



A11104 498580

NIST
PUBLICATIONS

NIST Special Publication 500-222

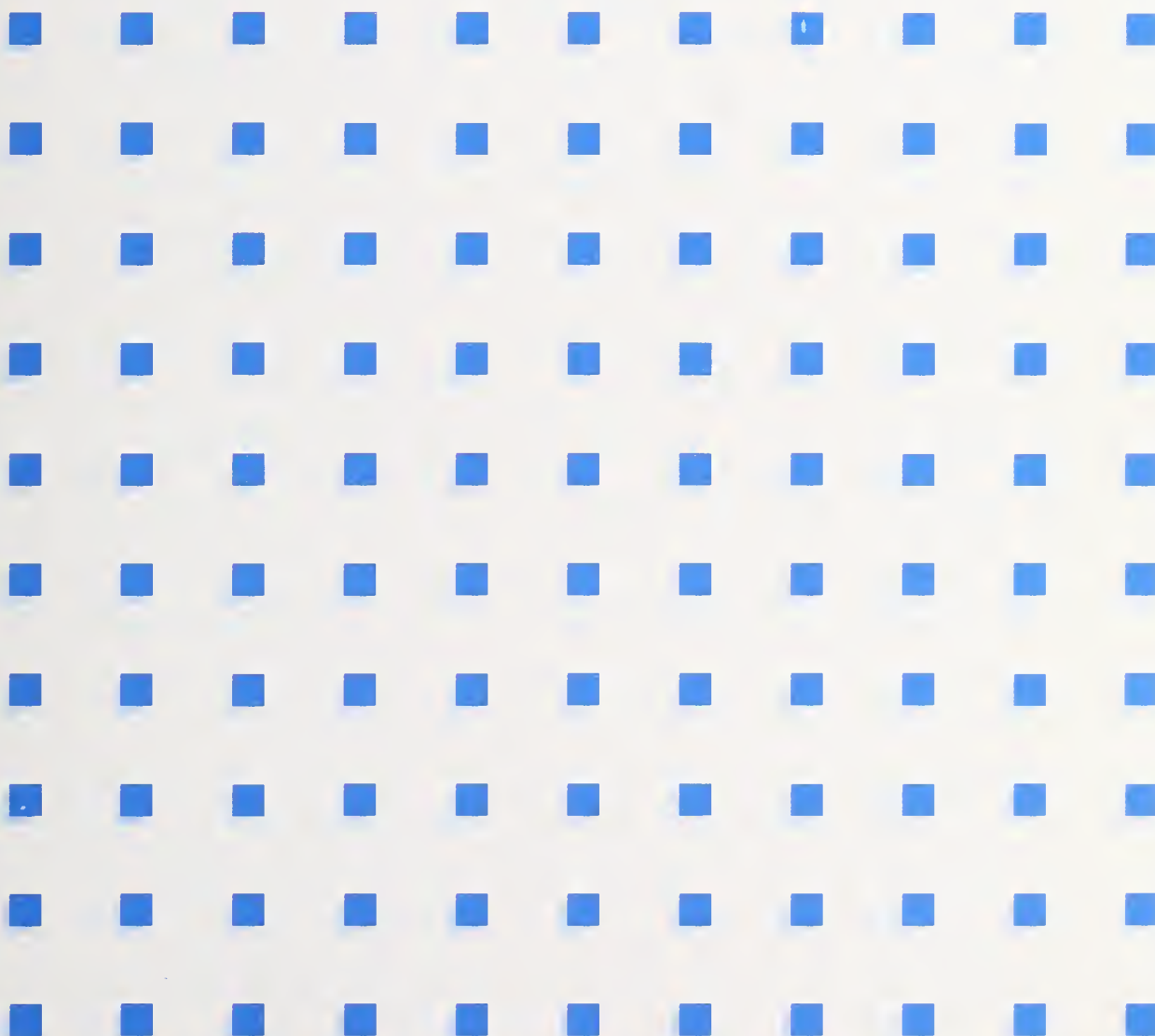
Computer Systems Technology

U.S. DEPARTMENT OF
COMMERCE
Technology Administration
National Institute of
Standards and
Technology

NIST

Glossary of Software Reuse Terms

Susan Katz
Christopher Dabrowski
Kathryn Miles
Margaret Law



QC
100
.U57

NO. 500-222
1994

The National Institute of Standards and Technology was established in 1988 by Congress to “assist industry in the development of technology . . . needed to improve product quality, to modernize manufacturing processes, to ensure product reliability . . . and to facilitate rapid commercialization . . . of products based on new scientific discoveries.”

NIST, originally founded as the National Bureau of Standards in 1901, works to strengthen U.S. industry’s competitiveness; advance science and engineering; and improve public health, safety, and the environment. One of the agency’s basic functions is to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for comparing standards used in science, engineering, manufacturing, commerce, industry, and education with the standards adopted or recognized by the Federal Government.

As an agency of the U.S. Commerce Department’s Technology Administration, NIST conducts basic and applied research in the physical sciences and engineering, and develops measurement techniques, test methods, standards, and related services. The Institute does generic and precompetitive work on new and advanced technologies. NIST’s research facilities are located at Gaithersburg, MD 20899, and at Boulder, CO 80303. Major technical operating units and their principal activities are listed below. For more information contact the Public Inquiries Desk, 301-975-3058.

Office of the Director

- Advanced Technology Program
- Quality Programs
- International and Academic Affairs

Technology Services

- Manufacturing Extension Partnership
- Standards Services
- Technology Commercialization
- Measurement Services
- Technology Evaluation and Assessment
- Information Services

Materials Science and Engineering Laboratory

- Intelligent Processing of Materials
- Ceramics
- Materials Reliability¹
- Polymers
- Metallurgy
- Reactor Radiation

Chemical Science and Technology Laboratory

- Biotechnology
- Chemical Kinetics and Thermodynamics
- Analytical Chemical Research
- Process Measurements²
- Surface and Microanalysis Science
- Thermophysics²

Physics Laboratory

- Electron and Optical Physics
- Atomic Physics
- Molecular Physics
- Radiometric Physics
- Quantum Metrology
- Ionizing Radiation
- Time and Frequency¹
- Quantum Physics¹

Manufacturing Engineering Laboratory

- Precision Engineering
- Automated Production Technology
- Intelligent Systems
- Manufacturing Systems Integration
- Fabrication Technology

Electronics and Electrical Engineering Laboratory

- Microelectronics
- Law Enforcement Standards
- Electricity
- Semiconductor Electronics
- Electromagnetic Fields¹
- Electromagnetic Technology¹
- Optoelectronics¹

Building and Fire Research Laboratory

- Structures
- Building Materials
- Building Environment
- Fire Safety
- Fire Science

Computer Systems Laboratory

- Office of Enterprise Integration
- Information Systems Engineering
- Systems and Software Technology
- Computer Security
- Systems and Network Architecture
- Advanced Systems

Computing and Applied Mathematics Laboratory

- Applied and Computational Mathematics²
- Statistical Engineering²
- Scientific Computing Environments²
- Computer Services
- Computer Systems and Communications²
- Information Systems

¹ At Boulder, CO 80303.

