O N L I N E

D A T A B A S E

START TO FINISH

Robert B. Garvey

Robert L. Womack IV

Witan Inc,
Kansas City, Missouri

Presentation Outline

I Introduction, what will be covered.

A The Foundations:

1 Goals; A System Language and Methodology

2 System Principles

A Elements
1 Components
2 Relationships

B Use in System Phases
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3 Information System Architecture

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B Control Tables

C Data Area Control

D Quiet Callability

B Dynamically Callable Programs:

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1. Introduction

Foundation

Bob Garvey will first lay the a foundation for the understanding of an approach used to understand, design, and implement interactive systems.

A system language, Goals, will be introduced to render systems and components.

A general set of principles will be presented incorporating the components and structures inherent in a structured system. The use of these components in the system life cycle and as a documentation system will evolve.

A general system architecture will be presented and an approach to interactivity will be discussed.

Callables

Bob Womack will present the detailed use of callable programs in the 3000 environment.

G O A L S

A System Language

Goals was designed to meet the following criteria:

* Provide good documentation
* Ease maintainence
* Expedite development
* Provide users early understanding of System functions and restraints
* Improve project management and reporting
* Reduce resources required for documentation
* Optimize System performance

Many of the above criteria can be achieved through reasonable structuring of the system . But many of the structuring techniques that are now popular are simply more trouble than they are worth. Yourdon, Jackson and certainly IBM's HIPO involve more work in their maintainence than rewards merit. Warnier comes closest to being worthwnile but cannot be reasonably maintained in machine sensible form.

Goals will be described as a methodology only because it seems to accomplish all the criteria of the popular "Methodologies", and much more. We do not feel that any of the methodologies should be considered ends in themselves and more sacred than the system at hand. Once the principles are learned and applied the implications should be obvious and the apparent need for a methodology forgotten.

Documentation

1 General Statement
2 Goals, Structural Notation

1 General Statement

The purpose of documentation is to assist in the maintainence and operation of a system. To those ends software documentation must be flexible, easily modifiable, current and easy to read. Witan has developed a system of documentation called Goals which uses simple text files associated through control numbers to meet the criteria listed above. The following sections (2 and 3) describe the general features of the structural notation used in Goals and the General system structure used in system projects.

Goals is used throughout the life of a project. It is used to:
1 To state requirements
2 Render flow and components in the analysis phase
3 To develop, test and render a general design
4 As a pseudo code or structured english for detail design
5 As a high level programming language
6 As a project network descriptor.

2 Goals, Structural Notation

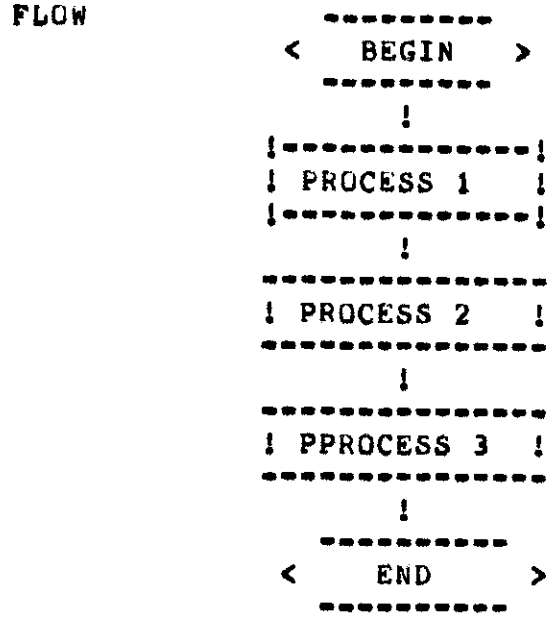
Formal structuring permit three primitive operations:
Sequence, Repetition and Alternation. Structural Notation was developed to meet the criteria of formal systems in a generalized way and was guided by the assumption that systems must be rendered in a machine sensible form. Goals relies upon text sequences and key words as it's basis. Structural Notation is the basis of the syntax of Goals.

