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MODEL MAKING: FROM 2-DIMENSIONAL CONCEPTIONS TO 3-DIMENSIONAL CONSTRUCTIONS

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ABSTRACT

Owing to the convergence of several specialized areas like architecture, fine/applied arts, theatre arts, film making, engineering, construction etc on the principle and practice of model making, this article dialogues the historical, intellectual , and practical trajectories of the model making process. This article traces the peculiar evolutionary trends of the model through religious times and spaces to the contemporary parlance of modelling and model use in a range of professions that have the principles and practice of model making as a common tributary. Additionally the modern materials and methods of model making are equally highlighted as well as some critical uses of the model.

KEYWORDS: Model, Model Making, Processes.

Model making is the process of creating traditional copies and prototypes of concepts such as mechanical type products, car bodies and inorganic objects that are mechanically shaped. The model making process also includes fabrication of machine parts and details of structures and objects achieved by sculpting (Model Making 2003). The model is conceived to provide a "true indication of the space relationships" of its subjects (Parker and Wolf 85). Every design problem requires special procedures, timing and techniques since there is often a client for every design effort. Thus planning is a general routine applicable to all model making ventures. Precision in the production of models is of particular importance to architectural, engineering or industrial design.

In making the model, preliminary rough sketches are made and chosen for further refinement and study, and the client is then presented with the design studies, usually in the form of a small model or a mock-up. Following the selection of the approved design, working drawings indicating the choice of materials and the specifications for finishing and assembly are prepared. Even a blind man could feel a model's three dimensionality, which is why a model is different from the perspective, isometric or axonometric drawing. The model's importance lies in the fact that its ultimate purpose in the industrial process is to serve as a preview or template from which an actual product is to be projected or fabricated. Thus the structure, the visual and the functionality of the model must be accurate if the end product is to be without fault in utility, particularly for industrial subjects. This is the reason why clients and those that use models are very particular about precision in the process of making it. We must bear in mind however that models that are made for aesthetic purposes or those that are made only for the designer's consumption are not necessarily made to precision.

Although the model is a 3-dimensional art form, it is first conceived in 2-dimensions - preliminary design and construction lines and colour sketches. As with other forms of creative arts the model evolves from three stages of creative processing: (1) aesthetic thought processes of design conception (2) 2-dimensional delineations and (3) the progression and projection into 3-dimensionality. In the first instance the artist or designer peruses his own subjective experiences in society, frames-up and categorises these in an iconographic mental catalogue from which he derives the visual archetype to confront a physical design problem. In the second stage the designer is phasing through the visual liaison between thought and form - the pilot research in sketching in lines and shapes and tints. Finally, having derived a creative conviction from his sketch experiments the designer projects the results into a solid interpretative and functional mass that confronts an equally functional problem. In conceiving the design all visual design principles including form, balance, texture, etc must be applied. During this process functionality must be considered as an integral part of the design concept. Other areas of vital consideration in model making for divergent clients include the political, financial and climatic environments as well as the technological capacity of the particular society.

As we have noted models are very often the miniatures of real or imagined large-scale subjects. At such instances they are produced or "constructed to an accurate scale" (Parker and Wolf 85). It is the job of the designer to determine the scale in which the model will be made. The usual scales are 1:100, 1:200 and 1:500. The 1:100 scale has an advantage because its bigger size could very quickly make one to determine the overall sense of the design. Models are usually made small for four critical reasons:

1. It is easier to carry a small model to a design meeting or for presentation.
2. They are easier to store.
3. With the smaller model the designer can further explore the design without additional huge investments in material, time and finance.
4. They are cost-effective because less material is required to make them. This is however not the case with miniatures made for the purpose of filmmaking, which require very intricate details that are expensive to produce in terms of workmanship.

Types of Models

Industrial design requires three types of models: (1) small or mock-up models, (2) detailed models and (3) working models. The mock-up model (plate1) in architectural profession is often called block model. It is a quick and faster model to build and shows the basic visual properties of the subject. The mock-up is a miniature and could be any size smaller than the actual object. A refined variation of the small model is the detailed model (plate 2), which is built to precise scale. This model is detailed and built to scale to show exactly what it should be like in real size. In contrast to the miniature the working model is made to the size of the finished product. Additionally a working model in industrial design must perform the

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mechanical or electrical functions that the finished product is purposed for. In an automobile industry a number of working models of a new brand of vehicle are "handmade and tested at proving grounds before final machine dies are ordered and production begins" (Industrial 2002).

