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The effect of employers' attitudes on the implementation of computer aided manufacturing techniques in the furniture industry in Western Australia

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The Effect of Employers' Attitudes on the Implementation of Computer Aided Manufacturing Techniques in the Furniture Industry in Western Australia.

By

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Abstract

In this study, the incorporation of computers in industry is compared with the industrial revolution. It is envisaged that computers in industry will bring about similar sweeping changes to the workforce as those that took place during the eighteenth century.

However, it is noted that, thus far, Australian industry leaders in general remain ignorant of these changes (Eckersley 1988,p.3) and the Western Australian furniture industry is no exception. If Australian industry in general and the Western Australian furniture industry in particular, are to avoid a similar decline in economic competitiveness to that experienced by European countries (Marcum 1986,p.28), there must be a change of attitude toward the implementation of computer technology.

In an attempt to determine and discuss some of the reasons for this attitude within the furniture industry in Western Australia, this study isolates the Western Australian furniture industry from other industries and collects information based on the beliefs of its employers. These beliefs, in turn, lead to attitudes which may affect the implementation of C.A.M. and it is these attitudes that were tested with the use of a questionnaire designed specifically for this purpose.

The following list questions areas anticipated as having the greatest bearing upon employers' attitudes.

1. What effect does the awareness of the capabilities of C.A.M. have on the decisions of employers as to whether or not C.A.M. should be implemented?
2. What effect does cost have on the implementation of C.A.M?
3. Is the availability of trained operators an issue?
4. Does the employer's perception of the suitability of C.A.M. to the furniture industry affect the rate of implementation?
5. Could the attitude of employers toward the current economic climate affect the rate of implementation?
6. Do employers believe that it is essential for them to become informed about new technology and do they feel that it is their responsibility to remain informed as technology advances?
7. Do employers believe that it is their responsibility to fully finance the implementation of C.A.M. themselves?

It is the employers' attitudes toward these issues that may be responsible, to some extent, for the poor rate of implementation of C.A.M. and for this reason were isolated and discussed in light of responses to the questionnaire.

In collecting the data, all companies with less than ten employees were exempt from the study unless they utilise C.A.M. in their current production methods. This was a necessary precaution as it is generally recognised that most small companies are mainly involved with custom built cabinets. Custom built cabinets, in comparison with mass produced furniture, are time consuming and would exclude them from the output required in order to make C.A.M. a viable prospect.

The results of this study were based on the data received from the participants of the survey which totaled 71 percent of all companies initially electing to participate.

The most notable finding of this research is that there is no significant difference in attitudes between employers with C.A.M. and employers without C.A.M. on issues related to implementing C.A.M. in the furniture industry in Western Australia.

Other findings include:-

- Both groups of employers are aware of the suitability of C.A.M. to the furniture industry.
- Both groups of employers are aware of the capabilities of C.A.M. for the furniture industry.
- The cost of implementation is a major concern for both groups of

employers.

- The availability of trained tradespeople has no significant influence upon the rate of C.A.M. installation within the industry.

- Manufacturers feel that they do not receive enough assistance both in terms of finance and information in order to computerise their businesses.

- The current economic climate is viewed more favourably for the implementation of C.A.M. by those manufacturers currently using C.A.M. than those who do not.

Declaration.

I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by any other person except where due reference is made in the text.

B. L. Ferguson.

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CHAPTER ONE

Background to the Problem

The history of the furniture trade and indeed most other trades had a fairly primitive beginning. That is, tools made in order to perform various tasks were extremely rudimentary. These tools were mostly made of stone and were sometimes attached to small branches that acted as handles. However both stone and handles were easily damaged and required regular replacement. Stone tools gave way to tools fashioned from bronze followed by iron and later steel. Nonetheless, changes in tool materials largely had little effect on the manufacturing procedures as craftspeople generally adopted the same methods and principles of construction with their new tools.

These methods of production were to continue through until the eighteenth century when those very same materials made it possible for the first major changes to methods of manufacturing. This well known and documented event, the Industrial Revolution, was to bring sweeping changes, not only to the methods of manufacturing, but also to society.

Prior to the Industrial Revolution, manufacturing processes were mainly laborious hand processes or in some cases may have employed some very basic machinery. However, in most cases this work was carried out in the homes of the workers which were spread across the countryside. This formed the basis of a decentralised society.

The effects of the Industrial Revolution were to reverse this trend and take the work out of the home and into centralised workshops which were equipped with heavy power driven machinery. The emphasis was now on large volume production with a major decrease in the number of workers required in order to achieve similar or increased outputs. This caused much tension during these times and often saw many men fighting in order to obtain employment.

Once again there is a revolution which rivals that of the Industrial Revolution. It is the "computer revolution" that now promises enormous change to industry, society and current methods of production. To some extent however, the germination of the seed of computerisation in industry, ironically, may be linked with Industrial Revolution itself. It was during the period of rapid change for the textile industry that the pattern weaving loom of Joseph Marie Jacquard was developed. First designed in 1801 but much improved by 1805, it operated with the use of punch cards and attachments in

order to produce complex weaving patterns.

Today, as was during the Industrial Revolution, the main aims of industry are to increase productivity and profitability, and decrease costs (direct and/or indirect) and with today's technology these aims can be accomplished.

The latest trend is to outlay high capital investment in an attempt to increase productivity and decrease labour costs and wastage within industry. In some instances, the investment made is further supplemented in order to customise the equipment to perform a dedicated task. That is, one machine is assigned to one machining function and has specific software and/or hardware such as robotic limbs customised in order to further increase or improve production.

Amidst such rapid change, it is interesting to say the least, that Western Australian industry in general, and the Western Australian furniture industry in particular, has been somewhat slow to adopt this technology.

This view is supported by a 1989 feasibility study "C.A.D./C.A.M. Training Centre Feasibility Study", carried out in areas of industry such as Architecture, Engineering, Fashion, Furniture, Plastics, and

Shipbuilding for the Technology & Industrial Development Authority (T.I.D.A.) of Western Australia.

This study, an in-house report not for publication (see Appendix I), centred around the commercial viability of a proposed C.A.D./C.A.M. training centre which had been intended to provide further training in C.A.D./C.A.M. technologies on a payment for services basis. The results of this study found that the market size and requirements were very small and as a result, the proposed concept of a C.A.D./C.A.M. training centre on a payment for services basis was not financially viable in Western Australia.

If the Western Australian furniture industry is to remain commercially viable, the Western Australian furniture manufacturer will have to look closely at adopting the equipment and production methods of other countries. If this does not happen, the progressive nature of these technologies will only increase the rate at which the industry will decline in productivity and this may be the very break that opposition furniture manufacturers are awaiting in order to cement their presence in this market-place.

The penalties for failure to adopt the new technologies in industry were noted by T.I.D.A. (1989) when in conclusion it stated:-

> "Survival of manufacturing industry depends substantially on its ability to remain competitive in the World market place. To do this, it must remain up-to-date with the implementation of new technologies."

In discussion with the senior representative from the Furniture Trades Study Area within the Office of Technical and Further Education (T.A.F.E.), it was noted that T.A.F.E. felt that, inevitably there must be an increase in the installations of C.A.D./C.A.M. equipment in the furniture industry in Western Australia if that industry is to remain competitive in the market-place. With this belief in mind, T.A.F.E. operate a C.A.D./C.A.M. installation at their Leederville Campus for the purpose of training apprentices as well as post trade training in the furniture trades. However, the Office of T.A.F.E., in order to meet T.A.F.E.'s anticipated demands for this technology in the future, is updating their installation to provide more relevant, in depth training in the use of C.A.D./C.A.M. equipment. At present, approximately 30 students enrol each semester, however, only 10 percent would be required to use these skills in industry. This evidence supports the results of T.I.D.A. (1989) in that there are relatively few manufacturers incorporating this technology in industry at present.

Currently a working party, known as the Furniture Industry Study Tour, consisting of representatives of the industry, the national union

body and T.A.F.E. (1 member), is investigating manufacturing methods within the furniture industry overseas. The T.A.F.E. representative, who is the senior officer of the Furniture Trades Study Area in Western Australia, is also investigating the extent to which "technology" has been absorbed within the furniture industry and the viability of incorporating similar technology within T.A.F.E. It is believed that this technology, if installed in Australia, will be approximately 10 years ahead of industry's present position. A report on the tour that was to be made available toward the end of the year or early 1990 is still pending.

Statement of Purpose

In general, employers in the Western Australian furniture industry are reluctant to adopt any of the C.A.M. technologies in their operations. This stance may be a costly one for the industry in terms of lost contracts. Such a reduction in contracts may result from either of the following two factors:-

1. Local contracts may decrease due to an increase in cost competitive imports resulting from the adoption of C.A.M. technologies in the furniture industries overseas and/or

2. Exports may decrease due to the expense created by the extensive labour requirements associated with local furniture

manufacturing procedures.

In order to counter these effects, it is necessary that more Western Australian furniture manufacturers implement these rapidly advancing technologies in the factory situation.

Therefore, of major concern, at this point, is the employer's attitude toward C.A.M. and a major question is therefore "Why are the employers in the Western Australian furniture industry reluctant to implement C.A.M. in their operations?"

Further development and implementation of improved technologies will continue in other countries. Should the Australian manufacturer and in particular the Western Australian furniture manufacturer choose not to implement these changes, they will continue to struggle as they become increasingly less competitive. If this is allowed to occur, all of the future efforts of the industry will be guided toward recovery and whilst recovering, overseas furniture manufacturers will forge ahead further with new technologies and methods at an ever increasing rate. This undeniably, will result in an increasing "technology gap" that will inevitably lead to disastrous consequences for the Western Australian furniture industry.

In this study, a number of experiences from the furniture industry in Western Australia were surveyed in an attempt to determine whether or not the attitudes of employers, with respect to this technology, are fundamentally responsible for the lack of implementation of C.A.M. technology.

Statement of Problem

It was the intention in this study to determine whether or not there was a connection between employers' attitudes toward C.A.M. and the installation of C.A.M. facilities in the furniture industry in Western Australia. This was achieved by obtaining and comparing data from questionnaires designed to determine the differences in attitudes between employers with C.A.M. installations and employers without C.A.M. installations in the furniture industry in Western Australia.

Objectives

Other objectives of this study were as follows:-

1. To determine whether employers' perceptions toward the suitability of implementing C.A.M. in the furniture industry were an impeding factor in its implementation in the furniture industry in Western Australia.

2. To determine whether the awareness or lack of awareness by employers on the capabilities of C.A.M. could have an effect on the implementation of C.A.M. in the furniture industry in Western Australia.

3. To determine whether or not perceptions of the cost of implementing C.A.M. were an impeding factor in the installation of C.A.M. in the furniture industry in Western Australia.

4. To determine whether the issue of training operators in the use of C.A.M. had any effect on the acceptance of C.A.M. in the furniture industry in Western Australia.

5. To determine with whom, according to employers, the responsibility lies, for keeping the furniture industry in Western Australia up-to-date with technological change.

6. To determine whether the employers saw the current economic climate as favourable for the implementation of C.A.M.

Definition of Terms

There are many terms that are synonomous with computers and the computer industry. These terms are also used within industry incorporating computerisation in its processes. Therefore, a number of these terms were used to some extent in this study. As such, it is necessary to define these terms in order to clarify exactly what is meant when they were used.

C.A.D. (Computer Aided Drafting) Any means by which drafting or information in the form of a drawing is drawn or communicated by means of a computer.

C.A.M. (Computer Aided Manufacturing) Any method of manufacture which utilises equipment that receives its instructions from a computer.

N.C. (Numerical Control) A method of digital control over the movement of a machine that is not directly connected to a computer.

C.N.C. (Computer Numerical Control) The use of a computer in conjunction with N.C. type of equipment in order to store and issue instructions for the purpose of guiding the machines tool path.

SOFTWARE Applications, generally written in machine code as a set of instructions in order to guide the function of a computer.

HARDWARE Any attachment which may be connected to and subsequently driven by a computer.

ROBOTIC LIMBS Any electronically controlled mechanical device, deployed to carry out a given task repeatedly.

SYSTEM 32 A method of manufacture, designed specifically for the furniture industries throughout the World. It incorporates a series of holes drilled at 32mm centres, with the use of specialised equipment, for the purpose of inserting specialised hardware items to assist in the construction process.

Limitations

There were a number of possible limitations within this research which may have lead to some misrepresentation of the real situation. These are:-

- There was a lack of recent relevant research available specifically on the Australian and especially the Western Australian furniture manufacturing scene. For example, there has been little or no research on the effects of employers' attitudes on anything to do with computers in manufacturing at all.

- In relation to attitudes, the research available on the furniture manufacturer on the Global scene is limited.

- There is a limited amount of research on the implementation of C.A.M. in the furniture industry in general, throughout the world.

- The selection of a relatively small sample, which has in turn led to an even smaller group of participants, may have biased the results.

- Time constraints did not allow for a comprehensive survey on the attitudes of employers to the degree which would be necessary to

draw absolute conclusions.

- The range of products, as well as the diversity of equipment and manufacturing techniques used in the furniture industry in Western Australia, may not readily lend itself to generalisations. For example, the diversity of manufacturing techniques vary greatly from the large through to the small manufacturers and from mass production lines through to customised lines and includes both indoor and outdoor furniture.

- Although assurances of privacy were given, some manufacturers may not have been totally frank in their response to the questionnaire.

- There is a strong air of jealousy within the industry, as manufacturers strive to keep secrets from each other about their methods of production and their products. This, to some extent, may also have affected the results.

CHAPTER TWO

Review of Literature

2.1 Attitude

The term "attitude" is one which has been in existence for quite some time and consequently, its definitions are many and varied. Allport in Jahoda (1966,p.15) discussed the origins of the word "attitude" and in so doing alluded to some of the reasons for its many definitions. However, in this review, the term "attitude" will be explored in detail in order to determine the appropriate context in which the term is used in this study.

Definition of Attitude

In the past, the term "attitude" has been the subject of much discussion (Kiesler, Collins and Miller 1969,p.5). However, in the quest to provide a definition for it, there appears to have been little agreement among writers in this field. Reich and Adcock (1976,p.28) noted this in saying:- "When it comes to definitions of attitude, almost every author coins his own."

Attitudes are the most fundamental idiosyncrasies possessed by all persons. They are those which would affect a persons' decisions upon issues, concerns or objects. Therefore, an attitude can be held toward something concrete such as a "woodworking machine", or toward something abstract, such as "technology".

Rosenberg, Hovland, McGuire, Abelson and Brehm (1960,p.1) define attitudes as:- "Predispositions to respond in a particular way toward a specified class of objects." and in so doing, offer a model defining three types of attitudinal response as:-

1. Affective
2. Cognitive
3. Behavioural

Triandis (1971,p.2) and Kelvin in Bynner, Cashdan and Commins (1972,p.11) researched attitudes, and in so doing, reviewed the work of Rosenberg et al (1960) in relation to these three types of attitudinal responses.

