**UNIT II**

**DESIGN PROCESS**

**Understanding How People Interact with Computers:**

Characteristics of computer systems, past and present, that have caused, and are causing, people problems. We will then look at the effect these problems have –

1. Why people have trouble with computers.
2. Responses to poor design.
3. People and their tasks.

**1) Why People Have Trouble with Computers:**

* Extensive technical knowledge but little behavioral training.
* With its extensive graphical capabilities.
* Poorly designed interfaces.
* What makes a system difficult to use in the eyes of its user?
* **Use of jargon:** Systems often speak in a strange language. Words that are completely alien to the office or home environment or used in different contexts, such as *filespec*, *abend*, *segment*, and *booboot*, proliferate. Learning to use a system often requires learning a new language.
* **Non-obvious design:** Complex or novel design elements are not obvious or intuitive, but they must nevertheless be mastered. Operations may have prerequisite conditions that must be satisfied before they can be accomplished, or outcomes may not always be immediate, obvious, or visible. The overall framework of the system may be invisible, with the effect that results cannot always be related to the actions that accomplish them.
* **Fine distinctions:** Different actions may accomplish the same thing, depending upon when they are performed, or different things may result from the same action. Often these distinctions are minute and difficult to keep track of. Critical distinctions are not made at the appropriate time, or distinctions having no real consequence are made instead, as illustrated by the user who insisted that problems were caused by pressing the Enter key “in the wrong way.”
* **Disparity in problem-solving strategies:** People learn best by doing. They have trouble following directions and do not always read instructions before taking an action. Human problem solving can best be characterized as “error-correcting” or “trial and error,” whereby a tentative solution is formulated based on the available evidence and then tried. This tentative solution often has a low chance of success, but the action’s results are used to modify one’s next attempt and so increase the chance of success. Most early computer systems, however, have enforced an “error-preventing” strategy, which assumes that a person will not take an action until a high degree of confidence exists in its success. The result is that when people head down wrong one-way paths, they often get entangled in situations difficult, or impossible, to get out of. The last resort action? Turn off the computer and start again.
* **Design inconsistency**: The same action may have different names: for example, “save” and “keep,” “write” and “list.” The same command may cause different things to happen. The same result may be described differently: for example, “not legal” and “not valid.” Or the same information may be ordered differently on different screens. The result is that system learning becomes an exercise in rote memorization. Meaningful or conceptual learning becomes very difficult.

**2) Responses to Poor Design:**

Errors, and other problems that befuddle one, lead to a variety of psychological and physical user responses.

**Psychological:**

Typical psychological responses to poor design are:

* **Confusion:** Detail overwhelms the perceived structure. Meaningful patterns are difficult to ascertain, and the conceptual model or underlying framework cannot be understood or established.
* **Annoyance:** Roadblocks that prevent a task being completed, or a need from being satisfied, promptly and efficiently lead to annoyance.

Inconsistencies in design, slow computer reaction times, difficulties in quickly finding information, out­dated information, and visual screen distractions are a few of the many things that may annoy users.

* **Frustration:** An overabundance of annoyances, an inability to easily convey one's in­tentions to the computer, or an inability to finish a task or satisfy a need can cause frustration.

Frustration is heightened if an unexpected computer response cannot be undone or if what really took place cannot be determined: Inflexible and un­forgiving systems are a major source of frustration.

* **Panic or stress:** Unexpectedly long delays during times of severe or unusual pres­sure may introduce panic or stress. Some typical causes are unavailable systems or long response times when the user is operating under a deadline or dealing with an irate customer.
* **Boredom:** Boredom results from improper computer pacing (slow response times or long download times) or overly simplistic jobs.
* These psychological responses diminish user effectiveness because they are severe blocks to concentration.
* Thoughts irrelevant to the task at hand are forced to the user’s attention, and necessary concentration is impossible.
* The result, in addition to higher error rates, is poor performance, anxiety, and dissatisfaction

**Physical:**

* Psychological responses frequently lead to, or are accompanied by, the following phys­ical reactions.
* **Abandonment of the system**: The system is rejected and other information sources are relied upon. These sources must, of course, be available and the user must have the discretion to perform the rejection. In business systems this is a common reaction of managerial and professional personnel. With the Web, almost all users can exercise this option.
* **Partial use of the system:** Only a portion of the system's capabilities are used, usu­ally those operations that are easiest to perform or that provide the most benefits. Historically, this has been the most common user reaction to most computer sys­tems. Many aspects of many systems often go unused.
* **Indirect use of the system:** An intermediary is placed between the would-be user and the computer. Again, since this requires high status and discretion, it is another typical response of managers or others with authority.
* **Misuse of the system:** The rules are bent to shortcut operational difficulties. This requires significant knowledge of the system and may affect system integrity.
* **Direct programming:** The system is reprogrammed by its user to meet specific needs. This is a typical response of the sophisticated worker.
* These physical responses also greatly diminish user efficiency and effectiveness.

They force the user to rely upon other information sources, to fail to use a system's complete capabilities, or to perform time-consuming "work-around" actions.

**3) People and Their Tasks:**

The user in today’s office is usually overworked, fatigued, and continually interrupted. The home user may also experience these same conditions, and often the pressures associated with children and family life as well. All computer users do tend to share the following:

* They tend not to read documentation,
* They do not understand well the problems the computer can aid in solving, and
* They know little about what information is available to meet their needs. Moreover, the users’ technical skills have often been greatly overestimated by the system designer, who is usually isolated psychologically and physically from the users’ situation

Unlike the users, the designer is capable of resolving most system problems and ambiguities through application of experience and technical knowledge. Often the designer cannot really believe that anyone is incapable of using the system created.

**Important Human Characteristics in Design:**

We are complex organisms with a variety of attributes that have an important influence on interface and screen design. Importance in design is perception, memory, visual acuity, foveal and peripheral vision, sensory storage, information processing, learning, skill, and individual differences.

* **Perception:** Perception is our awareness and understanding of the elements and objects of our environment through the physical sensation of our various senses, including sight, sound, smell, and so forth. Perception is influenced, in part, by *experience*.

