to them become detail sets. Additionally, the arrows can be thought of as data paths. Now redraw the diagram to reflect these set definitions. As much as possible, try to maintain two levels in the diagram, one for master sets and one for detail sets.

Here is the revised diagram of the sample data base which reflects these set identifications.



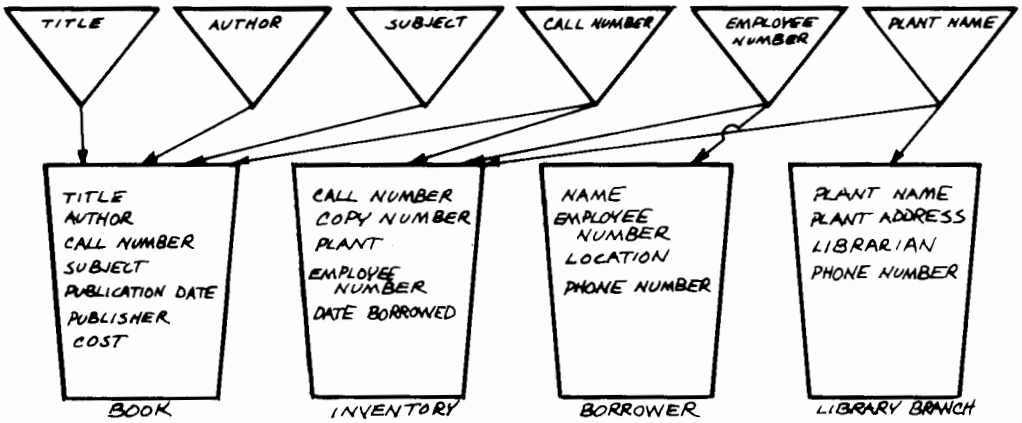

## Resolving Problems

At this point, two problems can be identified. The first one deals with the structure of the diagram. In an IMAGE data base, a master set cannot point to (have a path to) another master set, as is the case with Employee number and Call number. The second problem can be found by examining the Function Matrix. Functions 2 (which library has which books) and 4 (which employees have checked out which books and what is the copy number) are not solved.

Here the situation must be examined. Each book (Call number) can have multiple copies and therefore multiple borrowers, borrow dates and library branches. However, a specific copy of a book can only have one of each of these. Functions 2 and 4 are solved by knowing this information. To solve the problems, we merge the set containing Employee number, Date borrowed and Call number with the set containing Call number and Copy number and add Plant name, retaining the existing keys and paths and adding a path from Plant name to this new set.

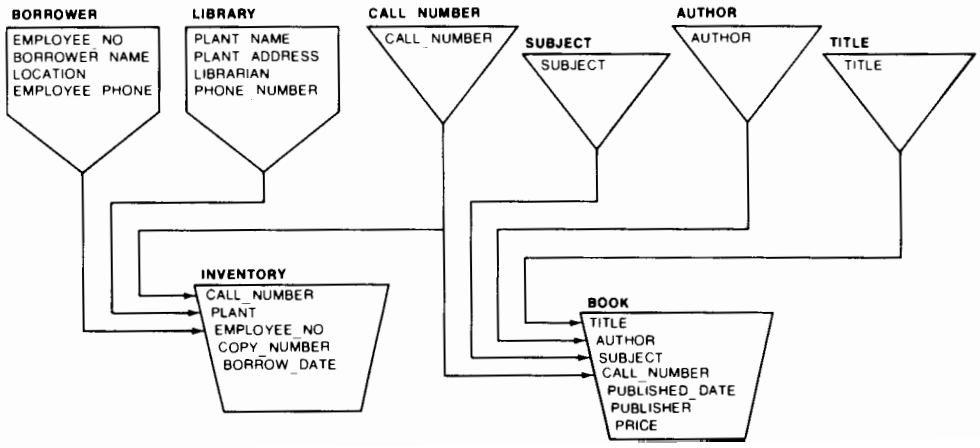
This merger makes it possible to represent the **relationships** between Book, Borrower and Library Branch. (As discussed in the intuitive design section, a detail set can be used to contain a relationship between two or more entities.) It also satisfies the links between Call number and Employee number, and Call number and Plant name, enabling the invalid paths between master sets to be erased and producing a valid IMAGE data base structure.

Here is the diagram which results from the merging of the two sets.




## Optimizing the Design

At this point, we have the same diagram produced by the initial representation of the data base using the intuitive process. From this point on, the optimization process is the same, producing the final diagram.



# Chapter 4
# Beyond the Diagram

Once you have completed a satisfactory data base diagram, there are a few additional details which must be specified. They are –

- valid names for data items
- valid names for data sets
- the type of each data item
- the type of each data set
- capacity of each data set
- passwords
- if the data base is to reside on more than one disc, the volume label of each set

This information is covered in Chapter 2 of the IMAGE/1000 Reference Manual.

# Chapter 5

# Special Considerations and Design Tips

## Set Types

**Detail data sets** are used to store multiple items of information. These items describe either an entity or a relationship between two or more entities. Detail data sets need not have any key items and related paths; in this case, the information they contain can be accessed using serial access mode.

**Manual master data sets** can be used for two primary reasons: The first is to save disc space and to prevent anomalies during data updates by storing information which describes a key item with the key. For example, if the INVENTORY set contained the borrower information and the BORROWER set had only Employee number, updating an employee's phone number would require changes to all entries in INVENTORY that contained books which the employee had checked out. This leaves room for error. The second reasion to use a manual master set is to ensure validity of key item values (and related detail entries) through manual rather than automatic entry of data values.

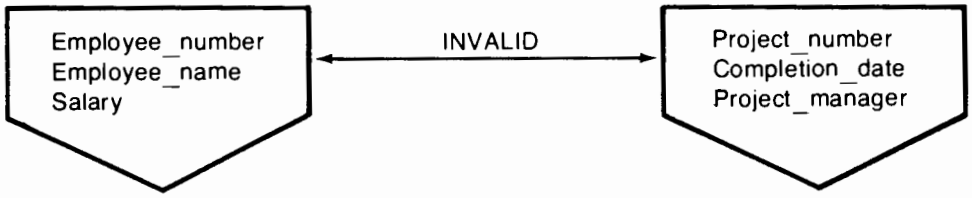
**Automatic master data sets** can be used to save time when key item values are too numerous or unpredictable to enter them manually. For example, if you are keeping test results in a detail data set and the figure resulting from the test, which is unpredictable, is a key item for the detail set, the related master set should be an automatic master. Therefore, when new test information is entered, the resulting figure need not be entered manually into a master set.

