PREPARED UNDER CONTRACT WITH THE ORGANIZED CRIME AND CRIMINAL INTELLIGENCE BRANCH, CALIFORNIA DEPARTMENT OF JUSTICE

A COMPUTER-BASED PROGRAM FOR CRIMINAL INTELLIGENCE ANALYSIS

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CDOJ Agreement 273
Anacapa Sciences Project 189

A COMPUTER-BASED PROGRAM FOR CRIMINAL INTELLIGENCE ANALYSIS

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Technical Report 189-2
August, 1975

Prepared for:

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ABSTRACT

A computer-based program--Organized Crime Analysis Program (*OCAP*)--was developed for the analysis of criminal intelligence. The program was designed to enhance the analysis of organized criminal activity, particularly cases in which large numbers of individuals and organizations are associated in complex ways.

The report is one part of a three-part *OCAP* package delivered to the Organized Crime and Criminal Intelligence Branch of the California Department of Justice. The computer programming package and an analyst instruction document were delivered separately. The report presents the intelligence model employed, outlines the developmental effort, describes the resulting program, and provides detailed analysis procedures.

The project was directed toward the development of an integrated set of computer-based routines which would *aid* the criminal intelligence analyst to derive meaning from available information. Emphasis was given to the optimum allocation of functions between analyst and computer, recognizing at the outset that the computer routines should be designed to support the logical reasoning and inference development of the analyst. To this end, *OCAP* was designed to 1) aid the selection and organization of information for analysis, 2) provide a flexible and selective system whereby the analyst can obtain needed analytical products and 3) minimize the time and effort required of the analyst to complete analytical routines.

OCAP was based on the idea that valid inferences about organized crime must necessarily be based on an understanding of the relationships among the individuals, organizations and criminal activities involved. Furthermore, an understanding of these relationships must typically be developed from fragmentary and incomplete information. Therefore, the *OCAP* computer routines were designed to help the analyst assemble the best picture possible of an organized criminal operation from available information. For example, depending upon the extent and nature of available information, criminal command structures can be defined, illegal trafficking networks (narcotics, guns, cars, etc.) can be described, money paths through fraudulent financial transactions can be delineated, and the pattern of criminal infiltration into legitimate business can be pictured.

ACKNOWLEDGEMENTS

This work was completed under contract with the Organized Crime and Criminal Intelligence Branch (OCCIB) of the California Department of Justice, under the monitorship of Steve Crawford and Dolve Spitz. The authors wish to acknowledge the support and guidance provided by Steve and Dolve, and the helpful suggestions provided by OCCIB intelligence analysts--Jerry Marynik, Bob Morehouse, Ron McCann, and Art O'Connell.

The authors also wish to recognize the many contributions of Arve Sjovold of General Research during the development and testing of *OCAP*, and of Sue Carter and Jim Scott of Anacapa Sciences in the preparation of this report.

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INTRODUCTION

This report describes a computer-based program--Organized Crime Analysis Program (*OCAP*)--developed for the analysis of criminal intelligence. The program was designed primarily to aid the analysis of organized criminal activity, particularly those cases in which large numbers of individuals and organizations are associated in complex ways. The report presents the intelligence analysis model employed, outlines the developmental effort, and describes the resulting analysis program (concepts, features, products and operation). In addition, detailed *OCAP* procedures are presented.

This report is one part of a three-part *OCAP* package delivered to the Organized Crime and Criminal Intelligence Branch (OCCIB) of the California Department of Justice. The computer programming necessary for *OCAP* implementation at the Law Enforcement Consolidated Data Center of the California Department of Justice in Sacramento, California was delivered separately. The third part of the *OCAP* package, an analyst instruction document, was delivered in a loose-leaf notebook format.

BACKGROUND

In recent years, law enforcement agencies have made greater use of the concepts and methods of criminal intelligence to increase the effectiveness of their operations. Although few agencies had any type of ongoing intelligence function 25 years ago, most agencies (national, state, and local) of even moderate size employ some form of intelligence now. In just the past few years, added emphasis has been given to increasing intelligence capabilities, particularly those required for combatting organized crime.

CRIMINAL INTELLIGENCE FUNCTIONS

Criminal intelligence consists of the collection, collation, analysis, and dissemination of information in support of the prevention and control of criminal activities. To this end, the intelligence function is designed

to aid management in the development of law enforcement strategies and tactics, in the selection of targets, in the allocation of manpower, and in the evaluation of the impact of enforcement efforts; it is designed to aid policymakers in the drafting of legislation, ordinances, and procedures; and it is designed to aid crime investigators by describing the nature of criminal operations and by providing investigative leads.

Analysis is the key to a successful criminal intelligence function. At its most elemental level, analysis is the process of developing meaning from incomplete information. The goal of analysis is to develop the most precise and valid inferences--hypotheses, conclusions, predictions, or estimations--possible with available data. In addition, analysis serves to highlight needed data and, consequently, helps to focus subsequent data collection efforts.

CRIMINAL INTELLIGENCE MODEL

The conceptual model which has guided the previous development of analytical techniques, the training of analysts, and the design of *OCAP* is illustrated in Figure 1, and summarized in the following paragraphs.

Information Input

Raw information used in criminal intelligence analysis (entered from the left in Figure 1) can take many forms. Examples include crime reports, investigative reports, agent reports, newspaper articles, public records, financial data, expert opinion, informant reports, photographs, tape recordings, previous analyses, reports from other agencies, interview summaries, telephone records, crime statistics, and research reports.

Data Evaluation

The validity, reliability, and relevancy of entered information is assessed. Reports submitted by intelligence officers typically contain a verbal or numerical assessment of information validity and source reliability. Data might also be evaluated, however, by the analyst through corroboration with information from alternative sources, or through other appropriate tests.

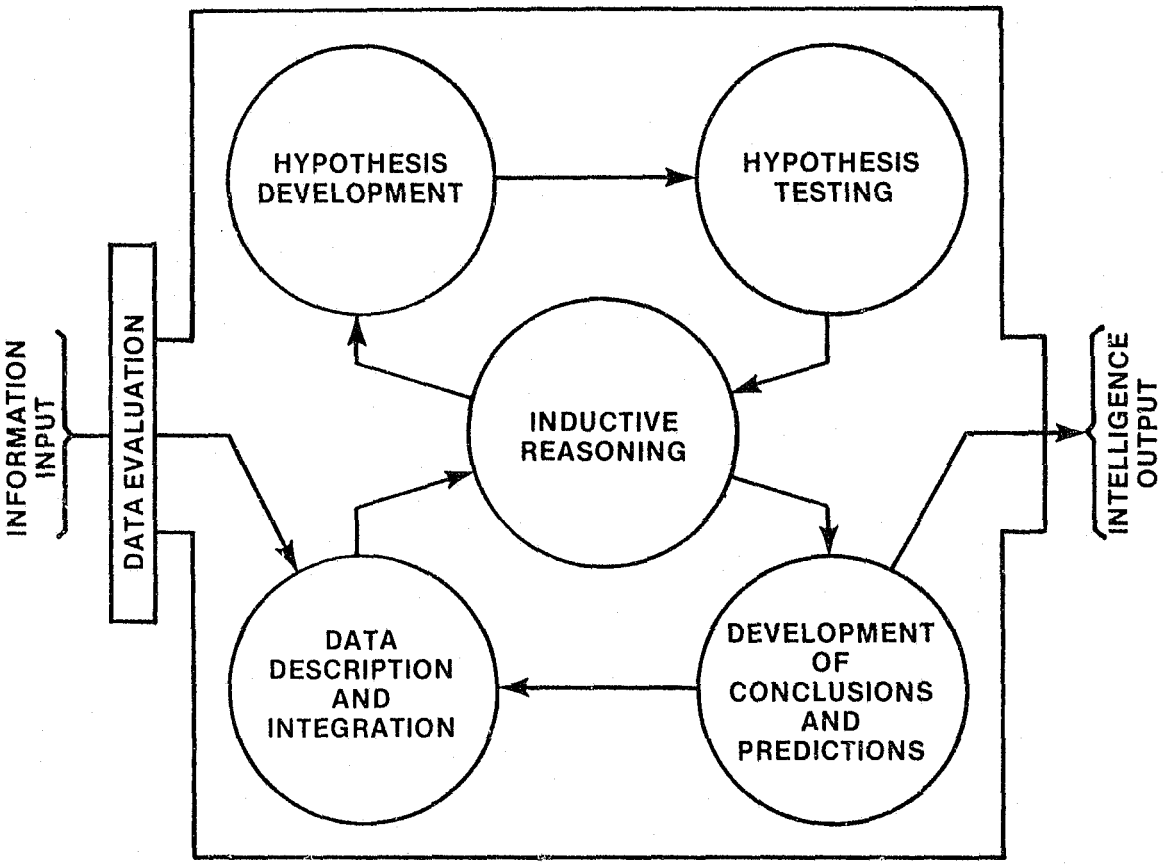


Figure 1. Criminal intelligence analysis conceptual model.

Data Description and Integration

Relevant information is pulled together into a meaningful and manageable form. A variety of techniques might be employed for this purpose. Link analysis is useful for defining the pattern of associations which exist among individuals and organizations (Harper and Harris, 1975). Flow charting techniques permit the analyst to define and depict relationships among events; to determine and illustrate the flow of money, narcotics, or other commodities; or to specify the sequence of critical activities involved in a criminal operation. Correlational methods are useful for determining relationships among criminal activities and their indicators. Methods of financial analysis can be employed to highlight significant changes in net worth or to identify hidden sources of income.

Inductive Reasoning

The analyst's use of inductive logic is at the heart of the intelligence analysis cycle because useful intelligence requires that the analyst go beyond the "facts" at hand. Specific items of information lead to a set of premises which in turn lead to an inference, or set of alternative inferences. Subjective conditional probability is employed by the analyst to assess and convey the validity of the inference.

Hypothesis Development

Initially, the analyst develops one or more hypotheses, or theories, about the integrated information. The hypothesis is a statement of the essential meaning contained in the information and stands to be confirmed or denied by additional testing. To be useful, the hypothesis must be specific, naming the nature and scope of the criminal operation, identifying key individuals and organizations, and specifying the methods employed. At this point in the analysis cycle, it is typically more useful to have a specific hypothesis at a lower level of assessed validity than a general hypothesis at a higher level of assessed validity.

Hypothesis Testing

Additional data collection efforts are focused within the framework of hypothesis testing. Information gaps, needed confirmations, and promising

leads help focus data collection where it will have the greatest impact. At this point, a plan is prepared for the purpose of making the data collection effort cost effective.

Development of Conclusions

The formulation of one or more conclusions completes the intelligence analysis cycle. The conclusion might take the form of an explanation, a prediction, an estimation, or a recommendation; or some combination of the four. As with the hypothesis developed initially, inductive reasoning plays a vital part in the development of a conclusion. At this point, intelligence can be disseminated to the user and can also serve to expand or refine the integrated information, providing a basis for the development of new hypotheses at a higher level of sophistication. In this manner a new analysis cycle is initiated.

MANUAL ANALYSIS TECHNIQUES AND TRAINING

Under contract with the Organized Crime and Criminal Intelligence Branch, California Department of Justice, analytical approaches, methods, and procedures were developed for the conceptual model described above. Then, a two-week training course on criminal intelligence analysis--the first law enforcement course developed on this subject--was designed (Harner and Harris, 1971). The pilot course was conducted in August, 1971; since then 40 courses have been conducted to date within California. Since January, 1974, these courses have been open for attendance by qualified personnel from throughout the United States.

Each training course consists of three main types of sessions. Sessions on *techniques* introduce analytical concepts and procedures, and provide classroom practice, guidance, and feedback on their application. Techniques include: the development and assessment of inferences, link analysis, flow charting, data evaluation, briefing techniques, information storage and retrieval concepts, frequency charting, data collection planning, data correlation, and financial analysis. *Organized crime* sessions introduce indicators of the more sophisticated and complex organized criminal activities. *Practical exercise* sessions use criminal analysis problems

designed to give analysts practice in applying techniques to realistic information. These practical problems typically require about four hours of team or individual work and are followed with feedback and discussion sessions in which results and recommendations are presented in oral briefings and then compared to model solutions.

To enhance the proper utilization of analytical personnel within law enforcement departments, a one-week companion course is given to law enforcement managers. This course emphasizes strategic decision making, tactical planning, intelligence management, organizational evaluation, and the effective utilization of analysis products. Ten intelligence management courses have been conducted to date for personnel within the United States and Canada.

REQUIREMENTS FOR *OCAP*

The project which led ultimately to *OCAP* was undertaken with the recognition that even as criminal intelligence analysts were being trained, were applying their skills, and were contributing significantly to the effectiveness of their agencies, they were not taking full advantage of existing technology. They were learning and applying manual methods adapted for law-enforcement application mainly from other disciplines. Thus, there was a need to undertake the systematic identification of law-enforcement intelligence analysis needs and the development of ways to satisfy those needs with available technology.

The requirements and some of the preliminary concepts for *OCAP* were developed during the initial phase of the study; the approach employed and the results obtained were described in an earlier report (Harris, de Mille, Sjovold, and Ford, 1975). Four main results were obtained and described: a set of requirements for computer-based intelligence analysis, concepts developed for satisfying the set of requirements, assessments of the potential value of the concepts by intelligence commanders from 34 key law enforcement agencies throughout the United States, and a schedule of proposed projects designed to develop the most promising concepts into useful analysis techniques. One of the selected projects has led to *OCAP*. The other project resulted in a computer-based simulation model for studying organized fencing; it will be described in a separate report.

PROJECT OBJECTIVES

The project was directed toward the development of an integrated set of computer-based routines which would *aid* the criminal intelligence analyst to derive meaning from available information. Emphasis was given to the optimum allocation of functions between analyst and computer, recognizing at the outset that the computer routines should be designed to support the logical reasoning and inference development of the analyst. To this end, *OCAP* was designed to 1) aid the selection and organization of information for analysis, 2) provide a flexible and selective system whereby the analyst can obtain needed analytical products and 3) minimize the time and effort required of the analyst to complete analytical routines. Within this framework, the project had the following specific objectives:

- To design and integrate required computer routines into a useful, practical analyst-computer system to enhance criminal intelligence analysis capability,

- To develop the system to the point of implementation at the OCCIB/LECDC facilities in Sacramento,

- To provide a basis, through implementation of the system, for advanced training in criminal intelligence analysis,

- To prepare detailed user instructions to facilitate system effectiveness at OCCIB and in support of local agencies, and to aid in the development and administration of advanced training courses.

PROGRAM DEVELOPMENT

The requirements were identified and the preliminary concepts were developed for *OCAP* in the first phase of the overall project. The approaches taken, procedures employed, and results obtained were described in an earlier report (Harris, de Mille, Sjovold, and Ford, 1975); consequently, they will not be described again here.

In this section, the development of *OCAP* is outlined from conceptualization through implementation. The sequence of tasks completed is illustrated in Figure 2; the tasks are summarized in the following paragraphs.

Database Preparation

Two criminal intelligence working files were prepared for use in the development and preliminary testing of *OCAP* routines. The files were designed to contain data representative of the types of information likely to be used with *OCAP*. In addition, the working files were designed to exercise the various concepts and features likely to be incorporated in *OCAP*.

Development and Test of Computer Routines

Computer programs for *OCAP* routines were designed, coded, and tested on the General Research Corporation CDC 6400 computer in Santa Barbara. The databases were employed to test the output formats and the computational accuracy of the routines. Programming was completed in FORTRAN.

System Integration

The several separate analytical routines were integrated into *OCAP*. The major criteria applied were conformance to the logic of the analytical process and manageability by the analyst. The operational testing to be described later played a significant part in this effort. As analysts employed the various computer routines in analyzing the special databases, they recorded the difficulties encountered and ideas for improvements. As shown in Figure 2, the results of the operational testing were fed back for use in system modification.

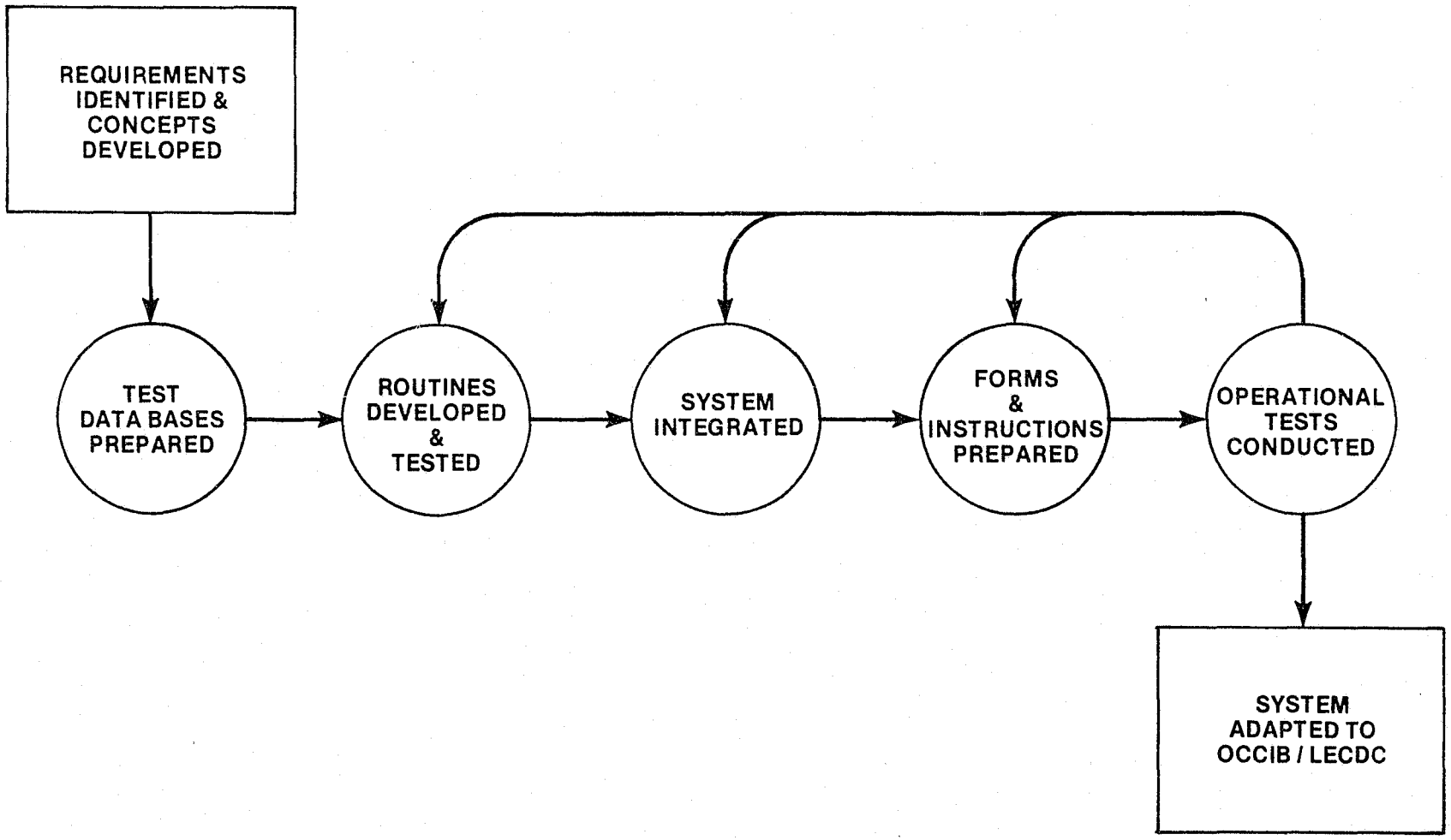


Figure 2. Task sequence in *OCAP* development.

Preparation of Forms and Instructions

Data input forms and analysis control forms were designed, and analyst instructions were prepared. This part of the development effort was largely iterative in nature; preliminary forms and instructions were prepared, used in operational tests, modified as a result of test findings, and so on. Both the forms and the instructions were prepared to adhere to established principles of human factors engineering.

Operational Testing

Three types of operational testing were conducted to support and assess *OCAP* development. Initially, the special databases were used by Anacapa Sciences and General Research staff members to exercise and modify the procedures and routines. Then, OCCIB analysts did the same and suggested improvements and additional desirable features. Finally analysts from the Region P Organized Crime Unit, the Tri-County Organized Crime Information Council (Monterey, San Benito, and Santa Cruz), the Drug Enforcement Administration, and OCCIB employed *OCAP* in the analysis of actual cases. Suggestions for improvements and additional features were also obtained from these analysts. The persons who participated in the operational testing are listed below together with the organizations with which they are affiliated; they are listed in order of their sequence of participation.

