

SIGMA - GENERALIZED INFORMATION SYSTEM

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1. INTRODUCTION

SIGMA (Generalized Information System) is a system for information handling, which provides the user with the following capabilities:

- . Batch and interactive data entry
- . Selection of information through key-words and pre-defined conditions
- . Report generation defined by the user
- . Storage of data in more than one data base so that hierarchical structures can be processed.

SIGMA was developed by the Systems Division of Promon Engenharia S.A. to assist Project Management in:

- . Project Control
- . Resources Control
- . Development of Interim-Systems
- . Budgeting
- . Information Control

2. SYSTEM DESCRIPTION

SIGMA is a system composed of a set of programs operating on a predefined data base structure under IMAGE. The information stored in the data bases is defined according to the user's application and it can be selected and edited in a report form by means of an oriented language.

In this section we will show:

- . Data Base Structure
- . Reports Available
- . Additional Resources

2.1 Data Base Structure

2.1.1 Structure Overview

In the structure handled by SIGMA, the information can be grouped in more than one Data Base.

The data bases can be interconnected to form a hierarchical structure.

To illustrate SIGMA structure, consider the following example:

- . We are controlling a set of information about equipments specified in a project. This control begins with the specification of equipment by the engineering department up to its purchase by the purchasing department. Control is executed through four documents:

- . Equipment List
- . Requisition
- . Inquiry
- . Purchase Order

To each document there is associated a set of information as follows:

Equipment List

- .. Code (Tag Number)
- .. Description (Technical Characteristics)
- .. Cost
- .. Scheduled delivery date
- .. Importation flag
- .. Requisition code → LINK INFORMATION

Requisition

- .. Code
- .. Scheduled issue date
- .. Issue date
- .. Date received by purchasing
- .. Note
- .. Purchase order code → LINK INFORMATION
- .. Inquiry code

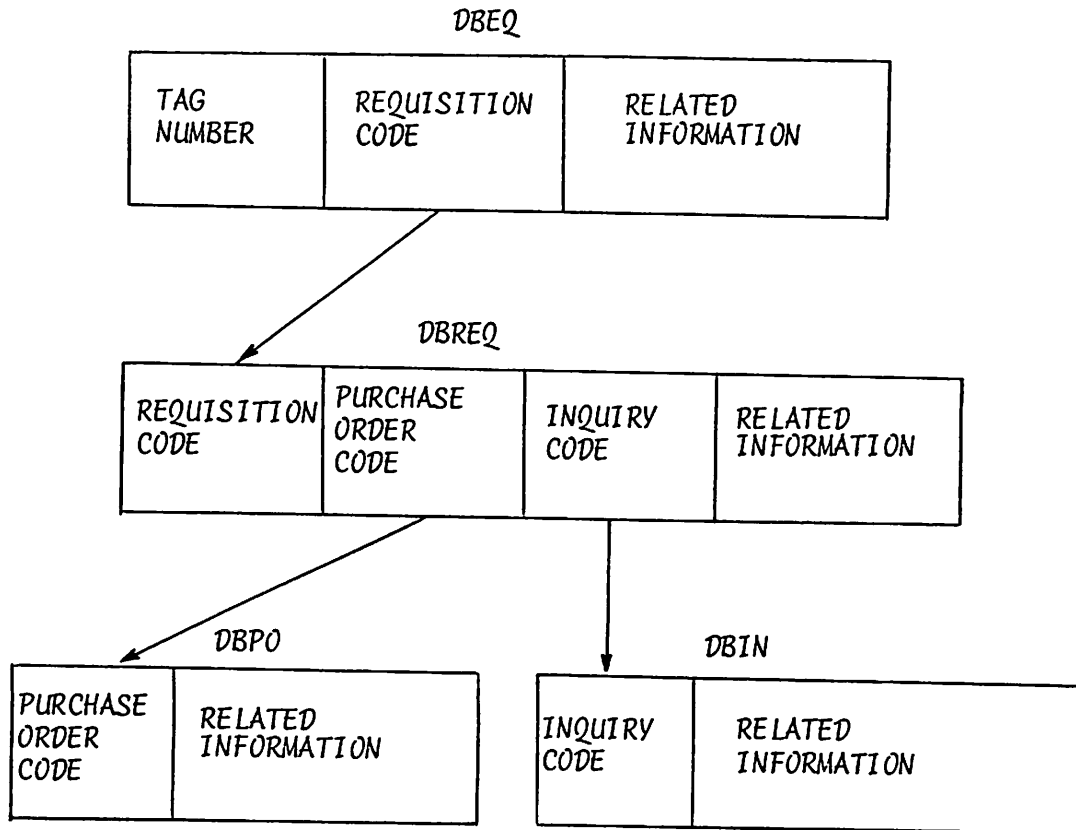
Inquiry

- .. Code
- .. Scheduled issue date
- .. Issue date
- .. Supplier 1
- 2
- 3
- .. Note

Purchase Order

- .. Code
- .. Supplier
- .. Issue date
- .. Order value
- .. Note

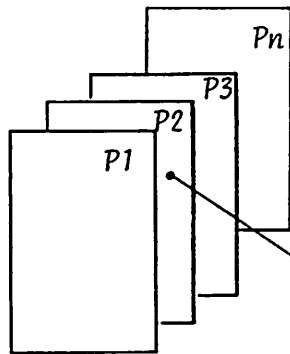
To each document there corresponds an IMAGE DATA BASE, which are linked each other as shown in the picture below.



