

This paper summarizes the work of a study group on ways to improve the usability of publications that support programming products. Task orientation, an approach to providing, organizing, and packaging information, is covered, together with innovations to improve the usability of programming publications: ease-of-use education, measurement of user opinion, and incorporating usability into the publications development process.

Improving the usability of programming publications

**by F. J. Bethke, W. M. Dean, P. H. Kaiser, E. Ort, and
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In mid-1979, a study group was convened at the IBM Santa Teresa Laboratory to find ways to improve the usability of publications supporting the Laboratory's programming products.¹ The group, called the System Information Ease-of-Use Study Group, consisted of technical writers, editors, and information planners—all members of the System Information (i.e., programming publications) Department at the Laboratory. The study group was asked to answer the question: "What can the planners, writers, and editors of programming publications do to make the books they work on more usable?"

The group's approach was a practical one. Because there was no base of knowledge of information usability on which they could call, they began by collecting ideas that could be immediately applied and by identifying skills that could be readily acquired and used. The objective was to recommend a set of actions that would have a direct, constructive effect on the usability of the Laboratory's publications.

To do this, the study group proceeded as follows:

- Defined ease of use as they understood readers (i.e., system users) to perceive it.
- Identified problems in achieving ease of use.
- Made specific recommendations to solve those problems.
- Identified tools and techniques already available to promote ease of use.

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- Defined a way to measure information ease of use. (To their knowledge, no means existed for measuring the usability of the Laboratory's publications or for determining what progress was being made.)

Readers' view of ease of use

From interviews with the intended audience and field personnel, and from readers' comments received over a period of time, the study group concluded that readers think information is easy to use when it is:

- Easy to find.
- Easy to understand.
- Task-sufficient, i.e., sufficient for the task at hand.

All three aspects are essential. For example, information may be both easy to find and easy to understand, but if it is wrong for the task at hand it is unusable. Similarly, readers may be able to find the information they need quite readily, but if it is unclear they cannot use it. Although information may be precisely what is needed and easy to understand, if readers cannot find it they cannot use it. Each of these aspects is itself subdivided into three factors, yielding a total of nine ease-of-use factors.

Ease of finding information may be thought of as being made up of the following factors:

the nine ease-of-use factors

- *Consistency*. Similar subjects have the same kind of information, presented in the same way. Readers know what they will find, where they will find it, and how to approach it.
- *Pointers*. Signposts, such as table of contents, index, headings, and highlights in text, announce the presence and location of information.
- *Arrangement*. The manner of presentation anticipates ways in which readers might look for information. Typical subject arrangements are by alphabetical or chronological order or by subject classification.

Ease of understanding is made up of the following factors:

- *Simplicity*. The vocabulary suits the audience, and no more than five to nine items are presented at one time so that they can be grasped without difficulty. A complex subject is organized in layers with nine or fewer items in each layer.
- *Concreteness*. Ideas and relationships are conveyed with appropriate examples and pictures. Verbal descriptions favor the specific over the general or abstract.

- *Naturalness*. The unfolding of information fits the way readers come to understand and use it. Checks are included so readers can verify that they are on the right track.

The following are factors involved in task sufficiency of information:

- *Completeness*. All the information needed to do the tasks related to a program is included. No essential task information is omitted.
- *Accuracy*. The information corresponds to the facts as readers are expected to encounter them in practice.
- *Exclusivity*. Information not related to tasks associated with a program is omitted.

The remainder of this paper discusses how we in the System Information Department implemented the study group's recommendations for improving the usability of our publications. The major topics covered are task orientation, ease-of-use education, ease-of-use measurement, and the incorporation of usability into the publications development process.

Task orientation

One of the study group's recommendations for improving usability was to use task orientation and the task-oriented publications architecture. *Task orientation* is an approach to designing information that results in task-sufficient publications. The *task-oriented publications architecture* is a tool that ensures consistency in the design of task-oriented libraries.