1. **Proximity**. Our eyes and mind see objects as belonging together if they are near each other in space.
2. **Similarity**. Our eyes and mind see objects as belonging together if they share a common visual property, such as color, size, shape, brightness, or orientation.
3. **Matching patterns.** We respond similarly to the same shape in different sizes. The letters of the alphabet, for example, possess the same meaning, regardless of physical size.
4. **Succinctness.** We see an object as having some perfect or simple shape because perfection or simplicity is easier to remember.
5. **Closure.** Our perception is synthetic; it establishes meaningful wholes. If something does not quite close itself, such as a circle, square, triangle, or word, we see it as closed anyway.
6. **Unity.** Objects that form closed shapes are perceived as a group.
7. **Continuity**. Shortened lines may be automatically extended.
8. **Balance.** We desire stabilization or equilibrium in our viewing environment. Vertical, horizontal, and right angles are the most visually satisfying and easiest to look at.
9. **Expectancies.** Perception is also influenced by expectancies; sometimes we perceive not what is there but what we expect to be there. Missing a spelling mistake in proofreading something we write is often an example of a perceptual expectancy error; we see not how a word *is* spelled, but how we *expect* to see it spelled.
10. **Context.** Context, environment, and surroundings also influence individual perception. For example, two drawn lines of the same length may look the same length or different lengths, depending on the angle of adjacent lines or what other people have said about the size of the lines.
11. **Signals versus noise.** Our sensing mechanisms are bombarded by many stimuli, some of which are important and some of which are not. Important stimuli are called signals; those that are not important or unwanted are called noise. Signals are more quickly comprehended if they are easily distinguishable from noise in our sensory environment. Noise interferes with the perception of signals to the extent that they are similar to one another. Noise can even mask a critical signal. For example, imagine a hidden word puzzle where meaningful words are buried in a large block matrix of alphabetic characters. The signals, alphabetic characters constituting meaningful words, are masked by the matrix of meaningless letters.

* **Memory:** Memory is not the most stable of human attributes, as anyone who has forgotten why they walked into a room, or forgotten a very important birthday, can attest.
* *Short-term,* or working-memory.
* *Long-term* memory.

*Short-term*, or working, memory receives information from either the senses or long-term memory, but usually cannot receive both at once, the senses being processed separately. Within short-term memory a limited amount of information processing takes place. Information stored within it is variously thought to last from 10 to 30 seconds, with the lower number being the most reasonable speculation.

*Long-term* memory contains the knowledge we possess. Information received in short-term memory is transferred to it and encoded within it, a process we call learning. It is a complex process requiring some effort on our part. The learning process is improved if the information being transferred from short-term memory has structure and is meaningful and familiar.

* **Sensory Storage:** Sensory storage is the buffer where the automatic processing of information collected from our senses takes place. It is an unconscious process, large, attentive to the environment, quick to detect changes, and constantly being replaced by newly gathered stimuli. In a sense, it acts like radar, constantly scanning the environment for things that are important to pass on to higher memory.
* **Mental Models:** As a result of our experiences and culture, we develop mental models of things and peo­ple we interact with.
* A mental model is simply an internal representation of a person's current understanding of something. Usually a person cannot describe this mental mode and most often is unaware it even exists.
* Mental models are gradually developed in order to understand something, explain things, make decisions, do something, or in­teract with another person.
* Mental models also enable a person to predict the actions necessary to do things if the action has been forgotten or has not yet been encountered.
* **Visual Acuity**

The capacity of the eye to resolve details is called *visual acuity*. It is the phenomenon that results in an object becoming more distinct as we turn our eyes toward it and rapidly losing distinctness as we turn our eyes away—that is, as the visual angle from the point of fixation increases.

* **Foveal and Peripheral Vision**

*Foveal vision* is used to focus directly on something; *peripheral vision* senses anything in the area surrounding the location we are looking at, but what is there cannot be clearly resolved because of the limitations in visual acuity just described. Foveal and peripheral vision maintain, at the same time, a cooperative and a competitive relationship. Peripheral vision can aid a visual search, but can also be distracting.

* **Information Processing**

The information that our senses collect that is deemed important enough to do something about then has to be processed in some meaningful way. There are two levels of information processing going on within us. One level, the highest level, is identified with consciousness and working memory. It is limited, slow, and sequential, and is used for reading and understanding.

In addition to this higher level, there exists a lower level of information processing, and the limit of its capacity is unknown. This lower level processes familiar information rapidly, in parallel with the higher level, and without conscious effort. We look nrather than see, perceive rather than read. Repetition and learning results in a shift of control from the higher level to the lower level. Both levels function simultaneously, the higher level performing reasoning and problem solving, the lower level perceiving the physical form of information sensed.

* **Movement Control :** Once data has been perceived and an appropriate action decided upon, a response must be made;
* In many cases the response is a movement. In computer systems, move­ments include such activities as pressing keyboard keys, moving the screen pointer by pushing a mouse or rotating a trackball, or clicking a mouse button The implications in screen design are:
* Provide large objects for important functions.
* Take advantage of the "pinning" actions of the sides, top, bottom, and corners of the screen.
* **Learning:** Learning, as has been said, is the process of encoding in long-term memory informa­tion that is contained in short-term memory.
* It is a complex process requiring some ef­fort on our part. Our ability to learn is important-it clearly differentiates people from machines.
* Given enough time people can improve the performance in almost any task. Too often, however, designers use our learning ability as an excuse to justify com­plex design.
* A design developed to minimize human learning time can greatly accelerate human performance.
* People prefer to stick with what they know, and they prefer to jump in and get started. Unproductive time spent learning is something frequently avoided.
* **Skill:** The goal of human performance is to perform skillfully. To do so requires linking in­puts and responses into a sequence of action.
* The essence of skill is performance of ac­tions or movements in the correct time sequence with adequate precision. It is characterized by consistency and economy of effort.
* Economy of effort is achieved by establishing a work pace that represents optimum efficiency.
* It is accomplished by in­creasing mastery of the system through such things as progressive learning of short­cuts, increased speed, and easier access to information or data.
* Skills are hierarchical in nature, and many basic skills may be integrated to form in­creasingly complex ones. Lower-order skills tend to become routine and may drop out of consciousness.
* System and screen design must permit development of increasingly skillful performance.
* **Individual Differences:** In reality, there is no average user. A complicating but very advantageous human char­acteristic is that we all differ-in looks, feelings, motor abilities, intellectual abilities, learning abilities and speed, and so on.
* In a keyboard data entry task, for example, the best typists will probably be twice as fast as the poorest and make 10 times fewer errors.
* Individual differences complicate design because the design must permit people with widely varying characteristics to satisfactorily and comfortably learn the task or job, or use the Web site.
* In the past this has usually resulted in bringing designs down to the level of lowest abilities or selecting people with the minimum skills necessary to per­form a job.
* But technology now offers the possibility of tailoring jobs to the specific needs of people with varying and changing learning or skill levels. Multiple versions of a system can easily be created.
* Design must provide for the needs of all potential users.

