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CONCEPTS, TECHNIQUES AND PROCEDURES FOR INFORMATION MANAGEMENT

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TABLE OF CONTENTS

CHAPTER 3 TECHNIQUES AND PROCEDURES TO BUILD AN INFORMATION FRAMEWORK

CHAPTER 1

INTRODUCTION

101. Purpose. This pamphlet explains the basics of managing computerized information.

102. General. The basic Marine Corps doctrinal guidance on information and its management is the Marine Corps Doctrinal Publications (MCDPs) and Marine Corps Warfighting Publication (MCWP) 6-23, *Information Management*. This pamphlet supplements those publications by providing information on techniques and procedures for managing information, along with explanations of why these techniques and procedures are necessary.

103. Basic Technique

a. The basic technique discussed in this pamphlet is the creation of information frameworks. This is not a new technique. It has long been used in managing information recorded on paper. Marine Corps' examples of information frameworks include: the structure of annexes, appendixes, and tabs in (1) MCWP 5-1, *Marine Corps Planning Process* for the operations order; (2) the Naval Standard Subject Identification Codes (SSIC) system; (3) the SSIC-based file outlines maintained by units; and (4) the SSIC-based message routing guide created and maintained by commands.

b. The basic concept behind this approach to information management is that tracking individual pieces of information in a large, complex body of information requires a structure of well-identified categories that provides a specific place for every piece of relevant information. When a piece of information is generated, it is initially labeled with an appropriate standard name (or names). It is then placed in its correct location. The SSIC and the names of operation orders annexes, appendixes, and tabs provide structures of standard terms for first categorizing individual pieces of information and second for identifying the specific locations to place pieces of information. **If an identified category has not been created for important information, the important information will never be captured.**

c. When information is kept on paper, the paper is (1) placed in the appropriate file folder or (2) given an appropriate annex, appendix, or tab title and placed in an operations order. When information is in a computer file, it is given a file name and placed in an appropriate computer folder or directory.

d. Organizations that effectively exploit information must create information frameworks such as are described herein. It is possible to create an infinite number of different pieces of data about any object. Without creating and using a standard information framework, those creating information will often provide products of little or no use.

104. Impact of Computerization

a. Computerization has increased the importance of information management techniques described in this pamphlet. Computer-based sensors can produce hundreds or thousands of pieces of data in less than a minute. No organization can afford to hire enough people to manually process and analyze this high volume of data. Rather, organizations use computer tools such as statistical programs, spreadsheets, and databases to analyze large quantities of data.

b. For these tools to be effective, the data names assigned by a computer-based sensor when it creates data must be the same names used by its supporting data analysis software. If a sensor is sending out data on a T72 tank (notice the lack of a hyphen or dash) and the data analysis software is set up for a T-72 tank (including the hyphen or dash), the T72 tank data may be unrecognized by the data analysis software.

105. Creating Useful Information

a. Information is valuable when used for making decisions. A piece of information has no value or importance by itself. The fact that a T-72 tank exists is useless. The fact that an enemy T-72 tank is at a particular road junction and moving towards friendly forces can be useful, however. Such information may indicate that the enemy is advancing - this information has great value. The information that the tank is moving towards friendly forces can be used to decide whether to warn front-line troops of a possible attack, fire artillery, or shift forces.

b. Because of the large amounts of data that either exist or can be created quickly, one of the primary aims of information management is to find or create those few (usually five to nine) pieces of information that are most important in a particular situation. In terms of Marine Corps information hierarchy, raw data must be processed to create, first, processed data (i.e., organized data) and then, second, knowledge. This knowledge is then converted into situational awareness by decision makers and becomes the basis for making decisions.

c. Useful information must be available in a timely manner. If important information is located somewhere in an information system but no one can easily access it when it is needed, the information is useless, and the information system has failed.

d. Thus, good information management provides decision makers and those who support them with the information they need when they need it for mission success. To provide quality information, data must be created using standard terminology, communicated, processed to locate and/or create the few important pieces of information, and finally presented to decision makers in a form they can easily understand.

106. Pamphlet's Approach

a. This pamphlet uses the term information in the manner that MCDP 6, Command and Control, defines the term: a collective term that includes in order of increasing sophistication and value - raw data, processed data, knowledge, and understanding.

b. Because this pamphlet is intended to complement the Marine Corps Doctrinal Publications and MCWP 6-23, it provides only the concepts needed to understand the techniques and procedures described in this manual. Readers should also review the MCDPs and MCWP 6-23.

c. Chapter 2, "Concepts Bearing on Management of Computerized Information," explains concepts that serve as rationales for techniques and procedures described in Chapter 3.

d. Chapter 3, "Techniques and Procedures to Build an Information Framework," describes information management techniques and procedures.

CHAPTER 2

CONCEPTS BEARING ON MANAGEMENT OF COMPUTERIZED INFORMATION

201. Purpose. This chapter explains concepts that illuminate why and how an information framework is built, maintained, and used to manage information. Computerized information is very similar to information recorded on paper, but there are some aspects of computerized information that are not intuitively obvious to those without experience in creating situational awareness from computerized information. This chapter presents these aspects as concepts and explains their relevance to managing geographic information. The chapter is divided into three parts. The first part contains introductory concepts, including some passages from MCDP 6, *Command and Control*, on the nature of information. The second part discusses concepts that explain why it is necessary to have an information framework. The third part discusses concepts relevant to structuring an information framework.

PART 1: INTRODUCTION

202. General

Computers operate in ways that require people to adopt new perspectives and procedures. This is because computer strengths can also be their weaknesses. When two people talk with each other, they share a common language. They use non-verbal communication means such as shrugs and nods in addition to words, and their mental processes compensate for ambiguous terms, slang, and the use of different terms to communicate the same thought. If someone tells a friend to meet him at his car, the friend understands what is meant. And if the friend replies that he would like a ride in the automobile, the meaning is clear even though a different word is used for car.

Computers work very precisely and very fast. When data is received from multiple sources (a key concept in net-centric warfare), this great advantage can be a disadvantage because different data sources may use different terms or words for the same idea. For example, one source may use the term “car”, another might use “auto”, and a third might use “automobile.” Unless the computer receiving and processing the data is programmed to treat “auto” and “automobile” as equal to “car,” it will only properly process the information containing the term “car”. Information with the terms “auto” and “automobile” will not be recognized. Thus the potential of computers becomes a weakness.

Further, increases in information volume and improvements in the capabilities of sensors and other devices to generate and transmit information have increased the chance of information overload. The few and better pieces of information produced by today’s and tomorrow’s better collection means are at risk of getting lost in ever-increasing masses of information being

produced. It is no longer possible to have a person check and if necessary, change every incoming piece of information so it is compatible with the computer system receiving it.

This reality is widely understood. Efforts to solve the problem have a variety of names: data mining, knowledge management and information management.

Lost among these names and terms are these key concepts:

You and I (and all other users of information) need the right information in the right form at the right time.

The human mind can follow only five to nine changing objects at a time.

Because of this, the significant purpose when working with information is the same now that it was before computers were used: find or create those few pieces of information that illuminate a particular situation or that allow a person to understand a situation. Advances in creating, processing, and communicating information have no effect on the ability of people to absorb and use information.

