Customizing of ARC/INFO technique using simple macro language

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This paper deals with the application of Geographic Information System (GIS) in production of digital maps, with the aim of improving and optimizing the procedure through ARC/INFO technology. Some Innovations were contributed to this procedure using Simple Macro Language (SML). The whole procedure leading to production of a detailed digital map was tested and presented, including four SML Programs. The Scheme was found to be time- saving and efficient.

يدور هذا البحث حول تطبيق موضوع نظم المعلومات الجغرافية فى إنتاج الخرائط الرقمية بهدف تحسين الأداء من خلال استعمال تقنية ARC/INFO. وقد تم إجراء بعض التحديث فى إجراءات هذا البرنامج باستخدام لغة الماكرو الخاصة به (SML). وقد اختبرت خطوات إجراء الطريقة المستعملة فى إنتاج خريطة رقمية – وتم تقديمها بالتفصيل بما في ذلك أربعة برامج مساعدة بلغة SML.وقد وجد أن هذا النظام يؤدى إلى توفير الوقت ويعمل بكفاءة عالية.

Keywords: GISs, ARC/ INFO, Simple macro language, (SML) Elanfoushi project, Tics digital mapping

1. Introduction

The last few years have seen an increase in the use of Geographical Information System (GIS) by a wide range of users. The growing interest in GIS reflects the fact that so mach information needed for management and commerce is specially refereed. In this paper a project was adopted which involves an application of GIS technology on a public district in Alexandria, Elanfoushi. The digital file for this area is based on a local coordinate system . Data of this project was captured from a digital Auto-CAD file. The purpose of this project is to show how ARC/INFO technology is used in generating Digital Maps, and creating some auxiliary programs, written in Simple Macro Language (SML). In this way the application of procedures of this technology would be much easier. The steps of project implementation are given, and the program models are shown in detail.

2. Data preparation

Usually, data of base map are divided into different parts in the vertical direction and some parts in the Harizontal direction. [1, 2]

In this work base map is divided into two parts U and L as shown in fig. 1. The geographic features are organized into 5 layers of data. The first layer includes buildings and its feature type is polygon (UBULD, LBULD). The second layer includes roads and its feature type is polygon (UROAD, LROAD). The third layer includes tram and its feature type is line (UTRAM, LTRAM). The fourth layer includes green land and its feature type is polygon (UGRL, LGRL), and the fifth layer includes sea and its feature type is polygon (USEA, LSEA). These layers are shown in fig.2.

Tic points are geographic control points allowing all coverage features to be registered to a common coordinate system. Other coverage, such as adjacent coverage or other layers of the same area, can be spatially related using the same tics and the same map projection to ensure geographic control.

For establishing the tic locations, fig 3 represents the master tic file. This file also contains the ID, X-Coordinates and Y-Coordinates (table 1) for each tic because the created tics will later be used to transform the coverage to real-world coordinates.

For managing the data for the project efficiently, it is required to set up a workspace organization to contain the coverage, files and

maps which will be created. At this point the database design for the project is completed. Fig. 4 shows the workspace organization at the beginning of the program.

Table 1
I D, X – Coordinates and Y - coordinates

ID	x-coordinates	y-coordinates
1	508017.441	944747.720
2	508454.621	944755.639
3	508023.093	944435.424
4	508460.273	944443.342
5	508028.746	944123.128
6	508465.926	944131.045

