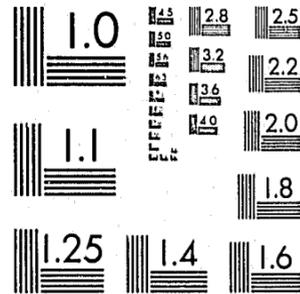


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THE COMPENDIUM OF PERFORMANCE MEASUREMENT LITERATURE

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SUMMARY

Purpose: The Compendium of Performance Measurement Literature is designed to maintain an up-to-date catalog of the recent, multi-disciplinary literature in the field of performance measurement. The principle focus of this Compendium is on the theory and practice of measurement processes and strategies, as well as on the theory and applications of specific measures and measurement technologies. A computerized referencing system and file maintenance capability are available for either batch or on-line processing to simplify access by researchers.

Benefits:

1. Facilitation of the development of performance measures, processes and strategies.
2. One-time creation of data base for all Criminal Justice System (CJS) performance measurement activities.
3. Making researchers aware of the scope of measurement problems and providing sources of information on similar problems that have appeared in the literature of other disciplines.

File

Contents:

1. Bibliographic Citation.
2. Classifying Keywords which describe:
 - a. Contents of Article
 - b. System Activities
 - c. Methodologies Invoked
 - d. Measure Characteristics
 - e. Measurement Goals
 - f. Issues in Strategy and Implementation
3. Brief Abstract

Computer

Capabilities:

1. Initial Library creation.

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2. Permanent Library updating (addition of new citations).
3. Citations and Abstracts retrieved by specifying one or more Keywords.
4. References chosen by Keyword entries printed using the following formats:
 - a. Abstracts and Bibliographies printed with all Keywords suppressed except those dealing with methodologies used.
 - b. Reference-by-Keyword-Occurrence Matrix printed in addition to the above.
5. Validation routines for adding citations to the permanent Library.

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I. INTRODUCTION

The Criminal Justice System (CJS) is currently in the process of defining a "uniform measurement philosophy" and corresponding technology for its managers and applied scientists. The need for such an effort was first identified in 1976 by Deutsch who equated the consistent application of an adequate measurement philosophy using appropriate measurement technologies with the determination of "empirical truths" concerning the operation of the CJS. The latter is a prerequisite for adequate evaluation, re-engineering and management of the System. To expedite the development of a precise technology of performance measurement for the CJS, the performance measurement community must draw upon the philosophy and technology of the better established sciences. It is for this reason that abstracts of articles which treat the measurement problem in the literatures of economics, computer science, operations research, psychology, statistics, and industrial and systems engineering are being assembled. At this point in time, 664 articles from technical journals representing those disciplines have been compiled and abstracts for the performance measurement community have been prepared and stored on computer files. A computerized accessing system is also now available to performance measurement personnel to facilitate retrieval of abstracts from the files. The accessing system and the computer files of citations, known collectively as the Compendium of Performance Measurement Literature (CPML), is the subject of this report.

A guide for abstract preparers, a user's guide, a guide for ongoing maintenance of the data base, and an executive summary for those interested either in using CPML or in articles for the abstract file, comprise this report; those interested in the CPML software are referred elsewhere.

II. COMPENDIUM OF PERFORMANCE MEASUREMENT LITERATURE OVERVIEW

In this section of the report, the capabilities of the CPML are introduced for persons who will contribute abstracts to the Compendium as well as for those who will use it as a research tool in the theory and practice of performance measurement. The reader is first acquainted with the information contents of a typical reference found in the CPML. A complete bibliographical citation introduces each entry; its format closely approximates that of a standard reference of the type used in a formal paper. A vector of 120 keywords has been designed to categorize the articles in the Compendium and to provide the CPML user with a simple mechanism for retrieving references. Finally, a free-form abstract describes the reference to the performance measurement community clarifying the importance of the work and enumerating its more salient attributes.

Following the description of the CPML file's contents, the reader is better prepared to examine the criteria used by the preparers of the abstracts to select references for the Compendium. In presenting these criteria within this overview, rather than in the abstract preparer's guide which follows, both users and referees must become acquainted with the specificity of the approach taken in collecting references; that is, even though they span several disciplines and practices, and focus on an undetermined number of different systems whose performance can be measured but are likely not of specific interest to the performance measurement community, the goal is to design a "uniform measurement

philosophy" and technology that draws from a multi-disciplinary theoretical base. Therefore, one can be sure that references dealing with the CJS will be found in the CPML, but to think that crime-related references preclude inclusion of interesting applications of performance measurement to other systems would be inconsistent with the stated goal. Specifying criteria for selecting references for input into the CPML, then, will clarify both the usefulness of the Compendium as a research tool and what to expect to find there, and it will focus referees on what to look for in searching for appropriate references and in preparing abstracts for them.

In two of the three appendices to this section, the 120 Keywords used in the preparation of abstracts are defined. These definitions and a supporting dictionary of concepts necessary to understand the subtleties of their use will prove invaluable for users and abstract preparers alike. In the remaining appendix, the journals that have been searched for articles included in the CPML are listed.

Information Content

The purpose of CPML is to store and facilitate the retrieval of abstracts of articles, books, theses and other sources of information on the theory and practice of performance measurement. A bibliographic citation accompanies each abstract for the sake of those users whose interest in the performance measurement issue is sufficiently stimulated by the CPML abstract to want to acquire the abstracted work in its entirety. The abstract itself is brief, averaging five 80-character lines in length. Its purpose is to clarify the usefulness of the reference to

the performance measurement theorist and practitioner, or to summarize the work so that such users can draw their own conclusions as to its importance. Abstracts consist of keywords not already found in the list of 120 used for reference retrieval, short descriptive phrases and brief sentences. Even equations may be useful and are the most descriptive in certain instances; however, since some members of the performance measurement community may not understand their use, equations appear infrequently. Similarly, abbreviations may be expedient in preparing the abstracts, but particular care has been taken to ensure that their usefulness to the referee does not hamper the comprehension of the reader.

Whereas the abstract is critical in conveying to the performance measurement community as succinctly as possible the merits of each reference, it is through the use of keywords that the practical retrieval of references by this community is implemented. Each entry in the Compendium has been scanned by a referee who has chosen from among the 120 keywords used for categorizing performance measurement theory and practice literature those words which best describe the contents of the reference. Thus, when a user wishes to find articles described by a particular subset of keywords, he screens out all articles for which the referees have specified those keywords as being inapplicable. Therefore the results of such a search will help the researcher to concentrate on references particularly relevant to his area of interest. In order for the CPML to be useful to a wide audience within the performance measurement community, however, the keywords themselves must span the domain of the performance measurement experience.

The 120 keywords that have been selected to categorize the literature of performance measurement contained in this Compendium are defined in Appendix IIC, with a glossary of concepts fundamental to understanding the keyword definitions presented in Appendix IIB. These keywords fall into the following 12 clusters:

Category 1: Contents of Article

Six keywords specify the emphasis of the reference. That is, they serve to distinguish between theoretical and applied work in performance measurement, literature surveys and review papers, and model building and analysis efforts.

Category 2: System Genre

These keywords categorize the system discussed in a reference. Human versus social versus physical systems are differentiated. Production, criminal justice and other social service systems are further categorized.

Category 3: System Structure

Not only is the type of application relevant to performance measurement theorists, but the inter-relationships of a system's components and of the activities it performs can impact the selection of performance measures and the strategy of measurement, not to mention the actual measurement process. The structural relationships of system components are, therefore, distinguished by four keywords and the relationships of system activities within a process model of the system are also distinguished.

Category 4: System Goal Structure

A multiplicity of system goals can confound the measurement strategy. Similarly, conflicts between goals, between short-term objectives and long-term goals, or between the formal goals and objectives and the informal (induced) objectives of the system can also have considerable impact on what measurements are taken. To be able to examine such nuances, eight keywords have been included in the Compendium.

Category 5: Methodology

Eighteen keywords distinguish between the techniques of analysis used in a reference that include statistical methods, and various model building, optimization, and evaluation methods.

Category 6: Measure Characteristics

The performance measure is one element of the process, measure and strategy trinity so important to performance appraisal. Whether the measure is objective or quantitative, given in absolute or relative units, or whether it is estimated in place of another is described here.

Category 7: Measure Dimensionality

The complexity of performance measurement can in some sense be gauged by the dimensionality of the measures used. Uni-dimensional measures are distinguished from multi-dimensional ones; composite and simple measures, complementary and unrelated measures are also differentiated.

Category 8: Relative Measures

If a measure is not measured in absolute units, then it serves

to compare two or more performances. The basis of such comparisons is of interest to performance measurement personnel; that is, the comparison between competing systems, for example, or current and past behaviors of the same system, or the system's present behavior relative to some recognized norm are important distinctions. Three keywords describe such bases of comparison. The method of comparison (viz, correlation, ranking or ratio) is also considered of some value for understanding the basis of comparison.

