COMPUTER-AIDED DESIGN:
TRAINING NEEDS IN FASHION AND TEXTILE DESIGN

by

DESIREE N SMAL

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TECHNIKON PRETORIA

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November 2003
DECLARATION BY CANDIDATE

I hereby declare that the dissertation submitted for the degree M Tech: Fashion, at the Arts Faculty, Technikon Pretoria, is my own original work and has not previously been submitted to any other tertiary institution. All work that is quoted is indicated as quotations and is acknowledged by means of a comprehensive list of references.

DESIREE N SMAL

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To the boys,

all three of them.
ABSTRACT

The use of CAD/CAM is an essential part in the manufacturing of any textile or apparel product and is forcing tertiary institutions to revise their approach to current training being offered to students. In this study research was conducted to determine the use and implementation of CAD in the textile industry. The development and future of CAD/CAM technology in the global textile industry was investigated, and the implementation thereof in the South African textile industry determined. An interview schedule was developed to ascertain the implementation and effectiveness of CAD training at tertiary level in the fashion- and textile disciplines at Technikons in South Africa. Descriptive statistical analysis was applied to analyze the data obtained. The analysis showed that CAD has indeed been used in industry for the past decade, yet only a small percentage of CAD operators have received the necessary CAD knowledge from the relevant apparel and textile design disciplines at Technikons in South Africa.

The results of the analysis were used to analyze and suggest restructuring of CAD training currently applied in the departments of Fashion Design and Technology and Textile Design, Technikon Pretoria. Recommendations such as improving on CAD resources and the development of CAD curricula were made for the improvement of course content regarding CAD training.
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CHAPTER 1
INTRODUCTION TO RESEARCH METHODOLOGY

1.1 Introduction

In the seventies the emphasis of the South African textile industry was on producing high volumes of products with little consideration given to consumer preferences. This has changed; today the consumer plays a determining role in the acceptance or the rejection of apparel and textile products.

The new approach by retailers is to keep stock levels small. This allows for continuous stock changes. New styles and a greater variety of textile and apparel products are constantly available to the consumer. Retailers therefore need to depend on the flexibility of textile and apparel manufacturers. Everyone is competing for the same consumer. Manufacturers and retailers are trying to stay one step ahead of their competitors and want the lead times in production to be constantly decreased. This is in response to the growing pressure from retailers to speed up the production of new styles and new and innovative products. Market forces are therefore driving the industry to manufacture efficiently, with speed and with flexibility. Companies today, even more than in the past, need to maximize their potential to be able to remain competitive.
The use of computer-aided-design (CAD) and computer-aided-manufacture (CAM) has provided the opportunity to assist in the process of product development, and has made manufacturing flexible.

In the seventies, only large manufacturers could afford to implement CAD/CAM systems into design and production. These systems were often cumbersome and highly technical, separating the design process from production. With computers becoming more accessible and cost effective, and software more discipline orientated and user friendly, the use of computers has become more accessible to medium-to-small manufacturers, as well as design studios.

In fact, Computer-integrated-manufacture (CIM), and global competitiveness is making it impossible for any business not to incorporate CAD/CAM into the design and manufacturing process. With computer technology a vital necessity in any successful business in increasingly competitive times, the training tertiary institutions provide at present should be adapted to the particular needs of the industry.

1.2 Research Problem

The use of CAD is an essential component in the manufacturing of any textile or apparel product and is forcing trainers to revise their approach to current training.
Two aspects need to be considered:

- To what extent should CAD training be incorporated into the curriculum?
- To what extent is CAD technology, the 'new tool', relevant to the current and future situation of the textile and apparel industry of South Africa?

The focus of this study will therefore be an analysis of apparel and textile manufacturing, and training in South Africa regarding:

- The development and growth of CAD technology in the apparel- and textile-manufacturing sector of the textile industry in South Africa.
- The type of CAD hardware and software that is currently being used by the textile industry.
- The extent of training in CAD technology at Technikons in Fashion Design, Textile Design and Clothing Production.
- The knowledge and skill the student should acquire in order to be a contributor to the workforce of the apparel and textile manufacturing segments of the textile industry.
- The development and improvement of curricula regarding specialized computer training at the Departments of Fashion Design and Technology and Textile Design, Arts Faculty, Technikon Pretoria.

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1 The concept *new tool* is further described in Paragraph 2.3.2: 26.
The information obtained will allow the departments of Fashion Design and Technology and Textile Design and Technology to improve on current CAD programmes, and to expand the facility to train students in the cutting edge technology used in industry. The research problem can be addressed by:

- Determining the needs of the apparel and textile manufacturing segments of the textile industry regarding the type of skills required of the student, which these segments of the industry could employ.
- Investigating the diversity of computer equipment relevant to the process of product development, which is used for apparel and textile design and manufacturing.
- Identifying the other Technikons which provide training in the fashion and textile fields. A study to ascertain the CAD training these institutions provide, as well as determining how efficient these institutions are in the placement of students in a CAD related environment in the textile industry (both in fashion- and textile design).

This information will form the basis for the development of curriculum and training methods to address the specific needs of the textile industry.
1.3 **Research Objective**

Based on the research problem identified, the objective of the research is to establish the computer and computer design related skills and knowledge a student should have on completion of his/her studies.

The objective of this research is:

- To establish what the industry is using in terms of *computer hardware and software* in this field of specialization.

- The *knowledge and skills in relation to CAD* the student should have, on completion of his/her studies.

Given the need for documented information necessary for development of the curricula of the Fashion Design and Technology and Textile Design departments, this study will establish the following two research areas: The *first* area is to establish the use of computer technology in relation to product development in the field of textile and fashion design and manufacture. This can be achieved by researching the following:

- The development of computer technology in the past five years globally.
- The development of computer technology in the past five years in South Africa.
- The future of computer technology in the South African textile industry.
- The type of computer hardware and software used.
- The reasons for specific computer hardware and software being used.
The second area that needs to be investigated, relates to the CAD literacy and computer design skills the industry needs. The prospective students the industry might employ should then:

- Be provided with training relative to what the industry requires.
- Be trained in accordance with job market requirements. Those students will then contribute to the growth and development of the textile industry.

1.4 Definition of Concepts

The following concepts are used in this study and therefore need to be defined in relation to the study. These concepts are listed in alphabetical order.

1.4.1 Computer-Aided-Design (CAD)

This is the design of a product or product range, by making use of dedicated/generic computer operating systems and software programmes. Dedicated computer programmes are available for both the fashion and textile disciplines, and are written exclusively for use in the textile industry. Generic software programmes are off-the-shelf programmes, for example Corel Draw, which can be used in other design disciplines as well.
1.4.2 Computer-Aided-Manufacture (CAM)

Product development and production is linked through the integration of computer-aided-design and computer-aided manufacture, and speeds up the process of production. The combination of CAD/CAM controls the production of textile products electronically.

1.4.3 Textile Industry

The textile industry of South Africa is responsible for the production of:

a) Fabric – woven, knitted or bonded cloth of any kind and purpose, for industrial and commercial use.

b) Products – produced from the fabric. Included is clothing, textile products for home decoration, industrial and commercial use.

The Textile Industry, for the purpose of this dissertation, has been divided in two segments. The first segment, the textile segment of the textile industry, refers to the design and manufacture of fabric, from raw product to finished cloth, for a specific purpose, intended for commercial or industrial use. The second segment, the apparel segment of the textile industry refers to the design and production of clothing for a specific purpose. The size structure of the textile industry can be divided into:

a) Large manufacturers who produce high volume quantities of textile and apparel products.
b) Small to medium manufacturers who produce smaller volumes of a particular type of textile or apparel product. This generally allows for the production of various products in lower volume production runs.

c) Design houses/studios, which generally produce very small quantities of products or are only involved in the process of product development and not the production of the products.

1.4.4 Training

The concept ‘training’ referred to in this dissertation is the training provided by Technikon(s) in South Africa, in the disciplines of Fashion Design and Technology, Textile Design and Technology, and Clothing Production. In particular the training needs of Technikon Pretoria are addressed. The training referred to is the training in the respective fields where computer technology is used for product development. This includes graphic computer packages, which are used for design, as well as dedicated computer programmes for product development.

1.5 Contribution of Study

The Departments of Fashion Design and Technology and Textile Design both experience some difficulty in fully preparing a student to enter the field of specialized computer technology. This is due to the shortage of resources:
The growth and development of specialized computer technology in both the apparel and textile design and manufacturing segments in the textile industry, has shown that it is necessary to re-evaluate the method of training of specialized computer technology currently used in both departments. The data collected will provide the necessary information to ensure the development of CAD curricula in the fashion- and textile design fields, with regard to the quality of training which Technikon Pretoria will be able to provide. The end result, a competent and highly skilled student, will therefore be able to contribute towards the specialized design and manufacturing sectors of the apparel and textile segments of the textile industry. This could further lead to the development of specific short and specialized courses in CAD training, thus providing greater expertise to the students and alumni alike.

1.6 Summary

The identified research problem has been discussed in this chapter. An overview has also been given of the objective of the research and the focus area of this study. In the following chapter, Chapter 2, the development in the use of CAD/CAM in apparel and textile design and manufacture is discussed.
CHAPTER 2

COMPUTER-AIDED-DESIGN (CAD) AND COMPUTER-AIDED-MANUFACTURE (CAM) IN APPAREL AND TEXTILE DESIGN AND MANUFACTURE

2.1 Introduction

A survey conducted in the United States of America during 2001 by Ross on CAD/CAM: Trends and Predictions, showed a definite move towards computer integration into the design and manufacturing world of textiles and related products. According to Ross there is a decided shift concerning the improvement of communication in the flow of electronic information - as illustrated in Figure 2.1. Many new apparel and textile manufacturers are focusing on design, product development and merchandising. All of the above-mentioned are advancing to the improvement of speed, quality and efficiency to market (Ross, 2001e: 1).

The integration of computer technology in the textile industry can best be described by means of the following flow chart:
The textile- and clothing manufacturing pipeline, from design to retail, focuses around the communicating of information. Computer software products are available to help facilitate communication and flow of up-to-date information to participants in product development and manufacturing. The objective being: productivity, efficiency and quality.

The product development process uses the information regarding consumer preferences such as sizing and consumer-buying habits supplied by the retailer. This data is collected by means of Electronic Point of Sale (EPOS) and is
subsequently forwarded to the manufacturer. The result is an interactive circle of information, which supplies design and production teams almost daily with information regarding retail sales, and allows manufacturers to respond immediately. The retailer is informed through Electronic Data Information (EDI) when the order can be expected, thus enabling the retailer to start with marketing and merchandising strategies to promote and sell the product. Business-to-Business (B2B) information has also increased effectiveness of ordering and billing between businesses. This effective method of information flow would not be possible without computer technology, and puts those companies who have integrated information technology (IT) into product development and manufacturing at a distinct competitive advantage.

Web Sales are another method of relaying information in the Business-to-Consumer (B2C) network. Jack Welsch, previous CEO of General Electric - USA said: “What we are really doing here is managing change. We are managing change every day. Change before you have to. You have to anticipate it. Most importantly, control your own destiny as much as you can or someone else will.” (Dockery, 2001: 1).

Speedo, an international sportswear manufacturer set up a modest website in 1998. Sales from this site proved rather unsuccessful. Two years later, the company began working on a new website, improving on it’s functionality. The company is now successful in selling through the web, due to changes that were
implemented just before the 2000 Sydney Olympics. Sales from the new sites have since doubled (Dockery, 2001: 1).

The information link between the product development process and manufacturing is what is referred to as the CAD/CAM link. Processes that are started in the product development stage are often electronically linked to processes in manufacturing. It has become apparent that the use of CAD/CAM systems is important to maximize the potential in the use of computer systems if companies want to remain competitive. The move towards total IT integration and CAD is becoming essential for the survival and growth of all manufacturers in the textile industry.

Mary Schoeser (1995: 7) describes the move towards the use of computer technology in every aspect of the textile pipeline as the *third industrial revolution*. The first industrial revolution resulted in the process of mass production. The second industrial revolution brought about higher standards in products, increased speed of production and greater conformity of product specifications. In the *third industrial revolution* the use of CAD/CAM is resulting in greater manufacturing flexibility.

Greater manufacturing flexibility:

a) Allows for design houses to respond to market changes more rapidly,

b) Allows for the integration of product development with manufacturing, and
c) Enhances inventory maintenance and product marketing.

Baker (1993: 56-58) refers to the implementation of CAD into the design process as the replacement of the pencil and paper by the electronic pen and computer screen (old tool = new tool)\(^1\). According to Teri Ross, president of *Imagine That!* (Ross, 1999: 1), these systems don’t just replace the designer’s pen and colour markers, but also a variety of time-consuming and costly product development tasks, and have become an extension of the designer’s senses. The conclusion that can be derived from these statements is that the use of CAD in the process of design and product development has become a necessity.

CAD can be used effectively not only in the design of industrial textiles, but also in the testing of the product’s safety. An example could be the space suit that needs to keep the astronaut safe from harsh elements during a space mission, but needs to be comfortable as well. This would have to be tested and the probability of malfunction calculated before the space mission takes place, in a virtual situation.

Fabric is also an extension of people’s senses. A certain fabric can enhance an emotional reaction. For example a silk fabric does not only feel soft when

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\(^1\) Baker (1993) is one of the authors who refer to the concept of traditional equipment as ‘old tools’ of the textile design trade, and technology as the ‘new tool’. Traditional tools would be the use of pencil and paper, and technology the use of CAD in the process of product development. Others authors, such as Gray (1998) have also differentiated between traditional and technology as *old* and *new tools*. This concept is further described in Paragraph 2.4: 30
touching it, but also gives the sense of movement (flow) when wearing it. Incorporating CAD with this sensual element into fabric or clothing allows the designer to take the senses a step further. Incorporating cyber design elements into textile products does just that. For example incorporating a cell phone into the sleeve of a shirt. The senses on the skin are activated when the cell phone rings, thus creating an immediate response from the wearer.

The developments in IT could also allow the consumer to multitask with the use of cyber elements that are incorporated into an accessory (hat) that the wearer is wearing. The following is a virtual example of where IT could lead us:

“Imagine crossing the road while wearing split image contact lenses (part virtual, part reality) and an arm telephone. The telephone rings, a car approaches, and the virtual side of your lenses chooses that moment to display the holiday brochure you were trying to locate.” (Braddock, 1999: chapter 2).

This is a virtual problem that might only need to be solved by future generations. If the development in cellphone design and capabilities has already progressed so far in only a few years, the type of scenario described above might not be so far-fetched.

The virtual situation is already visible in manufacturing. A South African textile company with a large number of base products and variants on the base product, has been able to turn around from 20% losses on turnover to profits of
the same percentage in approximately 18 months by using a product called *virtual factory* (Virtual factory, 2002: 25). This programme, which replicates the entire supply chain, is designed to assist management with planning and directing the flow of production. It allows management to change delivery dates and quantities, and solve problems before production even commences. The use of IT for *virtual problem solving* should therefore not be underestimated.

Many examples are available of how the use of CAD, and ultimately CAM has improved profits. One such example is a textile company that designs and manufactures fabrics for the corporate and hospitality world, healthcare institutions and institutional textiles (CAD propels creativity at Maharam, 2001:1). This American company was founded in 1902, and is still going strong after four generations.

The company has to be able to supply its customers with a sample length of fabric within two weeks after consultation with the client. To create a print can be a time-consuming and be a costly exercise; using a CAD system allows for the design to be implemented in a 3-dimensional image immediately. The company can then produce and show a realistic woven fabric simulation of the design to their customers in half the time it takes to weave an actual sample.
Some examples of how CAD is used in the design of a high-fashion fabric are illustrated below. These electronically design-enhanced fabrics are often referred to as ‘electronic textiles’.

**Figure 2.2**
*Fabrics designed with the aid of computer technology*

<table>
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<tr>
<th>Fabric designed for Issey Miyake, Spring/Summer collection of 1996. The fabric is a monofilament polyamide with a holographic finish. The transparent fabric shimmers against the skin, contrasting with the collar, pocket and cuffs.</th>
<th>Fabric designed for Yoshiki Hishinuma Spring/Summer collection of 1996. A moulded polyester fabric has been used. The heat moulded convex forms are placed for a strong relief effect.</th>
</tr>
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</table>

It is clear that the computer already has, and will in future continue to have, a profound effect on the textile industry.
2.2 The need for CAD technology

The computer has become a fact of life. Computers are used as a tool in providing solutions to problems arriving out of everyday situations. Many people would write a letter, calculate their monthly budget, and communicate business transactions via e-mail on a computer.

On the creative level, the computer is currently perceived by some as an additional medium to be used in design at some level during the student’s education. Many lecturers see it as a threat to craft and creativity.

According to Baker (1993: 10) the computer definitely does not inhibit or constrict the creative thought process, nor narrows the creative possibilities of the operator. The use of the computer in the process of design should thus not be seen as a threat to the creative thought process, but must rather be used as an advantage to the process of design and regarded as an additional medium, which can be used to complete the design process.