Triandis (1971,p.2) thus defined attitude as being "an idea (cognitive component) charged with emotion (affective component) which predisposes a class of actions to a particular class of social

situations (behavioural component)."

Kelvin in Bynner et al (1972, p.11) however, points out that each of these three components of attitude is to some degree dependent upon the other. For example, as the environment changes and people experience new sensations, new skills and new events, so too will their knowledge and understanding of the situation change. With this increase in knowledge and understanding, an increase in affect and/or emotion to that situation may thus be expected and will undoubtedly lead to a change in behaviour/attitude.

From the number of definitions available, however, a pattern has emerged. It appears that an attitude is an all encompassing, abstract construct which predictably displays itself in emotions or feelings. It is something which is sustainable over a period of time, although it is not immune to change. It can range from a strongly positive through neutral and to a strongly negative state, based upon judgements made in hindsight (past experience). Attitudes are triggered responses which have been aroused by these past experiences. They may manifest themselves in affective, cognitive or behavioural terms and each in turn may affect the other. Therefore, the following definition offered by Shaw and Wright (1967,p.3) is preferred as being the most appropriate for this study.

"A relatively enduring system of evaluative, affective reactions based upon and reflecting the evaluative concepts or beliefs which have been learned about the characteristics of a social object or class of social objects."

In other words, the term attitude in relation to this study, that is, "attitude toward technology", and in particular attitude toward the implementation of C.A.M. in the furniture manufacturing industry, denotes extensive and evaluative thought, which has been based on relevant past experiences and is subject to change based upon new experiences.

Formation of Attitudes

The abstract nature of the construct "attitude" may well be the fundamental basis for the extensive discussion which has taken place in the past. Shaw & Wright (1967,p.4), in defining attitude, felt that it was necessary to outline three similar constructs, namely, beliefs, concepts and motives. Beliefs, they felt, were the acceptance to some degree, of the existence of certain characteristics of an object or event without any value being placed upon them. Concepts were the platforms upon which evaluations were made, but were much more general than attitudes as they were not the result of evaluation. Whereas, motives on the other hand, were said to be similar to attitudes in that they were directional, that is, they determined the

possible direction of a behaviour without relating directly to the behaviour itself. However, these two constructs (motive and attitude) were then differentiated by explaining that the motive was driven by a predetermined urge and that the attitude may itself be the urge or the driving force.

Therefore, motivational qualities of an attitude (Shaw and Wright 1967, p.4; Halloran 1967, p.14) will influence, or direct a person's decision to carry out a particular behaviour. For example, a close relationship can be expected between positive or negative attitudes toward C.A.M., and the intention to implement C.A.M. either in the furniture industry or any other industry.

Attitudes are not innate, they are the result of some form of evaluative criteria. As people are not born with attitudes toward either concrete objects such as C.A.M., or abstract concepts such as technology, any attitudes toward these issues have developed as a result of past experiences, that is, retrospective evaluation.

However, Fishbein and Ajzen (1975) proposed that attitudes alone did not necessarily determine a particular behaviour. For example, the positive attitude of an employer toward C.A.M., <u>may not</u> necessarily be related to the employer's intention to install C.A.M. They proposed that

a combination of attitudes plus a component which they called "the subjective norm" determined the intention of whether or not to install C.A.M.

The "subjective norm" is the social or normative factors which may have some effect on the outcome of the decision making process. For example, people tend to be concerned about the opinions of others. That is, they are influenced by what others think they should be doing, by others' reactions to what they are doing or by some other external factors. It is only when the results of these factors have been considered, that a decision to act is finally realised. Therefore, the evaluation of the perceived pressure of a situation together with one's attitude toward a situation, combine to form the intention to act.

Although the extent to which the "subjective norm" affects the decision making process may be unclear, it is certain that it can have either a positive or negative influence upon decision making. A negative influence upon the decision to install C.A.M. in industry would occur when the risks associated with installation are perceived as being sufficiently great that it may result in an undesirable effect on that person's life. For example:-

1. at the end of any given month, should income not exceed expenditure, the immediate family of the employer (the subjective

norm), will not have the security and financial independence they expect, or

2. should there be any risk of bankruptcy, no matter how small, the pain of embarrassment and/or ridicule from company employees, suppliers and other allied associates (each a subjective norm), could have a negative effect on the decision to install C.A.M.

Conversely, the "subjective norm" may have a positive influence on decisions to incorporate C.A.M. technology in industry. For example:-

1. when offered Government financial assistance (subjective norm) in terms of a grant or subsidy as encouragement, one may be persuaded to install such equipment. or,

2. when competitors (subjective norm) have installed, or are considering the installation of, C.A.M. technology in order to increase their effectiveness at the expense of another manufacturer, the perceived threat may have a positive influence upon the decisions of the other manufacturer to install C.A.M. in order to remain competitive.

For reasons such as, although not limited to, those above, the "subjective norm" in the context of this study is considered a significant influence upon the attitude formation of employers in the furniture industry. Furthermore, it is considered more likely to have a positive, rather than negative, influence upon the decisions of furniture

manufacturers to install C.A.M. in the furniture industry due to the benefits that C.A.M. has to offer.

Measurement of Attitudes

In order that one may measure an attitude, one needs to know exactly what an attitude is. However, having defined "attitude", it is not difficult to see that measuring an attitude can have its associated problems. For example there are times when one may hear of a parent or a teacher referring to a child as having an attitude problem or referring to a child whose attitude needs to improve. On what basis has this been determined? It is likely that some sort of evaluation has taken place in that teacher's or parent's mind in order to arrive at these conclusions. Given this to be the case, one may feel compelled to ask:-

1. What has been evaluated?
2. How did this evaluation take place?
3. Did this evaluation actually measure an attitude or did it merely measure a behaviour?

As has been previously mentioned, attitudes may predictably display themselves in emotions or feelings, that is, they may manifest themselves in affective, cognitive, or behavioural terms. Therefore one must be careful when measuring attitudes, as these affective, cognitive and behavioural displays, in themselves, do not represent attitudes,

they merely reflect attitudes.

Attitudes are difficult to observe directly (Rosenberg 1960,p.1; Halloran 1967,p.15; Reich & Adcock 1976,p.30). What tends to be seen is the result of an attitude, not the attitude itself. As pointed out by Shaw and Wright (1967,p.4) "Attitudes rather than being overt responses, serve as predispositions to respond overtly.". Therefore, the measurement of attitudes based on observation alone may not be valid.

To give an example; an employer seen to upgrade the fire safety services in a factory workshop was assumed to be showing a positive attitude toward the safety of his/her employees. However, it was not until the employer was later questioned, that it was discovered he/she did not care too much for fire regulations at all; it was the prospect of having their operations suspended or being fined by the relevant safety authorities that the employer feared mostly. Therefore, although the attitude displayed appeared to be a positive one toward safety, the real attitude was a negative one of the safety code and its relevant authorities, and of course, this could not possibly be interpreted from the observation.

As is evidenced by the above example, the overt reactions themselves may not determine the attitude on display. Attitudes must

be measured by some form of indirect means. Suitable methods designed specifically for the assessment of attitudes are, Thurstone scales, Likert scales, Sociometry, Osgood's Semantic Differential and Guttman scales. For a discussion of the merits of each of these types of measure, refer to Kiesler et al (1969), Reich & Adcock (1976) or Shaw and Wright (1967).

Summary

In this section, the construct "attitude" has been discussed at length. It was noted that definitions for this term were many and varied. Other similar constructs to that of "attitude" have been outlined in order to assist in the clarification of an attitude. Some definitions of the construct "attitude" have been discussed and from these definitions, the most appropriate for the context in which the term will be used in this study was determined.

Having defined "attitude", it was then determined that an attitude was only formed after extensive evaluation of a particular situation. Furthermore, it was pointed out that the attitude alone did not form an intention to act. It was not until the influence of a third variable "the subjective norm" had been considered, that any intention to act would take place.

The influence of the "subjective norm" was then indicated as having a positive effect on the decisions of furniture manufacturer. As such, it was felt that it should only lead to an increase in preference for the installation of C.A.M. and not the rejection of C.A.M.

Finally, it was noted that attitudes were difficult to observe directly as they merely triggered a response to a given situation. It was then shown how this response may bear little reflection on the attitude in question. Therefore, as explained, it is necessary to use a proven method by which attitudes can be measured. These methods were identified as:-

1. Thurstone scales.
2. Likert scales.
3. Sociometry.
4. Osgood's Semantic differential.
5. Guttman scales.

As with "attitude", the term "technology", when used in a general context, has many meanings. Many people, when discussing "technology", may well reflect on their understanding of this term as it relates to them personally. Therefore, in the following section, the term "technology" will undergo a similar scrutiny to that of "attitude" in order to clarify the context in which this term also will be used.

2.2 Technology

The term "technology" is an integral part of this study and therefore one's understanding of this concept is important. It is a concept with a broad range of understandings that are indicative of one's past and present interactions with it. As such, it will be advantageous to discuss the term in some detail, in order that one may appreciate the context in which it is intended in this study.

Definition of Technology

In defining the term "technology", it is not the intention in this study to create a new definition, as currently the definitions are many and varied. However, a definition is required in order that it may focus attention on the more relevant aspects of technology as it pertains to the furniture industry.

Technology is a concept which transcends many, if not all, occupational boundaries. For example, technology has revolutionised medical procedures in hospitals, streamlined the modern office and its practices and upgraded industrial processes, resulting in new or improved products in all facets of industry.

Technology in many cases may be associated with efficiency. It

may also be associated with progressiveness and is certainly synonomous with, if not responsible for, innovation.

Therefore, whilst trying to acknowledge the many aspects of technology, many definitions, because of the extensive nature of this concept, tend to generalise over its meaning. For example, Hacker and Barder (1987,p.5) define "technology as "the sum of all human knowledge, used to transform resources for the purpose of meeting human needs.". As one can see, such a definition does not focus one's attention on any given aspect of technology. Similarly, definitions offered by Goetsch and Nelson (1987,p.4) and Susskind (1973,p.1) are open to much interpretation based on one's past and/or present experience with it. For example, top athletes may make use of technology in order to further their quest for improvement, so too, will furniture manufacturers make use of technology in order to further their quest for success. As the athletes experiences and the furniture manufacturers experiences with technology are quite different to each other's, what they each understand of "technology" may also be very different.

A further reason for the current confusion is that many people use the term to describe things which they do not understand. This is outlined by de Bono (1971,p.1) who stated:-

"Technology is a word used by non-technologists to describe what the other people are about. Technology is an impression rather than a definition. The more one examines the impression the more difficult becomes a definition. The closer you get to it the more it is not there."

In light of the above, a definition of technology which gives the more suitable impression in the context of this study is offered by Parkinson in Hall (1988,p.53) when technology is defined as:- "The branch of knowledge that deals with science and engineering, or its practice as applied to industry."

Technology, in the context of this study, is therefore used in reference to the improved equipment, such as computer aided manufacturing systems for use in the furniture workshop. It particularly refers to computer aided manufacturing techniques that improve methods of production and that facilitate the production of items of furniture, or additional features for those items of furniture which would not normally have been considered with the use of conventional methods of production.

Aspects of Technology

When one talks of "technology", one could be referring to any

number of aspects of technology. For example, one may refer to the "space shuttle" as a fine example of "technology". Similarly, a motor vehicle, a sewing machine, a woodworking machine or even a fishing rod or tennis racquet could be referred to as fine examples of "technology". The simple reason for this is, that each of these items may largely have been produced by or improved with the use of "technology". That is, their manufacture has largely been a result of technological processes and/or technological change. However, it is important to note, that in the case of this study, such material items are merely representative of a series of advances in technology at different stages, but in themselves are not "technology".

A second aspect of "technology" is that of process. That is, "technology" is used to refer to the process undertaken in order to produce a product or any of a product's individual components. An example of this "technology" in action is the process of producing electrical energy (the product) with the use of alternative energy sources such as biogas, wind power, solar power or tidal fluctuations. However, once again in the case of this study, this highly technical process is viewed largely as being a result of "technology", rather than being "technology" itself.

A third aspect of "technology", and the one most relevant to this

study, is an abstract concept which refers to a total system of technological processes working together in harmony for a common purpose. Such examples are "space technology", "medical technology", "industrial technology" and office technology" and when seen from these varying viewpoints, may endorse the various perspectives on its meaning.

This is supported by Hill and Johnston (1983,p.209) when they noted:-

> "Technologies have become interdependent systems that carry with them, and rely on, hidden technological and social contexts."

However, as previously mentioned, it is the third aspect of technology, that is, a technological system as it applies to the furniture industry, that more closely resembles the understanding of "technology" for the purpose of this study.

The Extent of Technology

In defining "technology", Sussikind (1973,p.1) argued that all previous inventions and all previous improvements as well as advances were "technology". In implying that "technology" does not specifically refer to <u>current</u> changes and advances, one could equally refer to the

advent of the axe in pre-historic days as being technology. With this in mind, it is little wonder there is a state of confusion over it's definition.

To aid in the clarification of the context in which the definition of "technology" is intended, the distinction between old and new must be made. Today's society is one which is highly technical and computerised and as such, the general conceptualisation of the term technology is very much related to these present day influences. The danger of relating to the many superseded technologies as "old" or "past" technologies, is the difficulty in determining the point at which a particular technology becomes "old". The alternative to identifying superseded technologies as " old" or " past" technologies is to introduce an extended nomenclature. Terms such as "appropriate technology", "high technology", "state-of-the-art technology", "new technology", "up-to-date technology" have now been introduced and are only further confusing the current situation as people strive to differentiate the latest of the current technologies from those of the past.

Therefore, when referring to technology in this study, it is not just any system that is being referred to, it is a system that utilises the more up-to-date equipment and in this case, computerised equipment, for the purpose of improved productivity and/or economy in the furniture industry in Western Australia.

Summary

In this section, it was noted that a number of definitions of "technology" were available. Many definitions, it was pointed out, were too broad due to the extensive nature of the concept and did not focus one's attention on any particular aspect of technology.

It was also pointed out that the term technology may mean many things to many people and that these differences of opinion may be based on the personal connections that one may have with technology. The analogy of an athlete's experience and a furniture manufacturers experience was used in order to clarify this point.

Three aspects of technology were then discussed. These were the aspects of referring to:-

1. an object as being technology, for example, the space shuttle.
2. processes as being technology, for example, the production of electricity with the use of solar power.
3. technology as being a total working system that operates in harmony for a common or given purpose.

It was this third aspect of technology that best described the situation to which the term would apply in the context of this study.

It was shown that an increase in terminology had been introduced in order to identify the more recent technologies from the technologies of the past. However this increase in terminology was said only to have increased confusion over the meaning of the term "technology".