Also lost in discussions of sophisticated computer databases is the simple truth that a piece of information is a representation of something, not the thing itself.

Information is valued because far better results are achieved when information is used to plan and monitor events than when events occur without a plan or supervision. It is usually much easier to produce a piece of information than to produce that which the information represents. Information is the foundation of planning and supervision.

The relative ease of producing and manipulating information can hurt as much as it helps. It is easy to make any number of errors with information. The phrase “garbage in, garbage out” is a popular expression for this reality. This is why it is important to understand certain basic concepts of information.

203. Marine Corps Doctrine on Information

Doctrinal publications provide good insights into the nature and uses of information. One of the best insights is in Marine Corps Doctrinal Publication 6 (MCDP 6), *Command and Control*. Figure 3 in that publication, "The Information Hierarchy," is shown at right.

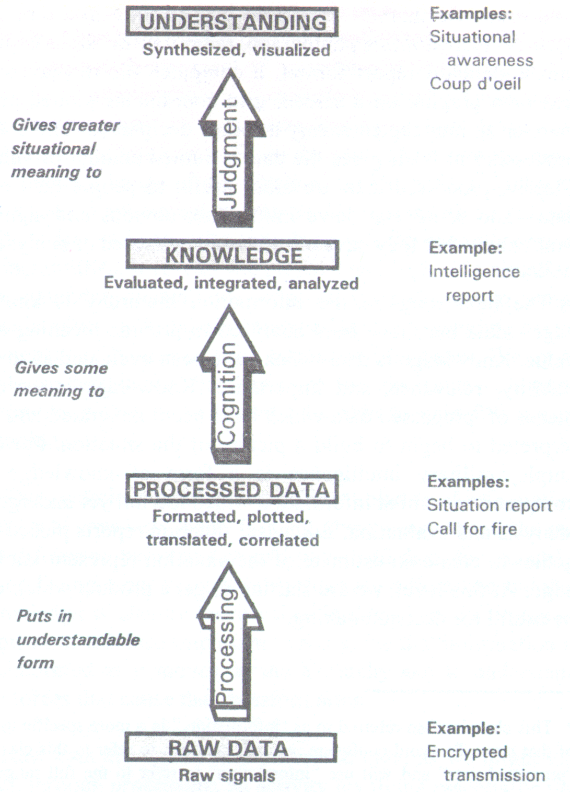


Figure 3. The information hierarchy.

As illustrated in the figure, the complexity of information varies widely. The simplest pieces of information are called data or raw data. The most complex are called understanding. Generally, understanding is achieved by starting with large quantities of data and processing it (in the broadest sense of the term) to arrive at small, well-focused statements that convey knowledge and understanding.

Situational awareness is generally understood to be essential for success in any endeavor. As MCDP 6 states:

The highest class of information hierarchy is understanding - knowledge that has been synthesized and applied to a specific situation to gain a deeper level of awareness. We may *know* what is going on and we *understand* why. Understanding results when we synthesize bodies of knowledge, use judgment and intuition to fill in the gaps, and arrive at a complete mental image of the situation. Understanding means we have gained situational awareness. Understanding reveals the critical factors in any situation. It reveals an enemy's critical vulnerabilities. It reveals the patterns and logic of a situation. Understanding thus allows us to anticipate events - to recognize in advance the consequences of new or impending developments or the effects of our actions on an enemy. We try to make understanding the basis for our decisions - although recognizing that we will rarely be able to gain full understanding.

PART 2: CHARACTERISTICS OF INFORMATION

204. Information: Arbitrary Symbols Used to Approximate Reality

Information represents selected aspects of reality. Information is not reality. Regardless of how much information we have on any object, the information cannot represent all aspects of that object. For information to be an effective tool (that is, if leaders are to have situational awareness), those managing information must understand the following:

A symbol (for example, name, number or icon) selected to represent an element of information is ultimately arbitrary. As was pointed out in paragraph 202, we can use any of several terms to represent something. In paragraph 202, the terms car, auto, or automobile were used to represent personal transportation vehicles. Indeed, there are many other suitable terms. Because the intent of information management is to improve understanding, it is important that everyone use the same symbol, although others might be better understood. The alternative is the use of equally good but different terms or other symbols by different commands or groups of specialists. This hinders situational awareness.

The aspects of reality that are important must be defined. Because it is impossible to create information about every aspect of every object, the specific items to be reported must be identified. For example, is the weight of a truck important? What about its horsepower, number of cylinders or the size of a bolt used in its door hinges? This is not a new concept. It is the basis for defining essential elements of information (EEIs), commanders' critical information requirements (CCIRs), and priority information requirements (PIRs). The ever-increasing capabilities of computers to store and process information and ever-expanding available bandwidth to communicate information are often viewed as giving people the ability to know and communicate everything. This is not true. Even with better computers and wider bandwidth, requirements must still be defined.

Defining categories of information is different from defining specific information requirements such as PIRs for a particular operation. Categories provide a list or framework for specific pieces of information. Events in a particular operation may not generate any information that falls into a specific category. But failure to define a category will make it much more difficult to acquire such information using computer-based decision support tools.

205. Consequences of Increasing Volumes of Information

The ever-increasing volume of information that has come with the advent of computers has significant consequences for information management.

First, the capabilities that enabled increasing volumes of information have not increased the ability of people to understand more information. Because of this, every information management effort must address the reduction of large quantities of information to the five to nine pieces of information necessary for a decision maker.

Second, because ever-increasing information volume requires an ever-improving capability to reduce information to the few important pieces that a decision maker needs, data reduction capabilities must be continually improved through the better use of software. This will be possible only if information is properly formatted to facilitate the use of decision support software.

Third, because communications systems as well as people need to be protected from information overload, effective information management must include methods to minimize the transmission of information by facilitating the identification and transmission of only the information required by a recipient.

Fourth, it must be possible to distinguish information by its level of detail and intended user. Examples: general information intended for use by a force commander and detailed information intended and required for maintenance officers or fire support coordinators.

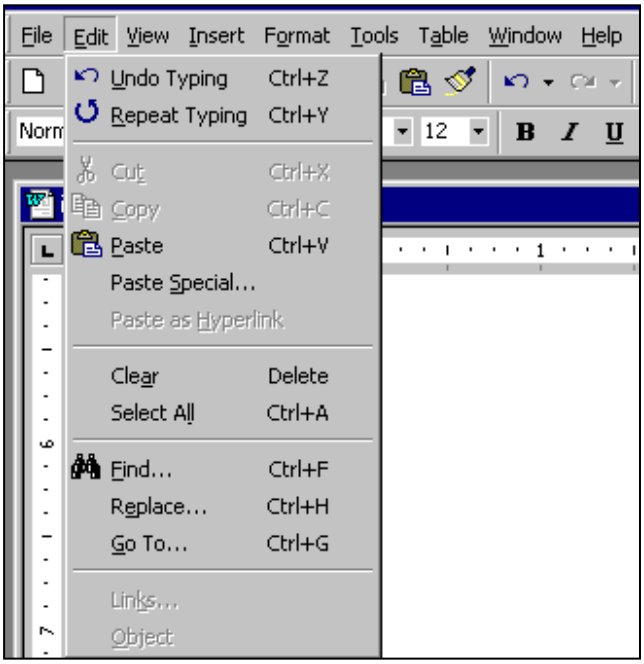
206. Need for Information Management Planning

As is true of many military tasks, preparation is essential for successful execution in information management. As was noted earlier, the need to identify information requirements for a specific operation is well understood and widely practiced using, among other techniques, CCIRs and PIRs. These requirements are identified during the planning for a particular operation.