**Human Considerations in Design:**

1. **The User's Knowledge and Experience**:

The knowledge possessed by a person, and the experiences undergone, shape the de­sign of the interface in many ways. The following kinds of knowledge and experiences should be identified.

* **Computer Literacy** - Highly technical or experienced, moderate computer experience, or none
* **System Experience** - High, moderate, or low knowledge of a particular system and its methods of interaction
* **Application Experience -** High, moderate, or low knowledge of similar systems.
* **Task Experience -** Other Level of knowledge of job and job tasks.
* **Systems Use -** Frequent or infrequent use of other systems in doing job
* **Education** - High school, college, or advanced degree
* **Reading Level** - Less than 5th grade, 5th-12th, more than 12th grade
* **Typing Skill** - Expert (135 WPM), skilled (90 WPM), good (55 WPM), average (40 WPM), or "hunt and peck" (10 WPM).
* Native Language or Culture- English, another, or several.

1. **JOB/TASK/NEED:**

* **Type of System Use -** Mandatory or discretionary use of the system.
* Frequency of Use - Continual, frequent, occasional, or once-in-a-lifetime use of system.
* **Task or Need importance** - High, moderate, or low importance of the task being performed.
* **Task Structure** - Repetitiveness or predictability of tasks being automated, high, moderate, or low.
* **Social Interactions -** Verbal communication with another person required or not required.
* **Primary Training -** Extensive or formal training, self-training through manuals, or no training.
* **Turnover Rate -** High, moderate, or low turnover rate for jobholders.
* **Job Category** - Executive, manager, professional, secretary, and clerk.
* **Lifestyle** - For Web e-commerce systems, includes hobbies, recreational pursuits, and economic status.

1. **PSYCHOLOCICAL CHRACTERISTICS:**

* **Attitude -** Positive, neutral, or negative feeling toward job or system.
* **Motivation** - Low, moderate, or high due to interest or fear.
* **Patience -** Patience or impatience expected in accomplishing goal.
* **Expectations** - Kinds and reasonableness.
* **Stress Level** - High, some, or no stress generally resulting from task performance.
* **Cognitive Style** - Verbal or spatial, analytic or intuitive, concrete or abstract.

1. **PHYSICAL CHARACTRISTICS:**

* **Age** Young middle aged or elderly.
* **Gender** Male or Female.
* **Handness** Left, right or ambidextrous.
  + **Disabilities** Blind, defective vision, deafness, motor handicap.

**Human Interaction Speeds:**

The speed at which people can perform using various communication methods has been studied by a number of researchers.

1. **Reading:** The average adult, reading English prose in the United States, has a reading speed in the order of 250-300 words per minute. Proof reading text on paper has been found to occur at about 200 words per minute, on a computer monitor, about 180 words per minute.

One technique that has dramatically increased reading speeds is called Rapid Serial Visual Presentation, or RSVP. In this technique single words are presented one at a time in the center of a screen.

New words continually replace old words at a rate set by the reader. For a sample of people whose paper document reading speed was 342 words per minute? (With a speed range of 143 to 540 words per minute.)

Single words were presented on a screen in sets at a speed sequentially varying ranging from 600 to 1,600 words per minute. After each set a comprehension test was administered.

**Reading**:

* **Prose text** - 250-300 words per minute.
* **Proof reading text on paper** - 200 words per minute.
* **Proofreading text on a monitor** - 180 words per minute.

1. **Listening:** Words can be comfortably heard and understood at a rate of 150 to 160 words per minute. This is generally the recommended rate for audio books and video narration (Williams, 1998). Omoigui, et al, (1999) did find, however, that when normal speech is speeded up using compression, a speed of 210 words per minute results in no loss of comprehension.

**Listening**:

* **Speaking to a computer**: 150-160 words per minute.
* **After recognition corrections**: 105 words per minute.

1. **Speaking:** Dictating to a computer occurs at a rate of about 105 words per minute (Karat, et al., 1999; Lewis, 1999). Speech recognizer misrecognitions often occur, however, and when word correction times are factored in, the speed drops significantly, to an average of 25 words per minute. Karat, et al. (1999) also found that the speaking rate of new users was 14 words per minute during transcription and 8 words per minute during composition.
2. **Keying:** Fast typewriter typists can key at rates of 150 words per minute and higher. Average typing speed is considered to be about 60–70 words per minute. Computer keying has been found to be much slower, however. Speed for simple transcription found by Karat, et al. (1999) was only 33 words per minute and for composition only 19 words per minute.

In this study, the fastest typists typed at only 40 words per minute, the slowest at 23 words per minute. Brown (1988) reports that two-finger typists can key memorized text at 37 words per minute and copied text at 27 words per minute. Something about the computer, its software, and the keyboard does seem to significantly degrade the keying process. (And two-finger typists are not really that bad off after all.)

**Keying:**

* **Typewriter**

**Fast typist** : 150 words per minute and higher

**Average typist:** 60-70 words per minute

* **Computer**

**Transcription** 33 words per minute

**Composition:** 19 words per minute

* **Two finger typists**

**Memorized text:**. 37 words per minute

**Copying text:** 27 words per minute

1. **Hand printing.** People hand print memorized text at about 31 words per minute. Text is copied at about 22 words per minute (Brown, 1988).