Task orientation assumes that readers seek out our publications with the objective of performing a task; that is, they are looking for information to help them to do something. Our books hold the facts they need, but searching for those facts and reading and understanding them are obstacles to readers' completing their work. Readers are likely to be impatient to get on with their work, and want to find relevant information fast. They need information that is easy to find, straightforward, and sufficient for the task. Task orientation results in this kind of information.

Following this approach, an information planner analyzes each user task to determine the information to provide, for example, in installing, operating, and using programs. Information not needed to do a task is omitted. Information required to perform each task is kept together, often in the same book, and the order in which information is presented is dictated by the order in which task steps (or subtasks) are to be performed. Task-oriented publications are given titles that indicate the tasks they support.

Task orientation is a new approach and contrasts with other approaches that have been used to design libraries of programming publications. As an example of a contrasting approach, consider software orientation, in which a planner concentrates on the structure and facilities of a program rather than on its use. Program use is suggested in the description of the facilities provided for communicating with the program. A software-oriented library for an operating system might consist of one book each for the supervisor, scheduler, job manager, I/O supervisor, and so on. Each book would contain a comprehensive description of the functions, organization, and method of operation of the program.

**software
orientation**

We have noticed several problems with this approach. For one thing, the reader must already know the structure of the program; an inexperienced user may thus become lost. Also, there is no way to gauge whether the information is complete. The tendency is to provide everything time allows and hope that readers have all the information they need. Most importantly, the reader's purpose in using these books is often overlooked; readers use our books because they are trying to do a particular task, not because they want to know everything.

Another approach that has been tried is user-role orientation, in which the information required to support a product is defined as what operators, system programmers, application programmers, and others need to know about the product. A planner who uses this approach to organize information might design an operator's guide, a system programmer's guide, an application programmer's guide, and so forth.

**user-role
orientation**

A problem with this approach is that users might define their roles differently from the way in which the publication designer defines them. Differences in the definition of roles can cause readers to look in the wrong places for information. Also, some roles, notably the system programmer role, are too broad to be useful as an organizing scheme because they encompass several distinct tasks that require different types of information.

Task orientation, on the other hand, deals with the tasks people commonly perform with computer programs, regardless of their job titles, and focuses on the information needed to perform the tasks.

The task-oriented architecture is a general scheme according to which a library of books for any given program may be designed. This architecture consists of a set of general, tailorable user-task descriptions and a set of conventions for writing, packaging, and titling task-oriented information.

**task-
oriented
architecture**

The task-oriented architecture extends the usability of task orientation by promoting consistency among publications for different programs. When the architecture is used to design a certain library, that library is consistent with others designed according to the task-oriented architecture. That is, there is consistency in user-task analysis, in the way similar kinds of information are presented and packaged into books, and in the way the books are titled. When similar kinds of information are structured and presented in the same way, the documentation scheme according to which they were written becomes clear to readers. When readers have formed a mental picture of the documentation scheme, they can predict the whereabouts of information they want and find it quickly.

The architectural tasks embrace all the work anyone is likely to do in using a program. The information that must accompany the program is that which one needs to perform the following tasks:

- *Evaluation.* Judging the applicability of a program to an installation, and deciding whether or not to install the program.
- *Planning.* Making fundamental decisions about the options available with a given program. The decisions are specified in written directions and procedures that are followed during the implementation tasks of installation, customization, operation, resource definition, and application programming.
- *Installation.* Making a program ready to do useful work.
- *Resource definition.* Defining the characteristics of such data processing resources as data files or user profiles used by or in connection with a program.

Guidelines for information planners and writers have been published that describe the task-oriented approach, present the architecture, give guidance for doing task analyses, and explain how to develop information to support tasks.²

- *Customization.* Enhancing or extending a program by using available enhancement and extension services and built-in facilities.
- *Application programming.* Designing, coding, compiling, executing, debugging, and testing an application program.
- *Operation.* Starting and stopping, monitoring, and reacting to abnormal events related to a program.
- *End use.* Using a program to do the work it was designed and constructed to do.
- *Program service.* Identifying, describing, reporting, and correcting a program problem.