² Some elements at Boulder, CO 80303.

Glossary of Software Reuse Terms

Susan Katz
Christopher Dabrowski
Kathryn Miles
Margaret Law

Computer Systems Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

December 1994



U.S. Department of Commerce
Ronald H. Brown, Secretary

Technology Administration
Mary L. Good, Under Secretary for Technology

National Institute of Standards and Technology
Arati Prabhakar, Director

Reports on Computer Systems Technology

The National Institute of Standards and Technology (NIST) has a unique responsibility for computer systems technology within the Federal government. NIST's Computer Systems Laboratory (CSL) develops standards and guidelines, provides technical assistance, and conducts research for computers and related telecommunications systems to achieve more effective utilization of Federal information technology resources. CSL's responsibilities include development of technical, management, physical, and administrative standards and guidelines for the cost-effective security and privacy of sensitive unclassified information processed in Federal computers. CSL assists agencies in developing security plans and in improving computer security awareness training. This Special Publication 500 series reports CSL research and guidelines to Federal agencies as well as to organizations in industry, government, and academia.

National Institute of Standards and Technology Special Publication 500-222
Natl. Inst. Stand. Technol. Spec. Publ. 500-222, 32 pages (Dec. 1994)
CODEN: NSPUE2

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1994

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

PREFACE

The Computer Systems Laboratory (CSL) within the National Institute of Standards and Technology (NIST) has a mission under Public Law 89-306 (Brooks Act) to promote the "economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by federal departments and agencies." When a potentially valuable innovation in information technology first appears, CSL may be involved in research and evaluation. Later on, CSL may serve government interests by participating in standardization of the results of such research, in cooperation with voluntary industry standards bodies. Finally, CSL helps federal agencies make practical use of existing standards and technology through consulting services and the development of supporting guidelines and software.

If certain commercial software products and companies are identified in this report for purposes of specific illustration, such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products identified are necessarily the best available for the purpose.

ABSTRACT

One method proposed for increasing the efficiency of software production in the development of large, reliable software applications is the systematic reuse of existing software products. Effective software reuse will require new techniques to supplement traditional software engineering practices. Preliminary research has already produced new methods and reports. As a result, new terminology has emerged. This report provides a baseline set of recommended definitions for terms commonly used in the software reuse community. The glossary will be expanded as further research results become available and are evaluated for use in software reuse programs.

ACKNOWLEDGMENTS

The authors would like to acknowledge the contributions of Carmelo Montanez-Rivera and Rebecca Segal of NIST in doing early work in developing this glossary. Dr. C. Ronald Green and the CRWG Reuse Committee, Linda Brown, Stan Levine, Doug Rosson, Mason Myers, and members of the MIWG/RAAT/IRAG committee reviewed versions of this paper and provided valuable advice. We would also like to thank Thomasin Kirkendall, Dolores Wallace, Jay Watkins, Elwood Schneider, Arnold Johnson and Dr. Selden Stewart of NIST, as well as Spencer Peterson, Dr. Hasan Sayani, and David Wheeler. We would also like to thank Jeni Lindeman, Peggy Himes, and Dorothy Snyder for proofreading this document.

1. INTRODUCTION

One method proposed for increasing the efficiency of software production in the development of large, reliable software applications is the systematic reuse of existing software products. Successful software reuse will require techniques to supplement traditional software engineering practices. Research has already produced new methods, a growing body of technical literature, and a number of software systems developed through reuse. As a result, new terminology has emerged. The glossary provided in this report will serve as a baseline set of recommended definitions for use by the software reuse community.

1.1 Background

In 1992, the Ballistic Missile Defense Organization (BMDO) established a Manufacturing Operations Development and Integration Laboratory (MODIL) for software producibility at NIST to transition emerging technology from the research community to government and industry. The purpose of the MODIL was to promote software producibility through (1) integration and extension of new methods and techniques into operational products and (2) the transfer of these products from the laboratory environment to the field. Earlier versions of this report, under the BMDO project, were produced from January, 1993, through November, 1993.

In 1994, the Department of Defense (DoD) Software Reuse Management Issues Working Group (MIWG), the Special Interest Group - Ada (SIGAda) Reuse Working Group Reuse Acquisition Action Team (RAAT), and the Council of Defense and Space Industry Associations (CODSIA) Industry Reuse Advisory Group (IRAG) established a working group to address adoption of the glossary as a baseline document. Funding support was provided by the Defense Information Services Agency/Center for Information Management (DISA/CIM). A version of this report, dated October, 1994, was produced for use by the MIWG/RAAT/IRAG.

1.2 Purpose

The purpose of this report is to present a baseline glossary of software reuse terms. The report also outlines plans for maturing the glossary. The purpose of developing and maintaining the glossary is to promote a consistent understanding of software reuse terms used in DoD and industry and to provide common definitions for use in the software reuse community.

1.3 Audience

The intended audience of this report is:

- . The DoD software reuse community and other government agencies, industry, and academia involved in software reuse.

- . Personnel practicing reuse (e.g., software engineers).
- . Personnel engaged in management and planning.
- . The acquisition community.

1.4 How the Glossary Was Developed

DoD standards and program documents provided the background information base for developing the initial glossary. Recent reports from industry and academia were reviewed for additional terminology and usages. After this initial survey work was completed, the set of multiple definitions for each term was reviewed, and a recommended definition was either chosen or developed from the information obtained. Similar terms were compared. Related terms were cross-referenced. Where there were multiple terms for the same idea, the best term was chosen as the recommended term on the basis of the literature survey. The alternate terms are still captured in the glossary, to reflect real-world usage, but they refer the reader back to the definition of the preferred term.