* **Hand printing**

**Memorized text**: 31 words per minute.

**Copying text**: 22 words per minute.

**Understand the Business Function:**

**Business definition and requirements analysis**

* **Direct methods:**
* **Individual Face-to-Face Interview**: - A one-on-one visit with the user to obtain information. It may be structured or somewhat open-ended.
* **Telephone Interview or Survey: -** A structured interview conducted via telephone.
* **Traditional Focus Group**: - A small group of users and a moderator brought together to verbally discuss the requirements.
* **Facilitated Team Workshop**:- A facilitated, structured workshop held with users to obtain requirements information. Similar to the Traditional Focus Group.
* **Observational Field Study:-** Users are observed and monitored for an extended time to learn what they do.
* **Requirements Prototyping:**- A demo, or very early prototype, is presented to users for comments concerning functionality.
* **User-Interface Prototyping:-** A demo, or early prototype, is presented to users to uncover user-interface issues and problems.
* **Usability Laboratory Testing: -** Users at work are observed, evaluated, and measured in a specially constructed laboratory.
* **Card Sorting for Web Sites: -** A technique to establish groupings of information for Web sites.
* **Indirect methods:**
* **MIS Intermediary:-** A company representative defines the user’s goals and needs to designers and developers.
* **Paper Survey or Questionnaire:**- A survey or questionnaire is administered to a sample of users using traditional mail methods to obtain their needs.
* **Electronic Survey or Questionnaire:**- A survey or questionnaire is administered to a sample of users using e-mail or the Web to obtain their needs.
* **Electronic Focus Group:**- A small group of users and a moderator discuss the requirements online using workstations.
* **Marketing and Sales:**- Company representatives who regularly meet customers obtain suggestions or needs, current and potential.
* **Support Line:**- Information collected by the unit that helps customers with day-to-day problems is analyzed (Customer Support, Technical Support, Help Desk, etc.).
* **E-Mail or Bulletin Board:**- Problems, questions, and suggestions from users posted to a bulletin board or through e-mail are analyzed.
* **User Group:**- Improvements are suggested by customer groups who convene periodically to discuss software usage.
* **Competitor Analyses:**- A review of competitor’s products or Web sites is used to gather ideas, uncover design requirements and identify tasks.
* **Trade Show:**- Customers at a trade show are presented a mock-up or prototype and asked for comments.
* **Other Media Analysis:**- An analysis of how other media, print or broadcast, present the process, information, or subject matter of interest.
* **System Testing:**- New requirements and feedback are obtained from ongoing product testing.

**Requirements Collection Guidelines:-**

Keil and Carmel (1995) evaluated the suitability and effectiveness of various requirements- gathering methods by collecting data on 28 projects in 17 different companies. Fourteen of the projects were rated as relatively successful, 14 as relatively unsuccessful. Each requirements collection method was defined as a developer-user *link*. Their findings and conclusions:

1. ***Establish 4 to 6 Different Developer-User Links:-*** The more successful projects had utilized a greater number of developer-user links than the less successful projects. The mean number of links for the successful projects: 5.4; the less successful: 3.2. This difference was statistically significant. Few projects used more than 60 percent of all possible links. Effectiveness ratings of the most commonly used links in their study were also obtained. (Not all the above-described techniques were considered in their study.) On a 1 to 5 scale (1 = ineffective, 5 = very effective) the following methods had the highest ratings:

**Custom projects** (software developed for internal use and usually not for sale):

Facilitated Teams 5.0

User-Interface Prototype 4.0

Requirements Prototype 3.6

Interviews 3.5

**Package projects** (software developed for external use and usually for sale):

Support Line 4.3

Interviews 3.8

User-Interface Prototype 3.3

User Group 3.3

1. ***Provide the Most Reliance on Direct Links: -*** The problems associated with the less successful projects resulted, at least in part, from too much reliance on indirect links, or using intermediaries. Ten of the 14 less successful projects had used none, or only one, *direct* link. The methods with the highest effectiveness ratings listed above were mostly direct links.

**Determining basic business functions:**

Major system func­tions are listed and described, including critical system inputs and outputs. A flow­chart of major functions is developed. The process the developer will use is summarized as follows:

* Gain a complete understanding of the user's mental model based upon:
* **The user's needs and the user's profile / Understanding the User’s Mental Model: -** The next phase in interface design is to thoroughly describe the expected system user or users and their current tasks. The former will be derived from the kinds of information collected in Step 1 “Understand the User or Client,” and the requirements analysis techniques described above. A goal of task analysis, and a goal of understanding the user, is to gain a picture of the user’s mental model. A mental model is an internal representation of a person’s current conceptualization and understanding of something.

Mental models are gradually developed in order to understand, explain, and do something. Mental models enable a person to predict the actions necessary to do things if the actions have been forgotten or have not yet been encountered.

* **A user task analysis/*Performing a Task Analysis:-*** One result of a task analysis is a listing of the user’s current tasks. This list should be well documented and maintained. Changes in task requirements can then be easily incorporated as design iteration occurs. Another result is a list of objects the users see as important to what they do. The objects can be sorted into the following categories:

Concrete objects—things that can be touched.

People who are the object of sentences—normally organization employees, customers,for example.

Forms or journals—things that keep track of information.

People who are the subject of sentences—normally the users of a system.

Abstract objects—anything not included above.

* + - Develop a conceptual model of the system based upon the user's mental model. This includes:

1. Defining objects.
2. Developing metaphors
   * + **Developing conceptual modes:**

* The output of the task analysis is the creation, by the designer, of a conceptual model for the user interface.
* A conceptual model is the general conceptual framework through which the system's functions are presented.
* Such a model describes how the interface will present objects, the relationships between objects, the properties of ob­jects, and the actions that will be performed.
* A conceptual model is based on the user's mental model. Since the term mental model refers to a person's current level of knowl­edge about something, people will always have them.
* Since mental models are influ­enced by a person's experiences, and people have different experiences, no two user mental models are likely to be exactly the same.
* Each person looks at the interface from a slightly different perspective. The goal of the designer is to facilitate for the user the development of useful *mental model of the system.*
* This is accomplished by presenting to the user a *meaningful concep­tual model of the system*.
  + - **Understanding mental models:**
* The next phase in interface design is to thoroughly describe the expected system user or users and their current tasks.
* The former will be derived from the kinds of informa­tion collected in Step 1 "Understand the User or Client," and the requirements analy­sis techniques described above.
* A goal of task analysis, and a goal of understanding the user, is to gain a picture of the user's mental model.
* A mental model is an internal rep­resentation of a person's current conceptualization and understanding of something.
* Mental models are gradually developed in order to understand, explain, and do some­thing.
* Mental models enable a person to predict the actions necessary to do things if the actions have been forgotten or have not yet been encountered.
  + - Users new mental model
    - **Design standards or style guides:**
  + A design standard or style guide documents an agreed upon way of doing something. It also defines interface standards, rules, guidelines, and conventions that must be followed in detailed design.
    - **Value of standards and guidelines:**
* Developing and applying design standards or guidelines achieve design consistency.
* This is valuable to users because the standards and guidelines:
* Allow faster performance.
* Reduce errors.
* Reduce training time.
* Foster better system utilization.
* Improve satisfaction.
* Improve system acceptance.
* These are valuable to system developers because they:
  + Increase visibility of the human-computer interface.
  + Simplify design.
  + Provide more programming and design aids, reducing programming time.
  + Reduce redundant fort.
  + Reduce training time.
  + Provide a benchmark for quality control testing.
    - **Document design:**
* Include check lists to present principles and guidelines.
* Provide a rational for why the particular guidelines should be used.
* Provide a rationale describing the conditions under which various design alternatives are appropriate.
* Include concrete examples of correct design.
* Design the guideline document following recognized principles for good document design.
* Provide good access mechanisms such as a thorough index, at able of contents, glossaries, and checklists.
  + - **Design support and implementation.**
* Use all available reference sources in creating the guidelines.