# Resolving Set Inconsistencies

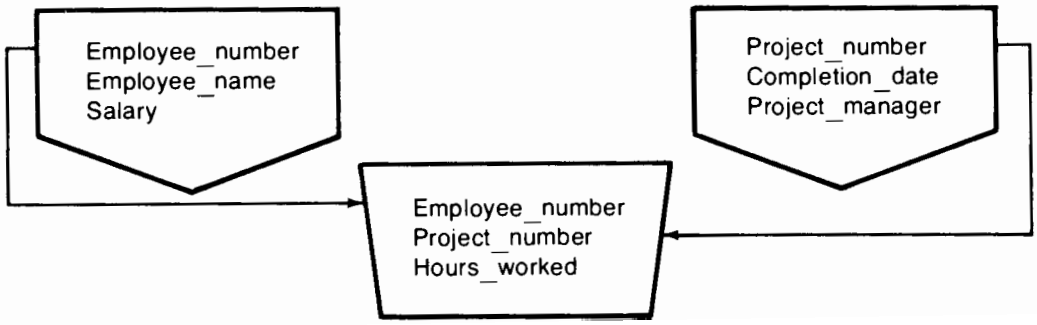
During the design process, two master data sets pointing to each other (an invalid condition) can be resolved by pointing them to a common detail data set instead.

## Example

For example, suppose a data base was keeping information about current projects and the employees working on those projects. Each project can have more than one person working on it, and each employee can be working on more than one project. Two data sets containing the necessary information might look like this -




The following modification results in a valid IMAGE/45 structure. Additionally, it allows information to be kept concerning how many hours an employee worked on a specific project.



# Resolving Redundancy

A group of data items may appear in two detail data sets. If the sets are linked via a common master data set, the redundant information may be removed from one of the detail data sets.

A group of data items in a detail data set which describe the same entity as a related key item and each have a particular value for a particular key item value can be taken from the detail set moved into the master set with the key item, causing the master data set to become a manual master set if it was an automatic master. If the detail set contains no other items, it can be deleted, along with the path.

# Considerations for Using Data Chains

When a detail set contains a key item linking it to a master set, all detail entries having the same value for the key item are automatically linked together with a data chain. There are three related factors to consider -

- More chains → easier access to detail entries
- More chains → more disc space used
- Long chains → slower access

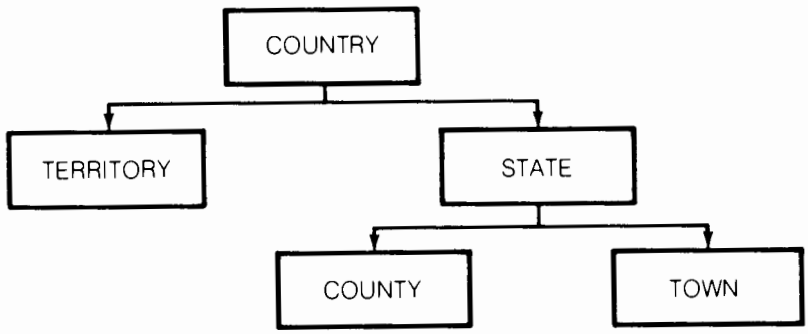
# Simulating a Hierarchy

A hierarchical, or tree, relationship is one which cannot be represented directly using an IMAGE/1000 data base. However, it is possible to simulate one. This can be done by creating a detail set for each block which is not at the top of the hierarchy. The links between blocks of various levels are made by inserting an extra automatic master data set for each block which is in the middle of the hierarchy and points to a block at a lower level, linking them through a common item. Each automatic master is given paths to the linked blocks (sets) and its related detail set.

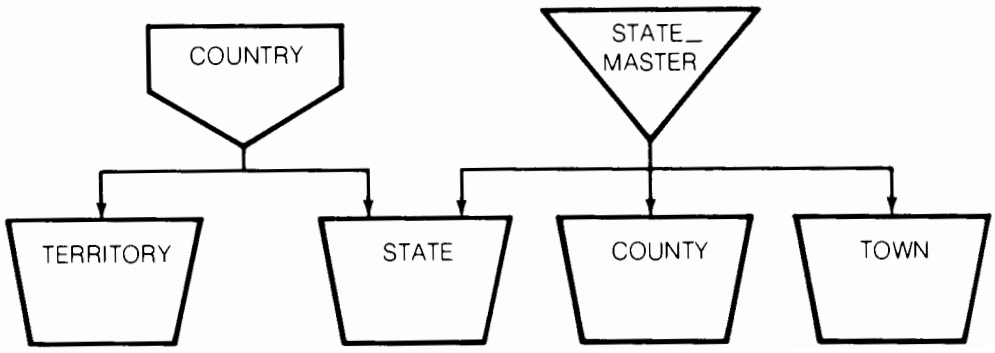
The top level of the hierarchy can be represented by either a manual master set or by an automatic master linked to a detail set.

## Example 1

Suppose a data base was being used to keep population information about countries. Each country is broken down in various ways, as shown in the diagram below.

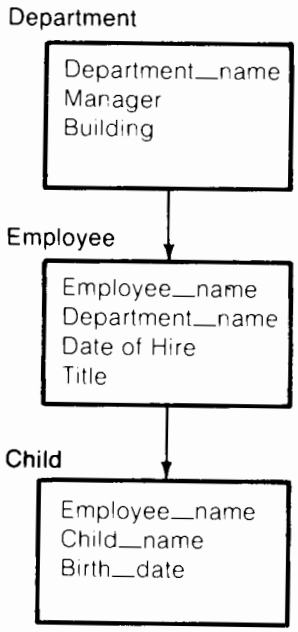



To simulate this using an IMAGE/1000 data base structure, STATE information is put into a detail set and an extra STATE automatic master is inserted. The following diagram is the result of this operation.