Analyst	*Organization*
Jim Howlett	Anacapa Sciences, Inc.
Arve Sjovold	General Research Corporation
Doug Harris	Anacapa Sciences, Inc.
Jerry Marynik	OCCIB
Dolve Spitz	OCCIB
Dick Fuller	Region P Organized Crime Unit
Jim Ashley	Tri-Counties Organized Crime Information Council
Frank Larkworthy	Drug Enforcement Administration
Bob Morehouse	OCCIB
Ron McCann	OCCIB
Art O'Connell	OCCIB

As shown in Figure 2, the results of the operational tests provided feedback for further modification of computer routines, system integration, forms, and instructions.

*Adaption of *OCAP* to OCCIB/LECDC*

Although it was outside the scope of this project to provide a "formal" implementation of *OCAP*, system software was adapted for the OCCIB/LECDC computer. Thus, a workable, tested system for use with the OCCIB/LECDC computer was delivered.

GENERAL PROGRAM DESCRIPTION

OCAP is based on the idea that valid inferences about organized crime must necessarily be based on an understanding of the relationships among the individuals, organizations and criminal activities involved. Furthermore, an understanding of these relationships must typically be developed from fragmentary and incomplete information. *OCAP* is a set of computer routines designed to help the analyst assemble the best picture possible of an organized criminal operation from whatever information is available. For example, depending upon the extent and nature of available information, criminal command structures can be defined, illegal trafficking networks (narcotics, guns, cars, etc.) can be described, money paths through fraudulent financial transactions can be delineated, the pattern of criminal infiltration into legitimate business can be pictured, and so on.

CONCEPTS

The fundamental unit of information needed for *OCAP* is a description of the relationship (link) between two persons or things (entities); the database upon which *OCAP* operates is simply a collection of these fundamental information units. Within this framework, *OCAP* can proceed from the most fragmentary and incomplete information toward building complex end products of the types mentioned above.

Since links between entities can be of different types and strengths, and since their existence is likely to be based upon information of different levels of estimated validity, *OCAP* computer routines operate on four main kinds of information--ENTITY, LINKTYPE, STRENGTH, and VALIDITY. Since an understanding of these four kinds of information is fundamental to the understanding of *OCAP* and how it operates, a brief description of each is provided here.

ENTITIES are persons or things that might be linked one to another in some way. Any name of 20 characters or less that has some meaning to the analyst can be an ENTITY. ENTITIES likely to be of greatest interest are *individuals* and *organizations*; however, there are many other possibilities, such as *places, telephone numbers,* and *criminal records.*

LINKTYPES are descriptions of the relationships (links) that connect one ENTITY to another in some way. Any name of 20 characters or less that has meaning to the analyst can be a LINKTYPE. Some LINKTYPES are directional (for example, a link might be based on the flow of money from A to B, but not from B to A). Others are nondirectional (for example, a link might be based only on information that C and D are associates, providing no basis for directionality).

STRENGTH is an estimate of the strength of the link between two ENTITIES, as judged from the information available. STRENGTH is measured on a numerical scale ranging from a low of 0 to a high of 99. For example, a link based upon the flow of 1 kilogram of heroin per week from A to B might be assigned a STRENGTH of 90, whereas a link based on the one-time purchase of one ounce of heroin by C from D might be assigned a STRENGTH of only 25.

VALIDITY is the likelihood that the link of specified STRENGTH actually exists as described. VALIDITY is measured on a numerical scale ranging from a low of 0 to a high of 99 (a probability value without the decimal point). In assessing the VALIDITY of a link the analyst needs to answer the question: "Based upon the information I have, how sure am I that a link of the specified LINKTYPE and STRENGTH exists between the ENTITIES named?

FEATURES

OCAP routines act upon the four types of information at the direction of the analyst to generate desired analytical products. The analyst has great selectivity and flexibility in obtaining what is needed. Some of the main features and products of *OCAP* are summarized below. More detailed descriptions and descriptions of other features and products, including those which support the features described and help assure the quality of the analysis, will be discussed later in the section on analytical products.

Association Listing

A listing is provided of the direct links and associated STRENGTHS between each ENTITY and all other ENTITIES. In calculating this list, two or more links which might exist for a single pair of ENTITIES are amalgamated and the increased STRENGTH of the resulting link is calculated automatically by *OCAP* routines. An example of an association listing is shown in Figure 3.

Indirect Link Calculations

Indirect links and their STRENGTHS are calculated and employed in *OCAP* routines. An indirect link is one that can be logically inferred from direct links. For example, strong direct links between A and B and between B and C provide the basis for calculating an indirect link (at reduced STRENGTH) between A and C. ENTITIES which are not to be used in calculating indirect links, for reasons discussed later, have an asterisk (*) as the first character in the ENTITY name, as shown in Figure 3.

Selective Link Networks

The analyst can obtain a link network with any selected ENTITY at center. A link network shows the strongest paths of links (direct and indirect) between the selected ENTITY and all other ENTITIES with which it is associated. If directional LINKTYPES are involved, a network in which the direction of links is *in to* the ENTITY can be obtained as well as a network in which the direction of links is *out from* the ENTITY. Of course, if only nondirectional LINKTYPES are involved, both networks would be identical. Directional LINKTYPES have an asterisk (*) as the first character in the LINKTYPE name to differentiate them from nondirectional LINKTYPES.

A link network example is shown in Figure 4. This network was obtained to highlight the flow of money in to Alvin X. Anapopolus. The network is interpreted precisely the same as the comparable flow chart shown in Figure 5; in fact, the computer printout can serve as the basis for preparing such a flow chart. The STRENGTH of direct and indirect links between Alvin X. Anapopolus and the other ENTITIES are shown. For example, Alvin X. Anapopolus and C. J. Candy Shoppes are linked indirectly with a STRENGTH of 71; Alvin

RUN DESCRIPTION - HARRIS ANAPOPOLUS PROJECT 30 JUNE 1975 NORMAL LINK EMPHASIS

LISTING OF DIRECT ASSOCIATIONS AND LINK STRENGTHS

NAME	ENTITIES CONNECTED TO (WITH CONNECTION STRENGTHS.)			
ANAPOPOLUS, ALVIN X	95-ANAPOPOLUS, CASIUS M	95-ANAPOPOLUS, BORIS V		
ANAPOPOLUS, BORIS V	99-ELMERSMART, GORDON E	97-DRAGLEY, FELICIA B	95-ANAPOPOLUS, ALVIN X	
ANAPOPOLUS, CASIUS M	95-ANAPOPOLUS, ALVIN X	92-FOSTER, BILL		
DRAGLEY, FELICIA B	97-ANAPOPOLUS, BORIS V 25-ELMERSMART, GORDON E	75-*EXTORTION 25-JONES, BOB	35-GUNTHER, MARY JO	35-FOSTER, BILL
C J CANDY SHOPPES	95-IMPALA, CYNTHIA JANE			
ELMERSMART, GORDON E	99-ANAPOPOLUS, BORIS V 25-DRAGLEY, FELICIA B	90-*EXTORTION	50-IMPALA, CYNTHIA JANE	47-JONES, BOB
FOSTER, BILL	99-*AUTO THEFT 35-DRAGLEY, FELICIA B	97-GUNTHER, MARY JO	92-ANAPOPOLUS, CASIUS M	88-HAMSTEAD, HARLEY S
GUNTHER, MARY JO	97-FOSTER, BILL	80-*AUTO THEFT	35-DRAGLEY, FELICIA B	
HAMSTEAD, HARLEY S	88-FOSTER, BILL	70-*AUTO THEFT		
IMPALA, CYNTHIA JANE	99-*ASSAULT	95-C J CANDY SHOPPES	50-ELMERSMART, GORDON E	
JONES, BOB	80-*ASSAULT	47-ELMERSMART, GORDON E	25-DRAGLEY, FELICIA B	
*ASSAULT	99-IMPALA, CYNTHIA JANE	80-JONES, BOB		
*AUTO THEFT	99-FOSTER, BILL	80-GUNTHER, MARY JO	70-HAMSTEAD, HARLEY S	
*EXTORTION	90-ELMERSMART, GORDON E	75-DRAGLEY, FELICIA B		

Figure 3. Sample association listing.

```
RUN DESCRIPTION = HARRIS  ANAPOPOLUS PROJECT  30 JUNE 75  MONEY FLOW EMPHASIS
LINKS IN TO      /ANAPOPOLUS, ALVIN X /
LINKS WITH STRENGTH=>  25
                                                                                    LINKTYPE  SOURCE
        ANAPOPOLUS, ALVIN X   100
        .    ANAPOPOLUS, BORIS V    97                                              *CONTROL  D1=01
        .    .    DRAGLEY, FELICIA B     97                                         *MONEY    D2=04
        .    .    ELMERSMART, GORDON E   97                                         *MONEY    D2=03
        .    .    .    IMPALA, CYNTHIA JANE   73                                   *CONTROL  D1=05
        .    .    .    .    C J CANDY SHOPPES      71                              *CONTROL  D1=07
        .    .    .    JONES, BOB             72                                  *CONTROL  D1=08
        .    ANAPOPOLUS, CASIUS M   97                                           *CONTROL  D1=01
        .    .    FOSTER, BILL           96                                      *MONEY    D2=02
        .    .    .    GUNTHER, MARY JO       94                                  *CONTROL  D1=12
        .    .    .    HAMSTEAD, HARLEY S     93                                  *MONEY    D2=01
```

Figure 4. Sample link network.

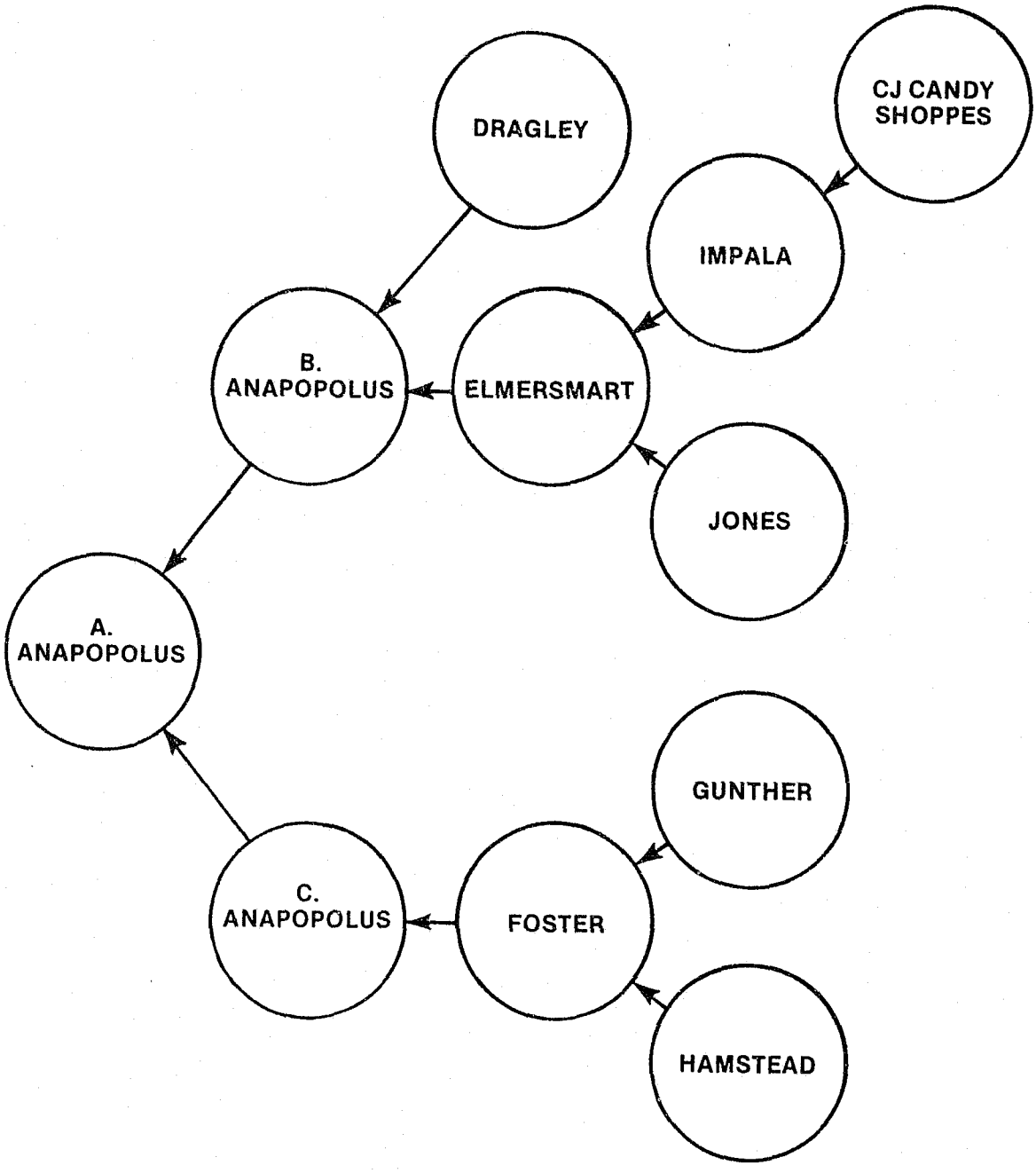


Figure 5. Money flow chart comparable to the sample link network in Figure 4.

X. Anapopolus and Boris V. Anapopolus are linked directly with a STRENGTH of 95. At the right in Figure 4, the LINKTYPE for each direct link is named (if amalgamated, the LINKTYPE of the strongest link in the amalgamation is named) and the coded source of information for that link is provided.

Link Path Listing

The analyst can obtain the path of links connecting any two ENTITIES. If more than one path exists, the paths are listed in order of decreasing STRENGTH. Figure 6 shows the listing of link paths between Alvin X. Anapopolus and C. J. Candy Shoppes. The PRINCIPAL PATH is the first one listed; it is the strongest path of links between the two selected ENTITIES and involves three intermediate ENTITIES--Boris V. Anapopolus, Gordon E. Elmersmart, and Cynthia Jane Impala. The other paths are listed in order of decreasing strength. For example, the next strongest path is the strongest path that goes "through" Felicia B. Dragley, the name listed in the THROUGH column.

Linktype Emphasis

In obtaining link networks, link paths, and other analytical products, the analyst may emphasize or suppress selected LINKTYPES. For example, to obtain a network that describes the flow of money in to or out from a selected ENTITY, the analyst can manipulate LINKTYPES in a way that emphasizes money flow. The analyst might, for example, in addition to emphasizing links reflecting money flow, emphasize links based on narcotics traffic in the *opposite* direction to the flow of narcotics (under the assumption that money flows in the opposite direction from narcotics), and suppress those LINKTYPES which are not related to the flow of money.

In emphasizing money flow in the link network of Figure 4, links based on money flow were emphasized in the direction of money flow, links based on command or control were emphasized in the opposite direction from the command structure (under the assumption that money flows toward higher command levels in criminal organizations), and other LINKTYPES were suppressed.

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 CONTROL LINK EMPHASIS

LINK PATHS BETWEEN /ANAPOPOLUS, ALVIN X / AND /C J CANDY SHOPPES /

STRENGTH	THROUGH	PATH
71	** PRINCIPAL PATH **	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, BORIS V /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/ /C J CANDY SHOPPES /
18	DRAGLEY, FELICIA B	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, BORIS V /DRAGLEY, FELICIA B /ELMERSMART, GORDON E/ /IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /
6	FOSTER, BILL	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, CASIUS M/FOSTER, BILL /DRAGLEY, FELICIA B / /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /
6	GUNTHER, MARY JO	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, CASIUS M/FOSTER, BILL /GUNTHER, MARY JO / /DRAGLEY, FELICIA B /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /

Figure 6. Sample listing of link paths.

OPERATIONAL OVERVIEW

An overview of the major steps needed to operate *OCAP* are summarized in this section; detailed procedures and descriptions of the forms for carrying out these operations are provided in later sections of this report. The relationships among these steps and the general operational flow of *OCAP* are illustrated in Figure 7.

Review Assembled Information

The analyst must become generally familiar with the available information assembled for analysis. If the information is relatively new, the analyst needs to take the time to read through it to gain an overview of the individuals, organizations, activities, and relationships involved, and to get some initial ideas about the kinds of analytical products needed.

Code Data

The analyst uses a data input form to help select relevant information and organize it so that it can be put into and acted upon by the computer. This operation is significantly more than a simple clerical task; careful judgment must be exercised in defining LINKTYPES, assessing STRENGTHS, and estimating VALIDITIES, to assure the validity and usefulness of the analytical products generated.

Enter Coded Data

Completed data input forms are provided to the computer operator or liaison person for entry. The forms are designed to be compatible with either punch-card or tape data entry systems.

Obtain Data Review Package

The first *OCAP* product is a printout designed to facilitate the identification and correction of errors in the database. The entered information is tabulated in four different ways to highlight errors and to help the analyst trace them to their location in the database.

Identify Errors

The analyst inspects each of the four tabulations in the Data Review Package for errors and uses a colored pen to note the errors identified.

Modify Entered Data

Using the database printout provided in the Data Review Package, the analyst inserts changes to correct the entered data and gives the modified printout to the computer operator or liaison person to execute the needed changes. If the modifications are extensive, the analyst obtains a modified Data Review Package and inspects it prior to initiating computer analysis runs.

Emphasize Linktypes

Using linktype emphasis control forms, the analyst emphasizes or suppresses different LINKTYPES for purposes of the analysis. Initially, the analyst obtains a "normal" run, in which all link STRENGTHS are used as entered without emphasis. This run can serve as a benchmark to aid the interpretation of later runs in which LINKTYPE emphasis is applied.

Select Entities

The analyst uses entity selection forms to select the different ENTITIES for which link networks or link paths are wanted.

Execute Routines

The completed forms serve to direct the execution of *OCAP* routines.

Obtain Analysis Package

The *OCAP* product at this point is a set of labeled printouts which are used directly for the analysis. As the analyst works with this package, ideas for additional analyses might arise; these can be obtained by repeating operations as shown in Figure 7.

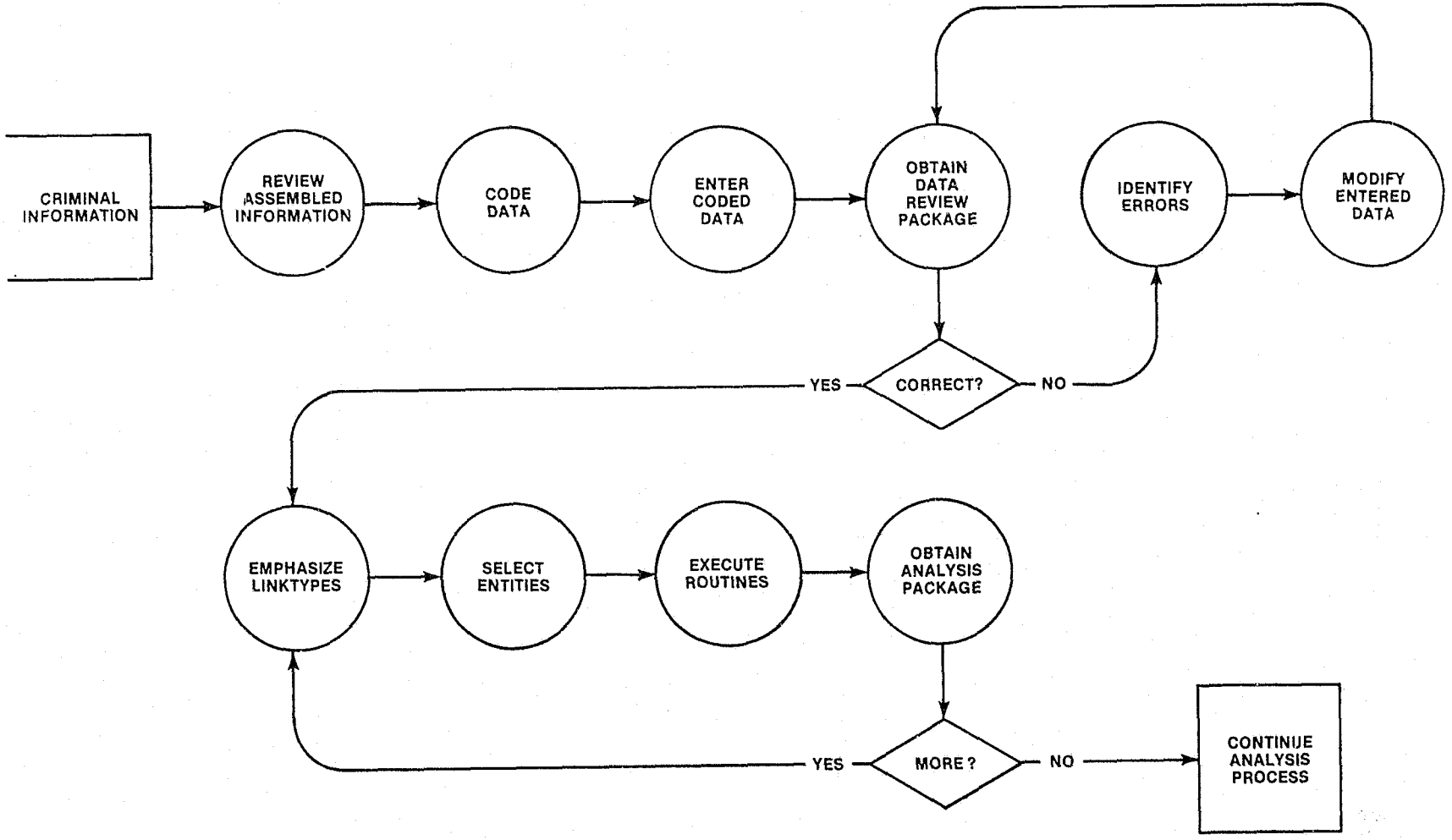


Figure 7. Major *OCAP* operations.