The study group recommended that task orientation be adopted and that the architecture, especially the guidelines that describe

it, be used as the primary tool in designing and developing task-oriented information. Thus we decided to design and write all new libraries in accordance with these guidelines. Architecture reviews were instituted early in the information planning cycle to ensure adherence to the guidelines. A course on designing task-oriented libraries was developed and taught to our planners and writers.

Education

Education is required for those who are to produce publications that are easier to use. The objectives of the curriculum include making information easy to use, developing the skills for writing more usable information, understanding the ways people use program products, and understanding our procedures for ensuring that information is usable. To provide this education, we have created courses and found ways for information developers to gain field experience.

The courses vary from less than one-half day to three days so as to minimize disruption of work and avoid overburdening course developers and teachers. The following are the courses developed and taught so far.

courses

A seminar on Designing Task-Oriented Libraries explains the principles of task orientation just discussed. The seminar shows the preparation of task-oriented information objectives, publications plans, and outlines by starting with generalized task descriptions and tailoring them according to a program's intended use.

Writing for Reader Understanding is a workshop that demonstrates the psychological principles underlying effective communication. Writers who grasp these principles are able to present information so that readers can grasp it easily.

In a seminar called Communicating Complex Subjects, students learn ways in which complex subjects can be made more understandable. The seminar teaches such expository techniques as varying pace and repeating, summarizing, and exemplifying.

A seminar on Common Writing Pitfalls examines six common faults of technical writing: wordiness, aimlessness, faulty usage and logic, use of technicalese, condensed thinking, and faulty construction. The skills gained help participants become better self-editors.

An Indexing Workshop is a practical in-depth study of the index, which is our main retrievability device. The workshop gives practice in creating useful index entries and in using our automated indexing tool.

A seminar on Field Orientation prepares one for branch office and customer location visits and for branch office work assignments. These work assignments include working with systems engineers or program support representatives by helping prepare classes for branch office personnel or customers, helping systems engineers install products, and participating in field tests.

consultants

We bring field personnel into the Laboratory to sit on a Publications Review Board for program products our Laboratory is developing.³ Board members know from experience with similar products how customers will use these new products. Review Boards give us both immediate and long-term advice. They suggest immediate usability improvements in the publications for a particular product. And from the continuing association with field personnel, we develop a broader understanding of the use made of our products.

Measuring ease of use

In the study group discussions, it became apparent that there was need for a measurement tool. How can one tell which existing manuals are in need of improvement? How can one verify that future efforts to improve ease of use are succeeding? How can one determine whether the study group's definitions of the nine ease-of-use factors are valid?

**existing
tools**

Investigation revealed that a number of attempts had been made to establish measurement methods for certain aspects of publications. A general discussion of many of these measurement techniques is given in Reference 4. In one approach, the Fog Index was designed to predict the grade level needed to read and understand a document. This index uses a formula based on mean sentence length and percentage of words of three or more syllables in a given publication. Another technique is termed the Cloze Procedure. In this procedure, words are deleted at regular intervals, and readers are asked to supply as many of the missing words as possible. The percentage of successes out of the total deletions is taken to be a measure of the comprehensibility of the original document. Other procedures use such measures as numbers of examples per page, numbers of illustrations per page, and the ratio of index size to main body size.

The study group evaluated these techniques to gain an idea of their effectiveness. Some methods have no scales attached to them. Although the measurements produce numbers, these numbers are not correlated with the relative success or failure of the publication. Some measurement methods have rating scales but have not been widely used or validated. Thus they exist more as theory than as proven tools. None of the existing techniques

specifically addresses ease of use. Most of the existing methods are concerned with readability, which is an important quality of a successful publication, but is only one of many qualities that constitute ease of use. Therefore, the study group believed that a broader mechanism—something designed to measure ease of use as a whole—was needed.

