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The implementation of the "Just-in-Time" manufacturing philosophy into the South African furniture industry

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assured that the strike was not related to the JIT program at the company.

A.F. Dreyer & Co. lost a total of 30 working days as a result of direct strike action. In addition to those days many hours of production time were lost prior to the strike in the form of "go slows".

The final result of this strike action was the dismissal of the entire black workforce at the company.

At this stage the entire JIT implementation effort collapsed. With the dismissed workers went months of implementation effort and training. Temporary workers were taken on and by mid-July a new workforce was present at the plant. The majority of the new workforce were from the Salvation Army and had never worked in a factory before, let alone with furniture.

It was believed that until such time as the workers knew the products and the machinery, little progress would be made in pursuing the JIT training and implementation programs. Production staff were now directing their attention to retraining an entire workforce in areas such as woodwork and machine operation, while simultaneously trying to keep quality levels up and fill and order backlog of almost three months.

The JIT program which had been instrumental in reducing inventory levels to a bare minimum, now resulted in a production facility with very little buffer stocks with which to absorb the shock of the loss of the entire workforce. The result was a total loss of

confidence in the JIT system by middle and shop floor management.

By September 1987 the new workforce had mastered the majority of the machinery and were familiar with the products and the way in which they were made. Although most of the middle and shop floor management had lost all commitment to JIT the owner encouraged its application. Training programs were started again however progress was far slower than at the start of the year.

Due to the high pressures on the manufacturing staff and the low morale in the plant, members of middle and shop floor management started to resign. Resignations included the polish shop foreman, the assembly shop foreman, the machine shop foreman, members of the maintenance team as well as the production manager. Despite the overwhelming odds against them at a time when orders were reaching their peak, the top management remained committed to the philosophy. September 1987 to February 1988 saw the introduction of many new projects which aided production planning and control. The majority of the work was however, directed to short term improvements without due consideration given to medium or long term goals.

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diagram of the layout as at February 1987 is indicated in Appendix E. The February 1987 layout was essentially a job shop type layout. A change from large batch sizes to very small lots with the introduction of Kanban cards, resulted in small batches being moved along long routings through the machine shop. This situation became more awkward and uneconomic, in terms of materials handling, the smaller the lot sizes became. The JIT steering committee decided to adopt the " factory within a factory" approach. The machine shop of the future would operate on group technology principles. A full scale relayout of the machine shop would be enormously expensive since it would necessitate the complete removal and refitting of not only all the compressed air and electricity supply lines, but also the dust extraction ducting. The relayout could only be justified if a long term view of the situation was taken. In view of the fact that one of the project constraints disallowed larg capital expenditures during the short term, it was decided that the planning of the layout would continue, but that no large physical shop floor changes would be made in the short term future. The new layout is thus presented in the form of a three dimensional scale model. [See section 4.8.3]

4.8.1 The Group Technology Concept

As pointed out by Karle [86] the implementation of a Just-in-Time manufacturing philosophy is ideally done once a group technology (GT) manufacturing system is operational, since many of the JIT principles are in fact GT principles.

Group technology is "An engineering and manufacturing philosophy

which identifies the 'sameness' of parts, equipment or processes". [87] The GT principles must be viewed as important tools in the design of a cellular type machine shop.

GT aims at identifying families of products i.e. products having basic similarities in design or manufacturing processes. The aim is to identify these similarities in design or manufacturing and then group them into families which can be managed in a group - perhaps a manufacturing cell or "factory within a factory".

GT allows a discipline to be imposed in both manufacturing process and in design. In a manufacturing process, after having identified the manufacturing cells, a standard routing is established between cells. The outcome is that the number of production process paths through the factory is lower. The cells themselves are regarded as workcentres, even though they may contain a variety of dissimilar machines. Also, within the cells it may be possible to allow workers to schedule the cell's workload. Overall control then takes place merely by inputs into the cell and outputs from it. The result of both standard routings and cells is a vast simplification in scheduling. [88] The Kanban trolley pull system is to be used between cells.