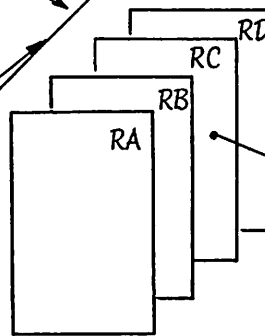
- . DBEQ - Equipment data base
- . DBREQ - Requisition data base
- . DBPO - Purchase order data base
- . DBIN - Inquiry data base

This data stored have the following hierarchy:

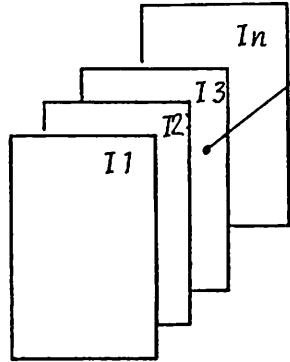
. Purchase Order



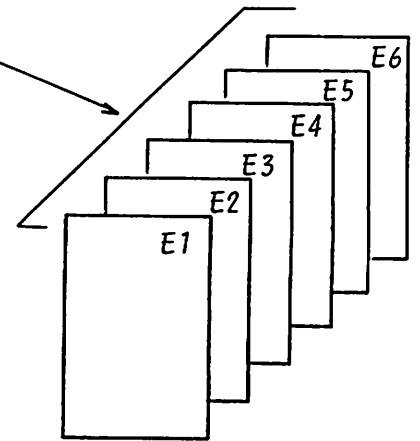
. Requisition



. Inquiry



. Equipment



2.1.2

Data Base Structure

SIGMA data bases have their own structure and they are dimensioned according to user's requirement.

There is no limitation to the number of IMAGE data bases used in the applications of SIGMA, this being indicated by the nature and complexity of the information under control.

In the definition of the SIGMA data structure, we shall use the following concepts:

- . ITEM (CODE)
- . DATUM(MNEMONIC)
- . INFORMATION UNIT
- . KEY WORD

. ITEM

Is a set of information identified by a CODE. The SIGMA data base is constituted by the set of all ITEMS.

. DATUM

Is an information identified by a mnemonic and associated to an ITEM. The ITEM is constituted by a set of DATA.

. INFORMATION UNIT

Is the triple:

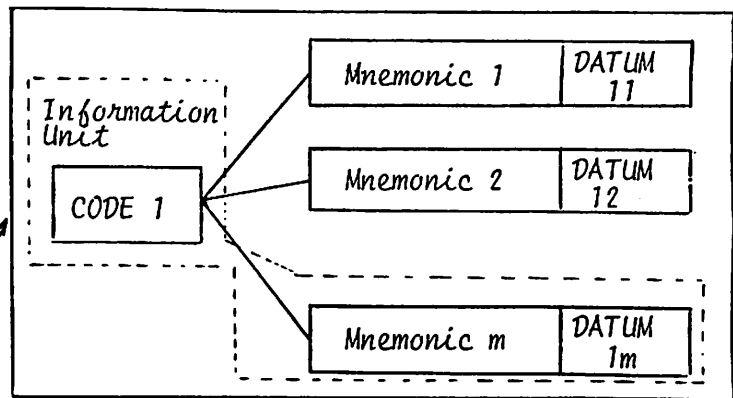
- .. CODE (of the ITEM)
- .. MNEMONIC (of the DATUM)
- .. DATUM

. KEY WORD

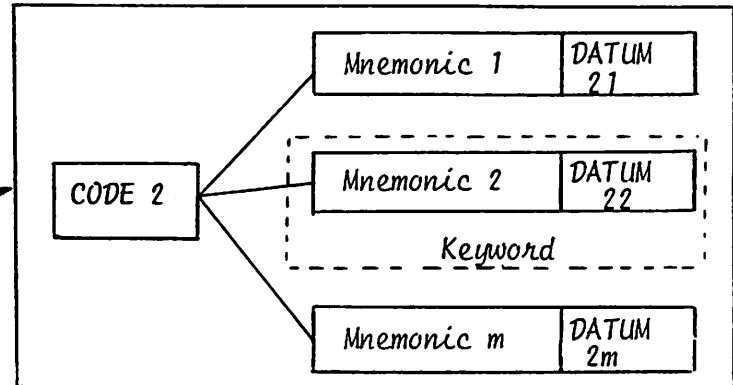
Is the double MNEMONIC + DATUM especially chosen by the retrieval of ITEMS.