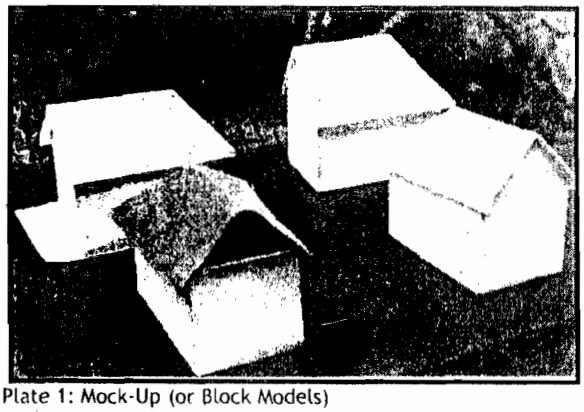

Plate 1: Mock-Up (or Block Models)

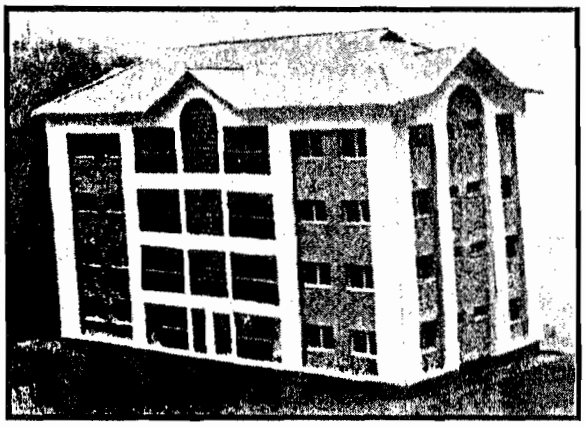

Plate 2: Detailed Model

Uses of the Model

The model is used in industrial, architectural, motion picture and plainly aesthetic situations. In industrial, architectural and motion picture contexts the scale and precision is of utmost importance in a working or detailed model because it is perceived as a representation of a large-scale product or structure. In the construction industry precision in model making is of prime importance because it enables the engineers to critic the project and observe possible weaknesses before execution. Besides, multimillion structural projects require explicit models to convince investors of the rationality of their investments. This is another area where the model comes to good use in construction, engineering and architectural industries. Architects, Artist, Town Planners, Engineers and Industrial Designers use models to convey compact and clear impression of a structure or building proposal. They also use models to clarify construction details (a circular column or object in plan may appear to be rectangular in elevation). In the case of complex planning development, models do assist the builder or engineer in performing his operation with greater confidence. With models, it is quite easy for a client to visualize what the building proposal looks like. Additionally, detailed models can be used for taking-off sizes.

In the context of industrial design, models are inalienable. We remember that, because industrial design is the "art and science involved in the creation of machine-made products," it is therefore "concerned with aesthetic appearance as well as with functional efficiency" (Industrial 2002).

In purely aesthetic contexts such as interior or exterior decorations precision and accurate scaling of the model is not necessary. But in the context of scene design for theatrical or film productions the model is "constructed to an accurate scale, thus giving the designer a miniature preview of how the setting is going to look" (Parker and Wolf 85). Working models (also called sketch model in scene design) are made of two-ply bristol board paper. Scale in this working model is important for the use of carpenters and other scenic artists upon whose skills and craftsmanship the scene designer depends. These workmen "interpret the model into full-scale scenery" on the theatre stage (Parker and Wolf 87).

Another use for modelling is found in the context of doll making. The earliest of which had religious significance, the doll is a "figure resembling a human being, usually small and in three dimensions" (Freud 2002). Some are made to life sizes and are used by cloths designs as fashion dolls to showcase their creative designs. Dolls still have religious significance in certain cultures (see plate 3 and 4). Ancient dolls were made as early as 600 BC with the sophistication of movable limbs (see plate 5). Ancient models were fashioned out of clay, rags, wood, bone, ivory, wax and terracotta (Freud 2002). Sophisticated dolls have become part and parcel of the emerging global culture. Dolls of global appeal have appeared in ethnic diversity (see plate 7). Models are also used in Map-making. They come as relief maps of the terrain of an area (English 2002). Often made from clay and plaster of paris (POP), relief maps are used in military, engineering and environmental planning.