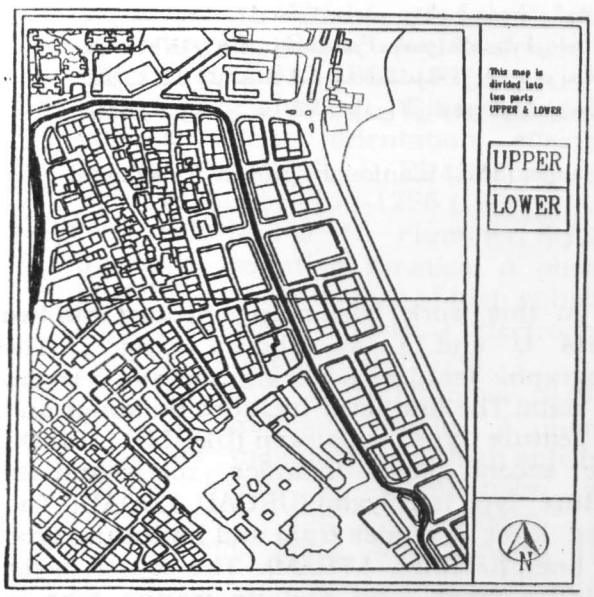

Fig. 1.The base map Elanfoushi district project.

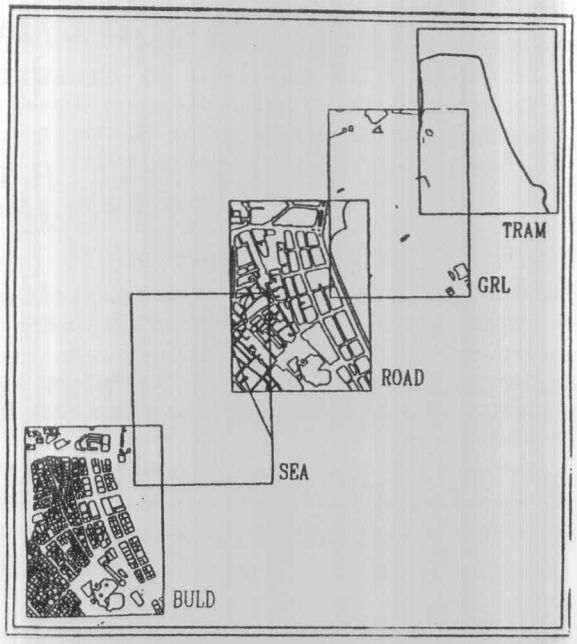

Fig. 2. Layers.

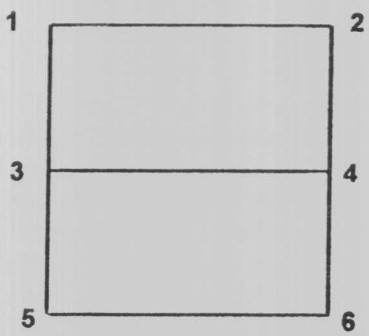

Fig. 3. Master tic file.

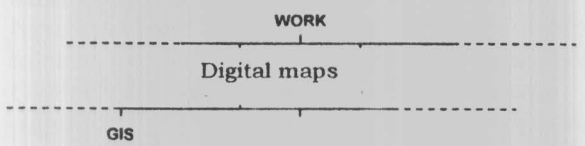

Fig. 4. Workspace at the beginning of the program.

3. Procedures of implementation

Capturing spatial data is manually done using digitizing under ARC/INFO. Digitizing is accomplished in ARC/INFO using ARCEDIT. ARCEDIT is a subsystem of ARC/INFO that provides capabilities for interactive data capture and editing [3]. The digitizing errors are identified, fixed and completely corrected. Topology of all coverage is constructed. Some additional data is put in arc attribute tables and in polygon attribute tables. This operation is very useful in selecting features later. This process is done by creating a new data file to the attributes, adding the attribute values to the file and joining the data file to the feature attribute table for the coverage. This process is done to all features, which need attribute values.

All coverage data are converted from digitizer units to Egyptian Trnsverse Mercator (ETM) projection. This process is done by using an empty coverage containing only tics. Then, updating the tic file with the real-world coordinates recorded from the original map.

Finally, e.g., the coverage UBULD is transformed to the coverage UBULDV4 using the ARC command TRANSFORM as follows:
An empty coverage called UTIC is created by using the ARC existing coverage UBULD

```
[ARC] CREATE UTIC UBULD
[ARC] CREATE UBULDV4 UTIC
[ARC] TRANSFORM UBULD UBULDV4
```

Once each map has been converted to digital form, and coordinate system has been adopted through the tic (control) points, the separated coverage (U and L) have been merged and used as layers (BULD, ROAD, TRAM, GRL, SEA).