Category 9: Measure Orientations

Another important dimension of a measure's attributes describes that which is being measured: the system's impact, the degree to which the system achieves its goals, the system's internal processes, its resource consumption, its response to external stimulæ, or its impact on its external environment.

Category 10: Measurement Goals

The goals of performance measurement quite obviously play a crucial role in prescribing the process, measure or strategy that is developed. The following four major subcategories distinguish between the goals or objects of performance measurement: system capabilities; system efforts; system outputs; and the adequacy of system outputs. Twenty-two measurement goals are differentiated under all of these subcategories.

Category 11: Issues in Strategy and Process Implementation

The specification of the process and strategy of performance measurement is most often subjugated to the definition of a per-

formance measure, even though quite often such should not have been the case. This section examines elements of both the procedural and strategic dimensions of measurement. Three subcategories deal with the preliminaries to both process and strategy formulation, with the development of each, and with some issues of process implementation.

Category 12: Empirical Issues in Implementation

The author's report of the collection and evaluation of empirical data is summarized with seven keywords.

Reference Selection Criteria

At this time, only journal articles have been abstracted for CPML. Our approach has been to search through those journals listed in Appendix IIA in volumes since 1967 for any articles meeting the criteria for reference selection defined below. The choice of these journals was predicated on the immediacy to the measurement of system performance of either the discipline or the methodologies emphasized by a journal's contributors. Thus, journals with modeling, systems analysis, or statistical orientations predominate.

The criteria used by referees in selecting articles for review can also be used when the scope of the current effort is expanded to other journals or reference types. The objective in designing this criteria has been to allow as much flexibility to the referees in selecting articles as is possible in order to prevent restricting otherwise appropriate references from the Compendium, the assumption being that the user is the ultimate benefactor even though he may be required to peruse more

abstracts to find references that meet his needs. The article selection criterion is therefore quite general:

Select an article for review when it contributes to the development of a uniform performance measurement theory and technology for the Criminal Justice System, or when it contributes to successful applications of same.

Of course, when reviewing articles, there exist many gray areas where it is debatable whether a particular article is an appropriate entry for the CPML. In these cases, the judgment of the referee in knowing what is of interest to the performance measurement community is essential. Thus, it is recommended that referees re-read Part II before attempting to review any of the literature of performance measurement.

APPENDIX IIA

List of Journals Surveyed

AIEE Transactions	Interfaces
Administrative Management	JASA (Journal of the American Statistical Association)
Administrative Science Quarterly	Journal of Applied Behavioral Science
American Statistical Association Social Statistics Proceedings	Journal of Operational Research
Benefit-Cost and Policy Analysis	Journal of Systems Engineering
Criminal Justice Review	Journal of Systems Management
Decision Sciences	Management Science
The Economic Journal	Naval Research Logistics Quarterly
Evaluation Quarterly	Operational Research Quarterly
Harvard Business Review	Operations Research
Harvard Law Review	Review of Economics in Statistics
Human Factors	Simulation
IEEE Transactions on Systems, Man and Cybernetics	Sloan Management Review
IEEE Transactions on Systems Science and Cybernetics	Socio-Economic Planning Sciences
Industrial Engineering	Technometrics
INFOR Journal (Canadian Journal for Operational Research and Information Processing)	Urban Affairs Quarterly

APPENDIX IIB

The following definitions will help to decipher the keyword descriptions in Appendix IIC:

control - the process of managing or regulating system behavior, activities, output, or structure.

control function - the relationship of system structure to the process of control; specifically, the configuration of system structure as organized along lines of control.

controller - a person or system component which controls one or more people or components.

empirical - determined through observation.

evaluation - the determination of the significance or worth of a system or its components through the study of models, theories, empirical evidence and performance measures.

goal - a formal reason for the existence of a system; a system's overall purpose.

goal structure - the relationship of a system's goals, objectives, and induced objectives to one another.

hierarchy - a system structure (or control function) in which the components of the system may be ranked by their importance in achieving the system's goals.

implementation - the process by which a system or process is realized.

induced objective - an informal objective of a system which can only be deduced through direct observation of system activities.

lead time - the delay between the start of an activity or process and its completion.

measure - an indicator that expresses the magnitude or direction of system activities or outputs or the degree to which they are determined.

measure dimensionality - the number of measures used to describe each activity, behavior or output.

measurement - the act by which dimensions of system behavior, activities and outputs are estimated.

measurement goals - the goals of the measurement process cast in very general terms.

measurement process - the totality of measurement activities directed by specified measurement goals.

measurement strategy - a policy which defines the data to be collected and the tactical aspects of acquiring, summarizing and evaluating it in accordance with the measurement goals.

measure orientation - a means of categorizing the measures being applied, the orientation of a measure relates the goals of measurement to specific system behaviors and outputs.

methodology - the techniques or disciplines used in the refereed material.

MIS - Management Information System, usually computerized.

objective - the operational expression whose achievement through system behavior contributes to the attainment of the system's goals.

output adequacy - often a goal of performance measurement attempting to systematically measure the attainment of output-related system goals and objectives.

process - a series of activities which are unified by a primary set of goals held in common. (See also measurement process.)

process implementation - the realization of the measurement process, the aim of all performance measurement, must include elements of process control: actualization, monitoring, evaluation and modification.

sampling - the process by which individual elements of a population are examined; such techniques of data collection are used to measure system activities, behaviors, outputs.

service - work that contributes to the welfare of another or which performs activities for him.

strategy - (see measurement strategy.)

strategy and process implementation preliminaries - a necessary step of strategy formulation which coordinates both the measurement goals with strategy development and the strategy with the measurement process, both with an eye on the implementation of the process.

strategy development - the process of measurement strategy formulation must precede the measurement process and its formulation.

subsystem - a component of or a subordinate to a system.

system - an entity having one or more components or activities which exhibits goal-oriented behavior within its environment.

system activity - a system's observable behavior, directed toward achieving its objectives or induced objectives.

system behavior - the entirety of activities performed by a system, including those which are observable and those which can only be inferred or theorized.

system capability - one possible goal of performance measurement, it relates to the measurement of system traits conducive to the attainment of system goals.

system component - an element of the system which may be, for example, a person, an organization, or even a geographic region.

system efforts - a likely goal of performance measurement that focuses on the estimation of the process of conversion of system resources and behaviors into desirable outputs.

system genre - the classification of the system by its attributes, behavior, outputs, or goals.

system output - the result of system activities might be a goal of performance measurement; in the case of service-oriented systems, a subset of these activities themselves may be the goal.

system structure - the arrangement of system components, often relative to either physical or control function order.

timeliness - the fact that an event occurs during a desired epoch.

validation - the process by which a system or another process is determined to be sound or fit to achieve its goals.

APPENDIX IIC

Keyword Definitions

Category 1: Contents of Article

Select at least one keyword which best describes the type of reference being cited.

- 1 - 01 Case Study. A specific application of performance measurement technology is examined.
- 1 - 02 Empirical Analysis. Two or more applications of measurement technology are compared/contrasted.
- 1 - 03 Literature Survey. Relevant literature is cited and evaluated.
- 1 - 04 Measurement Conceptualization. Description or formulation of process, measure, strategy in performance measurement.
- 1 - 05 Survey Analysis. Report and evaluation of questionnaires from measurement technology users or system personnel.
- 1 - 06 System Conceptualization. Theory and models of the system are developed, discussed or evaluated.

Category 2: System Genre

Select at least one keyword for each reference. If a particular system is not emphasized in a theoretical paper, select keyword 1-20.

- 1 - 07 CJS. The entire Criminal Justice System is emphasized.
- 1 - 08 Corrections. Prisons, jails, half-way houses, probation, parole, etc.
- 1 - 09 Courts. Adult or juvenile courts, preliminary hearings,

judicial activities, etc.

- 1 - 10 Juvenile Justice. Juvenile court and correctional institutions and activities.
- 1 - 11 Police. All police activities.
- 1 - 12 Prosecution or Defense. Criminal prosecutor or public defender roles.
- 1 - 13 Defense. Military systems.
- 1 - 14 Education. Primary, secondary, college and other educational or research systems.
- 1 - 15 Health. Medical delivery systems.
- 1 - 16 Mechanical. Physical or machine systems are emphasized rather than human enterprise systems.
- 1 - 17 Production. Systems related to the production of goods.
- 1 - 18 Public Service. Systems which serve the public and which are not mentioned elsewhere.
- 1 - 19 Service. Systems which provide services not for general consumption (i.e., offered by the private sector).
- 1 - 20 General. Systems which do not fall into one of the other categories; or, the article discusses systems in general or a generally-applicable methodology.

Category 3: System Structure

If the structure is evident, select a keyword for each component and/or activity relationship.

