The Possible Future Effects of Computers upon the Various Stages of Design

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As our society becomes increasingly industrialised and technology becomes more and more important, the computer becomes increasingly important, as it is one of the greatest tools of technology.

The importance of the computer has been proved in various spheres of activity, the most usual being:-

(1) Research;

(2) Assembly and Storage of Information;

(3) Technical work requiring complex calculations.

However, computers are now also being commercially applied in the field of design - a relatively new concept, in which the major application of computer-aided design has been in architecture and the drawing-up of plans. While not having the ability to create a drawing, a computer is able to repeat and combine various elements of a drawing with which it has previously been programmed. In this way the computer can assist in producing drawings which would otherwise be a time-consuming and repetitive task for the draughtsman. This ability the computer possesses, to reproduce in part or whole a blueprint, or design coupled with the computer's memory function, is the basis for the actual and theoretical systems examined in this thesis so as to investigate how far computer-aided design can be of use to the clothing manufacturer. The specific difficulties of the nature of clothing design must be taken into account; for example, the medium used - fabric - is not rigid and is therefore variable in its uses in design.

Before examining the extent to which computers can be of help to the designer, it is necessary to isolate and define the term DESIGN in relation not only to this text but also to the clothing industry itself.

Basically the design is nothing more than an IDEA. It is not the garment, not is it the pattern nor the sketch, but the initial concept of the garment. This concept, the design, must then be transformed into a three-dimensional reality - whether by drafting, or modelling in toile or fabric. A sketch may be used, but not necessarily.

If initially made in toile to ensure accuracy of fit the garment must then be made up, under supervision of the designer, in the chosen fabric. The designer then assesses the finished sample in terms of awsthetic value, suitability to the fabric, suitability to production in that particular company-machinery limitations for example, appeal to the firm's established or proposed market, and so on.

The designer may or may not be involved in the costing of a garment, depending on the personnel structure of the company. For the purpose of this thesis it is assumed that the designer has a certain involvement in the costing, as computers can be of value in this field and are therefore an aid to the designer.

The skill of a good designer is not only the creation of a garment which is aesthetically pleasing and which will be successful in its intended market, but also an economically sound garment which is produceable with the available labour and machinery.

The stages of design, as outlined below, must be examined in detail so as to determine how far the use of computers can benefit the designer.

STAGES OF THE DESIGN PROCESS

1. The initial conception, or idea, of the garment.
2. The transformation of that idea into a garment.
3. Grading and preparing the pattern for production.
4. The recording of styles, patterns, and relevant information.

STAGE ONE: The initial conception of a design

The subject here is a purely creative function: the idea may be entirely original, or it may be an adaptation or modification of an existing idea. No matter which, clothing design is dependent on creativity.

Inspiration comes to the designer from any and every source, and the successful designer is the one who can recognise in that inspiration a style which will sell and be popular, as well as being economically viable.

By what guide-lines does a designer recognise a successful style? Experience and good taste are major factors in this, but the successful designer is the one who also has an instinct for recognising a good style.

Is there any way in which the computer can assist in this function?

Computers are basically very simple machines. They have no instinct, initiative, or creative ability - three qualities which are essential in a successful designer. However, computers do have an enormous memory capacity, the ability to do complex mathematical calculations, and the ability to work at speeds many times faster than a human being. These qualities add up to fast and efficient decision-making, providing all the relevant information is avaialable and correctly programmed. Computers are often used to work out probabilities, and this function could be applied to garment design. By supplying the computer with information regarding previous successful and unsuccessful styles, style features which look well together, style features which are unattractive together, details of fabrics - colour, handle, suitability to specific styles, impractibility for other styles, details of current fashion trends; in short, by assembling and programming into the computer all the factors which a designer consciously, or unconsciously, takes into account when creating a new style, then by the systematic combination of all these factors the computer could produce three-dimensional drawings of a range of garments which theoretically should be successful styles.

But having 'produced' these styles, the computer has no sense by which to recognise which of these styles really will appeal to the market. This ultimate function must always fall back to the designer, who has the creative ability and most importantly, the instinct necessary to produce successful fashions.

Another drawback to this possibility of computer-produced designs is the inevitable standardisation of styles produced. As already stated, the computer has no inherent creative ability and is therefore restricted to the information with which it has been supplied and cannot alter angles, proportions, balance, - the type of adjustments a designer would automatically make in attempting to improve designs.