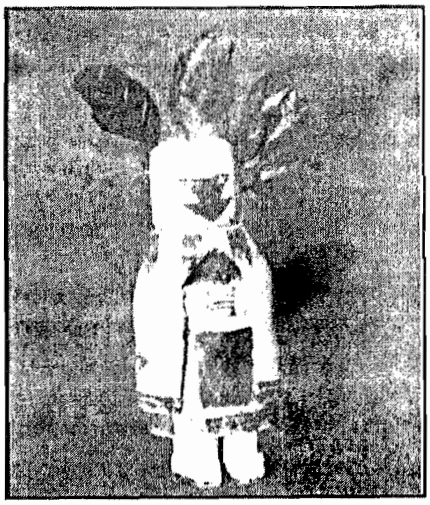

Plate 3: Hopi Kachina Doll

Part of Hopi religious practice is to make connections with clan ancestors, or *kachinas*. During these Hopi rituals, kachinas are represented by either specially carved dolls, such as the one shown here, or masked and costumed dancers that feature at festivals and ceremonies. Source: Microsoft Encarta Encyclopedia CD-ROM 2002

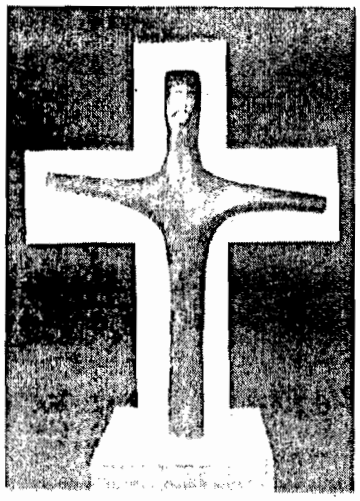

Plate 4: The Crucifix
Although the typical western mind does not readily conceive of it, religious items like this crucifix shown here, as well as those of Virgin Mary and Christ are dolls in every sense of the term. Westerners tend to ascribe religious dolls to so-called 'primitive' non-western societies. From the point-of-view of model making western dolls also have close affinity to religion. Source: Microsoft Encarta Encyclopedia CD-ROM 2002

Plate 5: Ancient Doll
Dolls have been found from times as early as 3000 bc. Ancient dolls were modeled from such organic materials as clay, bone, and wood. Movable limbs, such as those featured here, were an important step in the development of more realistic dolls. Source: Microsoft Encarta Encyclopedia CD-ROM 2002.

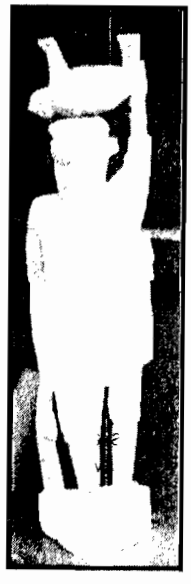

Plate 6: (Centre) African Ancient tradition doll from Ikot Ekpene in South Eastern Nigeria.

Plate 7: Barbie Doll
Modelers and manufacturers now more commonly produce ethnically diverse dolls, like this black Barbie. Dolls are modeled as toys, for the global fashion industry, for decoration purposes and for filmmaking where they are also mechanized to function like the live subjects. Source: Microsoft Encarta Encyclopedia CD-ROM 2002

It is in the context of filmmaking that models (also called miniatures) come to their ultimate creative application. Mechanised models and dolls have become intricate parts of the special effects of filmmaking. Further, actors are often 'modelled' with makeup latex, colour and other substances into non-human characters in movies (see plate 8). Also the "design, preparation and photography of models and miniatures forms a most important part of special effects work in motion picture production" (Models 469). Such models are made with very intricate details and to scales ranging from tabletops to life-size replicas. Models are used in filmic scenes of architectural and other structures that are quite impossible or way too expensive to construct at locations. They are also used in action of realistic scenes of naval battles, vehicular crashes, space travel or prehistoric life. The photography of models is normally combined with studio shots of live actors by digital and optical effects. Chartbusting films such as Star Trek, Star Wars, Jurassic Park etc utilised a great deal of models and model photography. The miniatures in motion picture production can approach life size. For instance, a

scene involving a mad car driving through a bustling street is not possible in reality. But the filmic effect is achieved by back-projecting a pre-shot street scene, against which actors play their scenes in a model car (Studio Complex 789).

The burning or collapse of a building, fire outbreaks, storms and explosions are realistically achieved in filmmaking with the use of models. This is because models subsume a 3-dimensional quality that is more convincing than a 2-dimensional painting by a very good artist. Miniatures are built as large as possible for convenience and believability. For example in the production of the film, Sink the Bismarck, the model ship was 9m long and was operated in a tank measuring 60m x 20m (Special Effects 727). In the context of filmmaking it is usually more expensive to build a small miniature. The reason is that the "cost of materials for a large miniature is relatively slight compared to the labour which goes into the detail work on a small one" (Special Effects 727). Models that must burn, explode or collapse define a special problem. Thus the kind of burn desired determines the kind of materials to be used - soft pine for burn sections and plaster for parts of the model that will not burn. For miniatures that will collapse, "the strength of construction materials is reduced in exact proportion to the reduction scale" (Special Effects 728). From the foregoing therefore model making must be meticulous in details, finish and accuracy to the extent of the use to which it is going to be put.