At a recent congress of the Computer Integrated Textile Design Association (CITDA) in New York (Ross, 1999: 1), a debate was held regarding the question: *Which comes first: design or computer skills?* Delegates felt that the computer can only contribute to making designers a success if they have received expert training in design, and should therefore view the computer as an instrument to
express their creativity. Designers also need to recognize the importance of computer-aided-design developing into computer-aided-manufacture. The conclusion arrived at the conference, was that the design software used in the creative process is only as good as the creativity of the person who operates it, and having the right medium at hand is essential to any successful designer.

The third industrial revolution as described by Schoeser (1995: 7), where the use of CAD/CAM resulted in greater manufacturing flexibility, started in the last quarter of the 20th century.

2.3 The development of computer-aided-design

The progress in the use of related computer technology for the textile industry has been far slower than the development of the personal computer. The history of CAD/CAM gives the reasons for the slow development, whereas the motivation behind the use of CAD/CAM in manufacturing gives an indication that the development of IT in the textile industry is still in a stage of growth.

2.3.1 The history of CAD/CAM

The use of computer technology in apparel production began in the early seventies (Gray, 1998: 4-10). Technology was used to focus on production,
and in particular on marker making\textsuperscript{2}. The use of dedicated apparel computer programmes emphasized the reduction of fabric waste during the laying-up of fabric for mass production.

The use of this type of technology in the early seventies resulted in the development of automated lay cutting machines, which could be linked to the marker process (Gray, 1998: 4-6). The computers were huge in size, immoveable and extremely costly. Specialized technical personnel were the only people qualified to operate the equipment. In the seventies the apparel industry produced products in massive volumes, resulting in large production runs of the same product, justifying the great costs of acquiring such equipment. Later the function of grading was added. The grading function allowed one to reproduce a style in a number of different sizes with the mere touch of a button, resulting in time saved and thus allowing production runs to increase. Programmes became easier to operate. The variety of systems increased, but were financially still only within the reach of large manufacturers due to the high cost of the equipment.

The first commercial application of this technology was seen in the late eighties. The cost of these systems was still excessive. The use of three-dimensional imagery (3D) was added. The function of scanning and

\footnote{The process of marker making is discussed at length in the implementation of CAD/CAM in product development. Please refer to Paragraph 3.2.2: 35.}
modifying an image was also incorporated and provided more possibilities in the design aspect of product development. The original function of marker making was developed to become more user friendly and easier to use by anyone who was creative and who had a technical inclination.

Computer technology in textile design and production was introduced to assist in the control of knitting and weaving processes. As with the apparel industry, only large manufacturers could afford the high costs involved with the acquisition of such computer technology. The only personnel able to operate the equipment were, as in the apparel industry, specialized technicians, who would subsequently interpret the designer’s ideas.

Graphic packages, traditionally used in other disciplines (such as, Graphic Design) were adapted for use in product development of a textile design. These were design programmes such as Corel Draw, Adobe Photoshop and Macromedia Freehand.

Specialized computer packages have now been developed specifically for use in product development of apparel and textile products. These programmes are currently mostly IBM compatible and can thus be loaded on personal computers, making them more accessible to small manufacturers and design studios.
Specific elements motivated the development of CAD and CAM in the textile industry.

2.3.2 The motivating force behind CAD/ CAM

Baker describes that the development of the human / computer interaction has made the visual representation of information more accessible for the operator (1993: 35-55). Designers can now apply their skills immediately on the computer by making use of icons and images displayed on the computer screen, and not merely by a set of commands typed in on a keyboard, as was the practice in the years before using graphical imagery. The latter entailed using a predetermined set of commands, which were typed in on the keyboard. These commands needed to be memorized in order to create a design on the computer screen, a process not very conducive to the creative process of design. The introduction of the electronic pen and the computer mouse became the artist’s tool, and was more ‘design friendly’ than the keyboard could be. One could say that this is the link between the old tool, the pencil and paper, and the new tool, the computer.

The initial cost of acquiring such a computer system was extensive. Over the years the expenditure on electronic equipment such as a personal computer, has been reduced. The result has been that the computer has become more accessible to a wider range of users. A small design studio can complete all
designs and visual presentations by making use of a generic graphic software programme such as Corel Draw or Macromedia Freehand. A large manufacturer will, due to high volume production turnover, make use of dedicated computer hardware and software for the stages of product development and production (Cooklin, 1991: 28-38).

The competitive nature of the textile industry has made it necessary for companies to seek faster and easier methods of product development (Gray, 1998: 3-4). The nature of apparel and interior decorating retail markets has changed from only having a standard range of products, to that of concentrating on consumer preferences, and thus having an even greater variety of products available to the consumer. The concept of Quick Response (QR) requires producing the right merchandise, at the right time, in the right quantities, when the consumer wants to buy it (Gray, 1998: 8-10). Wolfe (1998b: 87-88), describes this process as delivering the right products at the right time, thus enabling manufacturers a faster response to market trends. “Manufacturers constantly add and subtract garments from their lines, doing shorter production runs with more frequent style changes. They also ship/distribute smaller orders more often.” (Stone, 1990: 184).

Quick response greatly reduces the cost of clerical work, and in some cases, paper work is almost eliminated. By using Electronic Data Interchange (EDI),
mills, manufacturers and retailers can interchange information much faster. EDI is the communication of information or transactions via computer linkages between companies (Wolfe, 1998b: 569). Adapting to changes in the market has become much easier with the use of these electronic linkages. Wolfe (1998b: 85-87) provides the following example:

**Figure 2.3**
Information pipeline

- A textile firm has a computer system to measure, code and check a roll of fabric for flaws.
- The information is transferred to the apparel manufacturer before the roll of fabric arrives.
- When the fabric arrives, each roll is scanned by a bar code.
- The roll of fabric can now be moved directly to the cutting room for production, or be stored for distribution later.
- Apparel manufacturers scan the quantity of products produced each day, and inform the retailer when they are ready to deliver.
- The computer does all invoicing automatically.
In the above figure an example is given of how EDI is implemented in the information pipeline.

A direct result of electronic data interchange is the implementation of quick response (OR) linkages. Computers are used at all levels in business, such as ordering, distribution of data, storage, stock and re-ordering. Data can be electronically located, processed and used. With the use of a computer, companies can track all movement of goods. This increases the efficiency and productivity of all personnel in the company, thereby obtaining an advantage over competitors. Wolfe (1998b: 81) describes that this could be one of the main elements that separate winning companies from losers.

QR could lead to one unified industry, and not several separate segments. Another advantage is the concept of ‘just-in-time’ (JIT). A concept used by the retailer and manufacturer to keep just enough products on the shop floor, as required, and thus eliminating bulk. This makes stock recording and accounting easier, as well as lowering inventories and costs. The result of JIT is more correct deliveries, more frequently. The following diagram shows the benefits and result of implementing QR.
<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN GENERAL</td>
<td>SPECIFICALLY</td>
</tr>
<tr>
<td>Improved focus on consumer needs.</td>
<td>Improved distribution.</td>
</tr>
<tr>
<td>Improved communication.</td>
<td>Easier recording</td>
</tr>
<tr>
<td>Higher quality standards.</td>
<td>Shorter lead and response times.</td>
</tr>
<tr>
<td>Improved efficiency, i.e. Purchasing/distribution.</td>
<td>Improved sales forecasts.</td>
</tr>
<tr>
<td></td>
<td>Fewer retail markdowns.</td>
</tr>
</tbody>
</table>

The above table shows how QR can be implemented to increase production and lower costs in the process of manufacturing and in retail.

The result of using CAD/CAM in design and manufacturing is increased product development and production turnover. What needs to be established is the use of CAD/CAM over traditional methods of production.

### 2.4 Tradition And Technology

It is often the case that new technology is still having a problem in supplying a solution that has been adequately answered by traditional methods. (Baker, 1993: 35)
Baker refers to the traditional method of design as the “old tools”. These would include pencil and paper, used by the designer to communicate the design. The new technology (new tools) Baker refers to is to communicate the same design by making use of the computer. The question is then whether the use of new tools in design measures up against the use of old tools, which have a proven record of success. Alternatively the new and old need to work together. The new tools subsequently challenge the old tools (Baker, 1993: 35-55) in their continued use and appropriateness.

There is an increase in the pace at which product development currently takes place. The product end user, the consumer, has become accustomed to a variety of apparel and textile products available at any given time. To satisfy the demand of the consumer, the speed at which product development takes place has to increase to be able to supply a constant variance in products. To keep up with the constant demand for change in products, manufacturers of apparel and home furnishings products have to shorten the time from the start of product development to the finished product. The development process, which includes design, is the starting point of any production process. The fact that the computer stores information which can be altered at the touch of a button, assists the designer in developing more products in a much shorter time frame.
The textile industry is extremely competitive, and producers are constantly searching for a new competitive edge to perform better and to stay a step ahead of other producers. The development of new products and improved methods of production, are usually the most important. This is where making use of computer technology (new tools) can be most beneficial. The use of CAM in the production processes will increase the speed at which production can be completed. The pencil and paper (old tools) will not be able to sustain the above-mentioned changes that a computer will allow. CAD has therefore become an essential survival tool in the creative thought process as well as in product development, and has led to greater design skill. The development of computer graphic software packages and dedicated computer hardware and software for specific design disciplines, has added to the improvement of those specific design skills.

2.5 Summary

The development of, and the need to implement, CAD and CAM in the design and manufacture of products in the textile industry are clearly visible over the past 30 years. The use of IT in design and manufacturing is a necessity for any manufacturer that needs to stay ahead of competitors. In the following chapter the implementation of CAD/CAM within the process of product development and production is discussed.
CHAPTER 3
THE IMPLEMENTATION OF CAD/ CAM

3.1 Introduction

In the previous chapter the reasons for the use of CAD and CAM in the textile industry were discussed. The traditional manual method was compared with the use of computer technology in the design and manufacturing of textile products. The implementation and specific use of CAD and CAM in the apparel segment and the textile segment of the textile industry is discussed at length in Chapter 3. This chapter also looks at the future with regard to the use of CAD and CAM in apparel and textile segments of the textile industry.

3.2 The use of CAD/ CAM in product development

3.2.1 CAD hardware and software

Generally speaking computer hardware and software can be describe as follows:

- Hardware:
  Computer hardware is the equipment that can be observed. This could include equipment such as the monitor, hard-drive, keyboard and mouse. Peripherals can be added to the hardware to perform certain tasks and could include plotters, digitizing tables or printers.
Operating systems:

An operating system is the vehicle through which the hardware can read the software programmes. These operating systems are used in combination with software programmes. Certain software programmes can only operate on specific operating systems. Examples of operating systems could be Windows, Linux or Mac.

Software:

Software programmes are written to perform certain tasks. For example the software programme Microsoft Office is generally used when writing documents. Other software programmes, such as Corel Draw, are used to create or modify graphic images. Generic software programmes are software programmes, which can be used in a number of disciplines. Corel Draw can be used for design in Graphic Design as well as Fashion Design. Dedicated software is written solely for use in a specific discipline, for example Stork is a software programme written exclusively for use in the design of a fabric.

Certain software programmes are written for specific operating systems. The Lectra software was exclusively written for a Linux
operating system. The result of this was that no other software programmes could be used on that operating system. The software, which has recently been upgraded, can now also be used on a Windows operating system. This enables the user greater flexibility. For example: the Lectra software can now be used on the same hardware and operating system as the Microsoft Office and Corel Draw software.

In this dissertation hardware refers to the equipment and the specific peripherals that can be added to it. The Lectra software needs a digitizing table to scan a pattern piece, as well as a 2m plotter to print the modified pattern. Software is referred to as the specific programmes that are used to complete certain tasks.

The following are areas where CAD/CAM is implemented in the textile industry.

### 3.2.2 Apparel design and production

The product development process for the apparel segment of the textile industry includes forecasting, design, generating new patterns, digitizing, adapting existing patterns, pattern grading and the preparation of a lay marker. The concept of product development
refers to the stages involved with the development of a concept, whether textile or apparel, up to the point of readiness for production. Product development thus includes all processes from design to final prototype. Wolfe (1998b: 80) describes it as carrying the idea of the product through all the stages from initial conceptualization to actual appearance in the market.

An aspect very relevant to the textile industry is that the product often is developed for a specific target market. The term apparel refers to a broad spectrum in clothing and includes all possibilities of garment and garment combinations of women’s, men’s and children’s wear. Clothing can be divided into four categories. These are:

A. **Fashion-apparel:**

Wolfe (1998b: 28) refers to fashion as a style that becomes popular when it gains popular acceptance, and will remain a popular (fashionable) style for as long as it is accepted. *Fashion-apparel* therefore reflects a continuous process of change in accepted styles, and thus is the current and newest fashion style, as observed by the general public. These styles vary, and new colour combinations and shapes frequently appear. The constant changes result in shorter
production runs than in any of the other apparel manufacturing categories.

B. Stock apparel products:

Stock apparel products are frequently in demand, but are not necessarily fashionable products. They are divided into sub-categories of staple and semi-staple production. Staple production refers to the products in which only minor changes in fabric, style and shape occur. Styles remain the same throughout the year. Production runs are long and high volumes are produced. A good example of this type of product would be men’s underwear, or white t-shirts. Semi-staple production refers to products in which production runs are shorter, high volumes are produced and more style variations occur, of which some could be seasonal. A good example is men’s shirts where style changes could include sleeve lengths, pocket sizes, collar shapes or a change of cloth.

C. Corporate Wear:

Corporate wear refers to uniform type garments. Many companies provide corporate wear to their employees. This allows the customer to identify certain personnel responsible for specific services. Nurses wear a different type of garment than doctors and can therefore be identified as such. For security reasons workers in a factory would all wear the same overall, and thus an intruder would easily be identified.
Companies generally use their corporate colours as another method of identification. Companies also tend to make use of ordinary garments, such as denim shirts or caps, and add their company identification by means of an embroidered or screen printed logo.

C. Utility Wear:

*Utility wear* refers to clothing worn for a specific purpose. The protective garment a fireman wears when on duty is constructed with fabric finished in a predeter mined method to allow maximum protection during a fire. The shoes worn by a factory worker are hardened at the toe to prevent bodily harm from falling objects during production. These garments are constructed to enhance the capabilities of the materials used in construction of the garment.

Designers need to be very aware of the constant changes in the market and the needs of the consumer. Market trends change constantly and new fabrics with different characteristics are developed. Timing is therefore very important. The goods need to be available to the consumer at the correct time. This means that the products need to be available when they are predicted to be in demand (Wolfe, 1998b: 81).
Product development is also often referred to as sampling or producing an apparel prototype of an intended product. The prototype is used for the purpose of obtaining client approval, and acquiring product orders. Sampling is the most costly aspect of product development. Sampling is also an area where computer technology can have an advantage over the use of traditional manual sampling methods, by shortening the design-to-production time and allowing changes to be made to the product or design to suit the needs of the client (Holmes, 1994: 42). The process of product development is divided into forecasting, designing, pattern making, grading and preparation for production.

i) **Forecasting**

Forecasting is the process where the design team needs to research the market for new trends, as well as taking the needs of the target market into consideration. Computers are used to analyze consumer-buying habits supplied by the retailer. The price structure, which is an essential part of forecasting, relates to the price category that the product range finally fits into. This is the price the selected target market is willing to pay. The objective is to have the new styles commercially viable, motivating the consumer to buy the products produced by that particular manufacturer.
ii) Design

Designing is the process of coordinating the designer’s ideas with the merchandising plans of the company (Wolfe, 1998a: 84). The designer starts with sketches, and through a process of elimination, ends with a full collection or range of possible apparel designs. CAD software programmes have a wide range of applications of which technical drawing is one. This is an immensely important process, which needs to be done accurately, as all dimensional details of the product are reflected in this drawing. The second concept, visual presentation of the product in three-dimensional images is as important, because this is usually the method by which the designer would present the design to the customer. The visual presentation also becomes the tool through which orders are secured.
iii) Pattern making

Pattern making is a pre-production phase between the design and the construction of the final sample. This is a process that could be completed manually or by making use of a dedicated CAD programme. Generating new, or manipulating existing patterns is an important function of any dedicated CAD system for the apparel segment of the textile industry. It is possible to create a basic pattern block needed for the pattern construction process. These blocks are constructed to a predetermined set of measurements for a basic size, for example size 34, or to a client’s specific measurements. The designer can then go ahead and manipulate the pattern according to the design details. The
process of constructing a pattern on the computer is similar to the traditional method of pattern construction, and it would probably take as much time on computer as it would manually. The advantage the computer has is that all styles are stored on the hard drive, and can easily be retrieved and adapted to create a new style. To modify an existing pattern not yet entered into the computer system, one needs to scan the pattern into the computer. This process of scanning is referred to as digitizing.

**iv) Digitizing**

The digitizing process is performed on the digitizing table with a puck (Gray, 1998: 25-26). The patterns are taped to the digitizing table, and are then recorded into the computer by means of coded numbers on the puck. Each number has a different function.
The digitizing table picks up the information and registers it as an electronic pattern on the computer screen. With certain systems, during the digitizing process a predetermined code will automatically grade the point on the pattern as it is registered into the computer.

v) Grading

Grading is the process of duplicating a pattern into a range of sizes, either by enlarging it to bigger sizes, or reducing it to smaller sizes. In apparel production, grading pattern pieces by hand is time consuming. Manually, each size is increased individually and then traced from the group of patterns, referred to as a nest. During computer-aided-
grading a nest is created in the full size range (larger and smaller) in one operation. Each size can then be printed separately.