Continue Analysis Process

Although *OCAP* provides products designed to aid the analysis, the analytical process does not stop with the final *OCAP* output. Inferences must be developed and supported; any additional information needed for inference testing or confirmation must be collected; and the results of the analysis must be disseminated by written report and/or oral briefing. Thus, the process (including the additional use of *OCAP*) continues as depicted in Figure 7.

ANALYSIS PRODUCTS

The purpose of this section is to provide, by means of description and illustration, an understanding and appreciation of the kinds of analytical products obtainable from *OCAP*. The case example used earlier will be employed here as well to illustrate the analytical products. The figures illustrating the sample analysis results are presented in the order in which they appear in the *OCAP* analysis package. A complete package is not presented, however; results similar to those included and which would serve no additional descriptive purposes were left out.

DATABASE PRINTOUT AND ENTITY LISTING

OCAP gives the analyst, at the outset, a printout of the database used for the analysis. This provides a reference during the review and interpretation of the analysis results. In conjunction with the database printout, an alphabetical listing is provided of the entities in the database. Entities which are not interconnecting (those which begin with an asterisk) are listed last. The database printout and entity listing for the example case is shown in Figure 8.

SUMMARY OF PRESCRIBED LINKTYPE TREATMENT

To provide an immediately available summary of the linktype treatment for each analysis run, tables such as those in Figures 9, 16, and 20 are printed. The summary table shows the emphasis given--HI, LOW, NORMAL, LIMITED, or OFF--to the forward and reverse direction of links of each type, and gives the validity cut-off for each linktype. Incidentally, the table of Figure 21 indicates that no validity cut-off was entered for the *RECORD or *MONEY linktypes; a minus zero (-0) denotes no entry.

Two fundamental concepts are involved. The first concept is that of link directionality. Every link in the database has both a *forward* and *reverse* component. For directional linktypes (those which are identified with an asterisk in the first character), the forward direction is the direction indicated by the way the link was entered; forward is *from* the first entity listed on the data input form (FROM ENTITY) *to* the second

DATABASE FOR CRIMINAL INTELLIGENCE CODE= HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

SERIAL	SOURCE	LINKTYPE	DATE	STR	VAL	ENTITIES INVOLVED---			
D1-01	*CONTROL		5/26/75	95	90	ANAPOPOLUS, ALVIN X	ANAPOPOLUS, BORIS V	ANAPOPOLUS, CASIUS M	
D1-02	*CONTROL		5/20/75	70	90	ANAPOPOLUS, BORIS V	DRAGLEY, FELICIA B		
D1-03	*CONTROL		12/13/74	90	50	ANAPOPOLUS, BORIS V	ELMERSMART, GORDON E		
D1-04	*RECORD		10/ 2/71	90	99	ELMERSMART, GORDON E	*EXTORTION		
D1-05	*CONTROL		4/21/75	50	50	ELMERSMART, GORDON E	IMPALA, CYNTHIA JANE		
D1-06	*RECORD		4/27/68	99	99	IMPALA, CYNTHIA JANE	*ASSAULT		
D1-07	*CONTROL		6/ 1/75	95	50	IMPALA, CYNTHIA JANE	C J CANDY SHOPPES		
D1-08	*CONTROL		6/ 5/75	30	70	ELMERSMART, GORDON E	JONES, BOB		
D1-09	*RECORD		9/ 9/73	80	99	JONES, BOB	*ASSAULT		
D1-10	*RECORD		3/15/71	75	90	DRAGLEY, FELICIA B	*EXTORTION		
D1-11	*CONTROL		3/ 7/75	60	50	ANAPOPOLUS, CASIUS M	FOSTER, BILL		
D1-12	*CONTROL		4/18/75	95	70	FOSTER, BILL	GUNTHER, MARY JO		
D1-13	*RECORD		11/28/70	80	50	GUNTHER, MARY JO	*AUTO THEFT		
D1-14	*RECORD		10/11/72	99	99	FOSTER, BILL	*AUTO THEFT		
D1-15	*CONTROL		5/29/75	40	80	FOSTER, BILL	HAMSTEAD, HARLEY S		
D1-16	*RECORD		2/19/73	70	90	HAMSTEAD, HARLEY S	*AUTO THEFT		
(FOSTER AND GUNTHER HAVE BEEN LIVING TOGETHER SINCE OCTOBER 1974)									
D2-01	*MONEY		4/ 2/75	80	50	HAMSTEAD, HARLEY S	FOSTER, BILL		
D2-02	*MONEY		4/11/75	80	50	FOSTER, BILL	ANAPOPOLUS, CASIUS M		
D2-03	*MONEY		4/11/75	90	90	ELMERSMART, GORDON E	ANAPOPOLUS, BORIS V		
D2-04	*MONEY		4/23/75	90	70	DRAGLEY, FELICIA B	ANAPOPOLUS, BORIS V		
D3-01	CONTACT		2/12/74	35	70	FOSTER, BILL	DRAGLEY, FELICIA B	GUNTHER, MARY JO	
D3-02	CONTACT		10/28/73	25	60	JONES, BOB	ELMERSMART, GORDON E	DRAGLEY, FELICIA B	

NAMES OF ENTITIES IN THE DATABASE= HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

ANAPOPOLUS, ALVIN X	ANAPOPOLUS, BORIS V	ANAPOPOLUS, CASIUS M	DRAGLEY, FELICIA B	C J CANDY SHOPPES
ELMERSMART, GORDON E	FOSTER, BILL	GUNTHER, MARY JO	HAMSTEAD, HARLEY S	IMPALA, CYNTHIA JANE
JONES, BOB	*ASSAULT	*AUTO THEFT	*EXTORTION	

Figure 8. Database printout and entity listing for example case.

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 1975 NORMAL LINK EMPHASIS

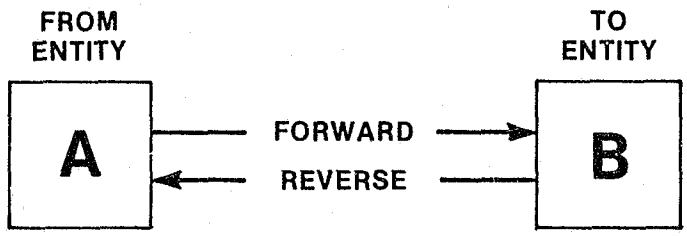
SUMMARY OF PRESCRIBED LINKTYPE TREATMENT FOR THIS RUN

LINKTYPE	FORWARD	REVERSE	CUTOFF
*CONTROL	NORMAL	NORMAL	0
*RECORD	NORMAL	NORMAL	0
*MONEY	NORMAL	NORMAL	0
CONTACT	NORMAL		0

Figure 9. Summary of linktype treatment for normal link emphasis.

entity listed (TO ENTITY). Reverse, of course, is the opposite direction. Forward and reverse directions are illustrated below for entities A and B.

OCAP permits the emphasis of link strength for directional links, differentially for the forward and reverse directions. On the other hand,



nondirectional links, by definition, always have equal strengths in both the forward and reverse directions. Emphasizing forward direction automatically emphasizes the reverse direction, identically, for nondirectional links.

The second concept is that of linktype emphasis. When emphasis is given to either the forward or reverse direction of a linktype, all links of that type are emphasized as indicated. The objective of emphasis, of course, is to highlight patterns of special interest by increasing or decreasing the prominence of links of selected types. For example, the analyst might want to highlight the pattern of money flow, organizational control, and so on.

There are five levels of emphasis to select from--high, normal, low, limited, and off. Emphasis involves a linear transformation of the link strengths, as originally entered into the database, to modified link strengths. Two things happen during the transformation: 1) the absolute value of the link strength is changed in accordance with the transformation function for the selected linktype emphasis, and 2) the link strength value is changed to a decimal fraction (divided by 100) for use in calculating strengths of indirect and amalgamated links.

The linear transformations are illustrated in Figure 10 for high, low, and normal linktype emphasis. For example, a link strength of 80 would be transformed to .40 under low emphasis, to .80 under normal emphasis, and to .90 under high emphasis. These values are then used in *OCAP* calculations; resulting decimal fractions are changed back to whole numbers prior to printing out the analytical products.

Limited emphasis changes the strength of all links to a single value of .004. The purpose of using this level of emphasis is essentially to eliminate the links from playing a strong role, but still to retain the links in the analysis. Typically the links given limited emphasis show up in the analytical products at a value of zero, or about zero. When the off level is used, on the other hand, links of the designated type are totally removed from the analysis.

ASSOCIATION LISTING

A listing of all direct links in the database together with corresponding link strengths are given in the form of the association listing as illustrated in Figure 11. All entities in the database are listed alphabetically in the column at left, labeled NAME. The entities linked directly to each named entity are shown at the right together with the strength of each link. For example, on the third line down, Casius Anapopolus is linked to Alvin Anapopolus with link strength 95 and to Bill Foster with link strength 92.

Where there is link directionality, direction goes from the entity named at the left to the entities with which it is linked at the right. Under normal link emphasis as in Figure 11, in which forward and reverse links are equal, directionality plays no part. However, in the association listing of Figure 18, obtained under control link emphasis, directionality is significant. For example, since the direction of control is from Alvin Anapopolus to Casius Anapopolus and Boris Anapopolus, the direct links on the first line from Alvin to Casius and from Alvin to Boris are both of high link strength. However, the strengths of the links in the opposite directions (Boris to Alvin and Casius to Alvin) are zero because the reverse directions of control links were given limited emphasis (see Figure 16).

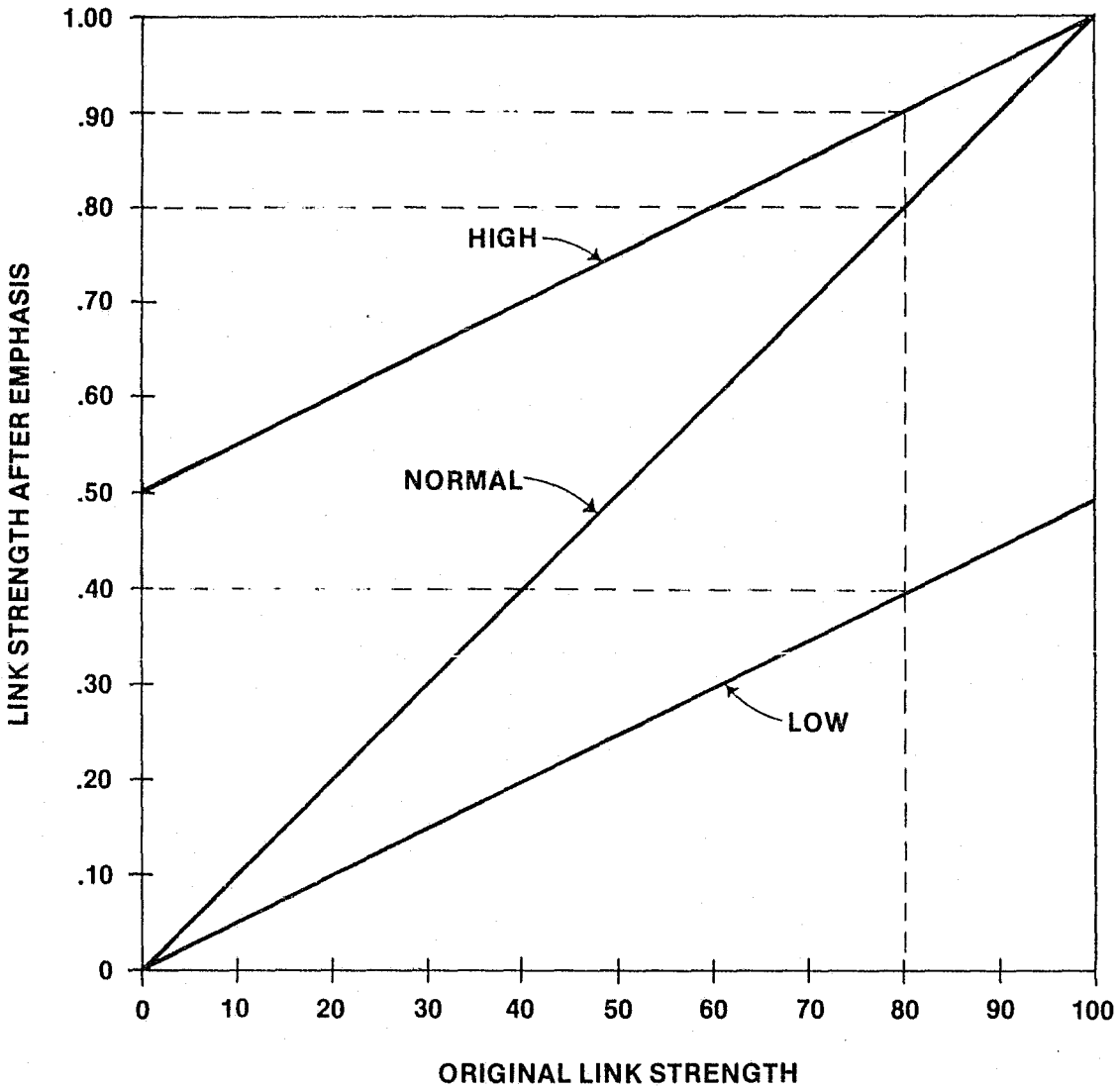


Figure 10. Linear transformation for high, normal and low linktype analysis.

RUN DESCRIPTION - HARRIS ANAPOPOLUS PROJECT 30 JUNE 1975 NORMAL LINK EMPHASIS

LISTING OF DIRECT ASSOCIATIONS AND LINK STRENGTHS

NAME	ENTITIES CONNECTED TO (WITH CONNECTION STRENGTHS.)			
ANAPOPOLUS, ALVIN X	95-ANAPOPOLUS, CASIUS M	95-ANAPOPOLUS, BORIS V		
ANAPOPOLUS, BORIS V	99-ELMERSMART, GORDON E	97-DRAGLEY, FELICIA B	95-ANAPOPOLUS, ALVIN X	
ANAPOPOLUS, CASIUS M	95-ANAPOPOLUS, ALVIN X	92-FOSTER, BILL		
DRAGLEY, FELICIA B	97-ANAPOPOLUS, BORIS V 25-ELMERSMART, GORDON E	75-*EXTORTION 25-JONES, BOB	35-GUNTHER, MARY JO	35-FOSTER, BILL
C J CANDY SHOPPES	95-IMPALA, CYNTHIA JANE			
ELMERSMART, GORDON E	99-ANAPOPOLUS, BORIS V 25-DRAGLEY, FELICIA B	90-*EXTORTION	50-IMPALA, CYNTHIA JANE	47-JONES, BOB
FOSTER, BILL	99-*AUTO THEFT 35-DRAGLEY, FELICIA B	97-GUNTHER, MARY JO	92-ANAPOPOLUS, CASIUS M	88-HAMSTEAD, HARLEY S
GUNTHER, MARY JO	97-FOSTER, BILL	80-*AUTO THEFT	35-DRAGLEY, FELICIA B	
HAMSTEAD, HARLEY S	88-FOSTER, BILL	70-*AUTO THEFT		
IMPALA, CYNTHIA JANE	99-*ASSAULT	95-C J CANDY SHOPPES	50-ELMERSMART, GORDON E	
JONES, BOB	80-*ASSAULT	47-ELMERSMART, GORDON E	25-DRAGLEY, FELICIA B	
*ASSAULT	99-IMPALA, CYNTHIA JANE	80-JONES, BOB		
*AUTO THEFT	99-FOSTER, BILL	80-GUNTHER, MARY JO	70-HAMSTEAD, HARLEY S	
*EXTORTION	90-ELMERSMART, GORDON E	75-DRAGLEY, FELICIA B		

Figure 11. Listing of direct associations and link strengths for normal link emphasis.

Actually, as discussed earlier, the strengths are slightly greater than zero before rounding.

In calculating the association listing, two or more links which might exist for the same pair of entities are amalgamated and the increased strength of the resulting link is calculated. The *OCAP* computational sequence is as follows. As each link of the original database is read into the program, its strength is modified by the prescribed linear transformation. Then, a search is made to determine whether any previous link exists connecting the same two entities in the same direction. If none is found, a new link is established with link strength as determined from the transformation. However, if one is found, the new link is amalgamated with the old link and the strength of the new amalgamated link is calculated by the following formula:

$$\left[\begin{matrix}\text{Amalgamated}\\ \text{Link Strength}\end{matrix}\right] = \left[\begin{matrix}\text{Old Link}\\ \text{Strength}\end{matrix}\right] + \left[\begin{matrix}\text{New Link}\\ \text{Strength}\end{matrix}\right] - \left[\begin{matrix}\text{Old Link}\\ \text{Strength}\end{matrix}\right]\left[\begin{matrix}\text{New Link}\\ \text{Strength}\end{matrix}\right]$$

Since, as discussed earlier, the linear transformation of original link strengths produced transformed link strengths having values between 0 and 1, the strengths of the resulting amalgamated links also have values between 0 and 1.

LINK NETWORKS

The analysis package provides link networks with selected entities as centers, and with prescribed directionality and link emphasis. In addition, through use of the link strength cut-off, only links at or above a specified cut-off level are included.

A link network shows the strongest paths of links between the selected entity (or entity grouping) and all other entities with which it is associated. As discussed earlier, if directional linktypes are involved, networks can be obtained in which the direction of links is *in to* the entity as well as *out from* the entity.

Path strength is the product of the strengths of the individual links which go to make up the path. Thus, for a path made up of N links, the path strength is calculated by the following formula:

$$\left[\begin{array}{c}\text{Path}\\ \text{Strength}\end{array}\right] = \left[\begin{array}{c}\text{Strength}\\ \text{Of Link 1}\end{array}\right] \left[\begin{array}{c}\text{Strength}\\ \text{Of Link 2}\end{array}\right] \cdots \left[\begin{array}{c}\text{Strength}\\ \text{Of Link N}\end{array}\right]$$

Path strength calculations are made after the linear transformation of link strengths to values between 0 and 1. Also, some of the links included in the path strength calculations are likely to be amalgamated links derived from the calculations described earlier. The path strengths are changed back to the original STRENGTH scale, with values from 0 to 99, for presentation on the link network.

A link network from the example case is shown in Figure 12. This network shows links out from Alvin Anapopolus; however, since normal link emphasis was given, the network of links in to Alvin Anapopolus would be identical. The link network is shown at the left; the corresponding linktype and the information source code of each direct link is shown at the right. In the link network, the pattern of connections is revealed in the same manner that a book's table of contents reveals the relationships among topics. For example, the network shows Alvin Anapopolus linked directly to only Boris Anapopolus and Casius Anapopolus. Boris Anapopolus is shown with direct links to Felicia Dragley and Gordon Elmersmart; Alvin Anapopolus, then, has indirect links (through Boris) to Dragley and Elmersmart.

The link strengths appear after each entity in the link network and signify the strength of the path of links between Alvin Anapopolus (the selected center) and each other entity in the link network. For example, Alvin Anapopolus is directly linked to Boris Anapopolus with a link strength of 95; he is indirectly linked--through Boris Anapopolus, Gordon Elmersmart, and Cynthia Jane Impala--to C. J. Candy Shoppes with a path strength of 45.