- 1 - 21 Single Component. The system is composed of one structural element.
- 1 - 22 Parallel Components. The system has two or more elements,

essentially functionally independent, or which provide a degree of subsystem redundancy.

- 1 - 23 Serial Components. The system possesses two or more elements in which the performance of one or more subsystems depends upon the performance of other subsystems.
- 1 - 24 Hierarchical Components. System components are related by a pyramidal control function which is dictated by an element's position in the structure. Hierarchical structure usually implies information exchanges and a supreme controller at the "top" of the pyramid.
- 1 - 25 Single activity. The system performs one function or a single activity.
- 1 - 26 Parallel Activities. Two or more system activities are performed simultaneously or independently of one another.
- 1 - 27 Serial Activities. Two or more activities are performed sequentially in a process.
- 1 - 28 Hierarchical Activities. Activities performed by the system may be ranked by their immediacy in achieving system goals.

Category 4: System's Goal Structure

Choose keywords that the author(s) of the reference might have used to describe the structure of the system's goal.

- 1 - 29 Mechanical. No goals exist.
- 1 - 30 Single Goal. The system has only one goal that motivates performance measurement. (Not applicable if "Multiple

Goals" appropriate.)

- 1 - 31 Multiple Goals. More than one system goal is known to exist.
- 1 - 32 Goal Conflicts. The author describes conflicts between system goals or between goal-oriented behaviors.
- 1 - 33 Objectives Conflict with Goals. Author(s) refers to conflicts between stated objectives and stated goals.
- 1 - 34 Objectives Conflict with Objectives. Author(s) cites examples of conflicts among stated objectives.
- 1 - 35 Induced objectives Conflict with Objectives. As shown by the author(s), induced objectives conflict with the stated objectives.
- 1 - 36 Induced Objectives Conflict with Goals. Author(s) cites inconsistencies between induced objectives and stated goals.

Category 5: Methodology

Select as many keywords as are appropriate to describe the methodologies used in the reference. At least one keyword from this category must be included for each reference.

- 1 - 37 Economics. The reference explains or models rational behavior using economic principles.
- 1 - 38 Evaluation. The reference deals with the appraisal of system behavior, structure, or function. (Contrast with organizational, measurement and system theories.)

- 1 - 39 Information Systems. Emphasizes data processing in measurement.
- 1 - 40 Mathematical Programming. Deterministic optimization methods for non-dynamic systems or processes.
- 1 - 41 Measurement Theory. The theory and technology of performance measurement.
- 1 - 42 Organizational Theory. Modeling, description, prescription of organizational structure and processes.
- 1 - 43 Probabilistic OR. Construction and optimization of probability models in Operations Research.
- 1 - 44 Psychometrics. Theory of mental performance measurement.
- 1 - 45 Simulation. Models are used to mimic system behavior.
- 1 - 46 Statistical Decision Theory. Decision analysis with incomplete information.
- 1 - 47 Statistical Inference. Parametric estimation and hypothesis testing.
- 1 - 48 Statistics - Descriptive. Histograms, sample moments, correlation and other simple statistics.
- 1 - 49 Statistics - Experimental Design. Analysis of variance and covariance, and experimental and quasi-experimental design.
- 1 - 50 Statistics - Nonparametric. Statistical inference for distribution-free and non-parametric problems.
- 1 - 51 Statistics - Regression. Statistical model building (contrast with "Statistics - Time Series"); includes most econometric model building.

- 1 - 52 Statistics - Sampling. Technique for collecting data based on the statistical properties of estimators and costs of data collection.
- 1 - 53 Statistics - Time Series. Statistical model building of data assumed to be generated by stochastic processes.
- 1 - 54 Systems Theory. Technology for modeling and analysis of dynamic systems.

Category 6: Measure Characteristics

Four pairs of attributes exist. A single performance measure must be described by one keyword from each pair. Multiple measures may require that both keywords in some pairs be chosen.

- 1 - 55 Absolute. (Contrast with "Relative.")
- 1 - 56 Relative. A comparative measure.
- 1 - 57 Direct. (Contrast with "Surrogate.")
- 1 - 58 Surrogate. A measure used in the place of another.
- 1 - 59 Objective. (Contrast with "Subjective.")
- 1 - 60 Subjective. A perceived measure, subject to interpretation.
- 1 - 61 Qualitative. (Contrast with "Quantitative.")
- 1 - 62 Quantitative. The measure expresses a quantity or amount.

Category 7: Measure Dimensionality

Choose at least one keyword for each measure of performance used or discussed.

- 1 - 63 Simple. The measure is composed of a single estimate of performance.

- 1 - 64 Composite. A single measure is a function of several simple measures.
- 1 - 65 Multiple, Complementary. More than one measure exists which together provide more information about a single behavior or output than each measure would separately.
- 1 - 66 Multiple. More than one measure exists, but they do not complement each other; e.g., they might be substitutes for each other, or they might measure unrelated behaviors, components or outputs.

Category 8: Relative Measures

Whether the "Relative" keyword in Category 6 is selected, at least one of the following should also be selected. A relative measure must be at least either "Competitive," "Historical," or "Normative."

- 1 - 67 Competitive. Measure compares behavior to that of another system or process. (Contrast with "Historical" and "Normative.")
- 1 - 68 Correlation. Simple, serial, multiple or partial correlations are used by the author(s).
- 1 - 69 Historical. Measure compares behavior to that of an earlier state. (Contrast with "Competitive" and "Normative.")
- 1 - 70 Normative. Measure compares behavior to that of an ideal system or to a specified objective. (Contrast with "Competitive" and "Historical.")
- 1 - 71 Ranking. An ordinal arrangement of performance measures

is presented.

- 1 - 72 Ratio. The ratio of two measures is the performance measure of interest.

Category 9: Measure Orientations

One or more of the following keywords should be included in a citation to categorize that which is being measured.

- 1 - 73 Impact. Measures the environment's response to the system.
- 1 - 74 Objective. Measures the degree of achievement of the system's objectives.
- 1 - 75 Process. Measures the internal behavior of the system.
- 1 - 76 Resource. Measures the resource consumption of the system.
- 1 - 77 Response. Measures the system's external behavior (viz, the behavior which impacts the system's environment).

Category 10: Measurement Goals

Choose those keywords which best describe the goals of performance measurement; it is not necessary that a keyword from each subcategory be selected. If other specific keywords are not appropriate in a subcategory, the default responses for each are: "Capability," "Effort," "Other Output" and "Adequacy."

System Capabilities

- 2 - 01 Adaptability. The system's aptitude for change.
- 2 - 02 Capability. The system's ability to meet its objectives or its goals.
- 2 - 03 Capacity. The system's capacity (e.g., prison capacity).

- 2 - 04 Control Effectiveness. The control function's effectiveness.
- 2 - 05 Goal Conflict. The degree to which system goals or objectives conflict.
- 2 - 06 Organizational Climate. The compatibility of system components.

System Efforts

- 2 - 07 Cost. The cost of system activities and maintenance.
- 2 - 08 Efficiency. The efficiency of system behavior.
- 2 - 09 Effort. The amount of effort expended by the system.
- 2 - 10 Productivity. The rate of production or system operation.
- 2 - 11 Resource Usage. The amount of resources consumed by the system.
- 2 - 12 Time Spent. The duration of system activities or processes.

System Outputs

- 2 - 13 Impact. The system's effect on its environment.
- 2 - 14 Quality. The quality of the system outputs, services or other activities.
- 2 - 15 Quantity. The quantity of output or activities.
- 2 - 16 Other Output. Any system's output variables not described by other Category 10 keywords.

Output Adequacy

- 2 - 17 Adequacy. The sufficiency of the system's output or its performance relative to its goals and objectives.

- 2 - 18 Breadth. The comprehensiveness, breadth or non-discriminatory nature of the outputs, activities or services provided by the system.
- 2 - 19 Effectiveness. The effectiveness of behavior or services of the system.
- 2 - 20 Equity. The fairness of activities or services provided by the system.
- 2 - 21 Reliability. The dependability of the system's output.
- 2 - 22 Timeliness. The timeliness of the system's output in achieving its goals or objectives.

Category 11: Issues in Strategy and Process Implementation

Select those keywords which best describe either the author's approach to measurement strategy and process formulation and implementation or his philosophy in these areas as developed in a theoretical presentation.

Preliminaries

- 2 - 23 Identify Behavior. Author identifies behavior or output to be measured.
- 2 - 24 Goal Classification. Author clearly identifies behaviors or outputs by orientation or goals of measurement.
(See Categories 9 and 10.)
- 2 - 25 System Classification. Author classifies behaviors or outputs according to system variables (e.g., structure, subsystem goals).
- 2 - 26 Exogenous Variables. Author identifies and evaluates the

effects of environmental factors on the system.

- 2 - 27 Staff Capabilities. Author discusses staff capabilities in implementing the measurement process.