At first, adjacent coverage are compared for checking errors of matching. The adjacent coverage are prepared for edge matching by using a topological overlay operation, CLIP. The adjacent coverage are edge matched by using ARC subsystem EDGEMATCH. Checking PAT item definition between the adjacent coverage is done. The different layers are created by using the MAPJOIN command. Finally, map sheet borders are removed by using DISSOLVE. The final workspace after these procedures is illustrated in fig. 5.

4. Generating maps

The final position of map components has been arranged in many ways to manipulate balance. Several layouts, designs and styles have been created before generating the final maps. Some key legend files have been created for explaining what the symbols of coverage features mean.

After all preparations, the process of creating maps started on the computer ARCPLOT program and the ARC/INFO plot system are used. ARCPLOT program is used for creating a map composition and the plot system is used for generating a plot file.

There are five basic steps for creating the final map using ARCPLOT as follows:

i- Indicating the display method for the map: either on the computer's screen or on a graphic plotter.

ii- Specifying the portion of the earth's surface that the map includes. (i.e. specify the map extent).

iii- Specifying certain parameters about the size and layout of the map. These include the final size of the map page, the position of the geographic features on the map, and the scale of the map.

iv- Drawing the geographic features on the map, such as Building, Road, Tram, and specifying the symbols used to draw and label them.

v- Adding additional cartographic elements to make the map easier to read and understand. These include titles, legends, a scale bar, a north arrow, and so on.

An example for creating a final map FINAL is explained in Appendix (A) and fig. 6 illustrate the final map FINAL.

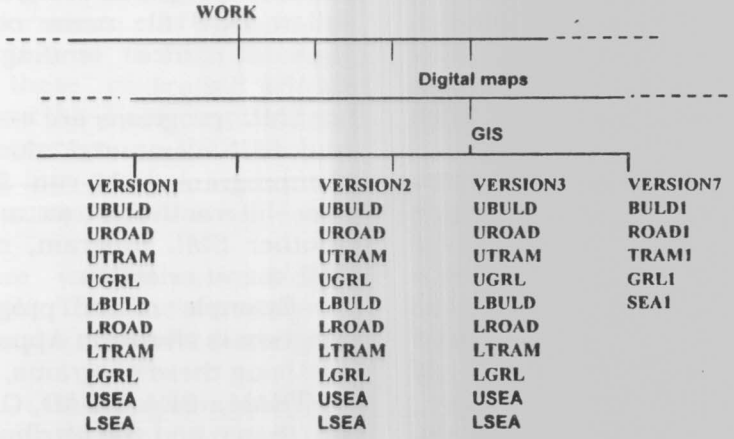

Fig. 5. Final workspace.