The better use of computer networks requires that commands create and update information frameworks. These frameworks define the categories of information that may be needed. Defining categories of required information is not new. It is completed separately for publications, intelligence and general message traffic. However, for net-centric warfare to be an effective reality, the separate efforts that address different parts of a unit's information needs must be combined into a single effort. This is because net-centric warfare aims to unify separate bodies of information (often called "stove-piped systems") into a single body of information. The key to this unification is a common set of terms that are used by all members of an organization when identifying, storing and retrieving information.

PART 3: STRUCTURING INFORMATION

207. Dividing Information to Find Situational Awareness



Probably the most important concept relevant to structuring an effective information framework is the fact that people gain understanding by working with only a few pieces of information at one time. Faced with complex information, successful leaders break it into small pieces they can comprehend. The mind can absorb a lot of information given enough time, but it can absorb and use only a very limited amount of information at one time. To master a complex problem, people examine a little information at a time. The insights gained by examining each small batch of information are combined until finally the entire mass of information is understood. Similarly, information categories are structured to resemble "trees."

Information "trees" provide structure to what would otherwise be unmanageable masses of information. The small top of an information tree lists five to nine most general categories of information. Each of these general categories, in turn, is divided into five to nine parts. This continues down the tree, with more categories identified the further one moves down the tree. Computer program taskbars and their drop-down menus (illustrated above right) are examples of an information tree and its application for managing computerized information.

The need to divide information into aggregations that an individual can comprehend leads to specialization. Thus, a fire support coordinator uses the language of his specialty and an information structure associated with the language. So too an intelligence officer, an operations officer, a logistician, and other specialists use special languages and associated information structures.

Because the domains of many military specialists overlap, any information framework that includes information from two or more specialties overlaps with some ideas expressed in two or more trees using different terms. More on this concept will be addressed later.

208. Basic Elements of Military Information

The previous paragraph explained how and why information is divided into small, simple sets to facilitate information management. This paragraph discusses information management elements that military forces must address if leaders are to have situational awareness.

CONCEPTS, TECHNIQUES AND PROCEDURES FOR INFORMATION MANAGEMENT

The first military information elements that must be addressed are the answers to the following questions:

Where am I? Where are other friendly units? Where is the enemy?

The second set of military information elements that must be addressed for the three categories just listed are:

Unit Location Time Activity

Each category is represented by a term and its definition. Grouping categories into "trees" creates information frameworks. These trees (1) convey the relationships between the categories of information and (2) facilitate understanding by minimizing the chance of information overload. If names and their definitions are arranged alphabetically, a lexicon or glossary is created. (A lexicon an alphabetical listing of the terminology used by specialists in their field of knowledge.) The box at left below is an example of terms arranged conceptually in a framework. A lexicon box with the same information and simple definitions is shown at right below.

Information framework with terms arranged to convey a conceptual framework:

a. Surface Materials
   (1) Dirt Road
   (2) Cement Road
   (3) Asphalt Road

b. Width
   (1) Single Lane Road
   (2) Two Lane Road
   (3) Three Lane Road
   (4) Four Lane Road
   (5) Six Lane Road
   (6) Eight Lane Road
   (7) Ten Lane Road

Lexicon:

Asphalt Road. A road covered with asphalt.

Cement Road. A road covered with cement.

Dirt Road. An unpaved road.

Eight Lane Road. A road divided into eight lanes.

Four Lane Road. A road divided into four lanes.

Road. A long narrow area prepared for and reserved for vehicle traffic.

Single Lane Road. A road with only a single lane.

Six Lane Road. A road divided into six lanes.

Surface Materials. The matter used to provide a base upon which vehicles can move easily over terrain.

Ten Lane Road. A road divided into ten lanes.

Three Lane Road. A road divided into three lanes.

Two Lane Road. A road divided into two lanes.

Width. The distance between two sides of a road stated in terms of rows or lanes for accommodating traffic.

209. Accuracy

The purposes for which a piece of information can be used are dependent on the information's accuracy. Because of this, a piece of information needs to address not only basic concerns such as the nature of the soil, the length of the bridge, or the condition of the enemy's tanks, but also considerations that allow users of the information to understand its accuracy. A location of an enemy's radar that is accurate enough for use in jamming that radar (i.e., an accuracy measured in miles) will be inaccurate to use for targeting the radar with a GPS-guided precision weapon (i.e., an accuracy requirement of a few meters).

Remember also that some information loses accuracy with time. Information on the location of an enemy tank unit is probably much less accurate a few days after it is initially located.

When users look at information on a computer screen or printed page, they need to understand that the information may not be accurate. People understand this easily when reminded that military deception is aimed at getting the other side to accept false information as true. People also understand this when reminded that a position given for an enemy armored unit in a week-old report may not be accurate. But, because of some quirk of human nature, people looking at an icon representing an enemy armored unit on a computer map tend to accept the position on the map as reality. Those with experience in computerized mapping often use the phrase "ground truth" meaning the real physical world compared to the world represented on their computer maps. Those with experience in using computer information are also prone to use the phrase "garbage in, garbage out."

Thus, information should include supplementary data with which users of the information can judge its accuracy. Intelligence specialists have long used such a system to inform information users of (a) the reliability of the information source and (b) the probability that the information is true. Footnotes in books and reports inform readers of the source of information. Metadata is a term now used to provide information on data sources, reliability, collection dates and more. Metadata is data about data.

210. Standardization of Information

Because information is most useful when it can be shared, it must be standardized. Words have standard meanings. Measurement units such as meters and ounces are standard. Monetary units are standard. Means of identifying location are standardized with systems of street numbers, street names, and unique identifiers for towns and cities, zip codes and area codes.

Standardization imposes uniformity and order on what might otherwise be chaotic. At first glance, uniformity may appear (1) not only desirable but also essential and (2) easy to achieve. If, however, one reflects on the fact that every situation has some aspect that makes it unique, it becomes clear that there are limitations to standardization. The criteria used to create information standards will depend on the use envisioned for the information. Since each user may have very different needs, a single standard will probably meet the needs of only a few users while causing many users' requirements to be unfulfilled.

That standardization has limits becomes even clearer when one reflects on the fact that it is possible to generate an infinite amount of data on almost any single thing. That is to say, since information on something can have an infinite number of parts or elements, practical considerations require that decisions be made on the elements of information that are most important. For example, is it important to list and locate each tree in a forest, or is it adequate just to provide an outline of a forest? Since information can be used in many circumstances and many ways, an effort to make every database record on a T-72 tank identical would probably create large, unmanageable amounts of information. There will be certain core data such as identification of an item (e.g., a T-72 tank) and its location, time, and activity. A targeting officer may be concerned with T-72 battle damage assessments. An intelligence officer may have concerns about a T-72's weight and speed. Further, a federal security agency may care about a T-72's serial number and its place and date of manufacture.