Following are the representations of the primitive structures using flowcharts and Goals. The word process is used to represent a step, a process or an item depending on the use of the notation at the time.

Goals Primitive Structures

S E Q U E N C E

FLOW

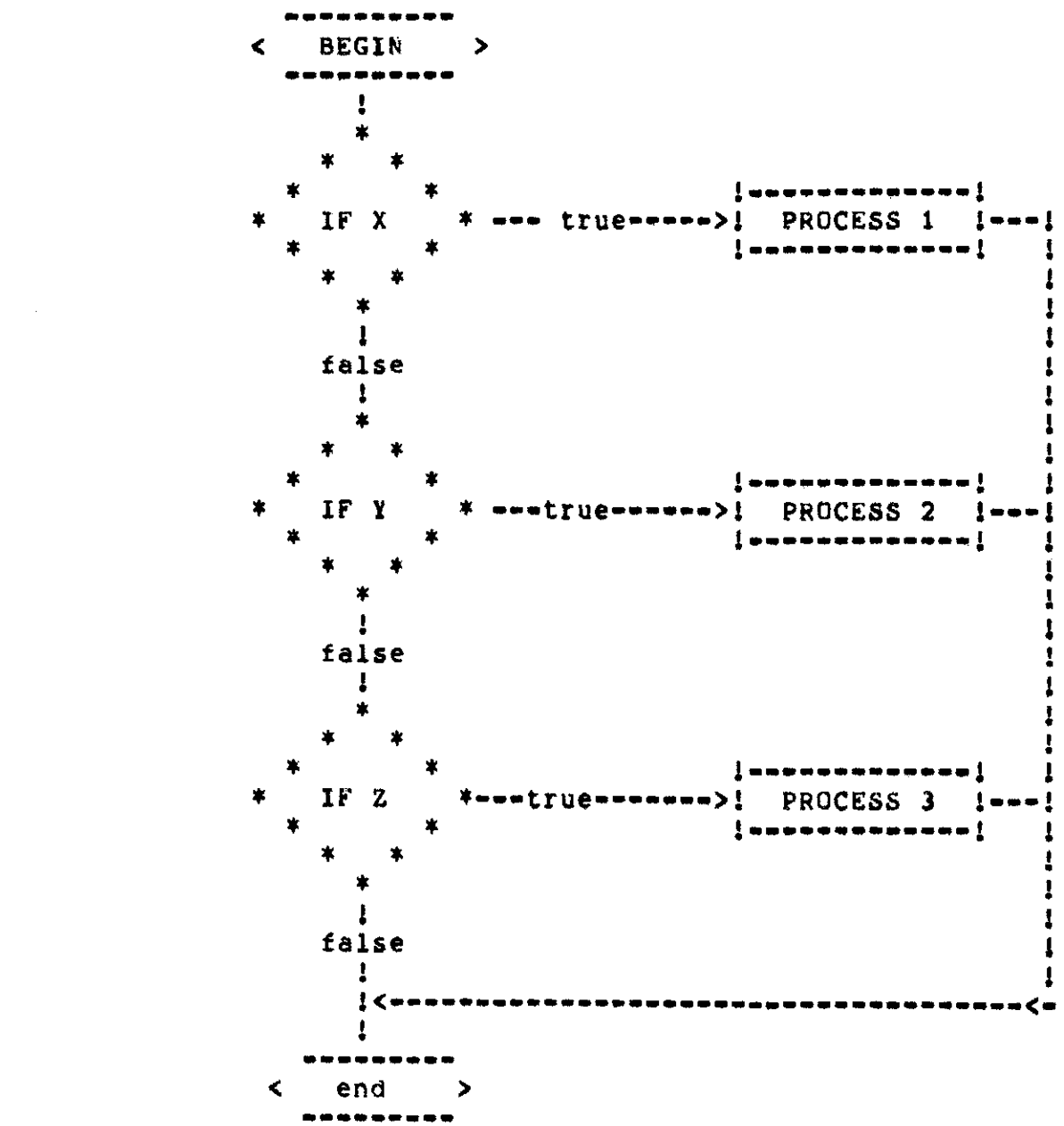


GOALS

1 PROCESS 1
2 PROCESS 2
3 PROCESS 3

A L T E R N A T I O N

FLOW

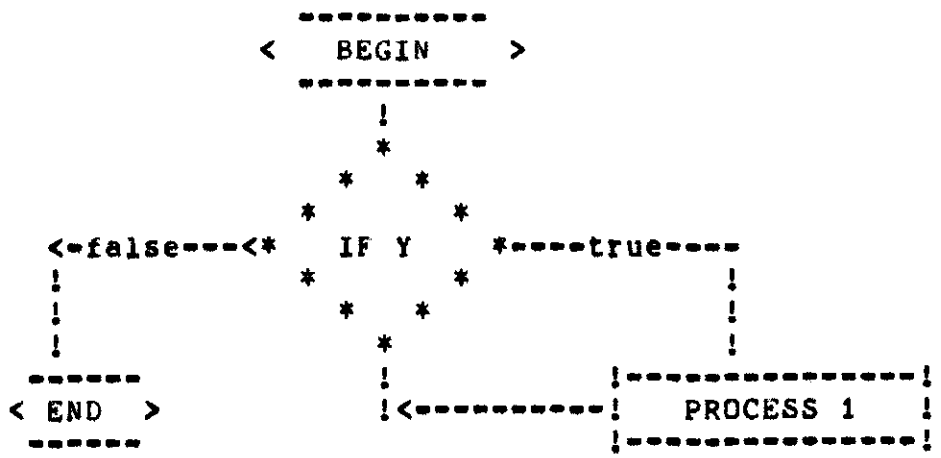


GOALS

IF X IS TRUE
PROCESS 1
IF Y IS TRUE
PROCESS 2
IF Z IS TRUE
PROCESS 3

R E P E T I T I O N

FLOW



GOALS

```
REPEAT UNTIL Y IS FALSE
   PROCESS 1
      PROCESS 1A
      PROCESS 1B
      PROCESS 1C
!
```

The exclamation point is used to signify control in the REPEAT loop. If the condition is met the control passes to the statement following the (!) on the same level. If the condition is met the control passes to the first statement following the condition.

Processes 1A through 1C were added to show a simple subsequence.

DATA STRUCTURING

Goals is also used to represent data structure. As with control structure there are three general structures which can be represented.

Data items listed line after line represent sequence:

```
1  item-1
2  item-2
3  item-3
```

Subsequences are represented as sequences on a level below the item of which they are are a part.

```
1  item-1
1A    item-1A
1B    item-1B
1C    item-1C
2  item-2
3  item-3
```

LEVELS: are represented graphically with the use of indentation. The first character in a line is considered to begin an "A" level subsequent levels are indented an additional three spaces each.

