

Newman and Spoull list six ground rules that should be considered in designing graphics software:

- 1. Simplicity.** The graphics software should be easy to use.
- 2. Consistency .** The package should operate in a consistent and predictable way to the user.
- 3. Completeness.** There should be no inconvenient omissions in the set of graphics functions.
- 4. Robustness.** The graphics system should be tolerant of minor instances of misuse by the operator.
- 5. Performance.** Within limitations imposed by the system hardware, the performance should be exploited as much as possible by software. Graphics programs should be efficient and speed of response should be fast and consistent.
- 6. Economy.** Graphics programs should not be so large or expensive as to make their use prohibitive.

FUNCTIONS OF A GRAPHICS PACKAGE

To fulfill its role in the software configuration, the graphics package must perform a variety of different functions. These functions can be grouped into function sets. Each set accomplishes a certain kind of interaction between the user and the system. Some of the common function sets are:

- Generation of graphic elements
- Transformations
- Display control and windowing functions
- Segmenting functions
- User input functions

Graphic Functions- The basic fns which are used to create various objects/images are called output primitives.

Attributes are another fns which are directly associated with the o/p primitives. They define the characteristics of the primitives. The attribute functions define the appearance of the image e.g. color, line-type etc.

Examples of primitive functions are:

- **POLYLINE-** to draw a set of connected straight-line vectors
- **POLYMARKER-** to draw a set of markers or shapes
- **FILL AREA-** to draw a closed polygon with interior fill
- **TEXT-** to create characters
- **GDP (Generalized Drawing Primitive)-** to specify the standard drawing entities like circle, ellipse, curves and splines etc.

The importance of standards in CAD

- To save the time of drafting.
- To make training easier.
- To make outsourcing more efficient

Meant by CAD data exchange

CAD data exchange involves a number of software technologies and methods to translate data from one Computer-aided design system to another CAD file format.

The main topic is with the translation of geometry (wireframe, surface and solid) but also of importance is other data such as attributes; metadata, assembly structure and feature data.

The reasons for evolving a graphic standard thus include:

- Need for exchanging graphic data between different computer systems.
- Need for a clear distinction between modeling and reviewing aspects.

STANDARDS FOR GRAPHICS PROGRAMMING

Attempts to develop a graphics standard resulted in the following developments in 70's:

A significant development in CAD standards is the publication of Graphical Kernel System (GKS) in 1982.

- **GKS (Graphical Kernel System)** is an ANSI and ISO standard. GKS standardizes two dimensional graphics functionality at a relatively low level. It provides a set of drawing features for two-dimensional [vector graphics](#) suitable for charting and similar duties. The calls are designed to be portable across different [programming languages](#), graphics devices and hardware, so that applications written to use GKS will be readily portable to many platforms and devices.

The Graphical Kernel System (GKS) provides a set of functions for the purpose of generating 2D pictures on vector graphics and/or raster devices. It also supports operator input and interaction by supplying basic functions for graphical input, picture segmentation and subsequent storage, retrieval and dynamic modification of graphical information.

- **Programmers Hierarchical Graphics System (PHIGS)**-includes in its functionality three dimensional output primitives and transformations. It has dynamic control over the visual appearance of attributes of primitives in a segment. The PHIGS standard defines a set of device-independent logical concepts.

- **Initial Graphics Exchange Specification (IGES)**- (pronounced eye-jess) is a vendor neutral file format that allows the digital exchange of information among computer-aided design (CAD) systems. Using IGES, a CAD user can exchange product data models in the form of circuit diagrams, wireframe, freeform surface or solid modeling representations.
- **OpenGL**-Silicon Graphics (SGI) developed the OpenGL application-programming interface (API) for the development of 2D and 3D graphics applications. It is a low-level vendor-neutral software interface. It is often referred to as the assembler language of computer graphics. It provides enormous flexibility and functionality. It is used on a variety of platforms.

The OpenGL API was designed for use with the C and C++ programming languages but there are also bindings for a number of other programming languages such as Java, Ada, and FORTRAN. OpenGL provides primitives for modelling in 3D. Its capabilities include viewing and modelling transformation, viewport transformation, projections (orthographic and perspective), animation, lighting etc.

- **STEP (Standard for the Exchange of Product model data)**- is also called as Product Design Exchange Specification (PDES). This is the standard data format used to store all the data relevant to the entire life cycle of the product including design, analysis, manufacturing quality assurance, testing and maintenance, in addition to the simple product definition data.

Three types of neutral files are discussed in this chapter. They are:

- i. Drawing exchange files (DXF)
- ii. IGES files
- iii. STEP files

A solution to this problem of direct translators is to use neutral files. These neutral files will have standard formats and software packages can have pre-processors to convert drawing data to neutral file and postprocessors to convert neutral file data to drawing file.

- **DXF file (Drawing Exchange File)** is a popular data exchange format adopted by many CAD system vendors. DXF format is easy to interpret though it is a lengthy file. The data pertaining to the drawing entities are included in the entities section.