4.8.2 The Development of Cells

From the P-Q charts [Appendix C] it was calculated that 20% of the parent items manufactured accounted for approximately 80% of the plant's flow volume. A computer data base was set up to aid in the classification and coding of the various components. In order to simplify the design of the new plant only the top 20%

the parent items were considered. The database held information regarding those parent items in an indented BOM type structure. The database also held fields containing the following information 1) parent item monthly flow quantities

2) component item monthly flow quantities
3) material used
4) component shape
5) component size
6) machine routing data.

The components were then coded in groups according to their size and shape by means of soft coding or "eyeball coding". This coding was then compared to the machine routing data. It was found that the majority of similar items followed similar machine routings. The major machine routings were then broken down into actual machines and machine numbers. After identifying the actual machines, cells were designed such that they contained a group of dissimilar machines which were indicated by the most common product routings. This follows the "Product Flow Analysis" or "PFA" technique as defined by Burbidge. [89] Overall classification was thus carried out according to the product routings and not to the components' sizes or shapes.

The cells are each designed to be capable of manufacturing a particular production family or similar group of parts. Different part types are made in the cell but all types of parts in the family go through the same machine (a few part numbers may skip one or more of the stations). While the cells do not make the same part over and over again like a dedicated production unit would, it makes the same family of parts over and over

again. Print 28 shows one example of a part in the machine shop. The print is a photograph of a part of the three dimensional model which is presented and discussed in section 4.8.3.



PRINT 28: Leg shaping group technology cell.

The majority of the kist legs follow the following routing sequence :- 6C-SQ-LM-SA-S. In print 28 the routing can be seen as follows. The raw blocks enter the plant through the gate marked (1). They are then fed through the six cutter machine which cleans the leg blocks in long strips (2). From the six cutter they are fed through a cross cut saw (3) which squares the blocks. From squaring they are moved to the leg machine (4) which carves the Queen Anne or another shape from the squared blocks. The shaped legs are now taken to sub-assembly (5) where wings are attached so that they can be fitted to the kist bottoms. After these wings are attached the winged legs are then placed on a Kanban trolley and delivered to their point of use which in this case is the kist line. This cell is one example of a cell at A.F. Dreyer. The GT layout and 3D model show all the