In the next figure we have a graphic representation of these concepts.

ITEM 1

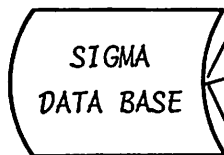
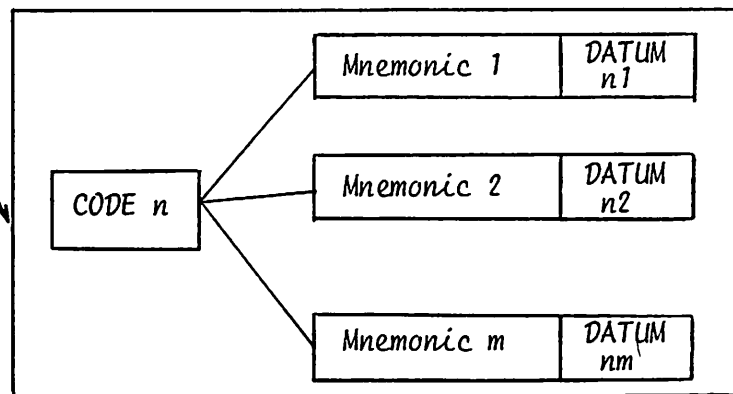


ITEM 2

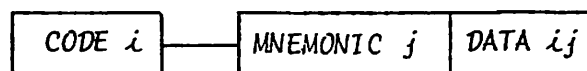


...