Strategy Development

- 2 - 28 Develop Strategy. Author develops a measurement strategy.
- 2 - 29 MIS. Author discusses management information system requirements and capabilities.
- 2 - 30 MIS Costs. Author discusses information system costs and implementation.
- 2 - 31 Process Adaptability. The adaptability of the measurement process or how future enhancements can be implemented is discussed by author.
- 2 - 32 Lead Times. Author approximates the lead time before the measurement process becomes operational.

Process Implementation

- 2 - 33 Execute Strategy. Author executes the measurement strategy or otherwise implements the measurement process.
- 2 - 34 Validate Pilot. Author discusses a pilot implementation with emphasis on validation of the measurement process, measure and strategy.
- 2 - 35 Improve Measure. Author improves or recommends improvements to performance measures.
- 2 - 36 Improve Process. Author suggests enhancements or improves the measurement process.

Category 12: Empirical Issues in Implementation

Select any of the following issues that either are presented in an application or are discussed in theory.

- 2 - 37 Cost of Collection. Author discusses the cost of data collection.
- 2 - 38 How Collected. Tactical aspects of data collection are discussed.
- 2 - 39 How Much. The quantity of data collected (e.g., sample sizes) is presented.
- 2 - 40 When to Collect. The timing of data collection is discussed.
- 2 - 41 Who Collects. Author discusses who should or does collect the data and their qualifications for doing so.
- 2 - 42 Who Evaluates. Whose responsibility it is for evaluating the data and their credentials are examined.
- 2 - 43 Timeliness. The timeliness of the data in achieving the objectives of performance measurement is described.

III. REFEREE'S GUIDE

This Referee's Guide is an essential reference for both abstractors and users of the Compendium of Performance Measurement Literature. It contains a procedural overview for collecting, abstracting and codifying entries to the CPML files. The Overview of the CPML presented in the preceding section gives the reviewers an understanding of the informational needs of the performance measurement community of scientists and engineers and it delineates the requirements for CPML abstracts. Since criteria for selection of articles for inclusion in the data file were also given in that section, the referee is directed to read the Overview before proceeding with this Guide. In this Guide, the mechanics of abstraction and of compiling the abstract files are presented for the referee.

Abstract Preparation and File Compilation Procedures

To date, the preparation of abstracts has been separated from the responsibility for creating and maintaining the computer files of CPML. In the preparation of abstracts, a referee selects an article or other reference according to the criteria established in the Overview. The referee then skims the article, pulling from it information dictated by these guidelines. Being now ready to codify the citation for the abstract file, the following information is recorded on standard eighty-column coding forms:

1. format specification parameters for the citation in the CPML files,

2. bibliographic information on the reference,
3. a vector of classifying keywords to describe the contents of the reference, and
4. a brief abstract.

Each of these is discussed in detail later in this Guide.

The responsibility for maintaining the actual CPML files rests with one clerical assistant. This person periodically collects the coded citations and enters them into a temporary computer file. Later, after the computer file has been screened for logical, formatting, and typographical errors, the citations are appended to the permanent collection and a back-up of the file is stored on magnetic tape. The debugging of the temporary file is facilitated by computer software which is described in the next section of this report. Examples of how to write and update both the temporary and the permanent files are also presented there.

Citation Formats

In this section, the requirements for coding the references and developing usable abstracts are described. Format specification parameters are required for each reference (computer record) because of the non-uniform lengths of both bibliographic and abstracted information. These formatting parameters constitute the first line of each reference in the computerized abstract files. Also included on this first line is the year of publication of the citation and a code number which distinguishes the work as either a journal article, text, book chapter, monograph, thesis/dissertation, or book. Following the first line is the list of authors of the referenced work. The remainder of the biblio-

graphic citation begins on a new line of the file after the list of authors. This information is input in a form so that the citation may be transcribed directly to a formal document for publication.

The vector of classifying keywords begins on the line after the bibliographic material. There are 120 elements, each containing a binary response: "x" means the keyword is applicable to the reference, a blank space means that it is not. As there are only 80 spaces per line on the coding forms, the keyword vector consumes two lines in the library file.

The last item included for each reference is a referee-supplied abstract which further describes the material for performance measurement personnel. Because of the needs for specific information, the abstract is commonly not the same as that supplied by the authors. Abstracts average four eighty-character lines in length.

Each of the above informational requirements is now addressed in detail. Note that the term "record", referred to in several places below, is the totality of information coded for any one reference.

Line One Format. The first line of each record has a fixed format composed of five separate fields of information. Below are the column numbers and responses desired for each field.

columns 1-2: Specify the type of reference that is being abstracted.

- 01 -- journal article
- 02 -- book chapter
- 03 -- monograph or report
- 04 -- thesis or dissertation
- 05 -- entire book
- 06 -- conference proceedings

columns 3-4: Enter the year of publication (e.g., '78" means 1978)

columns 5-6: Record the number of authors of the reference. Note that this number must be right-justified (e.g., "05" means five authors); also, if a chapter is the reference, specify only the number of authors of the chapter. It is important that the number of editors/authors of a book not be combined with that of a chapter when the latter is being cited.

columns 7-8: Enter the number of lines of additional bibliographic information (minus authors' names) required to fully cite the reference. This is entered after the citation is recorded on the coding form.

columns 9-10: Enter the number of lines of abstract supplied by the reviewer. This is also deferred until the material is written onto the coding form.

Format for Authors' Names. The next information to be recorded is the names of the persons responsible for writing the entry--editors' names are not included in any case. The number of authors must agree with the number entered in columns 5 and 6 of line one. The names are entered on the second line of the record and each must be specified within 20 columns in the following format:

- columns 1-18: Last name of author,
- column 19: first initial, and
- column 20: second initial (or blank if none given).

Up to four author's names can be entered on each line of the coding form (beginning in columns 1, 21, 41, and 61), and additional lines

may be used as necessary when there are more than four authors. If there are fewer than four authors on a line, the remaining columns are left blank.

Authors must be listed in the order specified on the reference. If there is no identifiable author, specify "UNKNOWN" in place of a surname and enter 01 in columns 5-6 of line one. For authors whose names have appendages such as Jr., Sr., or III, these must be included along with the surname. The appendage is separated from the last name by a comma and ended with a period; there is no space between the two: e.g., "ADAMS, JR."

Bibliography Format. All bibliographic information other than the authors' names should be specified on the lines immediately following the list of authors. This information is to be formatted such that a direct transcription to paper will result in a bibliographic citation ready for use in a published piece. This information begins in column 1 of the first line following the authors' names, and it continues on as many lines as are necessary. When a word must be carried over to the next line, it is written through column 80, and without hyphenation continued beginning in column 1 of the next line. This rule applies as well to numbers such as dates or paging.

Below are some additional rules to be followed in composing the bibliographic citation. The accompanying examples are not necessarily appropriate references for inclusion in the Compendium.

1. All items in the bibliography must be followed by a comma; the entry is terminated by a period.
2. Only standard abbreviations may be used for months or states and for words such as volume (vol.), page(s) (p., pp.) and number (no.).

3. A literal transcription of book, chapter, article, and paper titles is required. There must be no abbreviations other than those used by the authors. Misspellings by the authors should be followed immediately by "(sic)".

4. Only standard abbreviations should be used for journal names and only when their use will not confuse the reader:

<u>Standard</u>	<u>Non-Standard</u>
SIAM Journal of Applied Mathematics	SIAM J. of App. Math.
AIIE Transactions	A.I.I.E. Transactions
Operations Research	O.R.
JASA	Journal of A.S.A.

5. For journal articles, the arrangement of the information must follow this order:

- a. article title (use quotation marks to indicate; final quote placed after delimiting comma, e.g., "Crime Rates,");
- b. journal title (underlining not necessary);
- c. journal volume;
- d. issue number (if available);
- e. date (month and year, quarter and year, year only, as available); and
- f. pagination.

Example: "Stochastic Properties of Waiting Lines," Operations Research, vol. 3, no. 3, 1955, pp. 255-261.

6. For a chapter in a book, the order is: chapter title (use quotes); page numbers and the word "in" followed by book title; editor's name (first and second initials followed by surname; for multiple editors, list all, separating the last two by "and" using no comma) followed by "ed." or "eds."; publisher; city; and copyright year.

Example: "Stopping-Rule Problems," pp. 284-319 in Applied Combinatorial Mathematics, E. F. Beckenbach, ed., John Wiley and Sons, New York, 1964.

7. For a book, the order of presentation is: book title, publisher's name, city, copyright year.

Example: Principles of Operations Research, second edition, Prentice-Hall, Boston, 1975.

8. For monographs, theses or unpublished reports, use the order: title, miscellaneous information, publisher or other source, location of source, year.