Finally, the definition of "technology" in the context of this study was stated as "The branch of knowledge that deals with science and engineering, or its practice as applied to industry." (Parkinson in Hall 1988,p.53). However this definition was further clarified by noting that it particularly referred to the more up-to-date computerised equipment specially designed for the furniture industry. That is, computer aided manufacturing systems and manufacturing techniques for use in the furniture workshop and designed for the purpose of improved production and/or productivity.

In the next section, the effects of technology on individual attitudes will be discussed.

2.3 Attitudes to Technology

It is intended in this section to provide the link between "attitudes" and "technology", as described previously, as they relate to this study and in so doing, show how attitude formation may affect the implementation of technology in industry.

Forming Attitudes Toward Technology

During the Industrial Revolution, it is evident that there was much concern for one's safety and welfare in the community and this resulted primarily from the effects of unemployment created by the rapidly advancing technologies of the time. The loss of income resulting from this unemployment meant much worry, insecurity, hunger, heartache and suffering in general to families. This was primarily due to the associated reduction in living standards which accompanied unemployment.

Concern for this reduction in living standards due to unemployment has not diminished with time. Once again, people are concerned for the safety and welfare of their families. This is evident by a developing feeling of insecurity in the community, as many people believe that rapidly advancing technologies appear set to claim their jobs. This was evidenced by Eckersley (1988,p.3) in a study on

Australian Attitudes to Science and Technology and the Future, when he noted:-

> "Unemployment often tops the list of Australians' concerns, and we regard technological change as among the main causes of it."

Upon reflection and evaluation of such a negative characteristic of technology, one may see the potential for a disaster which could ruin not only their own lives, but also the lives of their families. Thoughts of such horrific consequences, attributed to the introduction of technology, may well result in unfavorable attitudes toward technology.

This assumption is further supported by Silver (1983,p.300) when she noted that certain elements, one of which is job security, could cause feelings of dissatisfaction in employment if they were inadequate, negative or absent in the job situation. Aspects of job security such as tenure, company stability and assurances of or threats to continued employment were listed as areas in which feelings of satisfaction or dissatisfaction could fluctuate based on the above criteria. This in turn may affect one's attitude toward that situation.

Conversely however, the attitudes of school children, as opposed to

the employees, toward technology have been shown by Nelson (1988,p.56) to be generally much more favourable. Furthermore, he reports that attitudes of students with computers at home are more positive than those without computers.

It is appreciated however, that the "technology" to which school children are exposed, is not the "technology" as defined in this study. It is also presumed that this technology probably does not have the same disastrous consequences for the students, as it does for the employees. Furthermore, it would be expected that technology in schools would be promoted in a positive light in order to inspire these children. Therefore, it is likely that the positive attitude of the school children could be attributed to their positive exposure to it as opposed to the negative exposure of the employees.

Therefore, attitudes toward technology may be attributed to one's reflection on positive or negative personal experiences with it, or indeed, may be the result of much reflection and evaluation of both positive and negative aspects experienced with it.

Formation of Employer Attitudes Toward Technology

Employers will also make judgements of technology, as did the employees and students, based on their own past experiences.

However, in Australia, the reality is that these experiences have been far from significant (Mullen 1987,p.12). One would have thought that mounting economic pressure through cost competitive imports and a loss of export revenue would have been sufficient motive to encourage the opposite. However, the lack of exposure to technology, and hence lack of experience with it, may have some bearing on the negative attitude of the Australian manufacturer, and may also be attributed to the rate of change and therefore increased difficulty in keeping up with technology.

The sole purpose for being in business, however, is to earn money. In order to earn money, manufacturers must be cost competitive and in order to be cost competitive they must adopt new technologies. The motives for change are there, so too are the advantages of change. For example, the implementation of technology in industry can have the following benefits:-

1. Increased productivity: achieved through twenty-four hour operation, no requirements for tea or lunch breaks and a constant rate of production being achieved.
2. Increased optimisation: the ability to manufacture with the least amount of waste as is economically possible.
3. Increased accuracy in manufacture: as the machines are capable of working to 0.001mm in accuracy.

4. Reduced errors in manufacture: A programme written once, then corrected with the use of sample components can then be used for a production run or number of production runs without any further programming required.
5. Increased cost competitiveness: Inevitable as a result of points one and two.
6. Reduction in the number of staff required: This aspect alone means enormous savings in terms of overheads such as, superannuation, workers compensation (to which the furniture industry contributes one of the highest premiums for belonging to the greatest risk of injury bracket), sick pay and holiday pay.

This is by no means an extensive list of the benefits offered to the manufacturer who adopts C.A.M. technology in industry, yet the current attitude of Australian industry is still basically negative.

Again, the sole purpose for being in business is to earn money and in order to earn money, manufacturers must be cost competitive. The ultimate penalty for failing to become cost competitive, may be the collapse of the business, as the manufacturer may no longer able to obtain contracts in order to remain in trading.

Summary

In this section, it was explained that both during the Industrial Revolution and in the current economic climate, employment meant security and a reasonable living standard to many people. When this security or living standard is threatened, people become concerned about the cause of this threat.

It was also noted that Australian's in general regarded technological change as one of the main causes of unemployment (Eckersley, 1988) and that this could in effect create negative attitudes toward technology among many people. However, research has shown (Nelson, 1988) that school children, the nations future workforce, had a more positive attitude toward technology and this may well have resulted from a positive exposure to a different form of technology. Attitudes toward technology were then concluded to be formed as a result of reflective evaluation, that is, they were formed when reflecting upon and evaluating one's past experiences with it.

The formation of the employer's attitude toward technology in Australia was also discussed. It was determined that a lack of experience in this area by employers may have resulted in a negative attitude toward technology. However, it was also determined that there should have been a much greater acceptance of technology in

industry due to the following benefits to the employer.

1. Increased productivity.
2. Increased optimisation.
3. Increased accuracy in manufacture.
4. Reduced errors in manufacture.
5. Increased cost competitiveness.
6. Reduction in the number of staff required.

In the next section, technology in industry, in general, will be discussed. Some of the reasons for implementing technology in industry will also be identified as well as the implications of failing to adopt technology in industry.

2.4 Industry and Technology

In this section, the implementation of technology in general, into industry, will be briefly discussed, as will the extent to which this implementation is taking place. Some of the reasons for the implementation of technology in industry will also be identified and examined. Finally, the implications of failing to adopt these technologies in industry will be addressed.

Extent of Technology in Industry

The extent to which technology in general, is being incorporated in industry is enormous. In fact, not only the extent, but the rate at which it is being incorporated is also enormous (Weston 1988,p.64; Willis 1984,p.53) and this may be attributed to the rate at which technology in general is changing. According to Solomon (1983,p.15) "We seem to have an appetite for change". However, this appetite for change is only one of numerous factors influencing the development of technology in industry.

Influencing Factors

Willingness, or lack of willingness, on behalf of manufacturers is a necessary factor for the implementation of technology in industry, however, a further factor that cannot be overlooked is that of people

and their requirements. Without people, there would not be much call for technology. It is those same requirements of the eighteenth century people that led to the Industrial Revolution, that are leading to the further development of technology in industry in the twentieth century. For example, owing to the greatly increased population of today, an increase in demand has resulted in the need for a larger volume of production. Coupled with this, due to extensive consumer legislation, is the need for the production of goods of an extremely high quality, as people are less tolerant of defective and/or unreliable goods. Furthermore, there is the need for an economical product. This product should not only be economical in terms of cost, but also in terms of wear. It is these and other demands of the people that are applying pressure to the manufacturer in order to ensure that they conform with the new technologies.

According to Edwards (1987,p.5) and Weston (1988,p.64) a third influencing factor, globally, is that there is becoming an increasing emphasis on the need to implement the new technologies in industry today. As one company strives to obtain a competitive edge over another by implementing C.A.M., the others must comply in order to remain competitive. It is this need to remain competitive at all times on a global basis, that is also influencing the acceptance of C.A.M. technologies in industry.

Consequences of Non-Compliance

The importance of the integration of this technology in industry is exemplified by Marcum (1986,p.28) when he reflects on the deteriorating international competitiveness of the most technically advanced European countries.

> "The primary source of Europe's poor performance both now and in the future is an underlying weakness in technology including the ability to innovate and to absorb and utilise new technologies."

If Australia is to keep up with the more advanced nations, then Australians must learn from the European experience and not only adopt and embrace this technology but further develop it and customise it to suit their needs.

Summary

In this section, not only the extent, but the rate at which technology in general, is being incorporated in industry, has been noted.

Some of the factors influencing the implementation of technology in industry were examined. These were:-

1. A willingness to change.
2. The "people" factor.
3. The pressures brought to bear by a deteriorating international competitiveness.

Finally, it was pointed out that if Australian companies were to remain competitive with other advanced nations, there was a clear need to adopt and customise new technologies for use in their own industries. This was evidenced by the failing European experiences based on their unsatisfactory ability to make use of the new technologies.

In the next section, the extent to which technologies have been incorporated in Australian Industry will be addressed.

2.5 Australian Industry and Technology

In this section, the need for Australia to incorporate new technologies in the manufacturing industry will be discussed, as will the rate at which it is being incorporated.

Global Competition

As C.A.M. technology has been accepted by many countries throughout the world, so too must Australia accept it if Australian industry is to remain competitive in business on a global basis. (Willis 1984,p.54, Yates 1987,p.24). This is highlighted by Hass (1987,p.75) in a simple but meaningful statement which represents the reality of the situation.

> "All manufacturing decisions must now meet the test of fierce global competition"

Therefore, if Australian industry finds itself increasingly unable to compete with their global trading partners, and if they do not attempt to comply with the new norm, Australia as a nation, will become increasingly poorer, resulting in a decline in both living standards and opportunities for employment.

Australian Acceptance of New Technologies

The implementation of C.A.D./C.A.M. technologies in Australia at this stage however, has been relatively slow according to Mullen (1987,p.12). One reason for this slow implementation, as suggested by the Chamber of Manufacturers in New South Wales and reported by Loch (1987,p.12), is a lack of appreciation of C.A.D./C.A.M. technology by the Australian businessman through a lack of training facilities:-

> "This retardation in appreciating C.A.D./C.A.M. is fundamentally due to the lack of training centres available to teach the average Australian businessman how to operate, and appreciate the computer industry and all that it has to offer."

This view was also supported by T.I.D.A. (1989,p.24) when it noted that although hands-on training for C.A.D. and C.N.C. machining was fairly well catered for in Western Australia, training in the managerial issues relating to C.A.D./C.A.M. technologies, was virtually non-existent.

These managerial issues may well be one of the basic factors in the reluctance of employers to embrace this technology. The fact that employers perceive that there is no outlet in which they can learn about the technologies, and uses to which they can be put, could well slow down the rate of acceptance. However, one would have thought, that if there was any sort of market for C.A.M. technologies in Australia, the supplier would have attempted to fill this gap, by themselves

initiating managerial/awareness courses, in order to procure sales.

Summary

In this section, pressures created as a result of the need to remain internationally competitive were outlined. If Australia could not remain competitive with their global trading partners, they would lose trade and as a result, become increasingly poorer. This, it was suggested, would affect living conditions and opportunities for employment in the future owing to a decline in trade.

The implementation of technology in Australian industry was noted to be fairly slow at present and that this might be due to a lack of information available for the Australian businessman on the capabilities of this technology. However, it was felt that the integrity of the suppliers was such, that, if there was the possibility of a market for their technology within the Australian industry, they would have initiated training in managerial and awareness type courses.

In the next and final section, the technologies that have been specifically designed for the furniture industry will be discussed.

2.6 Furniture Industry and Technology

This section will look at the development of technology which has been specifically designed for the furniture industry. It will also look at some of the advantages to be had by the furniture manufacturer with the implementation of these technologies.

Technologies and the Furniture Industry

The furniture industry is neither exempt from, nor able to avoid the vast array of technological change that is currently taking place. Manufacturing processes are constantly being affected by new materials and new hardware systems specifically designed for use in the furniture industry. These technologies are being developed at such a rate that it is difficult for manufacturers to keep up with them.

One of the major hardware technologies that has affected cabinet manufacturers throughout the world is the 32mm system (System 32). System 32 not only facilitates the use of economical flat panel products, but has resulted in the production of specialised machinery in order to maximise its benefits. This hardware system alone has resulted in increased productivity (Hall 1988,p.64; Lenckus 1985,p.47) and saw a total commitment from the industry in its acceptance. Clearly, the use of such a standardised system of assembly with a total industry

commitment must lend itself not only to the use of specialised equipment, but also to computerisation. If this is the case, then should manufacturers not pursue this automated system of manufacture?

As pointed out by Keltch (1984) and Urban (1988), there are obvious managerial advantages to be had by the furniture manufacturer in the area of information storage and retrieval. Manufacturers can store and generate data concerning payrolls, inventories, estimating and costing, employee records, designs, and cutting lists etc. However, there are other advantages to be had of technology in the furniture industry. For example, in terms of productivity and design capability, the tradespeople of the past who have produced some magnificent work, cannot compete with the speed, accuracy and intricacy of the new technologies. Not only will these new technologies do the job better and quicker, but they can repeat the same task an infinite number of times with perfection on every occasion.

Developments for the Furniture Industry

Garet (1988) outlines many of these machines that have been specifically designed for use within the furniture industry. They range from C.N.C. overhead routers with one, two, four, six or turret head spindles, to N.C. saws, C.N.C. sanding machines, shaping machines,

double-end tenoners, boring and milling machines. Also included are computerised presses capable of all of the following tasks:-

1. Spreading adhesives.
2. Positioning sheet materials in readiness for pressing of veneers or foils.
3. Veneering.
4. Foil laying.
5. Heat and pressure control for curing adhesives.
6. Automated stacking upon completion of pressing.

The Western Australian Furniture Industry

As has been stated previously, the implementation of C.A.D./C.A.M. technologies in Australia at this stage has been fairly slow. The same is true, if not more so, of the furniture industry in Western Australia. Although there is little research to draw from in order to substantiate this, in discussions with people involved in the furniture industry from T.A.F.E., from equipment suppliers and from industry itself, one can appreciate the lack of use of these technologies in the industry.

Furniture manufacturers are not readily adopting these technologies in the furniture industry in Western Australia. This decision, in light of international competitiveness for the industry, may seriously affect the industry's capacity for improved, if not continued,

success in the future. For as has been noted by Schutz (1986,p.3):-

> "Without the use of new technologies and consequent improvements in output, productivity and quality, the manufacturing sector in Australia will become increasingly uncompetitive."

Summary

This section noted that the furniture industry has not been ignored in the development of technologies. In fact, it would appear that there has been a machine developed in order to automate nearly every process employed within the industry. It has been pointed out that there are obvious advantages to be had by the manufacturer not only in information storage and retrieval, but also in the manufacturing processes.