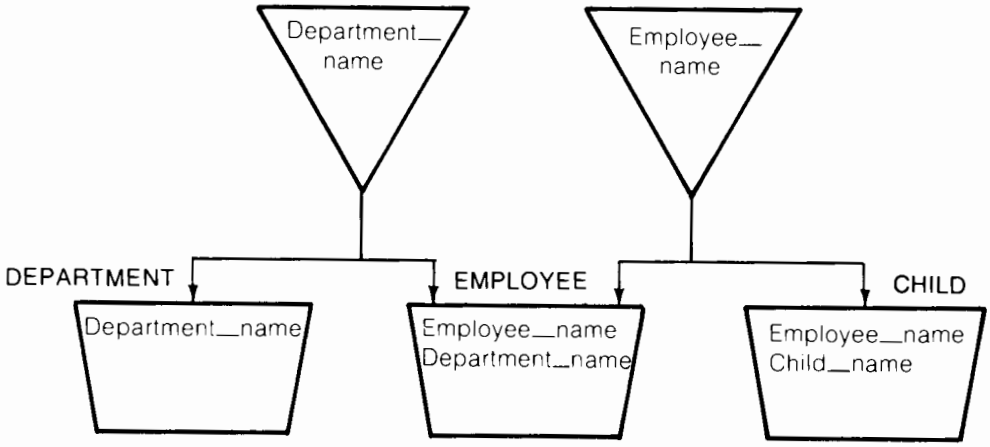


## Example 2

The following diagram illustrates a data base which keeps information about departments in a firm, the employees in each department and the children of the employees.




This hierarchy can be simulated by inserting two master sets, as follows –



# Chapter 6
# Examples

The following examples contain a brief description of the data management need and the resulting data base diagram.

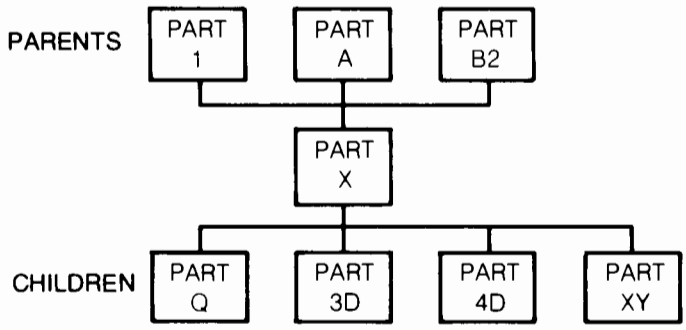
## Managing Parts

The Parts Coordinator in the Research and Development lab of a manufacturing company keeps track of all the parts used in various products. For each part, he keeps the following information -

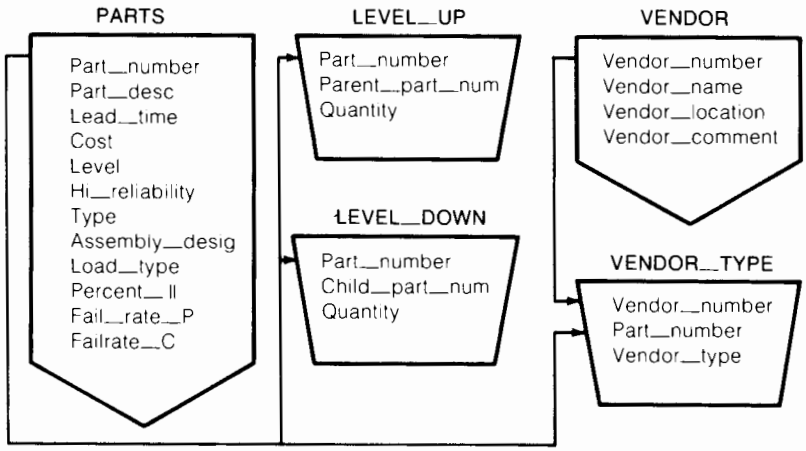
- description of the part
- other parts in which a part is used (parent)
- other parts which comprise a part (children)

Additionally, he keeps track of the vendors who supply the parts, denoting which vendor supplies which parts. Each vendor is given a type designation.

This data base is hierarchical in nature. Each part can have both 'parents' (parts used in) and 'children' (component parts), as shown below.



The final design of the data base illustrates how a hierarchy can be represented in an IMAGE/1000 data base.

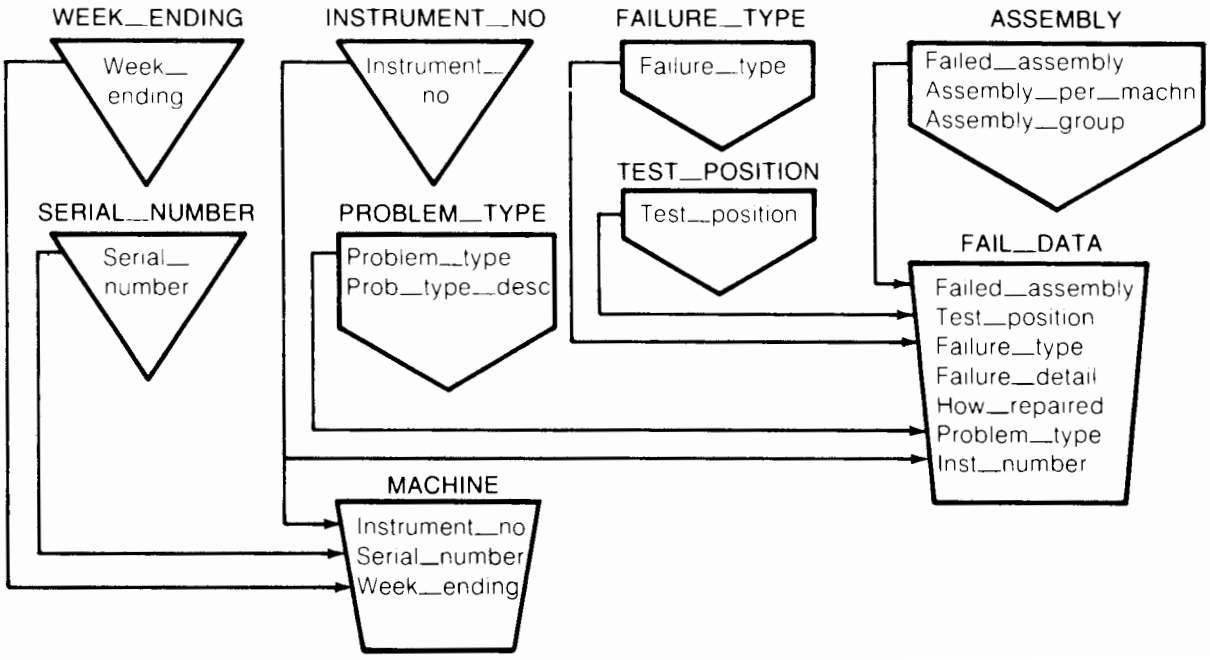



# Instrument Failure Analysis

The Quality Assurance Specialist of a production line in a manufacturing company is investigating the various ways in which the instrument fails. Each machine is given a number at the end of the line and is then put through tests at ten stations. Details about each occurrence of a failure include the following -

- instrument number and serial number
- assembly that failed
- where, out of the ten stations, did the failure occur?
- the nature of the failure

The following is the diagram for this failure analysis data base.