Successively lower levels (higher value characters and more deeply indented) represent subordinate processes. As will be seen in the general system structure the highest most levels are controled by increments of time; years, quarters, months, days, etc. while lower levels are controlled by events or conditions.

CONTROL NUMBERS: The control numbers used in Goals are developed by alternating the use of numbers and letters to represent sucessively lower levels within the system. The system is similiar to English outlining except that only capital letters and numeric characters are used. For a given statement there is nothing to indicate its position in the nierarchy unless the entire control number is dipicted or the starting control number on the page is given. When Goals statements are machine stored the entire control number is either stored or is assumed.

Repetition in data structuring can be represented by "(S)" at the end of the item name which is repeated, this can take the form of an expression (i.e. (0>s<15)).

```
1 item-1(S)
1A   item-1
```

Example: a file of accounts

```
        Account File
1 Account(s)
1A    Account
1B    Account number
1C    Name
1D    Address(s)
1D1      Address type (h=home,w=work)
1D2      Street number
1D3      Direction
1D4      Street name
1D5      Affix
1E    Amount due
1F    Order(s)
1F1      Order number
1F2      Item(s)
1F3         Item
```

ALTERNATION:
Alternation is represented with the IF control word or with the notation (1,0).

```
2A    IF segment descriptive code = 1
2A1      material
2B    IF segment descriptive code = 2
2B1      supply
```

This convention is seldom used because the REPEAT handles most situations for the case of data structuring.