The application of computers to differing fields of design is a limiting factor; could a system such as that described above be effectively applied to a high fashio concern, which of necessity requires a rapid style turnover? And would it be feasible to be continually updating the complex computer programme to keep pace with fashion changes?

Therefore, the most logical application of computers, in the function described above, would seem to be those areas which have a slow and undramatic style change; such as shirts, and industrial overalls. The amount of information required would be less than for a highly fashion-orientated design field, but as there is such a slow style-turnover then the amount of design work could hardly justify the time and expense involved.

Therefore, although such a scheme of computer-designing is theoretically feasible, its practical application can be seen to be limited, - mainly by the very nature of fashion, which dictates limits upon standardisation. The computer would seem to be no effective total substitute for the creative instinct of a good designer.

STAGE TWO: The transforming of the initial concept (or design) into a three-dimensional sample garment.

An idea cannot be objectively judged until it is transformed into a reality; so it is with designing, that until a garment is seen in the made-up state it cannot be properly assessed.

Designers favour various methods of transforming the design idea into a finished garment, although the method used is often dependent on the type of garment being created - for example, an evening dress in a draped style should ideally be modelled in fabric onto a stand or person.

The methods available are as follows:-

1. Modelling: toile may be used, or the proposed fabric type, the designer modelling onto the form until the desired effect is achieved.
2. Block-styling: the designer, or pattern-cutter working to a designer's sketch, maniputlates pattern blocks to cut the desired pattern, cuts out the garment in either toile or fabric, and then assesses the finished sample.
   The cutting of a pattern requires a good deal of skill and experience so as to accurately transform the original idea into a well-fitting garment.
3. A direct-measure system: this method is the same as block styling in that a pattern is made for the garment. However, this system does not involve the manipulation of block patterns but requires the taking of direct measurements and applying them, often straight onto the fabric. By taking enough measurements pattern shapes are obtained which are then cut out and made-up, the sample garment then being assessed by the designer. This system is no longer in wide use in the industry as uniformity of fit cannot be guaranteed.

These are the traditional methods of obtaining a finished design sample to be assessed before being accepted into the range. On the whole it is a very skilled job requiring the abilities of good pattern cutters and sample machinists. It can also be a time-consuming job where often only small details are changed, the bulk of the work being identical to a previous style.

Computer equipment which would prove to be a great time saver at this stage of the design process is already in existence, although its application is not yet widely recognised in the clothing industry.

The process involves the use of a Visual Display Unit, similar to a television screen, on which it is possible to reproduce three-dimensional objects and figures.

All films have a size range and a standard size to which their samples are made. These standard dimensions can be programmed into the computer and thus a three-dimensional body shape is projected on the screen. Not only is the body shape in correct proportions, but it can be rotated and viewed from any angle, still in a three-dimensional form. The operator of the visual display unit can draw a garment onto the body shape by means of a 'light-pen' and by the use of press-button controls is able to draw, alter details, move style features, and so on.

In this way the designer can see an immediate three-dimensional representation of his original idea. If certain details are not quite accurate the designer can make corrections by use of the light pen until the desired effect is achieved.

However, a three dimensional representation is only the start of the process. If the garment is considered good enough to be actually made up it must somehow be transformed into a reality. For this the computer is required to have a memory-bank of pattern pieces which have been previously programmed. This 'bank' will consist of body patterns, skirts, bodices, sleeves, necklines, collars, cuffs, pockets, and so on; all the pattern pieces would be interchangeable, for example neck shapes would be standardised so that any collar type can be fitted, the number

of neck shapes being kept as low as possible while still allowing for the greatest number of collar styles. Thus the operator can instruct the computer 'combine skirt 7 with bodice 3, neckline 12, and collar 8, sleeveless'. In effect this is a pattern specification.

Alterations to the pattern can be made on the Visual Display Unit by using the light pen, or the pattern can be altered after having been drafted out by the computer. However, once a comprehensive bank of pattern pieces and garment styles has been built up, alterations to patterns should not be a frequent necessity except for minor changes.