# Order Management/Sales Analysis

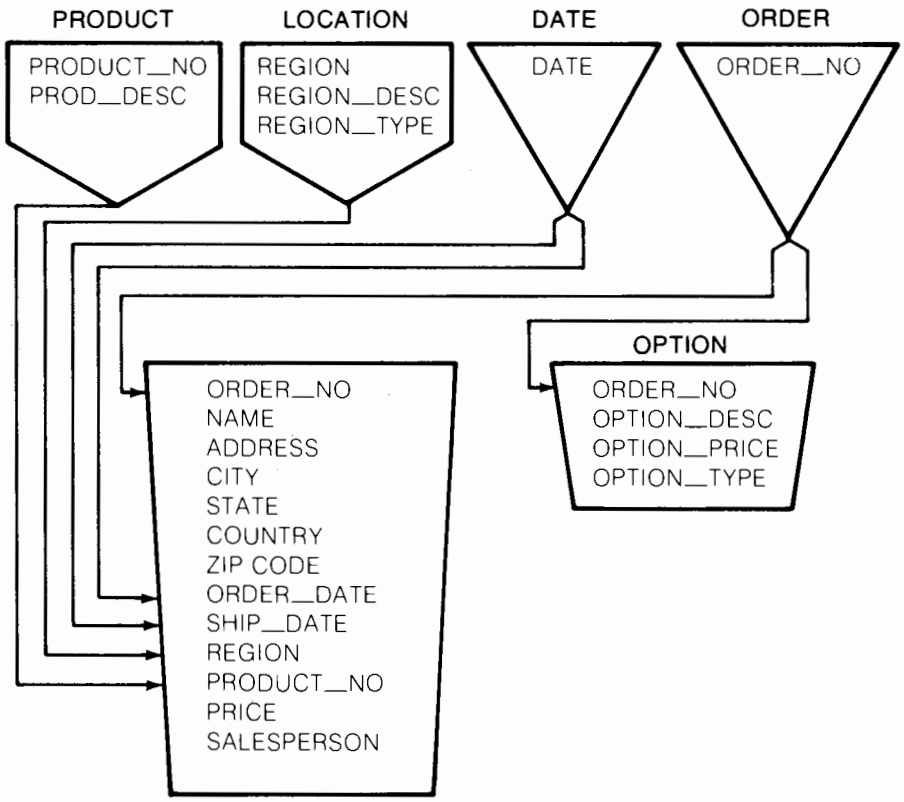
A bicycle company needs to keep track of its customer orders, summarizing the orders in the following ways -

- by product number
- by region

For each order, the following information is kept -

- details about the options ordered
- customer information
- salesman
- price
- product


To ensure timely shipments to customers, both the order date and the shipment date for each order are also kept.



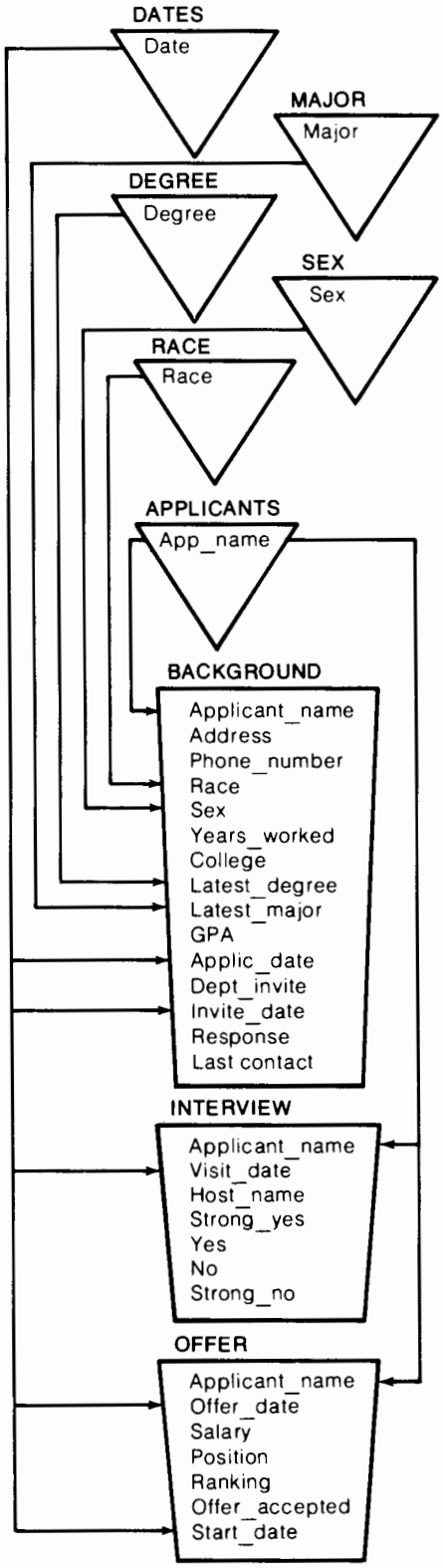

The PRODUCT set is a manual master data set to ensure the validity of the product numbers entered into the data base, and to store the description with the key item.

# Employee Recruiting

The Research and Development lab of a manufacturing company recruits new engineers from colleges around the world. They want to use a data base to identify each applicant, those they phone-screen, those they interview, those to whom they make job offers, and those who accept the job offer.