The problems inherent in creating a data standard that meets all needs may suggest that there should be no standard, but that is impractical. Without standardization, communications would be impossible. This booklet would not serve its purpose of recording and passing ideas without using words having standard meanings.

There needs to be a set of principles for guidance in achieving the necessary degree of information standardization. These principles are:

Information should be tailored to the purpose for which it will be used.

Standardized systems should be used to categorize information as much as possible.

Standardizing information is a historically challenging task that has been addressed for centuries. Professionals in many varied disciplines such as science, mathematics, engineering, accounting, law, medicine and government management have developed and maintained sets of standard terminology and data elements. These structures of terminology and data are well developed and hold great promise as guides for individual organizations that seek to create standardized terminology and data element sets to meet their needs.

211. Role of Specialist and Levels of Knowledge

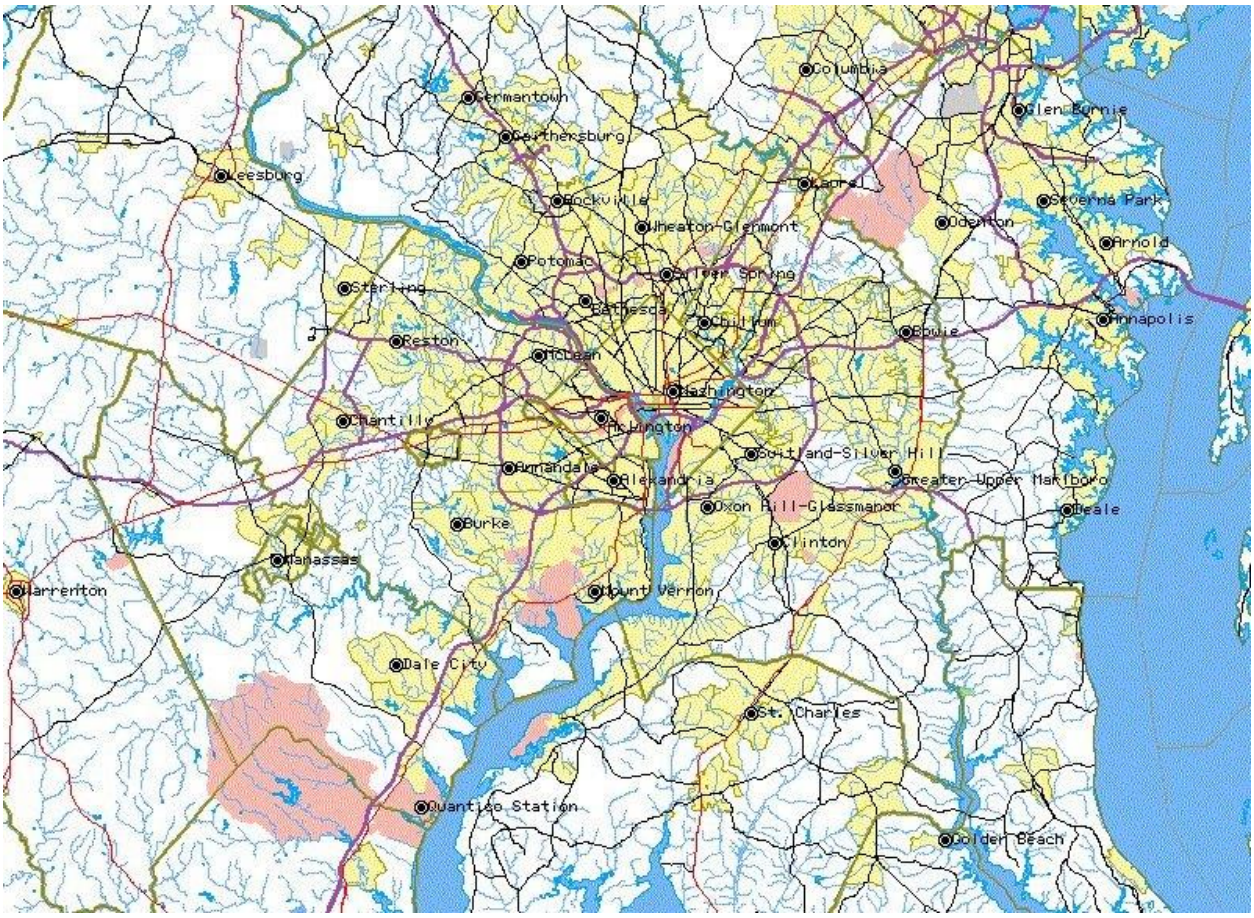
Specialists were mentioned earlier. They deserve special attention because their roles and importance are often questioned. Consider levels of knowledge. At one extreme is complete ignorance of a subject. At the other extreme is sophisticated knowledge of a subject. In-between is the general understanding of the informed layman. For an individual to be an effective informed layman, he or she usually needs to know and understand 30 to 100 basic concepts. Most car drivers meet this test. They know how fill up their gas tank and have their engine fluids checked. They know their vehicles need periodic maintenance and that their tires should be inflated properly and have adequate tread. They also know to stop at red lights and drive on the right side of the road. But, a driver who is an informed layman is neither ready to drive in a stock car race nor to overhaul his car engine. Indeed, if an average motorist took his engine apart without using a mechanic's manual or advice, he probably could not reassemble it.

Similarly, any general user of information educated on the basics of a subject can usually make skilled use of that information (just as a motorist knows to fill up his or her gas tank when the gas gauge indicates near-empty). But a general user can quickly get in trouble if he or she seeks to make decisions based on information with which he has no background or understanding. Thus it is said that only a fool performs as his own lawyer in a trial.

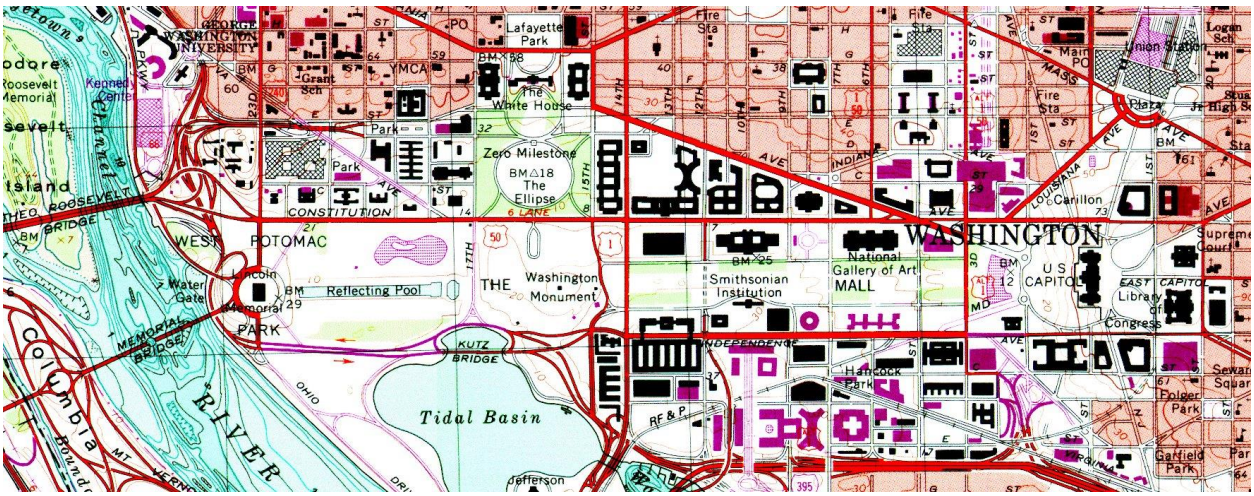
There is no easily defined line that divides the information that can be intelligently used by the informed layman from the information that requires the advice of a specialist. The effective use of information has an element of art to it - a need for judgment that is developed over time and with experience.