The study group first proposed as a premise that ease of use can be measured in terms of time or energy, or both. Ease of use may be thought of as the opposite of "difficulty of use" and, therefore, as the relative absence of energy and/or time expended. If one devotes equal levels of energy or effort to similar tasks A and B, but B requires more time, then A may be said to be the easier of the two tasks. If one devotes equal amounts of time to tasks A and B, but A requires a higher energy or effort level, then B may be said to be the easier task. In terms of technical publications, ease of use is thought of as the relative absence of effort/time spent in finding and understanding required information.

time and
energy as
measures

This premise posed the following questions: Could publications be measured by keeping time constant and measuring energy, or by keeping energy constant and measuring time? The measurement of time does not pose a problem. Time can be kept constant or measured easily. The measurement of energy is more complex. The effort expended in using a technical publication requires primarily mental energy, the measure of which is not a simple task.

Because of the complexity of measuring mental energy, an alternative premise was investigated. The study group sought to increase *perceived ease of use*, that is, ease of use as our readers experience it, rather than ease of use as objectively measured independently of their opinion. This goal is to increase satisfaction in ease of use as the users themselves perceive it. By this premise, the subjective measure of satisfaction is used in place of an objective measure of mental energy expended. The users' own view of the time and effort they expend in using the publications is the important thing. Therefore, user perception of a publication's ease of use is believed to be an adequate if not superior measure, as compared to the time-energy concept.

perceived
ease of use

Some reader opinion was available to us through Reader's Comment Forms, such user groups as GUIDE and SHARE, and through communications from field personnel. This sample, however, lacked scope, and the sampling methods lacked statistical rigor. A broader and more controlled method was needed. The study group decided to conduct a user survey as a practical means of measuring perceived ease of use.

Measurements associate numbers with objects or phenomena, thereby answering the questions "how many" or "how much."

finding a
standard

This activity requires a scale, which is a reference quantity, i.e., a unit that supplies the "what" of how much or how many.

As is implied earlier in this paper, ease of use (whether in using technical publications or in any activity) tends to be a relative matter. Something is seen as easy to use if it is easier than a known average of all things of that type that have been used before. To speak of the ease of use of a publication is to compare it with the average usability of similar publications.

This understanding suggested a two-part design for the survey. A broad survey would be done first to establish an average perceived ease-of-use level for the class of manuals on which our organization works. The second step would be to survey our organization's manuals individually, using the same methodology. Results for each manual could then be compared with the established average or baseline. This comparative method would overcome one of the traditional difficulties in surveys, that of interpreting the significance of the scale. Although the absolute meaning of the results for any single manual might be open to debate, when particular results are placed on the same scale as the baseline results, the comparison should demonstrate relative success or failure.

**the
questionnaire**

A questionnaire was created that formed the heart of the survey. It was designed to be answered over the telephone by persons who have actually used a particular manual in their jobs. The questionnaire consists of twenty-four questions. The central or stem question (How easy to use is this manual?) is asked twice in slightly different ways. Nine separate questions address the nine ease-of-use factors. Two other questions ask the reader to identify the things most responsible for whatever success or failure the manual has in being easy to use. (These two open-ended questions are phrased without reference to the nine factors, so as to avoid forcing users into our preconceived categories.) The reader is also asked to rate the ease of use of IBM programming manuals as a whole. This answer provides another way of measuring a manual's perceived differential from a norm.

A number of questions investigate possible correlations. Readers are asked whether they use a manual more as a guide or as a reference. Since the study group felt that the relative importance of the individual ease-of-use factors differs for the two usages, knowledge of which way the reader uses the manual allows two different sets of correlations and offers an opportunity to test this hypothesis.

Readers are also asked to rate the ease of use of the program product itself (i.e., the program or process the manual describes). These answers help to show whether there is any transference in

users' minds between the perception of ease or difficulty in using a product and the manual that applies to it.