To satisfy minority hiring requirements, they need to identify each applicant by sex and race. Additionally, they want to keep track of the major, college and degree of each applicant.

The resulting data base is shown here.



## READER COMMENT SHEET

**IMAGE/1000**
**Data Base Design Kit**

**92069-90006** **October 1981**

**Update No. _____**
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## Arranged alphabetically by country



### Product Line Sales/Support Key

| Key | Product Line |
|---|---|
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| CM | Components |
| C | Computer Systems |
| CP | Computer Systems Primary Service Responsible Office (SRO) |
| CS | Computer Systems Secondary SRO |
| E | Electronic Instruments & Measurement Systems |
| M | Medical Products |
| MP | Medical Products Primary SRO |
| MS | Medical Products Secondary SRO |
| P | Personal Computing Products |
| * | Sales only for specific product line |
| ** | Support only for specific product line |

**IMPORTANT: These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.**

*HP distributors are printed in italics.*

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Martinez 1640 **BUENOS AIRES**
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Telex: 122443 AR CIGY
Cable: HEWPACKARG
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*Biotron S.A.C.I.y.M*
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*9 Piso*
*1399 **BUENOS AIRES***
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*Telex: (33)17595 BIONAR*
*Cable: BIOTRON Argentina*
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*Fate S.A. Electronica*
*Bartolomeu Mitre 833*
*1036 **BUENOS AIRES***
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*Telex: 18137, 22754*
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Verkaufsburo Graz
8052 **GRAZ**
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Wehlistrasse 29
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A-1205 **VIENNA**
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*Telex: 88419*
*P*

*Wael Pharmacy*
*P.O. Box 648*
***BAHRAIN***
*Tel: 54886, 56123*
*Telex: 8550 WAEL GJ*
*M*

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B-1200 ***BRUSSELS***
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22471 **RIO DE JANEIRO**-RJ
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C,M

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Technisches Büro Böblingen
Herrenberger Strasse 110
D-7030 **BÖBLINGEN**
Tel: (07031) 667-1
Telex: 07265739 bbn or 07265743
A,CM,CP,E,MP,P

Hewlett-Packard GmbH
Technisches Büro Dusseldorf
Emanuel-Leutze-Strasse 1
D-4000 **DUSSELDORF**
Tel: (0211) 5971-1
Telex: 085/86 533 hpdd d
A,CM,CP,E,MS,P

Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Berner Strasse 117
Postfach 560 140
D-6000 **FRANKFURT** 56
Tel: (0611) 50-04-1
Telex: 04 13249 hpffm d
A,CM,CP,E,MP,P

Hewlett-Packard GmbH
Technisches Büro Hamburg
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: (040) 63804-1
Telex: 21 63 032 hphh d
A,CM,CP,E,MS,P

Hewlett-Packard GmbH
Technisches Büro Hannover
Am Grossmarkt 6
D-3000 **HANNOVER** 91
Tel: (0511) 46-60-01
Telex: 092 3259
A,CM,CS,E,MS,P

Hewlett-Packard GmbH
Technisches Büro Mannheim
Rosslauer Weg 2-4
D-6800 **MANNHEIM**
Tel: (621) 70050
Telex: 0462105
A,C,E

Hewlett-Packard GmbH
Technisches Büro Neu Ulm
Messerschmittstrasse 7
D-7910 **NEU ULM**
Tel:
Telex:
C,E

Hewlett-Packard GmbH
Technisches Büro Nürnberg
Neumeyerstrasse 90
D-8500 **NÜRNBERG**
Tel: (0911) 56-30-83
Telex: 0623 860
CM,CS,E,MS,P

Hewlett-Packard GmbH
Technisches Büro München
Eschenstrasse 5
D-8021 **TAUFKIRCHEN**
Tel: (089) 6117-1
Telex: 0524985
A,CM,CP,E,MS,P

### GREAT BRITAIN

Hewlett-Packard Ltd.
Trafalgar House
Navigation Road
**ALTRINCHAM**
Chesire WA14 1NU
Tel: (061) 928-6422
Telex: 668068
A,C,E,M

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton
**BRISTOL** BS8 2BN
Tel: 36806
Telex: 444302
P

Hewlett-Packard Ltd.
14 Wesley Street
**CASTLEFORD**
Yorkshire WF10 1AE
Tel: (0977) 550016
Telex: 5557355
C

Hewlett-Packard Ltd.
Fourier House
257-263 High Street
**LONDON COLNEY**
Herts., AL2 1HA
Tel: (0727) 24400
Telex: 1-8952716
C,E

Hewlett-Packard Ltd
Tradax House, St. Mary's Walk
**MAIDENHEAD**
Berkshire, SL6 1ST
Tel: (0628) 39151
E,P

Hewlett-Packard Ltd.
308/314 Kings Road
**READING**, Berkshire
Tel: 61022
Telex: 84-80-68
CM,P

Hewlett-Packard Ltd.
Quadrangle
106-118 Station Road
**REDHILL**, Surrey
Tel: (0737) 68655
Telex: 947234 C,E

Hewlett-Packard Ltd.
Westminster House
190 Stratford Road
**SHIRLEY**, Solihull
West Midlands B90 3BJ
Tel: (021) 7458800
Telex: 339105
C

Hewlett-Packard Ltd.
King Street Lane
**WINNERSH**, Wokingham
Berkshire RG11 5AR
Tel: (0734) 784774
Telex: 847178
A,C,E,M

### GREECE

*Kostas Karaynnis*
*8 Omirou Street*
***ATHENS** 133*
*Tel: 32-30-303, 32-37-371*
*Telex: 21 59 62 RKAR GR*
*E,M,P*

*"Plaiso"*
*G. Gerados*
*24 Stournara Street*
***ATHENS***
*Tel: 36-11-160*
*Telex: 21 9492*
*P*

### GUATEMALA

***IPESA***
*Avenida Reforma 3-48*
*Zona 9*
***GUATEMALA CITY***
*Tel: 316627, 314786, 664715*
*Telex: 4192 Teletro Gu*
*A,C,CM,E,M,P*

### HONG KONG

Hewlett-Packard Hong Kong, Ltd.
G.P.O. Box 795
5th Floor, Sun Hung Kai Centre
30 Harbour Road
**HONG KONG**
Tel: 5-8323211
Telex: 66678 HEWPA HX
Cable: HP ASIA LTD Hong Kong
E,CP,P