To actually produce the pattern pieces a PLOTTER is required; it consists basically of a table fitted with a moveable beam across the width of the table. The beam holds a pen which itself is free to move the length of the beam. Thus by causing the beam and the pen to move the computer can plot out pattern pieces of the table. The plotters range from slow units where plotted patterns need to be cut out by hand, to faster more expensive units which will cut out the patters.

It is possible for the plotter to actually cut the garment parts from the fabric; in effect this plotter substitutes a knife for the pen. The fabric is placed on a perforated rubber-backed table carrying stiff nylon bristles 1½" long to form a 'solid' yet porous table top which is not damaged by the reciprocating knife which cuts into its upper 'surface'. A very strong vacuum is applied under the table to hold the fabric firm.

Thus the garment parts can be cut out by the computer system, ready to be sewn up, only one person being required to operated the whole process.

In this way the designer could transform his original idea into a projected three-dimensional image, and then produce the cut garment pieces, all achieved with a computer-aided design system.

STAGE THREE: The grading and preparing of the pattern for production.

Few jobs performed in the process of designing and manufacturing a garment are as highly skilled, yet as tedious and laborious, as pattern grading. The work of grading requires conisderable experience, knowledge, and care in its execution; yet because of the amount of repetitite work and manual drafting involved it is not usually in itself an enjoyable or satisfying occupation.

It is generally acknowledged both within the trade and by official bodies such as the Clothing E.D.C. that there is an increasing shortage of skilled human graders. There are just not enough young people learning the skills of grading to satisfy the current demand in an expanding industry of increasing demands.

The necessity, therefore, is to de-skill the grading process; computer-based grading systems are now readily available to those firms whose volume of production would justify the installation of such a system. It is not the purpose of this thesis to go into the technicalities of such a system, rather to describe its operational use and to illustrate the advantages to the designer and/or grading personnel, and to consider possible future developments.

Various companies are now developing their own computerised grading systems, though there are methods and components which are basic to all systems.

System Components

1. Digitiser and table
2. Visual Display Unit

3. Teleprinter
4. Plotter
5. The computer

Each device is directly connected to the central computer resulting in a fully interactive system, and can be operated by only one trained person.

Digitiser and table

The digitiser has a double function in that firstly it is the central control of the system, issuing commands to the computer regarding data input, verification, editing, filing, and output; and secondly it is used to describe the shape of each original size pattern piece.

A present method of pattern-input or digitising, is by means of a 'free pencil' fine cross-hair viewer which is used to identify pattern points. The free pencil is so called because it can be held comforably in one hand and has no mechanical attachments, only a single cable connection. The shapes of the pattern pieces are described by positioning the fine cross-hairs of the viewer over a specific point, then pushing the appropriate button. This operating prcinciple facilitates quick, accurate, input with the minimum of operator fatigue.

For accurate and efficient grading, certain pre-requisites are necessary:

1. Grade-rule tables must be programmed: grade points must be identified to give movements, size by size, for example - $\frac{1}{8}$" on x axis, $\frac{1}{2}$" on y axis.
2. The master pattern produced, for example standard size 12, is the base pattern.
3. Constraints must be listed - checks, grain lines, and so on.
4. Style definition: the computer must be told to cut two sleeves, two backs, etc.

On completion of the original size pattern input, the grading rules are applied, using the free pencil to identify, a point, and the push buttons to indicate its magnitude and direction.

With this method of pattern data an operator can, in only twenty minutes, input ten pattern pieces complete with their grading rules. Straight lines, curves, and grading rules can all be edited at the time of input, and when completed a command to make a permanent record of the style can be issued from the digitiser.

Styles can be stored on removable magnetic disc cartridges which will hold between fifty and one hundred styles and are easily removed for storage when full.

A logical development of this input stage of computerised pattern grading would be the elimination, as far as possible, of the operator.

The computer could be programmed with a complete and comprehensive set of grade rule tables in which all grade points are identified: for example, a front bodice being pattern piece 'A' and the neck point identified as point 'A1', the shoulder point as 'A2', and so on; the computer could then, with a scanning device of some kind to 'look at' the pattern, recognise and apply all the grading points. The only function of the operator would then be to position the pattern under the scanning device, to set the process in motion, and to keep a check on the procedure.

