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This form should be completed and submitted with the program package to the SHARE Program Library Agency at the address shown above. Standards and instructions for submitting programs are in the "SHARE Reference Manual".

- (1) Program Number (to be filled in by SPLA)..... 360D-23,0,003
- (2) System Type (machine)..... 360/370
- (3) Search Key..... Plant Layout,
Facilities Design
- (4) Programming Systems/Languages..... Fortran IV
- (5) Author's Name and Address..... M. Deisenroth, Dept. Indust. Engr.
Purdue University
Lafayette, Indiana 47906
- (6) Direct Technical Inquiries to Name & Address (if different than Author) and J.A. Tompkins
Box 5511
North Carolina State University
Raleigh, North Carolina 27607
- (7) Title of Program..... PLANET: Plant Layout Analysis
and Evaluation Technique
- (8) Submitter's Installation Membership Code..... NCS
- (9) Submitter's Own Program Identification and Suffix(Optional).. PLANET
- (10) Primary Subject Code..... 230
- (11) Minimum System Requirements OS/Fortran IV
- (12) New or Revision Code (if revision, show prior Program Number in Item 1) N
- (13) Year Completed..... 1972
- (14) Date of Submittal..... 4/15/76
- (15) Documentation (number of original pages submitted)..... 8
- (16) Abstract (should contain sufficient information for a reader to determine the value of the program). Listed on the reverse side of this form are subjects which may serve as a guide for a descriptive abstract.

SHARE PROGRAM LIBRARY SUBMITTAL FORM

Subject Guide:

- a. Purpose
- b. Programming Language used
- c. Version and modification level or release number
- d. Field of application
- e. Type of routine (main program, subroutine, etc.)
- f. Specific description of machine requirements

ABSTRACT
PLANET (Plant Layout Analysis and Evaluation Technique) is a computer
program designed to determine suboptimal layout patterns for physical facilities.
PLANET is a construction routine which consists of three selection routines and a
placement routine. The selection routines determine the order in which depart-
ments are to enter the layout and the placement routine determines where to place
the departments so as to minimize handling costs. The input of flow data into
PLANET may be done in any one of the three following ways: (1) Extended Parts
Matrix, (2) From-To Chart, (3) Penalty Matrix. PLANET is written in Fortran IV
and contains approximately 1000 cards. Storage of 160k is required to implement
PLANET.
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(17) Signature of Submitter and Date J. A. Tompkins (James A. Tompkins) 4/15/76

(18) Signature of Installation Addressee W. H. Hamilton (NCS)

MAGNETIC TAPE KEY

The tape volume contains two files and three tape marks (TM) as shown below. The DCB information is the same for all files:

DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600)

File 1: PLANET Source Program
EBCDIC
962 card images
49 blocks
TM

File 2: Sample input data
EBCDIC
15 card images
1 block
TM
TM

PLANET USER'S GUIDE

PLANET, an acronym representing Plant Layout Analysis and Evaluation Technique, is a plant layout construction routine which consists of three selection procedures and a placement procedure. The selection procedures determines the order in which departments should enter the layout and the placement procedure determines the location within the layout where the department should be positioned. The basis for selection and placement may be either an extended parts list, a from-to chart or a penalty matrix, all of which represent the interrelationship among departments. Detailed information on PLANET may be obtained from either of the references stated at the end of this guide.

This guide is divided into three sections. The first section describes the input format, the second section lists the input for an example problem, and the last section lists and interprets PLANET'S diagnostics.

Section 1: Input Format

There are five different types of cards that may be submitted to PLANET. These five types are divided into three general categories: run data cards, departmental requirements, and flow specification cards.

RUN DATA CARDS

Each PLANET run must contain a single run data card which specifies:

1. The layout name or title.
2. The number of departments to be included in the layout.
3. The size of a unit block.
4. The options desired for this run.

There is only one acceptable format for this card and a description of the field specifications is given below.

Column

- | | |
|-------|--|
| 1 | The identification code 1 must be entered. |
| 2-8 | The date of the computer run, or any other date may be entered. This date will appear in the output. The date is entered in the form DDMMYY where DD is the day of the month, MMM is the month, YY is the year. |
| 9-50 | The layout title to be printed in the printout. |
| 51-52 | The number of departments to be entered in the layout. This number must be less than or equal to 99. |
| 53-60 | The size of a unit block in square units. It may be any square unit the user desires so long as the unit agrees with the area specification on the departmental requirements card. This field must be right justified and may contain a decimal point. |

Column

- 61-62 These two columns must be balnk.
- 63-64 A numeric code is entered to identify the type of materials flow data that is being entered.
- 01 Flow data is in the form of a Parts List.
- 02 Flow data is in the form of a From-To Chart.
- 03 Flow data is in the form of a Penalty Matrix.
- 65-66 A different selection flag field is available for each selection method available. Columns 65 and 66 are for selection Method A, 67 and 68 are for Method B, and 69 and 70 are for Method C. The numeric code present in each field will determine if that particular method is desired and what printout option should be used.
- 67-68
- 69-70
- 00 Do not use the selection method designated by this field.
- 01 Use the selection method indicated by this field and print a layout after the last department is placed in the layout.
- 02 Use the selection method indicated by this field and print a layout after each department is entered in the layout.

