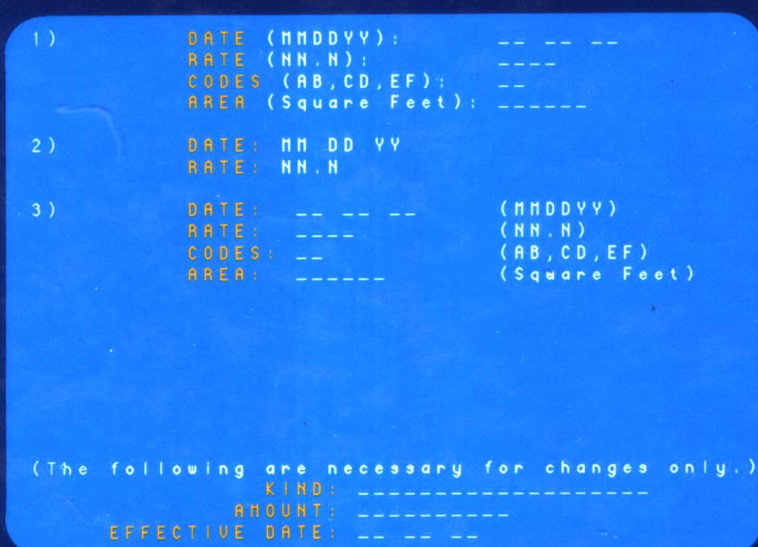
Third Edition

Handbook of SCREEN FORMAT DESIGN

Wilbert O. Galitz



QED Information Sciences, Inc.

THIRD EDITION

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Introduction 1

Today the most common communication bridge between a person and a computer system is a visual display terminal. The medium of this communication is a cathode ray tube upon which data and information are electronically inscribed. What information or data is placed on a display tube, how it is structured, and where it is located is called screen format design.

A well designed screen format can increase human processing speed, reduce human errors, and speed computer processing time. A poorly designed screen has the opposite effect: it will decrease human processing speed, provoke mistakes, and complicate machine operations. A well designed screen, then, will increase human productivity; a poorly designed screen will reduce it.

Screen format design, or screen design, as it is commonly called, is the topic of this handbook. In some quarters screen design is perceived as encompassing the programming steps necessary to provide a finished product to a user. It should be recognized that a discussion of this design activity is beyond the scope of this book. This document will only be concerned with how a screen looks and behaves for a user. It is directed toward developing a screen product that is easily used and visually clear. Simple programming concepts introduced are only those necessary to accomplish this objective.

AN HISTORICAL REVIEW

During its first twenty years, the data processing industry paid little attention to the human/computer interface in system design. The focus instead was on efficient use of central processing units and storage media. The high cost of technology and the fact that computers were used by a relatively few specialists sublimated the interface between humans and computers. Systems were, in effect, designed from the "inside out."

As computing power increased and computing costs decreased, computers touched more work lives. Computer usage by several users became usage by several hundred users, and, thus, personnel costs became a dominant factor in total systems costs. In the early 1980s the ratio of office workers to display terminals was on the order of 10 to 1. That is, for every ten white collar workers, there was one display terminal to be found in offices across the country. With the increasing popularity of the personal computer, this ratio has dropped dramatically.

Economics have thus forced a refocusing of system design emphasis onto the user. It has become more widely recognized that the ease and effectiveness of human interaction with computers depends on how well the interface reflects people's needs. Thus, the system design emphasis has shifted to the "outside in." Effective screen design from a user's perspective has assumed increasing importance.

Historically, screen design responsibility has fallen on programmers and systems analysts—those charged with designing and building computer systems. The design process, unfortunately, has developed with few guidelines. Technical considerations have received the most attention, and the human factors involved have not been well understood or have been neglected entirely. As a result, screen design has tended to be unsystematic and inconsistent, and has failed to adequately reflect human perceptual and processing capabilities. As a result, many screens in today's office systems are difficult to use and lack visual clarity.