However, the grading of complex and unusual pattern pieces - for example a raglan sleeve and front and back shoulder yoke cut in one piece - requires not only the application of technical and scientific rules, but also the application of experience in assessing the requirements of a good fit. Also, the fact that certain styles will be required only once more, if at all, in any successive season, restricts its application and also the justification of including it in such a system.

Therefore it can be seen that only those types of patterns which would be in regular use would be worthwhile including in a system incorporating ready-programmed grate rule tables, and any new style requiring different grading rules would not fit into the system. Alternatively, the complexity of the grade-rules which would be required to allow the system to cope with many style changes would be prohibitive. Once again, volume and type of production is seen to be a limiting factor.

Visual Display Unit

This unit (p.) is connected to the computer and will give a visual reproduction of input data. As the operator digitises the pattern shape it is displayed on the screen, and the next sequence of operations is prompted by messages displayed, which will also refer to the correct push button requirements. Arrows on the display are used to indicate the direction of point movement, together with numbers indicating the magnitude of the direction: this is used as a verification of grading rules.

If the digitising function were automatic, as described above, the visual display unit would provide an invaluable check on the graded parts.

If alterations are found to be necessary, they can be made either from the digitising table or directly off the screen by using a 'light pen' and push button controls. This enables the operator to correct any input errors immediately before committing the style to a permanent record. It also allows old original styles to be recalled from storage so that the shape or grading rules can be edited to form a new original style, thus cutting out the input sequence completely.

The telprinter

This is used as a hard copy record of messages between the operator and the system. The computer may make a request - for example, the sizes that the style should be graded to - by outputting a message on the teleprinter the operator relies by typing in the required size.

From then the time taken by the computer to calculate a single size grade up or down is approximately one second per piece; therefore a style with ten pieces graded to five sizes including the original, would take approximately fifty seconds to compute.

Once the pattern is graded the teleprinter can be used to list such useful information as perimeter and area calculations of individual pieces, and percentage cloth-utilisation figures from the completed lay-marker.

The Plotter

This piece of equipment produces either the individual pattern pieces or the full-size marker, according to instructions.

The plotter can take the form of the drum, which rotates and carries a roll of paper; or a flat table which is much bigger and more expensive. If individual pattern pieces are to be produced in a heavy card the flat bed plotter is required, these range from slow, relatively inexpensive units where the output is cut out by hand, to expensive fast devices which will also cut out the patterns.

As previously mentioned (p) it is possible for the plotter to actually cut the pattern pieces from fabric, although this necessitates the use of the nylon bristle 'table top' which allows the passage of the reciprocating knife blade.

It would be desirable to have a system whereby the plotter could both cut patterns and fabric, as well as being able to draw the marker. An adaptable table top would obviously be required so that the plotter would be able to draw the pattern or the full size marker on a hard-surface table top, then substitute a reciprocating knife blade for the pencil and a 'porous' nylon bristle table-top for the solid top so as to be able to cut out the garment parts. This of course presupposes that the reciprocating knife blade will be used to cut out the garment pieces; in fact experiments have

been tried out both with laser-beam cutting and water-jet cutting, both of which would obviously necessitate differing systems, and would entail their own peculiar difficulties.

This then is the sequence of events from the production of a master pattern - whether an original 'first-off', or from storage in the computer - to the final graded pattern, which can even be transferred into a lay, and will ultimately be cut out of fabric, all controlled by a computer.

The operator of such a system need not be fully conversant with the workings and technicalities of computers, rather he should be a designer, and/or pattern cutter who is conversant with grading practice, and who could be trained to operate the computer system.

The installation of a computerised pattern-grading system not only speeds up the grading process, but it is also found to give greater accuracy and consistency; a computer does not suffer from periods of inattention and produces a far more consistent work pattern.

However the possibility remains that such a grading system could lead indirectly to a certain standardisation of styles, in as much as a style which would not readily go through the computerised system may not be accepted for production, or may be accepted only if basic changes are made to that style. The main factor being taken into consideration becomes, not the style, as it should be, but the system itself; thus creativity is stifled.

The high cost of the installation of a computerised system for the design and/or grading process must also be taken into account. Actual costs cannot be accurately estimated until the requirements of the individual company have been analysed; in fact systems are usually designed to suit the customers' needs. This in itself is a contributing factor to the high cost of the system, a cost which cannot generally be met by the small manufacturer, and indeed, probably the medium sized manufacturer. Only the large

organisations would have the volume of production required to justify the installation of a computerised design-system, and the capital available to purchase it.