In the LINKTYPE column at the right, the type of each direct link is named. For example, the second linktype down, *MONEY, indicates that the nature of the link between Boris Anapopolus and Felicia Dragley is the transfer of money. If the direct link has resulted from an amalgamation of several links, the linktype of the strongest link in the amalgamation is named.

```
RUN DESCRIPTION - HARRIS  ANAPOPOLUS PROJECT  30 JUNE 1975  NORMAL LINK EMPHASIS

LINKS OUT FROM   /ANAPOPOLUS, ALVIN X /

LINKS WITH STRENGTH--  25
                                                                                                   LINKTYPE  SOURCE
       ANAPOPOLUS, ALVIN X   100
       .    ANAPOPOLUS, BORIS V    95                                                              *CONTROL   D1-01
       .    .    DRAGLEY, FELICIA B     92                                                         *MONEY     D2-04
       .    .    ELMERSMART, GORDON E   94                                                         *MONEY     D2-03
       .    .    .    IMPALA, CYNTHIA JANE   47                                                    *CONTROL   D1-05
       .    .    .    .    C J CANDY SHOPPES      45                                               *CONTROL   D1-07
       .    .    .    .    *ASSAULT               47                                               *RECORD    D1-06
       .    .    .    JONES, BOB             45                                                    *CONTROL   D1-08
       .    .    .    *EXTORTION             85                                                    *RECORD    D1-04
       .    ANAPOPOLUS, CASIUS M   95                                                              *CONTROL   D1-01
       .    .    FOSTER, BILL           87                                                         *MONEY     D2-02
       .    .    .    GUNTHER, MARY JO       85                                                    *CONTROL   D1-12
       .    .    .    HAMSTEAD, HARLEY S     77                                                    *MONEY     D2-01
       .    .    .    *AUTO THEFT            87                                                    *RECORD    D1-14
```

Figure 12. Link network out from Alvin Anapopolus under normal link emphasis.

In the column at the far right headed SOURCE, you are given the coded source of each direct link. Thus, if you want further amplification, clarification, or support for any direct link you can use the code to go to the ultimate information source.

Figure 14 illustrates a link network for a center which consists of three entities--Alvin, Boris and Casius Anapopolus. In this network the three entities are considered as a single entity for purposes of interpretation. However, the diagram does retain the structure of direct links as they relate to each individual entity in the group center. For example, even though Casius Anapopolus is in the group center, he is the entity to which Bill Foster is directly linked and this structure is retained in the diagram.

Figure 23 illustrates a network in which directionality plays a significant role. The linktype treatment for this network emphasized money flow (see Figure 21); it gave high emphasis to money links in the forward direction and also high emphasis to control links in the reverse direction (under the assumption that money flows toward the top of the command structure). The link network can be interpreted in precisely the same way as the flow chart presented earlier in Figure 5. The flow of money moves from the entities at the right through links to entities at the left.

FRACTIONS OF INPUT LINKS EXPLAINED

Since no single link network is likely to contain all of the links in the database, or even all links of any linktype, the analyst is provided a table, along with each link network, which shows the fraction of input links of different linktypes explained by the link network. The table for the network in Figure 12 is given in Figure 13. As shown in that figure, each linktype is listed in the left column labeled LINKTYPE. Then, all links of each type are classified into three classes--WITH, AGAINST, and EXCLUDED. In constructing this table, the program goes through the complete database and, ignoring any emphasis given, assigns each link to one of these classes. Those links with directionality the same as those in the link network are put in the WITH class; those which have directionality opposite to that of the network are put in the AGAINST class; and those

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 1975 NORMAL LINK EMPHASIS

FRACTIONS OF INPUT LINKS EXPLAINED.

LINKTYPE	PERCENT-WITH	AGAINST	EXCLUDED
*CONTROL	100.0	0.0	0.0
*RECORD	48.6	0.0	51.4
*MONEY	0.0	100.0	0.0
CONTACT	16.7	16.7	66.7

Figure 13. Fraction of links explained by link network out from Alvin Anapopolus under normal link emphasis.

which cut across the network (are outside the network) are put in the EXCLUDED class. Then, for each linktype, the percentage of the total input links, weighted by the input link strengths, are calculated and printed appropriately in the table. Thus, by using this table the analyst can estimate the extent to which the given link network contains the links and strengths which were put into the database originally.

As shown by the table in Figure 13, all of the control links of the example case are contained in the link network and are parallel to the direction of the network. The table also shows: that about half of the links based on criminal record are included in the network; all of the links based on money flow are included, but that their directionality is opposite to the directionality of the network; and that most of the links (67 percent) based primarily on nondirectional association (CONTACT) are not in the network.

LIST OF CENTERS EXPLAINING THE HIGHEST PERCENTAGES OF EACH LINKTYPE (BEST)

This product is an extension of the tabulations described above. The BEST calculation helps the analyst select entities for link network calculations by providing a list of the entities which will explain the highest percentages of each linktype when selected as the center of a link network. Figure 15 shows the BEST printout for the example case. As shown, LINKTYPE is named in the first column; network direction is indicated in the second column; link directionality, with respect to network direction, is indicated in the third column; and, in the remaining part of the printout to the right, the top ten entities are listed in order. For example, the link network out from Alvin Anapopolus is shown to contain 100% of the control links in the database having the same directionality as the network. Thus, by selecting a network with links out from Alvin Anapopolus, the analyst is assured of accounting for 100% of the control links in that direction. Furthermore, as shown lower down in Figure 15, by selecting a network with links in to Alvin Anapopolus, the analyst will account for 100% of the money links in that direction.

Since the generation of a table, such as the one shown in Figure 15, requires the calculation of the link network in to and out from each entity

```
RUN DESCRIPTION - HARRIS  ANAPOPOLUS PROJECT  30 JUNE 1975  NORMAL LINK EMPHASIS

LINKS OUT FROM   /ANAPOPOLUS, ALVIN X /ANAPOPOLUS, BORIS V /ANAPOPOLUS, CASIUS M/

LINKS WITH STRENGTH=-  25
                                                                                    LINKTYPE   SOURCE
      ANAPOPOLUS, ALVIN X   100
      ANAPOPOLUS, BORIS V   100
      .   DRAGLEY, FELICIA B     97                                                 *MONEY     D2=04
      .   ELMERSMART, GORDON E   99                                                 *MONEY     D2=03
      .   .   IMPALA, CYNTHIA JANE   49                                            *CONTROL   D1=05
      .   .   .   C J CANDY SHOPPES       47                                       *CONTROL   D1=07
      .   .   .   *ASSAULT                 49                                       *RECORD    D1=06
      .   .   JONES, BOB              47                                           *CONTROL   D1=08
      .   .   *EXTORTION              89                                           *RECORD    D1=04
      ANAPOPOLUS, CASIUS M  100
      .   FOSTER, BILL          92                                                 *MONEY     D2=02
      .   .   GUNTHER, MARY JO      89                                            *CONTROL   D1=12
      .   .   HAMSTEAD, HARLEY S    81                                            *MONEY     D2=01
      .   .   *AUTO THEFT            91                                           *RECORD    D1=14
```

Figure 14. Link network out from Anapopolus group under normal link emphasis.

RUN DESCRIPTION - HARRIS ANAPOPOLUS PROJECT 30 JUNE 1975 NORMAL LINK EMPHASIS

CENTERS WHICH EXPLAIN THE HIGHEST PERCENTAGE OF EACH LINK TYPE.

LINK TYPE	IN/OUT	WITH/AGAINST				
*CONTROL	OUT	WITH	100=ANAPOPOLUS, ALVIN X	87=ANAPOPOLUS, BORIS V	87=ANAPOPOLUS, CASIUS M	78=*AUTO THEFT
			78=FOSTER, BILL	77=DRAGLEY, FELICIA B	74=ELMERSMART, GORDON E	74=*EXTORTION
			73=HAMSTEAD, HARLEY S	70=JONES, BOB		
		AGAINST	46=C J CANDY SHOPPES	35=GUNTHER, MARY JO	33=IMPALA, CYNTHIA JANE	33=*ASSAULT
			30=JONES, BOB	27=HAMSTEAD, HARLEY S	26=ELMERSMART, GORDON E	26=*EXTORTION
			23=DRAGLEY, FELICIA B	22=*AUTO THEFT		
	IN	WITH	46=C J CANDY SHOPPES	35=GUNTHER, MARY JO	33=IMPALA, CYNTHIA JANE	33=*ASSAULT
			30=JONES, BOB	27=HAMSTEAD, HARLEY S	26=ELMERSMART, GORDON E	26=*EXTORTION
			23=DRAGLEY, FELICIA B	22=*AUTO THEFT		
		AGAINST	100=ANAPOPOLUS, ALVIN X	87=ANAPOPOLUS, BORIS V	87=ANAPOPOLUS, CASIUS M	78=*AUTO THEFT
			78=FOSTER, BILL	77=DRAGLEY, FELICIA B	74=ELMERSMART, GORDON E	74=*EXTORTION
			73=HAMSTEAD, HARLEY S	70=JONES, BOB		
*RECORD	OUT	WITH	49=ANAPOPOLUS, ALVIN X	49=ANAPOPOLUS, BORIS V	49=ANAPOPOLUS, CASIUS M	49=DRAGLEY, FELICIA B
			49=ELMERSMART, GORDON E	49=GUNTHER, MARY JO	49=IMPALA, CYNTHIA JANE	49=FOSTER, BILL
			49=C J CANDY SHOPPES	49=HAMSTEAD, HARLEY S		
		AGAINST	30=*ASSAULT	17=*AUTO THEFT	15=*EXTORTION	0=ANAPOPOLUS, BORIS V
			0=ANAPOPOLUS, CASIUS M	0=DRAGLEY, FELICIA B	0=ELMERSMART, GORDON E	0=IMPALA, CYNTHIA JANE
			0=C J CANDY SHOPPES	0=JONES, BOB		
	IN	WITH	30=*ASSAULT	17=*AUTO THEFT	15=*EXTORTION	0=ANAPOPOLUS, BORIS V
			0=ANAPOPOLUS, CASIUS M	0=DRAGLEY, FELICIA B	0=ELMERSMART, GORDON E	0=IMPALA, CYNTHIA JANE
			0=C J CANDY SHOPPES	0=JONES, BOB		
		AGAINST	49=ANAPOPOLUS, ALVIN X	49=ANAPOPOLUS, BORIS V	49=ANAPOPOLUS, CASIUS M	49=DRAGLEY, FELICIA B
			49=ELMERSMART, GORDON E	49=GUNTHER, MARY JO	49=IMPALA, CYNTHIA JANE	49=FOSTER, BILL
			49=C J CANDY SHOPPES	49=HAMSTEAD, HARLEY S		
*MONEY	OUT	WITH	47=HAMSTEAD, HARLEY S	26=DRAGLEY, FELICIA B	26=ELMERSMART, GORDON E	26=*EXTORTION
			26=IMPALA, CYNTHIA JANE	26=*ASSAULT	26=C J CANDY SHOPPES	26=JONES, BOB
			24=GUNTHER, MARY JO	24=*AUTO THEFT		
		AGAINST	100=ANAPOPOLUS, ALVIN X	100=ANAPOPOLUS, BORIS V	100=ANAPOPOLUS, CASIUS M	76=FOSTER, BILL
			76=GUNTHER, MARY JO	76=*AUTO THEFT	74=IMPALA, CYNTHIA JANE	74=*ASSAULT
			74=C J CANDY SHOPPES	74=JONES, BOB		
	IN	WITH	100=ANAPOPOLUS, ALVIN X	100=ANAPOPOLUS, BORIS V	100=ANAPOPOLUS, CASIUS M	76=FOSTER, BILL
			76=GUNTHER, MARY JO	76=*AUTO THEFT	74=IMPALA, CYNTHIA JANE	74=*ASSAULT
			74=C J CANDY SHOPPES	74=JONES, BOB		
		AGAINST	47=HAMSTEAD, HARLEY S	26=DRAGLEY, FELICIA B	26=ELMERSMART, GORDON E	26=*EXTORTION
			26=IMPALA, CYNTHIA JANE	26=*ASSAULT	26=C J CANDY SHOPPES	26=JONES, BOB
			24=GUNTHER, MARY JO	24=*AUTO THEFT		

Figure 15. List of entities which, when selected as centers, explain the highest percentage of each linktype (BEST) under normal link emphasis.

in the database, it is significantly more expensive in computer time than any other analytical product of the program. Consequently, the use of BEST might be most appropriate for the initial run under normal link emphasis. On subsequent runs, BEST would be requested only under special conditions.

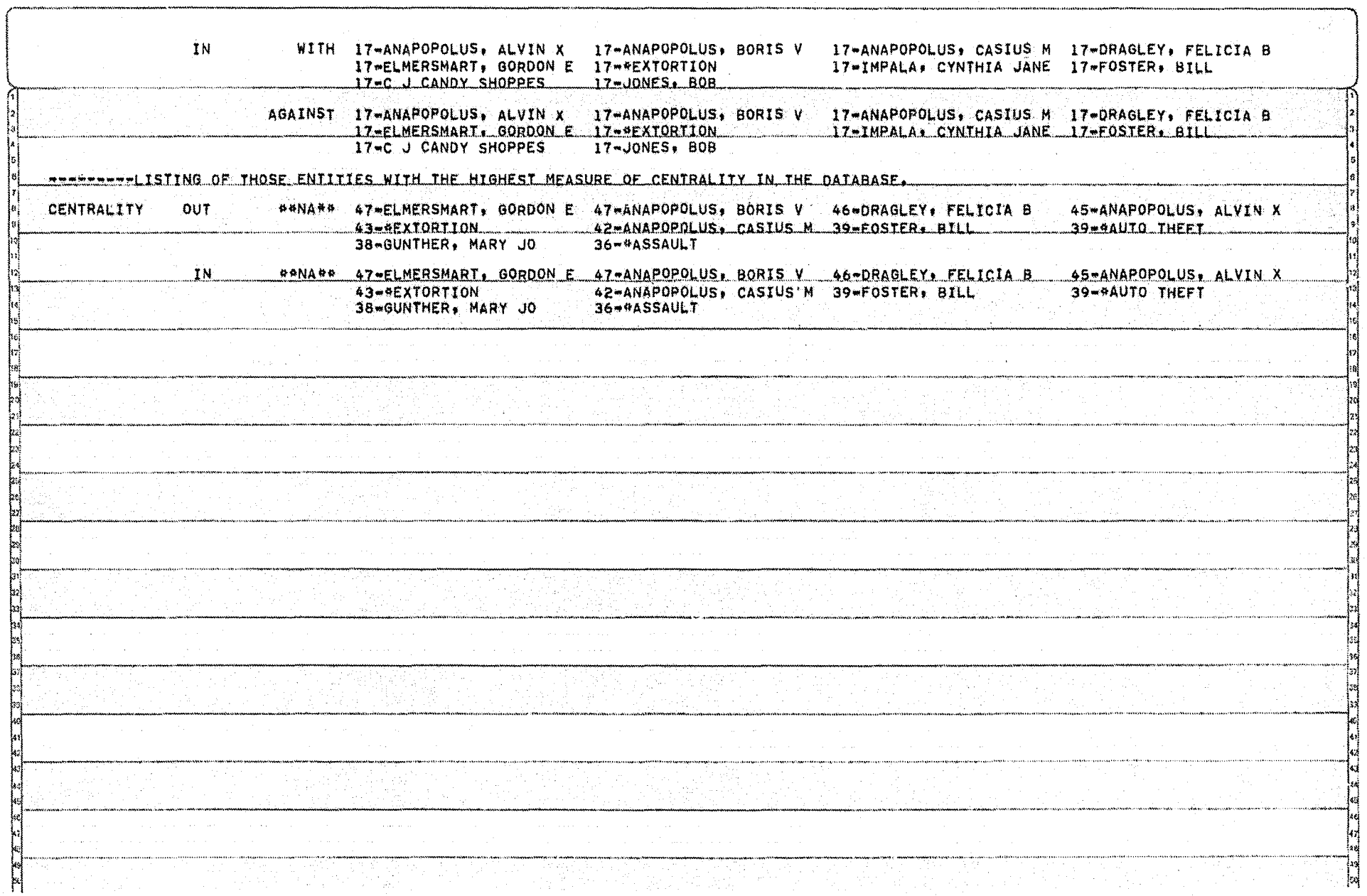
ENTITY CENTRALITY

For some analytical purposes, the analyst might want to determine which of the entities in the database are most centrally located relative to other entities. Thus, as part of the BEST calculations, centrality is measured and the ten entities with highest centrality measures are listed in order.

Centrality is based upon the idea that an entity with high link strengths to other entities in the database is more centrally located than another entity which has lower link strengths to other entities. Thus, if the lowest link strength from A to any other entity is 50 and the lowest link strength from B to any other entity is 20, A has greater centrality than B. The centrality measure, then, is the lowest link strength that an entity has with any other entity in the database; and this is the basis for the listing of entities in terms of centrality. The listing is illustrated in Figure 16 for the example case. It shows that Gordon Elmersmart and Boris Anapopolus have greatest centrality. The lowest link strength each has with any other entity in the database is 47. Since this listing of entities was developed under normal link emphasis, the listing is identical for both networks--the networks of links out from and in to the entities.

LISTING OF LINK PATHS BETWEEN SELECTED ENTITIES

The analyst is given a list of the link paths between each pair of entities selected for this analysis. The listing of link paths is illustrated in Figure 20 for the requested paths between Alvin Anapopolus and C. J. Candy Shoppes. Each path of links between these two entities is listed under the heading, PATH, at the right; there are four different paths of links between these two entities. In the column at the left labeled STRENGTH, the link strength between these two entities via the designated path is given. Paths are listed in order of decreasing strength.



	IN	WITH	17-ANAPOPOLUS, ALVIN X 17-ELMERSMART, GORDON E 17-C J CANDY SHOPPES	17-ANAPOPOLUS, BORIS V 17-*EXTORTION 17-JONES, BOB	17-ANAPOPOLUS, CASIUS M 17-IMPALA, CYNTHIA JANE	17-DRAGLEY, FELICIA B 17-FOSTER, BILL
		AGAINST	17-ANAPOPOLUS, ALVIN X 17-ELMERSMART, GORDON E 17-C J CANDY SHOPPES	17-ANAPOPOLUS, BORIS V 17-*EXTORTION 17-JONES, BOB	17-ANAPOPOLUS, CASIUS M 17-IMPALA, CYNTHIA JANE	17-DRAGLEY, FELICIA B 17-FOSTER, BILL

----------LISTING OF THOSE ENTITIES WITH THE HIGHEST MEASURE OF CENTRALITY IN THE DATABASE.

CENTRALITY	OUT	**NA**	47-ELMERSMART, GORDON E 43-*EXTORTION 38-GUNTHER, MARY JO	47-ANAPOPOLUS, BORIS V 42-ANAPOPOLUS, CASIUS M 36-*ASSAULT	46-DRAGLEY, FELICIA B 39-FOSTER, BILL	45-ANAPOPOLUS, ALVIN X 39-*AUTO THEFT
	IN	**NA**	47-ELMERSMART, GORDON E 43-*EXTORTION 38-GUNTHER, MARY JO	47-ANAPOPOLUS, BORIS V 42-ANAPOPOLUS, CASIUS M 36-*ASSAULT	46-DRAGLEY, FELICIA B 39-FOSTER, BILL	45-ANAPOPOLUS, ALVIN X 39-*AUTO THEFT

Figure 16. Listing of entities with highest measures of centrality.