2. USING THE GLOSSARY

The glossary is intended as a reference dictionary for anyone involved in software reuse. For any subject area, it provides a number of terms which are commonly in use, rather than just the recommended terms. Terms which may be synonyms of other terms are listed in their own right, so that they may be looked up alphabetically by users who encounter them in reuse literature or discussions. In these cases, the definition of the synonym will refer the reader to the recommended term where the actual definition is found.

Highlighted terms are defined elsewhere in the glossary. *Highlighted/italicized* words are defined in Appendix A - Related Software Engineering Terms. Where applicable, the glossary refers to related terms so that the reader can gain a broader understanding of the usage of the terminology (e.g., "See also...", "Compare..."). Where it was found in the reuse literature that several different terms were being used to mean the same thing, the glossary defines the recommended term and provides references to the recommended term from the alternate terms.

The reference provided for each definition represents the main source for that definition. The references are intended to acknowledge contribution and not necessarily to indicate an exact quote. Where no reference is attributed, the definition was synthesized from a number of sources and/or from a broad understanding of the topic area.

Generally, the glossary provides a single recommended definition for each term. Occasionally, alternate definitions are provided when terms are used in different contexts. In the future,

further alternative definitions may be added. A discussion of plans for maturing the glossary is provided in section 3.

Certain terms may have different meanings in different disciplines, such as in general software engineering, in domain analysis, or in reuse library systems. The glossary specifies the discipline context by the phrase "As used in . . . ," for example, "As used in Domain Analysis,"

For some terms, the definitions are followed by a paragraph marked "Discussion," explaining how the term is related to software reuse or to other terms in the glossary.

The glossary does not provide definitions for products or methods developed either commercially or in research institutions.

Appendix A contains definitions for related software engineering terms. It is provided as a quick reference for terms which do not have a definition specific to the context of reuse but are used in definitions found in the main glossary.

3. PLANS FOR MATURING THE GLOSSARY

Definitions will continue to be obtained from an ongoing survey of pertinent reuse literature and electronic access systems. As software reuse evolves and expands, the glossary will grow. It is important that the accumulation and evolution of terms occur in a consistent and controlled manner. To this end, the following guidelines for maturing the glossary are proposed:

- o New definitions will be added and existing definitions may be refined. Changes will be based on input from reviewers and on new literature that reflects experience with software reuse.
- o The number of sources from which terms are taken will be expanded. Sources especially relevant to DoD will receive primary consideration.
- o DoD directives, military standards, and documents will be used for guidance on selecting the definitions recommended for usage.
- o Cross-referencing will be expanded, emphasizing the relationships between terms.
- o Where it may be important, the origin and background of a term may be provided to give the reader greater insight into the usage of the term.

GLOSSARY

Adaptability:

The ease with which software can be modified to meet new *Requirements*. [DODSTR,p47]

Adaptation:

The process of modifying a **Software System** or **Asset** to perform its function in a different manner or on different data than was originally intended. [COHEN92,p14]

Architecture:

1. Organizational structure of a **System** or **Asset**. [ANSI90, p10]

2. The structure of **Components**, their interrelationships, and the principles and guidelines governing their *Design* and evolution over time.

Discussion:

It is recommended that the more specific terms (**Domain Architecture**, **Software System Design**) be used. There are also other types of **Architectures**, such as strategic **Architectures**, enterprise **Architectures**, standards **Architectures**, logical and physical **Architectures**, and hardware and software **Architectures**. Each has unique characteristics and may have unique *Applications*.

Asset:

Any product of the software life cycle that can potentially be **Reused**. This includes: **Domain Model**, **Domain Architecture**, *Requirements*, *Design*, code, *Databases*, *Database Schemas*, documentation, user manuals, test suites, etc. [DODV&S]

Discussion:

In **Reuse**, an **Asset** may be a distinct piece of information, or describe or perform a distinct function, or be a **Feature** of a **Software System**. An **Asset** is a part which is marked by its ability to be integrated into different wholes (e.g., **Software Systems**, **Domain Models**, *Designs*, etc.). Each of these wholes may, in turn, be considered an **Asset**. The term **Component** is a generic *Software Engineering* term that is often used as a synonym for **Asset**.

Compare: **Reusable Software Asset**

Asset Certification:

1. The process of assessing that an **Asset** correctly performs its stated function(s), adheres to quality and **Reuse** standards, and, possibly, is formally proven correct. [STARS1,p51]

2. Alternatively, the process of confirming that the information about an **Asset**, as given by the **Reuse Library**, is correct (including known errors).

Discussion:

To become part of a **Reuse Library**, an **Asset**, must be **Cataloged**. Some **Reuse Libraries** may also require **Asset Certification**.

Asset Evaluation:

The process of determining whether a particular **Asset** fits **Requirements** and **Constraints** of a particular **Software System** (as documented in its **Architecture**, or in its **Domain Model**). [STARS1,p51]

Discussion:

Asset Evaluation may occur when an **Asset** is about to be **Reused**, as opposed to **Asset Certification**, which occurs when the **Asset** is entered into the **Reuse Library**. **Evaluation** may also occur when a determination is made by a **Reuse Library** that an **Asset** fits a **Domain Model** or generic **Architecture**.

Asset Library:

Synonym for **Reuse Library**.

Catalog:

The index of information about **Assets** that is maintained for a **Reuse Library's** contents. [RIG93,p2]

Cataloging:

Placing information about an **Asset** into a **Software Reuse Library**. The **Asset** plus its **Catalog** information become a **Reusable Software Asset**. [DODSTR,pA-3]

Certification:

See **Asset Certification**

Cohesion:

1. The manner and degree to which the tasks performed by a single **Asset** are related to one another. [ANSI90,p11]
2. The degree to which an **Asset's** structure is unified in support of its function. [DODSTR,p47]
3. The degree of functional relatedness of processing elements within a single **Module**. [YOURDON,p407]

Discussion:

A high level of **Cohesion** in an **Asset** may aid in its **Reusability**.

Compare: **Coupling**

Cohesiveness:

See Cohesion

Commonality:

1. In **Domain Analysis**, an **Asset** or a distinct part, function, or **Feature** that is characteristic of the class of **Systems** within a **Domain** and that is represented in a **Domain Model** or **Domain Architecture**.