**Figure 3.3**
Grading a pattern nest

Once the grading process is complete, the designer can make use of measuring tools to measure all pattern pieces accurately, ensuring a perfect fit. With the process of grading completed, the production of a marker can commence.

**iv) Marker making**

The objective of marker making is to achieve the maximum usage of the fabric available. The computer operator needs to move the pieces around on the screen until adequate fabric utilization has been
achieved. This process is referred to as interactive marker planning (Carr, 1994: 15). The exact width of the fabric is entered into the specific section of the software programme, as well as any necessary constraints, such as placing selected pattern pieces on- or off the straight-of-grain of the fabric. All pattern pieces are displayed at the top of the screen. The operator takes a pattern piece and places it on the fabric displayed at the bottom of the screen. Each piece can then be moved around until the desired placement has been achieved. The marker length and fabric utilization is constantly monitored to enable the operator to achieve maximum fabric utilization at all times. In the manual marker making process, the marker maker will have to use actual size patterns on an actual lay-length, which could be 1,5m in width and 20m in length.

**Figure 3.4**
Marker in progress
3.2.3 Textile design and production

The textile segment of the textile industry is situated at the beginning of the textile pipeline\(^1\), and therefore needs to be ahead of consumer demand. These are textiles (fabrics) specifically created for a specific end-user (men, ladies or children) in the apparel market. Textile designers, as well as fashion designers, act on fashion trends. Depending on which category the fabric is intended for, textile production can begin 18 - 24 months before the products are ready for retail (Cooklin, 1991: chapter 10). Research should be done regarding colour, patterns and fabric weight, before fabrics for the new season can be developed. The trend information can be sourced through international magazines, or inspiration can be derived from, for example nature or architecture. Through trade licensing agreements, some textiles are designed for a specific designer apparel label (Wolfe, 1998a: 69-72).

For textile design and production the process of product development involves various processes. The appearance and performance of fabrics depends on their fibre content, type of yarn and fabric construction and finishing (Wolfe, 1998b: 115-116). Dedicated or

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\(^1\) Wolfe (1998b: 59-63) divides the textile pipeline into three market segments. Primary market segment is where fabric is produced from natural or man-made fibres. The secondary market segment relates to manufacturing, and the tertiary market segment to retailing.
generic computer software for the textile segment of the textile industry includes design preparation and preparation for production. In this segment one could use a number of generic computer software programmes. Generic programmes, such as CorelDraw, Adobe Photoshop and Macromedia Freehand, are originally written for graphic applications, but can be used successfully to create a textile design print. Dedicated programmes, such as ‘Stork’ exist but are extremely costly and are predominantly used by large manufacturers.

Designing on CAD, as described by Wolfe (1998b: 128), has shortened the cycles of production of both structural and applied textile design. Structural design is achieved by construction or building texture and interest into the fabric during the manufacturing process. This is done through weaving, knitting or embroidery processes. Applied design is a process that adds colour or pattern on top of the finished constructed fabric and can also be referred to as fabric finishing.

The electronic means of design has resulted in the processes of product development to be shortened compared to a much slower manual process. CAD has become a necessary business tool for large manufacturers as well as small textile design studios.
i) Visual presentation

As described in Design, a visual presentation of the product will enable the client to see what the final product and possible variations thereof should look like.

ii) Design

In textile design, an image is often the starting point of all fabric designs. Hardware, such as scanners and digital cameras, which can be used as a means of capturing data, all aid and speed up the process of designing on computer (Gray, 1998:17). Total control over the created image is possible and ideas can be developed into multiple designs, without destroying the original artwork. The advantage the computerized process has over a manual design process is that all images can be stored and thus the derived design pattern can constantly be modified without losing the original information. This enables the designer to add or change colour-ways, delete objects and add images and be even more creative and inventive (Gray, 1998: 17-18). The designer is in constant total control and is able to show the client a visual image ‘on site’. With traditional methods the designer has to restart almost from the beginning of the design process to achieve the same variety of design (Holmes, 1994: 42).
iii) **Fabric structures**

Manipulating each colour and weight of the yarn can produce different fabric structures. The CAD software programme can define yarn and stitch formation when creating a fabric construction from a given design. This applies to weaving structures, jacquard weaving structures, knit structures, embroidery and the construction of lace fabric.

![Fabric made on a computerized loom](image)

Fabric has a warp of golden polyester embroidery thread and a weft of wool/cashmere and cotton/linen (Braddock, 1998: 114).

The process of weaving on the computer is simplified. Designs can be changed faster, thus increasing the possibility of creating various colour-ways of one particular weave. It is also easier for the client to see the final effect of the weave construction in the different colour combinations. The design process can be linked to the actual process of weave construction.
This design is entirely computer-generated but gives the illusion of organic markings and screen printing (Braddock, 1998: 112).

Computer assisted weaving frees the weaver from time consuming tasks such as creating tie-ups, as the computer activates which harnesses need to be raised automatically. The art of jacquard weaving has also changed with the use of CAD-related weaving programmes. In previous years, a designer needed to be a technical jacquard-weaving specialist, to be able to understand the process of creating jacquard weaving constructions. The computer software developed simplifies the weaving process, as designs are automatically translated by means of weaving programmes into a woven article (Noonan, 2002: 1). CAD in weave construction creates the advantage that the richness of colour and the characteristics of the cloth are now available faster, by linking it to an automated weaving loom.
CAD also makes it possible to design a sweater on computer, and to electronically programme the knitting machines. The result is a sweater, which can be designed and produced in a matter of hours. To do a similar process manually means having to create a diagrammatical imprint of the design and setting the knitting machines accordingly. On the computer the illustrations (designs) are divided into a grid that indicate each stitch. The designer specifies the knit structures, resulting in a pattern. The information is directly passed electronically to the knitting machines, which, in turn, start the production process of the sweater. This is a good example of how CAD develops into the use of CAM. Realistic visuals of the intended products are seen on the screen and design changes can be made if necessary. The completed design is then ready for production immediately (Gray, 1998: 16). The CAD programme also allows the designer to get a realistic view which enables the designer to verify the intended fabric construction before production of the fabric commences.
This fabric was made on a computer-controlled knitting machine with a Jacquard inlay. It is the computer that makes possible the sophisticated blending of striped cloth with an ikat look (Braddock, 1998: 113).

iv) Sampling of fabric

The last, yet possibly the most important process is that of creating a sample length of fabric. Sampling in textile design is the process of producing only a short metre of a specified fabric design. Printing a fabric sample length of approximately 10m manually can be an expensive process compared with producing the same length of cloth by printing it digitally. Firstly the design needs to be painted on paper by hand. Secondly printing screens needs to be readied and thirdly the image needs to be printed on the cloth by hand or by machine. The above-mentioned cost can be greatly reduced with the use of digital printing equipment, which allows the designer to print the textile
design directly from the screen on to the cloth with a digital printer (Gray, 1998: 19-20). The CAD software allows the designer to:

- Produce an image,
- View the image on the computer screen,
- Adapt the garment collection,
- Change the colours of the collection and
- Print the image onto cloth directly, without having to programme huge and costly printing equipment.

Customers, who generally cannot visualize a product or design in a specific fabric, have the opportunity to see the product produced in the specified textile design.

The result is responsive manufacturing and mass customization of products. As the production of textile cloth (printing in particular) involves chemical processes, the use of digital printers improves environmental impact costs (Jacka, 2000b: 44-48).

The following is an actual working example of how CAD can change a design studio to become more competitive in the textile industry:
In “What Katie did” (Trevett, 1988: 38-39), the owner of the design studio describes how she incorporated CAD into her design studio. The concept of Quick Response (QR) influenced her decision to use CAD in product development. This proved to be the method of increasing her productivity without taking on more staff, and subsequently has led to money saved. The benefit of making use of CAD in her design studio is for her to be able to show her client the results instantly. This allows for more effective client interaction in the process of product development, as well as keeping the cost of production as low as possible. CAD has provided more flexibility in product development.

3.3 The future of CAD

Textile and apparel companies, who wish to be more successful in the market place, will have to become globally competitive. The vertical textile production plant of the future will need to integrate the areas of product development into the production unit. Information is exchanged by electronic methods, and production is computer assisted. This is referred to as Computer-Integrated-Manufacture (CIM) and can also be referred to as hands-off-manufacturing. It is a combination of electronic steps in the process of production. This means that part of the production can be done mechanically, i.e. pillowcases can be produced and packed mechanically, thus without the involvement of a machine operator. The main advantage of making use of such a system is that it allows for maximum coordination.
of the production processes, as well a centralized control of production operations (Wolfe, 1998b: 204). It is obvious that this type of process is not possible in every situation. The processes of product development, as well as most manufacturing processes needs manual input. The apparel sector of the textile industry will never be able to fully mechanize a production plant. The possibility of entering fabric on the one side of the manufacturing plant, and expecting a completed garment at the other, will never be an option. The benefit of integrating CIM into production is that it allows menial tasks to be done by machine and not operator. This allows the manufacturing plant to better utilize personnel.

Incorporating CAD and CAM systems into the process of product development and production should be seen as a possibility to increase opportunities. After all, electronic transfers are not possible from “old tool” drawing boards; the future lies in E-Design, E-manufacture and E-Retail.

Global trends such as mass customization, and E-Retailing reduce delivery times, improves service and quality, as well as virtual merchandising; all point towards an increased reliance on computer-aided systems.

(Jacka, 2000b: 44-48)

A visitor to a recent IMB show in Cologne in May 2000 mentioned that almost every piece of production equipment is connected to a computer. “In fact, every aspect of the Apparel and Textile world,
from design, production and ordering, to admin and quality control, has been taken over by computers”. (Jacka, 2000b: 45).

The conclusion that can be drawn from this is that CAD systems must play an integral part in design and manufacturing. Further implementation of CAD/CAM in product development can be observed in what is described as ‘the future trend of retailing’.

### 3.3.1 Made-to-Measure and three-dimensional body scanning

According to Terri Ross of the Computer Integrated Textile Design Association (CITDA) of the United States, there is a movement from an era of mass production of products, to that of mass customization of products; the latter would be to produce goods to an individual’s requirements (Ross, 2001c: 1).

The word lends itself to contradiction. The Oxford dictionary explains the concepts as such in the following table:
Table 3.1
Mass Customization

<table>
<thead>
<tr>
<th>WORD</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS</td>
<td>A large number or amount</td>
</tr>
<tr>
<td>MASS PRODUCTION</td>
<td>Production of large quantities of a standardized article by a standardized mechanical process</td>
</tr>
<tr>
<td>CUSTOM MADE</td>
<td>Made to a customer’s order</td>
</tr>
<tr>
<td>CUSTOMIZE</td>
<td>Make to order or modify according to individual requirements.</td>
</tr>
</tbody>
</table>

Wolfe (1998a: 441) describes *custom-made* as apparel sewn for a particular person who has ordered it, usually after seeing a sample garment, sketch or picture. This concept should not be confused with *custom-designed*. When custom-designing a garment for a customer, it would be according to his or her own design and measurements, and only one of that particular design will ever be made.

The difference in business trends between the twentieth and twenty-first century gives an indication of future business trends (Wolfe, 1998b: 475). The general concept of ‘pushing’ a product (producing a large quantity of products and flooding the market with them) has changed to that of ‘pulling’ a product (producing according to market trends). The result is that apparel manufacturers can respond faster to market trends and the needs of the consumer.
The concept *mass-customization* refers to the producing of a garment for an individual, according to the measurements of that particular individual, but based on a given prototype. Wolfe (1998b: 578) states the definition of this concept as offering “individual made items to everyone”. If the future of the Apparel Industry is then *mass-customization*, what does it entail and how can it be achieved? It has already been established that this is currently happening in the global market.

The industry belongs to those who respond the fastest to changes in the market. According to Wolfe (1998b: 473-475), this refers to flexible manufacturing and concludes that the process of product development and production should be interlinked. *Quick Response (QR)* which forces an alliance with mills and retailers are an important aspect thereof, as well as *Electronic Data Interchange (EDI)*\(^2\).

The process of allowing consumers to dictate and decide their own styles is already in practice in parts of the world. A men’s tailored suit manufacturer in France allows consumers to make the final decisions and choose the suit they would like to have produced for themselves on a website on the internet (Tailoring on the net, 1999: 27). The

\(^2\) The concept of QR and EDI are further explained in Paragraph 2.3.2: 26
consumers are given detailed directions in taking their body measurements. They then decide on their own choice of colours, fabric, fit, features and finish on the garment. The information is assessed and applied on the pattern in a software programme that changes the generic garment size to the body measurements given. The product is cut and assembled, and a number of weeks later a customized suit is delivered to the consumer. The whole process, from the initial fitting to the finished product, takes approximately twenty-one days. A similar example is available in the production of jeans in the USA. These examples are not similar to ready-to-wear collections already available in Internet shopping, where the retail store is substituted by a website.

Software solutions for the process of made-to-measure have increased. These are now designed to maximize production of apparel products, minimize the costs incurred during production of those products, improve quality, meet tight manufacturing deadlines and gain the competitive advantage. Made-to-measure also has a second advantage which is quite unique, that of direct contact with customer preferences. In future, the combination of CAD/CAM and made-to-measure could provide real winners in manufacturing. An aspect,
which is related to made-to-measure, is the concept of three-dimensional body scanning.

### 3.3.2 Three dimensional body scanning

Another aspect, which is becoming equally important, is *three-dimensional body scanning*. The application of *three-dimensional body scanning* (3D) has had an impact on both the consumer end, as well as the production end of the market (Mastnak, 2001: 1). This has lead to the development of the made-to-measure process for ready-to-wear (RTW)\(^3\) collections. This process could be the beginning of true integration of information technology (IT) into a consumer product. The client’s body will be scanned in a customized booth, with the result being a customized set of body measurements. The anthropometrical data obtained with such a scan can be used for developing the appropriate fit for made-to-measure or mass customization (What to see at IMB, 2000: 24).

In some American retail outlets, these scanning booths are located within the store. The scanned information is stored electronically, by means of a computer chip onto a ‘smart card’. The measurements can be updated when necessary. Consumers can observe new trends by

---

\(^3\) Ready-to-wear (RTW) collections are produced according to standardized size ranges and produced in volume. Collections can be produced in several cost brackets, and thus become available to a wider variety of consumers.
means of video, screens at the retail kiosk or the Internet. Upon entering the electronically captured information, the consumer can ‘virtually fit’ all selected garments. The consumer can then request certain specifications or modifications regarding fabric, fit or measurements, to be changed. When the consumer makes the final selection, the information is sent via radio frequency to an *interactive design center*. Here the adaptations and modifications on the design and patterns are performed, and the order is sent through for production. The computer generates a marker\(^4\), and the information is sent electronically to a *single ply laser cutter*. The cut parts are sent to a *flexible assembly process*. Finally it is packed and *shipped directly* to the consumer.

The garments, made to order, according to the measurements obtained during the scan, result in a well fitting collection, with the consumers having made the decision on fit. This is referred to as a *collection fit*, and could lead to a whole new business paradigm in manufacturing, distribution, and retail marketing. The concept of mass-customization can eventually change the face of retailing. Retailers might in future only offer a sample range of garments, and not rows of clothing to ‘pick-up-and-pay’.

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\(^4\) For a description of a marker and its purpose, refer to Paragraph 3.2.2 (iv): 44.
The consumer has changed from being a slave of fashion, to wanting products and styles that reflect her/his own personality (Ross, 2001e: 1).

3.4 Summary

The implementation of CAD/CAM in the industry and the future use thereof has been discussed in a global context. What needs to be established is whether the future of the South African textile industry faces similar developments in CAD-technology as is occurring in the international arena. In Chapter 4 the use of CAD/CAM in the South African textile industry is discussed.
CHAPTER 4

CAD/CAM IN SOUTH AFRICA

4.1 Introduction

The department of Trade and Industry gives the following overview of business in South Africa in general: “South Africa today is one of the most sophisticated and promising emerging markets globally. The unique combination of a highly developed first-world economy infrastructure and a huge emergent market economy has given rise to a strong entrepreneurial and dynamic investment environment, which possesses many globally competitive advantages and opportunities” (DTI, 2002: 1).

The quote implies that South Africa is in a definite growth period at present. Is this growth also visible in the use of computer technology in the textile industry or is this technology too advanced for the textile market?