It was also noted that the Western Australian furniture manufacturer is not readily adopting the new technologies and this decision, in relation to Australia's international competitiveness has been questioned. Finally it was noted that without the use of new technology in industry, and the benefits as a result, the manufacturing sector in Australia will become increasingly uncompetitive.

2.7 Summary of the Review

Having defined the terms "attitude " and "technology" in the context in which they will be used in this study, the development of both a positive and a negative attitude toward technology was explored. It was then pointed out that employers would, as did students (Nelson 1988,p.56) and Australians in general (Eckersley 1988,p.3), form their opinions of technology based upon their past experiences. However, it was noted that there was very little in the way of past experience in the use of this technology. The fact that there has generally been minimal application of the technology in industry throughout Australia, was also discussed and the current attitude of employers to the technology was questioned. It was then outlined that on a global basis, both the extent and rate at which technology, in general, is being incorporated in industry is enormous. Reasons offered for this were listed as:-

1. Having an appetite for change.
2. The demands of the people for a better quality, more economical product.
3. The need to remain competitive on a global basis.

The consequences of not accepting the new technologies in industry were discussed and were noted as being poor economic performance

and a lack of job opportunities.

Technology and the Australian industry was then examined and it was indicated that Australia, like other leading manufacturing countries, must keep abreast of the pace set by the most advanced countries if they are to remain competitive. A failure to do this would lead to a loss of trading opportunities and ultimately result in a poorer economy.

The acceptance of C.A.M. technology in Australian industry was then expressed as very slow. This may have resulted from the employers' perceived lack of training facilities for the businessman to become familiar with and appreciate it. However, it was felt that if there was an interest shown in the use of C.A.M. technology, suppliers would have remedied this situation in order to increase their own sales.

Finally, the technology that was available to the furniture industry itself was discussed. Not only were there the managerial technologies and their administrative advantages, but there were also technologies suitable for manufacturing in the form of heavy machinery which were capable of producing work with much more intricate detail and far more accurately than by hand. Furthermore, there was the advantage of greater speed and an ability to repeat the same task an infinite

number of times with perfection on every occasion.

It was noted that the implementation of this technology in the furniture industry in Western Australia has been a slow process. However, this is also the same general opinion of those involved within the industry itself. It was felt that this represented a negative attitude toward the technologies that are available and that this was an uneconomical decision on the part of the employer.

In conclusion, this prompts the questions "Why has this been the attitude?" and "To what extent is this attitude affecting the implementation of C.A.D./C.A.M. technology within industry?"

It is these issues that have led to the proposed study.

CHAPTER THREE

Design Of The Study

Methods

It was intended that the data for this research project should be collected from the person within the company responsible for the financial decisions of that company. In most cases this would be the employer. This was considered necessary as the installation of C.A.M. is a financial decision and only the person making those decisions can give accurate information.

The particular design selected for the data collection was that of a Likert Scale. This design was selected as it was felt that it enabled a quick recording of responses, and it provided an opportunity to avoid a neutral or undecided response from the employers.

In order to ensure full understanding of the requirements and to obtain a complete commitment from the respondent, it was initially considered necessary to visit the companies individually. A further advantage of visiting the company in person was that it avoided the company secretary or pay clerk from being given the task of

completing the instrument.

However, upon contacting the employers by phone, only two agreed to participate under these conditions. Others indicated that they were prepared to participate only if the questionnaires were posted out. This was subsequently agreed to and a return self-addressed envelope was included for the replies.

Another concern which arose whilst on the phone, after explaining what the study was about, was that many of the employers had quite a bit to say on the issues. This prompted the inclusion of a further sheet in the questionnaire to allow for some free comment on any other issue which had not yet been considered (see Appendix V).

Sample

In order to obtain good comparative data, an equal number of participants were involved from each of the two groups, that is, those who had C.A.M. and those who did not. It was also necessary to include one control measure in the study. This was to ensure that all participants had a minimum number of employees, as this would exclude all small manufacturers that simply could not afford the technology and therefore have made no effort to adopt or become familiar with it. However, any company which had adopted C.A.M.,

irrespective of the numbers of employees, was eligible.

As well as seeking information from a major supplier/installer of C.A.M. equipment, a search of information from The Furniture Industry Training Association's (F.I.T.A.) data base was conducted to obtain all eligible participants that fulfilled all requirements. All those found to be suitable were divided into the two groups, those employers with C.A.M. and those without C.A.M., and a random selection was made from these groups using a random numbers table.

For this survey, ten companies with C.A.M. and ten companies without C.A.M. were selected. Each company had in excess of ten employees with the exception of one. This was a small company of four with an N.C. installation. The first ten companies with C.A.M. that were contacted, accepted the invitation to participate. However, whilst enlisting the ten companies without C.A.M., it was discovered that one of the companies thought to be without C.A.M. had in fact updated their equipment. This company had accepted the invitation to participate in the study and as such was added to the list of companies with C.A.M. The study took place with eleven companies which utilise C.A.M. or N.C. equipment and ten companies without such equipment.

Instrumentation

The instrument, consisting of three sections, had one section devoted to the collection of data in order to determine the size and type of company that completed the questionnaire (see Appendix III). This section also coded in order to aid in identification of those companies that had not responded. This was to allow for any follow up calls were necessary in order to obtain a reasonable number of returns. The second consisted of the questionnaire sheet in order to facilitate the collection of data for analysis (see Appendix IV), whilst the third allowed for some comment on the issues of the questionnaire and sought opinions on what would encourage or discourage the use of C.A.M. in the industry (see Appendix V).

One third of the questionnaire developed for companies with C.A.M. technology required alternative wording from the questionnaire developed for companies without C.A.M. technology. This was considered necessary as some of the questions related specifically to the companies with C.A.M. would not relate to the experience of companies without C.A.M. Two of six domains were affected in this manner. (See Appendix IV).

The questionnaire was based on a Likert Scale with the following four fixed response options.

1. Strongly Agree.
2. Agree.
3. Disagree.
4. Strongly Disagree.

The fifth neutral option or "undecided" was deliberately omitted to force respondents to commit themselves to either a positive or negative response. This was necessary because of the nature of the issue, in a world where the rate at which technology is advancing rapidly, demanded such a conviction from the employer.

The questions on the sheet were divided into six domains of five questions. The same thirty questions were also sub-divided into two categories, that is, company specific questions, and general but topical questions. The six domains or themes assessed were as follows:-

1. Employer's attitude to the suitability of computers in the furniture industry.
2. The employer's understanding of the capabilities of computers in the furniture industry.
3. The employer's attitude toward the cost of C.A.M. equipment.
4. The employer's attitude toward training.
5. The employer's attitude toward the allocation of responsibilities toward the implementation of C.A.M. in the furniture industry.
6. The employer's attitude toward computerisation in the current

economic climate.

As previously mentioned, two of the six domains required questions that related specifically to the company making the response. This posed difficulties in structuring questions that were relevant to both companies with C.A.M. and companies without C.A.M. The two domains of concern were, employers' attitudes toward training and employers' attitudes toward computerisation in the current economic climate. Clearly, both of these areas required separate questioning structures, as the structure of a given question may not relate to the experience of employers with C.A.M. as well as the experience of employers without C.A.M.

All questions were structured in such a way that 50 percent were worded negatively and 50 percent were worded positively. The questions were also structured so that 50 percent were company specific questions, half of which were negative and half positive, and 50 percent were general but topical questions, again half of which were negative and half positive. Care was also taken to ensure that, wherever possible, a similar number of negative and positive type questions, as well as similar number of company specific and general but topical questions, were divided evenly throughout the six domains. (For the full details of each question (see Appendix VI).

The five questions within each of the domains were distributed at intervals of six within the questionnaire. This gave the maximum distance between questions from similar domains in order to help prevent identification of any domains of questioning by the respondent, and also assisted in easier collation of results. Where possible, positive and negative or company specific and general but topical questions were distributed evenly throughout the questionnaire.

Validity and reliability are important areas of all questionnaires and to this end were not overlooked in the development of the instrument used in this research.

In order to determine the face validity of the instrument, it was presented to an expert in the field whose suggestions were adopted.

In order to determine content validity, the instrument was presented to the Acting Head of the Department of Furniture Trades at Leederville Technical College who suggested that the term "computerised equipment" be changed to the more specific term of "computer numerical controlled machinery". This too was accepted.

In order to assess the reliability of the instrument, three senior lecturers and three lecturers were invited to trial it. The three Senior

Lecturers, one each from the Wood Machining, Upholstery and Cabinetmaking trades, and three lecturers, again one from each of the above trades, determined that there appeared to be no areas of controversy or ambiguity in the instrument.

Data Collection

All companies selected for participation in the study were advised by phone of the purpose of the study and invited to participate. They were assured of complete confidentiality of their responses. Two companies were visited in order to complete the questionnaire, the remaining companies were advised by phone that approximately 30 minutes would be required to complete the instrument and instructions were given by phone as well as attached to the instrument (see Appendix II).

Questionnaires were then forwarded by mail, to each of the employers that wished to participate. However, it was necessary, on two separate occasions, to make a number of follow up phone calls in order to secure a satisfactory number of returns. Six of the twenty-one companies finally indicated that they no longer wished to participate. The analysis went ahead with fifteen returns, ten of which, were from companies with C.A.M, and five from companies without C.A.M., representing a 71 percent response rate.

Analysis of Data

Because of the small sample, it was determined that the most appropriate method of analysis would be the use of chi square. Chi square, one of the nonparametric data analysis techniques, has been selected as it is amenable to the analysis of frequency data which is essentially the type of data obtained from the questionnaires.

The possibility of distortion through other means of analysis has been pointed out by Lumsden (1974,p.128) when he notes that if there are fewer that five and in particular, when there are only two score categories, and in this case there are four, although a weighted statistic would be mathematically correct, it "may be misleading for the attribute".

The use of chi square however, presents its own special problems whenever there are small numbers of data to be analysed. For example, when the contingency table from which the results are drawn, has expected observations of less than ten in any one cell, the results are less reliable. However, it is possible to combine similar categories in an attempt to increase the numbers of expected frequencies within the table (Arkin 1970,p.140; Koosis 1970,p.229) and for the purpose of this research, this was adopted. The options of agree and strongly agree were combined to form one group whilst those of

disagree and strongly disagree were combined to form the other.

In so doing, this option creates a two by two contingency table for analysis rather than a two by four table and this presents yet another problem. A two by two contingency table has only one degree of freedom and as such the results again become less reliable. This can be overcome by the addition of the "Yates correction factor for discontinuity" which renews the reliability of the data (Arkin 1970,p.140; Edwards 1967,p.333; Lumsden 1974,p.134).

A final obstacle was, that because of the small number of participants in the research, the numbers within the expected frequency cells of the contingency table in some cases, even when groups have been combined, still did not meet the required minimum of ten observations. With respect to situations where this occurs, Jongeling (1989,p.97) notes that the use of the Yates Correction Factor will also cater for this situation. Therefore, the use of the Yates Correction Factor of 0.5 was incorporated in all chi square calculations.

As the results were obtained within grouped sets of data, that is, each domain had a number of corresponding questions in order to measure that domain, it was necessary to obtain the alpha coefficient for that group of data.

The alpha coefficient is a measure of internal consistency between responses within grouped data. A high coefficient alpha means that there has been a good degree of consistency between response patterns within the grouped items. In order for the data to be said to be collapsible for the sake of discussion, it is generally accepted that a coefficient of 0.7 is the minimum level required (Galan and Nelson, 1986). Where this was not the case, generalisations were possible and as such the data was discussed separately within their groups.

The level of significance used to determine the significance of the results was $p \leq 0.05$. That is, there is five or less chances in one hundred, that any significant results obtained, were obtained purely by chance alone.

However, as two of the questionnaire's domains were structured with differing questions for employers with C.A.M. and employers without C.A.M., it was not possible to conduct a chi square calculation on these data. Therefore, the data are presented in a table in terms of frequency counts and discussed on face value.

Finally, section three was analysed by reviewing the data in order to determine a list of broad headings under which the data could be categorised. These headings were determined by interpreting the

meaning behind the responses obtained. Upon the formation of these headings, the data was then checked and slotted into the most appropriate category. Finally, a count was carried out in order to determine the number of respondents indicating some concern for that particular point. This process was then repeated at a later stage and a level of consistency for the categorisation was found to be good. These data were therefore used in support of the data obtained from the questionnaire.

CHAPTER FOUR

Research Findings.

Of the twenty one companies surveyed, fifteen responses, representing 71 percent of the total sample, were received. This comprised ten returns representing 91 percent of those surveyed with C.A.M. and five returns constituting only half of those surveyed without C.A.M.

Quantitative data analyses were undertaken by means of the computer based statistical programme "Lertap". The database consisted of fifteen records each with forty three separate fields. Of these, the first thirteen fields were dedicated to the determination of the size of the company, the extent of computerisation within the company and the type of market pursued by that company, whilst the remaining thirty fields were allocated to responses to the remaining items in the instrument.

Qualitative data analyses were undertaken by the development of categories and the application of these data to the categories on two separate occasions. Rater reliability in excess of 82 percent was

established and this data was used to supplement the quantitative data presented in the tables.

Tables in the following sections show the analyses of the data collected in relation to items within each domain. The exact wording of each item is to be found in the survey instrument which is included as Appendix V1.

The use of the Yates correction factor was found to be necessary in the chi square analysis of data. Where this has occurred, details are included with the table.

Alpha co-efficients were also generated for data in each of the tables in order to indicate the degree of consistency of response between items within each domain. With the exception of Table 6b, the alpha coefficient did not exceed the generally accepted level of 0.7 (Galan and Nelson 1986). This indicated a degree of inconsistency in response to many items within each of these domains. Where this was evident, items for that domain were analysed individually and not in aggregate. These inconsistencies may be attributed to the misunderstanding of items within each domain. The alpha coefficient in each case, is indicated below respective tables.

Employers' Perceptions of the Suitability of C.A.M.

Table 1 illustrates the issue of the employers' perceptions toward the suitability of implementing C.A.M. in the furniture industry in Western Australia. With a coefficient alpha of 0.413, each of the items are analysed individually.

Table 1.

Employers' Attitudes Toward The Suitability of C.A.M. in the Furniture Industry in Western Australia.

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	χ^2	Total	P
1	C.N.C. equipment is not only suited to large scale production in the furniture industry.	With C.A.M. Without C.A.M. Total	8 5 13	2 0 2	0.072	10 5 15	N.S.
7	There are only a limited number of outlets in Perth in which computer aided machining is suited	With C.A.M. Without C.A.M. Total	5 2 7	5 3 8	0.033	10 5 15	N.S.
13	I believe that our product output could not be increased with the installation of C.N.C. equipment	With C.A.M. Without C.A.M. Total	2 3 5	8 2 10	0.937	10 5 15	N.S.
19	I believe many components in this company's range can be produced with C.N.C. equipment.	With C.A.M. Without C.A.M. Total	9 4 13	1 1 2	0.072	10 5 15	N.S.
25	C.N.C equipment is suitable for the production of customised work in the furniture industry.	With C.A.M. Without C.A.M. Total	5 4 9	5 1 6	0.313	10 5 15	N.S.