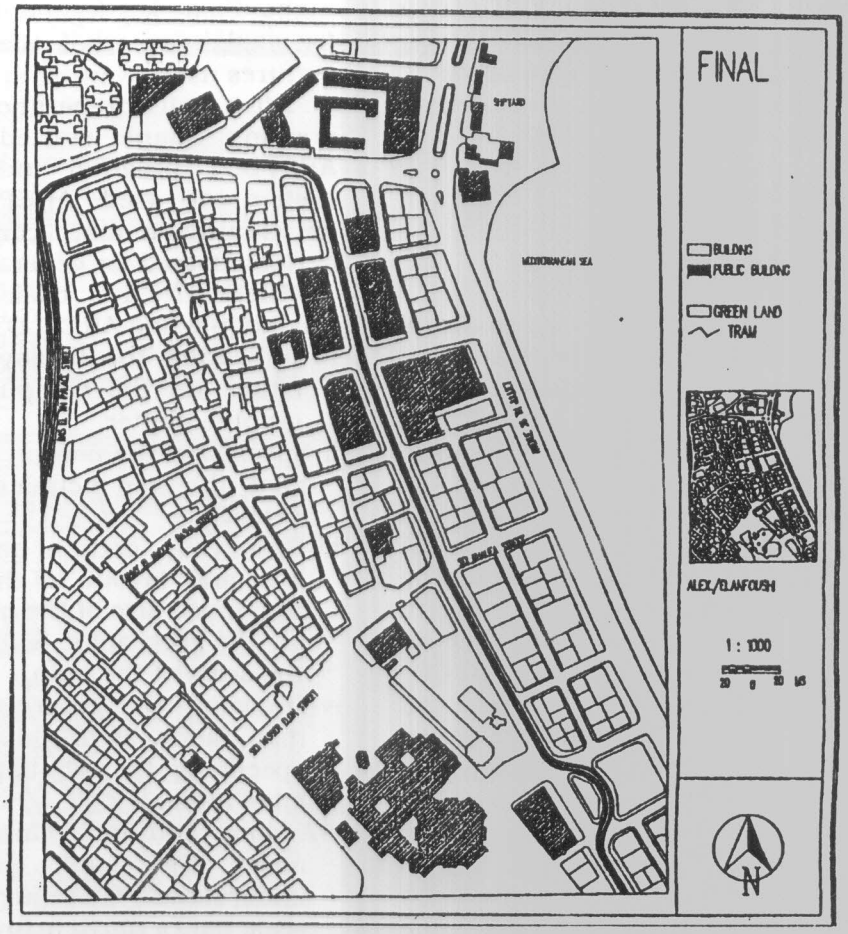

Fig. 6. Final map FINAL.

5. Simple macro language programs

During the implementation of ARC/INFO Technology for creating digital maps, the same sequence of commands has to be executed. So, for saving time and getting more flexibility in the process, some auxiliary programs in Simple Macro Language (SML) have been designed.

SML is PC ARC/INFO·s simple macro Language is a set of commands which constitute a simple programming language for building macros with some of the features of a high level programming language such as expression evaluation, handling of input and output, and directing program flow of control.

SML is composed of a set of components, which may be combined in an SML macro. Its components include variables to store values, commands to perform operations and logical expressions to perform tests to control program flow.

SML programs are created as text files that follow DOS file name conventions. It usually have names ending in SML (e.g ELANF.SML...).

SML programs are executed by issuing the and RUN command along with the name of the program to be run. SML programs can be run interactively, as an executable line in another SML program, or as the result of an SML menu selection.

Example of SML program, and SML menu program is shown in Appendix (B).

Using these programs, the coverage BULD, TRAM, SEA, ROAD, GRL, and FINCOV can be drawn and the attributes of these coverage can be listed.

A menu is comprised of text files, which are created with the system's text editor. The menu system typically contains three components: an SML file that is the driver for the system (ELANF.SML); files that represent what is seen on the screen and what actions are to be performed by selections from the menu – these are usually referred to as menu files; and other files that contain macros, call to other menus, etc...

The menu system driver can be used to initialize variables, set conditions, and establish when the menu system will terminate. The format of a menu file is important because it determines how the menu is displayed and what actions are taken when a selection is made. The contents of the ELANF.SML, ELANF.MNU, ELANDRAW.MNU, and ELANLIST.MNU are shown in Appendix (B). In both Appendices A and B, explanation remarks for program steps are shown, whenever necessary, in italics.

6. Conclusions

A study was carried out on the part of the authors on Geographical Information Systems (GIS) and also on ARC/INFO package in details.

The background was compiled from different references. The main application carried out in this paper is presented through a practical application for an area covering a public district in Alexandria named" El-anfoushi". Four useful macros were designed to improve and facilitate the use of ARC/INFO technology, and, in general to improve and facilitate the performance of geographic analysis. Their function is to draw coverage, list attributes of these coverage, provide capabilities for interactive data capture and editing, draw any coverage on the screen by using any selected line symbol, and make production of map composition much easier and quicker.