Plate 8: Makeup Modeling. In motion-picture production, makeup designers and modelers play an important part in preparing actors to appear on camera. In science-fiction films, makeup is especially important, because many of the roles call for nonhuman characters. This photo shows designers modeling one of the actors in *Star Trek IV* (1986). Source: Microsoft Encarta Encyclopedia CD-ROM 2002.

Models have become inalienable aspects of the contemporary global culture. Therefore a study into models and model making such as that done in this article is more than a justified academic enterprise insofar as the procedural and functionality dialectics so delineated stand beneficial to several academic disciplines. Such disciplines include architecture, fine arts, theatre arts, engineering, film studies, industrial design etc.

MATERIALS AND METHODS

There is a wide variety of materials available for model making in the market. Table 1 shows the basic range of such materials as are available in the Nigerian market.

Table 1: Model Making Materials

S/n	Model Making Materials
1	Wood and wood products e.g. paper
2	Glass of various thickness
3	Plastics and various polymer e.g. Perspex glass, pvc, fibreglass and
4	other synthetic materials including the binding materials.
	Other materials specifically for architectural modelling include:
5	embossed paper (textured paper) of various colours and qualities,
6	straw boards, chip boards
7	plywood and other manufactured woods
8	Adhesives- UHU gum
	-Evostic gum
	-Top bond glue
9	Sawdust for the preparation of grass
10	Turpentine
11	Spray paint
12	Pencil
13	Drawing ink of various colour
14	Clay
15	Plastecin
16	Plaster of Paris (POP)
17	Soap
18	Styrofoam
19	Wax

Table 2: Modelling Tools

Hand Tools	Machine Tools
Modelling knife with replaceable blades,	A: Sanding Machine
Straight edge	Buffing Machine
Forceps (for holding the work)	Filing Machine
Manual spray gun	Spraying Machine
Drawing board	Drilling Machine
Modelling board	Welding Machine
Bench vice	Computer/printer/plotter etc.
Chisels	Trimmer/guillotine
Punches	
Hand saws of various sizes and type	

Modelling Tools

Modelling tools include hand and machine tools (table 2). Just as hand tools, machine tools are designed to suit the type of material to be worked with, whether wood, plastic, or glass. Machine tools may include some or all of the wood working machine as well as metal machine tools. Computer Aided Design (CAD) is also a software employed in model making. This has perfected precision and delivery time in modelling and model productions.

METHODS OF MODELLING

There are basically two methods available: the manual method and machine method. The manual method is adopted in most cases for fast mock-up models. Accurate scale or precision is not required at this level. Also, materials that are easily carved, cut or moulded are used. This method is used when the designer wants to visualize and be sure of the views of his design. However, detailed models are often done using manual method or both manual and machine methods. Manual method is more expedient when only one or quite a smaller number of the same model is required. The machine method is employed when a larger quantity of the same model is

required or when precision and identicalness in objects are desirable. The basic procedure for any of the methods is: design, production of the different components of the particular model, assembling of the components and finishing.

Projecting from 2 to 3-dimentionality

Models are perceived in 3-dimension because they have depth (or height) in addition to length and breadth (fig. 1). When a 3-dimensional object in space is adjusted in such a manner that only one side is seen (fig. 2) or when neither the top, nor the two sides are seen except one side, the object will be seen as being flat or 2-dimensional (without thickness or depth).

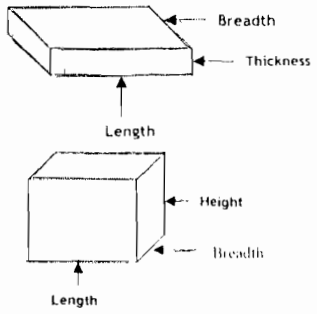

Figure 1: The concept of 3-dimensionality

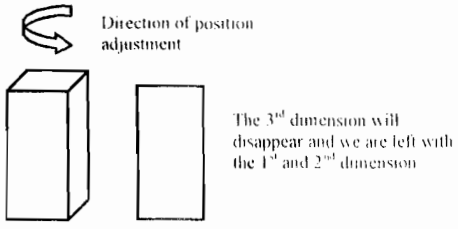

Figure 2: Enabling a 2-Dimensional View by Adjusting the position of a 3-Dimensional Object