At best, a poorly designed screen can exact a toll in human productivity, as illustrated in figure 1.1.

Based on an actual system requiring processing of 4.8 million screens per year, an analysis established that if poor clarity forced screen users to spend one extra second per screen, almost 1 additional person-year would be required to process all screens. A 20-second degradation in screen processing time would cost an additional 14 person-years.

At its worst, a poorly designed screen can create an impression that understanding it will require more time than one can afford to commit, or that it is too complex to understand at all. Those who have the luxury of doing so (managers and professionals) may refuse to use it, and the objectives of the system for which it was designed will never be achieved.

The benefits of a well designed screen are coming under much closer experimental scrutiny. Dunsmore (1982) attempted to improve screen clarity and readability by making screens less crowded. Separate items, which had been combined on the same display line to conserve space, were placed on separate lines instead. The result: screen users were about 20 percent more productive with the less-crowded version. Keister and Gallaway (1983) reformatted a series of screens following many of the same concepts to be described in this handbook. The result: screen users of the modified screens completed transactions in 25 percent less time and with 25 percent fewer errors than those who used the original screens.

Figure 1.1 Impact of inefficient screen design on processing time.

Additional Seconds Required per Screen in Seconds	Additional Person-Years Required to Process 4.8 Million Screens per Year
1	.7
5	3.6
10	7.1
20	14.2

Tullis (1981) has reported how reformatting inquiry screens following good design principles reduced decision-making time by about 40 percent, resulting in a savings of 79 person-years in the affected system.

Screen design may also be contributing to the visual fatigue reported by some system users. Studies of people's eye movements in using screens have uncovered instances where visual movements between screen and source documents exceed several thousand for one work day. At this number of movements, a significant difference in the brightness level between display screen and source document can fatigue the muscle of the eye. This has led to attempts to brighten the display screen or lower the illumination to try to achieve the proper balance. But what about the design of the screen? Several thousand eye movements a day may reflect poor screen design rather than an unsatisfactory environment or terminal. The symptoms of a problem rather than the cause are perhaps being addressed in some cases.

What can be done, then, to improve the screen design process? Plenty. While screen design is not yet a precise science, the body of knowledge derived from experimental studies is growing. And a wealth of information derived from printed material research (e.g., books and newspapers) and the graphics arts discipline is available to provide guidance until more research questions are answered. This material simply awaits conscientious application to the screen design process.

HANDBOOK OBJECTIVES

The purpose of this handbook is to assist a designer in developing an effective screen interface between a program and its users. It is intended as a ready reference source for all screen design. Its specific objectives are to enable the reader to:

- describe the considerations that must be applied to the screen design process,
- describe a series of design rules that can be applied to the several categories of screens,
- perform the design steps necessary to develop and lay out effective screens.

HANDBOOK SCOPE

The materials in this handbook, although far from exhaustive, represent an attempt to identify, collect and/or deduce, and ultimately document a useful set of guidelines for screen design. This handbook is the most complete and thorough reference source available to the screen designer today. The guidelines have been culled from a variety of sources:

- known human factors and psychological principles,
- analysis of the results of experimental studies in the behavioral disciplines,
- available guideline documents for people/machine interfaces,
- informal studies conducted by the author,
- the author's experience.

Although the validity of some guidelines cannot be absolutely guaranteed, as a whole they will provide a solid foundation for most screen design activities, at least until experimental evidence is available to prove, disprove, or modify them.

These guidelines will not answer every design problem that may be encountered. Application-specific requirements and guideline incompatibilities will never free the designer from performing design tradeoffs. It is hoped, however, that these guidelines will promote "wiser" decisions than have been possible in the past.

Types of Screens

Screens can be developed for a wide variety of purposes and in a wide variety of styles. Unfortunately, no consistent naming conventions exist in current documentation, various names being affixed to screens whose purpose seems similar. For this handbook, screen types will be catalogued as described below. This categorization is based on differences in screen functions that cause fundamental differences in screen structure and layout.