**System training and documentation**

* Training
* Documentation

**PART II (Screen designing)**

1. **Screen designing:**

* How to distract the screen user
  + - Unclear captions
    - Improper type and graphic emphasis
    - Misleading headings
    - Irrelevant and unnecessary headings
    - Inefficient results
    - Clustered and cramped layout
    - Poor quality of presentation
      * + Legibility
        + Appearance
        + arrangement
    - Visual inconsistency
    - Lack of design features
    - Over use of 3D presentations
    - Overuse of too many bright colors
    - Bad typography
* **Variety of distractions**
  + - Numerous audio and visual interruptions
    - Extensive visual clutter
    - Poor information readability
    - In comprehensible screen components
    - Confusing and inefficient navigation
    - Inefficient operations
    - Excessive or inefficient page scrolling
    - Information overload
    - Design in consistency
    - Outdated information
* **What screen users want**
* An orderly clean clutter free appearance
* An obvious indication of what is being shown and what should be done with it.
* Expected information located where it should be.
* A clear indication of what relates to what.
* Plain and simple english
* A clear indication of when an action can make a permanent change in data.
* **What screen users do**
* Identifies a task to be performed or need to be fulfilled.
* Decides how the task will be completed or need fulfilled.
* Manipulates the computers controls.
* Gathers necessary data.
* Forms judgments resulting in decisions relevant to task.
* **Design goals**
* Reduce visual work
* Reduce intellectual work
* Reduce memory work
* Reduce mentor work
* Eliminate burdens or instructions.

**Screen meaning and Purpose:**

* Each screen element . . .

— Every control

— All text

— The screen organization

— All emphasis

— Each color

— Every graphic

— All screen animation

— Each message

— All forms of feedback

* Must . . .

— Have meaning to screen users.

— Serve a purpose in performing tasks.

##### Organizing Screen Elements Clearly and Meaningfully:

* Visual clarity is achieved when the display elements are organized and presented in meaningful and understandable ways. A clear and clean organization makes it easier to recognize screen’s essential elements and to ignore its secondary information when appropriate.

##### Consistency

* Provide real-world consistency. Reflect a person’s experiences, expectations, work conventions, and cultural conventions.
* Provide internal consistency. Observe the same conventions and rules for all aspects of an interface screen, and all application or Web site screens, including:

— Operational and navigational procedures.

— Visual identity or theme.

— Component.

• Organization.

• Presentation.

• Usage.

• Locations.

* Follow the same conventions and rules across all related interfaces.
* Deviate only when there is a clear benefit for the user.
* Quite simply, consistency greatly aids learning. It establishes an expectation

##### Ordering of Screen Data and Content

* Divide information into units those are logical, meaningful, and sensible.
* Organize by the degree interrelationship between data or information.
* Provide an ordering of screen units of information and elements that is prioritized according to the user’s expectations and needs.
* Possible ordering schemes include:
  + Conventional.

— Sequence of use.

— Frequency of use.

— Function.

— Importance.

— General to specific.

* Form groups that cover all possibilities.
* Ensure that information that must be compared is visible at the same time.
* Ensure that only information relative to the users tasks or needs is presented on the screen.
* An organizational scheme’s goal is to keep to a minimum the number of information

##### Upper-Left Starting Point

* Provide an obvious starting point in the screen’s upper-left corner.

##### Screen Navigation and Flow:

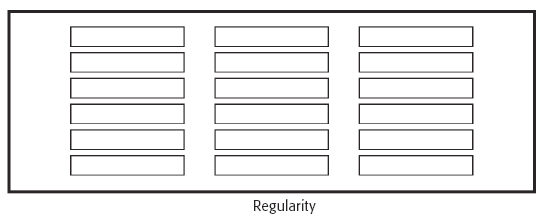
* Provide an ordering of screen information and elements that:
  + - Is rhythmic guiding a person’s eye through display
    - Encourages natural movement sequences.
    - Minimizes pointer and eye movement distances.
* Locate the most important and most frequently used elements or controls at top left.
* Maintain top to bottom, left to right flow.
* assist in navigation through a screen by
  + - Aligning elements
    - Grouping elements
    - Use of line borders
* Through focus and emphasis, sequentially , direct attention to items that are
  + - critical
    - Important
    - Secondary
    - Peripheral
* Tab through window in logical order of displayed information.
* locate command button at the end of the tabbing order sequence,
* When groups of related information must be broken and displayed on separate screens, provide breaks at logical or natural points in the information flow.
* In establishing eye movement through a screen, also consider that the eye trends to move sequentially , for example –
  + - From dark areas to light areas
    - From big objects to little objects
    - From unusual shapes to common shapes.
    - From highly saturated colors to unsaturated colors.
* These techniques can be initially used o focus a person’s attention.
* Maintain top to bottom, left to right throgh the screen.This top to bottom orientation is recommended for information entry for the following reasons –
* Eye movements between items will be shorter.
* Control movements between items will be shorter.
* Groupings are more obvious perceptually.
* When one’s eyes moves away from the screen and then back, it returns to about same place it left, even if it is seeking next item in sequence.
* Most product style guides recommend a left to right orientation.
* Our earliest display screens reflected this left to right entry orientation.
* Top to bottom orientation is also recommended for presenting displays of read only information tht must be scanned.