DEPARTMENTAL REQUIREMENTS CARDS

Each PLANET run must contain one departmental requirements card for each department to be considered in the run. This number of departments must agree with the number of departments indicated on the run data card. Each departmental requirements card specifies:

1. The name as a description of the department.
2. The department number or identifier.
3. The area requirements for the department.
4. The priority of placement (optional).

There is only one acceptable format for the departmental requirements card and the details are given below.

Column

- 1 The identification code 2 must be entered.
- 2-3 The department number of identifier must be entered as it is going to appear on the printed layouts. Any combination of letters or numbers may be used.
- 4-11 The area required for the department is entered in this field and must be right justified. It may contain a decimal point. The unit of measure must agree with the unit utilized to designate the unit block size on the run data card.
- 12-13 Departmental Priority (01 highest - 09 lowest).
- 14-79 The department name or description may be entered in this field.

FLOW SPECIFICATION CARDS

Each PLANET run must contain information on the material flowing through the facility; however there are three possible formats for inputting this information.

Parts List Cards

The user may elect to enter his data in the form of a parts list. If this option is desired, columns 63-64 of the run data card should contain a 01. Any number of parts list cards can be entered; however, the last data card must be followed by a trailer card with a 3 punched in column 1 and a 99 punched in columns 6-7. The format specifications for parts list cards is given below.

Column

- | | |
|-------|---|
| 1 | The identification code 3 must be entered. |
| 2-5 | The part number or identifier must be entered as it is going to appear on the printout. Any combination of letters, numbers or special characters may be utilized. |
| 6-7 | The number of departments listed in the move sequence must be entered in this field, right justified. This number must be less than or equal to 30. If more departments are necessary, the sequence must be broken and two or more parts list cards utilized to describe the specific part. |
| 8-10 | The frequency of movement must be entered in this field, right justified. The unit of time considered must be the same for all parts and is the unit of time considered when the total handling cost is printed, such as handling cost per month. |
| 11-20 | The cost per move per hundred units of distance traveled is entered in this field, right justified. The unit of travel should be consistent with the area units utilized earlier in the block size specification and the departmental area requirements. The field may contain a decimal point and is assumed to be in dollars. |
| 21-22 | These 30 fields contain the move sequence by utilizing the department numbers or identifiers specified on the departmental |
| 23-24 | requirements cards. The number of departments entered must correspond to the number indicated in columns 6-7. |
| 25-26 | |
| ... | |
| 79-80 | |

From-To Chart Cards

The user may already have data available in the form of a From-To Chart and may wish to utilize this as input. The number of cards required by this format is a multiple of the number of departments and depends on the number of cards necessary to enter the data for a single department. The cards must be sequenced on departments first and in the same order as

the departmental specifications cards. Within a department, cards must be sequenced by the card numbers indicated in columns 4-5.

Column

- 1 The identification code 4 must be entered.
- 2-3 The department number or identifier must be entered in this field for all cards which contain segments of the given departments row in the From-To Chart.
- 4-5 All From-To Chart cards for a given department must be grouped together and numbered in columns 4-5 starting with 01 and proceeding until the last card for that department is completed.
(The departmental sequence in identifying rows must match the sequence in identifying columns.)
- 6-10 These 15 fields represent elements from the From-To Chart. For
- 11-15 card 01 (columns 4-5) the fields represent the elements of
- 16-20 columns 1 through 15 of the From-To Chart, for card 02 they
- 21-25 represent the elements of columns 16 through 30, etc.
- ...
- 76-80

Penalty Matrix Cards

A final form of flow Specification data that may be entered is the penalty matrix. It should be remembered that the program is trying to minimize a summation of the products of the distances and elements of this matrix; hence a large penalty value for a given element will cause the program to try to locate the related departments close together. The number of cards required by this input format is a multiple of the number of departments included in the run. The cards must be grouped first by departments and in the same order as the departmental specification cards. Within a department, cards must be sequenced by the card number indicated in column 4.