The other type of alternation is within a string of data items where the item can either exist or not exist. Another way of representin a non-required item.

```
1 item-1
2 item-2
3 item-3(1,0)
```

This says that items 1 and 2 must exits or are required and item 3 is optional.

Discussion:

The highest level of repetition within a data structure is assumed to be the key to the file or at least the major sort sequence. If

additional keys are required they can be represented with the word KEY (i.e. item=3 (KEY)) or an additional data structure can be presented to represent the structure represented when the KEY is used.

Goals can be used to represent logical structures as well as the physical implementations. It is important that the required logical views of data be derrived and documented before any phy- sical structures be planned. A recommended goal in system design is to have a one to one relationship between the physical and the logical structures of the system. The coding complexity is reduced appreciably as well as the maintainence activity. An additional byproduct is the ability to use Query or other general inquiry languages in a more straight forward fashion.

2 Principles

An Information system is distinguished from operating systems, command interperters, compilers and the like. An Information System is that set of communications, operations, files and outputs associated with a single conceptual "file".

I am not talking about a single program. Historically I am talking more about an application area.

A. Elements

A1 Components

First an analogy: All purely mecanical devices are made up of elemental components; the incline plane, the wheel and axle, the lever and the chamber. The physics of these basic components and the materials from which they are constructed define the limits of their application. You may be saying, that list does not sound correct or "what about the screw". In listing elemental components certain definitions are inherent. I define the screw as a "rolled incline plane".

For information systems I assert that the list is: Communications, files, operations and outputs. The limits for such systems are defined by the ordering of the elements using the primitive structures (sequence, alternation and repetition).

As a note; to date the list of elemental components may have been input, process and output without reguard to to structure. This is more elemental considering all computer processes but is unbounded. This makes a general system design technique very difficult. Adding hierarchy to the above does not enhance these primitives to any great extent.

A2 Relationships

With these boundries and definitions in hand, lets look at the relationships that develop.

There is generally a one to one relationship between file structure and operations structure, between communications structure and operations structure, between output structure and operations structure. In other words the operations or control structure mimics the other components of the system and each componet is related to the other in structure. The structure begin with the file structure.

Example; if you have a file of accounts and you want to report them; the report program will have to be structured exactly the same as the file or database to report all the data in the file. Most often there is a one to one relationship between files and outputs. In the report example the report structure could be expected to look exactly like the file. If the report is to look different than the file there would be in intervening operation usually a sort or selection to convert an

intermediate output to the final output.

The same is true of communications which on the data processing level are the transmissions to the uses, the screens and the messages. The structure of a communication is generally the same as the operation structure which is the same as the data structure and thus the communication structure is the same as the data structure. This substantiates the theory that systems can be completly described knowing only the data structure. True but limited. Knowing the structure of any part should in theory give you the whole.

If everything describable about a system can be described in simple structures (and thus in Goals) and the components of a system include only communications, files, operations, and outputs and Goals can be used in all system phases then we have a framework for a general system covering conception through maintainence.

Lets look at any application. Traditionally you would begin with a requirements statement and do an analysis of the existing system. Forget flowcharts, classic narratives, and other charting techniques. Think of progressively decomposing the system using simple english outlining starting with the functions. Functions fit into the operations structure discussed. You will note that as you get down a level or two you will encounter repetitive tasks dependant on conditions, add REPEAT and IF to your outlines and keep describing. Remember that users can understand outlines and repetition and alternation are not difficult to understand.

Operations will include existing machine processes, manual proceedures, paper flows, sorting processes ect. As you are going through the operations keep a list of the files that are mentioned and note the file keys (and sorts) and any advantages or requests for multiple keys.

List any outputs or reports prepared by the organization or required in the future.

Communications will be minimal at this stage but note any memos that may go from one section to another of a "file" of notes used as crossreference or duplicate of any more perminent file.