Also, there is not an easily defined line that divides information into levels of greater generalization or greater detail. Dividing information about a specific subject into levels of detail is easily demonstrated with maps of different scales showing the same area. Three examples follow.

This small-scale map shows a large area. Only the few categories of information useful for intended users are shown (i.e., major highways and state boundaries).



This map shows a smaller area with more detail. Breadth of vision is traded for greater detail.



This large-scale map shows an even smaller area, but with much more detail. Again, breadth of vision is traded for greater detail.

When considering which collection of information (maps in this case) to use, the question is not which is the correct set of information (or map) on some absolute scale but rather which is the most appropriate information (or map) for a user's needs. Are a few broad categories of information needed that provide generalities covering a wide area of information? For example, driving from Norfolk, Virginia, to Huntington, West Virginia, one needs a small-scale, wide area map. Is very detailed information needed for a small area? A large-scale, detailed map such as the third map shown previously is needed to tour the Washington Mall. Remember, a collection of information that provides both breadth and depth may be so large that it is unusable for decision-making. Decision makers require either a few high-level information elements formatted so they are easy to understand or a few important but small details of a small area formatted so they are easy to understand. Presenting every available detail about a large area promotes information overload.

212. Context

One device commonly used to overcome the limitations of the human understanding is to exploit a person's capability to focus on a few important pieces of information overlaid on a hazy view of a larger body of background or context information. Road maps are used this way. An entire road map is the context with a select destination as the focal piece of information. A driver focuses on two or three turns in advance with little regard for the rest of the map. The focus is on a destination and the next few turns; a driver thinks about these in a larger if vague context of an entire map.

An effective information framework provides for context information as well as for specific most-important information decision that makers must include in CCIRs, PIRs, etc.

213. Conclusion

Because information is a human creation, the symbols we use to represent it are arbitrary. This is why people speak so many languages and have so many different symbols to represent the same thing. Those who use information effectively must define every category of information and the relationships between various elements.

Because an infinite amount of information can be produced about even the smallest object, those who would use information effectively must precisely define their needs. Otherwise, the result is an overload of information not needed or desired and a lack of necessary information.

Because people can handle only a few pieces of information at one time, planning must include the identification of information requirements for a period of action to follow (e.g., CCIRs and PIRs). Further, because people can handle so few pieces of information, an effective information system must distill large quantities of raw data down to a few important pieces of information that convey or can be characterized as knowledge. Knowledge is the foundation of understanding and situational awareness.

Finally, those who succeed do not take information for granted. They understand its nature and form. Information is the key to success in almost every field of endeavor.

CHAPTER 3

TECHNIQUES AND PROCEDURES TO BUILD AN INFORMATION FRAMEWORK

301. Purpose. This chapter describes procedures for managing computerized information with a focus on creating, using, and supporting an information framework.

302. General

a. Effective information management requires information frameworks. These frameworks provide structure for the terminology to be used when (1) creating information and (2) storing and otherwise processing information.

b. Because the use of information frameworks is an old and widely used technique, those creating information management techniques can and should draw on existing frameworks.

303. Information Framework Explained. The box at left below (shown earlier in paragraph 208) is an illustration of an information framework. The box on the right shows the same terms, with their simple definitions, arranged alphabetically. Such an arrangement is often called a glossary or lexicon.

Terms Arranged to Convey A Conceptual Framework

a. Surface Materials
   (1) Dirt Road
   (2) Cement Road
   (3) Asphalt Road
b. Width
   (1) Single Lane Road
   (2) Two Lane Road
   (3) Three Lane Road
   (4) Four Lane Road
   (5) Six Lane Road
   (6) Eight Lane Road
   (7) Ten Lane Road

Lexicon

Asphalt Road. A road covered with asphalt.

Cement Road. A road covered with cement.

Dirt Road. An unpaved road.

Eight Lane Road. A road divided into eight lanes.

Four Lane Road. A road divided into four lanes.

Road. A long narrow area prepared for and reserved for vehicle traffic.

Single Lane Road. A road with only a single lane.

Six Lane Road. A road divided into six lanes.

Surface Materials. The matter used to provide a base upon which vehicles can move easily over terrain.

Ten Lane Road. A road divided into ten lanes.

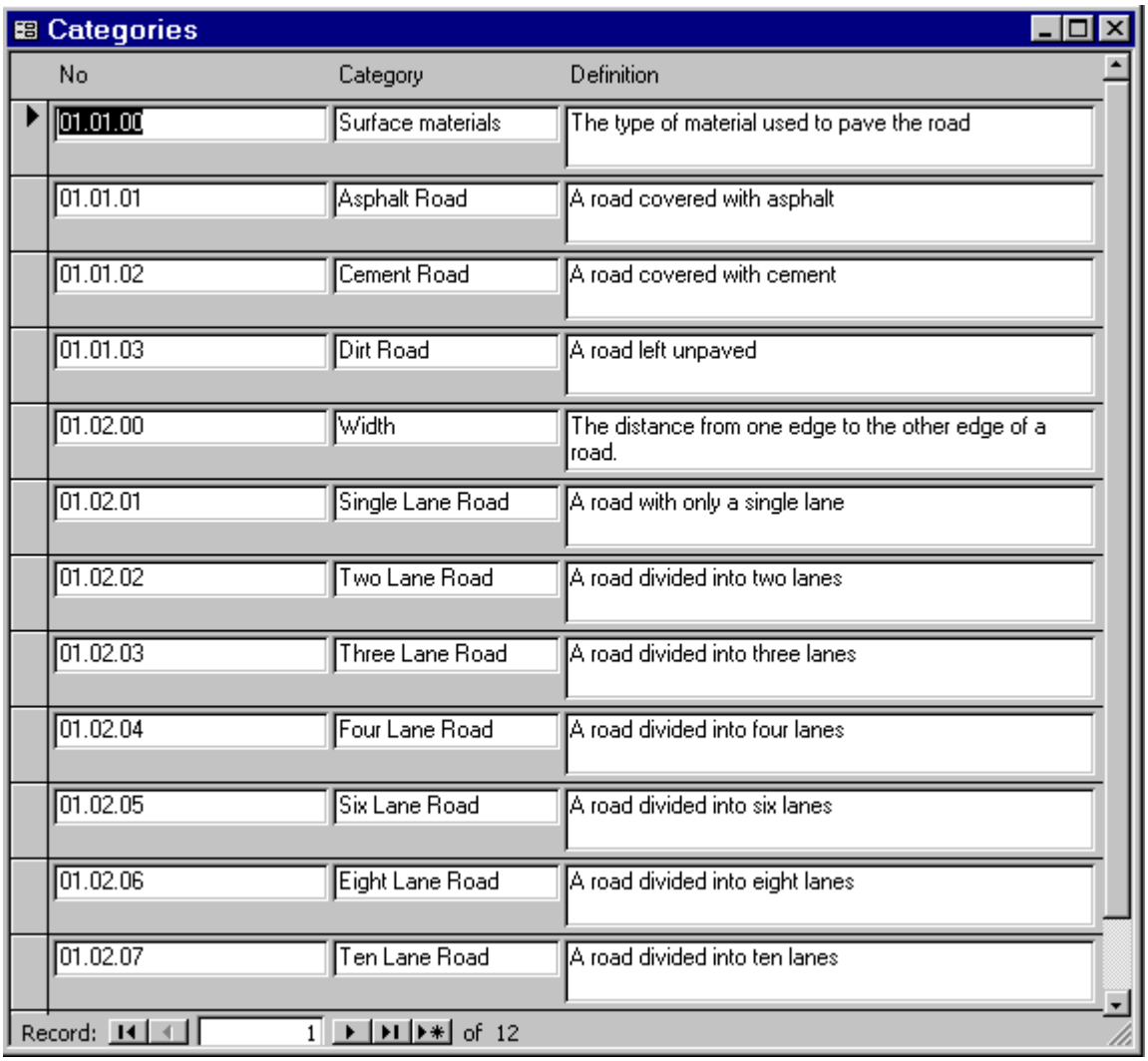
Three Lane Road. A road divided into three lanes.