NOTE:- Yates correction factor of 0.5 applied. N.S. = Not significant * = $p = < 0.05$ df = 1
Alpha Coefficient = 0.413

The Chi square analysis reported in Table 1 revealed no significant differences in response patterns between companies with C.A.M. and

companies without C.A.M. However, notable observations include:-

- A total of 87 percent (n=13) of employers agreed that C.N.C. equipment is suited both to large and small scale production in the furniture industry and that there are many product components within their own company's current range of goods that could be produced with the use of C.N.C. equipment (items number 1 and 19).

- The majority of companies, 80 percent (n=4) without C.A.M. and 50 percent (n=5) with C.A.M., reported that C.N.C. equipment is suitable for the production of customised work within the furniture industry (item 25). These findings indicate that the respondent group had consistent views on the type of production suitable to the use of C.A.M. This is further supported by the data shown in Table 8 (Appendix VII) wherein, only two of the fifteen respondents indicated that the use of this technology was inappropriate in the furniture industry.

Employers' Understandings of C.A.M.

Table 2 shows patterns of response in respect of the issues relating to employers' understandings of the capabilities of C.A.M. and its effects on the implementation of C.A.M. in the furniture industry in Western Australia.

The Chi square analysis reported in Table 2 revealed no significant difference in response patterns between employers with C.A.M. and employers without C.A.M. on each of the issues.

Table 2.

Employers' Understanding of the Capabilities of C.A.M. for the Furniture Industry in Western Australia.

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	χ^2	Total	P
2	C.N.C. machinery offers speed in machining processes far greater than that of most tradespeople.	With C.A.M.	8	2	0.469	10	N.S.
		Without C.A.M.	4	1		5	
		Total	12	3		15	
8	C.A.M. technology is capable of increasing productivity in even the smallest companies in Perth.	With C.A.M.	7	3	0.039	10	N.S.
		Without C.A.M.	3	2		5	
		Total	10	5		15	
14	C.N.C. machinery offers accuracy in machining far superior to that of most tradespeople.	With C.A.M.	8	2	0.469	10	N.S.
		Without C.A.M.	4	1		5	
		Total	12	3		15	
20	The flexibility of C.N.C. equipment is too limited for it to be adopted widely in industry.	With C.A.M.	1	9	2.089	10	N.S.
		Without C.A.M.	3	2		5	
		Total	4	11		15	
26	The type of production this company is involved in is too specialised for C.N.C. equipment.	With C.A.M.	2	8	0.636	10	N.S.
		Without C.A.M.	2	3		5	
		Total	4	11		15	

NOTE:- Yates correction factor of 0.5 applied. N.S. = Not significant * = $p = < 0.05$ df = 1
Alpha Coefficient = 0.685

Findings that have emerged from the data presented in Table 2 can be seen as follows:-

- Despite the lack of statistically significant differences in the understandings of individuals in companies with C.A.M. and companies

without C.A.M., relatively large absolute differences were evident in responses to item number 20. Ninety percent (n=9) of respondents with C.A.M. believed that, in terms of the flexibility of C.A.M., it is suitable for widespread implementation in the furniture industry, whereas 60 percent (n=3) of the companies without C.A.M. believe that the flexibility of C.N.C. equipment is too limited for it to be widely adopted.

- A total of 80 percent (n=12) of the respondent group conceded that the speed and accuracy of C.N.C. equipment is far greater than most tradespeople (items number 2 and 14).

- The majority of companies, 80 percent (n=8) with C.A.M. and 60 percent (n=3) without C.A.M., believe that C.A.M. is a suitable production technique for the manufacture of their product (item 26).

From the data shown in Table 2, and with the exception of item number 20, there is an indication that the respondent group had shared consistent views about the capabilities of C.A.M.

Employers' Attitudes Toward Cost of Implementation

Table 3 shows the data related to issues of the employers' perceptions of the cost of implementing C.A.M. in the furniture industry

in Western Australia.

The Chi square analysis of the data reported in Table 3 revealed no statistically significant difference between the response patterns of employers with C.A.M. and employers without C.A.M. on issues relating toward the cost of implementing C.A.M. within the furniture industry.

Table 3.

Employers' Attitudes Toward the Cost of Implementing C.A.M. in the Furniture Industry in Western Australia.

	ITEM	Category	Strongly Agree or Agree	Disagree or Strongly Disagree	χ^2	Total	P
3	The initial capital outlay is the major factor influencing the installation of such equipment.	With C.A.M. Without C.A.M Total—	9 3 12	1 2 3	0.469	10 5 15	N.S.
9	The costs of implementing C.A.M. would not easily be recovered in the manufacture of our products.	With C.A.M. Without C.A.M Total	4 4 8	6 1 7	0.836	10 5 15	N.S.
15	The cost of C.N.C. equipment does not warrant their application in the furniture industry.	With C.A.M. Without C.A.M Total—	0 2 2	10 3 13	1.801	10 5 15	N.S.
21	The cost of maintenance greatly influences our decision on the installation of C.N.C. equipment.	With C.A.M. Without C.A.M Total	4 3 7	6 2 8	0.034	10 5 15	N.S.
27	The cost of training staff to use C.A.M. is not likely to influence my decision to install it.	With C.A.M. Without C.A.M Total—	9 4 13	1 1 2	0.072	10 5 15	N.S.

NOTE:- Yates correction factor of 0.5 applied. N.S. = Not significant * = $p = < 0.05$ df = 1
Alpha Coefficient = 0.493

Key findings from the data presented in the above table include:-

- The majority of respondents 90 percent (n=9) of those with C.A.M. and 60 percent (n=3) of those without C.A.M., perceive the initial capital outlay as the major influencing factor on any decision to install C.A.M. within the industry (item 3). This is further supported by data shown in Table 8 (Appendix VII) wherein 46 percent (n=7) of respondents state the cost of purchase as a factor discouraging the implementation of C.A.M. within the industry. Data included in Table 7 (Appendix VII), revealed that 53 percent (n=8) of employers felt that an increase in government assistance would be a positive factor in encouraging the implementation of C.A.M. within the industry. Examples given as assistance that may be offered were:-

1. Increases in the tariff on imported furniture.
2. Reduction in the import duty on C.A.M. equipment.

- The majority of the respondent group (100 percent of those with C.A.M. and 60 percent (n=3) of those without C.A.M.) indicate that the use of C.A.M. in the furniture industry in Western Australia, is warranted, despite the initial cost of implementation (item 15).

- The majority of the respondent group 90 percent (n=9) of those with C.A.M. and 80 percent (n=4) of those without C.A.M., agree that the cost of training staff in the use of C.A.M. equipment is not likely to have any influence on their decision to install C.A.M. (item 27).

With the exception of item 9, the findings presented in Table 3 reveal that the respondent group shared uniform opinion on issues relating toward costs involved in the installation of C.A.M. in the furniture industry in Western Australia.

Employers Perspectives About Training

The data presented in Tables 4a and 4b, on the effect of issues related to the training of operators in the use of C.A.M. in the furniture industry, result from a different questionnaire to each of the respondent groups. Therefore a Chi square analysis is not appropriate. The findings in Tables 4a and 4b are discussed without reference to statistical tests for significant differences.

The alpha coefficients of -0.205 and 0.189 for Tables 4a and 4b respectively show marked inconsistency in response patterns to items within this domain. Because of this, an item analysis was conducted in order to determine single items contributing to these low alpha co-efficients. Each item in turn was eliminated and alpha co-efficients generated. No single confounding item was to be found.

Notable observations from the data presented in Table 4a are as follows:-

• Ninety percent (n=9) of the respondent group with C.A.M. installations feel that staff training costs are offset by the returns made in utilising C.A.M. equipment.

Table 4a.

Training Operators as an Influence on the Implementation of C.A.M. in the Furniture Industry in Western Australia.

(Companies with C.A.M.)

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	Total
4	Staff training costs are extreme in comparison with the returns offered by C.A.M.	With C.A.M.	1	9	10
10	T.A.F.E. should offer a complete training course for relevant C.A.M. processes to all apprentices.	With C.A.M.	6	4	10
16	I feel that training people in the use of C.A.M. is best done by the company as the need arises.	With C.A.M.	6	4	10
22	The time required for training in the use of C.A.M. is not an obstacle to further installations.	With C.A.M.	10	0	10
28	There are insufficient outlets for training of new staff in the use of C.N.C. equipment.	With C.A.M.	6	4	10

Alpha Coefficient = -0.205

• One hundred percent (n=10) of the respondent group with C.A.M. installations feel that the time required for training staff will not emerge as an obstacle to further installation of such equipment.

The data relating to employers without C.A.M. in Table 4b indicate

that:-

- Eighty percent (n=4) of the respondent group without C.A.M. installations feel that a lack of Government financial assistance for training will not affect their decisions on whether or not to install C.A.M. in their factories.

Table 4b.

The Effect of the Issue of Training Operators on the Implementation of C.A.M. in the Furniture Industry in Western Australia.

(Companies without C.A.M.)

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	Total
4	This company cannot afford the cost of training staff in the use of such equipment.	Without C.A.M	3	2	5
10	T.A.F.E. should offer a complete training course for relevant C.A.M. processes to all operations.	Without C.A.M	2	3	5
16	The availability of trained people will influence the implementation of C.A.M. for our company.	Without C.A.M	2	3	5
22	The lack of government assistance for training will not affect my decision to implement C.A.M.	Without C.A.M	4	1	5
28	The concept of C.A.M. is still new and therefore does not require any formal training at this stage.	Without C.A.M	1	4	5

Alpha Coefficient = 0.189

- Sixty percent of respondent companies without C.A.M. were unable to afford the cost of training staff in the use of C.A.M. equipment (item 4), whilst 60 percent of the same group feel that T.A.F.E., an

inexpensive source of training, is not an appropriate source of training for the country's future tradespeople.

- Eighty percent (n=4) of the respondent group without C.A.M. installations acknowledge the rate of advancement in C.A.M. technology and therefore agree with the need for current formal training in the use of such equipment.

On comparing the data within tables 4a and 4b, conflicting opinions are evident. These suggest that:-

- Sixty percent of the respondent group without C.A.M. (n=3), cannot afford the cost of training staff in the use of C.A.M. equipment (item 4, Table 4b), whilst 90 percent of the respondent companies using C.A.M. (n=9) believe to some extent that the advantages offered by C.A.M. itself, far outweigh the training costs (item 4, Table 4a).

- Sixty percent of the respondent group without C.A.M. (n=3) feel that T.A.F.E. is not the institution in which training in the use of C.A.M. should be conducted (item 10, Table 4b), whereas 60 percent of companies with C.A.M. (n=6) feel that T.A.F.E. is an appropriate source of training (item 10, Table 4a).

Other data included in Table 9 (Appendix VII), addressing other issues of concern to employers, reveals that 33 percent (n=5) of those total respondent group, commented further on the issue of training. A lack of training facilities was the most prominent concern. One particular comment noted that industry leaders were always well ahead of T.A.F.E. technology in practice. However, the same manufacturer notes that, although T.A.F.E. should offer training to the whole of industry, it would be more appropriate if it was guided toward management. Another manufacturer indicated that between T.A.F.E. and the equipment suppliers, an adequate training service was being provided.

From the data presented in Tables 4a and 4b, there does appear to be some difference of opinion between respondent groups on particular issues of training staff in the use of C.A.M. equipment. However, determination of the extent of these differences, whatever the degree, is beyond the scope of this study.

Responsibility for the Implementation of C.A.M.

Table 5 presents the results of items relating to whom, according to employers, the responsibility lies for the implementation of C.A.M. in the furniture industry in Western Australia.

The Chi square analysis on each of the items within this domain revealed no significant difference in the response patterns between companies with C.A.M. and companies without C.A.M.

Table 5.

Employers Attitudes Toward the Allocation of Responsibilities for Implementing C.A.M. in the Furniture Industry in Western Australia.

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	χ^2	Total	P
5	The responsibility for educating industry in possibilities of C.N.C. equipment lies with T.A.F.E.	With C.A.M.	5	5	0.313	10	N.S.
		Without C.A.M	1	4		5	
		Total	6	9		15	
11	It is not the responsibility of the suppliers to keep industry informed of changes in technology	With C.A.M.	4	6	1.065	10	N.S.
		Without C.A.M	0	5		5	
		Total	4	11		15	
17	The Government does not do enough to help industry to keep abreast of technological change.	With C.A.M.	9	1	0.072	10	N.S.
		Without C.A.M	4	1		5	
		Total	13	2		15	
23	Government financial assistance would greatly affect my decisions to implement/maintain C.A.M.	With C.A.M.	8	2	0.043	10	N.S.
		Without C.A.M	3	2		5	
		Total	11	4		15	
29	T.A.F.E. to play a greater research and advisory role to keep industry informed changes in technology.	With C.A.M.	7	3	0.469	10	N.S.
		Without C.A.M	5	0		5	
		Total	12	3		15	

NOTE:- Yates correction factor of 0.5 applied. N.S. = Not significant * = $p = < 0.05$ df = 1
Alpha Coefficient = 0.272

Relevant findings that emerge from the data presented in Table 5 include:-

- A coefficient alpha of .272 which indicates much inconsistency in response patterns of employers on this issue.

- A total of 80 percent of all respondent companies (100 percent of companies without C.A.M. (n=5) and 70 percent of companies with C.A.M (n=7)), believe that T.A.F.E. should play a greater research and advisory role in relation to the use of C.A.M. in the furniture industry (item 29). However, only 60 percent of the respondent group (20 percent of companies without C.A.M. (n=1) and 50 percent of companies with C.A.M (n=5)), felt that T.A.F.E. should assume responsibility for educating industry in the possibilities of C.N.C. equipment.

- The majority of respondents, 100 percent without C.A.M. (n=5) and 60 percent of companies with C.A.M. (n=6) felt that suppliers should keep them informed with changes in technology.

- The majority of respondents (90 percent with C.A.M. and 80 percent without C.A.M.), indicated that Government assistance to the industry in the area of technological change is lacking (item 17).

- 80 percent of employers with C.A.M. and 60 percent of employers without C.A.M. (n=3) would allow their decisions to implement C.A.M. to be influenced by Government financial assistance (item 23).

The findings obtained from the data presented in Table 5 indicate

that the respondent group had consistent views on who should be responsible for issues relating to implementing C.A.M in the workplace. They felt that other associated groups, that is, T.A.F.E., Government and the suppliers, were not assuming enough responsibility for the implementation of C.A.M. within the industry.