Examples: a) Sourcebook of Criminal Justice Statistics - 1976, National Criminal Justice Information and Statistics Service, Washington, D.C., 1977.

b) "A Performance Comparison of Labelling Algorithms for Calculating Shortest Path Trees," Technical Note #772, National Bureau of Standards, Washington, D.C., 1973.

c) Application of Kalman Filtering to Parameter Estimation of Macroeconomic Models, M. S. Thesis, Massachusetts Institute of Technology, Cambridge, Mass., 1974.

Keyword Format. There are 120 keywords to be marked—77 on the first line following the bibliographical citation, and 43 on the second. The keywords and their definitions are given in Appendices IIB and IIC. Mark an "X" in the column which corresponds to each keyword that applies to the article, leaving all other columns blank. A two-page keyword guide is furnished in Appendix IIIB to facilitate marking the coding form. The keyword names are typed along one edge of the guide so that when it is placed on the coding form it will help to eliminate errors in marking the coding form. Note that whenever the applicability of a keyword is questionable even after consulting the dictionary of keywords in Appendix IIC, the keyword should be marked as applicable in order to let the user of the CNPL be the final judge of its merit.

Abstract Format. The purpose of the abstract is to complement the information presented previous to it. It should be brief and concise. Complete sentences are not essential as long as the points are conveyed. The abstract should not contain judgmental information from the referee but should describe the system in more detail than the keywords can provide. Information regarding the specific methodology used and the major limiting assumptions can also be presented here. In essence, what is desired is any information not given elsewhere which highlights the reference's contribution to performance measurement theory and application. (Reconsider the Overview of the CPML for further clarification.) Hyphenate words that do not fit on a line (unlike the procedure for entering bibliographic citations). Return to line one to fill in columns 9 and 10 when the abstract has been coded.

APPENDIX IIIA

Sample Coded Reference

On the following page, a completely coded reference is shown on the standard coding form. Referees should try to find the citation on their own and go through the steps of recording the necessary information as specified in this report, comparing their responses (keywords, abstract) to those given here.

APPENDIX IIIB

Keyword Guide

On the following pages are the guides which should be used by the referee to mark the appropriate keywords on the coding forms. The use of such guides should eliminate most errors in recording the keywords in the CPML. The definitions, contained in Appendix IIC, should be referred to whenever the applicability of a keyword for a particular reference is in question.

1	Case Study	Contents of Article
2	Empirical Analysis	
3	Literature Survey	
4	Measurement Conceptualization	
5	Survey Analysis	
6	System Conceptualization	System Genre
7	CJS	
8	Corrections	
9	Courts	
10	Juvenile Justice	
11	Police	
12	Prosecution or Defense	
13	Defense	
14	Education	
15	Health	
16	Mechanical	
17	Production	
18	Public Service	
19	Service	
20	General	
21	Single Component	System Structure
22	Parallel Components	
23	Serial Components	
24	Hierarchical Components	
25	Single Activity	
26	Parallel Activities	System's Goal Structure
27	Serial Activities	
28	Hierarchical Activities	
29	Mechanical	
30	Single Goal	
31	Multiple Goals	
32	Goal Conflicts	
33	Objectives Conflict with Goals	
34	Objectives Conflict with Objectives	
35	Induced Objectives Conflict with Objectives	
36	Induced Objectives Conflict with Goals	
37	Economics	Methodology
38	Evaluation	
39	Information Systems	
40	Mathematical Programming	
41	Measurement Theory	
42	Organizational Theory	
43	Probabilistic OR	
44	Psychometrics	
45	Simulation	
46	Statistical Decision Theory	
47	Statistical Inference	
48	Statistics - Descriptive	
49	Statistics - Experimental Design	
50	Statistics - Nonparametric	
51	Statistics - Regression	
52	Statistics - Sampling	
53	Statistics - Time Series	
54	Systems Theory	Measure Characteristics
55	Absolute	
56	Relative	
57	Direct	
58	Surrogate	
59	Objective	Measure Dimensionality
60	Subjective	
61	Qualitative	
62	Quantitative	Relative Measures
63	Simple	
64	Composite	
65	Multiple, Complementary	Measure Orientations
66	Multiple	
67	Competitive	
68	Correlation	
69	Historical	
70	Normative	
71	Ranking	
72	Ratio	
73	Impact	
74	Objective	
75	Process	
76	Resource	
77	Response	

Adaptability Capability Capacity Control Effectiveness Goal Conflict Organizational Climate	System Capabilities
Cost Efficiency Effort Productivity Resource Usage Time Spent	System Efforts
Impact Quality Quantity Other Output	System Outputs
Adequacy Breadth Effectiveness Equity Reliability Timeliness	Output Adequacy
Identify Behavior Goal Classification System Classification Exogenous Variables Staff Capabilities Develop Strategy	Preliminaries
MIS MIS Costs Process Adaptability Lead Times	Strategy Development
Execute Strategy Validate Pilot Improve Measure Improve Process	Process Implementation
Cost of Collection How Collected How Much When to Collect Who Collects Who Evaluates Timeliness	

Measurement Goals

Issues in Strategy and Implementation

Empirical Issues in Implementation

IV. USER'S GUIDE

This User's Guide serves two purposes. First and foremost, it tells the performance measurement user how to access the Compendium and it describes by way of examples how the keywords are used to retrieve entries from the files. Second, since reference retrieval depends only on the keyword matches that occur, the frequency with which each keyword occurs in the entire reference collection is tabulated as the selectivity of each keyword should first be evaluated by a user before actually using CPML software for retrieval.

Access Through the Sorting Program

The CPML sorting program provides the user access to the CPML data base by matching keywords as discussed in the Overview. It is an interactive program: it must be executed at the terminal; however, output may be obtained at the terminal or it may be routed to the Computer Center Line Printer.

To run the sorting program, updated copies of files ABS and KEYS are required; ABS contains all bibliographic citations and abstracts, and KEYS contains the keywords for each reference. These two files reduce the time and cost of accessing the data base over the alternative, which is to use directly the master file PMD containing the combined information (see section V., FILE MAINTENANCE GUIDE). After signing-on the terminal in batch mode (see CDC User's Manual), type

```
GET,PMSORT/UN=IE663AA.
CALL,PMSORT.
```

These two statements execute the following procedure file called PMSORT (procedure files contain batch commands for manipulating other files and executing programs):

```
RWF.
ATTACH,ABS/UN=IE663AA,M=READ.
ATTACH,KEYS/UN=IE663AA,M=READ.
GET,SORTER/UN=IE663AA.
SORTER.
```

PMSORT gets files ABS and KEYS and executes the sorting program. Its usage is discussed in the following section and the sample outputs given in Appendices IVC and IVD are described.

Sample Keyword Access Sessions

Once PMSORT begins executing, the user's interaction is structured into input and output phases and into a keyword selection (sorting) phase:

1. During the input phase, PMSORT prints instructions for selecting sets of references and a listing of the 120 keywords used.
2. The output phase asks the user how he wishes the output to be printed. The two output options are to print everything at the terminal or to have everything routed to the line printer at the Computer Center.
3. The sorting phase of PMSORT is divided into sessions with the condition that each session outputs those references that are represented by an interesting subset of the keywords defined by a user. Thus, one or more sessions produce the same number of independent lists of references for perusal by the user.

In the input phase, the program first asks the user if instructions and/or a menu of keywords is desired. If the response is "yes", the

program also asks if a keyword menu is needed. In Appendix IVC, the user did not want a list of keywords. After the instructions have been printed, Session Number 1 begins. (Multiple sessions are possible; sample output appears in Appendix IVD.) The first keyword entered is 219, which matches 243 references. The number of references is subsequently narrowed to two by inputting qualifying keywords 107, 202, and 206. In terms of literal keywords, the user's focus was on:

219 - Effectiveness

107 - Criminal Justice System

202 - Capability

206 - Organizational Climate

The next keyword entered is "000." It indicates that the sorting process for all sessions is complete, i.e., no additional sessions are desired. The abstract and bibliographic citations of the matched references are to be output to some output device. The system now asks the user if inter-record keywords are desired. Inter-record keywords provide the user with a table of all the possible keywords associated with each matched reference. The user's response to the last question next indicates whether the output should be printed at the Computer Center's line printer, or if it should be output at the terminal. Frequently the output will be rather long, in which case it is a good idea to route the output to the high-speed line printer.

In Appendix IVD, multiple session use of PMSORT is demonstrated. The two lists of bibliographical and abstract materials selected by the two subsets of keywords is disposed to the line printer at the Computer Center.

APPENDIX IVA

Keyword Menu

After a user becomes familiar with the 120 keyword definitions in Appendix IIC, this brief listing of the keywords will speed the usage of PMSORT.