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 CONTROL LINK EMPHASIS

SUMMARY OF PRESCRIBED LINKTYPE TREATMENT FOR THIS RUN

LINKTYPE	FORWARD	REVERSE	CUTOFF
*CONTROL	HIGH	LIMITED	20
*RECORD	HIGH	OFF	20
*MONEY	LIMITED	HIGH	20
CONTACT	NORMAL		0

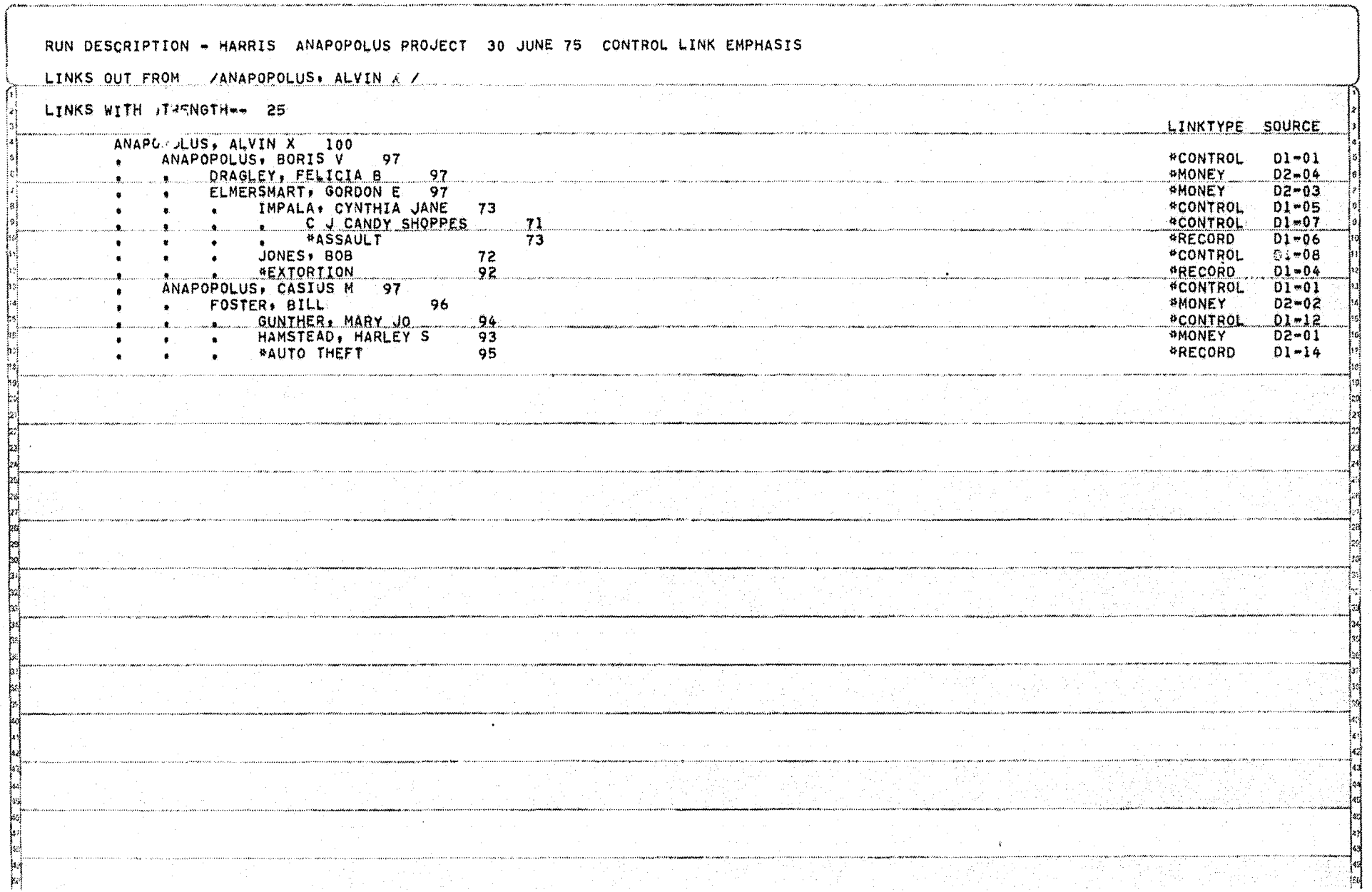
Figure 17. Summary of linktype treatment for control link emphasis.

RUN DESCRIPTION - HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 CONTROL LINK EMPHASIS

LISTING OF DIRECT ASSOCIATIONS AND LINK STRENGTHS

NAME	ENTITIES CONNECTED TO (WITH CONNECTION STRENGTHS.)			
ANAPOPOLUS, ALVIN X	97=ANAPOPOLUS, CASIUS M	97=ANAPOPOLUS, BORIS V		
ANAPOPOLUS, BORIS V	100=ELMERSMART, GORDON E	99=DRAGLEY, FELICIA B	0=ANAPOPOLUS, ALVIN X	
ANAPOPOLUS, CASIUS M	98=FOSTER, BILL	0=ANAPOPOLUS, ALVIN X		
DRAGLEY, FELICIA B	88=*EXTORTION 25=JONES, BOB	35=GUNTHER, MARY JO 1=ANAPOPOLUS, BORIS V	35=FOSTER, BILL	25=ELMERSMART, GORDON E
C J CANDY SHOPPES	0=IMPALA, CYNTHIA JANE			
ELMERSMART, GORDON E	95=*EXTORTION 1=ANAPOPOLUS, BORIS V	75=IMPALA, CYNTHIA JANE	74=JONES, BOB	25=DRAGLEY, FELICIA B
FOSTER, BILL	99=*AUTO THEFT 1=ANAPOPOLUS, CASIUS M	98=GUNTHER, MARY JO	97=HAMSTEAD, HARLEY S	35=DRAGLEY, FELICIA B
GUNTHER, MARY JO	90=*AUTO THEFT	35=FOSTER, BILL	35=DRAGLEY, FELICIA B	
HAMSTEAD, HARLEY S	85=*AUTO THEFT	1=FOSTER, BILL		
IMPALA, CYNTHIA JANE	99=*ASSAULT	97=C J CANDY SHOPPES	0=ELMERSMART, GORDON E	
JONES, BOB	90=*ASSAULT	25=ELMERSMART, GORDON E	25=DRAGLEY, FELICIA B	
*ASSAULT	0=JONES, BOB	0=IMPALA, CYNTHIA JANE		
*AUTO THEFT	0=HAMSTEAD, HARLEY S	0=FOSTER, BILL	0=GUNTHER, MARY JO	
*EXTORTION	0=DRAGLEY, FELICIA B	0=ELMERSMART, GORDON E		

Figure 18. Listing of direct associations and link strengths for control link emphasis.



```
RUN DESCRIPTION - HARRIS  ANAPOPOLUS PROJECT  30 JUNE 75  CONTROL LINK EMPHASIS

LINKS OUT FROM   /ANAPOPOLUS, ALVIN X /

LINKS WITH STRENGTH=-  25

                                                                                                  LINKTYPE  SOURCE
      ANAPOPOLUS, ALVIN X   100
      .    ANAPOPOLUS, BORIS V    97                                                              *CONTROL  D1-01
      .    .    DRAGLEY, FELICIA B     97                                                        *MONEY    D2-04
      .    .    ELMERSMART, GORDON E   97                                                        *MONEY    D2-03
      .    .    .    IMPALA, CYNTHIA JANE   73                                                   *CONTROL  D1-05
      .    .    .    .    C J CANDY SHOPPES      71                                             *CONTROL  D1-07
      .    .    .    .    *ASSAULT               73                                             *RECORD   D1-06
      .    .    .    JONES, BOB                72                                             *CONTROL  D1-08
      .    .    .    *EXTORTION                92                                             *RECORD   D1-04
      .    ANAPOPOLUS, CASIUS M   97                                                           *CONTROL  D1-01
      .    .    FOSTER, BILL           96                                                      *MONEY    D2-02
      .    .    .    GUNTHER, MARY JO       94                                                 *CONTROL  D1-12
      .    .    .    HAMSTEAD, HARLEY S     93                                                 *MONEY    D2-01
      .    .    .    *AUTO THEFT            95                                                 *RECORD   D1-14
```

Figure 19. Link network out from Alvin Anapopolus under control link emphasis.

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 CONTROL LINK EMPHASIS

LINK PATHS BETWEEN /ANAPOPOLUS, ALVIN X / AND /C J CANDY SHOPPES /

STRENGTH	THROUGH	PATH
71	** PRINCIPAL PATH **	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, BORIS V /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/ /C J CANDY SHOPPES /
18	DRAGLEY, FELICIA B	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, BORIS V /DRAGLEY, FELICIA B /ELMERSMART, GORDON E/ /IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /
6	FOSTER, BILL	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, CASIUS M/FOSTER, BILL /DRAGLEY, FELICIA B / /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /
6	GUNTHER, MARY JO	/ANAPOPOLUS, ALVIN X /ANAPOPOLUS, CASIUS M/FOSTER, BILL /GUNTHER, MARY JO / /DRAGLEY, FELICIA B /ELMERSMART, GORDON E/IMPALA, CYNTHIA JANE/C J CANDY SHOPPES /

Figure 20. Listing of link paths between Alvin Anapopolus and C. J. Candy Shoppes under control link emphasis.

RUN DESCRIPTION - HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 MONEY FLOW EMPHASIS

SUMMARY OF PRESCRIBED LINKTYPE TREATMENT FOR THIS RUN

LINKTYPE	FORWARD	REVERSE	CUTOFF
*CONTROL	LIMITED	HIGH	20
*RECORD	HIGH	OFF	=0
*MONEY	HIGH	LIMITED	=0
CONTACT	NORMAL		0

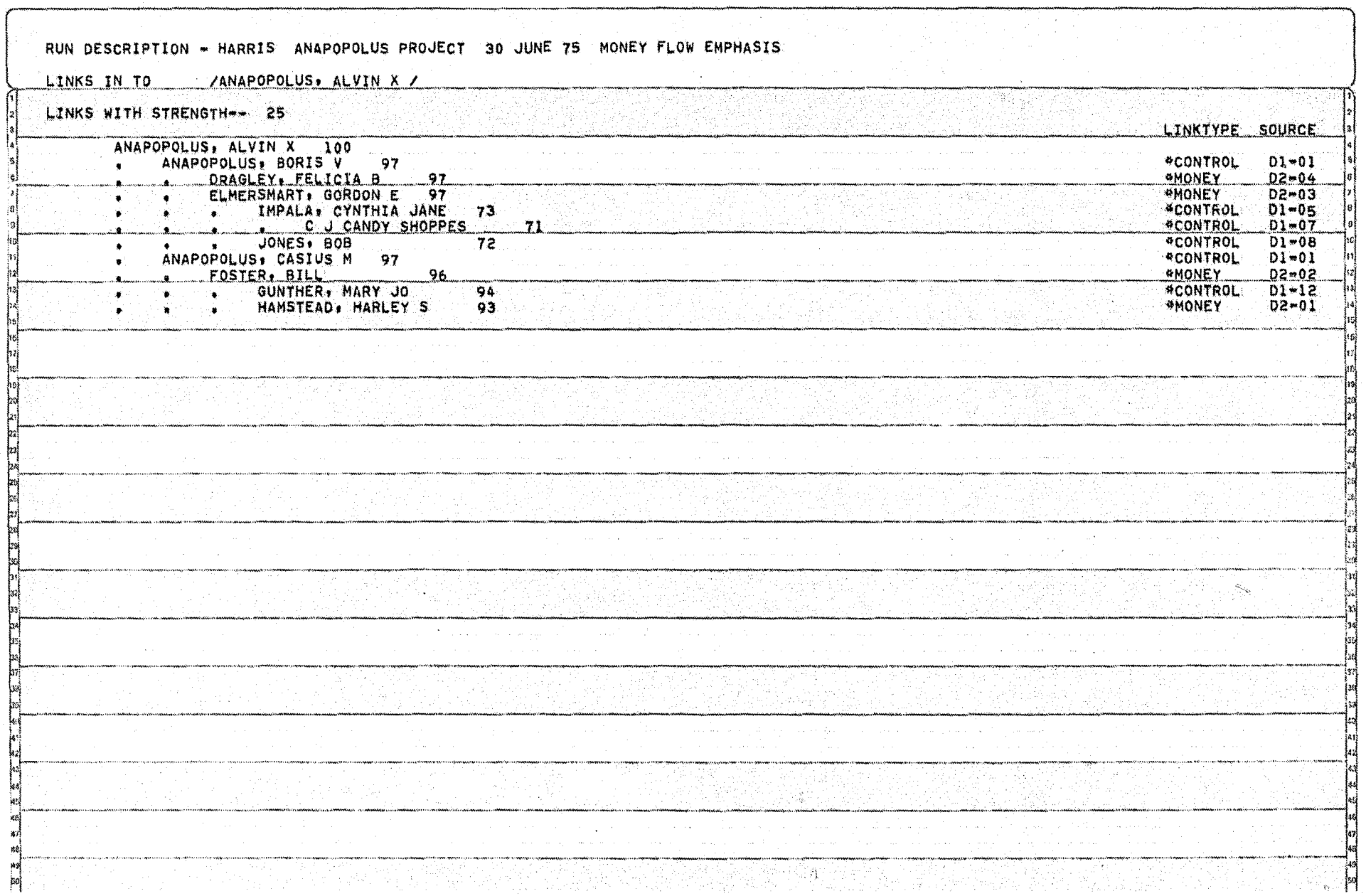
Figure 21. Summary of linktype treatment for money flow emphasis.

RUN DESCRIPTION = HARRIS ANAPOPOLUS PROJECT 30 JUNE 75 MONEY FLOW EMPHASIS

LISTING OF DIRECT ASSOCIATIONS AND LINK STRENGTHS

NAME	ENTITIES CONNECTED TO (WITH CONNECTION STRENGTHS.)			
ANAPOPOLUS, ALVIN X	0=ANAPOPOLUS, CASIUS M	0=ANAPOPOLUS, BORIS V		
ANAPOPOLUS, BORIS V	97=ANAPOPOLUS, ALVIN X	1=ELMERSMART, GORDON E	1=DRAGLEY, FELICIA B	
ANAPOPOLUS, CASIUS M	97=ANAPOPOLUS, ALVIN X	1=FOSTER, BILL		
DRAGLEY, FELICIA B	99=ANAPOPOLUS, BORIS V 25=ELMERSMART, GORDON E	88=*EXTORTION 25=JONES, BOB	35=GUNTHER, MARY JO	35=FOSTER, BILL
C J CANDY SHOPPES	97=IMPALA, CYNTHIA JANE			
ELMERSMART, GORDON E	100=ANAPOPOLUS, BORIS V 0=IMPALA, CYNTHIA JANE	95=*EXTORTION	25=JONES, BOB	25=DRAGLEY, FELICIA B
FOSTER, BILL	99=*AUTO THEFT 1=HAMSTEAD, HARLEY S	98=ANAPOPOLUS, CASIUS M	35=GUNTHER, MARY JO	35=DRAGLEY, FELICIA B
GUNTHER, MARY JO	98=FOSTER, BILL	90=*AUTO THEFT	35=DRAGLEY, FELICIA B	
HAMSTEAD, HARLEY S	97=FOSTER, BILL	85=*AUTO THEFT		
IMPALA, CYNTHIA JANE	99=*ASSAULT	75=ELMERSMART, GORDON E	0=C J CANDY SHOPPES	
JONES, BOB	90=*ASSAULT	74=ELMERSMART, GORDON E	25=DRAGLEY, FELICIA B	
*ASSAULT	0=JONES, BOB	0=IMPALA, CYNTHIA JANE		
*AUTO THEFT	0=HAMSTEAD, HARLEY S	0=FOSTER, BILL	0=GUNTHER, MARY JO	
*EXTORTION	0=DRAGLEY, FELICIA B	0=ELMERSMART, GORDON E		

Figure 22. Listing of direct associations and link strengths for money flow emphasis.



```
RUN DESCRIPTION - HARRIS  ANAPOPOLUS PROJECT  30 JUNE 75  MONEY FLOW EMPHASIS

LINKS IN TO      /ANAPOPOLUS, ALVIN X /

LINKS WITH STRENGTH=-  25
                                                                                    LINKTYPE  SOURCE
        ANAPOPOLUS, ALVIN X   100
        .    ANAPOPOLUS, BORIS V    97                                              *CONTROL   D1=01
        .    .    DRAGLEY, FELICIA B     97                                        *MONEY     D2=04
        .    .    ELMERSMART, GORDON E   97                                        *MONEY     D2=03
        .    .    .    IMPALA, CYNTHIA JANE   73                                   *CONTROL   D1=05
        .    .    .    .    C J CANDY SHOPPES      71                              *CONTROL   D1=07
        .    .    .    JONES, BOB             72                                  *CONTROL   D1=08
        .    ANAPOPOLUS, CASIUS M   97                                           *CONTROL   D1=01
        .    .    FOSTER, BILL           96                                      *MONEY     D2=02
        .    .    .    GUNTHER, MARY JO       94                                  *CONTROL   D1=12
        .    .    .    HAMSTEAD, HARLEY S     93                                  *MONEY     D2=01
```

Figure 23. Link network in to Alvin Anapopolus under money flow emphasis.

As shown in Figure 20, the strongest path (**PRINCIPAL PATH**) links Alvin Anapopolus to C. J. Candy Shoppes via three interconnecting entities--Boris Anapopolus, Gordon Elmersmart, and Cynthia Impala--with a strength of 71. For paths other than the strongest path, entities are named in the THROUGH column to help identify and describe the path. For example, the second path listed is not only the second strongest path between Alvin Anapopolus and C. J. Candy Shoppes, but it is also the strongest path that passes through Felicia Dragley, the entity named in the THROUGH column. The path has a strength of 18.

In completing path calculations, the network of links out from the first named entity, and the network of links in to the second named entity are calculated simultaneously. As a result, each entity in the path has two numbers associated with it--the link strength of that entity from the first named entity and the link strength of that entity to the last named entity. Remember that these link strengths are likely to be based upon indirect links as well as direct links and, as a consequence, the path through the subject entity is likely to contain other entities as well. Even so, the path strength between the two selected entities through the subject entity is simply the product of these two numbers. Remember also that transformed decimal values are used in the calculations. The entities in the database, then, are taken one at a time, and the paths through them are put in decreasing order of strength. Each path is then printed out as shown in Figure 20.

Not all possible paths are printed out. If the path associated with an intermediate entity has already been printed out through some other intermediate entity, that path is not printed because it, of course, would be identical. Also, if the link path passes through the same intermediate entity two times or more, it is not considered meaningful for this analysis and is not printed.

NOTE ON PROGRAM PROCEDURES

Detailed procedures for using *OCAP* in the analysis of criminal intelligence are provided in the following three sections. Although these same procedures are contained in the *OCAP* instruction document issued separately, they are provided here as a ready reference for the interested reader.

The procedures are divided into three sections, consistent with the three stages of *OCAP* operation--data preparation, data review and modification, and data analysis. The same case example used earlier to illustrate the program and its products is used to illustrate the procedures.

DATA PREPARATION PROCEDURES

The purpose of data preparation is to select, from your assembled information, that which is relevant and to put it into a form that can be acted upon by *OCAP*. Completion of the *DATA INPUT FORM* serves this purpose.

Prior to putting any information on the form, you should be generally familiar with the assembled information. If the case is relatively new to you, read through it to gain an overview of the individuals, organizations, and activities described, and of the kinds of analytical products likely to be useful.

Although coding information on the *DATA INPUT FORM* might, at first, appear to be a routine clerical task, it is not. The judgments required should force you to think through critical aspects of the case in depth and detail. Care taken at this early stage will help to assure the quality and validity of the analytical products generated later.

Procedures for completing the *DATA INPUT FORM* are provided in the paragraphs below; a sample form is shown in Figure 24. The procedures are illustrated with a case example.

1 PREPARE THE HEADING

The heading--ANALYST, CASE, and DATE--serves to identify the analysis project; it will appear at the top of the *OCAP* printout on each sheet of the Data Review Package and on the first sheet of each analysis run. The program places no restrictions on the descriptors or format used for the heading; however, you might want to select a meaningful format and use it consistently to facilitate later filing and referencing.

Since more than one *DATA INPUT FORM* is likely to be employed on a case, space is provided at the upper right for page numbering.

2 ENTER ENTITIES

For each link, print the names of the connected entities in the columns labeled FROM ENTITY and TO ENTITY. For directional links, direction is from

ORGANIZED CRIME ANALYSIS PROGRAM
Data Input Form

ANALYST (5) | CASE (23) | DATE (27) | PAGE (54) OF (58)

CONTROL (1)	FROM ENTITY (3–22)	TO ENTITY (24–43)	LINKTYPE (45–54)	STRENGTH (56 57)	VALIDITY (59 60)	MONTH (62 63)	DAY (65 66)	YEAR (68 69)	SOURCE (71–75)	SERIAL (77–80)

\- IF ENTITY CONTINUATION

* IF NOT INTERCONNECTING

* IF DIRECTIONAL LINKTYPE

Figure 24. Data Input Form.

the entity listed in the FROM ENTITY column at the left, to the entity listed in the TO ENTITY column at the right. Of course, this ordering is not required for nondirectional links. Up to 400 entities can be entered.

Entities can be persons or things; in fact, any name of 20 characters or less that has meaning to you can be an entity. Therefore, although individuals and organizations are probably the most common entities, entities might also be telephone numbers, criminal records, addresses, and so on.

When entering individuals as entities, put the last name first followed by a comma, and then first name and/or initial. Putting last name first will increase the usefulness of the alphabetical listing of the entities provided later in the Data Review Package. Proper description of individuals is illustrated in the sample completed form shown in Figure 25.

CAUTION Some of the entries in the sample completed *DATA INPUT FORMS* has been entered incorrectly to illustrate error correction procedures later. Therefore, *all* entries in Figures 25 and 26 do not serve to illustrate correct data preparation procedures.

Put an asterisk as the first character of any entity which cannot serve as an interconnection between other entities. It is necessary to distinguish between entities which can serve as interconnections and those which cannot. An interconnecting entity is one which can be the basis for an indirect link between two other entities. For example, if individual A is associated with individual B and individual B is associated with individual C, individual B is the interconnecting entity that permits the inference of an indirect link between A and C. However, some types of entities cannot serve to interconnect in this manner. For example, if individual A has (is linked to) criminal record type H (homicide, say) and individual C also has (is linked to) criminal record type H, criminal record type H is no basis for inferring an indirect link between A and C; just because the two individuals have records for the same type of crime is no basis to infer they are linked in any way to each other. Several entities of this type are illustrated on the completed form in Figure 25.