*Schmidt & Co. (Hong Kong) Ltd.*
*Wing On Centre, 28th Floor*
*Connaught Road, C.*
***HONG KONG***
*Tel: 5-455644*
*Telex: 74766 SCHMX HX*
*A,M*

### ICELAND

*Elding Trading Company Inc.*
*Hafnarnvoli-Tryggvagotu*
*P.O. Box 895*
***IS-REYKJAVIK***
*Tel: 1-58-20, 1-63-03*
*M*

### INDIA

*Blue Star Ltd.*
*Bhavdeep*
*Stadium Road*
***AHMEDABAD** 380 014*
*Tel: 42932*
*Telex: 012-234*
*Cable: BLUEFROST*
*E*

*Blue Star Ltd.*
*11 Magarath Road*
***BANGALORE** 560 025*
*Tel: 55668*
*Telex: 0845-430*
*Cable: BLUESTAR*
*A,CM,C,E*

*Blue Star Ltd.*
*Band Box House*
*Prabhadevi*
***BOMBAY** 400 025*
*Tel: 422-3101*
*Telex: 011-3751*
*Cable: BLUESTAR*
*A,M*

*Blue Star Ltd.*
*Sahas*
*414/2 Vir Savarkar Marg*
*Prabhadevi*
***BOMBAY** 400 025*
*Tel: 422-6155*
*Telex: 011-4093*
*Cable: FROSTBLUE*
*A,CM,C,E,M*

*Blue Star Ltd.*
*7 Hare Street*
***CALCUTTA** 700 001*
*Tel: 12-01-31*
*Telex: 021-7655*
*Cable: BLUESTAR*
*A,M*

*Blue Star Ltd.*
*Meenakshi Mandiram*
*XXXXV/1379-2 M. G. Road*
***COCHIN** 682-016*
*Tel: 32069*
*Telex: 085-514*
*Cable: BLUESTAR*
*A**

*Blue Star Ltd.*
*133 Kodambakkam High Road*
***MADRAS** 600 034*
*Tel: 82057*
*Telex: 041-379*
*Cable: BLUESTAR*
*A,M*

*Blue Star Ltd.*
*Bhandari House, 7th/8th Floors*
*91 Nehru Place*
***NEW DELHI** 110 024*
*Tel: 682547*
*Telex: 031-2463*
*Cable: BLUESTAR*
*A,CM,C,E,M*

*Blue Star Ltd.*
*1-1-117/1 Sarojini Devi Road*
***SECUNDERABAD** 500 033*
*Tel: 70126*
*Telex: 0155-459*
*Cable: BLUEFROST*
*A,E*

*Blue Star Ltd.*
*T.C. 7/603 Poornima*
*Maruthankuzhi*
***TRIVANDRUM** 695 013*
*Tel: 65799*
*Telex: 0884-259*
*Cable: BLUESTAR*
*E*

### INDONESIA

*BERCA Indonesia P.T.*
*P.O.Box 496/Jkt.*
*Jln. Abdul Muis 62*
***JAKARTA***
*Tel: 373009*
*Telex: 31146 BERSAL IA*
*Cable: BERSAL JAKARTA*
*A,C,E,M,P*

*BERCA Indonesia P.T.*
*P.O. Box 174/Sby.*
*J.L. Kutei No. 11*
***SUBAEE-SURABAYA***
*Tel: 68172*
*Telex: 31146 BERSAL SD*
*Cable: BERSAL-SURABAYA*
*A*,E,M,P*

### IRAQ

Hewlett-Packard Trading S.A.
Mansoor City 9B/3/7
**BAGHDAD**
Tel: 551-49-73
Telex: 2455 HEPAIRAQ IK
CP

### IRELAND

Hewlett-Packard Ireland Ltd.
Kestrel House
Clanwilliam Court
Lower Mount Street
**DUBLIN** 2, Eire
Tel: 680424, 680426
Telex: 30439
A,C,CM,E,M,P

*Cardiac Services Ltd.*
*Kilmore Road*
*Artane*
***DUBLIN** 5, Eire*
*Tel: (01) 351820*
*Telex: 30439*
*M*

# SALES & SUPPORT OFFICES

## Arranged alphabetically by country

### ISRAEL

*Electronics Engineering Division*
*Motorola Israel Ltd.*
*16 Kremenetski Street*
*P.O. Box 25016*
***TEL-AVIV 67899***
*Tel: 338973*
*Telex: 33569 Motil IL*
*Cable: BASTEL Tel-Aviv*
*A,CM,C,E,M,P*

### ITALY

Hewlett-Packard Italiana S.p.A.
Traversa 99C
Giulio Petrone, 19
I-70124 **BARI**
Tel: (080) 41-07-44
**M**

Hewlett-Packard Italiana S.p.A.
Via Martin Luther King, 38/111
I-40132 **BOLOGNA**
Tel: (051) 402394
Telex: 511630
CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 **CATANIA**
Tel: (095) 37-10-87
Telex: 970291
C,P

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVLIGLIO**
Tel: (2) 903691
Telex: 334632
A,CM,CP,E,MP,P

Hewlett-Packard Italiana S.p.A.
Via Nuova san Rocco A
Capodimonte, 62/A
I-80131 **NAPOLI**
Tel: (081) 7413544
A,CM,CS,E

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
Tel: (010) 68-37-07 E,C

Hewlett-Packard Italiana S.p.A.
Via Turazza 14
I-35100 **PADOVA**
Tel: (49) 664888
Telex: 430315
A,CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA**
Tel: (06) 54831
Telex: 610514
A,CM,CS,E,MS,P*

Hewlett-Packard Italiana S.p.A.
Corso Giovanni Lanza 94
I-10133 **TORINO**
Tel: (011) 682245, 659308
Telex: 221079
CM,CS,E