The macros were written using Simple Macro Language (SML). The function assigned to these macros can be described briefly as follows:

i- Program ELANF. : By using this program the ordinary user and inexperienced user of ARC/INFO can display the layers, list the output of analysis, and list the attribute of the layers by a single click of the mouse button. This program consists of a director program and subprograms used by the director program.

ii- Program ARCEDIT.SML. : by using this program the ordinary user can perform editing of features in the subsystem ARCEDIT in ARC/INFO.

iii- Program ARCPLOT.SML: By using this program any layer can be drawn on the screen by typing the name of the layer and the line symbol.

iv- Program FINAL.SML: This program is designed to automate the task of generating maps. Alternatively, the user has to do this manually by typing many consecutive, cumbersome orders to generate the final map.

Final these macros were tested and found to be time saving and of great help and convenience in carrying out such work.

Appendix A

Creating a Final Map FINAL
[ARC] ARCPLOT

i- Indicating the display method for the map: either on the computer's screen or on a graphic plotter.

: DISPLAY 4

ii-Specifying the portion of the earth's surface that the map includes. (i.e. specify the map extent).

: MAPE BULD2
: MAP FINAL

iii- Specifying certain parameters about the size and layout of the map. These include the final size of the map page, the position of the geographic features on the map, and the scale of the map.

: PAGEUNITS CM
: PAGESIZE 58 67
: MAPLIMITS 1 1 47 66
: MAPPOSITION CEN CEN
: MAPUNITS METERS
: MAPSCALE 1000
: LINESYMBOL 13
Drawing the outline of map
: BOX 0 0 58 67
: BOX 1 1 57 66
: BOX 47 1 57 66

```
: LINE 47 11 57 11
: LINESYMBOL 16
: BOX .2 .2 57.8 66.8
: LINESYMBOL 1
```

iv- Drawing the geographic features on the map, such as Building, Road, Tram, and specifying the symbols used to draw and label them.

```
: POLYS BULD2
: ASEL BULD2 POLY
: RESEL BULD2 POLY CODE = 'PUB.BUL'
: POLYGONSHADES BULD2
: MAPE GRL2
: POLYS GRL2
: ASEL GRL2 POLY
: RESEL GRL2 POLY CODE = 'GRL'
: POLYGONSHADES GRL2 59
: LINESYMBOL 6
: MAPE ROAD2
: POLYS ROAD2
: ASEL ROAD2 POLY
: RESEL ROAD2 POLY CODE = 'SEA'
: POLYGONSHADES ROAD2 88
: LINESYMBOL 16
: MAPE TRAM2
: ARCS TRAM2
```

V- Adding additional cartographic elements to make the map easier to read and understand. These include titles, legends, a scale bar, a north arrow, and so on.

```
: TEXTSYMBOL 50
: TEXTSIZE 2
: MOVE *
: TEXT 'FINAL'
: TEXTSYMBOL 38
: TEXTSIZE .8
: KEYBOX 1.6 .8
: KEYPOSITION *
: KEYSHADES BULD.KEY
: KEYPOSITION *
: KEYSHADE PAR.KEY
: KEYPOSITION *
: KEYSHADE GRL.KEY
: KEYPOSITION *
: KEYSHADE PBULD.KEY
: LINE *
: MOVE *
: TEXT 'TRAM'
: MAPE NORTH
: MAPLIMITS 47 1 57 11
: POLYS NORTH
: TEXTSIZE 2
: MOVE *
: TEXT 'N'
: MAPE SCALE
: MAPLIMITS
: POLYS SCALE
: TEXTSIZE .8
: MOVE *
: TEXT 'MS'
: MEND
```

At this point, the final map has been saved as a plot file that can be sent to a plotter as follows:

```
: DISPLAY 1039
: PAGEUNITS CM
: PAGESIZE 58 67
: PLOT FINAL
: Q
```

Appendix B

Appendix B1

ELAANF. (SML program & SML menu selection):
By using these programs the coverage BULD, TRAM, SEA, ROAD, GRL, and FINCOV can be drawn, and the attributes of these coverage can be listed.