2. A measure of how common the problem (or *Application*) is that is being solved with a given **System**; one of the factors in program generality (and in **Reusability**). [YOURDON,p407]

Compare: **Difference**

Component:

One of the parts, either hardware or software, that make up a system. [ANSI90,p18] Often used as a synonym for **Asset**.

Constraint:

1. As used in software **Reuse** and **Reuse Libraries**, a rule or restriction governing the **Reuse** of **Assets**, particularly as relates to **Environment**.

2. As used in *Software Engineering*, a functional or operational **Requirement** for a **Software System** that limits the possible solution space. [STARS1,p51]

Context:

1. The circumstances, situation, or **Environment** in which a particular **Software System** or a **Domain** exists. [KANG90,p2][DODINIT,pB1][PETER91]

2. The academic discipline in which a particular term has meaning (e.g., the disciplines of *Software Engineering*, **Domain Analysis**).

Context Analysis:

The process of determining the scope and boundary of a **Domain**, as described in the **Feature-Oriented Domain Analysis** (FODA) Method. [KANG90] See **Domain Definition**.

Discussion:

In the **Domain Engineering** process, **Context Analysis** occupies the same place as **Domain Definition**, except that in FODA, **Context Analysis** emphasizes analysis of interaction between **Systems** in a **Domain** and the domain environment.

Coupling:

1. The degree of data or control connectivity between different **Assets** of a **Software System**. [DODSTR,p48]

2. The manner and degree of interdependence between **Assets**. [ANSI90,p22]

3. A measure of the strength of interconnection between one **Asset** and another. [YOURDON,p409]

Discussion:

A high degree of **Coupling** between **Assets** in a **Software System** may limit their **Reusability**.

Coupling makes modification to the **System** complex and difficult. Because **Coupled Assets** cannot be separated from each other easily and used alone, the scope of **Reuse** is narrowed.

Compare: **Cohesion**

Decoupling:

The process of making **Assets** more independent of one another to decrease the impact of changes to, and errors in, the individual **Assets**. [ANSI90,p25]

Compare: **Coupling**

Difference:

In **Domain Analysis**, an **Asset** or a distinct part, function, or **Feature** that distinguishes **Systems** within a domain from each other and that is represented in a **Domain Model** or **Domain Architecture**.

Compare: **Commonality**

Domain:

A distinct functional area that can be supported by a class of **Software Systems** with similar **Requirements** and capabilities. A **Domain** may exist before there are **Software Systems** to support it. [PRIET91,p14], [DODV&S,p2]

Domain Analysis (DA):

1. The analysis of **Systems** within a **Domain** to discover **Commonalities** and **Differences** among them. [DODV&S,p2]

2. The process by which information used in developing **Software Systems** is identified, captured, and organized so that it can be **Reused** to create new **Systems** within a **Domain** [PRIET90].

3. The result of the process in (1) and (2).

Discussion:

Domain Analysis can be viewed as systems analysis applied across a class of **Software Systems** in a **Domain**. [PREIT91,p14]

The principal products of **Domain Analysis** are the **Domain Model**, and in some **Domain Analysis** methods (but not all), the **Domain Architecture**.

Domain Analyst: A person who performs **Domain Analysis**.
[DABR92,p15]

Domain Architecture:

A generic, organizational structure or *Design* for **Software Systems** in a **Domain**. The **Domain Architecture** contains the *Designs* that are intended to satisfy *Requirements* specified in the **Domain Model**. A **Domain Architecture** (1) can be adapted to create *Designs* for **Software Systems** within a **Domain** and (2) provides a framework for configuring **Assets** within individual **Software Systems**. The **Domain Architecture** documents *Design*, whereas the **Domain Model** documents *Requirements*.

Domain Description:

See **Domain Definition**

Domain Definition:

1. The process of determining the scope and boundaries of a **Domain**.
2. The result of the process in (1).

Discussion:

The process establishes what major functions and capabilities are within the **Domain**, what functions and capabilities are excluded from the **Domain**, and what interactions exist with external **Domains**. In the **Domain Engineering** process, a **Domain Definition** is established prior to beginning the development of the **Domain Model**.

Domain Engineering:

A Reuse-based approach to defining the scope (i.e., **Domain Definition**), specifying the structure (i.e., **Domain Architecture**), and building the **Assets** (e.g., *Requirements*, *Designs*, software code, documentation) for a class of **Systems**, subsystems, or *Applications*. **Domain Engineering** can include the following activities: **Domain Definition**, **Domain Analysis**, developing the **Domain Architecture**, and **Domain Implementation**.

Domain Expert:

Individual who is intimately familiar with the **Domain** and can provide detailed information to the **Domain Analysts**.
[DABR92,p16]

Domain Implementation:

The process of creating adaptable **Assets** that can be Reused in the development of **Software Systems** within a **Domain**. **Domain Implementation** may also include the specification of a

software development process that describes how **Software Systems** in the **Domain** are developed through **Reuse of Assets**.

Domain Manager:

Individual or organization responsible for managing the definition, use, evaluation, and evolution of **Assets** within the **Domain**. [DABR92,p15]

Domain Model:

A product of **Domain Analysis** which provides a representation of the *Requirements* of the **Domain**. The **Domain Model** identifies and describes the structure of data, flow of information, functions, **Constraints**, and controls within the **Domain** that are included in **Software Systems** in the **Domain**. The **Domain Model** describes **Commonalities** and variabilities among *Requirements* for **Software Systems** in the **Domain**. [DODV&S,p4]

Discussion:

The **Domain Model** documents *Requirements*, whereas the **Domain Architecture** documents *Design*.

Domain Scoping:

See **Domain Definition**

Environment:

The circumstances or conditions in which a **Software System** executes. This includes interfaces with an operating system, interfaces with other **Systems**, dependency on *Database* management systems, hardware or network **Constraints**, or any factor that affects the functioning of the **Software System**.

Extraction:

The retrieval of **Assets** from a **Reuse Library**. [RIG93,p2]

Faceted Classification:

A method derived from the field of library science which can be used to provide multiple access routes to **Reusable Software Assets** in a **Reuse Library**. [PRIET90], [DODSTR,pA-3]

Discussion:

Each facet in the scheme represents a particular aspect of a software **Asset** such as its function, its operating environment, or other significant attributes. Each user of a **Reuse Library** may use different facets, or key information, in searching for relevant **Assets**.