Put a dash (-) in the CONTROL column to continue the listing of entities beyond two. To obtain all possible links among three or more

ORGANIZED CRIME ANALYSIS PROGRAM
Data Input Form

ANALYST HARRI$ (5–23) | CASE ANAPØPØLU$ (27–54) | DATE 26 JUNE 75 (58–67) | PAGE 1 OF 2

CONTROL (1)	FROM ENTITY (3–22)	TO ENTITY (24–43)	LINKTYPE (45–54)	STRENGTH (56 57)	VALIDITY (59 60)	MONTH (62 63)	DAY (65 66)	YEAR (68 69)	SOURCE (71–75)	SERIAL (77–80)
	ANAPØPØLU$, ALVIN X	ANAPØPØLU$, BØRI$ V.	*CØNTRØL	95	90	05	26	75	D1-01	
-	ANAPØPØLU$, CA$IU$ M									
	ANAPØPØLU$, BØRI$ V	DRAGLEY, FELICIA B	*CØNTRØL	70	90	05	20	75	D1-02	
	ANAPØPØLU$, BØRI$ V	ELMER$MART, GØRDØN E	*CØNTRØL	90	50	12	13	74	D1-03	
	ELMER$MART, GØRDØN E	*EXTØRTIØN	*RECØRD	90	99	10	02	71	D1-04	
	ELMER$MART, GØRDØN E	IMPALA, CYNTHIA JANE	*CØNTRØL	50	50	04	21	75	D1-05	
	IMPALA, CYNTHIA JANE	*A$$UALT	*RECØRD	99	99	04	27	68	D1-06	
	IMPALA, CYNTHIA JANE	C J CANDY $HOPPE$	*CØNTRØL	95	50	06	01	75	D1-07	
	ELMER$MART, GØRDØN E	JØNE$, BØB	*CØNTRØL	30	70	06	05	75	D1-08	
	JØNES, BØB	*A$$AULT	*RECØRD	80	99	09	09	73	D1-09	
	DRAGLEY, FELECIA B	*EXTØRTIØN	*RECØRD	75	90	03	15	71	D1-10	
	ANAPØPØLU$, CA$IU$ M	FØ$TER, BILL	*CØNTRØL	60	50	03	07	75	D1-11	
	FØ$TER, BILL	GUNTHER, MARY JØ	*CØNTRØL	95	70	04	18	75	D1-12	
	GUNTHER, MARY JØ	*AUTØ THEFT	*RECØRD	80	50	11	28	70	D1-13	
	FØ$TER, WILLIAM F	*AUTØ THEFT	*RECØRD	99	99	10	11	72	D1-14	
	FØSTER, BILL	HAM$TEAD, HARLEY $	*CØNTRØL	40	80	05	29	75	D1-15	
	HAM$TEAD, HARLEY $	*AUTØ THEFT	*RECØRD	70	90	02	19	73	D1-16	
(FØSTER AND GUNTHER HAVE BEEN LIVING TØGETHER $INCE ØCTØBER 1974)										
	HAM$TEAD, HARLEY $	FØ$TER, BILL	*MØNEY	80	50	04	02	75	D2-01	
	FØ$TER, BILL	ANAPØPØLU$, CA$IU$ M	*MØNEY	80	50	04	11	75	D2-02	
	ELMER$MART, GØRDØN E	ANAPØPØLU$, BØRI$ V	*MØNEY	90	90	04	11	75	D2-03	
	DRAGLEY, FELICIA B	ANAPØPØLU$, BØRI$ V	*MØNEY	90	70	04	23	75	D2-04	
	FØ$TER, BILL	DRAGLEY, FELICIA B	CØNTACT	35	70	02	12	74	D3-01	

- IF ENTITY CONTINUATION
* IF NOT INTERCONNECTING
* IF DIRECTIONAL LINKTYPE

Figure 25. Sample completed Data Input Form, Page 1.

ORGANIZED CRIME ANALYSIS PROGRAM
Data Input Form

ANALYST HARRI$ (5–23) | CASE ANAPØPØLU$ (27–54) | DATE 26 JUNE 75 (58–67) | PAGE 2 OF 2

CONTROL (1)	FROM ENTITY (3–22)	TO ENTITY (24–43)	LINKTYPE (45–54)	STRENGTH (56 57)	VALIDITY (59 60)	MONTH (62 63)	DAY (65 66)	YEAR (68 69)	SOURCE (71–75)	SERIAL (77–80)
~	GUNTHER, MARY JØ									
	JØNE$, BØB	ELMER$MART, GØRDØN E	CØNTACT	25	60	10	28	73	D3-02	
~	DRAGLEY, FELICIA B									
	END DATA									

~ IF ENTITY CONTINUATION
* IF NOT INTERCONNECTING
* IF DIRECTIONAL LINKTYPE

Figure 26. Sample completed Data Input Form, Page 2.

entities, the listing of entities can be continued beyond the first line, to as many lines as needed, by putting a dash (-) in the CONTROL column or each added line. The continuation operates differently for directional and nondirectional links. For nondirectinal links, all possible links are obtained among the entities listed. For example, if the four entities listed were A, B, C, and D, the following six nondirectional links would be entered into the program: A-B, A-C, A-D, B-C, B-D, and C-D. For directional links, on the other hand, only the entity first listed in the FROM ENTITY column would be linked to the other entities. For example, if the four entities listed were A (the first entity listed under FROM ENTITY), B, C, and D, the following three directional links would be entered into the program: A to B, A to C, and A to D. The entity continuation feature is illustrated on the sample completed *DATA INPUT FORMS* shown in Figures 25 and 26.

CAUTION Remember, only a single strength and a single validity estimate is provided for all the links entered into the program by the entity continuation feature. Therefore, do not use the entity continuation feature unless the *identical* strength and validity applies to each resulting link.

3 ENTER LINKTYPE

In the column labeled LINKTYPE, describe the nature of each link using a word of 10 characters or less. The LINKTYPE entry is critical to the analysis because it is through the emphasis or suppression of linktypes that you are able to control the analysis and obtain desired analytical products. Linktype is a descriptor reflecting the primary characteristic of a link. For example, a link based on the flow of narcotics from one entity to another might employ *Narcotics* as a descriptor; a link based only on some kind of association between two people might be described by *Contact*; a link between a person and that person's record for extortion might use the descriptor *Record*. You may employ as many as 20 different linktypes to describe the links entered.

For directional linktypes, put an asterisk (*) as the first character in the LINKTYPE descriptor. As discussed earlier, there are two kinds of links--directional and nondirectional. Links are directional when directionality is primarily from one entity to the other. For example, money might flow from A to B but not from B to A. Links are nondirectional when

directionality is not known, is not relevant, or is always as great in one direction as it is in the opposite direction. For example, nondirectional links might connect A and B because they are business associates, or might connect C and D because they meet together regularly. To distinguish between directional and nondirectional linktypes, use an asterisk(*) as the first character of each directional linktype.

From the point of view of program operation, you may use any descriptors you wish in the LINKTYPE column so long as each descriptor is of 10 characters or less and the number of descriptors does not exceed 20. However, from the point of view of project management and coordination, you might want to employ a standard set of linktypes. The development and use of a standard set, of course, is a management function that is beyond the scope of these instructions.

LINKTYPE entries for the case example are illustrated in Figures 25 and 26.

4 ASSIGN LINK STRENGTHS

Estimate the strength of each link and enter the numerical link strength value in the column labeled STRENGTH. The numerical value can range from a low of 0 to a high of 99 to reflect your subjective estimate of link strength based upon the information you have available.

Estimate link strength under the assumption that the link really exists; you will estimate the likelihood that the link exists (link VALIDITY) using procedures described in the next step. Making a distinction at this point between strength and validity is important because *OCAP* handles each in a different way. Furthermore, a meaningful analysis requires that estimates of strength and validity be kept as pure and as separate as possible. For example, information might show a link between A and B based upon the regular transfer of large sums of money from A to B. Consequently, you might assign a high link strength, say 95. However, the information to support this link might be from a questionable source, requiring you to assign a low validity value to the link. On the other hand, a link of low strength might be based upon a wealth of confirmed information and, consequently, assigned a very high validity value. In any analysis, you are

likely to encounter a wide range of possible combinations of link strength and link validity values.

STRENGTH entries are illustrated in Figures 25 and 26.

5 ASSIGN LINK VALIDITY

Estimate the validity of each link and enter the numerical link validity value in the column labeled VALIDITY. Validity is the likelihood that the designated link of specified linktype exists between the named entities at the specified link strength. The numerical value can range from a low of 0 to a high of 99 to reflect your subjective judgment of link validity based upon the available information and the sources from which it was obtained. VALIDITY entries are illustrated in Figures 25 and 26.

The numerical scale is essentially a probability scale without decimal points. Use it in exactly the same way that you have been trained to use probability. For example, interpret a scale value of 80 as the probability of .80 (or an 80 percent chance) that the link exists as described.

6 ASSIGN DATE (OPTIONAL)

Using numerical codes, you may enter the date associated with any link in the columns labeled MONTH, DAY, and YEAR. In entering date, use numerical codes for MONTH advancing chronologically from 01 for January to 12 for December; for DAY use the number of the day in the month; and for YEAR, use the last two numbers of the year (for example, 75 for 1975). The assignment of dates is illustrated in Figures 25 and 26.

Date is printed along with other information in the *OCAP* database printout. Thus, by assigning dates, you will obtain a more complete data reference. Dates might also serve as an additional control for your analysis. For example, chronological separation of your database is possible to permit analytical products to be generated for before/after comparisons, or other potentially useful comparisons or data breakouts.

7 ASSIGN SOURCE IDENTIFICATION (OPTIONAL)

Using any codes you wish of five characters or less in the column labeled SOURCE, you may identify the source of the information upon which

each link was based. This identifier/locator code will appear not only on the database printout but also on link networks generated during the analysis. The purpose of using this feature is to facilitate your going back to the original source of information to substantiate or amplify links which later appear to be critical, interesting, questionable, etc.

Many different coding methods might be useful, depending upon the nature and form of the information. The system used in the example shown in Figures 25 and 26 combined document number with page number; for example, D1-05 refers to information on Page 5 of Document 1.

8 ASSIGN SERIAL NUMBER (OPTIONAL)

Using any set of four characters or less, a serial number may be entered in the column labeled SERIAL. This feature gives you the flexibility of an additional set of characters to serve as descriptors, identifiers, locators, etc. These codes will appear only on the database printout, however.

9 ENTER NOTES (OPTIONAL)

Enter any desired applifying or clarifying notes, by putting the first character (other than a blank space or dash) in the CONTROL column. The note will appear on the database printout on the same line, relative to other entries, on which it was entered on the *DATA INPUT FORM*.

When entering a note, ignore all columns and column headings except for the CONTROL column, as illustrated by the example in Figure 25. Although the sample note appears on only one line, you may use as many lines as you wish. Remember, however, that each line must start with a character (other than a blank space or dash) in the CONTROL column. As shown in Figure 25, you might want to accentuate the note by enclosing it in parentheses, or by some other means.

10 ENTER END DATA

Enter the words END DATA on the line following the last entry on the *DATA INPUT FORM* to signify that there are no more entries. Put this entry in Columns 1 through 7, ignoring labeled columns. END DATA has been entered incorrectly in Figure 25; it should have started in Column 1.

CONTINUED

1 OF 2

DATA REVIEW AND MODIFICATION PROCEDURES

At this point, information on the DATA INPUT FORM has been entered into the computer where preliminary calculations have been performed and the results printed out for your review. The purpose of your review is to:

- Locate and correct data input errors.
- Gain a preliminary understanding of your database.
- Modify your database, if necessary, to facilitate the analysis.

The Data Review Package is made up of four parts; each is described briefly in the following paragraphs and illustrated by the case example introduced earlier.

DATA REVIEW PACKAGE

Database Printout. You are given a complete printout of all information put into the computer from the *DATA INPUT FORM* (your database for the analysis). The initial, uncorrected database printout for the example case is shown in Figure 27. The numbers listed in the first column under CARD identify the lines of the database and are used to refer other parts of the Data Review Package back to the database.

Linktype Distribution. You are given a distribution of the links for each linktype. As shown at the top of Figure 28, the distribution gives the lines on which links of each type appear. Any errors can thus be traced to the lines on which they appear in the database printout.

Linktype Statistics. For each linktype, you are given the number, mean, standard deviation (SIGMA), minimum value and maximum value of the links in the database. These linktype statistics for the sample case are shown in the lower part of Figure 28. The column labeled NUMBER gives the number of links in the database of each linktype. The column labeled MEAN gives the calculated average strength assigned to all links of that linktype. The column labeled SIGMA gives the standard deviation about the mean for strengths of links of that linktype; standard deviation is a measure of how closely the link strengths group themselves around the mean link strength--about 70 percent of data values will usually be found within one standard deviation of the mean. The columns labeled MINIMUM and MAXIMUM provide the highest and lowest strengths assigned to links of that linktype.

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

DATABASE FOR CRIMINAL INTELLIGENCE CODE-

CARD	SER.	SOURCE	LINKTYPE	DATE	STR	VAL	ENTITIES INVOLVED---		
1		01-01	*CONTROL	5/26/75	95	90	ANAPOPOLUS, ALVIN A	ANAPOPOLUS, BORIS V.	
2				-0/-0/-0	-0	-0	ANAPOPOLUS, CASIUS M		
3		01-02	*CONTROL	5/20/75	70	90	ANAPOPOLUS, BORIS V	DRAGLEY, FELICIA B	
4		01-03	*CONTROL	12/13/74	90	50	ANAPOPOLUS, BORIS V	ELMERSMART, GORDON E	
5		01-04	*RECORD	10/ 2/71	90	99	ELMERSMART, GORDON E	*EXTORTION	
6		01-05	*CONTROL	4/21/75	50	50	ELMERSMART, GORDON E	IMPALA, CYNTHIA JANE	
7		01-06	*RECORD	4/27/68	99	99	IMPALA, CYNTHIA JANE	*ASSUALT	
8		01-07	*CONTROL	6/ 1/75	95	50	IMPALA, CYNTHIA JANE	C J CANDY SHOPPES	
9		01-08	*CONTROL	6/ 5/75	30	70	ELMERSMART, GORDON E	JONES, BOB	
10		01-09	*RECORD	9/ 9/73	80	99	JONES, BOB	*ASSAULT	
11		01-10	*RECORD	3/15/71	75	90	DRAGLEY, FELECIA B	*EXTORTION	
12		01-11	*CONTROL	3/ 7/75	60	50	ANAPOPOLUS, CASIUS M	FOSTER, BILL	
13		01-12	*CONTROL	4/18/75	95	70	FOSTER, BILL	GUNTHER, MARY JO	
14		01-13	*RECORD	11/28/70	80	50	GUNTHER, MARY JO	*AUTO THEFT	
15		01-14	*RECORD	10/11/72	99	99	FOSTER, WILLIAM F	*AUTO THEFT	
16		01-15	*CONTROL	5/29/75	40	80	FOSTER, BILL	HAMSTEAD, HARLEY S	
17		01-16	*RECORD	2/19/73	70	90	HAMSTEAD, HARLEY S	*AUTO THEFT	
18		(FOSTER AND GUNTHER HAVE BEEN LIVING TOGEHTER SINCE OCTOBER 1974)							
19		02-01	*MONEY	4/ 2/75	80	50	HAMSTEAD, HARLEY S	FOSTER, BILL	
20		02-02	*MONEY	4/11/75	80	50	FOSTER, BILL	ANAPOPOLUS, CASIUS M	
21		02-03	*MONEY	4/11/75	90	90	ELMERSMART, GORDON E	ANAPOPOLUS, BORIS V	
22		02-04	*MONEY	4/23/75	90	70	DRAGLEY, FELICIA B	ANAPOPOLUS, BORIS V	
23		03-01	CONTACT	2/12/74	35	70	FOSTER, BILL	DRAGLEY, FELICIA B	GUNTHER, MARY JO
25		03-02	CONTACT	10/28/73	25	60	JONES, BOB	ELMERSMART, GORDON E	DRAGLEY, FELICIA B
----------END DATA CARD IS MISSING----------									
27				-0/-0/-0	-0	-0	END DATA		

Figure 27. Example database printout (uncorrected).

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

LINKTYPE DISTRIBUTION

*CONTROL	16	13	12	9	8	6	4	3	1
	27	2							
*RECORD	17	15	14	11	10	5			
*REDCRD	7								
*MONEY	22	21	20	19					
CONTACT	25	23							

LINKTYPE STATISTICS

TYPE	NUMBER	MEAN	SIGMA	MINIMUM	MAXIMUM
*CONTROL	9	69.44	24.20	30.00	95.00
	2	50.00	0.00	50.00	50.00
*RECORD	6	82.33	9.60	70.00	99.00
*REDCRD	1	99.00	0.00	99.00	99.00
*MONEY	4	85.00	5.00	80.00	90.00
CONTACT	2	30.00	5.00	25.00	35.00

Figure 28. Example linktype distribution and statistical summary (uncorrected).

Entity Distribution. You are given a list of all entities in alphabetical order; along with the list, you are given the distribution of links involving each entity. As with the linktype distribution, the numbers refer to the lines of the database printout on which the links are described. An example entity distribution is shown in Figure 29.

REVIEW AND MODIFICATION PROCEDURES

1 IDENTIFY ERRORS IN THE ENTITY DISTRUBUTION

Using the entity distribution, locate and note errors associated with entities. The methods to be used, together with some of the types of errors commonly encountered, are illustrated in Figure 30. Note, initially, that some of the entities seem to be listed twice; this can result from any differences in the way the entity is entered. Boris V. Anapopolus appears twice because, in Line 1, a period was placed after his middle initial whereas no period was used elsewhere. The error was circled, as was the line on which it appeared in the database. Felicia B. Dragley appears twice because Felicia was misspelled on Line 11; *assault appears twice because of a misspelling on Line 7; and Bob Jones appears twice because an extra space was inadvertently inserted on Line 9 between his first and last names.

Another type of error shown in Figure 31 is that of using two names for the same individual--William F. Foster on Line 15 is the same person as Bill Foster elsewhere. Even though both names might be correct, the result is having two entities in the database where only one is desired.

The entity named "End Data" appears erroneously in the list because of an improper entry on the *DATA INPUT FORM*. The term "End Data," signifying there are no more data to be entered, should have been started in Column 1 but, as shown in Figure 26, was actually started in Column 3. As a consequence, the term was treated as an entity.

As shown in Figure 30, each error is identified on the entity distribution, and the line on which it appears in the database is circled.

2 IDENTIFY ERRORS IN THE LINKTYPE DISTRIBUTION

Using the linktype distribution, locate and note errors associated with linktypes. The methods to be used, together with error examples, are

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

ENTITY DISTRIBUTION

ANAPOPOLUS, CASIUS M	20	12	2			
ANAPOPOLUS, BORIS V	22	21	4	3		
ANAPOPOLUS, BORIS V.	1					
ANAPOPOLUS, ALVIN X	1					
C J CANDY SHOPPES	2					
DRAGLEY, FELECIA B	11					
DRAGLEY, FELICIA B	25	23	22	3		
ELMERSMART, GORDON E	25	21	9	6	5	4
END DATA	27					
FOSTER, BILL	23	20	19	16	13	12
FOSTER, WILLIAM E	15					
GUNTHER, MARY JO	23	14	13			
HAMSTEAD, HARLEY S	19	17	16			
IMPALA, CYNTHIA JANE	8	7	6			
JONES, BOB	25	10				
JONES, BOB	9					
*ASSAULT	10					
*ASSUALT	7					
*AUTO THEFT	17	15	14			
*EXTORTION	11	5				

Figure 29. Example entity distribution (uncorrected).