KEYWORD MENU

CATEGORY 1 : CONTENTS OF ARTICLE

101-CASE STUDY
102-EMPIRICAL ANALYSIS
103-LITERATURE SURVEY

104-MEASUREMENT CONCEPTUALIZATION
105-SURVEY ANALYSIS
106-SYSTEM CONCEPTUALIZATION

CATEGORY 2 : SYSTEM GENRE

107-CRIMINAL JUSTICE SYSTEM
108-CORRECTIONS
109-COURTS
110-JUVENILE JUSTICE
111-POLICE
112-PROSECUTION OR DEFENSE
113-DEFENSE(MILITARY)

114-EDUCATION
115-HEALTH
116-MECHANICAL
117-PRODUCTION
118-PUBLIC SERVICE
119-SERVICE(PRIVATE SECTOR)
120-GENERAL SYSTEMS

CATEGORY 3 : SYSTEM STRUCTURE

121-SINGLE COMPONENT
122-PARALLEL COMPONENTS
123-SERIAL COMPONENTS
124-HIERARCHIAL COMPONENTS

125-SINGLE ACTIVITY
126-PARALLEL ACTIVITIES
127-SERIAL ACTIVITIES
128-HIERARCHIAL ACTIVITIES

CATEGORY 4 : SYSTEM GOAL STRUCTURE

129-MECHANICAL
130-SINGLE GOAL
131-MULTIPLE GOALS
132-GOAL CONFLICTS

133-OBJECTIVES CONFLICT (WITH GOALS)
134-OBJECTIVES CONFLICT (WITH OBJECTIVES)
135-INDUCED OBJECTIVES CONFLICT (WITH OBJECTIVES)
136-INDUCED OBJECTIVES CONFLICT (WITH GOALS)

CATEGORY 5 : METHODOLOGY

137-ECONOMICS
138-EVALUATION
139-INFORMATION SYSTEMS
140-MATHEMATICAL PROGRAMMING
141-MEASUREMENT THEORY
142-ORGANIZATIONAL THEORY
143-PROBABILISTIC OPERATIONS RESEARCH
144-PSYCHOMETRICS
145-SIMULATION

146-STATISTICAL DECISION THEORY
147-STATISTICAL INFERENCE
148-STATISTICS-DESCRIPTIVE
149-STATISTICS-EXPERIMENTAL DESIGN
150-STATISTICS-NONPARAMETRIC
151-STATISTICS-REGRESSION
152-STATISTICS-SAMPLING
153-STATISTICS-TIME SERIES
154-SYSTEMS THEORY

CATEGORY 6 : MEASURE CHARACTERISTICS

155-ABSOLUTE
156-RELATIVE
157-DIRECT
158-SURROGATE

159-OBJECTIVE
160-SUBJECTIVE
161-QUALITATIVE
162-QUANTITATIVE

CATEGORY 7 : MEASURE DIMENSIONALITY

163-SIMPLE
164-COMPOSITE

165-MULTIPLE, COMPLEMENTARY
166-MULTIPLE, UNRELATED

CATEGORY 8 : RELATIVE MEASURES

167-COMPETITIVE
168-CORRELATION
169-HISTORICAL

170-NORHATIVE
171-RANKING
172-RATIO

CATEGORY 9 : MEASURE ORIENTATIONS

173-IMPACT
174-OBJECTIVE
175-PROCESS

176-RESOURCE
177-RESPONSE

CATEGORY 10 : MEASUREMENT GOALS

SYSTEM CAPABILITIES

201-ADAPTABILITY
202-CAPABILITY
203-CAPACITY

204-CONTROL EFFECTIVENESS
205-GOAL CONFLICT
206-ORGANIZATIONAL CLIMATE

SYSTEM EFFORTS

207-COST
208-EFFICIENCY
209-EFFORT

210-PRODUCTIVITY
211-RESOURCE USAGE
212-TIME SPENT

SYSTEM OUTPUTS

213-IMPACT
214-QUALITY

215-QUANTITY
216-OTHER OUTPUTS

OUTPUT ADEQUACY

217-ADEQUACY
218-BREADTH
219-EFFECTIVENESS

220-EQUITY
221-RELIABILITY
222-TIMELINESS

CATEGORY 11 : KEY ISSUES IN STRATEGY AND IMPLEMENTATION

PRELIMINARIES

223-IDENTIFY BEHAVIOR
224-GOAL CLASSIFICATION
225-SYSTEM CLASSIFICATION

226-EXOGENOUS VARIABLES
227-STAFF CAPABILITIES

STRATEGY DEVELOPMENT

228-DEVELOP STRATEGY
229-MANAGEMENT INFORMATION SYSTEMS
230-MANAGEMENT INFORMATION SYSTEM COSTS

231-PROCESS ADAPTABILITY
232-LEAD TIMES

PROCESS IMPLEMENTATION

233-EXECUTE STRATEGY
234-VALIDATE PILOT

235-IMPROVE MEASURE
236-IMPROVE PROCESS

CATEGORY 12 : EMPIRICAL ISSUES IN IMPLEMENTATION

237-COST OF COLLECTION
238-HOW COLLECTED
239-HOW MUCH
240-WHEN TO COLLECT

241-WHO COLLECTS
242-WHO EVALUATES
243-TIMELINESS

APPENDIX IVB

Keyword Frequency Distribution

To determine the selectivity of the keywords for designing the PMSORT usage sessions, the frequency with which each keyword appears in the data base should be consulted. This distribution follows for the current 664 references.

<u>KEYWORD NUMBER</u>	<u>FREQUENCY</u>	<u>PERCENT OF TOTAL REFERENCES</u>
101	325	48.9
102	84	12.7
103	57	8.6
104	384	57.8
105	116	17.5
106	178	26.8
107	46	6.9
108	33	5.0
109	25	3.8
110	9	1.4
111	52	7.8
112	8	1.2
113	12	1.8
114	23	3.5
115	37	5.6
116	15	2.3
117	84	12.7
118	86	13.0
119	25	3.8
120	474	71.4
121	162	24.4
122	326	49.1
123	146	22.0
124	140	21.1
125	116	17.5
126	179	27.0
127	164	24.7
128	136	20.5
129	31	4.7
130	265	39.9
131	300	45.2
132	75	11.3
133	14	2.1
134	12	1.8
135	2	.3
136	6	.9
137	69	10.4
138	497	74.8
139	76	11.4
140	65	9.8
141	238	35.8
142	125	18.8
143	76	11.4
144	92	13.9
145	90	13.6

146	38	5.7
147	100	15.1
148	181	27.3
149	64	9.6
150	20	3.0
151	101	15.2
152	54	8.1
153	73	11.0
154	62	9.3
155	209	31.5
156	330	49.7
157	365	55.0
158	177	26.7
159	303	45.6
160	209	31.5
161	227	34.2
162	404	60.8
163	137	20.6
164	235	35.4
165	282	42.5
166	152	22.9
167	211	31.8
168	59	8.9
169	105	15.8
170	135	20.3
171	90	13.6
172	48	7.2
173	159	23.9
174	303	45.6
175	399	60.1
176	196	29.5
177	222	33.4

201	104	15.7
202	384	57.8
203	69	10.4
204	161	24.2
205	50	7.5
206	134	20.2
207	93	14.0
208	130	19.6
209	261	39.3
210	79	11.9
211	172	25.9
212	64	9.6
213	185	27.9
214	173	26.1
215	165	24.8
216	317	47.7
217	247	37.2
218	89	13.4
219	243	36.6
220	62	9.3

221	66	9.9
222	55	8.3
223	414	62.3
224	324	48.8
225	260	39.2
226	95	14.3
227	111	16.7
228	452	68.1
229	79	11.9
230	13	2.0
231	159	23.9
232	13	2.0
233	342	51.5
234	158	23.8
235	104	15.7
236	99	14.9
237	21	3.2
238	342	51.5
239	95	14.3
240	55	8.3
241	116	17.5
242	224	33.7
243	43	6.5

APPENDIX IVC

Sample Outputs--Single Session

Output for two uses of PMSORT can be found in this and the following appendices. In this appendix, a complete listing of a single session (only one subset of keywords specified) is shown, with the inter-record keyword matches also printed.

PERFORMANCE MEASUREMENT REVIEW DATA BASE RETREIVAL PROGRAM

DO YOU WANT INSTRUCTIONS AND/OR A MENU OF KEYWORDS ? (YES OR NO)
? YES
DO YOU WANT A LISTING OF KEYWORDS ?
? NO

KEYWORD CODES SHOULD BE ENTERED AS 3-DIGIT NUMBERS, AS PRESENTED IN THE KEYWORD MENU. THE FIRST DIGIT OF THE KEYWORD SHOULD ALWAYS BE A 1 OR A 2, TO INDICATE WHICH CLASS THE KEYWORD IS IN. FOR EXAMPLE, A POSSIBLE KEY INPUT IS: 101 FOR CASE STUDY. ONCE THE INITIAL KEYWORD HAS BEEN ENTERED, ALL RECORDS MATCHING THAT KEY ARE LOCATED. ADDITIONAL KEYS MAY BE ENTERED TO FURTHER QUALIFY THE SORTING PROCESS. THE ITERATIVE PROCESS WILL CONTINUE UNTIL ALL POSSIBLE KEYWORDS HAVE BEEN ENTERED, OR UNTIL '000' IS INPUT AS A KEY. '000' DISCONTINUES THE SORTING PROCESS, AT WHICH POINT ALL EXISTING MATCHES WILL BE PRINTED.