### JAPAN

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho
**ATSUGI**, Kanagawa 243
Tel: (0462) 24-0451
CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
3-30-18 Tsuruya-cho
Kanagawa-ku, Yokohama-Shi
**KANAGAWA**, 221
Tel: (045) 312-1252
Telex: 382-3204 YHP YOK
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Sannomiya-Daiichi Seimei-Bldg. 5F
69 Kyo-Machi Ikuta-Ku
**KOBE CITY** 650 Japan
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi Yasoji Bldg 4F
4-3 Chome Tsukuba
**KUMAGAYA**, Saitama 360
Tel: (0485) 24-6563
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
4-73, San-no-maru, 1-chome
**MITO**, Ibaragi 310
Tel: (0292) 25-7470
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Sumitomo Seimei Bldg.
11-2 Shimo-sasajima-cho
Nakamura-ku
**NAGOYA**, Aichi 450
Tel: (052) 581-1850
CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4th Floor
5-4-20 Nishinakajima, 5-chome
Yodogawa-ku, Osaka-shi
**OSAKA**, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
A,CM,CP,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi 3-chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
A,CM,CP,E,MP,P*

### JORDAN

*Mouasher Cousins Company*
*P.O. Box 1387*
***AMMAN***
*Tel: 24907, 39907*
*Telex: 21456 SABCO JO*
*E,M,P*

### KOREA

*Samsung Electronics*
*4759 Shinkil, 6 Dong*
*Youngdeungpo-Ku,*
***SEOUL***
*Tel: 8334311, 8334312*
*Telex: SAMSAN 27364*
*A,C,E,M,P*

### KUWAIT

*Al-Khalidya Trading & Contracting*
*P.O. Box 830 Safat*
***KUWAIT***
*Tel: 42-4910, 41-1726*
*Telex: 2481 Areeg kt*
*A,E,M*

*Photo & Cine Equipment*
*P.O. Box 270 Safat*
***KUWAIT***
*Tel: 42-2846, 42-3801*
*Telex: 2247 Matin*
*P*

### LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 ***BRUSSELS***
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,CM,CP,E,MP,P

### MALAYSIA

Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
Suite 2.21/2.22
Bangunan Angkasa Raya
Jalan Ampang
**KUALA LUMPUR**
Tel: 483544
Telex: MA31011
A,CP,E,M,P*

Protel Engineering
Lot 319, Satok Rd.
P.O. Box 1917
**KUCHING, SARAWAK**
Tel: 535-44
Telex: MA 70904 Promal
Cable: Proteleng
A,E,M

### MEXICO

Hewlett-Packard Mexicana, S.A. de C.V.
Avenida Periferico Sur No. 6501
Tepepan, Xochimilco
**MEXICO CITY 23, D.F.**
Tel: (905) 676-4600
Telex: 017-74-507
A,CP,E,MS,P

Hewlett-Packard Mexicana, S.A. de C.V.
Rio Volga 600
Colonia del Valle
**MONTERREY**, N.L.
Tel: 78-42-93, 78-42-40, 78-42-41
Telex: 038-410
CS

### MOROCCO

*Dolbeau*
*81 rue Karatchi*
***CASABLANCA***
*Tel: 3041-82, 3068-38*
*Telex: 23051, 22822*
*E*

*Gerep*
*2 rue d'Agadir*
*Boite Postale 156*
***CASABLANCA***
*Tel: 272093, 272095*
*Telex: 23 739*
*P*

### NETHERLANDS

Hewlett-Packard Nederland B.V.
Van Heuven Goedhartlaan 121
NL 1181KK **AMSTELVEEN**
P.O. Box 667
NL1080 AR **AMSTELVEEN**
Tel: (20) 47-20-21
Telex: 13 216
A,CM,CP,E,MP,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL 2906VK **CAPPELLE**, A/D Ijessel
P.O. Box 41
NL2900 AA **CAPELLE**, Ijssel
Tel: (10) 51-64-44
Telex: 21261 HEPAC NL
A,CM,CP

### NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
169 Manukau Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 68-7159
Cable: HEWPACK Auckland
CM,CS,E,P*

Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
P.O. Box 9443
Kilbirnie, **WELLINGTON** 3
Tel: 877-199
Cable: HEWPACK Wellington
CM,CP,E,P

*Northrop Instruments & Systems Ltd.*
*Eden House, 44 Khyber Pass Road*
*P.O. Box 9682*
*Newmarket,* ***AUCKLAND***
*Tel: 794-091*
*A,M*

*Northrop Instruments & Systems Ltd.*
*Terrace House, 4 Oxford Terrace*
*P.O. Box 8388*
***CHRISTCHURCH***
*Tel: 64-165*
*A,M*

*Northrop Instruments & Systems Ltd.*
*Sturdee House*
*85-87 Ghuznee Street*
*P.O. Box 2406*
***WELLINGTON***
*Tel: 850-091*
*Telex: NZ 3380*
*A,M*

### NIGERIA

*The Electronics Instrumentations Ltd.*
*N6B/S70 Oyo Road*
*Oluseun House*
*P.M.B. 5402*
***IBADAN***
*Tel: 461577*
*Telex: 31231 TEIL NG*
*A,E,M,P*

*The Electronics Instrumentations Ltd.*
*144 Agege Motor Road, Mushin*
*P.O. Box 6645*
*Mushin,* ***LAGOS***
*A,E,M,P*

### NORTHERN IRELAND

*Cardiac Services Company*
*95A Finaghy Road South*
***BELFAST*** *BT 10 OBY*
*Tel: (0232) 625-566*
*Telex: 747626*
*M*

### NORWAY

Hewlett-Packard Norge A/S
Folke Bernadottesvei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (BERGEN)
Tel: (05) 16-55-40
Telex: 16621 hpnas n
CM,CS,E

Hewlett-Packard Norge A/S
Oesterndalen 18
P.O. Box 34
N-1345 **OESTERAAS**
Tel: (02) 17-11-80
Telex: 16621 hpnas n
A*,CM,CP,E,MS,P

### OMAN

*Khimji Ramdas*
*P.O. Box 19*
***MUSCAT***
*Tel: 72-22-17, 72-22-25*
*Telex: 3289 BROKER MB MUSCAT*
*P*

### PAKISTAN

*Mushko & Company Ltd.*
*10, Bazar Road*
*Sector G-6/4*
***ISLAMABAD***
*Tel: 28624*
*Cable: FEMUS Rawalpindi*
*A,E,M*

*Mushko & Company Ltd.*
*Oosman Chambers*
*Abdullah Haroon Road*
***KARACHI*** *0302*
*Tel: 511027, 512927*
*Telex: 2894 MUSHKO PW*
*Cable: COOPERATOR Karachi*
*A,E,M,P**