Effects of the Current Economic Climate

Tables 6a and 6b show data related to the issue of favourability of computerisation in the current climate. Table 6a, wherein items were found to have an alpha coefficient of only 0.21, clearly shows again the inconsistency in response patterns among respondents with C.A.M.

These data indicate that:-

- The majority (80 percent) of respondents believe that their C.A.M. installations are not being used to capacity.

- Given the above, 70 percent of respondents with C.A.M. installations believe that C.A.M. still has a cost competitive edge over conventional methods of manufacturing (item 18).

- Seventy percent of the respondent group that use C.A.M. feel that the Western Australian market is not so limiting that C.A.M. cannot be

successfully adopted. This is a fundamental belief necessary for the successful implementation of C.A.M. within the industry.

Table 6a.

The Effect of the Employers' Attitudes Toward the Current Economic Climate on the Implementation of C.A.M. in the Furniture Industry in Western Australia.

(Companies with C.A.M.)

	ITEM	Company	Strongly Agree or Agree	Disagree or Strongly Disagree	Total
6	Our current C.A.M. equipment does not have the capacity to increase output if required.	With C.A.M.	2	8	10
12	C.A.M. has allowed us to diversify into areas of production which we normally would not consider.	With C.A.M.	5	5	10
18	C.A.M. allows us to be more cost competitive in the current market.	With C.A.M.	7	3	10
24	The W.A. market is very limited thus limiting the extent to which C.A.M. may be successfully adopted	With C.A.M.	3	7	10
30	C.A.M. has allowed us to pursue markets other than those in W.A. as outlets for our product.	With C.A.M.	4	6	10

Alpha Coefficient = 0.21

The data relating to employers with C.A.M. indicate that these employers feel the current economic situation to be reasonably sound for the implementation of C.A.M. within the furniture industry in Western Australia.

Data shown in Table 6b reveals a very different viewpoint however, and with an alpha coefficient of 0.753 among items, the group without C.A.M. were consistent in their responses to items within this domain.

Table 6b.

The Effect of the Employers' Attitudes Toward the Current Economic Climate on the Implementation of C.A.M. in the Furniture Industry in Western Australia.

(Companies without C.A.M.)

	ITEM	Company	Strogly Agree or Agree	Disagree or Strongly Disagree	Total
6	There is not sufficient demand for our product at present to warrent the implementation of C.A.M.	Without C.A.M	5	0	5
12	The cost of implementing C.A.M. would not have any effect on the price of our product.	Without C.A.M	1	4	5
18	My current lines of manufacture are suited to mass production processes with C.N.C. equipment.	Without C.A.M	1	4	5
24	C.A.M. is unnecessary as mass produced furniture items are easily imported.	Without C.A.M	2	3	5
30	Our present production methods are unable to cater for current requirements.	Without C.A.M	1	4	5

Alpha Coefficient = 0.753

The key findings revealed by the data in table 6b are:-

- All respondents without C.A.M. (n=5), believe there is insufficient

demand for their product to warrant the implementation of C.A.M.

- Eighty percent of those respondents are able to cater for their current requirements with present production methods.

- Eighty percent of respondents without C.A.M. believe that their current lines of manufacture are not suited to mass production processes (item 18).

- Most believe that if they were to implement C.A.M., this would have an effect on the cost of their product (item 12).

The findings in Table 6b indicate that employers not utilizing C.A.M. within their company, feel that the current climate is not conducive to the implementation of C.A.M. as they are able to cope in the present situation without it. In general it is felt that C.A.M. is an expensive alternative to their current production methods that would necessitate an increase in the cost of their product.

Support for this is also offered by data in Tables 8 and 9 (Appendix VII) where, for both groups of respondent, the market size is stated as an important factor which may influence the implementation of C.A.M. in the industry.

CHAPTER FIVE

Discussion.

It has been the intention in this study, to determine whether the attitudes of employers utilising C.A.M. as a production method in the furniture industry in Western Australia are significantly different from the attitudes of employers who do not use C.A.M. These results were then to be used in order to determine whether or not these attitudes influence the extent of implementation of C.A.M. within the industry.

In so doing, this study focused on the attitudes of employers in relation to the following areas.

1. Suitability of C.A.M. to the furniture industry in Western Australia.
2. Understanding of C.A.M.'s capabilities.
3. Cost of implementing C.A.M.
4. Effects of training requirements for C.A.M.
5. Allocation of responsibilities for the implementation of C.A.M.
6. Current economic climate.

The following discussion is based on each of these issues and is discussed in light of the results obtained from this study.

The Suitability of C.A.M.

Companies that have incorporated C.A.M. within their manufacturing procedures, have experienced the advantages and disadvantages that C.A.M. has to offer. Based on these experiences, these companies have indicated that C.A.M. is a suitable production method for both mass production and customised manufacturing. Upon analysis of data in Table 1, relating to issues on the suitability of CA.M. in the furniture industry in Western Australia, no statistically significant differences in attitudes were indentified between employers with C.A.M. and employers without C.A.M This suggests that respondent companies without C.A.M. accept themselves, that C.A.M. is a suitable method of manufacture for both mass production and customised work.

Although a number of companies without C.A.M. are involved with mass production, and others mass produce a small number of components for the manufacture of standardised goods, discussions with a number of furniture trades lecturers within T.A.F.E., suggest it is generally accepted that the greater number of these companies deal mostly with individual contracts. Given that, companies not adopting

C.A.M. have indicated that C.A.M. is a suitable method of manufacture for the furniture industry, these results confirm that issues relating to the suitability of C.A.M. in the furniture industry in Western Australia, do not appear to exert any substantial influence upon the number of C.A.M. installations within the industry.

The attitudes portrayed in Table 1 indicate favourable attitudes for the implementation of C.A.M. in the furniture industry in Western Australia and are shared by both respondent groups.

The Understanding of the Capabilities of C.A.M.

On issues relating to the understanding of the capabilities of C.A.M., the majority of employers agreed that C.A.M. is far more capable in terms of speed and accuracy than most trades people (items 2 and 14, Table 2). The outcome of these two items alone, it would seem, should have a very favourable effect upon the attitudes of manufacturers toward the implementation of C.A.M. in the furniture industry, particularly upon employers who do not currently have C.A.M. facilities in their workshop. Alarmingly however, within each of these two items, 20 percent (n=2) of the respondents with C.A.M. did not feel that C.A.M. was either faster or more accurate. This is possible if each of these companies have recently acquired their C.A.M. equipment, as it is likely that they may be experiencing the usual hiccups involved with

commissioning expensive computerised equipment. It is also possible that the equipment installed, may greatly exceed the company's current requirements and is therefore not being used to its maximum potential. A further possibility may be that the equipment is being used for purposes, or in a manner other than which it was intended. Problems of this nature may be costly to the manufacturer, and could well result in a negative attitude. These examples are expected to be isolated and not indicative of the normal situation.

The majority of companies taking part in the research, did not feel that their own particular lines of manufacture were too specialised for C.A.M. and that C.A.M. was suited to all aspects of industry. This acknowledgement of the capabilities of C.A.M. is a favourable result for the argument to install C.A.M. and supports data presented in Table 1 whereby, respondent companies without C.A.M. accept themselves, that C.A.M. is a suitable method of manufacture for both mass production and customised lines in the furniture industry.

These data, it is thought, are supportive of the implementation of C.A.M. in the furniture industry. The fact that companies without C.A.M. installations share similar attitudes to those with C.A.M. installations, would indicate that there may be aspects other than a lack of understanding of C.A.M.'s capabilities, that ultimately affect the

respondents decision upon whether or not to install C.A.M.

Attitudes Toward The Cost of Implementing C.A.M.

Understandably, for most manufacturers, the initial capital outlay is a major influencing factor upon the installation of C.A.M. in the furniture industry in Western Australia (item 3, Table 3). The installation of C.A.M. is an extremely expensive decision to make and should manufacturers not anticipate major increases in productivity and profitability to offset the cost of installation, installing C.A.M. may be seen as somewhat of a gamble and attitudes toward installation would not be very favourable.

The majority of each respondent group however (item 15), 100 percent n=10 with C.A.M. and 60 percent n=3 without C.A.M., felt that despite the cost of C.A.M. equipment, its application within the furniture industry is warranted. This is consistent with data in Tables 1 and 2 whereby employers felt that C.A.M. was not only suited to the furniture industry (items 1 and 19, Table 1), but employers understood the capabilities and therefore the possibilities of such equipment (items 2 , 8, 14, and 26, Table 2). These results are indicative of a favourable reflection upon C.A.M., and therefore attitude toware C.A.M., by the majority of manufacturers both with and without C.A.M.

The attitude of employers from each of the respondent groups on the cost of training were similar in that costs associated with training would not influence their decision on whether or not to implement C.A.M. This was expected, as companies that can afford the cost of implementing such equipment would see the cost of training as an integral part of implementation or as being very small by comparison. The costs associated with the training of staff in the use of C.A.M. equipment in the furniture industry in Western Australia, have little or no affect upon the extent of C.A.M. installation within the industry.

Item 9 within this domain shows some difference in attitude that needs to be identified. Sixty percent (n=6) of the respondent group with C.A.M. felt that the cost of implementing C.A.M. could easily be recovered, whereas 80 percent (n=4) of those without C.A.M. did not feel that this was the case. Such a difference may result from the very different lines of manufacture as well as the varying volumes of manufactured goods associated with each of the groups. For example, large manufacturers involved in the furniture aspect of the trade may be required to produce 500 or more chairs of a given design whereas smaller manufacturers involved in built-in products such as kitchen cabinets, wardrobes, or vanity units, would not be required to produce such large quantities. Certain components of such built-in cabinets are repeatable however and are therefore suitable for production in

quantities to be stored and used as required. The periodic use of C.A.M. equipment in this manner however, in order to stockpile components, would not lend itself to a speedy recovery of the investment. This may explain the difference in attitudes toward an issue that most, if not all, manufacturers would consider carefully prior to installing C.A.M.

Given the results of Table 3, it appears that attitudes toward some items associated with the cost of implementing C.A.M. in the furniture industry, may have an effect on the extent of implementation of C.A.M. in Western Australia. However, analysis shows that the extent of the difference between the two groups is not significant and therefore these attitudes equally affect manufacturers of both groups.

Attitudes Toward Training

From the results of findings in Table 4a, there is a consensus of opinion amongst those companies that currently use C.A.M. in the furniture industry in Western Australia, that staff training costs are offset by production returns (item 4), and that time requirements for training will not hinder the further implementation of C.A.M. equipment where and when the need arises (item 22). This positive attitude toward training on behalf of these employers, indicates the importance that employers place upon the correct training requirements, although the majority of employers have indicated little

knowledge of available training facilities (item 28) in Western Australia. This finding is consistent with Lock (1987,p.12) and T.I.D.A. (1989,p.24), whereby the lack of training facilities available for teaching the Australian businessman both in the use of C.A.M. and the managerial aspects of C.A.M., is considered fundamental to the lack of appreciation of this equipment.

Correct training is necessary in order for an operator to gain a full understanding of the processes involved in the use of the relevant piece equipment. If staff undergo the correct training for the equipment, they will achieve the maximum production benefit from the equipment resulting from a knowledge of the many short cuts that C.A.M. has to offer. Without this training, operators can make costly errors resulting in expensive downtime and major repairs.

The findings of Table 4a are indicative of positive attitudes toward training. These findings suggest that the availability of trained operators is not an issue likely to result in the reduction of further C.A.M. facilities by companies that currently utilise C.A.M. This is further evidenced by item 16 whereby the majority of respondents (n=6) believe that training is best done as the need arises.

Table 4b indicates that the majority of respondents without C.A.M.

(n=4) believe that there is a clear need for formal training in the use of C.A.M. (item 28). However, in contrast to those companies with C.A.M., the majority of respondents without C.A.M. (n=3) consider themselves unable to afford training for their staff in the use of this equipment (item 4). It is likely that these employers believe they stand to gain little from such training in the forseeable future that they are reluctant to fund this training. Furthermore, the majority of respondents did not feel that apprentices should receive training in the use of this equipment, even though it may be given free of charge to the employer during the apprentice's normal course of study (item 10).

Although the majority of respondents indicated that the availability of trained people and/or lack of Government funding for training would not affect their decisions to implement C.A.M. (item 22), the issue of apprentice training is a sad indictment upon this sector of the furniture industry in view of the Government's recent initiative of multiskilling for the whole population. The training of apprentices should be up-to-date, with a sound knowledge of past and present methods of production. It should also be progressive, with an insight into what their future holds for them. C.A.M. is an integral part of this future and as such, relevant training should not be denied them.

The results from Table 4b indicate that employers without C.A.M.

share a personal interest in training in order to keep up-to-date with technological changes taking place within the industry. However, based on the findings of Table 4b, it is clear that an increase in the number of tradespeople trained in the use of C.A.M. equipment will not affect an increase in the number of C.A.M. installations in this sector of the furniture industry in Western Australia.

Responsibilities for the Implementation of C.A.M.

From the results observed in Table 5, the findings indicate that the attitudes of employers with C.A.M. and employers without C.A.M. on issues relating to the responsibilities for implementing C.A.M., have much room for improvement. Neither group of employers wished to assume responsibility for issues relating to the implementation of C.A.M. in the furniture industry. That is, they felt that it was the responsibility of the suppliers to keep the industry constantly informed with changes in technology (item 11). They also believed that it was the responsibility of the Government to help the industry keep abreast of technological change (item 17), that the Government should contribute financial assistance to this end (item 23) and that T.A.F.E. too should adopt a greater research and advisory role in order to keep the industry informed of the changes taking place (item 29).

The lack of willingness to assume responsibility for keeping

up-to-date with such technology may indeed have an effect on the rate of implementation of C.A.M. in the Western Australian furniture industry. This might result from a decreased awareness of equipment becoming available in the future and of its capabilities.

A further point of interest is items 11 and 29, whereby 100 percent (n=5) of those surveyed without C.A.M. believe that the responsibility for keeping them informed of changes in technology lies firmly with the suppliers and T.A.F.E. Given that those companies currently without C.A.M. stand to be the major benefactors of becoming informed, it is surprising to say the least, that they are not more willing to seek information regarding advances in technology themselves.

Issues relating to the allocation of responsibilities for the implementation of C.A.M. do appear as though they may have an effect on the implementation of C.A.M. in the furniture industry in Western Australia. However, as the attitudes of those respondents with C.A.M. are not significantly different from those respondents without C.A.M., any negative effect upon implementation may equally affect either group of employers.