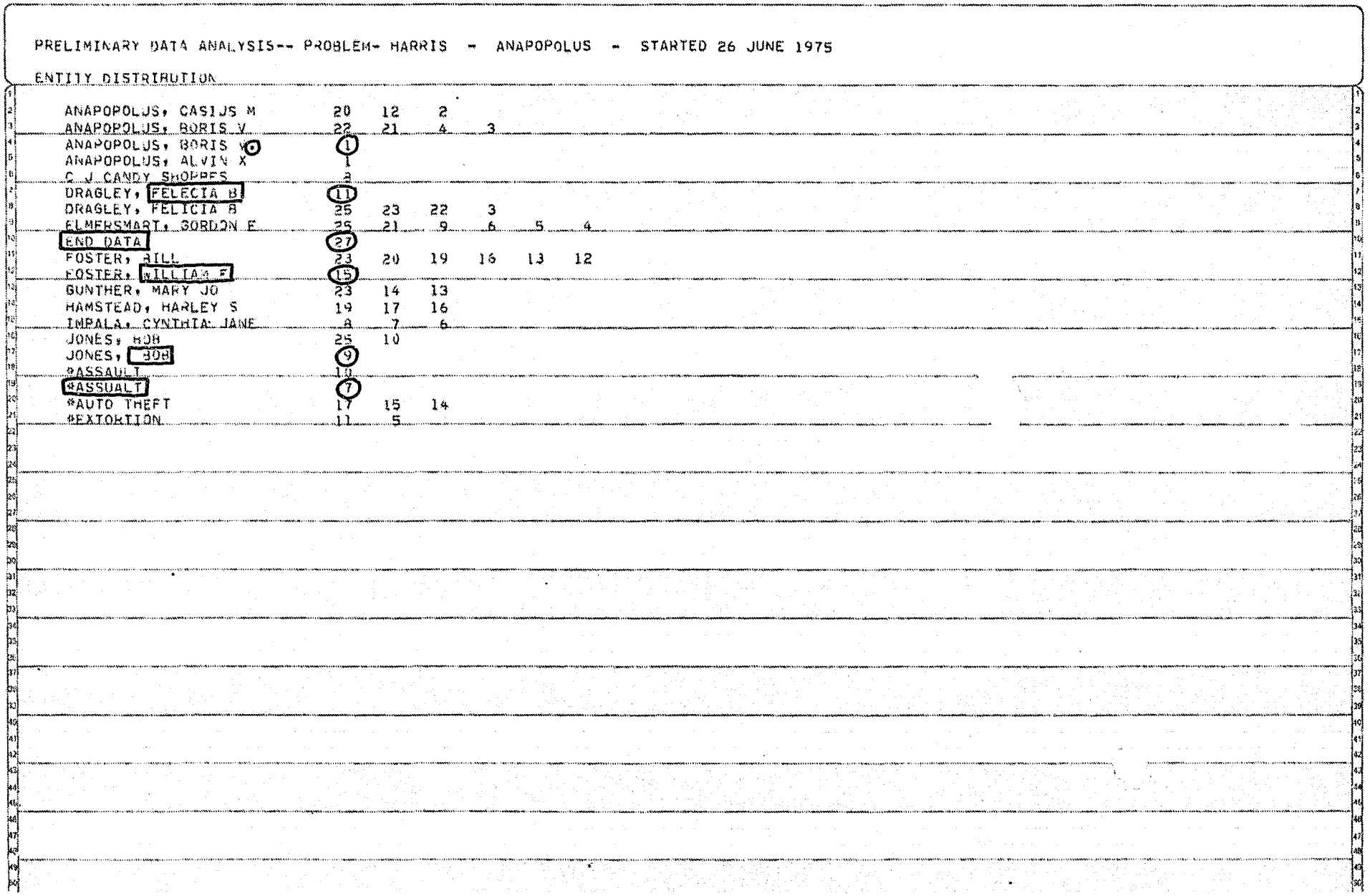


Figure 30. Example entity distribution (errors noted).

illustrated in Figure 31. Two errors are shown. The first is a linktype which, for reasons to be discussed later, was left blank on Lines 2 and 27. The second is a transposition of the O and C in the linktype named *RECORD on Line 7, resulting in an additional linktype--*REOCRD. These errors are noted on the linktype distribution; the lines of the database on which they occur are circled.

3 NOTE ERRORS AND CORRECTIONS ON THE DATABASE PRINTOUT

First, circle the lines of the database on which errors identified in the entity and linktype distributions are found. As shown in Figure 32, these were Lines 1, 2, 7, 9, 11, 15 and 27.

Second, note the errors on the database printout in the manner shown in Figure 32.

Third, review the database printout; identify and correct any additional errors not already identified. In Figure 32, an additional error, found on Line 18, is the transposition of the T and H in the word TOGETHER.

Fourth, on the database printout, state the action required to correct the errors noted on each line. The actions required to correct errors in the example case are shown in Figure 32. Most corrections are obvious; some are not. On Line 2, the errors were caused by failing to enter the dash (-) in the CONTROL column into the computer to signify entity continuation. As a result, Line 2 in the database was produced with a single entity, a blank linktype, and blanks (as indicated by -0) in the DATE, STRENGTH, and VALIDITY columns. These errors are all corrected by simply adding the dash (-) for entity continuation. The "End Data" error on Line 27 was discussed previously; it can be corrected by the proper insertion of the End Data instruction (card).

4 REVIEW LINKTYPE STATISTICS

Review the statistics--NUMBER, MEAN, SIGMA, MINIMUM and MAXIMUM--for each linktype to identify any potentially abnormal values. Linktypes with statistics that deviate significantly from your expectations might be looked into further. The link strengths originally entered for these linktypes can be inspected in the database printout for entry errors, or perhaps, for judgments that in retrospect appear inadequate.

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

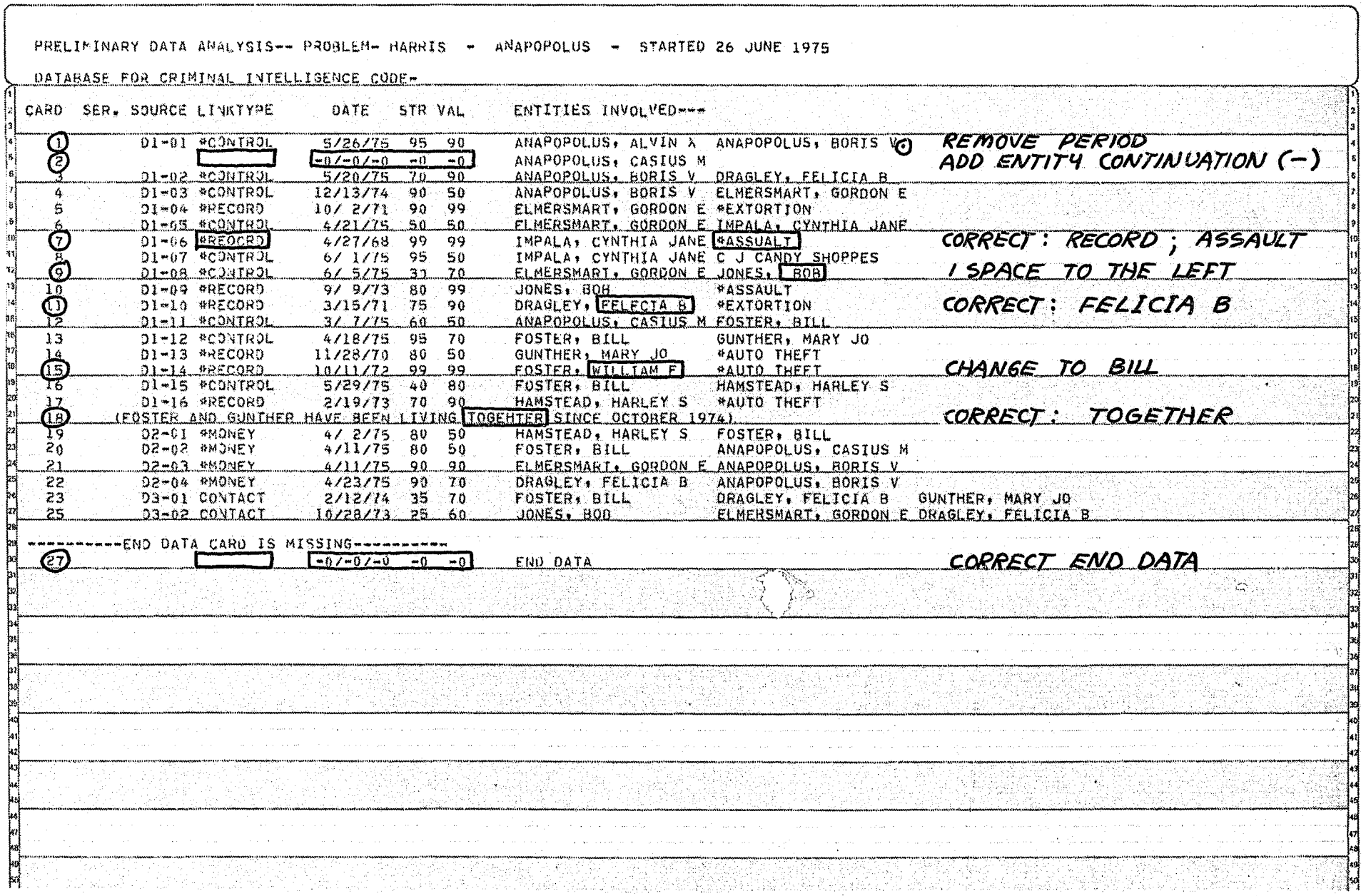
LINKTYPE DISTRIBUTION

*CONTROL	16	13	12	9	8	6	4	3	1
[redacted]	27	2							
*RECORD	17	15	14	11	10	5			
*REOCRD	7								
*MONEY	22	21	20	19					
CONTACT	25	23							

LINKTYPE STATISTICS

TYPE	NUMBER	MEAN	SIGMA	MINIMUM	MAXIMUM
*CONTROL	9	69.44	24.20	30.00	95.00
[redacted]	2	50.00	0.00	50.00	50.00
*RECORD	6	82.33	9.60	70.00	99.00
*REOCRD	1	99.00	0.00	99.00	99.00
*MONEY	4	85.00	5.00	80.00	90.00
CONTACT	2	30.00	5.00	25.00	35.00

Figure 31. Example linktype distribution and statistical summary (errors noted).



PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

DATABASE FOR CRIMINAL INTELLIGENCE CODE-

CARD	SER.	SOURCE	LINKTYPE	DATE	STR	VAL	ENTITIES INVOLVED---		
1		D1-01	*CONTROL	5/26/75	95	90	ANAPOPOLUS, ALVIN A	ANAPOPOLUS, BORIS V.	REMOVE PERIOD
2				-0/-0/-0	-0	-0	ANAPOPOLUS, CASIUS M		ADD ENTITY CONTINUATION (-)
3		D1-02	*CONTROL	5/20/75	70	90	ANAPOPOLUS, BORIS V	DRAGLEY, FELICIA B	
4		D1-03	*CONTROL	12/13/74	90	50	ANAPOPOLUS, BORIS V	ELMERSMART, GORDON E	
5		D1-04	*RECORD	10/ 2/71	90	99	ELMERSMART, GORDON E	*EXTORTION	
6		D1-05	*CONTROL	4/21/75	50	50	ELMERSMART, GORDON E	IMPALA, CYNTHIA JANE	
7		D1-06	*RECORD	4/27/68	99	99	IMPALA, CYNTHIA JANE	*ASSUALT	CORRECT: RECORD ; ASSAULT
8		D1-07	*CONTROL	6/ 1/75	95	50	IMPALA, CYNTHIA JANE	C J CANDY SHOPPES	
9		D1-08	*CONTROL	6/ 5/75	30	70	ELMERSMART, GORDON E	JONES, BOB	I SPACE TO THE LEFT
10		D1-09	*RECORD	9/ 9/73	80	99	JONES, BOB	*ASSAULT	
11		D1-10	*RECORD	3/15/71	75	90	DRAGLEY, FELECTA B	*EXTORTION	CORRECT: FELICIA B
12		D1-11	*CONTROL	3/ 7/75	60	50	ANAPOPOLUS, CASIUS M	FOSTER, BILL	
13		D1-12	*CONTROL	4/18/75	95	70	FOSTER, BILL	GUNTHER, MARY JO	
14		D1-13	*RECORD	11/28/70	80	50	GUNTHER, MARY JO	*AUTO THEFT	
15		D1-14	*RECORD	10/11/72	99	99	FOSTER, WILLIAM F	*AUTO THEFT	CHANGE TO BILL
16		D1-15	*CONTROL	5/29/75	40	80	FOSTER, BILL	HAMSTEAD, HARLEY S	
17		D1-16	*RECORD	2/19/73	70	90	HAMSTEAD, HARLEY S	*AUTO THEFT	
18		(FOSTER AND GUNTHER HAVE BEEN LIVING TOGEHTER SINCE OCTOBER 1974)							CORRECT: TOGETHER
19		D2-01	*MONEY	4/ 2/75	80	50	HAMSTEAD, HARLEY S	FOSTER, BILL	
20		D2-02	*MONEY	4/11/75	80	50	FOSTER, BILL	ANAPOPOLUS, CASIUS M	
21		D2-03	*MONEY	4/11/75	90	90	ELMERSMART, GORDON E	ANAPOPOLUS, BORIS V	
22		D2-04	*MONEY	4/23/75	90	70	DRAGLEY, FELICIA B	ANAPOPOLUS, BORIS V	
23		D3-01	CONTACT	2/12/74	35	70	FOSTER, BILL	DRAGLEY, FELICIA B	GUNTHER, MARY JO
25		D3-02	CONTACT	10/28/73	25	60	JONES, BOB	ELMERSMART, GORDON E	DRAGLEY, FELICIA B
----------END DATA CARD IS MISSING----------									
27				-0/-0/-0	-0	-0	END DATA		CORRECT END DATA

Figure 32. Example database printout (corrections noted).

5 MODIFY THE DATABASE

Make any desired changes in the database. You might wish at this time to make changes in the database that you believe will facilitate your analysis, changes which are in addition to the correction of errors. For example, as a result of your review of linktype statistics you might change some of your link strength values. In addition, you might delete certain entities or even complete lines from the database, or you might combine linktypes that appear too similar to warrant separate treatment. To make these types of modifications, identify the specific items to be changed and provide instructions for changes in the same way that you would to correct errors.

6 OBTAIN AND CHECK THE CORRECTED, MODIFIED DATABASE

Prior to initiating your analysis, obtain and check your corrected, modified database. This step is always necessary to assure the quality of your analysis, unless, of course, the corrections are few and minor in nature. The corrected Data Review Package for the example case is shown in Figures 33, 34, and 35.

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

ENTITY DISTRIBUTION

ANAPOPOLUS, BORIS V	22	21	4	3	1		
ANAPOPOLUS, CASIUS M	20	12	1				
ANAPOPOLUS, ALVIN X	1						
C J CANDY SHOPPES	8						
DRAGLEY, FELICIA R	25	23	22	11	3		
ELMERSMART, GORDON E	25	21	9	6	5	4	
FOSTER, BILL	23	20	19	16	15	13	12
GUNTHER, MARY JO	23	14	13				
HAMSTEAD, HARLEY S	19	17	16				
IMPALA, CYNTHIA JANE	8	7	6				
JONES, BOB	25	10	9				
*ASSAULT	10	7					
*AUTO THEFT	17	15	14				
*EXTORTION	11	5					

Figure 33. Example entity distribution (corrected).

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

LINKTYPE DISTRIBUTION

*CONTROL	16	13	12	9	8	6	4	3	1
*RECORD	17	15	14	11	10	7	5		
*MONEY	22	21	20	19					
CONTACT	25	23							

LINKTYPE STATISTICS

TYPE	NUMBER	MEAN	SIGMA	MINIMUM	MAXIMUM
*CONTROL	9	69.44	24.20	30.00	95.00
*RECORD	7	84.71	10.63	70.00	99.00
*MONEY	4	85.00	5.00	80.00	90.00
CONTACT	2	30.00	5.00	25.00	35.00

Figure 34. Example linktype distribution and statistical summary (corrected).

PRELIMINARY DATA ANALYSIS-- PROBLEM- HARRIS - ANAPOPOLUS - STARTED 26 JUNE 1975

DATABASE FOR CRIMINAL INTELLIGENCE CODE-

CARD	SER. SOURCE	LINKTYPE	DATE	STR	VAL	ENTITIES INVOLVED---		
1	01-01	*CONTROL	5/26/75	95	90	ANAPOPOLUS, ALVIN X	ANAPOPOLUS, BORIS V	ANAPOPOLUS, CASIUS M
3	01-02	*CONTROL	5/20/75	70	90	ANAPOPOLUS, BORIS V	DRAGLEY, FELICIA B	
4	01-03	*CONTROL	12/13/74	90	50	ANAPOPOLUS, BORIS V	ELMERSMART, GORDON E	
5	01-04	*RECORD	10/ 2/71	90	99	ELMERSMART, GORDON E	*EXTORTION	
6	01-05	*CONTROL	4/21/75	50	50	ELMERSMART, GORDON E	IMPALA, CYNTHIA JANE	
7	01-06	*RECORD	4/27/68	99	99	IMPALA, CYNTHIA JANE	*ASSAULT	
8	01-07	*CONTROL	6/ 1/75	95	50	IMPALA, CYNTHIA JANE	C J CANDY SHOPPES	
9	01-08	*CONTROL	6/ 5/75	30	70	ELMERSMART, GORDON E	JONES, BOB	
10	01-09	*RECORD	9/ 9/73	80	99	JONES, BOB	*ASSAULT	
11	01-10	*RECORD	3/15/71	75	90	DRAGLEY, FELICIA B	*EXTORTION	
12	01-11	*CONTROL	3/ 7/75	60	50	ANAPOPOLUS, CASIUS M	FOSTER, BILL	
13	01-12	*CONTROL	4/18/75	95	70	FOSTER, BILL	GUNTHER, MARY JO	
14	01-13	*RECORD	11/28/70	80	50	GUNTHER, MARY JO	*AUTO THEFT	
15	01-14	*RECORD	10/11/72	99	99	FOSTER, BILL	*AUTO THEFT	
16	01-15	*CONTROL	5/29/75	40	80	FOSTER, BILL	HAMSTEAD, HARLEY S	
17	01-16	*RECORD	2/19/73	70	90	HAMSTEAD, HARLEY S	*AUTO THEFT	
18	(FOSTER AND GUNTHER HAVE BEEN LIVING TOGETHER SINCE OCTOBER 1974)							
19	02-01	*MONEY	4/ 2/75	80	50	HAMSTEAD, HARLEY S	FOSTER, BILL	
20	02-02	*MONEY	4/11/75	50	50	FOSTER, BILL	ANAPOPOLUS, CASIUS M	
21	02-03	*MONEY	4/11/75	90	90	ELMERSMART, GORDON E	ANAPOPOLUS, BORIS V	
22	02-04	*MONEY	4/23/75	90	70	DRAGLEY, FELICIA B	ANAPOPOLUS, BORIS V	
23	03-01	CONTACT	2/12/74	35	70	FOSTER, BILL	DRAGLEY, FELICIA B	GUNTHER, MARY JO
25	03-02	CONTACT	10/28/73	25	60	JONES, BOB	ELMERSMART, GORDON E	DRAGLEY, FELICIA B

Figure 35. Example database printout (corrected).

DATA ANALYSIS PROCEDURES

Having completed the procedures for data preparation, review, and modification, you now have a database that is ready for analysis. Through use of the *LINKTYPE EMPHASIS CONTROL FORM* and the *ENTITY SELECTION FORM*, you can instruct *OCAP* to perform the operations required to get you the analytical products you need. In this, you have the flexibility to select the entities you wish to focus on, and to control the emphasis you wish to give to the different linktypes.

Your analysis is likely to be iterative in nature; you will probably cycle back through the operational sequence several times--selecting different entities, varying the linktype emphasis, and requesting different products--before you feel you have exhausted the analytical possibilities.

The analytical steps are described below and are illustrated with the case example employed in the previous sections. Also, when they are needed for understanding or clarification, new concepts will be introduced and explained. The *LINKTYPE EMPHASIS CONTROL FORM* and *ENTITY SELECTION FORM* employed in the analytical steps are shown in Figures 36 and 37. The products obtained by means of these analytical steps will be described and illustrated later in the next major section.

1 COMPLETE THE DESCRIPTIVE HEADING

At the top of the *LINKTYPE EMPHASIS CONTROL FORM* in the spaces labeled DESCRIPTIVE HEADING, describe the analysis run. This heading will then appear at the top of the sheet for each different analytical product generated in the run. At a minimum, you should include your name, the project or case title, the date, and a description of the linktype emphasis employed. The headings entered for three different runs are shown in Figures 38, 39, and 40 for the example case.