In the previous chapters the influences that shape the economy as well as the global manufacturing trends were discussed in relation to the use of computer technology in the textile industry. In this chapter the South African textile industry is discussed.
4.2 The textile industry of South Africa

The following information is an overview of the textile industry of South Africa as reflected in the *Business Guidebook, 7th edition, 2002/2003*, compiled by the Department of Trade and Industry:

South Africa is a major producer of wool fibres, polyester staple fibres and man-made filament yarns. The textile industry is the 6th largest employer in the manufacturing sector, and the 11th largest exporter of goods. Approximately 300 textile manufacturers produce hosiery, knitted cloth, woven cloth and industrial textiles. The main production areas are Eastern and Western Cape and Kwa-Zulu Natal. Approximately 122 000 people are employed in the textile industry. The production capacity in the textile segment of the industry is approximately 66,000 spindles and 4,700 looms, with an average capacity utilization of 89%. The apparel segment of the textile industry produces approximately 435 million garments per annum. Sophisticated consumer demands and low-level overall consumption characterize the South African textile and apparel markets. The clothing sector of the textile industry is dependent on the demand of the consumer. Private consumption expenditure and dissuasive factors such as increased interest rates have a negative impact on the domestic market. The consumer is more likely to supplement the interior of their house or clothing with accessories during difficult economic times than buying new products. Only the products, which have completed their function and have reached the end of their useful life, will be replaced, *i.e.* the torn towel or the sock with holes.
The import of clothing still exceeds exports (Table 4.1), yet apparel manufacturers have shown an increase in exports of 11% per annum since 1997. This has resulted in export becoming a permanent feature for many firms.

Table 4.1
Import and export figures of the textile industry - 2001

<table>
<thead>
<tr>
<th>2001</th>
<th>EXPORT R million</th>
<th>IMPORT R million</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEXTILES</td>
<td>2 106</td>
<td>3 468</td>
</tr>
<tr>
<td>CLOTHING, EXCLUDING FOOTWEAR</td>
<td>2 053</td>
<td>1 981</td>
</tr>
</tbody>
</table>

SACU Trade statistics: 2001

Table 4.1 gives an indication of imports and exports of apparel and textile products in 2001. For the textile industry medium term export prospects were increased with specific trade agreements that have substantially improved market access for South African manufacturing exporters (DTI 2002: 9). These agreements include:

- FTA, Free Trade Agreement with the European Union.
- AGOA, the American Growth and Opportunity Act.
- Southern African Development Community Free Trade Agreement.

The most prominent of these trade agreements for the textile industry is the AGOA agreement with the United States of America. The Act, constituted in 2001, will allow access of duty free and quota free apparel into the United States of America. The apparel should be manufactured from fabric that has originated
from Sub-Saharan Africa. The opportunity for export is initially in place for eight
years and forms a major part of the American trade and development act (TDA)
of 2000. It aims to promote stable and sustainable economic growth and
development in Sub-Saharan Africa. This has opened a huge prospective market

After the eight-year export window, a decision will be made as to whether the
export incentive will be continued. The continuation of the export concessions
will depend on whether the initiative has produced the desired effects. These
effects should be *job creation* and upliftment of Sub-Saharan Africa. In South
Africa, in particular, the emphasis is on job creation and *upliftment of previously
disadvantaged communities*. This project has given South Africa a great
opportunity to create a reputation as a producer of textile products in the
international arena. However, to be able to do this, South African companies will
have to become internationally competitive (Jacka, 2000b: 44-48).

Jack Kiplin of the Export Council for the Textile Industry predicted in 2001 that
exports would rise gradually and would top R3, 5 million by 2003, with 15,000
jobs created in that period of time, and as many as a 100,000 jobs created over
the eight year period that the trade agreement is in place (Hood, 2001: 33).
Government policy is to (re)enter the global trading arena. This implies lowering of import tariffs. The result is that imported goods have become a major source of competition for the local apparel industry. The local market has worsened by trading practices such as dumping, smuggling, quota-busting and cheaper international products allowed into the country by relaxed import restrictions. South Africa’s location in the southern hemisphere has advantages in its seasonal differences with the northern hemisphere markets.

As in any other business, when computer technology is used correctly, it can enhance business potential and create real winners. Computer technology should be used as a ‘tool’ to be utilized to its fullest potential, and not as a ‘force on its own’ (Majewski, 2001: 34). Although South Africa is perhaps lagging in the use of internet for personal use or in business, there is no arguing that the ‘digital economy’ is here and will change the way business is conducted. Manufacturers need to get closer to their customers, the retailers, or learn to bypass them and interact immediately with the end-user. According to Majeswki (2001: 37) the use of computer technology in design will grow, and will have an impact on production.

Stephen Gray (1998: 1) mentions that the manufacturing sector of the textile industry continuously needs to strive for quicker response to a market that is demanding a better choice of-, a higher quality of- and a greater style of
product. Jack Kipling, Chairman of the Export Council for the clothing industry, often refers to the survival of the textile industry in South Africa as having to find its ‘zone of excellence’ (Jacka, 2000a: 49).

It is clear that there is potential for growth in the textile industry, especially where exports are concerned, therefore CAD/CAM will need to play a more important role in the textile industry of South Africa.

4.3 The Future Of CAD/CAM in South Africa

Richard Ashcroft of Options Systems of South Africa commented on the topic of South African companies wishing to export to first world countries, “..e-commerce will not work in the industry unless the retail, apparel and textile industries are open with each other and the pipeline is shortened. The present situation of 6-8 weeks lead-time is too long. Delivery should be shortened.” (Jacka, 2000c: 16).

Mr. Bandara of Lectra systems (SA) recently mentioned in an article that the textile industry in South Africa is in a CATCH-22 situation (Jacka, 2000b: 44). If South Africa is not competitive enough, it will not get the orders and subsequently not create new job opportunities. Yet, to be able to be competitive at an international level, companies need to invest in systems that will increase production efficiency and reduce delivery times.
This immediately poses the question whether increased use of, and investments in technology, creates job opportunities or destroys existing jobs. According to Jacka (2000b: 44-45), a certain part of the labour will become redundant, but opportunities for others will be created. Due to the expected higher production volumes the total number of jobs will increase and a greater portion of jobs will become more advanced technologically.

The Clothing, Footwear, Textiles and Leather SETA (CFTL SETA)\(^1\) identified seventeen skills priorities in 2001 (Jacka, 2000d: 41-44). This was attained through consultation with the industry, as well as providers of training. Only three of these skill areas, which are relevant to this study, are highlighted:

i) **No 6**

*Developing and using technology.* Focused learning will result in people who are able to develop new and appropriate technology. In addition, through assessing standards and qualifications, learners will be able to optimally utilize the new technology, thus increasing outputs, improving quality, reducing waste and ensuring business sustainability.

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\(^1\) SETA: Sector Education and Training Authorities. The setas were formed to fund training or workers through learnerships, and are made up of employers and employee organizations, each with a 50-50 representation partnered by a government department.
ii) No 8

*Using and implementing IT.* Learning programmes will enable people to optimize resources, developing strong communications and networks, and remain abreast with information technology.

iii) No 16

*Improving product development skills.* This initiative will focus on the acquisition of technical skill that will result in a capacity to continuously design and develop new products in the sector.

Nicola Young believes that the number of people being trained or who will be ‘up-skilled’ in the industry will increase, as will the standard of the training received, in line with the new standards developed by the National Clothing Qualities Framework (NQF) (Jacka, 2000d: 42).

If it is assumed that the textile industry is in a growth period and there is a definite need for CAD/CAM skilled labour, are tertiary institutions, and in particular Technikons, offering courses that would supply the need that has been discussed?

**4.4 Training in CAD/ CAM**

The focal point of the research in this dissertation is the need for improved CAD training.
“It is said that each half hour produces enough new knowledge to fill a twenty four volume edition of the Encyclopedia Britannica.” (Knoll, 1989: 1). This quotation can refer to the need for academics to stay abreast of computer technology in general, and especially in their chosen field of expertise. This is the only possible way to ensure that educators have the ability to provide students with the expert skill they require to excel upon entering the textile industry.

Jill Simmons (2003: 2) mentions that computer technology is a great facilitator to the changes the textile industry is facing at present. It can span geographical boundaries and drive the manufacturing process efficiently at a cost effective level. Stephen Gray explains the following regarding the need for design oriented computer literate personnel: “It does not matter how clever, efficient, or easy to use a CAD/CAM system is, the ultimate determining factor is human. Success or failure depends on people, not equipment. Ultimately, so much of the success of a company depends on its personnel” (1998: 82-89).

Training people to become literate in CAD and CAM programmes has become essential to the successful use of any CAD/CAM system. Robin Baker (Baker, 1993: 11) gives a more detailed description of the situation:

The need to educate the experts in the field of computing in art and design, and to create greater design awareness of the application of computing to all areas of study is now widely recognized. It is based on the assumption that institutions of higher education will need to be able to produce graduates who have the skill to
keep pace with the development of technology, to apply them creatively in their work, and play a role in the technological future of their particular discipline.

In Paragraph 2.1: 14, the move towards the incorporation of computer technology is referred to as the third *industrial revolution*. One can also describe the industrial revolution in the following figure. It is important to note at which level design becomes more prominent. This figure is based on an article written by Charles Owen and describes the move from product driven manufacturing to consumer driven productivity (1991: 25-26).

**Figure 4.1**
**Industrial Revolution**

<table>
<thead>
<tr>
<th>INDUSTRIAL REVOLUTION</th>
<th>INITIAL YEARS</th>
<th>PRODUCERS NEED TO PRODUCE IN QUANTITIES. ('60s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INVENTIVE</td>
<td>ENTREPRENEURS</td>
</tr>
<tr>
<td></td>
<td>MANUFACTURING</td>
<td>EXPERTISE</td>
</tr>
<tr>
<td></td>
<td>MANUFACTURING</td>
<td>EXPERTISE</td>
</tr>
<tr>
<td></td>
<td>MARKETING AND SALES STRATEGY</td>
<td>Move towards the needs of the consumer</td>
</tr>
<tr>
<td></td>
<td>BUSINESS ADMINISTRATION METHODOLOGY</td>
<td>Better management and management of operations once more places more emphasis on the production and less on the consumer.</td>
</tr>
<tr>
<td></td>
<td>DESIGN</td>
<td>Design begins to feature as a more prominent aspect of manufacture. (Late ‘80s)</td>
</tr>
<tr>
<td></td>
<td>NEW CONCEPT: DESIGN</td>
<td>A move towards quality, design innovation and design detail.</td>
</tr>
</tbody>
</table>
The world now finds itself in a post-industrial era, where the emphasis no longer is on mass-production, but rather on the needs of the market\(^2\). This has resulted in producing smaller batches more often. To be able to accomplish this in all levels of product development and production, equipment, and in particular CAD/CAM, needs to be used to respond to the faster turn-around in production.

The process of product development starts with the concept of design. CAD therefore is an integral part of design. The content of the courses in Fashion- and Textile Design, focus around the concept of product development (design). Owen describes the use of CAD as the following: “The evolution of the computer is making it possible to extend the designer’s mental as well as physical capabilities.”(Owen, 1991: 28).

The use of computer technology in design has put the concept of design into another category. The emphasis now falls on design technology and the transformation from design to design technology becomes possible through the use of computers. Firstly by means of hand skills, where the computer becomes an artist medium and secondly as an extension of the designer’s mind. This allows the designer to deal in-depth with the functional complexities of design problems relating to:

---

\(^2\) Refer to the third industrial revolution as described in paragraph 2.1: 14.
- Product performance,
- Human interaction with the product and
- Cultural aspects.

Baker also describes the use of the computer as a medium that is “...taking designers into new areas of work that require very different attitudes and skills” (1993: 142). The computer, when used only as extension of the designer’s medium, allows the designer to complete the design process with greater efficiency. However the computer should also be approached as a medium in it’s own right, and not merely as an extension of the design curriculum. In some design disciplines it could well be that the emerging digital method of design might eventually replace the traditional design discipline. An example of this can be found in the graphic design discipline, which has extended into multi-media, and has become a design discipline in its own right.

‘Out sourcing’ and ‘being mobile’ are two concepts that have become very relevant to small design studios and small to medium manufacturers. Many students, upon completion of their studies, find themselves in such small business ventures. *Outsourcing* is a new trend that has emerged over the past few years. It can be defined as making use of a specialist who is not part of the company’s permanent staff, but who can provide a service. This service can be performed either off-site or in-house. Traditionally outsourcing was only used in
the manufacturing of apparel and textile products. Manufacturers would enter into contracts with specialists to do part of their production. An example of this could be:

i) A specialist pattern maker would be contracted in only during the phase of product development.

ii) Part of the production could be sent to a cut-make-trim factory, which is only responsible for the production of the products and not for product development or the distribution of products.

iii) Certain CAM processes such as embroidery, which require specialist technology, are often outsourced.

There are already a number of CAD studios for apparel design and manufacturing, which specialize in pattern making and grading on computer. For many smaller manufacturers and design studios this has become an essential service and permits these manufacturers to compete with the larger manufacturers without having to acquire costly CAD equipment. A similar situation could arise in the design aspect of product development in the form of ‘design bureaus’.

Teri Ross in an article on free-lance design explains the importance of ‘*being mobile*’ (Ross, 2001d: 1). In the industrial age, designers were mobile enough needing only a suitcase with pencils, paper and a pair of scissors. With the
technological revolution, designers are able to do much more with the same suitcase they carry. Except now, a laptop computer allows the designer access into the whole information supply chain at the touch of a button and replaces the pencil and paper. The designer is able to be more proficient in the process of product development with links via e-mail to suppliers, data regarding consumer-buying trends and communication with the manufacturing plant.

The slow progress in the use of computer-aided-design into the fashion- and textile design disciplines has been an operational problem. Some operating conditions have changed to assist this process of integration. The *first* was the incorporation of Graphical User Interface (GUI) that allows visuals (icon on the desktop) and not only numerical text to represent information and has increased the use of the computer as a creative tool. The *second* is the pen and the mouse that compares favorably with the traditional artist tool such as the pencil, therefore software programmers have become easier to use. And *thirdly*: the cost factor. Computer systems have come down considerably in price and are no longer bulky in size. This cost aspect has always been the major stumbling block in the integration of computers into the design discipline.

Computer technology, in particular CAD, CAM, CIM have already been fully integrated into manufacturing in the textile industry. Computer technology, in
particular CAD, has also been implemented in the design curricula. Has the transfer of knowledge regarding computer technology been successful?

Educators often find themselves in a quandary. Some educators return to the academe after several years in industry. Others have been predominantly involved in training and are therefore often hesitant to enter and overlap into other fields of design, or even technology. The same methods of teaching are still implemented for the reason that they have become a good base of knowledge. This leaves the danger of not keeping up with developments in industry. It does not mean that the knowledge supplied is not feasible; it simply means that the recognized method of teaching often excludes the possibility of incorporating changes occurring in industry into the syllabus.

Not only is the training of a student concerned with supplying the correct knowledge to excel in industry, but also with preparing students to become entrepreneurs and provide work opportunities for others.

The training students receive at tertiary level should equip them with foundation knowledge of the industry they will be entering into. As a training institution, Technikon Pretoria should provide training to students, who will not only be able to hold their own in the market place, but will also contribute to the industry in a significant way. The Mission Statement of Technikon Pretoria promises, among
others, the following to a prospective student: “The Technikon is committed to
transfer relevant, cutting-edge knowledge and technology...”.

The questions that need to be asked are whether the training provided is:

a) On par with the Mission Statement of Technikon Pretoria.

b) On par with the technology as found in the textile industry.

In the 1980s most design and art disciplines were exposed to some form of
computerization. This has slowly grown. Almost all design offices in any design
discipline use a computer in one way or another. The same situation can be
observed in the educational design disciplines. According to Baker (1993: 56)
computer technology can be applied to design education in two ways.

It can either be seen to play a supporting role, thus a tool in
allowing a designer to visualize ideas or providing instruction
on how it can be manufactured.

It could become a topic in its own right, thus becoming a
subject on its own. This could eventually lead to the
development of computing, as a design discipline in its own
right. A move towards this can be seen in the start of multi-
media disciplines at educational design institutions.

It is imperative that students know the fundamentals of design on computer, and
what is used in industry. The choice by a textile designer of using a vector based
product or a raster-based product can have a varied effect on their end-result. Vector images are made by a series of lines and curves, which mathematically determine the image. The clarity of drawing is higher and can therefore produce better textile prints. Raster-based images are formed by pixels and are therefore used when manipulating a scanned image and working with a dimension drawing (Colussy, 2001: 1).

In the disciplines of Textile and Apparel Design the new tool, CAD, cannot develop to its full potential without the sound background knowledge of the old tool, pen and paper. In other words, a student needs to be knowledgeable in design and construction to be able to apply this knowledge onto the computer. The full potential of the one cannot be achieved without the other. It is easy to state that CAD education should play a more important role in fashion and textile design without giving an example of how CAD training is done at present. Therefore an in-depth look at CAD training at Technikon Pretoria in Fashion- and Textile Design needs to be performed.

### 4.5 Summary of CAD Training at the Departments of Fashion- and Textile Design, Technikon Pretoria

The Departments of Fashion- and Textile Design have, through preceding years, been able to equip students with sufficient knowledge to excel in industry. Training at both departments compare favorably with similar departments at
other Technikons in South Africa. CAD training is also incorporated in the syllabi in both departments, yet CAD is only seen as another medium to be used to complete a design. Both departments experience problems in giving training in CAD as well as changing student’s perceptions of the importance of CAD in industry today. The following section gives a description in:

- The methods used in CAD training.
- The equipment used in CAD training.
- The hours allocated towards CAD training.
- The content of CAD training at present.
- The problem areas in current CAD training.