Feature:

An attribute or characteristic of a **System** that is meaningful to, or directly affects, the user, developer, or other entity that interacts with a **System**.

Discussion:

Feature concepts are defined differently by several **Domain Analysis** methods, including [KANG90], [MOORE91], and [STARS1].

Horizontal Domain:

A **Domain** that provides information or services to more than one **Domain**. Examples of **Horizontal Domains** include communications, graphical user interfaces, and **Databases**.

Compare: **Vertical Domain**

Horizontal Reuse:

Reuse of **Assets** in more than one **Vertical Domain**.

Compare: **Vertical Reuse**

Interoperability:

See **Reuse Library Interoperability**

Library:

See **Reuse Library**

Library Metric:

A standard of measure that can support quantitative comparisons and evaluations related to **Reuse Library** operations. [RIG93,p3]

See also: **Metric**

Library Mechanism:

See **Reuse Library System**

Metric:

1. A quantitative measure of the degree to which a **System**, **Asset**, or process possesses a given attribute. [ANSI90,p47]

2. The definition, algorithm, or mathematical function used to make a quantitative assessment of a software product or process. [PENG93]

Discussion:

Metrics are used in making quantitative assessments of such topics as the amount of **Reuse**, the reliability of **Assets**, the effort associated with reusing **Assets** or other characteristics of a **Domain** or **Software System**.

Opportunistic Reuse:

The ad hoc **Reuse** of **Assets** in the development of **Software Systems** using a software development process that has not been altered to accommodate **Systematic Reuse**. In **Opportunistic Reuse**, the developer determines where **Reuse** can be applied to develop a **Software System** without the organized use of **Domain**

Engineering products during successive stages of a *Software Engineering* process.

Compare: **Systematic Reuse**

Planned Reuse:

See **Systematic Reuse**

Replication:

The repetition or duplication of an **Asset** within a **Software System**.

Reusability:

1. The degree to which an **Asset** can be used in more than one **Software System**, or in building other **Assets**, with little or no **Adaptation**. [PETER91]

2. In a **Reuse Library**, the characteristics of an **RSA** that make it easy to use in different **Contexts**. [RIG93,p3]

Reusable Asset:

See **Reusable Software Asset (RSA)**

Reusable Component:

See **Reusable Software Asset (RSA)**

Reusable Software:

Software *Designed* and implemented for the specific purpose of being **Reused**. [PETER91] **Reusable Software** is a broad term applying to **Assets**, **Applications**, or **Software Systems**. The recommended term is **Reusable Software Asset (RSA)**.

Reusable Software Asset (RSA):

An **Asset** that has been **Catalogued** and is stored in a **Reuse Library**. [RIG93,p1]

See also **Asset** and **Asset Certification**

Discussion:

The term **Reusable Software Asset** connotes more value added than an **Asset**. This value lies in the meta-information regarding the **Asset** in its **Catalog** entry, and in the **Reuse Library** or **Reuse Library System** in which it is contained. These additions make it easier to locate appropriate **Assets** which have been evaluated for **Reuse** and to determine information about their suitability for **Reuse** in a particular context. In contrast, an **Asset** is a software product which may or may not be locatable and/or reusable, and an **Asset** may or may not have to be certified, depending on the *Requirements* of the **Reuse Library**. An **Asset** may be stored in a **Repository**.

Reusable Software Component (RSC):

Synonym for **Reusable Software Asset (RSA)**.

Reusable Software Library:

See **Reuse Library**

Reuse:

1. To use again. [Webster]
2. The process of implementing or updating **Software Systems** using existing software **Assets**. [DODSTR,p2] [COHEN92,p5] [KANG90,p3] [DODINIT,pB3] [PETER91]

Discussion:

Reuse is the application of **Reusable Software Assets**, with or without adaptation, to more than one **Software System**. **Reuse** may occur within a **Software System**, across similar **Software Systems**, or in widely different **Software Systems**. [DODV&S,p2]

Reuse-Based Development:

The use of a disciplined, systematic, quantifiable approach to the development, operation, and maintenance of software (where **Reuse** is a primary consideration in the approach). [PETER91]

Discussion:

Reuse-Based Development uses **Domain Engineering** products during systems/*Software Engineering*.

Reuse Library:

A controlled collection of **Reusable Software Assets**, together with the procedures and support functions required to provide the **RSAs** for **Reuse**. The procedures and support functions may be automated via a **Reuse Library System**. If this is the case, then the **Reuse Library** contains both the **RSAs** and the **Reuse Library System**. [RIG93,p4]

Compare: **Software Repository**

Reuse Library Interoperability:

The ability of two or more distinct, heterogeneous **Software Reuse Libraries** to dynamically provide access to the other's **Assets**, **Asset** descriptions, and other available information. [STARS1], [DODV&S]

Reuse Library System:

A **Software System** that automates the procedures and support functions of a **Reuse Library**. A **Reuse Library System** includes the storage capabilities of a **Software Repository**, but it is more than a storage facility. It provides capabilities that assist the user in accessing the contents of what is stored

(e.g., browsing, hypertext, etc.). Reusable **Assets** are stored in a **Reuse Library** which is supported by a **Reuse Library System**. [BRAUN92,p8]

Reverse Engineering:

The process of analyzing an existing **Software System** to derive its *Design, Requirements*, and other *Software Engineering* products.

Salvage:

The process of finding and *Reengineering* an existing **Component** so that it may potentially be **Reused** in subsequent *Applications*, developments, or maintenance. [GPALS92,p21]

Software Architecture:

See **Architecture**

Software Application:

See *Application*

Software Asset:

See **Asset**

Software Component:

See **Component**

Software Engineering Environment:

The supporting hardware, software, and firmware used in the production of software throughout its life cycle. Typical elements include computer equipment, compilers, assemblers, operating systems, debuggers, simulators, emulators, test tools, documentation tools, *Requirements, Designs*, CASE tools, and *Database* management systems. [ANSI90,p67]

Discussion:

A **Reuse Library System** can be among the tools in a **Software Engineering Environment**. Other tools, such as CASE tools, can enhance **Reuse** and improve the quality of information about **Assets** in a **Catalog**.

Software Repository:

A permanent, archival storage place for software and related documentation. [ANSI90,p68] [PETER91]

Discussion:

A **Software Repository** is simply a storage mechanism for **Assets**, as opposed to a **Reuse Library System**, which provides both storage and user-friendly mechanisms to find and access stored **RSAs**.