Two Lane Road. A road divided into two lanes.

Width. The distance between two sides of a road stated in terms of rows or lanes for accommodating traffic.

304. Building an Information Framework

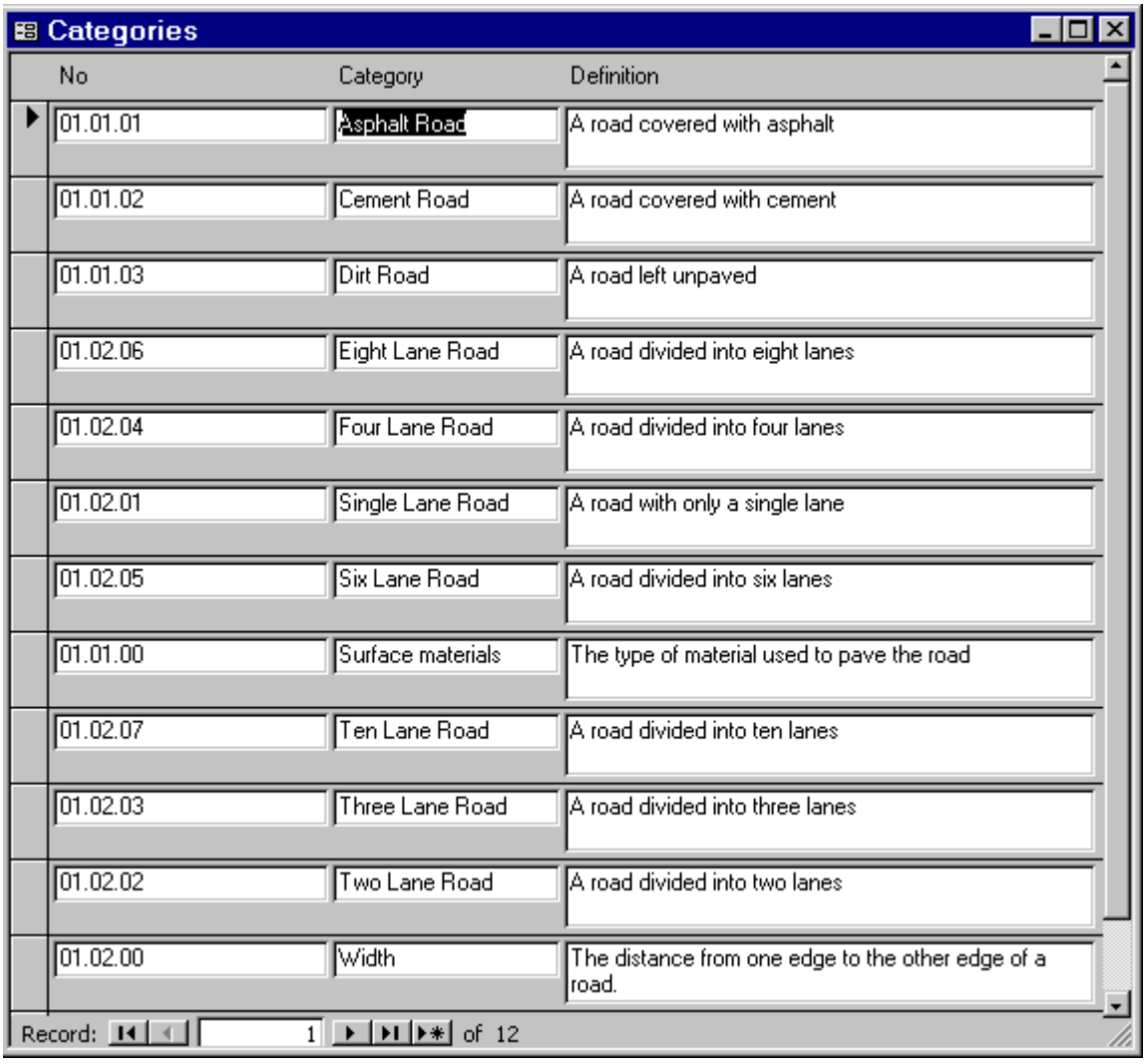
a. As demonstrated in previous diagrams, an information framework is an outline. In addition to showing categories, a framework also shows relationships between terms. The figure below shows how an information framework and lexicon can be combined into a single database with relationships. The database and form in this diagram were created using Microsoft's Access database management software.



Numbers in the left column specify the relationship between categories in the information framework.

b. An information framework can be built using a database management tool (such as Microsoft's Access software) to (1) list categories of information, (2) show relationships between categories with techniques such as assigning each category a number, and (3) record category definitions.

The advantage of using a database management tool (e.g., Access) is that a database can be easily reformatted to serve different purposes. In the figure below, the information in the database is displayed in lexicon form using a sort function to arrange the category names in ascending alphabetical order.



Categories

No	Category	Definition
01.01.01	Asphalt Road	A road covered with asphalt
01.01.02	Cement Road	A road covered with cement
01.01.03	Dirt Road	A road left unpaved
01.02.06	Eight Lane Road	A road divided into eight lanes
01.02.04	Four Lane Road	A road divided into four lanes
01.02.01	Single Lane Road	A road with only a single lane
01.02.05	Six Lane Road	A road divided into six lanes
01.01.00	Surface materials	The type of material used to pave the road
01.02.07	Ten Lane Road	A road divided into ten lanes
01.02.03	Three Lane Road	A road divided into three lanes
01.02.02	Two Lane Road	A road divided into two lanes
01.02.00	Width	The distance from one edge to the other edge of a road.

Record: 1 of 12

c. Remember, building an information framework is nothing more than creating an outline that:

(1) Lists all categories of information, and

(2) Shows relationships between categories.