##### Visually Pleasing Composition

* Provide visually pleasing composition with the following qualities:
  + Balance
  + Symmetry
  + Regularity.
  + Predictability.
  + Sequentially.
  + Economy.
  + Unity.
  + Proportion.
  + Simplicity.
  + Groupings.

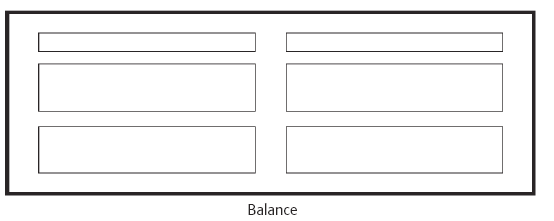
##### Regularity

* Create regularity by establishing standard and consistently spaced horizontal and vertical alignment points.
* Also, use similar element sizes, shapes, colors, and spacing.



##### Balance

* Create screen balance by providing an equal weight of screen elements, left and right, top and bottom.



##### Symmetry

* Create symmetry by replicating elements left and right of the screen centerline.

##### 

##### Predictability

* Create predictability by being consistent and following conventional orders or arrangements.

##### Sequentiality

* Provide sequentiality by arranging elements to guide the eye through the screen in an obvious, logical, rhythmic, and efficient manner.
* The eye tends to be attracted to:

— A brighter element before one less bright.

— Isolated elements before elements in a group.

— Graphics before text.

— Color before black and white.

— Highly saturated colors before those less saturated.

— Dark areas before light areas.

— A big element before a small one.

— An unusual shape before a usual one.

— Big objects before little objects.

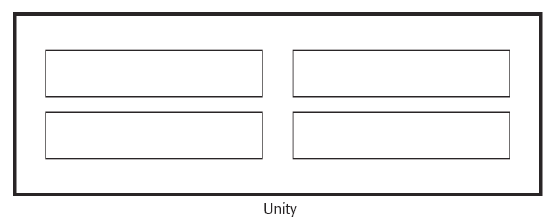
##### 

##### Unity

* Create unity by:

— Using similar sizes, shapes, or colors for related information.

— Leaving less space between elements of a screen than the space left at the margins.



##### Proportion

* Create windows and groupings of data or text with aesthetically pleasing proportions.

Pleasing proportions.

Square 1:1

Square-root of two 1:1.414

Square-root of three 1:1.732

Double square 1:2

Golden rectangle 1:1.618

**Simplicity (Complexity)**

* Optimize the number of elements on a screen, within limits of clarity.
* Minimize the alignment points, especially horizontal or columnar.
  + Provide standard grids of horizontal and vertical lines to position elements.
* complexity guidelines:
  + Optimize the number of elements on a screen, within limits of clarity.
  + Minimize the alignment points, especially horizontal or columnar.

##### Groupings

* Provide functional groupings of associated elements.
* Create spatial groupings as closely as possible to five degrees of visual angle (1.67 inches in diameter or about 6 to 7 lines of text, 12 to 14 characters in width).
* Evenly space controls within a grouping, allowing 1/8 to 1/4 inch between each.
* Visually reinforce groupings:

— Provide adequate separation between groupings through liberal use of white space.

— Provide line borders around groups.

* Provide meaningful titles for each grouping.

##### Perceptual Principles and Functional Grouping

* Use visual organization to create functional groupings.

— Proximity: 000 000 000

— Similarity: AAABBBCCC

— Closure: [ ] [ ] [ ]

— Matching patterns: >> < >

* Combine visual organization principles in logical ways.

— Proximity and similarity: AAA BB CCC

— Proximity and closure: [ ] [ ] [ ]

— Matching patterns and closure: ( ) < > { }

— Proximity and ordering: 1234 1 5

5678 2 6

3 7

4 8

* Avoid visual organization principles that conflict.

— Proximity opposing similarity: AAA ABB BBC CCC

— Proximity opposing closure: ] [ ] [ ] [

— Proximity opposing ordering: 1357 1 2

2468 3 4

5 6

7 8

##### Grouping Using White Space

* Provide adequate separation between groupings through liberal use of white space.
* For Web pages, carefully consider the trade-off between screen white space and the requirement for page scrolling.

##### Grouping Using Borders

* Incorporate line borders for:

— Focusing attention on groupings or related information.

— Guiding the eye through a screen.

* Do not exceed three line thicknesses or two line styles on a screen, however.

— Use a standard hierarchy for line presentation.

* Create lines consistent in height and length.
* Leave sufficient padding space between the information and the surrounding borders.
* For adjacent groupings with borders, whenever possible, align the borders left, right, top, and bottom.
* Use rules and borders sparingly.
* In Web page design:

— be cautious in using horizontal lines as separators between page sections.

— Reserve horizontal lines for situations in which the difference between adjacent areas must be emphasized.

##### Grouping Using Backgrounds

* Consider incorporating a contrasting background for related information.

— The background should not have the “emphasis” of the screen component that should be attended to. Consider about a 25 percent gray screening.

— Reserve higher contrast or “emphasizing” techniques for screen components to which attention should be drawn.

##### Visual Style in Web Page Design

* Maintain a consistent and unified visual style throughout the pages of an entire Web site.
* Base the visual style on:

— The profile and goals of the Web site owner.

— The profile, tastes, and expectations of the Web site user.

##### Amount of Information

* Present the proper amount of information for the task.

— Too little is inefficient.

— Too much is confusing.

* Present all information necessary for performing an action or making a decision on one screen, whenever possible.

— People should not have to remember things from one screen to the next.

* Restrict screen or window density levels to no more than about 30 percent.

##### Web Page Size

* Minimize page length.

— Restrict to two or three screens of information.

* Place critical or important information at the very top so it is always viewable when the page is opened.

— Locate it within the top 4 inches of page.

* Determining an optimum page length will require balancing these factors. Arguments for shorter pages and against longer pages are that longer pages:
  + Tax the user’s memory, as related information is more scattered and not always visible.
  + Can lead to a lost sense of context as navigation buttons and major links disappear from view.
  + Display more content and a broader range of navigation links making it more difficult for users to find and then decide upon what path to follow.
  + Require excessive page scrolling, which may become cumbersome and inefficient.
  + Are less conducive to the “chunking” information organization scheme commonly employed in Web sites.
    - Arguments for longer pages are that they:
      * Resemble the familiar structure of paper documents.
      * Require less “clicks” for navigating through a Web site.
      * Are easier to download and print for later reading.
      * Are easier to maintain because they possess fewer category navigation links to other pages.