### 4.5.1 **Department of Fashion Design and Technology**

This section discusses CAD training in the department of Fashion Design and Technology at Technikon Pretoria.

The Department of Fashion Design and Technology at Technikon Pretoria educates students in the use of CAD in design and pattern technology. The programme used for training in pattern technology and grading is Lectra. This is a dedicated apparel product development programme focusing on pattern construction, pattern grading and the preparation of a marker. Prostyle, which is part of the Lectra software package, is loaded on one computer workstation only. The cost of acquiring another software package is high. It is
for this reason that the programmes used for design and illustration are Corel Draw and Micromedia Freehand. These software packages are off-the-shelf graphic packages that can be adapted for use in apparel design, illustration and product presentation.

Note: Due to the layout of the computer laboratory, and the respective software programmes loaded on each workstation, training on the Lectra programmes is referred to as ‘Lectra training’; training in design and illustration is referred to as ‘Corel training’.

A. Current computer hardware and software used

The computer laboratory in the Department of Fashion Design and Technology consists of seven workstations. These workstations are situated in two rooms, which are adjacent to each other and are all interlinked by means of a computer network system. Four are located in room A, and three in room B. Figure 4.2 gives an overview of the layout in the computer laboratory in the Department of Fashion Design and Technology.
**ROOM A:** All four computers are loaded with the Lectra software Modaris, Diamino, and Vigiprint. The four workstations are also linked with the 2m-width fly-pen plotter and A1-digitizing table. One of the workstations has, in addition to the above-mentioned, the Lectra design software programme called Prostyle. The Lectra software operated in a Linux operating system and was acquired by the department in 1997. In January 2003 the computer laboratory was upgraded to Compaq EVO Pentium IV, to accommodate extra software and to allow the Lectra software to be converted to IBM
compatibility. Windows XP, Corel Draw, and Microsoft Office software have recently been loaded on the computer workstations. This enables the department to multi-task the computer workstations in room A. Supporting hardware in room A is an A4 HP930 colour printer and a A4 HP scanner. One Micromedia Freehand graphic software computer package will in future also be loaded on one of the computers in this room. It is the department’s intention to gradually acquire more of these software packages for each of the remaining workstations.

**ROOM B:** Allocated in this room are three Pentium III computers. Each workstation is loaded with the following: Corel Draw and Microsoft Office, and each has a CD-writer. As in room A, the workstations in this room are networked with each other, as well as with the workstations in room A. It is the department’s intention to gradually acquire more Lectra software packages for each of the remaining workstations in room B, yet the cost of each software package, even at a discounted education price, is excessive and cannot be accommodated within the normal operational budget. Additional hardware in room B is an A3/A4 Hp 1220 colour printer and an A4 HP scanner.
B. Hours allocated to CAD training

The hours allocated to creative subjects, theoretical subjects and computer subjects are outlined in the following table.

Table 4.2
Hours per week allocated to CAD training: Fashion

<table>
<thead>
<tr>
<th>SECOND YEAR SUBJECTS</th>
<th>HRS/WEEK</th>
<th>%</th>
<th>THIRD YEAR SUBJECTS</th>
<th>HRS/WEEK</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREATIVE DESIGN</td>
<td>5</td>
<td>17½</td>
<td>CREATIVE DESIGN</td>
<td>4</td>
<td>14½</td>
</tr>
<tr>
<td>ILLUSTRATION FIGURE DRW</td>
<td>2</td>
<td>2</td>
<td>ILLUSTRATION FIGURE DRW</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>TECHNICAL DRAWING</td>
<td>1½</td>
<td>5</td>
<td>TECHNICAL DRAWING</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>THEORY OF CLOTHING</td>
<td>1½</td>
<td>5</td>
<td>THEORY OF CLOTHING</td>
<td>1½</td>
<td>6</td>
</tr>
<tr>
<td>PATTERN TECHNOLOGY</td>
<td>4</td>
<td>13½</td>
<td>PATTERN TECHNOLOGY</td>
<td>4</td>
<td>14½</td>
</tr>
<tr>
<td>GARMENT TECHNOLOGY</td>
<td>5</td>
<td>17½</td>
<td>GARMENT TECHNOLOGY</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>GRADING</td>
<td>2</td>
<td>6</td>
<td>GRADING</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>CLOTHING FACTORY MANAGEMENT &amp; TECHNOLOGY</td>
<td>1</td>
<td>3</td>
<td>CLOTHING FACTORY MANAGEMENT &amp; TECHNOLOGY</td>
<td>1½</td>
<td>6</td>
</tr>
<tr>
<td>FINANCE AND ADMIN</td>
<td>1</td>
<td>3</td>
<td>MARKETING</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>COMPUTER STUDIES</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIALIZED CLOTHING TECHNOLOGY (CAD)</td>
<td>3</td>
<td>10</td>
<td>SPECIALIZED CLOTHING TECHNOLOGY (CAD)</td>
<td>4</td>
<td>14½</td>
</tr>
<tr>
<td><strong>Total hours</strong></td>
<td>30</td>
<td>100</td>
<td><strong>Total hours</strong></td>
<td>27</td>
<td>100</td>
</tr>
</tbody>
</table>
Specialized Computer Technology (SCT)\(^3\) forms a part of pattern technology and creative design, depending on the type of work performed, and is therefore an integral part of those subjects. Computer Studies is a subject taught only in second year and teaches basic computer literacy.

**C. CAD training**

This information is based on the current CAD training scenario of 2003. Student numbers reflected in this research are those of the second to fourth year students of 2003. A general intake of 35 – 40 new students is prevalent. Some students drop from the course during or at the end of the year, and some new students join the department from other Technikons or private design colleges. An average student group consists of 35 students.

**CAD training for second year students**

*Time allocated for training:*

One lecturer is responsible for both Lectra and Corel Draw training and thus the training sessions are run simultaneously. Students are divided into groups. Four students can be accommodated in a Lectra training group and three students can be accommodated in a Corel Draw training group. Three hours per week is allocated for all CAD training and each group receives only

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\(^3\) SCT is the name given to the subject that teaches specialized computer training (CAD). This includes the dedicated product development software (Lectra) and Corel Draw / Micromedia Freehand.
one hour of training. In the allocated time, twelve students receive training in Lectra and nine students receive training in Corel Draw per week.

Training in Lectra:

As shown in table 4.2, only 10% of the total weekly class schedule is allocated for training second year students on CAD. The floor space in the computer lab is limited, and it is therefore easier to accommodate only one student per workstation. The student group for 2003 consists of 36 students, resulting in nine groups consisting of four students each for Lectra training. A student would therefore only be able to make use of the allocated time of one hour of training every ninth week. By the time the student returns to the next session, students have forgotten some of the work they have learnt. Training students on the Lectra software is more intricate than on Corel Draw. The student needs to combine general computing skills with pattern construction. The relationship between computer pattern construction and manual pattern construction often takes a while to comprehend. The length of time between sessions makes this even harder for the student. The second years need to be trained in the eight basic pattern manipulation, construction and grading modules. The knowledge gained will then enable them to apply computer pattern construction and grading techniques to their work in the third year of study. The students spend too little time on the computer equipment and are therefore not able to remember much in third
year, which results in re-training. Training in Lectra can at present only skim the surface of the capabilities of the equipment. Due to time constraints in-depth training cannot be achieved. This process repeats itself in the third year of study and the result is that students do not gain enough knowledge of CAD to be able to cope once employed in industry. This forwards the problem to industry to re-train new employees, who should have had sufficient knowledge to be productive immediately, on their CAD system. As shown in the analysis of the research, this is a situation that industry wants to have rectified (refer to Paragraph 6.2.1: 124).

At present the department is trying to incorporate CAD into other subjects such as Clothing Factory Management and Technology. The cutting room module incorporates marker making and students are taught to create a marker in CAD and are given a mark on the final result. In-depth training in marker making is essential for industry. One project on marker making is therefore not enough.

The lack of time in CAD training has at present a negative influence on the student. Most second year students lose interest in the subject and do not see the value of being able to use CAD efficiently.
Training in Corel Draw:

The 36 students in second year are grouped in groups of three, and therefore receive Corel Draw training only once per term. Students are not trained in Corel Draw in the first term because the training on Lectra is much more intense and therefore needs extra time. The training on Corel Draw includes using the software to:

- Manipulate and use scanned images,
- Create lettering,
- Change / manipulate colour on images and
- Create complimentary backgrounds to storyboards and layouts.

Training in Computer Studies:

Students receive two hours basic computer literacy training per week in the subject Computer Studies. The basic training involves MSWord and Excel. The course is at present reduced to a period of 6 months and not 12 months, as most students are already computer literate when entering tertiary education. The majority of students receive computer training at secondary level. Only 10-15% of the student group is computer illiterate. Another 25% are unsure about certain aspects such as how to create a spreadsheet on Excel. Those students who are of the opinion that they have sufficient knowledge regarding MSWord and Excel are allowed to complete five projects that will test their basic computer skill level. Projects can be done in their own
time and handed in on a given date. Students who need assistance in certain areas will then attend only the session they require. This allows the lecturer to concentrate on the 15% that need basic computer literacy skills. Projects test students on document writing skills, creative word skills, the making of tables in Word, and spreadsheets in Excel. After the six-month period the allocated time can be used for Corel Draw training. Lectra will be omitted from this training period. Both rooms can be used for training, allowing seven students to be accommodated in the same hour.

The placement of this subject at second year level is not correct. Most students in their first year need the computer to complete projects. The subject Computer Studies would be more appropriate in the beginning of the first year of study as a short intensive course, or could be spread over two or three short courses throughout the first year. If students know how to operate and use Microsoft Word programmes, training on Corel Draw becomes easier. Training for Corel Draw could even start in the second half of the first year of training.

**CAD training for third year students:**

*Time allocated for training:*

For Lectra training four hours are allocated per week, with four students in each group. The third year group of 2003 is significantly smaller than in
previous years and consists of only 22 students enrolled for the subjects Pattern Technology III and Creative Design III. For Lectra training each student has one hour every sixth week. For Corel training the total third-year group is divided into groups of three, and each student receives training for one hour every seventh week. Third-year students are encouraged to use the computer in their ‘open time’. The allocated CAD training hours comprises 14½% of their total weekly tutoring hours (refer to table 4.2: 84).

*Training in Lectra:*

Students are given specific projects whereby they need to rely on the training received in second year to complete a project. Projects are related to the work completed in the design and construction subjects. An example would be the grading of patterns created for their compulsory tailoring project. Grading for the tailoring projects is also completed manually, allowing students to compare manual and computer grading. Several interim projects are also given to re-confirm the grading principles. Computer grading is also done on 40% of their open range collection⁴. The remaining 60% is graded manually. Students also learn to print full-scale graded patterns on the plotter, as well as the art of correct digitizing. Students should learn more of pattern construction on the computer, but time does not always allow for this.

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⁴ Third year students are given the chance to combine a collection of clothing (open range). The students each select their own theme for their open range.
One of the biggest problems of CAD training at Technikon Pretoria is that CAD is not seen as a separate subject in the subject structure. Marks obtained in CAD are included in other subjects and then comprise of only a small percentage of that subject. For instance grading is 20% of the total pattern technology mark. Computer grading is thus approximately 5 - 7% of the total pattern technology mark. Students do not perceive this as crucial and will therefore forfeit these marks and not attend CAD sessions.

*Training in Prostyle:*

Prostyle is a dedicated design software programme of Lectra with which students can create:

- Design specification sheets,
- Technical drawings of their designs,
- Design and/or manipulate fabric for use in a 3-D image on their designs and
- Complete final layouts.

The department has been able to acquire only one of these software programmes due to the high cost thereof. It is for this reason that the department has decided to acquire generic design software programmes, such as Corel Draw and Macromedia Freehand, which can be adapted to the needs in fashion design education. These programmes are available at a fifth
of the cost of a programme such as Prostyle. Only students that show a keen interest in broadening their knowledge of CAD are shown how to create a technical drawing. With the constraints of time and resources previously described, it becomes virtually impossible to additionally train a group of 22 students on one software programme.

*Training in Corel Draw:*
Corel Draw projects are also partly incorporated into design and illustration subjects. The objective of training on Corel Draw at the third year of training is to teach students how to use the computer for design layouts and illustrations.

**CAD training for fourth year students:**
Students can specialize in any apparel related field of interest in their fourth year of study. The computer laboratory is available to them, but it depends on their own area of specialization to what extent they make use of the facility.

The department has had one student in the past that completed 50% of her projects required for fourth year on the computer (Lectra and Corel Draw). The student had completed all design layouts and illustrations on Corel Draw, and completed all grading on the Lectra system. She was unfortunately not
confident enough to construct all the patterns required for her collection on
the Lectra system as well, and eventually opted for manual pattern
construction methods. The work completed on computer was extremely
successful. Even her Theory of Clothing subject dealt with the development
and use of CAD in the apparel segment of the textile industry. In Business
Studies she researched the possibility of starting a CAD studio from home
that would provide a service in computer pattern construction and grading for
small and medium enterprises, as well as provide training on CAD.

CAD could become a specialized area of experimentation and research for
fourth year students.

4.5.2 Department of Textile Design

This section discusses CAD training in the Department of Textile Design at
Technikon Pretoria.

A. Current computer hardware and software used

The hardware in the computer laboratory of the Department of Textile Design
consists of five Apple Mac computers, and seven Pentium II PC computers.
Supporting hardware is one A4 Umax scanner, an A3/A4 electronic tablet and
pen, and one each of the following printers:

- A4 1520 Epson Stylus colour printer,
- A3/A4 Magic Colour laser printer,
- A4 480 Epson Stylus colour printer.

The software includes Micromedia Freehand, Adobe Photoshop, Fractal Painter and Microsoft Office. The placement of the workstations in the laboratory can be seen in figure 4.3. The department has always been fortunate to have talented lecturers with extensive knowledge of CAD and its uses in design and production in the textile industry.

**Figure 4.3**

Computer laboratory in the Department of Textile Design.
B. Hours allocated to CAD training:

The hours allocated to creative subjects, theoretical subjects and the computer subject are outlined in table 4.3. In the second year of study CAD training forms part of the subject Preparatory Studies. In third year CAD training is part of the subject Textile Design Technology. At fourth year level computer training is offered as part of Textile Design Studies, but CAD could be incorporated into an area of specialization. Training at second and fourth year level is compulsory. At third year level students have the option of partaking in CAD training. Approximately 75% of the third year students (2003) have decided to receive CAD training.
Table 4.3
Hours per week allocated to CAD training: Textiles

<table>
<thead>
<tr>
<th>SECOND YEAR SUBJECTS</th>
<th>HRS/WEEK</th>
<th>%</th>
<th>THIRD YEAR SUBJECTS</th>
<th>HRS/WEEK</th>
<th>%</th>
<th>FOURTH YEAR SUBJECTS</th>
<th>HRS/WEEK</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREPARATORY STUDIES</td>
<td>7</td>
<td>19</td>
<td>PREPARATORY STUDIES</td>
<td>6</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEXTILE DESIGN</td>
<td>8</td>
<td>24</td>
<td>TEXTILE DESIGN</td>
<td>8</td>
<td>24</td>
<td>TEXTILE DESIGN</td>
<td>7½</td>
<td>23</td>
</tr>
<tr>
<td>TEXTILE DESIGN STUDIES</td>
<td>3</td>
<td>9</td>
<td>TEXTILE DESIGN STUDIES</td>
<td>3</td>
<td>9</td>
<td>TEXTILE DESIGN STUDIES</td>
<td>7½</td>
<td>23</td>
</tr>
<tr>
<td>TEXTILE DESIGN PRACTICE</td>
<td>2</td>
<td>6</td>
<td>TEXTILE DESIGN PRACTICE</td>
<td>2</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEXTILE DESIGN TECHNOLOGY</td>
<td>10</td>
<td>30</td>
<td>TEXTILE DESIGN TECHNOLOGY</td>
<td>10</td>
<td>30</td>
<td>TEXTILE DESIGN TECHNOLOGY</td>
<td>13</td>
<td>39</td>
</tr>
<tr>
<td>COMPUTER TECHNOLOGY (Part of Preparatory studies)</td>
<td>5</td>
<td>12</td>
<td>COMPUTER TECHNOLOGY (Part of Textile Design Technology)</td>
<td>5</td>
<td>12</td>
<td>COMPUTER TECHNOLOGY (Part of Textile Design Technology)</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total hours</strong></td>
<td><strong>33</strong></td>
<td><strong>100</strong></td>
<td><strong>Total hours</strong></td>
<td><strong>30</strong></td>
<td><strong>100</strong></td>
<td><strong>Total hours</strong></td>
<td><strong>33</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

C. CAD training:

**CAD training for second year students:**

The second year group is divided into two groups to accommodate all students. This enables a second year student group to attend a CAD session every second week for 2½ hours. Training in this manner can be successful, but the time lapse between training sessions is still too great. Students forget what they have learnt two weeks prior. The selected software, Micromedia Freehand and Adobe Photoshop, are sufficient in training students' basic CAD.
skills. Marks obtained for computer design are incorporated into the subjects Preparatory Studies, Textile Design and Textile Design Technology.