AN INPUT OF '100' ALLOWS MULTIPLE SORTING SESSIONS, WITHOUT PRINTING OF FINAL MATCHED RECORDS FROM EACH SESSION. INPUTTING '100' WILL BEGIN ANOTHER SESSION. AN INPUT OF '000' WITH MULTIPLE SESSIONS WILL OUTPUT FINAL MATCHED RECORDS FROM ALL SESSIONS.

SESSION NUMBER 1

ENTER YOUR FIRST KEYWORD CODE:
? 219

A TOTAL OF 243 MATCH(ES) WERE MADE ON QUALIFYING KEYWORD 219 .

DO YOU WISH TO ENTER ANOTHER KEYWORD ? AN INPUT OF '000' DISCONTINUES THE SORT, AND EXISTING MATCHED RECORDS WILL BE PRINTED. '100' STOPS THE SORT AND STARTS ANOTHER SESSION :

? 107
QUALIFYING KEY 107 NARROWED DOWN RECORD MATCHES TO A TOTAL OF 22 .

ANOTHER KEY MAY BE ENTERED :
? 202
QUALIFYING KEY 202 NARROWED DOWN RECORD MATCHES TO A TOTAL OF 10 .

ANOTHER KEY MAY BE ENTERED :
? 206
QUALIFYING KEY 206 NARROWED DOWN RECORD MATCHES TO A TOTAL OF 2 .

ANOTHER KEY MAY BE ENTERED :
? 000

DO YOU WANT INTER-RECORD KEYWORD MATCHES FOR THIS SESSION ?
? YES

DO YOU WANT THE OUTPUT ROUTED TO THE COMPUTER
CENTER LINE PRINTER ?

1 =====
 SESSION NUMBER 1
 PERFORMANCE MEASUREMENT DATA BASE
 RESULTS OF SORT ON KEY WORD(S) :
 219 107 202 204
 =====

1.
 R B HOFFMAN
 "PRODUCTION FACTORS IN POLICING SERVICES," DECISION SCIENCES, VOL. 2, PT. 3, 197
 1, PP. 432-447.

ANALYSIS OF PRODUCTION FACTORS IN THE PROVISION OF POLICING SERVICES IN TERMS OF
 EFFICIENCY, EFFICIENCY OF THE USE OF EXISTING RESOURCES, ALTERNATIVE RESOURCE
 USE, ALTERNATIVE TECHNOLOGIES AND TASKS IS EVALUATED. SUGGESTS MORE PROFESSION-
 ALISM TO IMPROVE POLICE SERVICES.

2.
 A BLUMSTEIN
 "MANAGEMENT SCIENCE TO AID THE MANAGER: AN EXAMPLE FROM THE CRIMINAL JUSTICE SYS
 TEM," SLOAN MANAGEMENT REVIEW, VOL. 15, NO. 1, 1973, PP. 35-48.

COMPUTER MODEL DESIGNED FOR MGRS IN CJS CALLED JUSSIM IS DEV'LD. MODEL STRUCTURE
 OUPUTS, OPERATIONS ARE DISCUSSED, FEEDBACK MODEL, IMPLEMENTATION, APPLICATIONS
 ARE DISCUSSED . HELP MGRS USE MGT SCIENCE TOOLS.

1
 =====

INTER RECORD KEYWORDS

1
 CONTENTS OF ARTICLE

		KEYWORDS					
ARTICLE		101	102	103	104	105	106
1			X				
2					X	X	

1
 SYSTEM GENRE

		KEYWORDS												
ARTICLE		107	109	110	111	112	113	114	115	116	117	118	119	120
1		X											X	

KEYWORDS	
ARTICLE	121 122 123 124 125 126 127 128
1	X
2	X X

1
SYSTEM GOAL STRUCTURE

KEYWORDS	
ARTICLE	129 130 131 132 133 134 135 136
1	X
2	X

1
METHODOLOGY

KEYWORDS	
ARTICLE	137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154
1	X
2	X X X X X

137-ECONOMICS
 138-EVALUATION
 139-INFORMATION SYSTEMS
 140-MATHEMATICAL PROGRAMMING
 141-MEASUREMENT THEORY
 142-ORGANIZATIONAL THEORY
 143-PROBABILISTIC OPERATIONS RESEARCH
 144-PSYCHOMETRICS
 145-SIMULATION

146-STATISTICAL DECISION THEORY
 147-STATISTICAL INFERENCE
 148-STATISTICS-DESCRIPTIVE
 149-STATISTICS-EXPERIMENTAL DESIGN
 150-STATISTICS-NONPARAMETRIC
 151-STATISTICS-REGRESSION
 152-STATISTICS-SAMPLING
 153-STATISTICS-TIME SERIES
 154-SYSTEMS THEORY

1
MEASURE CHARACTERISTICS

KEYWORDS	
ARTICLE	155 156 157 158 159 160 161 162
1	X
2	X X X X

1
MEASURE DIMENSIONALITY

KEYWORDS	
ARTICLE	163 164 165 166
1	X
2	X

1
RELATIVE MEASURES

ARTICLE	167	168	169	170	171	172
	N O N E					

1 MEASURE ORIENTATIONS

KEYWORDS						
ARTICLE	173	174	175	176	177	
1				X		
2		X				

1 MEASUREMENT GOALS

SUB-CATEGORIES:	KEYWORDS:
SYSTEM CAPABILITIES	202 - 206
SYSTEM EFFORTS	207 - 212
SYSTEM OUTPUTS	213 - 216
OUTPUT ADEQUACY	217 - 222

KEYWORDS																						
ARTICLE	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222
1		X		X		X		X		X				X		X		X		X		
2		X				X			X	X					X	X		X		X		

1 KEY ISSUES IN STRATEGY AND IMPLEMENTATION

SUB-CATEGORIES:	KEYWORDS:
PRELIMINARIES	223 - 227
STRATEGY DEVELOPMENT	228 - 232
PROCESS IMPLEMENTATION	232 - 236

KEYWORDS														
ARTICLE	223	224	225	226	227	228	229	230	231	232	233	234	235	236
1				X										
2			X		X	X	X		X					

1 EMPIRICAL ISSUES IN IMPLEMENTATION

KEYWORDS						
ARTICLE	237	238	239	240	242	243
2	X			X		

APPENDIX IVD

Sample Outputs—Multiple Sessions

Here, the output for two subsets of keywords (i.e., two sessions) is shown, minus the listing of the chosen references themselves. The actual listing of the references has been directed to the line printer at the computer center to save time at the terminal.

PERFORMANCE MEASUREMENT REVIEW DATA BASE RETRIEVAL PROGRAM

DO YOU WANT INSTRUCTIONS AND/OR A MENU OF KEYWORDS ? (YES OR NO)
? NO

SESSION NUMBER 1

ENTER YOUR FIRST KEYWORD CODE:
? 145

A TOTAL OF 90 MATCH(ES) WERE MADE ON QUALIFYING KEYWORD 145 .

DO YOU WISH TO ENTER ANOTHER KEYWORD ? AN INPUT OF '000' DISCONTINUES THE SORT, AND EXISTING MATCHED RECORDS WILL
BE PRINTED, '100' STOPS THE SORT AND STARTS ANOTHER SESSION !

? 100

DO YOU WANT INTER-RECORD KEYWORD MATCHES FOR THIS SESSION ?
? NO

SESSION NUMBER 2

ENTER YOUR FIRST KEYWORD CODE:
? 165

A TOTAL OF 202 MATCH(ES) WERE MADE ON QUALIFYING KEYWORD 165 .

DO YOU WISH TO ENTER ANOTHER KEYWORD ? AN INPUT OF '000' DISCONTINUES THE SORT, AND EXISTING MATCHED RECORDS WILL
BE PRINTED, '100' STOPS THE SORT AND STARTS ANOTHER SESSION !

? 124
QUALIFYING KEY 124 NARROWED DOWN RECORD MATCHES TO A TOTAL OF 01 .

ANOTHER KEY MAY BE ENTERED !

? 101
QUALIFYING KEY 101 NARROWED DOWN RECORD MATCHES TO A TOTAL OF 30 .

ANOTHER KEY MAY BE ENTERED !
? 000

DO YOU WANT INTER-RECORD KEYWORD MATCHES FOR THIS SESSION ?
? NO

DO YOU WANT THE OUTPUT ROUTED TO THE COMPUTER
CENTER LINE PRINTER ?
? YES

AFTER THIS PROGRAM ENDS AND CONTROL IS RETURNED TO THE MAIN PROCESSOR TYPE:
RUF
ROUTE,OTF,DC=LP,
THE OUTPUT CAN BE PICKED UP IN THE COMPUTER CENTER UNDER ACCOUNT 10.