Data entry screens. Data entry screens are designed to collect information quickly and accurately. Commonly called data collection screens, they usually contain a number of captioned fields into which data is keyed. Data entry screens are sometimes referred to as fixed form or form fill-in screens.

All data entry screens are not alike. Whether or not data keying is being performed from a specially designed (or dedicated) source document to be used with the screen will cause fundamental differences in screen design.

- *With a Dedicated Source Document*—When keying is performed from a dedicated source document, the document will be the visual focus of the user's attention. Keying aids will be built into the document itself, and the design of the screen will be interwoven with the design of the document.

- *Without a Dedicated Source Document*—When there is no dedicated document from which keying is performed, the primary visual focus of the user will be the screen itself. Screen clarity as an end in itself will assume a much more important role in the design process.

Both kinds of data entry screens are discussed in this handbook.

Inquiry screens. Inquiry screens are used for displaying the contents of computer files. Data on these screens does not change, and they are designed for ease of information location and visual clarity.

Multipurpose screens. Multipurpose screens are combination screens achieving more than one objective. They may be used to enter data into the system, review what is there, and possibly change what is displayed. As such, they combine the characteristics of the data entry and inquiry screens.

Question and answer screens. A question and answer screen consists of alternating communications between the computer and the user. Each communication is short and contains one idea at a time. Communications may contain captions or be free-form (without captions).

Menu screens. The primary purpose of a menu screen is to permit a user to select one or more alternatives from a variety of alternatives. As such, it combines the characteristics of both data collection and inquiry screens.

These screens may be designed for use on a monochromatic (one-color) alphanumeric terminal, a color alphanumeric terminal, or a graphics terminal. Separate chapters will be devoted to color and graphics and the unique considerations they present.

OVERVIEW

Chapter 2 sets the stage for the screen design guidelines by looking at the user, discussing why people have trouble with computer systems and their typical responses to poor design. It explains the differences between discretionary and nondiscretionary system use and then sets forth four commandments for designing for users. The chapter concludes with a review of critical human considerations in screen design. Chapter 3 addresses the dialogue between people and computers. It defines the concept of ease of use and the kinds of dialogues available, and presents directions and guidelines for achieving an effective people/computer interface. Chapter 4 focuses on actual screen design. It discusses a test for good design, visually pleasing composition, objective measures of a well-designed screen, the structure of words and messages, and how to use the various monochromatic display features.

Following chapter 4 emphasis shifts to specific types of screens. Chapter 5 treats data collection or data entry screens; chapter 6, inquiry screens; and chapter 7, multipurpose screens. Chapters 8 and 9 deal with question and answer screens and menu screens respectively.

As color displays are becoming more prominent, the use of color in screen design is discussed in chapter 10. Chapter 11 surveys new directions in the use of graphics.

Also, since effective data entry screen design frequently involves development of source documents, chapter 12 presents guidelines for good source document design.

The concluding chapter 13 provides an illustrated review of the design steps necessary to define, design, and lay out a typical data entry screen.

HOW TO USE THIS HANDBOOK

This handbook provides some general design considerations and guidelines (chapters 2, 3, 4), guidelines applicable to specific kinds of screens (chapters 5 through 9), unique situation design guidelines (chapters 10, 11, 12), and a design steps review (chapter 13). After an initial reading, the handbook user need only be concerned with the chapters relevant to the kind of screen being designed. Table 1.1 serves as an aid in determining chapter relevancy.

Table 1.1 Chapter relevancy for various types of screens.

If you are going to design ...	*See chapter ...*
A data entry screen and related source document	2, 3, 4, 5-1, 5-2, 12
A data entry screen to be used without a related source document	2, 3, 4, 5-1, 5-3
An inquiry screen	2, 3, 4, 6
A question and answer screen	2, 3, 4, 8
A menu screen	2, 3, 4, 9
A multipurpose screen	7, plus chapters relevant to the particular kind of screen
A screen using color	10, plus chapters relevant to the particular kind of screen
A screen using graphics	11, plus chapters relevant to the particular kind of screen