The perception of a manual's physical nature is the basis of a question that tests whether the publication's aesthetics correlates with its perceived ease of use. Finally, a number of demographic questions are asked, to look for correlations with reader experience, position, and the like.

To establish a *baseline* (i.e. the average or standard against which individual manuals can later be compared), a subset of all IBM manuals was defined. This subset contains all large-system programming manuals produced by the development laboratories and currently in use by customers. It excludes such specialized items as reference cards and product specification sheets.

survey
methodology

Thirty manuals were selected from this subset in the following manner. The more than one thousand manuals in the subset were listed in order of number of copies distributed. (Not all customers use all manuals.) Then the one hundred most used manuals were identified, from which the thirty manuals to be surveyed were selected at random. The weighting of the selection in this manner was based on the expectation that the more widely used manuals contribute more toward the general perception of the average ease-of-use level in the user community.

Twenty users of each manual were asked to respond to the questionnaire. This procedure produced a total of six hundred responses. To enhance representation the users were chosen from among many customers. Every manual was judged by only one user per customer location, and no location judged more than three manuals. Thus the number of customer locations represented exceeded two hundred. Individual users were selected to be representative of all the users of the manual at each location.

Over the next few years, we intend to survey all new manuals as they are written at the Santa Teresa Laboratory, as well as existing manuals that we maintain whose ease-of-use level is of particular interest to us. Existing manuals can be surveyed immediately. New manuals must be in use long enough for customers to form an adequate perception of them. We believe that three months for guides and six months for references is adequate time for this purpose. To survey an individual manual, at least thirty customers who use it will be selected at random. From those selected customers, one representative user from each location will be asked to answer the questionnaire.

Incorporating usability into the publication process

The study group recognized that if publications were to be easier to use, usability would have to be emphasized in the process of

planning, developing, and maintaining publications. Therefore, the study group recommended the following actions:

- Review publication planning documents for task sufficiency. In adopting this recommendation, new reviews, called "architecture reviews," were added to the process.
- Edit outlines and drafts for task sufficiency, ease of understanding, and retrievability.
- Make indexes available with final drafts, and review the indexed drafts for information retrievability.
- Fix usability problems in publications that are already in use.

The first three of these actions emphasize ease of use during the publication planning and development process. The last emphasizes ease of use in maintaining publications.

**architecture
reviews**

Two architecture reviews are held for each new library of publications. At the first review, the task analysis that an information planner does for a programming product is inspected. This review ensures that all the tasks that need to be covered in the publications are identified, that the tasks have been grouped together in a proper way, and that the tasks have been sufficiently analyzed for the next step, which is library design. The first review makes the task analysis more detailed and helps ensure that writers provide exactly the information needed to understand and use the product. This review also helps information planners complete the task analysis. During the review, product-related tasks are identified that are not in the original task list.

At the second review, the structure of the library and of each planned publication is inspected. This review ensures that the library is properly organized and the publications properly titled. The second review makes for more uniform and consistent publications. It also ensures that we will take a consistent approach to packaging and titling information for all products.

**technical
edits**

A technical edit is a review of an outline or draft with the objectives of suggesting improvements in usability and of correcting such errors in writing mechanics as grammar, punctuation, and spelling. Before the study group existed, editors conducted their reviews without a consistent usability focus. The study group recommended that editors always consider and comment on the ease-of-use aspects of task sufficiency, ease of understanding, and retrievability.

To carry out this recommendation, editors have devised and begun using Editorial Review Summary Sheets, a sample of which is shown in Figure 1. The summary sheet is divided into four parts, of which Task Sufficiency, Ease of Understanding, and Retrievability have already been discussed. The fourth part,

Figure 1 Sample Editorial Review Summary

EASE OF USE	Document:	General Information Manual
Editorial Review Summary	Date:	5/15/80
	Author:	E. Ort
	Editor:	M. Dean

Task Sufficiency

1. Most of "Routine Data Set Management" and all of "Managing Data Sets and Procedure Library Members" are redundant. The redundancy doesn't seem to serve any purpose and should be removed.
2. On page 11, you don't really describe how to estimate direct-access storage requirements; you just outline the factors that a user has to take account of. The section needs to be more helpful.