2 LIST LINKTYPES

In the column labeled LINKTYPE on the *LINKTYPE EMPHASIS CONTROL FORM*, list those linktypes which you wish to give other than normal emphasis. Unless you list the linktype and indicate the emphasis desired, the linktype

ORGANIZED CRIME ANALYSIS PROGRAM
Linktype Emphasis Control Form

DESCRIPTIVE HEADING

1 80

LINKTYPE	FORWARD EMPHASIS				REVERSE EMPHASIS				VALIDITY CUT-OFF
	HI	LOW	LTD	OFF	HI	LOW	LTD	OFF	
1 10	15	20	25	30	35	40	45	50	61 62
* IF DIRECTIONAL LINKTYPE									

INSTRUCTIONS

1. List linktypes to be given other than normal emphasis.
2. For nondirectional links, only desired forward emphasis need be checked (reverse = forward).
3. For directional links, check both forward and reverse for other than normal emphasis of either.
4. On line after last listed linktype, print END LINK.
5. To obtain normal emphasis for all linktypes, print only END LINK on first line and check nothing under forward or reverse emphasis.
6. For each linktype, print the validity cut-off level desired.
7. For "normal run" print desired validity cut-off on first line only.

Figure 36. Linktype Emphasis Control Form.

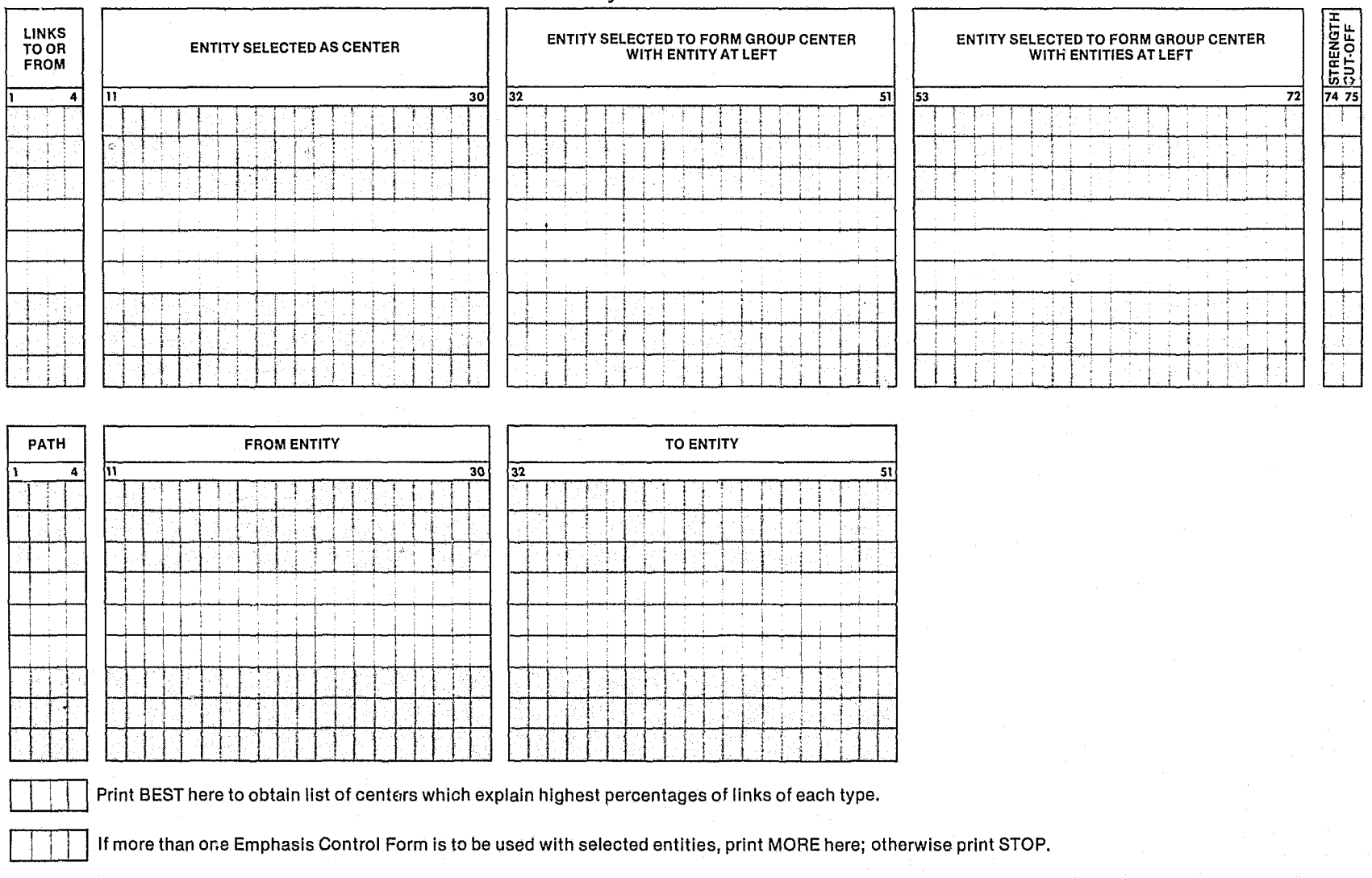


Figure 37. Entity Selection Form.

ORGANIZED CRIME ANALYSIS PROGRAM

Linktype Emphasis Control Form

DESCRIPTIVE HEADING

HARRI$ ANAPØPØLU$ PRØJECT 30 JUNE 1975 NØRMAL LINK EMPHAI

1 80

LINKTYPE	FORWARD EMPHASIS				REVERSE EMPHASIS				VALIDITY CUT-OFF
	HI	LOW	LTD	OFF	HI	LOW	LTD	OFF	
1 10	15	20	25	30	35	40	45	50	61 62
END LINK									00

* IF DIRECTIONAL LINKTYPE

INSTRUCTIONS

1. List linktypes to be given other than normal emphasis.
2. For nondirectional links, only desired forward emphasis need be checked (reverse = forward).
3. For directional links, check both forward and reverse for other than normal emphasis of either.
4. On line after last listed linktype, print END LINK.
5. To obtain normal emphasis for all linktypes, print only END LINK on first line and check nothing under forward or reverse emphasis.
6. For each linktype, print the validity cut-off level desired.
7. For "normal run" print desired validity cut-off on first line only.

Figure 38. Linktype Emphasis Control Form example completed for normal link emphasis.

ORGANIZED CRIME ANALYSIS PROGRAM
Linktype Emphasis Control Form

DESCRIPTIVE HEADING

HARRI$ ANAPØPØLU$ PRØJECT 30 JUNE 75 CØNTRØL LINK EMPHAI

1 80

LINKTYPE	FORWARD EMPHASIS				REVERSE EMPHASIS				VALIDITY CUT-OFF
	HI	LOW	LTD	OFF	HI	LOW	LTD	OFF	
1 10	15	20	25	30	35	40	45	50	61 62
*CØNTRØL	X						X		20
*RECØRD	X							X	20
*MØNEY			X		X				20
END LINK									

* IF DIRECTIONAL LINKTYPE

INSTRUCTIONS

1. List linktypes to be given other than normal emphasis.
2. For nondirectional links, only desired forward emphasis need be checked (reverse = forward).
3. For directional links, check both forward and reverse for other than normal emphasis of either.
4. On line after last listed linktype, print END LINK.
5. To obtain normal emphasis for all linktypes, print only END LINK on first line and check nothing under forward or reverse emphasis.
6. For each linktype, print the validity cut-off level desired.
7. For "normal run" print desired validity cut-off on first line only.

Figure 39. Linktype Emphasis Control Form example completed for control link emphasis.

ORGANIZED CRIME ANALYSIS PROGRAM
Linktype Emphasis Control Form

DESCRIPTIVE HEADING

HARRI$ ANAPØPØLUS PRØJECT 30 JUNE 75 MØNEY FLØW EMPHAI

1 80

LINKTYPE	FORWARD EMPHASIS				REVERSE EMPHASIS				VALIDITY CUT-OFF
	HI	LOW	LTD	OFF	HI	LOW	LTD	OFF	
1 10	15	20	25	30	35	40	45	50	61 62
*CØNTRØL			X		X				20
*RECØRD	X							X	
*MØNEY	X						X		
END LINK									

* IF DIRECTIONAL LINKTYPE

INSTRUCTIONS

1. List linktypes to be given other than normal emphasis.
2. For nondirectional links, only desired forward emphasis need be checked (reverse = forward).
3. For directional links, check both forward and reverse for other than normal emphasis of either.
4. On line after last listed linktype, print END LINK.
5. To obtain normal emphasis for all linktypes, print only END LINK on first line and check nothing under forward or reverse emphasis.
6. For each linktype, print the validity cut-off level desired.
7. For "normal run" print desired validity cut-off on first line only.

Figure 40. Linktype Emphasis Control Form example completed for money flow emphasis.

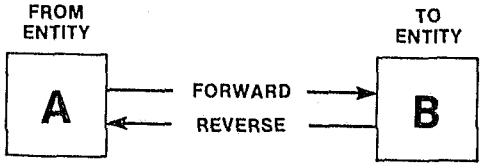
will be given normal emphasis. That is, the link strengths will not be increased or decreased in the analysis run from the values you entered originally. Consequently, if you want all links to be given normal emphasis, do not list any linktype in the LINKTYPE column.

On the line after the last listed linktype, put END LINK. This term signifies that there are no more linktypes in the list. Of course, if a normal run is desired, only the term END LINK will appear in the LINKTYPE column. An example of a form completed for a normal run is shown in Figure 38; forms showing the linktype listings for control link emphasis and money flow emphasis are shown in Figures 39 and 40.

3 INDICATE LINKTYPE EMPHASIS

Prior to taking the necessary steps required for linktype emphasis, you need to understand two fundamental concepts that are involved. The first concept is that of link directionality. Every link in the database has both a *forward* and *reverse* component. For directional linktypes (those which you have identified with an asterisk in the first character), the forward direction is the direction indicated by the way you entered the link on the *DATA INPUT FORM;* forward is from the entity listed in the FROM ENTITY column to the entity listed in the TO ENTITY column. Reverse, of course, is the opposite direction. Forward and reverse directions are illustrated below for entities A and B.

OCAP permits you to emphasize link strength for directional links, differentially for the forward and reverse directions. On the other hand,



nondirectional links, by definition, always have equal strengths in both the forward and reverse directions. Emphasizing forward direction automatically emphasizes the reverse direction, identically, for nondirectional links.

The second concept you need to understand is that of linktype emphasis. When emphasis is given to either the forward or reverse direction of a linktype, all links of that type are emphasized as indicated. The objective of emphasis, of course, is to highlight patterns of special interest by increasing or decreasing the prominence of links of selected types. For example, you might want to highlight the pattern of money flow, organizational control, and so on.

You have five levels of emphasis to select from--high, normal, low, limited, and off. Emphasis involves a linear transformation of the link strengths, as originally entered into the database, to modified link strengths. Two things happen during the transformation: 1) the absolute value of the link strength is changed in accordance with the transformation function for the selected linktype emphasis, and 2) the link strength value is changed to a decimal fraction (divided by 100) for use in calculating strengths of indirect and amalgamated links.

The linear transformations are illustrated in Figure 41 for high, low, and normal linktype emphasis. For example, a link strength of 80 would be transformed to .40 under low emphasis, to .80 under normal emphasis, and to .90 under high emphasis. These values are then used in *OCAP* calculations; resulting decimal fractions are changed back to whole numbers prior to printing out the analytical products.

Limited emphasis changes the strength of all links to a single value of .004. The purpose of using this level of emphasis is essentially to eliminate the links from playing a strong role, but still to retain the links in the analysis. Typically the links given limited emphasis show up in the analytical products at a value of zero, or about zero. When you use the off level, on the other hand, you totally remove links of the designated type from the analysis.

Controlling linktype emphasis is simple. For the selected linktype, check the desired emphasis level--HI, LOW, LTD, or OFF--in the FORWARD

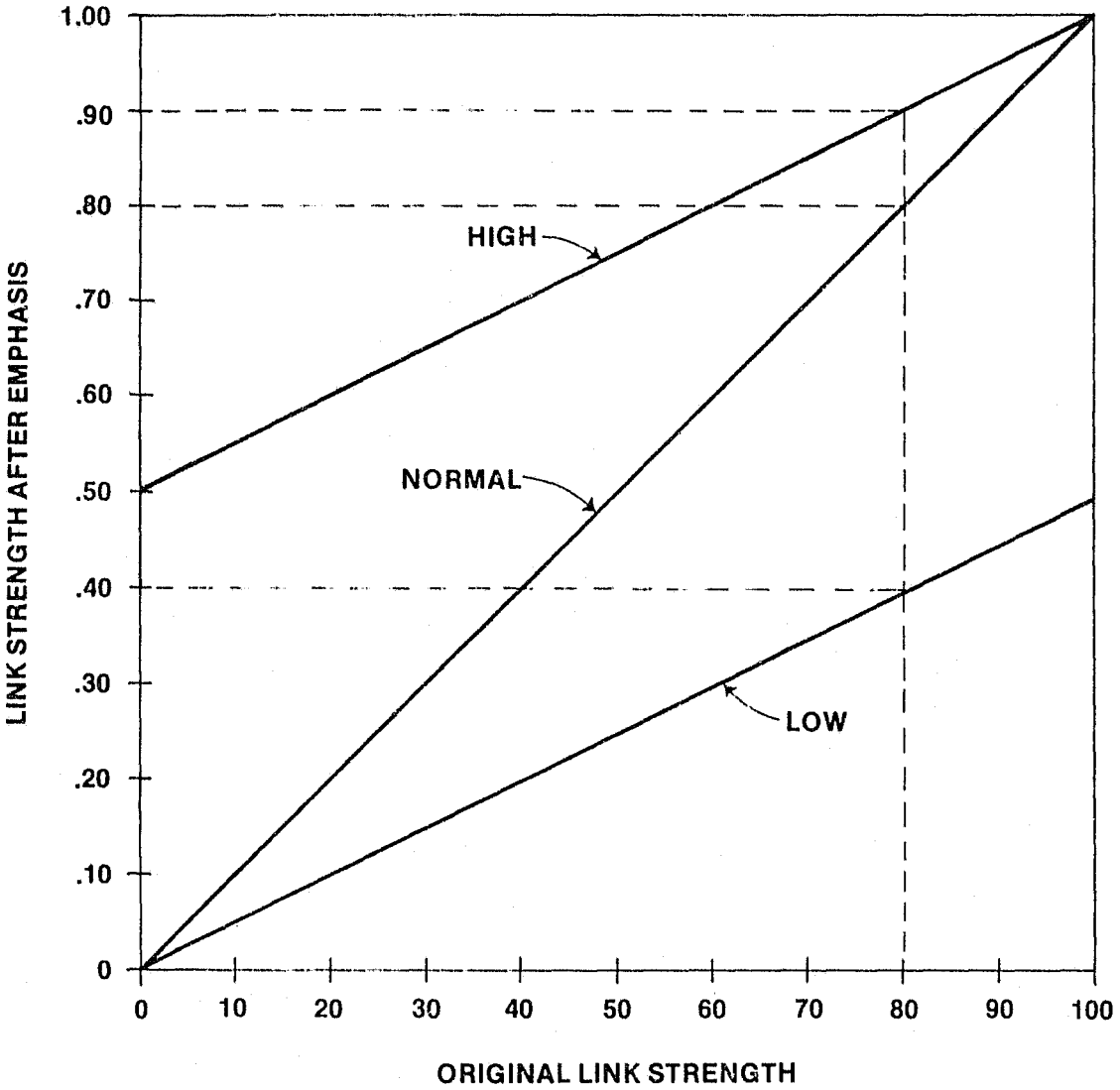


Figure 41. Linear transformation for high, normal and low linktype analysis.

EMPHASIS and/or REVERSE EMPHASIS columns. For nondirectional links, only the FORWARD EMPHASIS column need be used because the forward and reverse directions will be treated the same. As stated earlier, normal emphasis is obtained by not checking any of the emphasis alternatives.

4 ENTER VALIDITY CUT-OFF

On the *LINKTYPE EMPHASIS CONTROL FORM* in the column labeled VALIDITY CUT-OFF enter the validity cut-off levels. Links with validities below the entered level will not be used in the analysis. Enter the validity cut-off desired for each linktype on the appropriate line; for a normal run, the validity cut-off need only be entered on the first line. As shown in Figure 38 for the example case, a validity cut-off of 0 was entered for the run with normal link emphasis. Figure 39 illustrates the use of a validity cut-off of 20 for linktypes emphasized during the run which highlighted control links. In Figure 40, validity cut-off was inadvertently not entered for *RECORD and *MONEY linktypes; the results of this error will be shown later.

5 SELECT ENTITIES AS LINK NETWORK CENTERS

On the top part of the *ENTITY SELECTION FORM*, print the names of the entities (centers) for which you want link networks. If the network center is a single entity, you will use only the column labeled ENTITY SELECTED AS CENTER. If the network center is a group of two or three entities, you will use one or both of the two additional columns, as shown in the entity selection example in Figure 42.

6 SELECT LINK NETWORK DIRECTION

In the column labeled LINKS TO OR FROM on the *ENTITY SELECTION FORM*, print TO if you want the network to consist of links *in to* the selected center, and print FROM if you want the network to consist of the links *out from* the selected center. The network in to the selected center will consist of the strongest paths of links with directional components toward the center. The network out from the selected center will consist of the strongest paths of links with directional components out from the center. In a run in which all links are given normal emphasis (forward and reverse directions are equal), the "to" and "from" networks will be identical. The

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Entity Selection Form

LINKS TO OR FROM (1–4)	ENTITY SELECTED AS CENTER (11–30)	ENTITY SELECTED TO FORM GROUP CENTER WITH ENTITY AT LEFT (32–51)	ENTITY SELECTED TO FORM GROUP CENTER WITH ENTITIES AT LEFT (53–72)	STRENGTH CUT-OFF (74–75)
TO	ANAPØPØLU$, ALVIN X			25
FROM	ANAPØPØLU$, ALVIN X			25
TO	ANAPØPØLU$, ALVIN X	ANAPØPØLU$, BØRI$ V	ANAPØPØLU$, CA$IU$ M	25
FROM	ANAPØPØLU$, ALVIN X	ANAPØPØLU$, BØRI$ V	ANAPØPØLU$, CA$IU$ M	25

PATH (1–4)	FROM ENTITY (11–30)	TO ENTITY (32–51)
PATH	ANAPØPØLU$, ALVIN X	C J CANDY $HØPPE$
PATH	HAM$TEAD, HARLEY $	IMPALA, CYNTHIA JANE
PATH	ELMER$MART, GØRDØN E	GUNTHER, MARY JØ
PATH	ANAPØPØLU$, BØRI$ V	HAM$TEAD, HARLEY $

BEST Print BEST here to obtain list of centers which explain highest percentages of links of each type.

MØRE If more than one Emphasis Control Form is to be used with selected entities, print MORE here; otherwise print STOP.

Figure 42. Entity Selection Form completed for example case.

selection of link network direction is illustrated for the example case in Figure 42.

7 ENTER LINK STRENGTH CUT-OFF

In the column labeled STRENGTH CUT-OFF on the *ENTITY SELECTION FORM*, enter the link strength cut-off levels. Links with strengths below the entered level will be eliminated from the link networks produced by *OCAP*. Enter the link strength cut-off desired for each center on the appropriate line of the form. As shown in Figure 42, a cut-off of 25 was used for each center in the case example.

8 REQUEST LINK PATHS

Using the PATH, FROM ENTITY, and TO ENTITY columns on the *ENTITY SELECTION FORM*, request the link paths between designated pairs of entities. As illustrated in Figure 42, print the word PATH and names of the entities in the appropriate columns to obtain a listing of link paths between the entities named.

CAUTION Be sensitive to linktype emphasis and link direction when requesting paths. Depending upon linktype emphasis, paths from A to B might be strong whereas paths from B to A might be weak. It might be necessary, for instance, to request paths in both directions for some pairs of entities to be assured of gaining a complete picture.

9 REQUEST BEST CENTERS (OPTIONAL)

To obtain a list of the entities which, as centers for link networks, explain the highest percentages of links of each type, print BEST in the designated blocks at the bottom of the *ENTITY SELECTION FORM*. This *OCAP* feature is provided in recognition of the fact that it is unlikely that any center will have a link network containing all the links in the database, or even all the links of a given linktype. Consequently, to aid you in selecting centers for subsequent runs, the BEST feature is available at your option. BEST has been requested, in Figure 42, for the case example.

The BEST output gives you, for each linktype, the ten entities which contain the highest percentage of database links in their link networks. The BEST output is illustrated and described in the next section.

[10] ENTER MORE OR STOP INSTRUCTION

At the bottom of the *ENTITY SELECTION FORM* in the designated blocks, print either MORE or STOP. Enter MORE if more than one *LINKTYPE EMPHASIS CONTROL FORM* is to be used with the selected entities; otherwise enter STOP. In Figure 42, MORE was entered.

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Harper, W. R. & Harris, D. H. Development of a training program for intelligence analysts. Santa Barbara, California: Anacapa Sciences, Inc., Technical Report 140-1, September 1971.

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