305. Use of Existing Information Frameworks

a. As noted in Chapter 2, various organizations including the military, educational institutions, professional associations, industrial groups, and government agencies have created arrangements of terms that are considered standards. The five-paragraph military order or SMEAC (i.e., situation, mission, execution, administration, and communications) is a widely used example. It is a standard for arranging and presenting information issued as an order.

b. In terminology standards promulgated by various organizations, each category of information has a name and definition, and relationships between the categories of information are well defined. Interestingly, just as previous diagrams use numbers to define relationships, so too are paragraphs or categories of information numbered in the five-paragraph order.

c. Building an information framework can at once be simplified and more effective by using existing standardized information frameworks. There are at least two advantages:

(1) It is much quicker to adapt or change something that already exists and is well developed than it is to create something on blank paper.

(2) Since there is a general trend in network growth towards greater interoperability, it is becoming increasingly important for information created in one system to be used by other systems. Ultimately, the Marine Corps will want to draw on information from other military services, joint commands, other government agencies, non-governmental organizations such as CARE, and commercial organizations such as Lloyds of London. If a Marine Corps command's information framework is built using relevant standard categories, when that command needs information from other organizations it can use the categories in its information framework to first search for the needed information, then request it, and finally save it and use it.

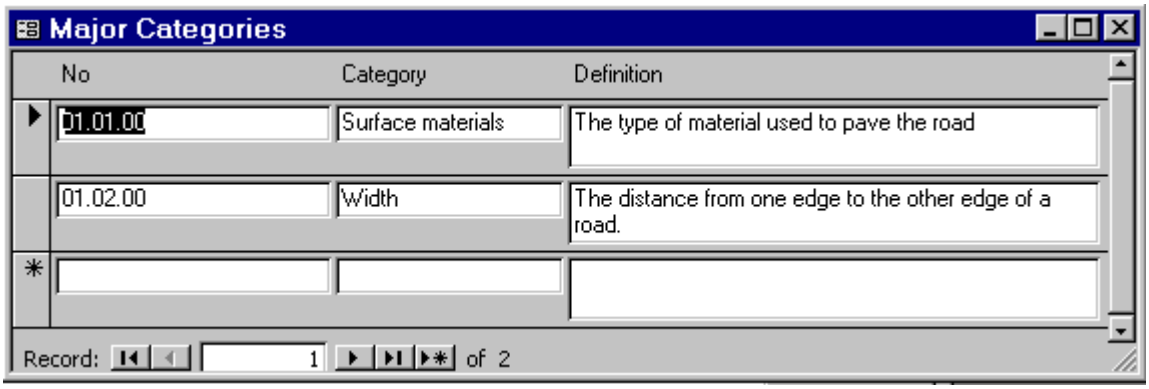
306. Depth of Frameworks

a. The depth of a framework (i.e., its level of detail) is determined by the information requirements of its intended users. A high-level headquarters probably needs general information on a very wide variety of subjects, while an artillery battalion's information framework focuses on very detailed information in a few technical areas.

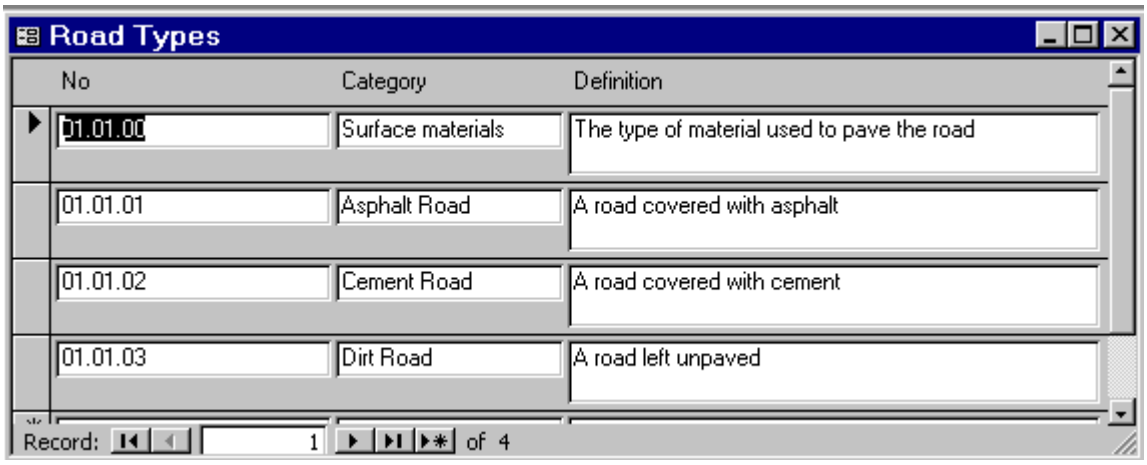
b. Information requirements within a headquarters or an organization can widely vary. Some sections or subordinate elements need only general information. Other sections or subordinate elements need detailed information in one or a few areas.

c. The result of varied requirements is an information framework with both considerable depth and breadth. Fortunately, database management software (e.g., Access) provides tools to build large and complex information frameworks that can display only small desired information portions needed by a particular user.

(1) The figure below displays the major categories of information from the information framework previously seen in paragraph 304.



(2) The next figure displays only the categories of information pertinent to a particular aspect of the paragraph 304 information framework (i.e., road surface).



307. Need to Modify Information Frameworks

a. It is necessary to modify an information framework as experience is gained using the framework to meet user information requirements or as concerns of headquarters change. Categories can be added, renamed or deleted. It may be necessary to change relationships or create new categories.

b. This can be easily accomplished using database management tools (e.g., Access). In fact, it is so easy that controlling changes is a significant challenge. Individual users want to adjust a framework to meet their needs. As is true with all large organizations, coordinating new ideas and changing requirements for an organization's information framework is a major challenge.

c. Remember, an information framework should accommodate every perspective important to an organization. A particular object can be categorized in many ways. To a commander, a specific bridge may be a strategic piece of key terrain. To an engineer, the bridge may be categorized by its weight-carrying capacity. To a military policeman, the bridge may be a

potential bottleneck while a fire support section may categorize the bridge as a potential target. The intention of an information framework is not to determine a single category for a bridge, but to provide enough categories so an organization can use information about a bridge in whatever manner necessary to facilitate mission accomplishment.

308. Relationships. By adjusting relationships, it is possible to adjust an information framework without changing the terms used to identify its categories. For example, if a category "bridges" is initially placed under a category "engineers" (that is, a subcategory of "engineers"), and later it is decided to create a new category of "mobility" and change bridges to a subcategory of mobility, the framework can be accomplished by simply changing the bridges category number. If a category for engineers is numbered 04.07 and bridges are numbered as engineers subcategory 04.07.06, then relationships can be easily adjusted by creating a new "mobility" category 04.08 and changing bridges to 04.08.06. Though the relationships are new, the term bridges and all information files and indices based on this term would remain valid.