**CAD training for third year students:**

The department has decided that for this year (2003), due to the large student group (29 students), the third year group will be given the option of CAD training, thus not making it a compulsory part of the subject. The remainder of the group is divided into two, and each student attends a CAD training session for 2½ hours every second week.

Despite exposure to industry demands students do not seem to be fully aware of, or interested in, the importance of CAD in the textile industry. Industry requirements point to the use of CAD as important and students should not ignore the opportunity to develop their skills. Marks obtained for computer design is combined with the subject Textile Design, as students need to complete part of the design manually.

**CAD training for fourth year students:**

Students make use of the CAD system in their selected area of specialization, where required, but the use of CAD is optional. Marks obtained, where applicable, are incorporated into Textile Design and Textile Design Technology. Students are also given an in-depth training on Microsoft Office
to assist them in the writing of their essays (part of the subject Textile Design Studies IV).

The information that has been described in the preceding sections (4.5.1 and 4.5.2) has highlighted several positive aspects of CAD training in both departments. The content of CAD courses is extensive, yet several problem areas exist.

4.5.3 Addressing the problem areas in current CAD training

The following are problem areas highlighted by the lecturers involved in CAD training at the respective departments of Fashion- and Textile Design at Technikon Pretoria.

i) The number of workstations per student group per year

The total fashion student population in an average year that needs access to CAD equipment is approximately 85, and for the textile department approximately 80 per year. Table 4.4 shows the estimated student groups who need access to CAD training per year.
The workstations currently provided are not enough to sufficiently train students. The current student workstation ratio is:

- Department of Textile Design and Technology: One workstation for every seven students.
- Department of Fashion Design and Technology: One workstation for every 12 students.

Computer technology is, as any construction subject, a subject that needs constant re-enforcement. Students can only obtain computer knowledge through repetition. The cost in acquiring workstations and supporting software is the deciding factor, and development of the computer laboratories has been a slow process.
ii) **Allocated hours for CAD training**

The time allocated by both departments towards CAD training is at present insufficient. This is a direct result of an inadequate number of workstations per student group available for training. Students tend to lose interest in the subject. In the Department of Fashion Design and Technology the computer laboratory is available for use every day of the week, yet students, due to lack of training, have not felt confident to use the equipment on a regular basis.

The computer laboratory in the Department of Textile Design is only available during scheduled lecturing hours when the CAD lecturer is available, as students are only allowed to work under supervision. To be proficient in computer work, each student needs to work on the computer once a day, or at least, twice per week.

iii) **CAD as a separate subject**

CAD is currently not structured as a subject in its own right, and forms a small component of other subjects. For example CAD grading forms part of grading in general. Grading forms part of the subject Pattern Technology, and only constitutes 20% of the total Pattern Technology mark. Students therefore often do not see the necessity for CAD and in some cases would
forfeit the mark obtained in CAD. This problem is heightened by the current student ratio per workstation.

Emphasis should also be placed on integrating CAD subject matter into other subjects. Students need to realize the relationship between manual and computer processes. Students would still be required to learn the basic design and construction skills manually. All CAD programmes are of no use if students do not understand the process of pattern construction or changing the colour-ways of a design. A comment made by Tierry Ross is: “...any CAD software is only as good as the operator who runs it.’ (Ross, 1999: 3).

iv) **CAD software programmes**

There are several generic design software programmes available on the market, as well as other dedicated design software programmes. Training on these generic programmes are equally essential as a student starting her/his own design studio from home would only be able to afford these types of programmes. Yet if training on CAD is to be successful, sufficient exposure to dedicated programmes such as Stork, Prostyle or Fashion Vision become essential as well.
4.5.4 Comments made by Alumni currently working in industry using CAD in product development

To determine whether the perceptions regarding current training are correct, informal interviews were held with two Alumni currently employed in the industry. Both were employed directly upon completing their qualifications, and were given positions where using CAD for product development was paramount. One Alumna obtained a Diploma in Fashion Design and Technology, and the other a Diploma in Textile Design and Technology.

The interviews were held telephonically and Alumni were asked about their experience in their respective working environments. The objective of the questions asked, was to establish if the CAD training they had received had been sufficient. The first interview was with an Alumna currently working at a local manufacturer of ladies apparel:
The Alumna has been involved with the process of generating new patterns on a CAD programme for the past two years. These are her comments:

1. The Cad training she received did help her in her work, yet it was only basic training and not in-depth enough. The training she received was not enough for her to be confident in computer grading tasks given by her employer.

2. The student mentioned that the use of CAD in product development is definitely increasing, and that the CAD training she received at tertiary level gives her an advantage over students who have not received CAD training.

3. Her biggest concern was the lack of proof of her training. She currently has two years industry experience in CAD, but not a diploma or certificate to show that she has received such training. The CAD training is a component of the subject Pattern Technology, and is therefore not mentioned on the diploma students receive. This situation is highlighted in 7.3.3.

The second interview was with an Alumnus currently working at a studio specializing in ceramic tiles. His previous experience with using CAD in a working environment was at another surface design company, specializing in crockery:
The alumnus has been involved with surface designs on computer:

Although as a student, he received basic CAD training once per week, he admits not giving full attention to the training because he did not perceive the computer training to be as important as the other subjects. This meant that he basically knew nothing when starting at his first employment. Although the company allowed designing by hand, design on computer was just so much faster.

He mainly had to work on Adobe Photoshop and Freehand on PC. He was fortunate to receive help from a fellow alumni working at the same design studio, but it took three months to really be able to work at pace.

He has since moved to another design studio and is yet again working only on CAD. He is working mainly on Adobe Photoshop and Freehand, on an Apple Macintosh computer. Asked which he prefers, the answer was a definite ‘Apple Mac’. He experiences less screen freezing problems and can work at a much faster pace.

The type of work he needs to do at his present employment is much more fine art oriented, whereas the work done at the previous studio was of a more graphic design nature.

He expressed the same concern as the alumni fashion student regarding the lack of proof of training.
4.6 Summary

Training in CAD at the Department of Fashion Design and Technology and the Department of Textile Design has been partially successful. CAD training has been implemented, yet several problem areas have been highlighted. These problem areas were confirmed with the informal interviews conducted with Alumni currently working in a CAD-related environment in industry.

The computer definitely does not inhibit the creative thought process, nor narrows the creative possibilities, nor constrains it. The usage thereof must rather be seen as an advantage, and an essential medium, which can be used to complete and speed up the process of design.

Additionally, considering the development and use of computer technology at all levels of manufacturing in the textile industry, one has to see the necessity for training students to the fullest use of the equipment. This will enable designers to succeed in the rapidly developing technological industry they will enter. The computer, and use thereof, cannot merely be seen as another option or method of design. More emphasis must be placed on the use of the computer as a topic, a tool of the future, and the role that product development on computer has to play in the manufacturing process.
In chapter 5 the research is structured as such to determine the use of CAD/CAM in the textile industry in South Africa, and the training students studying in the disciplines of fashion- and textile design at Technikons in South Africa receive in CAD/CAM.
CHAPTER 5

RESEARCH

5.1 Introduction

During the previous chapter the growth in the textile industry in South Africa was discussed. This has resulted in the continued implementation and integration of CAD/CAM systems in fashion- and textile design and manufacturing. The move towards implementing computer technology has also resulted in a need for CAD training in tertiary education. The use of CAD already forms part of the curriculum in fashion and textile design in Technikon education. The research conducted in this study needs to prove that the training the student currently receives is on par with developments in the industry.

The purpose of this chapter is to report on the research environment, the population and sample, and the research method used in the empirical study. The results of the investigation will be reported in Chapter 6.

5.2 Research Environment

The empirical study was conducted in the textile design and manufacturing environment, consisting of three components, namely the:

- Apparel design and manufacturing component;
- Textile design and manufacturing component; and
- Specialized computer-training component.
The difference in nature in each of these environmental components demanded a different research approach.

The CAD systems used for apparel design and manufacturing, are predominantly dedicated systems. Only three CAD systems were selected for the research for the apparel design and manufacturing component. Although several other dedicated CAD systems are also used by the industry, these three specific CAD systems were selected as these systems are currently used for CAD training at Technikons in fashion and clothing production courses.

In the textile design and manufacture component of the textile industry, it was decided not to concentrate on a specific dedicated CAD system. There are dedicated systems in use in industry, but the training at present is done on generic CAD software programmes such as Adobe Photopaint and Macromedia Freehand. The dedicated systems available for use in industry are too costly to acquire for training purposes.

In the third component, specialized computer training, only Technikons offering three specific courses were included in the research structure. The courses included offer training relevant to fashion design, textile design and apparel production.
5.3 Research

5.3.1 Apparel design and manufacturing component

The apparel design and manufacturing component of the textile industry consists of two areas. In the first area prominent suppliers of dedicated CAD and CAM software and hardware that distribute their products throughout South Africa were identified. Three of these suppliers were identified for the purpose of this study, as these suppliers supply CAD systems that are predominantly used by Technikons offering the selected courses in Fashion Design and Technology and Clothing Production.

In the second area three geographical regions where apparel manufacturing is most likely to occur were established. The following table shows the distribution of ladies-wear manufacturers in South Africa. In this product category a total of 340 manufacturers are listed.

Table 5.1
Distribution of ladies-wear manufacturers in South Africa

<table>
<thead>
<tr>
<th>GAUTENG</th>
<th>CAPE (Includes Eastern and Western Cape)</th>
<th>KWA-ZULU NATAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>120</td>
<td>70</td>
</tr>
</tbody>
</table>

**TOTAL: 267**

Statistics taken from the Pursuit 2001 list of companies.

The three most prominent apparel-manufacturing regions in South Africa where apparel design and manufacturing is most likely to occur were
selected, namely: Gauteng, Cape, including Western- and Eastern Cape, and Kwa-Zulu Natal.

**5.3.1 Textile design and manufacturing component**

The textile design and manufacturing component of the textile industry consists of specific companies who use dedicated CAD software or off-the-shelf CAD products for their product development processes. These companies represent textile design and textile manufacturing in South Africa.

**5.3.3 Specialized computer-training component**

Tertiary education (also referred to as higher education) refers to all institutions that offer education that follows secondary education. These institutions include Universities, Technical colleges, Technikons and private providers of higher education. For the purpose of this study it was decided to concentrate on all Technikons in the tertiary education sector of South Africa offering the following courses:

a) Textile Design.

b) Fashion Design and Technology

c) Clothing Production.
5.4 Research Population And Sample

5.4.1 Apparel design and manufacturing:

The population of the apparel design and manufacturing component consisted of all manufacturers currently using CAD/CAM systems supplied by three specific CAD/CAM technology suppliers in South Africa. The three CAD systems (in alphabetical order) are:

- Gerber, supplied by Intamarket.
- Lectra, supplied by Lectra systems of SA.
- Polygon, supplied by Midcomp.

Each of the above-mentioned suppliers of CAD technology, supply CAD and CAM software packages relative to product development, product presentation and manufacture. The above-mentioned suppliers sell CAD/CAM technology to apparel manufacturers in the selected geographical regions of South Africa.

The following table shows the distribution of apparel designers and manufacturers using CAD/CAM systems from the three identified suppliers in South Africa.
Table 5.2
Distribution of apparel designers and manufacturers using CAD/ CAM

<table>
<thead>
<tr>
<th>CAD/ CAM supplier</th>
<th>GAUTENG</th>
<th>CAPE (Includes Eastern and Western Cape)</th>
<th>KWA-ZULU NATAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERBER</td>
<td>6</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>LECTRA</td>
<td>21</td>
<td>17</td>
<td>44</td>
</tr>
<tr>
<td>POLYGON</td>
<td>6</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

Statistics reflect information received from suppliers in 2001.

The three CAD/CAM suppliers were approached and asked for permission to access their client list for the three identified prominent geographical manufacturing areas in South Africa. These apparel designers and manufacturers are currently using CAD/CAM equipment for product development and production.

The following figure illustrates the population of the apparel design and manufacturing component and the method by which the sample was selected.

Figure 5.1
Apparel component population and the quota sample method
A quota sampling method was used to select the sample. Quota sampling is a simplified form of stratified random sampling. The method amounts to the formation of cells (or homogenous sub-populations) by using control characteristics for which the figures of the population are available. The sample sizes can be taken from each cell, and sample elements are then collected at random (Steyn, 1999: 39).

The apparel design and technology component consisted of nine organizations selected from each software supplier, three from each specified geographical region. A table of random numbers was used to select the manufacturers. A total of 27 manufacturers were selected. Only three Polygon users are situated in the Cape region. One of the selected candidates could not be reached, and subsequently only two manufacturers were approached. Of the initial 27 selected manufacturers, only 26 were contacted. Table 5.3 gives an indication of the number of manufacturers selected from each region.

**Table 5.3**  
Companies selected for the apparel design and manufacture sample

<table>
<thead>
<tr>
<th>Region</th>
<th>Gauteng</th>
<th>Cape</th>
<th>Kwa-Zulu Natal</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERBER</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>LECTRA</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>POLYGON</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
5.4.2 Textile design and manufacturing

The population of the textile design and manufacturing component consisted of manufacturers who have an established relationship with the Department of Textile Design of Technikon Pretoria. They allow the students of the department into their production environment as visitors, or as new recruits. These manufacturers are familiar with the level of expertise of the student who finishes his/her course in the Department of Textile Design at Technikon Pretoria. These manufacturers produce a variety of textile products.

The types of CAD and CAM systems used by the textile segment of the textile industry vary greatly. A number of generic graphic design computer packages are also used. No specific CAD systems, dedicated to the textile segment of the textile industry, or suppliers of CAD and CAM systems were identified, as opposed to the case with the apparel design and manufacturing component. The computer technology that the textile design and manufacturing population use is a good representation of the type of CAD equipment currently in use by the textile industry at large. It is also the computer-related design and production environment the students of the Department of Textile Design of Technikon Pretoria could find themselves in, on completion of their studies. These organizations represent textile design, surface design and textile manufacturing; and include large, medium and small manufacturers.
The following figure illustrates the population of the textile design and manufacturing component and the sampling method.

**Figure 5.2**

*Textile component population and the purposive sample method*

A *purposive sampling method* was used for selecting the sample for the textile design and manufacturing component. This method allows the researcher to identify the selection based on the knowledge the researcher has of the population (Brink, 1990: 102). The segment of the population was chosen based on the relationship these design studios and manufacturers have with the Department of Textile Design at Technikon Pretoria. The sample therefore consisted of fourteen specific textile design studios and textile manufacturers. Table 5.4 gives an indication of the number of manufacturers selected and the region in which these design studios and manufacturers are situated.
Table 5.4
Companies selected for the textile design and manufacture sample

<table>
<thead>
<tr>
<th>Region</th>
<th>Gauteng</th>
<th>Cape</th>
<th>Kwa-Zulu Natal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of manufacturers per region</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

The majority of manufacturers are in the Gauteng region.

5.4.3 Specialized computer-training

Technikons in South Africa that offer courses in fashion and textile design were considered to represent tertiary education. The segment of the population selected for the sample consisted of Technikons where the specific fashion and textile design courses are presented in the departments of Fashion and Textile Design. These courses are:

- Fashion Design and Technology;
- Production Technology; and
- Textile Design and Technology.

The Departments of Fashion- and Textile Design were the population for the training component for the empirical study. The following figure illustrates the population of the specialized computer-training component, and the sampling method.
One or more of the above-mentioned courses are offered at the selected Technikons. As in the textile design and manufacturing component, a *purposive sampling method* was used. The selected Technikons (in alphabetical order) are:

- Border Technikon
- Cape Technikon
- Durban Technikon
- Eastern Cape Technikon
- ML Sultan
- Peninsula Technikon
- PE Technikon
- Technikon North-West
- Technikon Witwatersrand
Table 5.5 gives an indication of the number of departments offering the three specified courses at Technikons that are selected and the regions in which these Technikons are situated.

**Table 5.5**
Departments selected for the specialized computer-training sample

<table>
<thead>
<tr>
<th>COURSES</th>
<th>Fashion Design and Technology</th>
<th>Textile Design</th>
<th>Clothing production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauteng</td>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Cape</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Kwa-Zulu Natal</td>
<td>2⁺</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

5.5 Research method

The survey was conducted by directly approaching the companies or departments in the various research samples. A specified contact person was established in all companies and/or departments. The interview schedule was forwarded directly to the identified contact person, via Internet or facsimile. This method of survey was possible due to the low number of interviewees. A 100% response rate was achieved. All interview schedules were sent out in January and February 2001. Once the correct contact person had been determined, the person was approached telephonically. Background information and an

---

¹ When the research was conducted, the merging between ML Sultan Technikon and Durban Technikon had not yet taken place. They are therefore in this dissertation seen as two separate Technikons.
explanation on the nature of the research were disclosed. Figure 5.4 describes
the method of interviewee selection in the form of a flow diagram.

![Figure 5.4
Flow diagram of interviewee selection](image)

All interview schedules were personally addressed with a cover page containing
the following:

- Instructions on which sections the interviewee needed to complete.
- Method of returning interview schedule, either by e-mail or facsimile.
- A return date.
- Return contact details.