Compare: **Reuse Library**

Software Reuse:
See **Reuse**

Software Reuse Library:
See **Reuse Library**

Software System:
An organized collection of computer programs, procedures, associated documentation, and data (i.e., **Assets**) pertaining to the operation of a computer system that accomplish a specific function or set of functions. [ANSI90,p66,74]

Subdomain:
A **Domain** that can be viewed as part of a larger **Domain** (**Context**-dependent).

Support Domain:
Synonym for **Horizontal Domain**.

System:

1. A collection of **Assets** organized to accomplish a specific function or set of functions. [ANSI90, p73]
2. A set of interrelated parts, which may include people, methods, hardware, software, and/or firmware, that function together to achieve an overall purpose.

Discussion:
Generally more inclusive than a **Software System**, although the terms are sometimes used synonymously.

Systematic Reuse:
Reuse of **Assets** in which **Software Systems** are developed using a *Software Engineering* process that is specifically structured for **Reuse**. **Systematic Reuse** means that software development is guided by an organized use of **Domain Engineering** products (including a **Domain Model**, **Domain Architecture**, and other **Assets**) during successive stages of a *Software Engineering* process.

See **Domain Engineering**

Compare: **Opportunistic Reuse**

Traceability:

1. The degree to which a relationship can be established between two or more products having a predecessor-successor or superior-subordinate relationship to one another. [ANSI90,p78]
2. In *Software Engineering*, the successful cross-referencing across a **Software System's** related **Assets**, from operational software **Modules** back to their original *Requirements*,

including all intervening stages of development and testing, and related documentation.

3. In **Domain Engineering**, the characteristic of **Domain Models**, **Domain Architectures**, **Designs**, and **Software Systems** that, for any particular **Asset**, identifies and documents the derivation path (from the preceding phase in the *Software Engineering* process) and allocation/flowdown path (to the successive phase) of *Requirements* and *Constraints*. [STARS1,p56]

Vertical Domain:

A **Domain** which addresses aspects of a single function or *Application* area. [BRAUN92,p8] Examples include payroll **Systems**, automated weapons **Systems**, robotic control **Systems**. A **Vertical Domain** draws on capabilities from any **Horizontal Domains** that support its purpose.

Compare: **Horizontal Domain**

Vertical Reuse:

Reuse of **Assets** within a **Vertical Domain**.

Compare: **Horizontal Reuse**

APPENDIX A

RELATED SOFTWARE ENGINEERING TERMS

Application:

1. Synonym for **Software System**.
2. A **Software System** that interacts directly with some non-software system (e.g., human, robot, etc.).

Application Generator:

A type of tool that uses software *Designs* and/or *Requirements* to generate entire software *Applications* automatically, including program source code and program control statements.

Discussion:

An *Application Generator* may be one of the tools in a **Software Engineering Environment**, or it may be used independently.

Compare: *Source Code Generator*

Code Generator:

1. A synonym for *Source Code Generator*.
2. In compiler technology, the back end of a compiler, which builds object code or assembly code.

Configuration Item:

1. In DoD software development, an aggregation of hardware or software that satisfies a function and is designated by the Government for separate *Configuration Management*. [MIL-STD-973]
2. In DoD software development, a digital data file [MIL-HDBK-59A] that is designated by the Government for separate *Configuration Management*.
3. An aggregation of hardware, software, or both, that is designated for *Configuration Management* and treated as a single entity in the *Configuration Management* process. [ANSI90, p20]

Configuration Management:

In DoD software development, the discipline applying technical and administrative direction and surveillance over the life cycle of *Configuration Items* to:

- a. Uniquely identify *Configuration Items*, including versions and their status.
- b. Identify and document the functional and physical

- characteristics of *Configuration Items*.
- c. Control changes to *Configuration Items* and their related documentation.
- d. Record and report information needed to manage *Configuration Items*, including the approval status of proposed changes and the implementation status of approved changes.
- e. Audit *Configuration Items* to verify conformance to specifications.

[MILSTD-973]

Discussion:

In *Software Reuse*, the process of cataloging and classifying all *Assets*, recording and controlling the release and change of these assets throughout the system life cycle, recording and reporting the status of *Assets* and change requests, and verifying the completeness and correctness of *Assets*.

Database:

A collection of interrelated data stored together in one or more computerized files. [ANSI90, p25]

Discussion:

A *Database* could be an *Asset*, the mechanism for storing a set of related *Assets*, or a *Catalog*.

Database Schema:

The information that describes the structure of the data in a *Database*.

Discussion:

The *Design* of a *Catalog* or *Library* could contain a *Database Schema*. However, the *Database* refers to a *Database Schema* that is populated with actual instances of data. Similarly, for a delivered *Software System*, the *Database Schema* and the *Database* represent separate *Assets*, and support different types of *Reuse*.

Design:

1. The process of defining the *Architecture*, *Components*, *interfaces*, and other characteristics of a *System* or *Component*. [ANSI90, p 25)
2. The specification (n.) defining a solution for meeting *Requirements*.
3. The process (v.) of defining a solution for meeting *Requirements*.

Extensibility:

The ease with which a **System** or **Component** can be modified to increase its storage or functional capacity. [ANSI90, p32]

Functional Baseline:

1. The version of an **Asset** that is established after initial completion of the definition of the **Software System** functions and associated data, interface characteristics, functional characteristics for key *Configuration Items*, and tests required to demonstrate achievement of each specified characteristic. This baseline is normally controlled by the customer; e.g., the Government. [MIL-STD-490A]

2. In *Configuration Management*, the initial, approved technical documentation for a *Configuration Item*. [ANSI90,p35]

Module:

A **Component** which is either code or *Design*. Examples of *Modules* include source code *Modules*, object code *Modules*, and *Design Modules*.

Portability:

The extent to which a *Module* originally developed on one computer or operating system can be used on another computer or operating system. [BRAUN92,p8]

Discussion:

The greater the *Portability* of an **Asset**, the greater the potential for reuse. Therefore, *Portability* should be one of the items of meta-information accompanying each **Asset** in a **Catalog**.