Ease of Understanding

1. The word "migrate" and its forms shouldn't appear in the book. It is much clearer to speak of "moving data sets from one direct-access storage device to another."
2. "Current" is another confusing term. When data are moved from one direct-access storage device to another, which would you call the "current" one? See the draft for a suggested way to avoid this problem.

Pictorial

Your figure in the introduction has no apparent connection with the containing text. See the large comment on page 5.

Retrievability

The relationship between "Determining Data Set Characteristics" and the other migration steps is unclear. This subject is more in the realm of "routine data set management." If you agree, please discuss the subject in the section with that name.

Pictorial, emphasizes our interest in the use of graphics when they can convey information better than words or when they supplement text. The summary sheet helps writers see how well they have addressed ease of use and suggests general steps they can take to make their drafts easier to use.

A good index can make the difference between a publication in which information is easy to retrieve and a publication in which it is not. To ensure that writers create good indexes, we require them to include an index in their final-review drafts. Reviewers can then use the draft much as a user would. In particular, they can review the index to determine how comprehensive it is and how well it ties together related pieces of information.

Traditionally, the maintenance of publications has mainly dealt with technical inaccuracies. The study group recognized that the

reviews of
indexed
drafts

fixing
usability

concept of maintenance must be broadened to include correcting usability problems that affect users. A noteworthy example of this is the updating of IMS/VS Version 1 publications. We had indications that the current IMS/VS publications should be superseded by a set of publications that would help customers make better use of the IMS/VS program. Because of the number of users affected and the potential benefit of an improvement, we decided that a usability update to the publications was warranted. We made major changes in the focus, organization, and packaging of some IMS/VS Version 1 publications.⁵

A key element in our approach to usability maintenance is user feedback via questionnaires. As we pointed out in the section on measurement, we use questionnaires to survey users about a variety of IBM publications. The survey gives us an average usability rating against which to compare individual IBM publications. If users find that a publication is hard to use, we make plans to improve its usability. We are now reviewing the publications we maintain to determine which of them should be measured via the questionnaire.

Concluding remarks

Although the ease-of-use study group did not focus on the ease of use of computer programs, programming was not ignored. A number of recommendations were made to the programming development organization, and the following activities resulted:

- A programming development ease-of-use study group has been established to determine what is needed to produce more usable programming products.
- A technical report has been published showing how task orientation can be applied to writing programming objectives and specifications.⁶ A pilot project to produce task-oriented programming documents is under consideration.
- Usability evaluations have become part of the formal review of programming specifications. A checklist has been prepared to aid reviewers.⁷
- More emphasis is being placed on developing on-line information as an alternative to or as a supplement to hard-copy books. In addition, users of future products will see on-line messages with complete explanations. Thus there will be no book of messages.

We are continuing to apply and refine ideas on writing discussed in this paper, and we foresee projects to further refine our methodology. One such project being considered is directed

toward enhancing our measurement techniques. Another project is that of experimenting with the physical and visual characteristics of publications (e.g., type size, fonts, ratio of white space to text, and graphics). There is also much research to be done on the psychology of reading, which should aid us in moving from opinions to facts about what users do and what they need in their publications.

Finally, we expect task-orientation concepts and their application to be widely accepted and grow far beyond their genesis in publications.

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IMS/VS Version 1 System/Application Design Guide, SH20-9025.
IMS/VS Version 1 Application Programming Reference Manual, SH20-9026.
Information in the first of these original publications has been divided and expanded into the following publications:
IMS/VS Version 1 Data Base Administration Guide, SH20-9025.
IMS/VS Version 1 System Administration Guide, SH20-9178.
Information in the second of the original publications has been revised and included in the following publication:
IMS/VS Version 1 Application Programming: Designing and Coding, SH20-9026.
These publications are available through IBM branch offices.
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