A few interview schedules were not returned in the specified time. These
companies/departments were contacted telephonically. When no response was
received after requests to return the interview schedule, the interviewee was
contacted and together with the interviewer, the interview schedule was completed telephonically.

5.6 Interview Schedule

5.6.1 Compilation of the interview schedule

All three sample segments used the same interview schedule. The schedule was divided into four (4) sections, and each section was colour coded. The four sections were:

- **GENERAL**
  This section needed to be completed by all interviewees, and contained information regarding geographical location, market segment and name of the company or institution and the respondent. Questions included no 1 - 4.

- **SECTION A**
  This section contained information for the apparel design and manufacture component, and needed to be completed by all selected companies in the apparel sample. Questions included no 5 - 15.

- **SECTION B**
  This section contained information for the textile design and manufacture component, and needed to be completed by all companies in the textile sample. Questions included no 16 - 25.

---

2 For a copy of the interview schedule please refer to Appendix 1: 168
All departments in the training sample completed the training section. Questions included no 26 - 36.

### 5.6.2 Objective of the interview schedule

The questions in each of the sections of the interview schedule were focused on obtaining the following information:

- The type of CAD related computer hardware and software the textile industry is currently using.
- The length of time the selected manufacturers have been using CAD equipment.
- The training the CAD operators have received.

In section C (training) additional relevant questions regarding the training on CAD equipment were asked. These included:

- How many hours per week trainees receive training on CAD.
- How effective the CAD training is.
- How effective the training institution has been in placing students in CAD related positions in the textile industry.

The questions asked in the interview schedule for all three sections can therefore be divided into three categories. These categories are:

A. CAD hardware and software.

B. Qualifications and training of CAD operator.

C. Training in CAD.
The following table shows which questions were asked of all three segments, and which questions were directed towards the training segment in particular.

Table 5.6  
Categories of interview schedule questions

<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>APPAREL</th>
<th>TEXTILES</th>
<th>TRAINING</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOGRAPHICAL AREA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What type of system do you use</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>How long have you used this system</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Are you satisfied or not</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Reasons - if not</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>CAD SOFTWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What type of software do you use</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>How long have you used this software</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Are you satisfied or not</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Reasons - if not</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>The qualifications of the CAD operator/trainer</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>CAD related training the operator/trainer has received</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Level(s) of students which receive training in CAD</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Number of hours the students receive CAD training</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Are the number of hours enough</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>If not how many should it be</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>In what subject is CAD incorporated</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>Problems with CAD training</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
<tr>
<td>How many students are placed in a CAD related working environment</td>
<td>🌞</td>
<td>🌞</td>
<td>🌞</td>
</tr>
</tbody>
</table>

The research aims to provide answers to CAD training in particular, a number of questions are therefore directed only towards training.
5.7 Conclusion

All the manufacturers and training institutions that were approached were extremely helpful, giving more information than was required in the interview schedule. The analysis of data collected with the Interview Schedule as research instrument will be discussed in Chapter 6.
CHAPTER 6
RESULTS

6.1 Introduction

In Chapter 5 an overview was given of the various populations, for each of the components of the Textile and Apparel Manufacturing Industry, the sampling method, the research instrument and the data acquisition process. In this chapter the results of the research are discussed.

The discussion of the data analysis is divided into three categories to meet the research need stated in Chapter 1.3:

- CAD hardware and software
- Qualifications and training received by CAD operators in industry
- Training in CAD at Technikons in the three specified courses (refer to Chapter 5.3.3: 108) at present.

6.2 CAD Hardware and Software

The analysis of the computer hardware and software used in industry is divided into three sections. These are the apparel design and manufacturing section, the textile design and manufacturing section and the specialized computer-training section.
6.2.1 CAD hardware and software in apparel design and manufacturing

In this section the CAD hardware and software used by the companies interviewed in the apparel design and manufacturing component are discussed.

Questions 5 – 13 dealt with the use and approval of CAD hard- and software by the selected companies in the apparel design and manufacturing segment. Questions 5 – 8 dealt in particular with CAD hardware used. The three CAD systems identified in the interview schedule were Lectra, Gerber and Polygon. The graph in Figure 6.1 shows the usage of each of these systems by the apparel design and manufacturing sample. The graph shows the following:

- Lectra is illustrated at 38%;
- Gerber at 35%; and
- Polygon at 23%.

Interviewees were given the option to list systems not specified in the interview schedule. The system Padd listed in the interview schedule was not selected and therefore shows as 0%. Another system, Assyst, used by apparel manufacturers was identified, and its use in the selected population shows as 4%.
Almost all companies in the research sample are satisfied with the systems they are operating at present, and would not like to change from the system that they are currently using. The graph in Figure 6.2 shows 88% approval of the CAD systems the companies are currently using.

A comment made by one of the companies is that the Gerber system is better in marker making, and the Lectra system better in pattern making. The Polygon system is a good basic system, yet not as versatile and user friendly as the other two systems that were investigated.
Questions 9 – 12 dealt with the CAD software used by the manufacturers. The CAD software programmes identified in the interview schedule are the programmes associated with Lectra, Gerber and Polygon. The graph in Figure 6.3 shows the usage of each of these systems by the apparel design and manufacturing sample:

- Two Lectra software programmes Modaris and Diamino - 34%, and Prostyle - 4% are indicated as being used by the majority of manufacturers in the selected population of the research. Modaris is the programme in which pattern construction and grading is completed, and Diamino the section of the software programme in which marker making is completed. Prostyle is a product presentation programme.

- Accumark, the Gerber software programme in which pattern construction, grading and marker making is completed, shows as 35%.

- The Polygon software programme used for pattern manipulation, grading and marker making, is used by 23% of the selected sample.

An additional software programme, Assyst - 4%, has also emerged from the analysis. Two other product presentation software programmes Prima Vision and Fashion Vision, listed on the interview schedule show as 0%, and are therefore not used by the apparel companies in the selected sample.
Question 13 asked the selected companies for how long they had been using CAD. It is interesting to note that 73% of the interviewees have already been using CAD systems for the past 10 years. A further 27% have been using CAD systems for longer than 10 years. One manufacturer has been using a CAD system for approximately 20 years (Figure 6.4).

The analysis of Figure 6.4 shows the following:

- Thirty eight percent of the apparel manufacturers interviewed have been using CAD between one and five years;
Thirty five percent of the apparel manufacturers interviewed have been using CAD between five and ten years; Nineteen percent of the apparel manufacturers interviewed have been using CAD between ten and fifteen years; and Eight percent of the apparel manufacturers interviewed has been using CAD for more than fifteen years.

One of the most significant comments made was that computer knowledge is essential when training students; manufacturers should not have to do the training.

6.2.2 CAD hardware and software in textile design and manufacturing

In this section the CAD hardware and software used by the companies interviewed in the textile design and manufacturing component is discussed.

Questions 16 – 22 dealt with the use and approval of CAD hard- and software by the selected companies in the textile segment. The interview schedule identified no specific CAD system for use by textile manufacturers. For this reason a much wider variety of CAD hardware and software used by the textile manufacturers, emerged from the analysis.
Questions 16 – 19 dealt with CAD hardware used by textile manufacturers. One interesting aspect is that the use of Apple Macintosh based computers is less than the use of Personal (PC) based computers (Figure 6.5). The Apple Macintosh-based products are in general used by almost all applied design disciplines, such as Graphic Design and Photography. The work performed on an Apple Macintosh computer is of better screen clarity with regard to quality of completed work. Yet the cost involved with acquiring an Apple Macintosh is much higher than the cost involved in acquiring a PC. The PC is IBM compatible and Windows based, and this operating system allows for greater product variety. PC based computer work can therefore be used by home design studios. Even a training discipline such as graphic design currently trains students on both Apple Macintosh and PC. One comment made was that the after-sales-service support the provider of Apple Macintosh hardware and operating systems gives is very good.

Figure 6.5
CAD hardware used in textile manufacturing

<table>
<thead>
<tr>
<th>CAD hardware used in textile manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned system</td>
</tr>
<tr>
<td>Dedicated system</td>
</tr>
<tr>
<td>Apple Mac</td>
</tr>
<tr>
<td>PC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>14%</th>
<th>14%</th>
<th>29%</th>
<th>43%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple Mac</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In Figure 6.5 the use of Apple Macintosh computers represents 29% and the use of PC represents 43%. The use of a dedicated textile CAD system and a commissioned CAD system is shown as 14% each. Mention is made by the selected manufacturers of the use of a dedicated textile CAD system, Stork. This is the only system that can accommodate the laser engraver used for engraving screens in textile printing. It is interesting to note that Stork 4000 is currently also moving to rewrite their product to IBM compatibility, thus allowing the product to be run on a PC.

Questions 20 – 23 dealt with CAD software used by textile manufacturers. Question 20 (Figure 6.6) reveals that the companies interviewed selected only two possible answers in the interview schedule. One textile company in the selected sample uses a CAD software programme, Gerber - 8%, generally used in apparel design and manufacturing.

![Figure 6.6](image_url)

**Figure 6.6**

**CAD software in textile manufacturing**

![Pie chart showing percentages of CAD software usage: Gerber 8%, Dedicated system 17%, Other 75%]
The software programmes listed on the interview schedule were not selected by any of the textile companies who completed the questionnaire. These are Prostyle, Prima Vision and Fashion Vision.

Seventeen percent indicate the use of a dedicated textile software programme and 75% a variety of other software programmes. Figure 6.7 shows which programmes are specified.

![Figure 6.7 Other CAD software programmes used](image)

The 34% (Figure 6.7) indicates the use of the dedicated textile software programme Stork 4000. The remaining percentages shown repeatedly as 11% indicate the use of general software programmes. The programmes are graphic design software programmes and include Adobe Photoshop, Macromedia Freehand, Nedgraphics, Dorstyle, Corel Draw, or a combination of the afore-mentioned. These programmes can be adapted to suit the need
for textile design. One other programme that is mentioned is *Info Design*, a software programme specifically developed for use in textile design.

The interviewed textile companies repeated the same comment made by apparel manufacturers regarding re-training of new employees on a CAD system. Companies cannot afford to take the responsibility of spending extra time and money in training students on CAD. This should be the responsibility of training institutions.

In questions 17 and 22 the interviewed companies were asked if they were satisfied with their current choice of CAD hardware and software. Both questions showed an 86% positive response to these questions.

In the textile section of the interview schedule, the question related to the length of time the company had been using a/several CAD system(s) was not included. This information could have been valuable in determining the length of use of CAD systems in the industry.

### 6.2.3 CAD hardware and software used in training

In this section the CAD hardware and software used by the departments in the selected Technikons interviewed in the training component is discussed.
In the training component of the interview schedule, the question regarding
the type of systems used was not included. An informal interview was held
telephonically with each department in the training sample to determine the
following:

a) The number of work stations at each department and
b) The type of systems used.

The result of these informal interviews showed that the dedicated CAD
systems used in training fashion students are Lectra, Polygon or Gerber.
Other software programmes such as Adobe Photoshop, Macromedia Freehand
and Corel Draw, are used in training fashion and textile students. The
systems on which training is conducted relate to the CAD systems the
industry uses.

### 6.3 Training and qualifications of CAD operators

The questions discussed in this section relate to the skills-related qualifications
the CAD operators working on the CAD equipment have, as well as the training
these operators have received to enable them to work on the CAD equipment.
The three categories were asked the same questions regarding qualifications and
CAD training.
6.3.1 Training received by CAD operators

In this section the training the CAD operators received to enable them to operate the equipment is discussed.

Questions 15, 25 and 36 dealt with the training operators received to enable them to operate the CAD system. In question 15 the CAD training operators working in apparel manufacturing had received, was asked. The operators who completed the interview schedule (Figure 6.8) show that 58% indicate having received training from the CAD hard- and software supplier, whereas only 15% of the employees working on the CAD equipment had received training from other CAD operators (predecessors). Another 8% have taught themselves on the CAD system.

Figure 6.8
Operator training: Apparel
Nineteen percent have received a combination of general computer training, self-training, training by the CAD supplier and training received from the employee working on the CAD programmes before them (predecessor). None of the interviewed CAD operators have received CAD training from a Technikon.

Question 25 dealt with the CAD training operators working in textile design and manufacturing, had received. Forty two percent of the interviewees indicate having received training from a CAD supplier, 8% received training from a Technikon, and an equal percentage have taught themselves, as illustrated in Figure 6.9. For the remaining 42% of interviewees, training was received from previous CAD operators (predecessors) or they taught themselves.

Figure 6.9
Operator training: Textile
Figure 6.9 indicates that more employees in the textile design and manufacturing component have previously received training from a Technikon than employees in the apparel design and manufacturing component.

Question 36 dealt with the CAD training operators, working in the training section, have received. Fifteen percent of the interviewees in the training segment (Figure 6.10) did not respond to the question. Fifty four percent of the interviewees received training from the supplier of CAD equipment. Training received from a Technikon or having taught him- or her selves both show as 8%. The remaining 15% indicated that they received general computer training.
6.3.2 Qualifications of CAD Operators:

In this section the background qualifications the CAD operators received to enable them to perform their duty is discussed.

Questions 14, 24 and 35 dealt with the qualifications of the operators currently operating the CAD system. In question 14 the principal professional background of CAD operators in apparel design and manufacturing is pattern construction (37%), and garment construction (12%). Figure 6.11 also indicates that 12% of the interviewees have an overall fashion design background. Another 8% have a professional background in Production Technology, and 4% indicated not having received any formal apparel-related training. The predominant qualifications of the remaining 27% indicate having background knowledge of pattern construction.

Figure 6.11
Qualifications CAD operator: Apparel
In question 24 the analysis of the qualifications of CAD operators in the textile section (Figure 6.12) show as 75% having a textile design professional background, and a further 8% as having a production background. The remaining 17% did not respond to the question.

![Figure 6.12](image_url)

Question 35 discloses that the qualifications of the CAD trainers in the training section vary. Lecturers often need to teach several subjects within a discipline. In Figure 6.13, 15% of the trainers did not answer the question. Eight percent have a predominantly professional background in pattern construction, 8% in textile design, 39% in fashion design and a further 15% in art (referred to as other in Figure 6.13). Fifteen percent did not specify their qualifications. All lecturers do need the discipline-related qualifications to be able to lecture. It can therefore be assumed that the 15% of the interviewees have a combination of qualifications of the possible given answers in the question.
The data analyzed in this section shows that all operators of CAD equipment have either a fashion- or textile design related background to enable them to complete tasks in their teaching, and design and manufacturing-working environment.

### 6.4 Training in CAD

The questions discussed in this section all relate to CAD training currently given to students in the three specified courses (refer to chapter 5.3.3: 109) in the departments of Fashion- and Textile Design at Technikons in South Africa.

Question 26 investigated in which year students receive CAD training whereas questions 27 – 29 examined the allocated time for CAD training.
The data obtained showed that CAD training is generally taught from second year level onwards and is supplemented with short courses. These short courses are given to compensate for lack of time spent on training on CAD. Sixty one percent of the interviewees are able to train students up to three hours per week. Thirty nine percent of the interviewees mentioned that they are able to train students for ten hours per week. As shown in Figure 6.14, only 8% manage to spend more than 10 hours per week on CAD training.

**Figure 6.14**

Hours per week used for CAD training

<table>
<thead>
<tr>
<th>Hours per week used for CAD training</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 10 hours</td>
<td>8%</td>
</tr>
<tr>
<td>7-10 hours</td>
<td>23%</td>
</tr>
<tr>
<td>5-7 hours</td>
<td>8%</td>
</tr>
<tr>
<td>1-3 hours</td>
<td>61%</td>
</tr>
</tbody>
</table>

It is interesting to note that almost a third of the interviewees feel that the time allocated is not sufficient for appropriate CAD training, and that students do not gain enough experience. The following question (question 29) asked how many hours should be allocated to CAD training. It can be noted in Figure 6.15 that most interviewees would prefer a minimum of 7 hours training per week.
Twenty three percent of interviewees did not indicate what the allocated training hours for CAD should be. The following is the analysis of the number of hours that should be allocated to CAD training as suggested by the interviewees:

- Thirty one percent of interviewees would like to spend between one and three hours per week on CAD training;
- Fifteen percent feel that between three and five hours is needed for CAD training;
- Eight percent of interviews would like to have up to seven hours per week for CAD training; and
- Twenty three percent require more that ten hours per week.

It is interesting to note that only one third of the interviewees recognizes the need for in-depth training.
Question 30 showed in which subject CAD is incorporated. Fifteen percent of the interviewees did not indicate in which subject CAD is incorporated. At present CAD forms part of Pattern Technology (31%), and Creative Design (15%).

![Figure 6.16 (a) Subjects in which CAD is incorporated](image)

The remaining 39% of interviewees named other subjects that were not specified in the given answer possibilities (Figure 6.16(b)). These subjects are:

- Clothing Management and Technology (44%);
- A combination of Creative Design and Drawing and Illustration (14%);
- Drawing and Illustration (14%);
- A combination of Pattern Technology and Creative Design (14%); and
- Production Technology and Organization (14%).
It is interesting to note that 58% of the interviewees have listed CAD training under the theoretical subjects (Figure 6.16(b)). These subjects include Clothing Management and Technology, and Production Technology and Organization. An assumption can therefore be made that these respondents put more emphasis on the theoretical incorporation of CAD/CAM technology in production, instead of practical inclusion of CAD training in the course syllabus.