Reengineering:

The process of examining, altering, and re-implementing an existing **Software System** to reconstitute it in a new form. [STARS1,p55]

Requirement:

1. A condition or capability needed by a user to solve a problem or achieve an objective. [ANSI90,p62]

2. A condition or capability that must be met or possessed by a **System** or system **Component** to satisfy a contract, standard, specification, or other formally imposed document. [ANSI90,p62]

Discussion:

The set of all *Requirements* forms the basis for subsequent development of the **System** or **Asset**. When considering an **Asset** for **Reuse**, the **Catalog** information about that **Asset** must be evaluated to determine whether or not the **Asset** meets the *Requirements* of the **System** for which it is being considered.

Software Engineering:

The use of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the use of engineering principles in the development of software. [ANSI90,p67]

Source Code Generator:

A tool that uses software *Requirements* and/or *Designs* to automatically generate source code. An *Application Generator* generates entire **Applications**, whereas a *Source Code Generator* may generate smaller pieces of source code. Synonym for *Code Generator* (however, **Source Code Generator** is the recommended term). Compare with *Application Generator*.

BIBLIOGRAPHY

- [ANSI83] An American National Standard: IEEE Standard Glossary of Software Engineering Terminology, ANSI/IEEE Std 729-1983, IEEE Standards Department, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.
- [ANSI90] Software Engineering Terminology, IEEE 610.12, ANSI/IEEE, March 30, 1990.
- [BAILIN1] Bailin, S., and J. Moore, The KAPTUR Environment: An Operations Concept, CTA Incorporated, Rockville, MD.
- [BAILIN2] Sidney C. Bailin, "Domain analysis with KAPTUR," presentation, CTA Incorporated, 1992.
- [BOHL] Bohl, Marilyn, Information Processing, Second edition, Science Research Associates, Inc., Chicago, IL, 1971.
- [BRAUN91] Christine Braun, William Hatch, Theodore Ruegsegger, "Domain Specific Software Architectures--Command and Control," GTE Federal Systems, Bob Balzer, Martin Feather, Neil Goldman, Dave Wile, USC, Information Sciences Institute.
- [BRAUN92] Christine L. Braun, "Software Reuse," presentation, GTE Federal Systems Division, November 11, 1992.
- [CARDS92] Central Archive for Reusable Defense Software (CARDS) Draft Glossary, August 6, 1992.
- [COAD91] Peter Coad and Edward Yourdon, Object-Oriented Analysis (second edition), Yourdon Press, Englewood Cliffs, NJ, 1991.
- [COHEN92] Sholom Cohen, "A Model Base for Software Engineering," Software Engineering Institute, Carnegie Mellon University, July 1992.
- [DABR92] Dabrowski, Christopher and Kirkendall, Thomasin Preliminary Report on Domain Analysis Methods, Computer Systems Laboratory, NIST, December 22, 1992.
- [DATE] Date, C. J., An Introduction to Database Systems, Third Edition, Addison-Wesley Publishing Company, 1982.

- [DeMarco] DeMarco, Tom, Structured Analysis and System Specification, YOURDON, Inc., New York, NY, 1978
- [DOD2167A] Military Standard, Defense System Software Development, DOD-STD-2167A, Department of Defense, February 29, 1988.
- [DODINIT] Domain Analysis Guidelines (Draft), DoD Software Reuse Initiative, May 1992.
- [DODSTR] DoD Global Protection Against Limited Strikes Software Reuse Strategy, February 1992.
- [DODV&S] DoD Software Reuse Initiative Vision and Strategy, July 15, 1992.
- [DUSINK] E.M. Dusink, J. van Katwijk, Reflections On Reusable Software And Software Components, Technical University Delft.
- [GALL83] Frank J. Galland, Dictionary of Computing, ed. 1983.
- [GORLEN] Keith E. Gorlen, Sanford M. Orlow, Perry S. Plexico, Data Abstraction and Object Oriented Programming in C++, John Wiley & Sons, West Sussex PO19 1UD, England.
- [GPALS92] GPALS Software Reuse Execution Plan, DRAFT, November 17, 1992.
- [HU89] David Hu, C/C++ for Expert Systems, Management Information Source, Inc., Portland, OR, 1989.
- [KANG90] Kyo C. Kang, Shalom G. Cohen, James A. Hess, William E. Novak, A. Spencer Peterson, Feature-Oriented Domain Analysis (FODA) Feasibility Study, Carnegie-Mellon University Software Engineering Institute, November 1990.
- [MIL-HDBK-59A] Military Handbook 59A, "Management of Digital Data Files," U.S. Department of Defense, September 28, 1990.
- [MIL-STD-490A] Military Standard 490A, "Specification Practices," U.S. Department of Defense, June 4, 1985.
- [MIL-STD-973] Military Standard 973, "Configuration Management," U.S. Department of Defense, April 17, 1992.

- [MOORE91] Moore, J., and S. Bailin, "Domain Analysis: Framework for Reuse," in Domain Analysis and Software Systems Modeling by R. Prieto-Diaz and G. Arango (eds.), IEEE Computer Society Press, Los Alamitos, CA, 1991, pp. 179-203.
- [PENG93] Wendy W. Peng and Dolores R. Wallace, Software Error Analysis, National Institute of Standards and Technology Special Publication 500-209, U.S. Department of Commerce, March 1993.
- [PETER91] A. Spencer Peterson, Coming to Terms with Software Reuse Terminology: A Model-Based Approach, Software Engineering Institute, Carnegie Mellon University, ACM Software Engineering Notes, April 1991, Volume 16, Number 2, pgs. 45-51.
- [PRIET90] Prieto-Diaz, Ruben, "Domain Analysis: An Introduction," ACM SIGSOFT Software Engineering Notes, Vol. 15, No. 2, pgs. 47-54, April, 1990.
- [PRIET91] Prieto-Diaz, Ruben, "The Reuse Library Process Model," IS-40.2 03041-002, STARS Reuse Library Program, New York, NY, March 1991.
- [PYST88] Arthur Pyster and Bruce Barnes, The Software Productivity Consortium Reuse Program, IEEE, 1988.
- [RANDOM] The Random House College Dictionary, Revised Edition, Random House, Inc., New York, NY, 1980.
- [RIG93] RIG Technical Report RTR-0001 RIG Glossary, April 1, 1993.
- [SPC1] Reuse Driven Software Processes Guide Book, Software Productivity Consortium, SPC-92019-CMC, Version 02.00.03, November, 1993.
- [STARS1] UT40-STARS Reuse Concept Volume I-Conceptual Framework for Reuse Process, Version 1.0, Informal Technical Data, February 14, 1992.
- [STARS2] Reuse Library Process Model, STARS Program, July 26, 1991.
- [ULLMAN] Ullman, Jeffrey D., Principles of Database Systems, Second Edition, Computer Science Press, Rockville, MD, 1982.