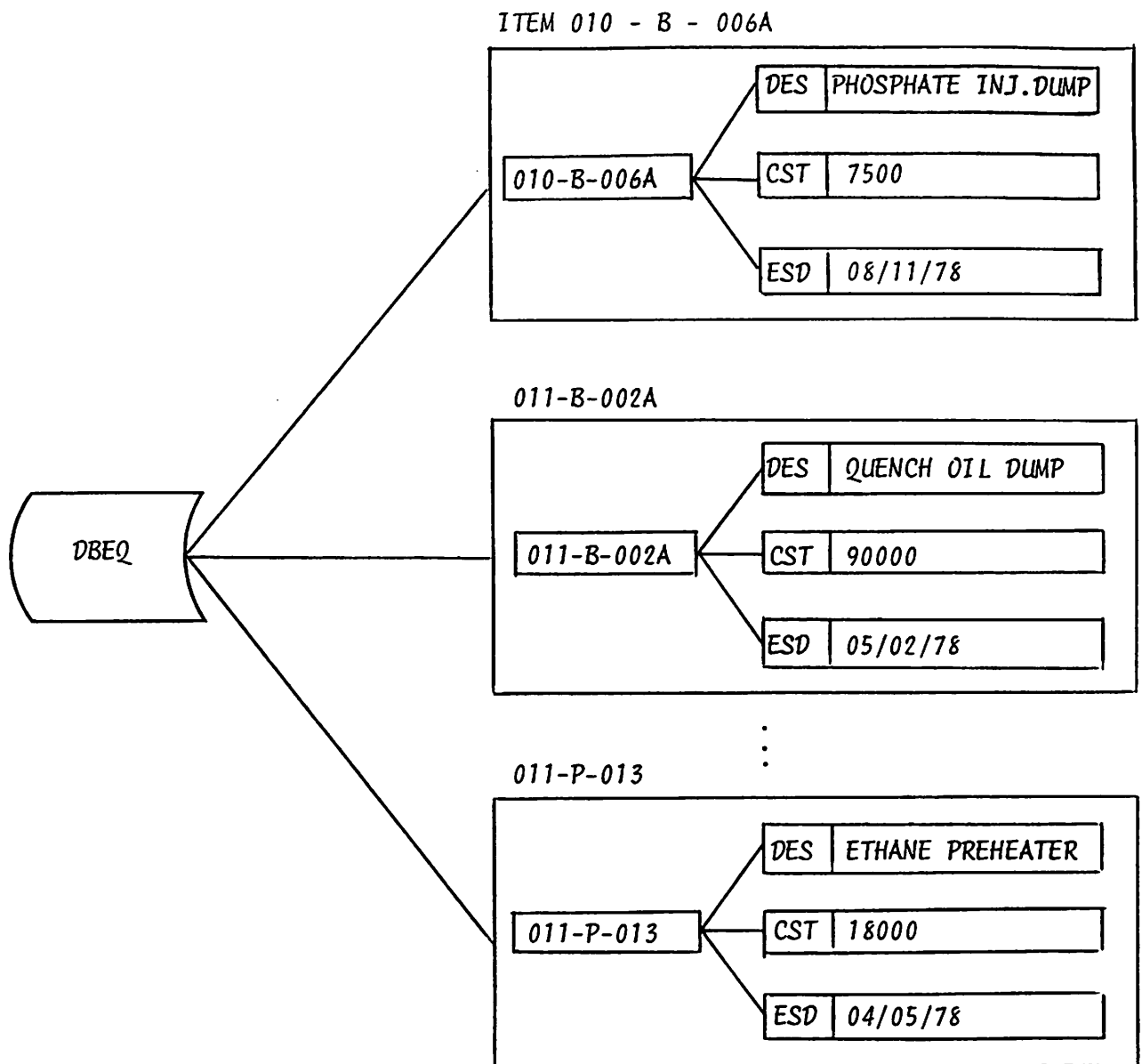
ITEM n



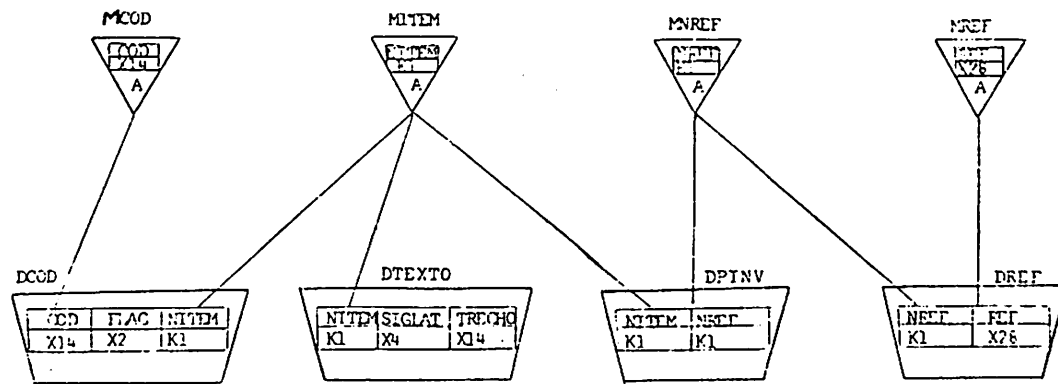
- NOTES: 1. $\rightarrow$ means "it is composed of"
 2. $-$ means "it is associated to"
 3. n = number of ITEMS; m = number of mnemonics
 4. The UNIT INFORMATION is composed of



In the next figure we have an example of the data base DBEQ, which contains the EQUIPMENT LIST.



SIGMA uses IMAGE's data bases with a structure as is shown in figure below:



The detail data sets have the following characteristics:

. Code data set (DCOD)

In this detail data set are stored the CODES of the ITEMS. The elements of the data set are:

- .. the code (COD)
- .. the atualization flag (FLAG)
- .. the internal number of the item generated by the system (NITEM)

. Text data set (DTEXT0)

In this detail data set are stored the information unities. The elements of the data set are:

- .. the number of the item (NITEM)
- .. the mnemonic of the DATUM
- .. the DATUM

. Inverted search data set (DPINV)

In this detail data set are stored the association: number of item (NITEM) - number of keyword (NREF).

. Keyword data set (DREF)

In this detail data set are stored the keywords. The elements of data set are:

- .. Keyword (REF)
- .. Number associated to keyword (NREF)

This structure is handled by 10 programs, seven in SPL and three in FORTRAN. The programs are funcionally distributed as follows:

- . SIGMA01
 - . SIGMA02
 - . SIGMA03
 - . SIGMA04
 - . SIGMA05
 - . SIGMA06
 - . SIGMA07
 - . SIGMA08
 - . SIGMA09
 - . SIGMA10
- DATA ENTRY
- REPORT SELECTION
- REPORT EDITING
- REPORT DEFINITION
- AUXILIARY PROGRAMS