None of the interviewees see the need of having the CAD subject as a separate subject.

Questions 31 – 34 examined the success of CAD training and the placement of students in a CAD related environment in industry. Sixty-nine percent of the respondents’ feel that the training they provide on CAD has been
successful (Figure 6.17), 23% indicated no and 8% did not respond to the question.

![Figure 6.17](image-url)

The reasons for unsuccessful training are specified as:

- The number of workstations in relation to the number of students is not sufficient for effective training on CAD.
- The limited amount of time that is allocated to training the total number of students in the design courses has resulted in students either sharing workstations, or sharing the time allocated to a particular student group. This has resulted in students not being able to gain sufficient experience on the computer equipment. As mentioned before, some respondents try to compensate by offering short courses to students.
- Mention was made in 6.2.1: 134 and 6.2.2: 137; of how industry feels about the need for adequate CAD training of future employees.
Reviewing the analysis of the questions in the training section, insufficient emphasis is placed on CAD related training at Technikon level.

Student placement (question 33) in CAD-related positions in industry shows a 62% success rate (Figure 6.18). Twenty three percent were unsuccessful and 15% of the respondents did not reply to the question.

More than half (54%) of the interviewees (question 34) did not respond to the question relating to the number of students placed in industry. The response received show a 46% placement number of between 1 and 10 of students placed in a CAD related environment in industry (Figure 6.19).
6.5 Conclusion

Valuable information has been derived from the analysis in this chapter. It does show that training institutions use CAD systems that are also used by the textile industry. The textile industry is indeed in a growth period, and the need for skilled labour in computer technology will become increasingly necessary. CAD technology should therefore play a more important role in design education in future.
CHAPTER 7

SUMMARY OF ANALYSIS AND RECOMMENDATIONS TO EFFECTIVE TRAINING IN CAD

7.1 Summary

In Chapter 1 the research problem was highlighted, an explanation given of the objective of the research, certain specific discipline-related concepts were defined; and the contribution of the study discussed.

The history, development and need of CAD technology in the textile industry was discussed in Chapter 2. Computer technology, or ‘new tools’ as described in Paragraph 2.4: 30, can be most beneficial to manufacturers where speed of product-to-market is necessary. The use of CAM in the production processes will increase the speed at which production can be completed. The pencil and paper (old tools) will not be able to sustain the above-mentioned changes that a computer will allow.

Concepts such as QR and EDI (refer to 2.1: 14) incorporate computer technology, and assist manufacturers to speed up the process from initial design concept to final product. Quick response linkages ensure that manufacturers and retailers are in constant contact with each other and information regarding market trends and needs can be accessed and processed immediately. This ensures quick response to consumer demands. Manufacturers therefore cannot
be competitive without the incorporation of computer technology in their daily business transactions.

The implementation of CAD, and future use of CAD technology, was discussed in Chapter 3. For manufacturers to compete in a national and global textile arena, the use of CAD/CAM is a necessity. A new trend in the textile industry is that manufacturers can now outsource a selected part of their production, but the company contracted to do the selected part of production does not necessarily need to be in the same country. This could only be possible with computer linkages.

South Africa has entered into a number of trade agreements with several countries, as discussed in Chapter 4, which indicates that the future of the textile industry in South Africa is in a growth period. If the textile industry of South Africa wishes to compete at an international level, companies need to invest in CAD and CAM systems that will increase production efficiency. Chapter 4 also points out the current situation in CAD training in the Departments of Fashion Design and Technology and the Department of Textile Design. Several problem areas in CAD training were identified.
In Chapter 5 the population and research sample was identified. The research method, and the structure and objective of the Interview Schedule used to gather the research data was discussed.

The analysis of the research data, as presented in Chapter 6, has established that CAD and CAM are already widely used by apparel and textile producers in South Africa and that CAD has become an essential part of design and manufacturing in the South African textile industry. It is interesting to note that the textile industry has been using CAD/CAM systems for the past 10 years. The software programmes used by Technikons are similar to the programmes used in the textile industry, yet training in CAD has only been implemented in recent years. Technikon Pretoria only started training in CAD in 1995. The research data obtained also indicated that only a small percentage of CAD operators in industry have received CAD training from a Technikon. The analysis of the interview schedule highlighted that industry deems CAD extremely important. Mention was made of the fact that manufacturers cannot afford to take the responsibility of training new employees on CAD systems, and that this should be the responsibility of the training institutions. The training institutions interviewed also made mention that not enough time is currently allocated towards efficient CAD training. All institutions interviewed have experienced problems in effective CAD training.
The need regarding employees that are fully CAD literate in the textile industry, and the type of CAD literacy the CAD training at Technikons can supply is illustrated in Figure 7.1:

The above figure shows that the use of CAD in industry is extensive. The Technikons are able to supply the textile industry with students who have completed their studies, which includes some CAD training. Yet the analysis reveals that the demand indicated by industry is not fully met by Technikons. The ideal situation in tertiary training institutions, such as the Technikons, would be to supply the textile industry with what is required. The two circles in Figure 7.1 would then be almost equal in size.

The analysis also showed that although CAD is at present a part of the courses in Fashion- and Textile Design it does not play as important a role in tertiary education as it should.
All manufacturers and design studios have their own methods or procedures of production, and it is accepted that some re-training/adapting when starting in a new position should occur. A number of fashion- and textile design students in CAD achieve excellent work. Yet not enough is accomplished in CAD training to ensure that a whole group of students, who have completed their studies, are fully CAD literate. No students currently leaving the fashion- and textile departments have sufficient knowledge to take up a CAD-related position in the textile industry.

The following are recommendations to remedy the current problems experienced in CAD training in both the Department of Fashion Design and Technology and Textile Design at Technikon Pretoria. Possible areas of further research will also be discussed in 7.5.

7.2 Recommendations for efficient CAD training

The recommendations regarding CAD training for Technikon Pretoria are divided into the following categories.

- CAD resources
- CAD software programmes
- Similarities experienced in the disciplines of fashion and textiles
- Specializing the field of CAD
- Development of CAD curricula
7.2.1 Resources

This section is divided into the workstations used for CAD training and the time allocated towards CAD training.

A. Workstations

One of the biggest problems facing both the Departments of Fashion Design and Technology and Textile Design is the lack of resources for efficient CAD training. As outlined in Paragraph 4.2: 63, effective training becomes difficult given the resources that are available. The ratio of student per workstation in the Department of Textile Design is better than that in the Department of Fashion Design and Technology. Current figures indicate the student ratio per workstation in the Department of Textile Design is 1:7. The ratio in the Department of Fashion Design and Technology is 1:12. The desired ratio of student to workstation for effective training, should at minimum be one workstation for every three students. The preferable ratio should be 1:1. Given the budget constraints of both departments this is not always possible. Logistics to expand either of the two computer laboratories is limited.
B. Time

The only possible way of learning a design or construction skill is by method of repetition. All design and construction subjects have a 10% - 20% theoretical base and the remaining section of the subject is practical. The remaining 80% can only be experienced and learnt heuristically. Computer knowledge falls into the same category. Training can only be successful if a student is shown the basic theoretical component on the computer. The value of design and construction on computer is achieved only if the student is able to apply the basic knowledge in an actual process. For example, the student can be shown how to apply the menus available in the computer programme to design a textile surface design. The value of the basic training becomes apparent when the student is able to apply the knowledge gained of basic CAD training in his or her own design. The only way for a student to gain expert knowledge in CAD design and the capabilities of the CAD programme is through experimentation and repetition. The same principle is applied in CAD pattern construction and manipulation. The student therefore needs to have access to the computers and computer tutors on a daily basis. The cost of the computer hardware and software is high. To justify the cost of the equipment, it should be used to its fullest potential. Students should be allowed access and be encouraged to use the laboratory on a daily basis for CAD, and not only for word processing.
7.2.2 Variety of computer hardware and software available for student use

The student should be exposed in the training environment to the equipment used in industry. Both departments have to some extent succeeded in this. Although the use of the existing software is sufficient at present, the need for acquiring a dedicated textile system such as Stork will become important in future. The cost of acquiring such a system is high, and not currently within reach of the operating budget of the Department of Textile Design. If more emphasis is to be placed on effective CAD training, such a system will become a necessity. Several dedicated textile and fashion software programmes are available on the market. Some of these programmes such as Fashion Vision or Prostyle should also be available to students. Corel Draw or Adobe Photoshop can be adapted for use in design training, but dedicated software programmes are written for the textile industry and therefore have more possibilities in design. Here are some examples:

- **Prostyle** has the option of creating a technical drawing.
- **Specgraph** allows the operator to draw patterns created in Modaris into production specification sheets.
- **Fashion Vision** allows the operator to create weave constructions on the screen.
7.2.3 Similarities in the fashion and textile disciplines

The disciplines of textile and fashion design are interrelated. Both the departments of Fashion Design and Technology and Textile Design use, to some extent, the same software programmes. The application of the software programme in each discipline will differ. Some dedicated hardware and software is geared to a specific discipline; i.e. the Lectra system. The software programme Prostyle (part of Lectra) has a large textile design component that could be of great value to a textile student. Students in each discipline should, where the need arises, be able to interact with the other discipline. A fashion student in his/her first year only gains basic textile component knowledge yet should be encouraged to explore the area of textile surface design if needed. This could especially be encouraged at fourth year level.

7.2.4 Specialized course in Design Technology

A new course can be developed from the existing textile- and fashion design courses. A course in technology could place more emphasis on digital design and production. This would then become an area of specialization. A course such as this could concentrate on CAD and possibly take it further into the implementation of CAM. Due to the current course structure and resources available, the implementation of CAM can only be dealt with theoretically.
A specialized course in CAD technology could alleviate the current problem regarding fully implementing CAD into the current curriculum. Due to the market the students who complete the current courses in fashion- and textile design would be entering into, the current course structure should however not relinquish the inclusion of CAD into the curriculum.

7.2.5 Development of CAD curricula

To be able to train students in efficient use of CAD programmes more emphasis should be given to CAD training. The following are suggestions on how the current curricula in fashion- and textile design can be amended to remedy the problem areas experienced in CAD training.

A. A separate subject

CAD training should be seen as a separate subject in the course structure. By doing so students will experience the importance of CAD development in the industry and therefore the need for training on CAD-related programmes. The lack of student participation in CAD training was highlighted in Paragraph 4.5.3: 97. Students should comprehend the development and use of CAD technology in the textile industry.
B. **CAD incorporated into other subjects**

Computer training should be incorporated into other related subjects in the respective syllabi of the design disciplines. All subjects interrelate, therefore CAD technology even as a separate subject, should be integrated into other subjects. This would mean that more lecturers would become involved with CAD training. Not all have to be CAD specialists, but if other lecturers within the respective departments recognize CAD and its uses, it could become an extension of their subject content. This could be achieved by:

- Recognizing CAD as a medium to be explored.
- Incorporating CAD into the existing subject content.
- Encouraging students to explore the use of CAD.

7.3 **Development of a specialized CAD centre for fashion and textile design**

A well-equipped specialized CAD centre could resolve all problems mentioned in Paragraph 7.2: 150. The formation of such a center is to provide a hub of expertise. The objective of the facility would be to provide:

- Formal CAD training for all existing fashion and textile courses at the Departments of Fashion Design and Technology and Textile Design.
- Informal CAD training for alumni or other interested parties.
A service to the textile industry in the processes of product development.

A support infrastructure that could provide CAD assistance to small entrepreneurial businesses in the fields of fashion and textile design.

Exposure to various software programmes used in the textile industry for all fashion and textile students.

7.3.1 The facility

The objective of such a facility is to provide sufficient resources to accommodate an average group of 25 students simultaneously for CAD training. This facility would be used for CAD training of both departments and should be able to provide the student with resources to:

- Complete written projects electronically as required.
- Complete design projects as required.
- Complete construction projects as required.

The resources would include PC and Apple Macintosh computer workstations. These workstations should be equipped with all necessary graphic software programmes that are currently being used by the Departments of Fashion and Textile Design. The software should include Corel Draw, Adobe Photoshop, Micromedia Freehand and Microsoft Office. Dedicated textile and
fashion design software such as the dedicated system (Lectra) currently being used by the Fashion Department can be loaded onto the PC workstations. Other textile dedicated computer software programmes, such as Prostyle, Fashion Vision or Stork should also be included. The existing digitizer and plotter are sufficient to service the Lectra programme. All computers should be networked but do not necessarily need internet access. Supporting hardware such as A3/A4 colour printers and scanners should be included. A digital printer for printing sample lengths of fabric could be an added advantage for both training and providing a service to the textile industry.

7.3.2 Formal CAD training

The facility would service both fashion and textile students in their respective CAD training of the existing courses. With a sufficient number of workstations available a group of 25 students could receive training simultaneously, which will result in effective training. Students can then, by careful scheduling, be able to have access to a computer every day. Students who wish to specialize in CAD will also have access to the CAD programmes in other disciplines.

7.3.3 Informal CAD training

The centre would be in a position to supply training to any interested parties who either wish to further their CAD training, or who have not previously received CAD training (alumni). The training should be scheduled according
to resource availability. Informal training could be charged at a market related fee and therefore could become an income-generating resource for the centre. Training could be given to:

- Industry, as required.
- Private colleges who do not have access to CAD equipment, or who cannot afford CAD equipment at present.
- The suppliers of CAD hard- and software could make use of the centre as their training facility, or provide training for new clients.
- Private individuals who require or want to further their CAD training.

7.3.4 Providing a service to the textile industry of Gauteng

The centre could assist small / medium manufacturers and design studios by providing several product development processes. This service is geared towards those manufacturers who cannot afford to acquire a CAD system. Services would be charged at a market related fee and could therefore become a second income-generating resource for the centre. The service could include the following processes for fashion and textile design and production respectively:
i) Apparel design and manufacturing:

1. Design presentations (layouts).
2. Computer-aided pattern manipulation or construction.
4. Computerized marker making.
5. Made-to-measure pattern making, a facility that is included in the Lectra software.

ii) Textile design and manufacturing:

1. Surface design.
2. Three-dimensional presentations.
3. Colour separations.
4. Computerized weave and knit constructions.
5. Digital printing of sample lengths of cloth.

7.3.5 Support infrastructure

Many small design studios, especially those started by recently graduated students, do not have the financial infrastructure to acquire the necessary CAD equipment. The centre could therefore assist such studios in making its CAD equipment and expertise available. Once again a market related fee

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1 Made-to-measure and its use in the textile industry is fully described in Paragraph 3.3.1: 54
could be charged and could become the third income-generating resource for the centre.

7.4 Possible further areas of research

During the research it has become clear that there are various other areas of research, which can be investigated in future. These are:

7.4.1 Computer-Aided-Manufacture (CAM)

An important area of research is the impact CAM will have in the future on training. It has already been established that CAD and CAM are greatly integrated, and therefore will need to be incorporated in training. Training institutions have certain difficulties with implementing CAM into the syllabi. Firstly is it difficult to simulate production into the training environment in an ongoing basis. CAM systems are geared for continuous volume production, and therefore not always feasible in a study environment. This does not diminish the need for CAM implementation into the learning environment. Enough evidence is given in this research document to indicate that computer technology is fast becoming a necessity in production on any volume level.

Secondly, the cost of acquiring such equipment is extreme, and because this cost cannot be recovered from products sold, it could become a financial burden on the training institution. Once again this aspect does not diminish
the need for CAM implementation in the learning environment. Research should be conducted to see where and how this could be most successfully achieved.

### 7.4.2 Research including all tertiary institutions

This research has only been conducted between Technikons offering specific apparel and textile design related courses\(^2\). Many private design colleges have also now been SAQA\(^3\) accredited. This has brought many of the private colleges potentially in competition with Technikons. If private colleges now offer courses which are in line with the courses offered at Technikons, it will become necessary to investigate what computer technology training they supply, how the training is implemented, and what their success rate in student placement in a computer related environment in industry is. In due course one would need to establish how this compares with the training offered at Technikons in South Africa. This research can then also be extended to incorporate the training provided at Universities, as well as at Technical College level in South Africa.

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\(^2\) Please refer to the research problem and research objective as described in Paragraph 1.2: 6 and 1.3: 9.

\(^3\) SAQA: South African Qualifications Authority.
7.5 Conclusion

The developments in industry often surpass the developments in training methods. That has become the present situation in the textile industry and training for the textile industry.

Not only is the staff in the two relevant departments concerned about the current CAD training situation, the comments made by students during a recent (2003) course evaluation also reflected this.

Possible recommendations to change current CAD training in the Department of Fashion Design and Technology and Textile Design have been discussed in this chapter. Some of these recommendations, such as the development of a CAD centre, are long-term recommendations that would require financial investments. Others, such as the development of CAD curricula, could be implemented immediately.

The Technikon Pretoria in its Mission Statement refers to committing to transfer of relevant, cutting edge knowledge and technology. This is not only the commitment of the management of Technikon Pretoria, but of its staff as well. Tertiary institutions need to supply the industry with what it requires. If trends in manufacturing have changed, methods of training should also change commensurably.
REFERENCES


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