====[NO]=====

16.165 CP SECONDS EXECUTION TIME
/RUF
RUF COMPLETE.
/ROUTE,OTF,DC=LP,
ROUTE COMPLETE.

V. FILE MAINTENANCE GUIDE

Ongoing maintenance of the data base is essential if the Compendium of Performance Measurement Literature is to be a useful research tool. In this Guide, the procedure necessary to do this is discussed. The creation and updating procedures for the master file are presented here, and the software needed to perform these operations are listed and briefly described. Next, the error-checking procedure is described and its interface with the updating procedure discussed. A necessary precaution in maintaining a data base such as CPML is the creation of a back-up file whose chance of being destroyed is minimal. The final segment of this Guide describes a procedure for creating a back-up file and storing it on magnetic tape.

File Creation and Updating

The CPML sorting program presented in the User's Guide for the purpose of retrieving reference abstracts requires two data files for input: ABS and KEYS. File ABS contains numbered abstracts and bibliographic material, while file KEYS contains the corresponding keyword streams associated with the abstracts. SORTER, the main sorting program performs all sorting on file KEYS. When all sorting is complete, the appropriate abstracts are retrieved from file ABS. It is therefore necessary to create and update these files as PMD, the master data file containing bibliographic information, abstracts, and keywords, is added to or modified.

For this purpose, procedure file UPDATE was created. UPDATE contains the following code:

```
ATTACH,PMD/UN=IE663AA.
COPY,PMD,MAIN.
RWF.
GET,CREATE.
PURGE,KEYS.
PURGE,ABS.
RETURN,ABS,KEYS.
DEFINE,ABS.
DEFINE,KEYS.
CREATE.
RETURN,CREATE.
RETURN,MAIN.
GET,SORTER.
CH,KEYS/CT=PU.
CH,ABS/CT=PU.
STATUS,F.
```

When UPDATE executes either new versions of ABS and KEYS replace the older ones, or if they do not already exist, they are created for the first time. UPDATE should be run in the account desired to hold ABS and KEYS, presently IE663AA, using the next two commands:

```
GET,UPDATE.
CALL,UPDATE.
```

Whenever certain errors are present in PMD, program CREATE, which is executed by UPDATE, will not run successfully and an error message will result. (See error-checking section.)

Once ABS and KEYS have been updated the interactive sorting program may be used any number of times. (See USER'S GUIDE--Access Through the Sorting Program.)

Error Checking

The CPML data base file, PMD, containing abstracts with inserted keywords, is the input file for program UPDATE; UPDATE reads file PMD and creates two direct-access files, ABS and KEYS. File ABS contains sequenced abstract text, while file KEYS contains the corresponding numbered

In order for a run of UPDATE to complete, file PMD must be free of errors. This fact provides an error-checking function. Program CREATE is the heart of the UPDATE procedure file, and it alone can be used to detect errors in PMD formatting. Note that format errors are the only errors detected; grammatical and typographical errors will remain undiscovered.

To use CREATE as an error-checking device, all that is needed is to run CREATE, with MAIN (an exact copy of PMD created by the statement COPY,PMD,MAIN) in the input file and with ABS and KEYS available for updating. The necessary commands are:

```
ATTACH,PMD/UN=IE663AA.
GET,CREATE.
COPY,PMD,MAIN.
ATTACH,ABS/M=W.
ATTACH,KEYS/M=W.
CREATE.
```

Two cases will result:

- a) CREATE executes successfully; therefore, no formal errors exist in PMD=MAIN.
- b) CREATE does not execute and a FORTRAN run-time error results.

The error will usually indicate a PND=MAIN line number and be of the "illegal data in field" type. To correct the error, enter TED,PMD and examine the indicated line for the format error by entering the line number. If an error does not exist there, sequentially search the lines immediately above the indicated line, beginning with the first line preceding it, until the error is detected. Enter EXIT when the error is found. A common mistake involves line one formatting (see the REFEREE'S GUIDE).

Updating the Master Data File

To update the master file, PMD, a temporary file PMDB is used to debug new references, and it is then appended to the end of PMD. Procedure file CREATE (see above) is used to debug PMDB. To append PMDB to the end of PMD, use the commands:

```
ATTACH,PMD/UN=IE663AA,M=WRITE.
ATTACH,PMDB/UN=IE663AA,M=READ.
TED,PMD
ON BRIEF
LAST
ADD+PMDB
EXIT
REPLACE,PMD.
PURGE,PMDB.
DEFINE,PMDB.
```

PMD is now the old version of PMD with the old version of PMDB appended to the end, but PMDB is now void. The procedure files UPDATE and PMDTAPE (see first and last segments of this section) should then be run to create file KEYS and ABS, and the tape back-up file, respectively.

Note that, whenever new references are added to either the PMD or the PMDB files, an asterisk in the first column of an otherwise blank line must separate each reference in the files or an error will occur in running program CREATE. This asterisk helps to debug these files by simplifying the formatting checks. (See Appendix VA for a sample listing of PMD or PMDB, but note how the format changes in files ABS and KEYS as shown in Appendix VB.)

Back-Up File Creation

To prevent indiscriminate erasure of the master data file, PMD, a procedure file called PMDTAPE saves a copy on magnetic tape.

PMDTAPE will not run from the terminal, but it can be submitted on-line for execution as a batch job using the commands:

```
RETURN,PMD.
GET,PMDTAPE.
SUBMIT,PMDTAPE,B.
```

This procedure often takes over an hour to run. Whether or not PMDTAPE has finished running can be determined using the following

commands:

```
GET,PMDAY.
LIST,F=PMDAY.
```

The result is a listing of an executed version of PMDTAPE with the commands each preceded by the time at which it was executed. If these times do not correspond with those of the latest renewal of the tape back-up file, then the new back-up is not yet completed; otherwise, a listing of the new master back-up may be picked up at the computer center. In addition to a listing of the back-up file, a frequency distribution for the keywords from file KEYS is computed by PMDSTAT. This distribution is given in Appendix IVA for those references in PMD as of the date of this writing. Such output may be helpful in specifying the keyword subsets when compiling references by subject. (See USER'S GUIDE--Accessing Through the Sorting Program.)

Below is a listing of PMDTAPE for the back-up created on March 16 (note that the password for account number IE663AA must be added):

```
/JOB
ARCHIVE,T400.
USER,IE663AA,[password].
DEFINE,PMD316.
ATTACH,PMD/M=READ.
COPYEI,PMD,PMD316..
REWIND,PMD.
TED,PMD.
REWIND,PMD.
GET,PMDSTAT/M=READ.
FTN,I=PMDSTAT,L=0.
ATTACH,KEYS/M=READ.
LGO,KEYS.
RETURN,PMD316,PMD.
```

```
VSN,TAPE=C5667.
ARCHIVE,OP=DP.
DAYFILE.
RWF.
DAYFILE,PMDAY.
REPLACE,PMDAY.
EXIT.
DAYFILE,PMDAY.
REPLACE,PMDAY.
/EOR
LNP*
EXIT
/EOR
*FILE PMD316
/EOR
```

It is recommended before running PMDTAPE that the back-up file be given a name which corresponds to the date of its creation; hence, PMD316 corresponds to PMD--March 16 version. To change the name of the back-up file before running PMDTAPE, enter

```
GET,PMDTAPE/UN=IE663AA.
TED,PMDTAPE.
C /PMDmdd/PMDm'd'd'/A
EXIT
REPLACE,PMDTAPE/UN=IE663AA.
```

This permanently changes PMDTAPE so that the former date m-dd is everywhere changed to m'-d'd'. Note that the third and fourth lines above do not end with periods, and the C in line three is followed by a space.

If there is ever any question as to the name of the back-up file, listing PMDTAPE will clarify this:

```
GET,PMDTAPE.
LIST,F=PMDTAPE.
```

Also, if a listing of PMDAY shows that the first "EXIT." command is executed before "REPLACE,PMDAY.", then the following commands should be input before re-running PMDTAPE:

```
RETURN,PMD.
PURGE,PMDmdd.
PURGE,PMDm'd'd'.
```


APPENDIX VB

Sample ABS and KEYS Records

Five bibliographic citations accompanied by their abstracts are shown as an example of the format of file ABS. Similarly, file KEYS is shown for five sample references showing the reformatting used by CPML to speed the user's access to the bibliography. Note how both files have been reformatted; file KEYS has all 120 keywords for each reference on a single line, while both ABS and KEYS references are now numbered.

REFERENCES

- Control Data Corporation, NOS Version 1; Time-Sharing User's Manual—
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Criminal Justice System: Four Conceptual Approaches, National In-
stitute of Law Enforcement and Criminal Justice, United States
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END