- [USDA93] An Overview of Object-Oriented Programming,
Graduate School, United States Department of
Agriculture (USDA), February 1993.
- [WEBSTER] Webster's II New Riverside University Dictionary,
The Riverside Publishing Company, Boston, MA, 1984.
- [YOURDON] Yourdon, Edward, and Constantine, Larry, Structured
Design, Second Edition, YOURDON, Inc., New York,
NY, 1978.

INDEX

Adaptability (4)
Adaptation (4), (11), (12)
Application (6), (12), (13), (15), (16), (19)
Application Generator (16), (19)
Applications (ii), (1), (4), (8), (11), (13), (16), (19)
Architecture (4-9), (13), (14), (17)
Architectures (4), (15)
Asset (4-7), (9-13), (15), (17-18)
Asset Certification (4), (5), (11)
Asset Evaluation (5)
Asset Library (5)
Asset's (5)
Assets (5-15), (17)

Catalog (5), (11), (13), (17), (18)
Cataloged (5)
Cataloging (5), (17)
Certification (4), (5), (11)
Code Generator (16), (19)
Cohesion (5-7)
Cohesiveness (6)
Commonalities (7)
Commonality (6), (7)
Component (4), (6), (11-13), (17), (18)
Configuration Item (16), (18)
Configuration Management (16), (18)
Constraint (6)
Constraints (5), (9), (15)
Context (3), (6), (11), (14)
Context Analysis (6)
Contexts (2), (11)
Coupled (7)
Coupling (5-7)

Database (4), (9), (13), (17)
Database Schema (17)
Database Schemas (4)
Databases (4), (10)
Decoupling (7)
Design (4), (8), (9), (13), (17), (18)
Designed (11)
Designs (4), (8), (13), (15), (16), (19)
Difference (6), (7)
Differences (7)
Domain (3-10), (12), (14), (15)
Domain Analysis (3), (6-10)
Domain Analyst (8)
Domain Analysts (8)

Domain Architecture (4), (6-9), (14)
 Domain Definition (6), (8), (9)
 Domain Engineering (6), (8), (11), (12), (14), (15)
 Domain Expert (8)
 Domain Implementation (8)
 Domain Manager (9)
 Domain Model (4-9), (14)
 Domain Models (4)
 Domain Scoping (9)
 Domains (8), (10), (15)

 Environment (1), (6), (9), (13), (16)
 Extensibility (18)
 Extraction (9)

 Faceted Classification (9)
 Feature (4), (6), (7), (9), (10)
 Functional Baseline (18)

 Horizontal Reuse (10), (15)

 Interoperability (10), (12)

 Libraries (5), (6), (12)
 Library (3), (5), (9-14), (17)
 Library Mechanism (10)
 Library Metric (10)
 Library's (5)

 Metric (10)
 Module (5), (18)
 Modules (14), (18)

 Opportunistic Reuse (10), (14)

 Planned Reuse (11)
 Portability (18)

 Reengineering (13), (18)
 Replication (11)
 Requirement (6), (18)
 Requirements (4), (5), (7-9), (11), (13-18)
 Reusability (5-7), (11)
 Reusable Asset (11)
 Reusable Component (11)
 Reusable Software (4), (5), (9), (11), (12)
 Reusable Software Asset (4), (5), (11), (12)
 Reusable Software Component (12)
 Reusable Software Library (12)
 Reuse (1), (ii), (iii), (1-15), (17), (18)
 Reuse Libraries (5), (6), (12)

Reuse Library (3), (5), (9-14)
 Reuse Library Interoperability (10), (12)
 Reuse Library System (10-13)
 Reuse-Based Development (12)
 Reused (4), (5), (7), (8), (11), (13)
 Reverse Engineering (13)
 RSA (11), (12)
 RSAs (12), (13)
 RSC (12)

Salvage (13)
 Software Application (13)
 Software Architecture (13)
 Software Asset (4), (5), (9), (11-13)
 Software Component (12), (13)
 Software Engineering (ii), (1-4), (6), (11-16), (19)
 Software Engineering Environment (13), (16)
 Software Repository (12), (13)
 Software Reuse (1), (ii), (1-3), (5), (6), (12), (14), (17)
 Software Reuse Library (5), (14)
 Software System (4-7), (9-14), (16-18)
 Software System's (14)
 Software Systems (1), (4), (7-12), (14), (15)
 Source Code Generator (16), (19)
 Subdomain (14)
 Support Domain (14)
 System (4-7), (9-14), (16-18)
 Systematic Reuse (ii), (1), (10), (11), (14)
 Systems (1), (i), (1), (3), (4), (6-15)

Traceability (14)

Vertical Domain (10), (15)
 Vertical Reuse (10), (15)

**ANNOUNCEMENT OF NEW PUBLICATIONS ON
COMPUTER SYSTEMS TECHNOLOGY**

Superintendent of Documents
Government Printing Office
Washington, DC 20402

Dear Sir:

Please add my name to the announcement list of new publications to be issued in the series: National Institute of Standards and Technology Special Publication 500-.

Name _____

Company _____

Address _____

City _____ State _____ Zip Code _____

(Notification key N-503)



NIST Technical Publications

Periodical

Journal of Research of the National Institute of Standards and Technology—Reports NIST research and development in those disciplines of the physical and engineering sciences in which the Institute is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Institute's technical and scientific programs. Issued six times a year.

Nonperiodicals

Monographs—Major contributions to the technical literature on various subjects related to the Institute's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NIST, NIST annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NIST under the authority of the National Standard Data Act (Public Law 90-396). NOTE: The Journal of Physical and Chemical Reference Data (JPCRD) is published bimonthly for NIST by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements are available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Institute on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NIST under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NIST administers this program in support of the efforts of private-sector standardizing organizations.

Order the following NIST publications—FIPS and NISTIRs—from the National Technical Information Service, Springfield, VA 22161.

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NIST pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NIST Interagency Reports (NISTIR)—A special series of interim or final reports on work performed by NIST for outside sponsors (both government and nongovernment). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service, Springfield, VA 22161, in paper copy or microfiche form.

U.S. Department of Commerce
National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

Official Business
Penalty for Private Use \$300