Your documentation is now shaping up; your notebook and I assume that the whole world has change to 8 1/2 by 11, should be divided into communications, file, operations and outputs.

The starting point for design is the detailing of the files in your file list. You will want to reduce the files as much as possible to a single file. By way of naming conventions the "file" should have the same name as the system at hand.

You will notice that many of the manual files are really communications in that they are "views" of the file that are required in a particular subfunction.

The design of the conceptual file must be validated against the required operations. I am going to leave this hanging for a moment to discuss a General System Structure.

3 General System Structure

A General System Structure is presented on the following page in Goals.

This structure is not applicable in all systems but is used as a pattern for system discription, design and understanding.

The key elements of design of this structure are:

1. File unity; a system with this structure has only one conceptual file. It may have any number of datasets of or physical files but they must be formalized into one.
2. Journalizing or logging; all changes made to data items can be (and normally should be) logged.
3. Last action dating; incorporated as part of logging, permits an offline log.

   One detailed implication of this is need to have a date stamp in each detail set and a master date stamp in the master file.

General System Architecture

```
Begin system
REPEAT until EDSystem
  REPEAT until EOYear
     REPEAT until EOQuarter
        REPEAT until EOMonth
           REPEAT until EODay
              REPEAT for each user
                 Begin online
                 identify operator and security
                 Open system file
                 Open current files
                 REPEAT for each Communication
                    IF control transfer
                       transfer control
                    IF batch request
                       initiate request
                    IF update , add or delete
                       Begin
                       Memo to LOG
                       LOCK
                       Update ,add or delete
                       UNLOCK
                       End
                    IF inquiry
                       perform communication operation
                    .
                 !
              !
           End Online
           Begin daily batch
           Perform daily batch processing
           Run LOG analysis
           If end of week
              Perform Monthly Processing
           .
           ROLL FILES
        !
     !
     perform Monthly processing
     Perform Quarterly processing
  !
  Perform end of year processing
!
Close system
End
```

A GENERAL DESIGN

with this Architecture and database design complete we have the basis for the development and implementation of any application.

Step 1 is inquiry into our file; if there is only one search criteria then we calculate into to file and return the master data or a summary. Once positioned in a master we can chain through our detail sets or follow appropriate programatic paths.

The master screen (a communication) should provide inquiry, update, and addition ability.

Each detail set should have a screen providing the same update add and inquiry ability. Our screens will be one for one with the detail sets. Think of a detail set as having a buffer that will correspond to communication (VIEW) buffer. Moving date within one program is facilitated with this concept.

The list of detail sets becomes a list of programs which must be written to handle the retrieval, update, addition, deletion and editing of data for the detail set.

When this is complete you will have a functioning system; it will not function well. I have intentionally oversimplified. The office proceedures which may be in place or will evolve will dictate what combination of sets will appear on a screen but no effort was be lost in developing the barebones system according to this method. Each set (detail set) should have its own program to handle retrieval and update. When requirements demand inclusion the programs can usually be used with few changes. You can take this one step further to include a general scheme to handle multiple data sets on one screen.

The question then becomes; "How do I tie this all together?".

4 Interactivity and Control

Lets say that we have written a system composed of a series of programs that correspond to our data sets. The way in which we permit interactivity is through a control program called MENU.

4A Menus

A master data set will exist at the top of the conceptual file and the primary search path will be the file key. Other search paths will be provided through subsystems such as "Name Family" or through automatic masters. For all detail sets associated to the master there will be a program to handle that data set. Your analysis will dictate all the processes that the operator may wish to perform. As other requirements develop associating more than one data set the code can be combined and new screens developed.

The menu control program provides transfer of control. It can do this either "quietly" of "loud". Loud is the obvious implementation; the operator choses a data set from a menu screen, the control is transfered via a "call" to a dynamic subprogram the data set is accessed updated, ect. and control returns to the controlling menu. But let us give the operator the ability to "tell" the system where he wants to go next. If he does a common area flag can be set to say don't display the menu simply transfer control to some other subprogram. We call are common area for data SYSBLK and out flag(s) Q1, Q2, ect. (you are not limited to one level of menu).