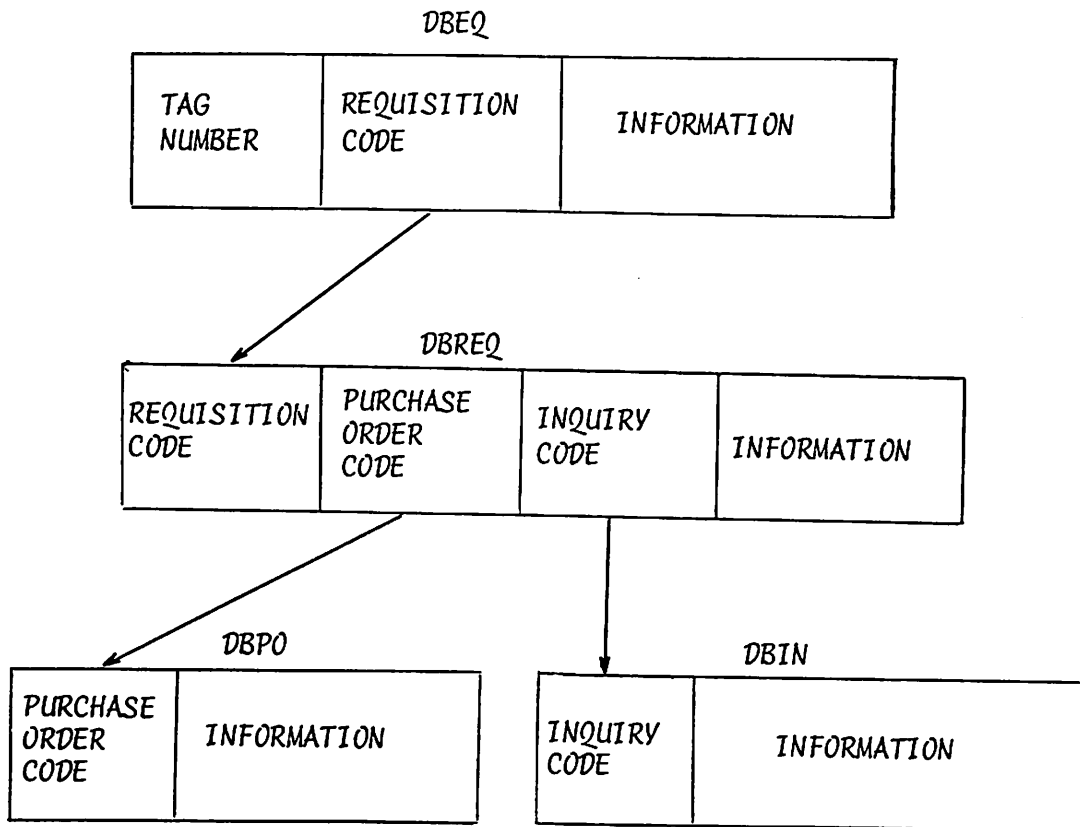
2.1.3 Data Base Linkage

SIGMA data bases are independent among themselves regarding creation and updating.

In the process of information retrieval however, it is possible to agree with various data bases, since there are linkage elements among the data bases.

A linkage element between two data bases is a data element common to two data bases. In one of them it is necessarily a code.

The figure below shows the linkages among data bases DBEQ, DBREQ, DBIN, DBPO.



2.2

Data Base Handling

2.2.1

Data Base Updating

Data base updating is performed through four commands:

- . ADD
- . REPLACE
- . DELETE
- . EQUIVALENCE

. ADD

A code₁ [/code₂],mnemonic,"data"

A 011 - B - 011A,CST,"4000"

A 011 - B - 011A/011 - B - 011A,ESD,"01/06/78"

. REPLACE

R code₁ [/code₂],mnemonic,"data"

R 011 - F - 012,CST,"700000"

R 011 - F - 012/011 - F - 013,ESD,"06/03/78"

. DELETE

D code₁ [/code₂],[mnemonic]

D 011 - B - 002A

D 011 - B - 002A/011 - B - 002B

D 011 - B - 002A/CST

D 011 - B - 002A/011 - B - 002B,CST

For batch processes, it is possible to update the data base through records, with pre-defined lay-outs. The next figure shows this alternative.

[illegible]

OBSERVAÇÕES

1 - Os campos correspondentes as colunas 17, 31, 33 e 74 deverão ser preenchidos obedecendo uma das seguintes opções:

- letra A - Inclusão de uma nova informação
- letra R - Alteração de uma informação existente
- letra D - Exclusão de uma informação existente

2- Quanto à origem do fornecimento preencher o campo correspondente conforme descrito abaixo

IE - Equipamento importado

BE - Equipamento nacional

BR - Equipamento nacional

DQ- Concorrência internacional

54. **Concurrence internazionale**

2.2.2

Information Retrieval

We have three types of information retrieval:

- . Through the CODE
- . Through the KEY WORDS
- . From the ITEMS which were updated

Retrieval through CODE:

Retrieval through the CODE is executed by the command:

$L \text{ code}_1 \left[\text{code}_2, \text{mnemonic} \right]$

=>L 011- Б -002A,DES

* 011- B -002A
DES QUENCH OIL PUMP

=>L 011- B -002A

* 011- B -002A
CST 90000
DES QUENCH OIL PUMF
ESD 02/05/78
REQ PR-011-31-001
TIP IMP

=>L 011- B -002A/011- B -002B, DES

* 011- E -002A
DES QUENCH OIL PUMP

* 011- B -002B
DES QUENCH OIL PUMP

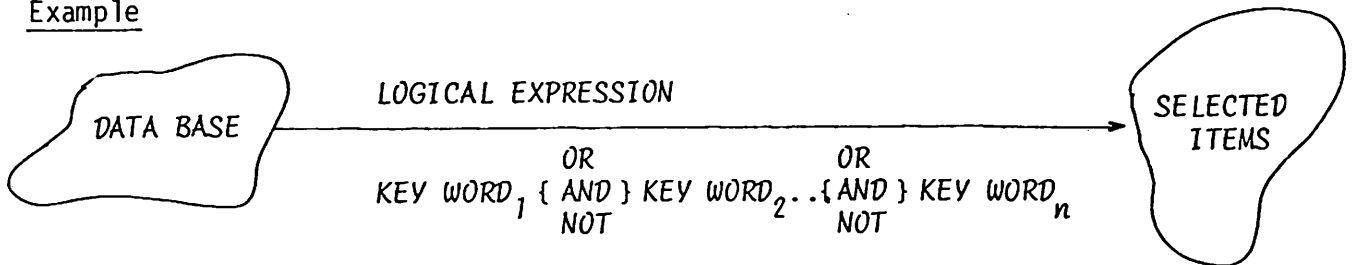
In this type of retrieval we have:

- .. all information must be in the same DATA BASE
- .. the retrieved information can only be edited in a standard form

Retrieval through KEYWORDS

The KEY WORDS can be combined through Boolean operators (OR,AND,NOT) making logical expressions which will be used in the selection of a sub set of ITEMS.

Example



The retrieved ITEMS can be edited by a user pre-defined report.

Retrieval through ITEMS

The third type of retrieval is that where only the ITEMS which were updated in a given period are retrieved.

We will see in more detail these two last types of retrieval in the next section.

2.3

Reports

The printing of reports requires three phases or steps:

- . Definition
- . Selection
- . Edition

2.3.1

Report Definition

The reports are defined through an oriented language:

The following elements are supplied in the definition of a report:

- . Report title
- . Selection specification
- . Heading specification
- . Column specification
- . Sort specification

In the next figure we show the definition of three reports.

REPORT 1

The characteristics are:

- . All information is in the same data base
- . ALL ITEMS are selected

```
1 BEGIN "REP1";
2 FLAG=" ";
3 << SELECTION SPECIFICATION >>
4 A:="$$$;ALL EQUIPMENTS";
5 << HEADLINE SPECIFICATION >>
6 CABEC:= " EQUIPMENT LIST REPORT";
7 CAREC:= " PROJECT CODE: PS01";
8 CABEC:= " REPORT CODE: REP1";
9 << COLUMN SPECIFICATION >>
10 COLUNA:=COD," EQUIPMENT CODE",14;
11 COLUNA:=DES,"EQUIPMENT DESCRIPTION",35;
12 COLUNA:=ESD,"SCHEDULEDELIVERY",9;
13 COLUNA:=TIP,"IMP",3;
14 COLUNA:=CST," COST",10,(M);
15 << SORT SPECIFICATION >>
16 $CONTROLE:=COD,(1,4),A;
17 $CONTROLE:=COD,(7,3),A;
18 $CONTROLE:=COD,(5,2),A;
19 $CONTROLE:=COD,(11,4),A;
20 END;
```

REPORT 2

In this report we have:

- . The information is in three data bases
- . Only the imported equipments (A:=TIP:IMP) are selected.

```
1 BEGIN "REP2";
2 FLAG=" ";
3 << SELECTION SPECIFICATION >>
4 A:="TIP:IMP";
5 << HEADLINE SPECIFICATION >>
6 CAREC:= " REQUISITION REPORT - ONLY THE EQUIPMENTS TO BE IMPORTED";
7 CABEC:= " PROJECT CODE: PS01";
8 CAREC:= " REPORT CODE: REP2";
9 << COLUMN SPECIFICATION >>
10 COLUNA:=REQ," REQUISITION CODE",13;
11 COLUNA:=COD," EQUIPMENT CODE",14;
12 COLUNA:=DES,"EQUIPMENT DESCRIPTION",32;
13 COLUNA:=RSI,"SCHEDULED ISSUE",9;
14 COLUNA:=RID," ISSUE DATE",8;
15 COLUNA:=RRP,"RECIVED PURCH",8;
16 << SORT SPECIFICATION >>
17 $CONTROLE:=REQ,(1,13),1,A;
18 $CONTROLE:=COD,(1,4),A;
19 $CONTROLE:=COD,(7,3),A;
20 $CONTROLE:=COD,(5,2),A;
21 $CONTROLE:=COD,(11,4),A;
22 END;
```

. REPORT 3

In this report we have:

- . The information in the three data bases
- . Only the items that were updated in the last period (FLAG:="*") are selected.