##### Deciding on Long versus Short Pages

* + - * + To find specific information quickly:

— Create many links to short pages.

* + - * + To understand an entire concept without interruption:

— Present the entire concept in one page with internal links to subtopics.

* + - * + To print all or most of the content to read offline:

— Use one long page or prepare a version that uses one page.

* + - * + If page will be loading over slow modems and all pages are not needed:

— Create a comprehensive contents page with links to many short pages.

##### Scrolling and Paging

* + - * + Scrolling:

— Avoid scrolling to determine a page’s contents.

— Minimize vertical page scrolling.

— When vertical scrolling is necessary to view an entire page:

* + - * + Provide contextual cues within the page that it must be scrolled to view its entire contents.
        + Provide a unique and consistent “end of page” structure.

— Avoid horizontal page scrolling.

* Paging:

— Encourage viewing a page through “paging.”

— Create a second version of a Web site, one consisting of individual screens that are viewed through “paging.”

##### Distinctiveness

* Individual screen controls, and groups of controls, must be perceptually distinct.

— Screen controls:

• Should not touch a window border.

• Should not touch each other.

— Field and group borders:

• Should not touch a window border.

• Should not touch each other.

— Buttons:

• Should not touch a window border.

• Should not touch each other.

* A button label should not touch the button border.
* Adjacent screen elements must be displayed in colors or shades of sufficient contrast with one another.

##### Focus and Emphasis

* Visually emphasize the:

— Most prominent element.

— Most important elements.

— Central idea or focal point.

* To provide emphasis use techniques such as:

— Higher brightness.

— Reverse polarity or inverse video.

— Larger and distinctive font.

— Underlining.

— Blinking.

— Line rulings and surrounding boxes or frames.

— Contrasting color.

— Larger size.

— Positioning.

— Isolation.

— Distinctive or unusual shape.

— White space.

* De-emphasize less important elements.
* To ensure that emphasized screen elements stand out, avoid:

— Emphasizing too many screen elements.

— Using too many emphasis techniques.

— Screen clutter.

* In Web page design:

— Call attention to new or changed content.

— Ensure that page text is not overwhelmed by page background.

##### Presenting Information Simply and Meaningfully

* Provide legibility.

— Information is noticeable and distinguishable.

* Provide readability.

— Information is identifiable, interpretable, and attractive.

* Present information in usable form.

— Translations, transpositions, and references to documentation should not be required to interpret and understand information.

* Utilize contrasting display features.

— To attract and call attention to different screen elements.

* Create visual lines.

— Implicit and explicit, to guide the eye.

* Be consistent.

— In appearance and procedural usage.

##### Typography

* In typography, by definition a typeface is the name of a type, such as Times New Roman, Arial, Verdana, or Helvetica. A font is a typeface of a particular size, such as Times Roman 16 point or Arial 12 point. In screen design, the terms have become somewhat interchangeable.

##### Font Types and Families

* Use simple, common, readable fonts.

— Any sans serif such as Helvetica or Verdana.

— Times Roman.

* Use no more than two families, compatible in terms of line thicknesses, capital letter height, and so on.

— Assign a separate purpose to each family.

— Allow one family to dominate.

##### Font Size

* Use no more than three sizes.

— Consider “X” height.

* For graphical systems use:

— 12 point for menus.

— 10 point for windows.

* For Web pages use:

— 12–14 points for body text.

— 18–36 points for titles and headings.

* For line spacing use one to one and one-half times font size.
* Never change established type sizes to squeeze in more text.

##### Font Styles and Weight

* Use no more than:

— Two styles of the same family.

• Standard and italic.

• Italic is best presented in a serif font.

— Two weights.

• Regular and bold.

• Bold is best presented in a sans serif font.

* Use italics when you want to call attention.
* Use bold when you want to call attention or create a hierarchy.
* In Web pages, use an underline only to indicate a navigation link.

##### Font Case

* Use mixed-case for:

— Control captions.

— Data.

— Control choice descriptions.

— Text.

— Informational messages.

— Instructional information.

— Menu descriptions.

— Button descriptions.

* Consider using upper case or capitalization for:

— Title.

— Section headings.

— Subsection headings.

— Caution and warning messages.

— Words or phrases small in point size.

* Use all lower case with caution.

##### Defaults

* For graphical operating systems, use the standard system fonts.
* For Web pages design for the default browser fonts.
* Consider that the user may change the fonts.

##### Consistency

* Establish a consistent hierarchy and convention for using typefaces, styles, and sizes.

— Decide on a font for each different level of importance in the hierarchy.

— Communicate hierarchy with changes in:

• Size.

• Weight.

• Color.

##### Other

* Always consider the visual capabilities of the user.( Age Considerations )
* Always verify that the design has succeeded using the selected fonts.

##### Captions/Labels

* Identify controls with captions or labels.
* Fully spell them out in a language meaningful to the user.
* Display them in normal intensity.
* Use a mixed-case font.
* Capitalize the first letter of each significant word.
* End each caption with a colon (:).
* Choose distinct captions that can be easily distinguished from other captions.

— Minimal differences (one letter or word) cause confusion.

##### Data Fields

* For entry or modifiable data fields, display data within:

— A line box.

— A reverse polarity box.

* For inquiry or display/read-only screens, display data on the normal screen background.
* Visually emphasize the data fields.

##### Control Captions/Data Fields

* Differentiate captions from data fields by using:

— Contrasting features, such as different intensities, separating columns, boxes, and so forth.

— Consistent physical relationships.



* For single data fields:

— Place the caption to left of the data field.



— Align the caption with the control’s data.

— Alternately, place the caption above the data field.

—Align captions justified, upper left to the data field.



— Maintain consistent positional relations within a screen, or within related screens, whenever possible.

* For multiple listings of columnar-oriented data, place the caption above the columnized data fields.



Control Caption/Data Field Justification

* First Approach

— Left-justify both captions and data fields.

— Leave one space between the longest caption and the data field column.



* 2. Second Approach

— Left-justify data fields and right-justify captions to data fields.

— Leave one space between each.



##### Control Section Headings

* Provide a meaningful heading that clearly describes the relationship of the grouped controls.
* Locate section headings above their related screen controls, separated by one space line.