Column

- 1 The identification code 5 must be entered.
- 2-3 The department number or identifier must be entered in this field for all cards which contain segments of the given departments row of the Penalty Matrix.
- 4 All Penalty Matrix cards for a given department must be grouped together and numbered in column 4 starting with 1 and proceeding until the last card for that department is completed.
- 5-6 These 38 fields represent elements from the Penalty Matrix. For
- 7-8 card 1 these fields represent the elements of columns 1 through
- 9-10 38 of the Penalty Matrix, for card 2 they represent the elements
- 11-12 of columns 39 through 76, etc.
- ...
- 79-80

Section 2: Input for an Example Problem

Column 1

↓
115JAN76_EXAMPLE_PROBLEM_____0700000400__02010101

2_A___120002

2_B___80001

2_C___60001

2_D___120001

2_E___80001

2_F___120001

2_G___120002

4_A0100000000450001500025000100000500000

4_B0100000000000000000030000250001500000

4_C0100000000000000000000050001000000

4_D010000000020000000000000350000000000

4_E01000000000000000000000000006500035

4_F010000000005000000000000250000000065

4_G0100000000000000000000000000000000

Section 3: PLANET Diagnostics

1. ERROR NUMBER 001 -- THE PROGRAM DID NOT FIND THE PROPER LABEL IN THE CARD LABEL COLUMN FOR THE RUN DATA CARD.

This indicates that a "1" was not found in the first column of the Run Data Card. Either the card is in error or the deck is not in the proper order.

2. ERROR NUMBER 002 -- THE PROGRAM DID NOT FIND THE STATED NUMBER OF DEPARTMENTAL REQUIREMENTS CARDS BEFORE ENCOUNTERING A NEW LABEL IN COLUMN 1.

The Run Data Card has indicated the number of departments to be included in the layout, but an insufficient number of Departmental Requirements Cards has been found. Check out the area cards to insure that you have enough and that no errors have been made in punching the data. If everything still looks right, check the Run Data Card to see how many departments are indicated.

3. DEPARTMENT xx WILL NOT APPEAR IN THE FINAL LAYOUT SINCE THE AREA REQUIRED FOR IT IS LESS THAN ONE BLOCK.

This is more of a warning than an error. The department identified by "xx" is too small to be included in the layout. If this is not desirable, the size of a unit block should be decreased.

4. ERROR NUMBER 004 -- THE PROGRAM FAILED TO FIND THE PROPER LABEL IN THE FIRST COLUMN OF THE PARTS LIST CARD.

Check the card and correct. Could be caused by an improper indication on the Run Data Card.

5. THE ABOVE CARD HAS AN INVALID NUMBER IN THE SIXTH AND SEVENTH COLUMNS AND IS BEING IGNORED.

The Parts List Card indicates either too many or too few moves for the particular part. If more than 30 moves is necessary, divide the flow and use more than one Parts List Card to indicate this item.

6. THE ABOVE MOVE SEQUENCE CONTAINS A 'xx' WHICH WAS NOT LISTED AS A DEPARTMENT IDENTIFIER.

Either the Parts List Card has a wrong identifier or the Area Requirements Card has been mispunched. Multiple errors on the same card will cause this message to be repeated with each error detected.

7. ERROR NUMBER 007 -- THE PROGRAM FAILED TO FIND THE PROPER LABEL NUMBER IN THE FIRST COLUMN OF A FROM-TO CARD.

Check the card for punching errors.

8. ERROR NUMBER 008 -- THE DATA CARDS FOR THE FROM-TO CHART DO NOT LIST THE DEPARTMENTS IN THE SAME ORDER AS THE AREA CARDS.

The rows and columns of the from-to chart must be in the same order as the area department requirements cards. Often this error is caused by the area cards being out of order.

9. ERROR NUMBER 009 -- THE DATA CARDS WITHIN DEPARTMENT xx ARE NOT IN THE PROPER SEQUENCE.

The From-To Cards should be sequenced on columns 4 and 5. Check the deck to insure that the sequence is correct.

10. ERROR NUMBER 010 -- THE PROGRAM HAS FOUND THE MAXIMUM COST VALUE TO BE NONPOSITIVE.

The program has checked the costs and found a negative quantity. Check all flow specification cards

11. ERROR NUMBER 011 -- THE PROGRAM DID NOT FIND THE PROPER LABEL NUMBER IN ONE OF THE PENALTY MATRIX DATA CARDS.

Check the first column of the Penalty Matrix Cards.

REFERENCES

1. Deisenroth, M. P. and Apple, J. M., "A Computerized Plant Layout Analysis and Evaluation Technique," Technical Papers Annual Conference AIIE, Norcorss, Georgia, 1972.
2. Tompkins, J. A. and Moore, J. M., Computer Aided Facilities Design: A User's Guide, Facilities Planning and Design Division, American Institute of Industrial Engineers, 25 Technology Park, Norcross, Georgia, 1976, Chapter 5.