NOTE: This period is defined by the user of the SYSTEM.

```
1 BEGIN "REP3";
2 FLAG="*";
3 << SELECTION SPECIFICATION >>
4 A1="$$$ALL EQUIPMENTS";
5 << HEADLINE SPECIFICATION >>
6 CARECI=" PURCHASE ORDER REPORT "
7 T 26 "ONLY THE ITEMS THAT WAS UPDATED AFTER 10/05/78";
8 CABECI=" PROJECT CODE: P801";
9 CARECI=" REPORT CODE: REP3";
10 << COLUMN SPECIFICATION >>
11 COLUNA1=POD,"PURCHASE ORDER CODE",8;
12 COLUNA1=REQ," REQUISITION CODE",13;
13 COLUNA1=COD," EQUIPMENT CODE",10;
14 COLUNA1=DES,"EQUIPMENT DESCRIPTION",32;
15 COLUNA1=TIP,"IMP",3;
16 COLUNA1=CST,"COST ($)",9,(M);
17 COLUNA1=SUP,"SUPPLIER",14;
18 << SORT SPECIFICATION >>
19 SCONTROLE1=POD,(1,6),I,T,A;
20 SCONTROLE1=REQ,(1,13),I,T,A;
21 SCONTROLE1=COD,(1,4),A;
22 SCONTROLE1=COD,(7,3),A;
23 SCONTROLE1=COD,(5,2),A;
24 SCONTROLE1=COD,(11,4),A;
25 TOTAL=CST;
26 END;
```

2.3.2 Selection

SIGMA allows the following types of selections in the report edition:

- . Through KEY WORDS (Logical expression)
- . Through CONDITIONS
- . Only the ITEMS that we updated in one period (FLAG="*").

2.3.3 Edition

Edition is done in the final phase of the report issuing so that it is possible to use the same selection to issue various types of reports.

SIGMA possesses the following capabilities for edition:

- . classification of columns
- . inhibition of columns
- . totalization of columns
- . generation of columns as linear combination of previous columns.

In the next figures we show three typical reports.

21/SET/1978 16149 HORAS
EQUIPMENT LIST REPORT
PROJECT CODE: P391
REPORT CODE: RFP1

PAG 1

EQUIPMENT CODE	EQUIPMENT DESCRIPTION	SCHEDULED IMP DELIVERY	COST
010- B -006A	PHOSPHATE INJECTION PUMP	11/08/78 IMP	7,500
010- B -006B	PHOSPHATE INJECTION PUMP	12/01/78 IMP	7,500
011- B -002A	QUENCH OIL PUMP	02/05/78 IMP	90,000
011- B -002B	QUENCH OIL PUMP	02/05/78 IMP	90,000
011- B -002C	QUENCH OIL PUMP	02/05/78 IMP	90,000
011- B -002D	QUENCH OIL PUMP	02/05/78 IMP	90,000
011- B -004B	MIDDLE OIL DRAW-OFF PUMP	03/10/78 IMP	2,000
011- B -005A	FUEL OIL PUMP	02/05/78 IMP	2,000
011- B -011A	NAPHTA FEED PUMP	01/06/78 IMP	4,000
011- B -011B	NAPHTA FEED PUMP	01/06/78 IMP	4,000
011- F -012	HIGH PRESSURE STEAM SUPER HEATER	06/03/79	800,000
011- F -013	HIGH PRESSURE STEAM SUPER HEATER	06/03/79	800,000
011- P -013	ETHANE PREHEATER	05/04/78	18,000
011- P -015A	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -015B	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -015C	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -015D	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -015E	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -015F	QUENCH OIL COOLER	03/09/78 IMP	54,000
011- P -016A	FUEL OIL COOLER	07/07/78 IMP	35,000
011- P -016B	FUEL OIL COOLER	07/07/78 IMP	35,000
011- P -016C	FUEL OIL COOLER	07/07/78 IMP	35,000