### PANAMA

*Electrónico Balboa, S.A.*
*Apartado 4929*
*Panama 5*
*Calle Samuel Lewis*
*Edificio "Alfa" No. 2*
***CIUDAD DE PANAMA***
*Tel: 64-2700*
*Telex: 3480380*
*Cable: ELECTRON Panama*
*A,CM,E,M,P*

*Foto Internacional, S.A.*
*P.O. Box 2068*
*Free Zone of Colon*
***COLON 3***
*Tel: 45-2333*
*Telex: 3485126*
*Cable: IMPORT COLON/Panama*
*P*

### PERU

*Cómpania Electro Médica S.A.*
*Los Flamencos 145, San Isidro*
*Casilla 1030*
***LIMA*** *1*
*Tel: 41-4325*
*Telex: Pub. Booth 25424 SISIDRO*
*Cable: ELMED Lima*
*A,CM,E,M,P*

### PHILIPPINES

*The Online Advanced Systems Corporation*
*Rico House, Amorsolo Cor. Herrera Street*
*Legaspi Village, Makati*
*P.O. Box 1510*
***Metro MANILA***
*Tel: 85-35-81, 85-34-91, 85-32-21*
*Telex: 3274 ONLINE*
*A,C,E,M*

*Electronic Specialists and Proponents Inc.*
*690-B Epifanio de los Santos Avenue*
*Cubao,* ***QUEZON CITY***
*P.O. Box 2649 Manila*
*Tel: 98-96-81, 98-96-82, 98-96-83*
*Telex: 742-40287*
*P*

### POLAND

*Buro Informasji Technicznej*
*Hewlett-Packard*
*Ul Slawki 2, 6P*
***PL00-950 WARSZAWA***
*Tel: 39-59-62, 39-67-43*
*Telex: 812453 hepa pl*

# SALES & SUPPORT OFFICES

## Arranged alphabetically by country

### PORTUGAL

*Telectra-Empresa Técnica de Equipmentos Eléctricos S.a.r.l.*
*Rua Rodrigo da Fonseca 103*
*P.O. Box 2531*
*P-**LISBON** 1*
*Tel: (19) 68-60-72*
*Telex: 12598*
*A,C,E,P*

*Mundinter*
*Intercambio Mundial de Comércio S.a.r.l*
*P.O. Box 2761*
*Avenida Antonio Augusto de Aguiar 138*
*P-**LISBON***
*Tel: (19) 53-21-31, 53-21-37*
*Telex: 16691 munter p*
*M*

### PUERTO RICO

Hewlett-Packard Puerto Rico
P.O. Box 4407
**CAROLINA**, Puerto Rico 00630
Calle 272 Edificio 203
Urb. Country Club
**RIO PIEDRAS**, Puerto Rico 00924
Tel: (809) 762-7255
Telex: 345 0514
A,CP

### QATAR

*Nasser Trading & Contracting*
*P.O. Box 1563*
***DOHA***
*Tel: 22170*
*Telex: 4439 NASSER*
*M*

*Scitecharabia*
*P.O. Box 2750*
*I'DOHA*
*Tel: 329515*
*Telex: 4806 CMPARB*
*P*

### ROMANIA

*Hewlett-Packard Reprezentanta*
*Boulevard Nicolae Balcescu 16*
***BUCURESTI***
*Tel: 130725*
*Telex: 10440*

### SAUDI ARABIA

*Modern Electronic Establishment*
*P.O. Box 193*
***AL-KHOBAR***
*Tel: 44-678, 44-813*
*Telex: 670136*
*Cable: ELECTA AL-KHOBAR*
*C,E,M,P*

*Modern Electronic Establishment*
*P.O. Box 1228, Baghdadiah Street*
***JEDDAH***
*Tel: 27-798*
*Telex: 401035*
*Cable: ELECTA JEDDAH*
*C,E,M,P*

*Modern Electronic Establishment*
*P.O. Box 2728*
***RIYADH***
*Tel: 62-596, 66-232*
*Telex: 202049*
*C,E,M,P*

### SCOTLAND

Hewlett-Packard Ltd.
Royal Bank Buildings
Swan Street
**BRECHIN**, Angus, Scotland
Tel: 3101, 3102
CM,CS

Hewlett-Packard Ltd.
**SOUTH QUEENSFERRY**
West Lothian, EH30 9TG
GB-Scotland
Tel: (031) 3311000
Telex: 72682
A,CM,E,M

### SINGAPORE

Hewlett-Packard Singapore (Pty.) Ltd.
P.O. Box 58 Alexandra Post Office
**SINGAPORE**, 9115
6th Floor, Inchcape House
450-452 Alexandra Road
**SINGAPORE** 0511
Tel: 631788
Telex: HPSGSO RS 34209
Cable: HEWPACK, Singapore
A,CP,E,MS,P

### SOUTH AFRICA

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 120
Howard Place
Pine Park Center, Forest Drive, Pinelands
**CAPE PROVINCE** 7450
Tel: 53-7955, 53-7956, 53-7957
Telex: 57-0006
A,CM,CS,E,MS,P

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 37066
Overport
**DURBAN** 4067
Tel: 28-4178, 28-4179, 28-4110
CM,CS

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 33345
Glenstantia 0010 **TRANSVAAL**
1st Floor East
Constantia Park Ridge Shopping Centre
Constantia Park
**PRETORIA** Tel: 98-1126 or 98-1220
Telex: 32163
C,E

Hewlett-Packard South Africa (Pty.) Ltd.
Daphny Street
Private Bag Wendywood
**SANDTON** 2144
Tel: 802-5111, 802-5125
Telex: 89-84782
Cable: HEWPACK Johannesburg
A,CM,CP,E,MS,P

### SPAIN

Hewlett-Packard Española S.A.
c/Entenza, 321
**E-BARCELONA** 29
Tel: (3) 322-24-51, 321-73-54
Telex: 52603 hpbee
A,CM,CP,E,MS,P

Hewlett-Packard Española S.A.
c/San Vicente S/N
Edificio Albia II,7 B
**E-BILBAO** 1
Tel: (944) 423-8306, 423-8206
A,CM,E,MS

Hewlett-Packard Española S.A.
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