The possible application of a 'Computerised Design Service' is inidcated here. Many firms already have links with central computers based elsewhere in this country, or even abroad, which they use for functions such as stock processing and production control. The same principle could be applied to a designing and grading computerised system whereby firms would have the digitiser, the visual display unit, the teleprinter, and the plotter, all of which could be connected through the GPO telephone grid to a central computer. Under this system the central computer could be of a complex type able to handle not only the many functions required, but also a large number of firms at any one time, each firm having its particular programme which of course cannot be intercepted by any other user.

Alternatively a group of companies could purchase a system and centre it in the main company, installing the necessary components in the subsidiary companies, so that all the companies could share the use, and the cost, of the system.

STAGE FOUR: The recording and storage of styles, patterns and relevant information

Most clothing firms retain styles and their patterns and information from two and three seasons ago, especially those manufacturers who aim for the more mature market where style changes are slow and undramatic. Storage space, however, is a real problem. The sight of rows upon rows of paper and card patterns hanging from girders in the ceiling is all too familiar. The storage problem is eliminated when computers are used because of the large amount of information which can be stored on a typical magnetic tape, saving space, and also providing a much more efficient storage system from which the designer can easily obtain information which could include, for example, the following:-

1. A three-dimensional representation of every style
2. The patterns, fully graded
3. The markers, plus fabric widths, marker lengths, and percentage efficiency
4. A cost sheet for each garment, detailing such items as trimmings, threads, fabric specifications
5. Retail information about the style: was it a good seller, which colours were most popular?

All this information may be easily stored and instantly recalled by the computer as and when required.

Of course, a manufacturer catering for the high-fashion market will rarely use patterns from two or even one season ago as fashion changes will necessitate a modified body shape, for example, causing last season's styles to be out of proportion on this year's body shape. However, the information given will still be valid and will provide useful references from season to season.

This computer-store will also form a basis of much of the factory records. Indeed, the store should not be restricted to the design room records and information, but should be used extensively throughout the factory for such functions as stock control, progress control, the recording of orders and so on.

CONCLUSION

The designer process has been broken down into its various stages in an attempt to examine and illustrate how computers can be an aid to the designer at present, and how they can possibly be an aid to the designer of the future.

The major problem, which occurs again and again, is the reconciliation of fashion, or rather the nature of fashion, and the essential nature of a computerised system of design.

Fashion is ever-changing. It requires experienced interpretation on the part of the designer so as to ensure the success of styles. Fashion requires an intiutive awareness of current trends yet (fashion) in the long term is unpredictable.

In contrast to this is the computerised system, based entirely on logic: computers require facts in order that they may function correctly. Nor are computers creative: they can only interpret information according to the programme, having no instinct or sixth sense by which to recognise a fashionable style.

Therefore, because garemtn design is an essentially creative function, the computer cannot be expected to design successful styles.

However, as has been shown in the text, the designer can, even at this present time, benefit greatly by using the computer as an aid in all the subsequent stages of design.

Future possibilities must include the programming of a computer, so as to 'teach' it pattern-making. Given information regarding body dimensions - this already having been achieved with three-dimensional body representation- plus a thorough and comprehensive programme on pattern making and the principles of achieving a good fit, the computer could draft, for example, a skirt and 'try it on' the three dimensional figure. Fabric properties must also be programmed so that the computer can simulate the drape of the garment: already computers are being used in the construction industry to calculate areas of stress and loads: this principle could also be adapted to fabric properties.

Thus the designer, using a light pen could draw the design onto the three-dimensional figure, then the computer could assess the design and produce a pattern, continually verifying the fit.

No doubt future developments will bring about radical changes in the structure of the industry: complete automation of the whole garment making operation must be the computer developer's ultimate aim.

However, clothing manufacturers are, on the whole, notoriously unenthusiastic about radical changes: this is an attitude which must change. If the clothing industry is to progress we must be prepared to explore and experiment with new avenues of technology.

Only by being prepared to invest time and money, and above all interest and enthusiasm in future developments will it be possible for us to ensure that the clothing industry benefits, to the greatest degree possible, from advancing technology.

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