A menu structure may look like this:

```
        MAIN MENU
     REPEAT UNTIL PARENT OR END OF SYSTEM
       IF LOUD
          GET MAIN MENU SCREEN
          SEND (SHOW) SCREEN
          REPEAT UNTIL EDITS PASS
            EDIT FIELD
            IF EDITS FAIL
               SEND SCREEN
            .
          SET MODE TO QUIET
       IF QUIET
          IF NEXTPROCEEDURE=A
             CALL A
          IF NEXTPROCEEDURE=B
             CALL B
              ...
          IF NEXTPROCEEDURE =N
             CALL N
          ELSE
             CALL CONTROL'NUMBER'TABLE
          .
       !
```

Through this technique those programs which are not being used are not using memory resources. The CONTROL NUMBER TABLE refers to implementations which have levels of menus. If the control reference is not handled at that menu level control is appropriatly passed to the proper level where a control program can handle it.

The quiet "CALL" technique can be used for any of the data set programs discussed by putting the quiet call structure "around" the program and requiring the passing of appropriate data into or from the communication buffer. Bob Womack will describe this technique in the "NAME FAMILY" discussion.

SL's and USL's

S L ' s

- Modules, Entry points, Programs referenced in require CST entries if they are not allready referenced in a running program.
- Code is sharable by all programs. The PUB.SYS SL is avalable to all programs. Account and group SL's are available to programs being run out of that Account.
- You need exclusive access to the SL to make an entry in it.
- When SL entries are made you do not need to prepare the SL. It is available after you have exited the segmenter.

U S L ' s

- Programs compiled into a USL must be prepared before they are runnable.
- Many programs may be compiled into the same USL. When a program is run the system will look to the USL for resolution of called programs, it then looks to the PUB.SYS SL unless a library is specified in the RUN. (RUN prog;LIB=G)
- All USL resolved entries create XCST entries except the outer block.

CST's and XCST's

- There are 192 CST entries available to user processes
- There are 1028 XCST entries available to user processes.

COMPILE INTO A USL

```
!JOB JOBNAME,username/ serpass.accountname/accountpass;OUTCLASS=,1
!COBOL progname,$NEWPAS ,$NULL
!SEGMENTER
USL $OLDPASS
NEWSEG progname,progname'
PURGERBM SEGMENT,progna e'
USL yourusl
PURGERBM SEGMENT,progna e
AUXUSL $OLDPASS
COPY SEGMENT,progname
EXIT
!TELL user.acct; yourprog ---> yourusl
!EOJ
```

P R E P O F U S L

```
!JOB DyourUSL,user/userpass.account/accountpass;PRI=ES;OUTCLASS=,1
!PURGE yourrun
!CONTINUE
!BUILD yourrun;DISC=2500,1,1;CODE=PROG
!SEGMENTER
USL yourusl
PREPARE yourrun;MAXDATA=16000;CAP=MR,DS
EXIT
!TELL user.acct;  yourrun ---> yourrun
!EOJ
```

C A L L A B L E S I N T O S L ' s

```
!JOB D!SL,user/userpass.account/accountpass;OUTCLASS=,1
!COBOL yourprog,$OLDPASS,$NULL
!SEGMENTER
AUXUSL $OLDPASS
SL SL
ADDSL yourprog
EXIT
!TELL user.acct;  yourrun ---> yourrun
!EOJ
```

M E N U

```
REPEAT until parent or  nd of system
   IF load
      get menu screen
      show screen
      REPEAT until edits pass
         edit fields
         IF edit fail
             send screen
      ! .
      set mode to quiet
   .
   IF quiet
      IF nextprocedure = "O"
          CALL "O" USING ., ., .
      IF nextprocedure = "I"
          CALL "I" USING ., ., .
           .
           .
           .
      IF nextprocedure = "n"
          CALL "n" using ., ., .
      ELSE
          CALL "CONTROLNUMBERTABLE" using nextprocedure
      .
! .
```