Current Economic Climate

The argument for the implementation of C.A.M., given the country's

current economic circumstances, can be seen in item 18 (Table 6a) whereby C.A.M. has allowed the majority of respondents utilising C.A.M. to be more cost competitive. Given also, that the majority of companies utilising C.A.M. do not believe that it is being used to capacity (item 6), this potential to remain cost competitive, and indeed become even more profitable in the future, is testimony to the suitability of C.A.M. in the current economic climate.

Many manufacturers that have successfully implemented and utilised C.A.M. in the Western Australian furniture manufacturing scene have been able to develop other markets for their products throughout Australia and indeed, throughout the World (item 30). This may be attributed to an increased cost competitiveness that is achieved with the capabilities of C.A.M. Manufacturers that use C.A.M. have also been able to introduce diversity in both their range and style of product whilst maintaining a competitive edge over the market. This level of success is necessary in order to realise and maximise the benefits that C.A.M. has to offer. The current economic climate does not appear to present any problems to the manufacturer using C.A.M.

Table 6b however, indicates that a very different viewpoint exists from manufacturers without C.A.M. on this same issue. All respondents without C.A.M. (n=5) have indicated that there is insufficient demand

for their product in order to warrant the implementation of C.A.M. (item 6). This may reflect a fragile, custom design and built, market whereby individual contracts may be numerous enough to keep a number of small manufacturers in work, but not enough to allow the mass production of such contracts.

A further consideration both for manufacturers with C.A.M. and manufacturers without C.A.M., is that a number of minor differences in overall dimensions and design features will make each job somewhat unique. It is these unique differences in many cases that can render a product unsuitable for mass production. This has been a major consideration for the majority of respondents (n=4) without C.A.M. (item 18).

Finally, the majority of companies without C.A.M. (n=4) are able to cater for their current production requirements without any additional equipment (item 30). To invest in C.A.M. at this stage would seem like throwing good money away unnecessarily.

Therefore, from the findings indicated in Table 6b, it would appear that the current economic climate does have a major affect upon the decisions of manufacturers without C.A.M., on whether or not to install C.A.M. in the furniture industry in Western Australia.

CHAPTER SIX

Conclusions and Recommendations.

Based on the results of this research, the attitudes of employers that currently utilise C.A.M. amongst their manufacturing techniques are not significantly different to those of employers without C.A.M. That is, both groups of employers have displayed a good understanding of the capabilities of C.A.M. and of its suitability to the furniture industry in Western Australia. Both groups have expressed similar concerns with respect to the cost of implementing C.A.M. in the furniture industry, but agree that these costs are not unreasonable. Both groups of employers have indicated that the availability of trained tradespeople and costs associated with the training of operators, are not influencing factors upon the implementation of C.A.M.

Factors associated with the responsibilities for implementing C.A.M. have emerged as possibe factors affecting the rate at which employers are likely to implement C.A.M. in the furniture industry in the future. Both groups of employers have indicated similar concerns on this issue. They believe that groups other than themselves should play a greater research and advisory role in order that greater assistance to the

industry may be offered. The type of assistance sought by the employers, is mainly informed advice. The employers present awareness of the capabilities and suitability of C.A.M. to the furniture industry, would suggest that employers are currently able to keep up with changes in technology affecting the industry and are not in need of such assistance.

Finally, one major difference that has surfaced as a possible conflict of opinion between the two groups of respondents, is the effect of the current economic climate. The current economic climate according to those with C.A.M. is very favourable for the further implementation of C.A.M., whereas those without C.A.M. equipment, believe that the current economic climate is not conducive to the implementation of C.A.M. These differences in attitude may largely be explained by the suitability of some goods to mass production whereby those with C.A.M. specialise in mass production and those without C.A.M. specialise in customised goods.

From the results of this study, issues related to the current economic climate within the industry and the cost of implementing C.A.M. appear to have the greatest effect upon the implementation of C.A.M. in the furniture industry in Western Australia. These concerns are also supported by the Furniture Industry Association of Western

Australia which has expressed an interest in the research (see appendix VIII). A spokesperson for the Furniture Industry Association has indicated that the cost of C.A.M. is probably the major contributing factor to the lack of C.A.M. facilities within the industry in Western Australia. This, he believed, was followed closely by a low volume of product sales within Western Australia thereby not justifying the use of expensive C.A.M. equipment in the state.

Furthermore, he believed that there was a need for a type of rationalisation similar to that demonstrated in the region of Northern Italy known as the "Chair Triangle". The "Chair Triangle" incorporates a number of manufacturers that produce a range of components for the manufacture of chairs only. For example, some manufacturers specialise in the producion of back legs for chairs with equipment specially designed for this task, whilst others manufacture various styles of front legs only. Similarly, rails, back rests and seat frames are produced by other manufacturers. For the furniture company, fulfilling an order is a simple task of contacting the appropriate manufacturer and ordering the required number and style of components to assemble when necessary.

The senior officer representing T.A.F.E., whilst on the "Furniture Industry Study Tour", visited the "Chair Triangle" to view first hand,

how this system operated. He later commented favourably of this type of rationalisation and noted that a similar rationalisation of the country's resources was a successful strategy during the war when cooperation was absolutely necessary throughout the industry, to alleviate manpower shortages that were prevalent at the time. He feels that this is the direction in which the furniture industry in Western Australia should be heading.

Similar procedures for rationalisation in order to improve the industry's current competitiveness may include:-

- Small manufacturers ordering components that are used on a regular basis from the larger manufacturers, thereby increasing the utilisation of C.A.M. equipment.

- Setting up a cooperative specifically designed for this purpose.

- Larger manufacturers letting out their equipment when it is not in use. For example, if large manufacturers estimate company usage of C.A.M. equipment to be approximately 60 percent of its capacity in the week, it may be advertised within the industry that the equipment is available to let on two nominated days per week. This would allow those wishing to use the equipment to contact them for this purpose.

This will also afford the large number of smaller manufacturers in Western Australia, who have not been included in this study, the opportunity to increase their knowledge of C.A.M. equipment.

If such cooperation within the industry can be obtained, this may have a positive effect on those manufacturers currently considering the installation of this equipment. This could lead to an increased supply of C.A.M. facilities in Western Australia and may have a compounding effect upon cooperation amongst manufacturers.

Cooperation amongst manufacturers however, is the one factor that has not been considered at this point. As has been indicated earlier in this study and as has been experienced during the course of this study, an air of jealousy exists between manufacturers and their production methods. Larger manufacturers may become concerned with the above mentioned methods of rationalisation within the industry, as they are competing with other manufacturers, both large and small, for the same contracts. Concerns may result from a loss of work due to others renting the equipment of the large company and using it in order to undercut the tenders of the same company. These sorts of fears may need to be overcome through the incorporation of some type of moral code within the industry or the concept of rationalisation would surely be defeated.

Clearly this situation will need to change. Cooperation amongst manufacturers is necessary in order to make these suggestions successful. New technology in the Western Australian furniture industry is becoming ageing technology overseas. If the industry does not act now the threat of increasingly cheaper imports to contend with may eventually lead to the decline of the local manufacturing scene.

The importance of integrating this technology in industry no matter what the cost is exemplified by Marcum (1986,p.28) when reflecting on the deteriorating international competitiveness of the most technically advanced European countries he states:-

> "The primary source of Europe's poor performance both now and in the future is an underlying weakness in technology including the ability to innovate and to absorb and utilise new technologies."

If the Western Australian furniture industry is to keep up with the more advanced nations and if it is not to be priced out of its own market place, it must learn from this European experience and develop the required level of co-operation necessary to adopt and customise this technology to suit further their own specific needs.

Recommendations for Further Research.

During the course of this study, it became evident that there were other areas which should be addressed in order to substantiate the proposals made within the conclusion of this report. Two such areas are:-

1. As a control measure within this study, it was decided to exempt all manufacturers with four or less employees from the study in order to avoid any bias in the results due to unaffordability and/or a somewhat dilettante attitude which is believed to be prevalent. It is therefore recommended that a further study be undertaken in order to determine the extent of the knowledge that these manufacturers have with regard to C.A.D./C.A.M. equipment within the industry. This study should include manufacturers from all aspects of the furniture industry, that is, manufacturers of fine furniture, kitchen and built in furniture and should include outdoor furniture manufacturers also. This information may then be used in order to assess the viability of component production by larger manufacturers, similar to that of the "chair triangle" rationalisation, for the smaller furniture manufacturers in Western Australia.

2. The cost of implementing the appropriate technology is significant and the rate at which it is out-dated is equally as

significant. An investment in equipment that may soon become out-dated will very soon prove to be more of a burden than an asset to a company which is competing against others using more appropriate or up-to-date equipment. As a result, many employers may feel that the time is not right for investing in C.A.M. as it is still a fairly new technology undergoing constant change. It is therefore recommended that a study be undertaken in order to examine the extent of C.A.M. within the industry and the current usefulness and productivity of initial installations by larger manufacturers in order to allay fears of equipment becoming outdated.

It is acknowledged however, that employers may have different reasons for not adopting C.A.M. technology in industry and that the results of the proposed research will not provide a solution to the lack of C.A.M. facilities in the furniture industry in Western Australia. However, it is not intended that a solution be provided from such research, but rather, that a starting point be provided in order that a solution may be derived.

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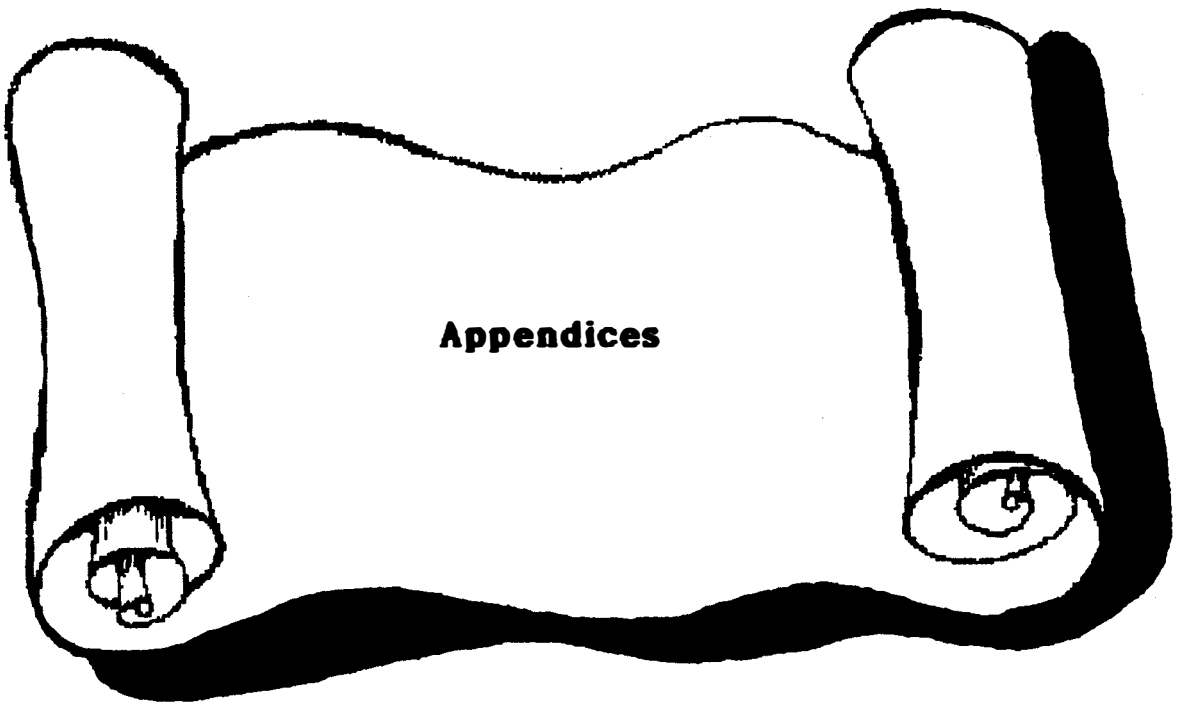

Appendices

APPENDIX I

Application for Report

20 Naree Road,
Wilson. 6107.
PH: 451 2984.

30th March 1989.

Attention Mr. M. Revington,
Technology & Industry Development Authority.
Box D160 Perth 6001.

Dear Sir,

Further to our discussion by phone on 30th March with respect to the report completed by your department on the current existence of CAD/CAM in the manufacturing industry in Western Australia, would it be at all possible for me to obtain a copy of this report for use in a research study (thesis toward an honours degree) on CAM in the furniture industry in Western Australia.

The purpose of requesting the report is purely for study purposes only and no further copies will be made nor will this report be distributed to anyone for any reason whatsoever.

Trusting you can help me.

Yours sincerely,

B. FERGUSON.

REPLY FROM T.I.D.A.

TECHNOLOGY & INDUSTRY
DEVELOPMENT AUTHORITY
OF WESTERN AUSTRALIA

170 St. George's Terrace,
Perth. Western Australia.

Postal Address:
Box D160, G.P.O., Perth.
Western Australia 6001

Telephone: (09) 327 5555
Telex AA94681
Facsimile 327 5542

Mr Brian Ferguson
[redacted]

Dear Mr Ferguson,

SYSTEMS INTELLECT REPORT ON THE ESTABLISHMENT OF A CADCAM CENTRE

Your letter of 30th March 1989 and our various telephone calls refer.

Attached please find a copy of the abovementioned report. It is provided to you on the clear understanding that its contents are to be used only for the thesis work you are currently undertaking, and are not to be used for any other purpose. The report is not to be distributed or circulated to anybody else without the prior permission of ourselves. However due acknowledgement of the report, as may be appropriate, should be made in your published thesis.

Also attached, as requested, is a copy of the DID Industry Profile on Furniture and Mattresses (ASIC 254).

Yours sincerely,

[redacted]

Michael Revington
SENIOR PROJECT OFFICER

7th April 1989

encl.

mire0393

Instructions.

1. READ ALL QUESTIONS CAREFULLY.

2. DETERMINE YOUR OPINION.

3. THERE ARE NO RIGHT OR WRONG ANSWERS.

4. ANSWER QUESTIONS ON THE PAPER PROVIDED.

5. Answer the questions as indicated in section 1.

6. CIRCLE the most appropriate response to the questions in section 2.
   I.E. place a circle around the number 1. if you **strongly agree.**
   2. if you **agree.**
   3. if you **disagree.**
   4. if you **strongly disagree.**

7. Do **NOT** circle half way between numbers.

8. If you change your mind, place a CROSS through the first response and circle the preferred response.

9. Section 3 asks two questions to which a brief response only is required and allows the opportunity for any further comments you may wish to make.

Thank you for your assistance.

BF:AB 05/06/89

SECTION 1.

Please answer the following questions as truthfully as possible.

Do **NOT** place your name on this paper. Thank you.