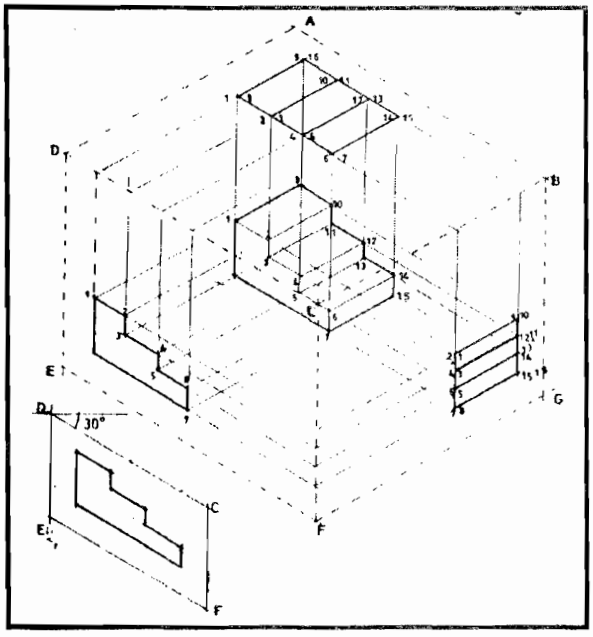

Figure 3: Isometric (3-dimensional) drawing

From the foregoing therefore a model maker requires much information about the different views of the project he is modelling in order to be successful. Such information includes the profile of the object both in plan, section and the elevations. Each view of the profile is flat and must be projected one to the other to create 3-dimensionality. The basic principle of orthographic projection (fig.3) is the system of suspending the block between three planes - the front vertical plane, the end vertical plane and the horizontal plane - and projecting views of the block onto these planes. These planes are at right angles. A model maker has only the 2-dimensional drawings (plans, front, back and end elevations) to work with in order to build the 3-dimensional model. He has the following steps to follow:

(1) Use the principle of orthographic projection to transform the two dimensional drawings (plan, front and end elevations) to 3-dimensional drawing.
(2) Use this isometric 3-dimensional drawing to build the model as in figure 3.

The above implies that designs must be conceived in 2-dimension as well as 3-dimension for aesthetic and functional checks and balance. Models are either built from cut pieces of materials or sculpted and cast in resin, POP or other plastic materials. At the end of the cutting or sculpting and casting, the various are adhered to form one compact whole. Finishing for models might include painting, lacquering and mounting (in glass cases or on pedestals). In the respect of board and paper models, painting should be done before cutting and joining to achieve evenness in the colour. If the colouring is done after joining, it turns out patchy and untidy. Although the medium of resin, POP and polymer (plastics) could be pre-coloured, it is usually the practice to spray-paint and detail the sculpted and cast model with detailing brushes after sanding smooth with sandpaper. A variety of paints is available at art shops, which include metallic colours like gold, silver, bronze, brass etc, which can give a professional quality finish.

CONCLUSION

What this article has done is to dialogue the historical, intellectual and practical trajectories of the model making process. The article has shown that models are not just required but that they also an inalienable aspect of a variety of specialised professional fields including architecture, fine/applied arts, theatre arts, film making, engineering, construction and industrial design. Aside from highlighting the materials and contemporary methods of model making, this article has also established the importance of models to both scholarship and professional practice. Models are therefore the creative conjunction of art, design and industrial functionality.

REFERENCES

Edward T. W. *Concept Source Book*. Tucson : Architectural Media, 1985.

English, H. van. "Map." *Microsoft Encarta Encyclopedia*. CD-ROM. Microsoft, 2002.

Freud, Mel. "Doll." *Microsoft Encarta Encyclopedia*. CD-ROM. Microsoft, 2002.

"Gypsum." *Microsoft Encarta Encyclopedia*. CD-ROM. Microsoft, 2002.

"Industrial Design." *Microsoft Encarta Encyclopedia*. CD-ROM. Microsoft, 2002.

Model Making.
www.bntstudios.com/model_making_Description_page.htm. 23 October 2003.

"Models." *Focal Encyclopedia of Film and Television Techniques*. London: Focal, 1973.469.

Morling, K. *Geometric and Engineering Drawing*. London: African U P, 1986.

Parker, W. Oren and R. Craig Wolf. *Scene Design and Stage Lighting*. Seventh edition. Orlando: Harcourt, 1996.

"Special Effects." *Focal Encyclopedia of Film and Television Techniques*. London: Focal, 1973. 727-728.

"Studio Complex". *Focal Encyclopedia of Film and Television Techniques*. London: Focal, 1973.469.