ACQUISITION CODE	EQUIPMENT CODE	EQUIPMENT DESCRIPTION	SCHEDULED ISSUE	ISSUE DATE	RECEIVED PURCH.
PR-010-31-001	010- B -006A	PHOSPHATE INJECTION PUMP	01/03/77	01/02/77	01/04/77
	010- B -006B	PHOSPHATE INJECTION PUMP	01/03/77	01/02/77	01/04/77
PR-011-31-001	011- B -002A	QUENCH OIL PUMP	01/02/77	01/05/77	01/05/77
	011- B -002B	QUENCH OIL PUMP	01/02/77	01/05/77	01/05/77
	011- B -002C	QUENCH OIL PUMP	01/02/77	01/05/77	01/05/77
	011- B -002D	QUENCH OIL PUMP	01/02/77	01/05/77	01/05/77
	011- B -004B	MIDDLE OIL DRAW-OFF PUMP	01/02/77	01/05/77	01/05/77
	011- B -005A	FUEL OIL PUMP	01/02/77	01/05/77	01/05/77
	011- B -011A	NAPHTA FEED PUMP	01/02/77	01/05/77	01/05/77
	011- B -011B	NAPHTA FEED PUMP	01/02/77	01/05/77	01/05/77
PR-011-42-001	011- F -012	HIGH PRESSURE STEAM SUPER HEATER	01/10/77	01/11/77	01/12/77
	011- F -013	HIGH PRESSURE STEAM SUPER HEATER	01/10/77	01/11/77	01/12/77
PR-011-43-001	011- P -013	ETHANE PREHEATER	01/12/77	01/06/77	01/10/77
	011- P -014A	FUEL OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -016B	FUEL OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -016C	FUEL OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -016D	FUEL OIL COOLER	06/07/77	06/10/77	06/12/77
PR-011-43-002	011- P -015A	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -015B	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -015C	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -015D	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -015E	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77
	011- P -015F	QUENCH OIL COOLER	06/07/77	06/10/77	06/12/77

PURCHASE ORDER CODE	REQUISITION CODE	EQUIPMENT CODE	EQUIPMENT DESCRIPTION	IMP COST (£)	SUPPLIER
31-001	PR-010-31-001	010- B	-006A PHOSPHATE INJECTION PUMP	IMP 7,500	WORTHINGTON
		010- B	-006B PHOSPHATE INJECTION PUMP	IMP 7,500	WORTHINGTON
				15,000	
	PR-011-31-001	011- B	-002A QUENCH OIL PUMP	IMP 90,000	WORTHINGTON
		011- B	-002B QUENCH OIL PUMP	IMP 90,000	WORTHINGTON
		011- B	-002C QUENCH OIL PUMP	IMP 90,000	WORTHINGTON
		011- B	-002D QUENCH OIL PUMP	IMP 90,000	WORTHINGTON
		011- B	-004B MIDDLE OIL DRAW-OFF PUMP	IMP 2,000	WORTHINGTON
		011- B	-005A FUEL OIL PUMP	IMP 2,000	WORTHINGTON
		011- B	-011A NAPHTA FEED PUMP	IMP 4,000	WORTHINGTON
		011- B	-011B NAPHTA FEED PUMP	IMP 4,000	WORTHINGTON
				372,000	
				387,000	
42-001	PR-011-42-001	011- F	-012 HIGH PRESSURE STEAM SUPER HEATER	800,000	CONFAB
		011- F	-013 HIGH PRESSURE STEAM SUPER HEATER	800,000	CONFAB
				1,600,000	
				1,600,000	

CONTINUA-

2.4 Additional Resources

2.4.1

Data editing

SIGMA does the following editing checks:

- . CODE of ITEM
- . Date
- . Monetary Values

2.4.2

Handling of Dates and Monetary Values

- . Dates

.. $(\text{Date}_1 - \text{Date}_2) = \text{running days}$

.. $(\text{Date}_1 + \text{Running Days}) = \text{Date}_2$

- . Monetary

.. $\text{COST} = \text{COST}_0 \{^{\pm}\} K_1 \text{COST}_1 \{^{\pm}\} \dots \{^{\pm}\} K_n \text{COST}_n$

$\{K_1, K_2, \dots, K_n\} \in \mathbb{R}$

3. SYSTEM PERFORMANCE

SIGMA performance has been kept high, considering its generality. In the figure below we show some results of SIGMA application.

. DATA STORAGE

DATA BASE	# ITEMS	# DATA PER ITEM	# KEY WORDS PER ITEM	DISC SPACE (# SECTORS)
1	2700	23	4	5012
2	8000	19	4	11142
3	3500	4	0	2426

. DATA BASE UPDATING

- .. 1000 information (no key-word) = \$ 25.00
- .. 1000 key-words = \$ 37.00

. REPORT WITH 1000 LINES

- .. All information are in the same data base = \$ 15.00
- .. The information are in two data bases = \$ 60.00

NOTE: Reference values used in costs calculations:

- . Elapsed time = \$ 12.00 per hour
- . CPU time = \$ 160.00 per hour
- . 1000 Disc Access = \$ 1.50
- . 1000 Printed Lines = \$ 2.75
- . 1000 Card Read = \$ 2.00

. LIMITATIONS

- .. Maximum Number of UNIT INFORMATION per IMAGE data base = 64000
- .. Maximum Number of DATA per ITEM = 100
- .. Maximum Number of KEYWORDS per ITEM = 24
- .. Maximum Number of Characters per CODE = 14
- .. Maximum Number of Characters per DATUM = 56
- .. Maximum Number of Characters per KEYWORD = 25
- .. Maximum Number of IMAGE data base in a report = 9
- .. Maximum Number of Columns on a report = 14
- .. Maximum Number of headlines = 3

oOo