309. Documentation. It is not enough to just create an information framework. Database management software can manipulate information much more than simple filtering and sorting. For this potential to be fully realized, users need well-documented aids in addition to a database. These aids must (a) help users understand a database framework and (b) provide them with tools and understanding to identify specific categories of information needed to create situational awareness. Forms of documentation may include:

a. A copy of a software program information framework that allows a model to be arranged:

(1) Conceptually (i.e., so that the relationships are apparent) or

(2) Alphabetically.

b. Descriptions of categories in a framework. These are basically extracts from doctrine, domain models, or subject theories. The figure below is an example. Names of categories are highlighted or **bolded** along with a category definition and relationships. This document explains relationships and the importance of individual categories.

ROADS: Logistical Connectors

Roads connect various parts of an organization or political entity by providing a means of communication and transportation between its parts. Roads can be categorized by **surface material** or **width**. Both systems of categorization are important but serve different purposes.

Surface materials are important because they affect traffic-ability and maintainability. **Dirt roads** are easily constructed and easily repaired but most likely to be adversely affected by rain. **Asphalt roads** are quicker to build and easier to maintain than cement roads but they are less durable. **Cement roads** are sturdy and not rendered impassable by rain but are the most difficult to maintain.

The width of a road when measured in **lanes** indicates the amount of traffic that can be carried. It is the distance between two sides of a road stated in terms of rows or lanes for accommodating traffic.

c. A web page version of a document describing a framework with links to supplementary information.

d. A database with relevant documentation links in the information framework. Some database management software (e.g., Microsoft's Access) has hyperlink capabilities. Within a database record, hyperlinks can be established to instantly access other records, documents, images, computer files or Internet sites for more information. When a blue underlined hyperlink is activated (i.e., clicked), it automatically locates and opens the linked data.

e. A document that provides:

(1) Procedures for controlling the expansion and other modifications of an information framework and

(2) A record of data sources for those parts of an information framework that are drawn from generally accepted standards.

310. Tolerances. The increasing use of computers has greatly decreased the tolerance for data variations. As paragraph 105 noted, a difference of one character in a data entry can make a significant difference between recognizing data and ignoring data. Attention to detail, data consistency, and controls ensuring a coordinated development of information formats are very important.

311. Keywords

a. Keywords are terms used to characterize pieces of information. As discussed in paragraph 203, information has a wide range of complexity. At one extreme is raw data perhaps reporting that a sensor detected something at certain time and place. At the other extreme, an intelligence report could discuss the probable intentions of an enemy commander, the political organization of a group that is terrorizing the United States, or the technical characteristics and use of a new weapon.

b. Raw data should use terms already included in an organization's information framework. If piece of data is received on a T-72, the fact that a T-72 is a tank should not have to be added by hand. If this action is required, the potential for rapid information processing and fast decision-making may be compromised.

c. A piece of complex information (e.g., intelligence report) may contain scores or hundreds of terms that are also included in an organization's information framework, but it will probably focus only on areas listed in an organization's information framework. A report's focus should be characterized and recorded using keywords drawn from an organization's information framework.

d. Keywords allow a complex piece of information (e.g., sophisticated intelligence report) to be filed in a directory relating to a report's primary subject. But, a report can also be accessed by reference to its secondary subjects or concerns. For example, a report on a foreign political

group might be filed under non-governmental political organizations but it may also have key-words that identify the group by its name, its leaders, and the country in which it is active.

e. Keywords can also be used to indicate whether a piece of complex information is intended for general users or technicians. This is an important concept as military data management migrates towards net-centric warfare with ever-greater quantities of available information.

312. Using Computer Search Tools

a. Background. Because computers are very well suited for quickly searching large quantities of information for text strings (e.g., MGRS) selected by computer users, many programs include search features such as illustrated below. To use these search tools, a string of text is entered into a search window. Search results will exactly match the input text string.

Using a computer copy and paste technique, a user can (1) copy a search term from an information framework database or other supporting documents, (2) paste the term into the search window and then (3) search. The obvious potential advantage of using standard terms and a paste and cut technique is that they greatly increase the probability of quickly finding information correctly matching a specific term.

b. Specific Tools. Among the many ways for searching electronic information are:

(1) Databases based on keywords,

(2) Word processing documents with text strings,

(3) Any type of electronic information files using keywords,

(4) Internet searches using keywords or text strings, and

(5) Network searches.

313. Directory Structures. It may seem logical to place all files in a single directory and use a database or a search technique to locate desired files. Since it is impossible to see the importance of every piece of information when it is created, received and filed, provisions must be made to store computer files in well-structured directories in a logical manner. This technique has been used for many years in libraries for book storage (i.e., the Dewey decimal classification system). Each book is assigned a catalogue number and placed accordingly on library shelves. This technique places books on the same subject in the same area. If one knows the title of a single

book covering an unfamiliar topic area, he or she can easily locate similar books on the same topic files on the library shelves in proximity to the known book title. This is a very imprecise technique but it can be used effectively when information is not needed immediately.

314. Naming Individual Files. Computer files, whether databases, map images, spreadsheets, or textual reports, should be appropriately named to facilitate their identification. File names may include subject identification and/or date (e.g., Kuwaiti_Recon_Report_Jan_2001.doc) or function (e.g., Desert_Map.jpg). Regardless of how the names are constructed or derived, the use of a systematic file-naming procedure will facilitate future searches and uses for information not envisioned when a file is created and stored.

315. Exploiting Capability to Assign Multiple Categories

a. Information on paper may be assigned multiple categories (e.g., characterizing a bridge as intelligence and logistical information). However, a sheet of paper can only be stored in one place. Computer information, on the other hand, can be "stored" in numerous places because computer information is not really placed in a physical folder in a computer. A computer folder represents an electronic link, not a physical placement. Thus the "placement" of information on a computer hard drive establishes an electronic link. Computers have the potential to create multiple links to a single piece of information.

b. However, computer users must be alert to storing multiple copies of one piece of information in several different places. This is dangerous, because in the heat of action, one copy of the information may be updated and the other copies may remain unchanged. The updated information renders all other copies outdated and incorrect but the unchanged and incorrect copies may be as readily available as the updated piece of information. Significant operational problems have arisen from having and using multiple copies of the same information. These problems are often very expensive to correct or repair. While it may take a little more work when creating and filing a document or other piece of information to cross-reference it properly, the potential savings in the time and monies required for remedial actions may be huge.

316. Summary

a. All Marine Corps organizations have frameworks to guide their service members in filing and retrieving information. Examples include file outlines and the numbering system for doctrinal publications. With a net-centric approach, it is necessary to have an information framework that draws together all previously separated systems and extends them to include information not previously covered.

b. So much information exists that organizations must create information frameworks to adequately address their needs. This is not a new approach. This is why CCIRs, PIRs, and similar tools and techniques have long been used. The improved capabilities of communications and computers have led some to believe that it will soon be possible to receive all information. This is not the case. A properly constructed information framework helps members of an organization acquire, store, and easily access information required for mission accomplishment.

c. Databases and similar software permit the access and use of information with flexibility previously impossible. Information displayed conceptually can be resorted so it is displayed alphabetically. Using data filtering and similar techniques, large masses of information that would overpower a person's ability to absorb and understand it can be reduced to easy-to-understand displays.

d. For the potential of new computer information management software to be fully realized, information frameworks must first be created and then used for creating and filing information.

INDEX

K

M

N

P

S

W