ELANF.SML

```
&REM ELANF.SML - DRIVER FOR EXAMPLE
MENU SYSTEM
&LABEL TOP
POPUP ELANF.MNU SML
&GOTO TOP &IF &NE %1 QUIT
&RETURN
```

ELANF.MNU

```
&REM 1 2 1 1 1 39
&REM DRAW`FEATURE LIST`ATTRIBUTES
CLEAR QUIT
&REM EOF
&JUMP %1
%1
&RETURN

&LABEL DRAW`FEATURE
POPUP ELANDRAW.MNU SML
&RETURN

&LABEL LIST`ATTRIBUTES
```

```
POPUP ELANLIST.MNU SML
&RETURN
```

ELANDRAW.MNU

```
&REM 2 1 2 1 9 17
&REM `DRAW`FEATURE
&REM BUILDING
&REM ROAD
&REM TRAM
&REM SEA
&REM GREEN`LAND
&REM
&REM RETURN
&REM EOF
&JUMP %2
&RETURN

&LABEL BUILDING
MAPE BULD1
ASEL BULD1 POLY
LINESYMBOL 1
POLYS BULD1
RESEL BULD1 POLY CODE = 'PUB.BUL'
POLYGONSHADES BULD1 46
&RETURN

&LABEL ROAD
MAPE BULD1
LINESYMBOL 6
POLYS ROAD1
&RETURN

&LABEL TRAM
MAPE BULD1
LINESYMBOL 7
ARCS TRAM1
&RETURN

&LABEL SEA
MAPE BULD1
LINESYMBOL 8
ARCS SEA1
&RETURN

&LABEL GREEN`LAND
MAPE BULD1
LINESYMBOL 7
POLYS GRL1
&RETURN

&LABEL RETURN
&RETURN
```

ELANLIST.MNU

```
&REM 3 1 2 13 9 17
&REM `LIST`ATTRIBUTES
&REM BUILDING
&REM ROAD
&REM TRAM
&REM SEA
&REM GREEN`LAND
&REM
&REM RETURN
&REM EOF
&OPENW TEMP
&JUMP %3
&RETURN

&LABEL BUILDING
LIST BULD1 POLY
&GOTO POPUP
&RETURN

&LABEL ROAD
LIST ROAD1 POLY
&GOTO POPUP
&RETURN

&LABEL TRAM
LIST TRAM1 ARCS
&GOTO POPUP
&RETURN

&LABEL SEA
LIST SEA1 POLY
&GOTO POPUP
&RETURN

&LABEL GREEN`LAND
LIST GRL1 POLY
&GOTO POPUP
&RETURN

&LABEL RETURN
&CLOSEW
&SYS "DEL TEMP"
&RETURN

&LABEL POPUP
&CLOSEW
POPUP TEMP 0 1 1 1 12 78
&SYS "DEL TEMP"
&RETURN
```

EXECUTION OF THE PROGRAM

The following commands are entered to execute the program.
[ARC] ARCPLOT
: DISPLAY 4
: &RUN ELANF.SML
The menu displayed on the screen will looks like this

DRAW FEATURE LIST ATTRIBUTES
CLEAR QUIT

When DRAW FEATURE is selected the submenu is displayed on the screen in the following from.

DRAW FEATURE
BUILDING
ROAD
TRAM
SEA
GREEN LAND
RETURN

By using the mouse, any coverage can be drawn by clicking the name of the coverage in this submenu.
When LIST ATTRIBUTES is selected the submenu is displayed on the screen appear as follows:

LIST ATTRIBUTES
BUILDING
ROAD
TRAM
SEA
GREEN LAND
RETURN

By using the mouse, any coverage attributes can be listed by clicking the name of the coverage in this submenu. When CLEAR is selected the screen is cleared. When QUIT is selected the ARCPLOT subsystem is closed. Below are the other three SML programs