	YES	NO
1. Does this company use a computer of any description for any reason whatsoever?	___	___
1.1. If NO, do you intent to do so in the near future?	___	___
1.2. If YES, which of the following operations are computerised.		
1. Word Processing.	___	___
2. Accounts.	___	___
3. Stock Control.	___	___
4. Costing/Quoting.	___	___
5. Pay Roll.	___	___
6. Design/Drafting. (C.A.D.)	___	___
7. Machining. (C.A.M.)	___	___
8. Machining. (N.C.)	___	___
9. Other. Please specify. _____		

2. This company employs _____ (how many) employees.

3. This company does/does not produce for an Eastern States market.

4. This company does/does not produce for an overseas market.

APPENDIX IV

SECTION 2.

REMEMBER
Confidentiality is assured.

1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
1	Computerised equipment is not only suited to large scale production in the furniture industry.	1	2	3	4
2	Computer numerical controlled machinery offers speed in machining processes far greater than that of most tradespeople.	1	2	3	4
3	The initial capital outlay is the major influencing factor on any decision of this company to install such equipment.	1	2	3	4
4	Staff training costs are extreme in comparison with the returns offered by C.A.M.	1	2	3	4
5	The responsibility for educating industry in the possibilities of computerised equipment lies with T.A.F.E.	1	2	3	4
6	Our current C.A.M. equipment does not have the capacity to increase output should an increase in the demand of our product be required.	1	2	3	4
7	There are only a limited number of furniture outlets in Perth in which computer aided machining is suited.	1	2	3	4
8	Computer aided machining technology is capable of increasing productivity in even the smallest companies in Perth.	1	2	3	4
9	The costs of implementing C.A.M. would not easily be recovered in the manufacture of our current range of products.	1	2	3	4
10	T.A.F.E. should offer a comprehensive training course in the use of C.A.M. processes in industry to all apprentices.	1	2	3	4

REMEMBER
Confidentiality is assured.

1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
11	It is not the responsibility of the suppliers to keep industry constantly informed of the rapid changes in technology from which we may benefit.	1	2	3	4
12	The implementation of C.A.M. has allowed us to diversify into areas of production which we would not normally have considered.	1	2	3	4
13	I believe that our product output could not be increase with the installation of computerised equipment.	1	2	3	4
14	Computer numerical controlled machinery offers accuracy in machining processes far superior to that of most tradespeople.	1	2	3	4
15	The cost of computerised equipment does not warrant their application in the furniture industry.	1	2	3	4
16	I feel that training tradespersons in the use of C.A.M. is best done by the company as the need arises.	1	2	3	4
17	The Government does not do enough to help industry to keep abreast of technological change.	1	2	3	4
18	C.A.M. allows us to be more cost competitive in the current market.	1	2	3	4
19	I believe there are many product components within this company's current range of goods that can be produced with the aid of computerised equipment.	1	2	3	4
20	The flexibility of computerised equipment is too limited for it to be adopted widely in industry.	1	2	3	4

REMEMBER
Confidentiality is assured.

1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
21	The cost of maintenance is a commercial factor which greatly influences our decision on the installation of computerised equipment in the workshop.	1	2	3	4
22	The time required for training in the use of computerised equipment is not an obstacle to the installation of further computerised equipment.	1	2	3	4
23	Government financial assistance would greatly affect my decisions on the implementation of C.A.M.	1	2	3	4
24	The Western Australian market is a very limited market which therefore limits the extent to which C.A.M. may be successfully employed.	1	2	3	4
25	Computerised equipment is suitable for the production of customised work in the furniture industry.	1	2	3	4
26	The type of production this company is involved in is too specialised for computerised equipment.	1	2	3	4
27	The cost of training staff in the use of C.A.M. is not likely to influence my decision to install such equipment.	1	2	3	4
28	There are insufficient outlets whereby training of new staff can be carried out in the use of computer numerical controlled equipment.	1	2	3	4
29	T.A.F.E. should play a greater research and advisory role in order to keep industry informed of future changes in technology.	1	2	3	4
30	The implementation of C.A.M. has allowed us to pursue markets other than those in Western Australia as outlets for our product.	1	2	3	4

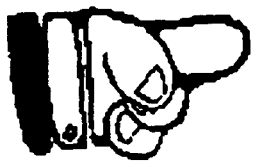
REMEMBER
Confidentiality is assured.

SECTION 2

1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
1	Computerised equipment is not only suited to large scale production in the furniture industry.	1	2	3	4
2	Computer numerical controlled machinery offers speed in machining processes far greater than that of most tradespeople.	1	2	3	4
3	The initial capital outlay is the major influencing factor on any decision of this company to install such equipment.	1	2	3	4
4	This company cannot afford the cost of training staff in the use of such equipment.	1	2	3	4
5	The responsibility for educating industry in the possibilities of computerised equipment lies with T.A.F.E.	1	2	3	4
6	There is not sufficient demand for our product at present to warrant the implementation of C.A.M.	1	2	3	4
7	There are only a limited number of furniture outlets in Perth in which computer aided machining is suited.	1	2	3	4
8	Computer aided machining technology is capable of increasing productivity in even the smallest companies in Perth.	1	2	3	4
9	The costs of implementing C.A.M. would not easily be recovered in the manufacture of our current range of products.	1	2	3	4
10	T.A.F.E. should offer a comprehensive training course in the use of C.A.M. processes in industry to all apprentices.	1	2	3	4

REMEMBER
Confidentiality is assured.



1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
11	It is not the responsibility of the suppliers to keep industry constantly informed of the rapid changes in technology from which we may benefit.	1	2	3	4
12	The cost of implementing C.A.M. would not have any effect on the price of our product.	1	2	3	4
13	I believe that our product output could not be increase with the installation of computerised equipment.	1	2	3	4
14	Computer numerical controlled machinery offers accuracy in machining processes far superior to that of most tradespeople.	1	2	3	4
15	The cost of computerised equipment does not warrant their application in the furniture industry.	1	2	3	4
16	The availability of trained tradespersons will be an influencing factor when considering the implementation of C.A.M. for our company.	1	2	3	4
17	The Government does not do enough to help industry to keep abreast of technological change.	1	2	3	4
18	My current lines of production are suited to mass production.	1	2	3	4
19	I believe there are many product components within this company's current range of goods that can be produced with the aid of computerised equipment.	1	2	3	4
20	The flexibility of computerised equipment is too limited for it to be adopted widely in industry.	1	2	3	4

REMEMBER
Confidentiality is assured.

1. STRONGLY AGREE.
2. AGREE.
3. DISAGREE.
4. STRONGLY DISAGREE.

		S/A	A	D	S/D
21	The cost of maintenance is a commercial factor which greatly influences our decision on the installation of computerised equipment in the workshop.	1	2	3	4
22	The lack of government assistance toward the cost of training people in the use of C.A.M. would not affect my decision to implement C.A.M.	1	2	3	4
23	Government financial assistance would greatly affect my decisions on the implementation of C.A.M.	1	2	3	4
24	The implementation of C.A.M. is unnecessary as mass produced furniture items required by the population are easily imported.	1	2	3	4
25	Computerised equipment is suitable for the production of customised work in the furniture industry.	1	2	3	4
26	The type of production this company is involved in is too specialised for computerised equipment.	1	2	3	4
27	The cost of training staff in the use of C.A.M. is not likely to influence my decision to install such equipment.	1	2	3	4
28	The concept of computer aided machining is still very new and therefore does not require any formal training at this stage.	1	2	3	4
29	T.A.F.E. should play a greater research and advisory role in order to keep industry informed of future changes in technology.	1	2	3	4
30	Our present production methods are unable to cater for current requirements.	1	2	3	4

APPENDIX V

SECTION 3.

Please respond briefly to the following questions.

1. What factors would encourage your company to install or update computer aided machining facilities within the company?

2. What factors do you believe discourage the implementation of computer aided machining facilities within the furniture industry in Western Australia?

3. If you would like to comment further on any of the issues covered in the questionnaire you may do so in the space below.

APPENDIX VI

Notes:- All question types are identified as positive or negative with the codes pos or neg next to each question.

All question types are identified as C for company specific or as G for general but topical.

Each question is numbered for the convenience of checking in the questionnaire.

Employer's Attitude to the Suitability of Computers in the Furniture Industry.

Question No 1 pos G — Computer numerical controlled equipment is not only suited to large scale production in the furniture industry.

Question No 7 neg G — There are only a limited number of furniture outlets in Perth in which computer aided machining is suited.

Question No 13 neg C — I believe that our product output could not be increased with the installation of computer numerical controlled equipment.

Question No 19 pos C — I believe there are many product components within this company's current range of goods that can be produced with the aid of computer numerical controlled equipment.

Question No 25 pos G — Computer numerical controlled equipment is suitable for the production of customised work in the furniture industry.

Employer's Understanding of Capabilities of Computers.

Question No 2 pos G — Computer numerical controlled machinery offers speed in machining processes far greater than that of most tradespeople.

Question No 8 pos G — Computer aided machining technology is capable of increasing productivity in even the smallest companies in Perth.

Question No 14 pos G — Computer numerical controlled machinery offers accuracy in machining processes far superior to that of most tradespeople.

Question No 20 neg G — The flexibility of computer numerical controlled equipment is too limited for it to be adopted widely in industry.

Question No 26 neg C — The type of production this company is involved in is too specialised for computer numerical controlled equipment.

Employer's Attitude to Cost

Question No pos C	3	The initial capital outlay is the major influencing factor on any decision of this company to install such equipment.
Question No neg C	9	The costs of implementing C.A.M. would not easily be recovered in the manufacture of our current range of products.
Question No neg G	15	The cost of computer numerical controlled equipment does not warrant their application in the furniture industry.
Question No neg C	21	The cost of maintenance is a commercial factor which greatly influences our decision on the installation of computer numerical controlled equipment in the workshop.
Question No pos C	27	The cost of training staff in the use of C.A.M. is not likely to influence my decision to install such equipment.

Employer's Attitude to Training. (Those with computers.)

Question No neg C	4	Staff training costs are extreme in comparison with the returns offered by C.A.M.
Question No pos G	10	T.A.F.E. should offer a comprehensive training course in the use of C.A.M. processes in industry to all apprentices.
Question No neg C	16	I feel that training tradespersons in the use of C.A.M. is best done by the company as the need arises.
Question No pos C	22	The time required for training in the use of the new equipment is not an obstacle to the installation of further computer numerical controlled equipment.
Question No neg G	28	There are insufficient outlets whereby training of new staff can be carried out in the use of computer numerical controlled equipment.

Employer's Attitude to Training. (Those without computers.)

Question No neg C	4	This company cannot afford the cost of training staff in the use of such equipment.
Question No pos G	10	T.A.F.E. should offer a comprehensive training course in the use of C.A.M. processes in industry to all apprentices.
Question No neg C	16	The availability of trained tradespersons will be an influencing factor when considering the implementation of C.A.M. for our company.
Question No pos C	22	The lack of government assistance toward the cost of training people in the use of C.A.M. would not affect my decision to implement C.A.M.
Question No neg G	28	The concept of computer aided machining is still very new and therefore does not require any formal training at this stage.

Question No 5 The responsibility for educating industry in the possibilities of computer numerical controlled equipment lies with T.A.F.E.

pos G

Question No 11 It is not the responsibility of the suppliers to keep industry constantly informed of the rapid changes in technology from which we may benefit.

neg G

Question No 17 The Government does not do enough to help industry to keep abreast of technological change.

neg G

Question No 23 Government financial assistance would greatly affect my decisions on the implementation of C.A.M.

neg C

Question No 29 T.A.F.E. should play a greater research and advisory role in order to keep industry informed of future changes in technology.

pos G

Attitudes to Computerisation in the Current Climate. (Those with computers.)

Question No 6 Our current C.A.M. equipment does not have the capacity to increase output should an increase in the demand of our product be required.

neg C

Question No 12 The implementation of C.A.M. has allowed us to diversify into areas of production which we would not normally have considered.

pos C

Question No 18 C.A.M. allows us to be more cost competitive in the current market.

pos C

Question No 24 The Western Australian market is a very limited market which therefore limits the extent to which C.A.M. may be successfully employed.

neg G

Question No 30 The implementation of C.A.M. has allowed us to pursue markets other than those in Western Australia as outlets for our product.

pos C

Attitudes to Computerisation in the Current Climate. (Those without computers.)

Question No 6 There is not sufficient demand for our product at present to warrant the implementation of C.A.M.

neg C

Question No 12 The cost of implementing C.A.M. would not have any effect on the price of our product.

pos C

Question No 18 My current lines of manufacture are suited to mass production processes with the use of computer numerical controlled equipment.

pos C

Question No 24 The implementation of C.A.M. is unnecessary as mass produced furniture items required by the population are easily imported.

neg G

Question No 30 Our present production methods are unable to cater for current requirements.

pos C

APPENDIX VII

TABLE 7

Section 3

Question Number 1: What factors would encourage your company to install or update computer aided machining facilities within the company?

Categories.	Responses
Government Assistance.	8
Market Size.	5
Reduction in Cost of Equipment.	3
Better Quality.	3
Greater Speed.	2
Can do more Inconvenient Work.	2
Reduced Space Requirements.	1
Lack of Conscientious tradespeople.	1
Smaller more Appropriate Equipment.	1
None.	1
Increased Cost Competitiveness.	1
Occupational Health and Safety Laws.	1
Access to Latest Technology.	1

TABLE 8

Section 3

Question Number 2: What factors do you believe discourage the implementation of computer aided machining facilities within the furniture industry in Western Australia?

Categories.	Responses
Market Size.	8
Cost of Purchase.	7
Cost Competitiveness.	3
Awareness.	3
Lack of Service.	3
Maintenance	3
Not Appropriate..	2
No Committment.	2
Availability.	1
Lack of Training Facilities.	1
Lack of Trained Operators.	1

TABLE 9

Section 3

Question Number 3: If you would like to make any further comment on the issues covered in the questionnaire, please do.

Categories.	Responses
Training.	5
Marketing.	1
Rising costs may lead to Implementing.	1
Stronger home based market.	1

FURNITURE INDUSTRY ASSOCIATION OF W.A. (INC.)

279 LORD STREET, PERTH
WESTERN AUSTRALIA, 6000
TELEPHONE (09) 328 4044 FAX (09) 227 6627
General Manager: MIKE FOLKARD, C.D., A.I.M.M.

AN AFFILIATE OF THE FURNITURE MANUFACTURERS ASSOCIATION OF AUSTRALIA

19/7/89

Mr B Ferguson
[redacted]

Dear Mr Ferguson

SURVEY ON COMPUTERISATION OF THE FURNITURE INDUSTRY IN WESTERN AUSTRALIA

We understand you are conducting the above survey and we would like the opportunity to offer our comments. We represent over 250 members who have a vital interest in the future of this industry.

We look forward to hearing from you and should you have any queries please do not hesitate to contact the undersigned.

Yours sincerely

[redacted]

MIKE FOLKARD
General Manager