— Alternately, headings may be located within a border surrounding a grouping, justified to the upper-left corner.



* Indent the control captions to the right of the start of the heading.
* Fully spell out in an uppercase font.
* Display in normal intensity.

— Alternately, if a different font size or style exists, the heading may be displayed in mixed case, using the headline style.



##### Control Subsection or Row Headings

* Provide a meaningful heading that clearly describes the relationship of the grouped controls.
* Locate to the left of the:

— Row of associated fields.

— Topmost row of a group of associated fields.

* Separate from the adjacent caption through the use of a unique symbol, such as one or two greater than signs or a filled-in arrow.
* Separate the symbol from the heading by one space and from the caption by a minimum of three spaces.
* Subsection or row headings may be left- or right-aligned.
* Fully spell out in an uppercase font.
* Display in normal intensity.

— Alternately, if a different font size or style exists, the heading may be displayed in mixed-case using the headline style.



##### Field Group Headings

* Provide a meaningful heading that clearly describes the relationship of the grouped controls.
* Center the field group heading above the captions to which it applies.
* Relate it to the captions by a solid line.
* Fully spell it out in an uppercase font.
* Display it in normal intensity.

— Alternately, if a different font size or style exists and is used, the heading may be displayed in mixed-case, using the headline style.



##### Web Page Headings

* Control Headings:

— For groupings of controls, follow the control heading guidelines.

* Page and Text Headings:

— Provide a meaningful page heading that clearly describes the content and nature of the page that follows.

— Provide meaningful text headings and subheadings that clearly describe the content and nature of the text that follows.

— Establish a hierarchy of font styles, sizes, and weights dependent upon the organization created and the importance of the text content.

— Settle on as few sizes and styles as necessary to communicate page content and organization to the user.

— Do not randomly mix heading levels or skip heading levels.

##### Instructions

* Incorporate instructions on a screen, as necessary:

— In a position just preceding the part, or parts, of a screen to which they apply.

— In a manner that visually distinguishes them, such as:

• Displaying them in a unique type style.

• Displaying them in a unique color.

— In a position that visually distinguishes them by:

• Left-justifying the instruction and indenting the related field captions, headings, or text a minimum of three spaces to the right.

• Leaving a space line, if possible, between the instructions and the related control, heading, or text.



— Using a mixed-case font.

##### Completion Aids

* Incorporate completion aids on a screen, as necessary:

— In a position to the right of the text entry control to which they apply.

— In a manner that visually distinguishes them, including:

• Displaying them within a parentheses ( ).

• Possibly displaying them in a unique font style.

— If the controls are arrayed on the screen in a columnar format, position the completion aid, or aids:

• Far enough to the right so as to not detract from the readability of the entry controls within the column.

• But close enough to the related control so that they easily maintain an association with the related control.

— Left-alignment of completion aids in a column of controls is desirable but not absolutely necessary.



##### Information Entry and Modification (Conversational) Screens

* Organization:

— Logical and clear.

— Most frequently used information:

• On the earliest screens.

• At the top of screens.

— Required information:

• On the earliest screens.

• At the top of screens.

* Captions:

— Meaningful.

— Consistently positioned in relation to data field controls.

— Left- or right-aligned.

— Mixed case using headline style.

* Text boxes/selection controls:

— Designate by boxes.

* Spacing and groupings:

— create logical groupings.

— Make them medium in size, about 5 to 7 lines.

* Headings:

— Upper case or headline-style mixed case.

— Set off from related controls.

* Control arrangement:

— Align into columns.

— Organize for top-to-bottom completion.

* Required and optional input:

— Consider distinguishing between required and optional data input through:

• Placing required and optional information within different screens, windows, or groups.

• Identifying information as required or optional in a completion aid.

• Identifying required information with a unique font or symbol.

* Instructions and completion aids:

— Include as necessary.

• Position instructions before the controls to which they apply.

• Position completion aids to the right of the controls to which they apply.

##### Grids

* Usage:

— To enter large amounts of related data or information.

* Design guidelines:

— provide descriptive headings and, where appropriate, subheadings for columns and rows.

* Do not include colons (:) after the headings.

— Justify column headings according to the data presented in the table cells.

• Left-justify headings for columns containing text.

• Right-justify headings for columns containing numbers.

— Left-justify row headings.

— Organize the data or information to be entered logically and clearly.

• Place similar information together.

• Place most important or frequently used information at the top.

• Arrange information chronologically or sequentially.

— Use light backgrounds.

— Provide consistent spacing between columns and rows.

— If more than seven rows are presented, insert white space after every fifth row.

##### Data Presentation

* Provide visual emphasis to the data.
* Give the data a meaningful structure.

— Spell out any codes in full.

— Include natural splits or predefined breaks in displaying data.



* For data strings of five or more numbers or alphanumeric characters with no natural breaks, display in groups of three or four characters with a blank between each group.



##### Data Display

* Consider not displaying data whose values are none, zero, or blank.



* Consider creating “data statements,” in which the caption and data are combined.



##### Tables

* Usage:

— To present and/or compare large amounts of data or information.

* Design guidelines:

— Provide descriptive headings and, where appropriate, subheadings for columns and rows.

• Do not include colons (:) after the headings.

— Justify column headings according to the data presented in the table cells.

• Left-justify for columns containing text.

• Right-justify for columns containing numbers.

— Left-justify row headings.

— Organize the presented data or information logically and clearly.

• Place similar information together.

• Place most important or frequently used at the top.

• Arrange chronologically or sequentially.

— Justify the data presented in a column according to its content.

• Left-justify textual data.

• Right-justify numeric data.

— Length should not exceed the depth of a screen.

— Use light backgrounds.

• Highlight a particular cell, column, or row using a contrasting display technique.

— Provide consistent spacing between columns and rows.

— If more than seven rows are presented, insert white space after every fifth row.

— Use caution in placing borders around cells.

##### Intranet Design Guidelines

* Provide a single home page containing at least:

— A directory hierarchy.

— A search facility.

— Current news.

* Present a visual style that is:

— Different.

— Distinguishing.

— Unified.

* Orient the intranet Web site toward tasks.
* Include many options and features.
* Develop a strong navigational system.

##### Extranet Design Guidelines

* To distinguish the extranet from the Internet, provide a subtle difference in:

— Visual style.

— Navigation.

* Provide links to the public Internet site.