APPENDIX B2

ARCEDIT.SML
This program provides capabilities for interactive data capture and editing. The statements of this program is illustrated here:

```
&REM ADDLABEL.SML-PROVIDES
CAPABILITIES FOR INTERACTIVE
&REM DATA CAPTURE AND EDITING
DISPLAY 4
&RESPONSE 1 "ENTER THE COVERAGE
NAME"
MAPEXTENT %1
EDIT %1
&RETURN
```

APPENDIX B3

ARCPLOT.SML
This program used to draw any coverage on the screen by using any selected line symbol. The statements of this program is illustrated here:

```
&REM ARCPLOT.SML-BY USING THIS
PROGRAM IT CAN BE DRAWING
&REM ANY COVERAGE
DISPLAY 4
&RESPONSE 2 "ENTER THE NAME OF
COVERAGE"
MAPEXTENT %2
&RESPONSE 3 "ENTER A LINESYMBOL (#
FROM 1 TO 100)
LINESYMBOL %3
ARCS 2%
&RETURN
```

APPENDIX B4

FINAL.SML
Production of Map Composition is difficult and time consuming but using this program it can be produce Map Composition much easier in small time. The statements of this program is illustrated here:

```
&REM THIS PROGRAM USED TO CTEATING
THE FINAL MAP
DISPLAY 4
&TYPE" "
&TYPE "      **** WELCOME TO DRAWING
THE MAPPOSITION *** "
&TYPE" "
```

```
&RESPONSE 4 "ENTER THE NAME OF THE
LAYER USED TO MAPEXTEN: "
MAPE %4
&RESPONSE 5 "ENTER THE NAME OF THE
FINAL MAP: "
MAP %5
PAGEUNITS CM
PAGESIZE 58 67
MAPLIMITS 1 1 47 66
MAPPOSITION CEN CEN
MAPUNITS METERS
MAPSCALE 1000
LINESYMBOL 13
BOX 0 0 58 67
BOX 1 1 57 66
BOX 47 1 57 66
LINE 47 11 57 11
LINESYMBOL 16
BOX .2 .2 57.8 66.8
&TYPE      " *** NOW START TO DRAW THE
COVERAGE *** "
&SV 9 N
&LABEL WHILE
&RESPONSE 7 "ENTER THE NAME OF THE
LAYER" :
&RESPONSE 8 "ENTER A LINESYMBOL (#
FROM 1 TO 100) :"
LINESYMBOL %8
ARCS %7
&QUERY 9 "THIE LAYER IS THE LAST
LAYER? "&Y
&GOBACK WHILE &IF &NE %9 Y
&TYPE "      **** NOW START TO TYPE THE
TEXT *** "
&SV 13 N
&LABEL WHILE1
&RESPONSE 10 "ENTER THE TEXTSYMBOL
(# FROM 1 TO 100) :"
TEXTSYMBOL %10
&RESPONSE 11 "ENTER THE TEXTSIZE : "
TEXTSIZE %11
MOVE*
&RESPONSE 12 "ENTER THE TEXT DO YOU
WANT TYPE IT : "
TEXT %12
&QUERY 13 "THIS TEXT IS THE LAST TEXT?
"&Y
&GOBACK WHILE1 &IF &NE %13 Y
&TYPE "      **** NOW START TO DRAW THE
SYMBOLE *** "
&SV 14 N
&LABEL WHILE2
&RESPONSE 15 "ENTER THE TEXTSYMBOL
(# FROM 1 TO 100): "
TEXTSYMBOL %15
&RESPONSE 16" ENTER THE TEXTSIZE : "
TEXTSIZE %16
KEYBOX 1.6 .8
KEYPOSITION*
&RESPONSE 17 "ENTER THE KEYSHADE
FILE NAME"
KEYSHADE %17
&QUERY 14 "THIS SYMBOLIS THE LAST
SYMBOL : "&Y
&GOBACK WHILE2 &IF &NE %14 Y
MAPE NORTH
MAPLIMITS 47 1 57 11
POLYS NORTH
MAPE SCALE
MAPLIMITS
POLYS SCALE
MEND
PAGEUNITS CM
PAGESIZE 58 67
PLOT %5
&RETURN
```

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