other proposed cells. They are :-

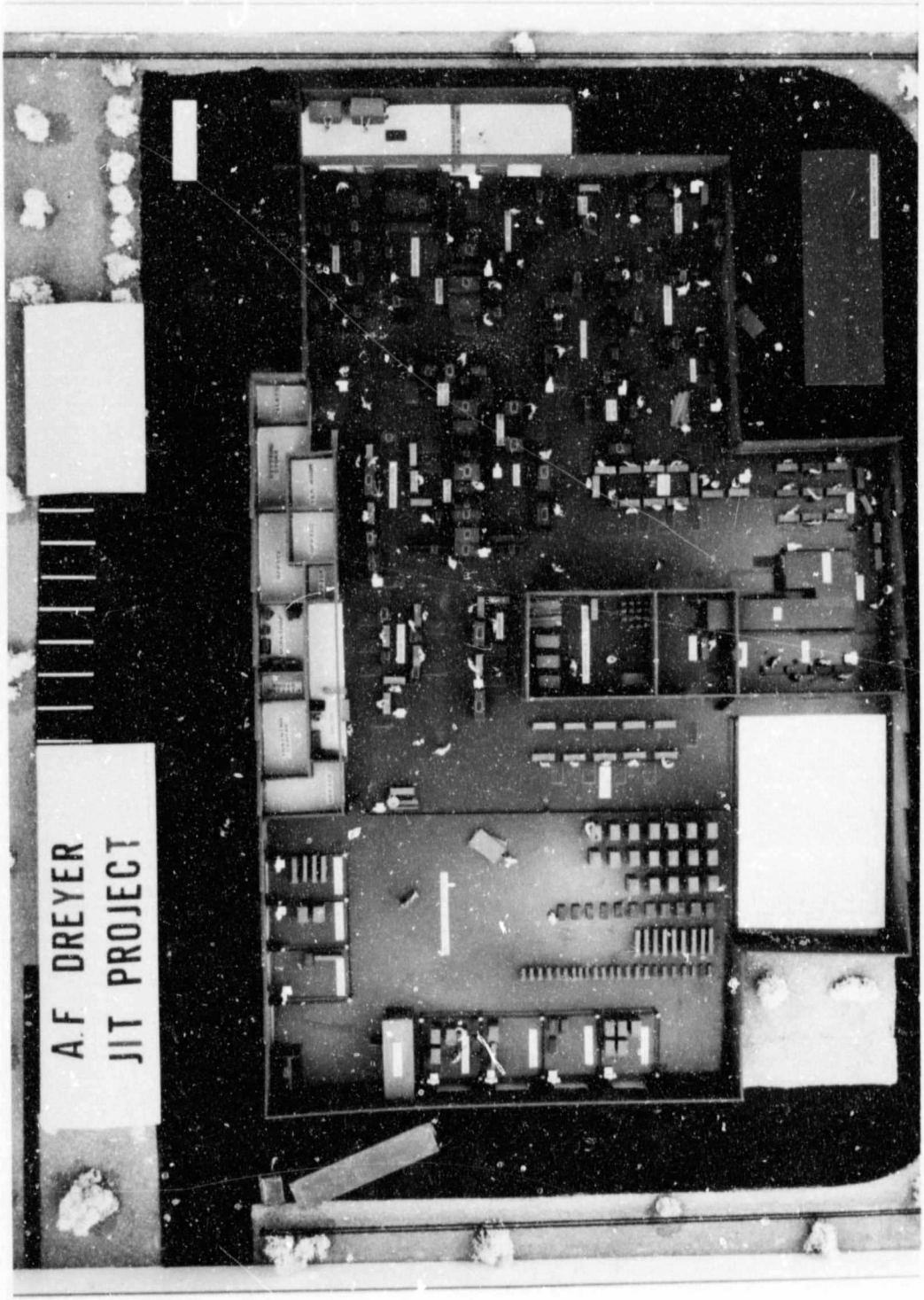
- leg shaping
- offcut control
- veneer preparation
- veneering
- board breakout
- showpieces
- drilling and dowel fitting
- kist carcass preparation
- kist carcass sanding
- support fabrication
- thicknessing and routing
- finishing and polishing
- cabinet and stool assembly
- bedroom suite assembly
- robe assembly
- kist assembly
- bedroom suite assembly.

Some of the cells where volumes are high are linked to form flowlines [see Appendix F] but generally products are transferred from cell to cell and cell to assembly cell via Kanban trolleys from raw material to finished product. In order to avoid the separation of the manufacturing and assembly functions, cells feed directly onto the assembly lines where possible. In some instances where there are sufficient small machines, some of the machines are dedicated to the actual assembly cells. [e.g. drill presses and frequency presses on the kist assembly line] In some cases definite cells were not developed in favour of a flowline

type arrangement. [e.g. see Appendix F. The majority of board type items follow the red flowline and the majority of the solid imbuia kist components follow the blue flowline.] Where fabrication cells are adjacent to the assembly lines and feed them directly, Kanban squares are used to link the flow.

The construction of a cell creates a responsibility centre where none existed before and a single cell supervisor or cell leader would be in charge of matters that used to be fragmented among several shop managers. The leader and work group may also be charged with making improvements in quality, cost, delays, flexibility, worker skills, lead time, inventory performance, scrap, setup reduction, equipment "up time" and a host of other factors that would improve control. [90]

Cellular type manufacturing made sense at the A.F. Dreyer plant because a) distinct product families exist, b) there were, in most cases, several of each type of machine and taking a machine out of a cluster and dedicating it to a cell does not rob the rest of the plant of all its capacity, leaving no way to produce other components, c) the machines are heavy and expensive to move due to the ducting and power points but are nevertheless moveable. The advantages of cellular manufacturing in the furniture industry far outweigh the costs of reorganizing machinery. "The moving costs are nominal compared to what some manufacturers elect to do instead : investing precious capital to buy new equipment and putting it in the same poor locations operated by people who are organized in the same poor way as before." [91]



PRINT 29 Plan view of cellular layout

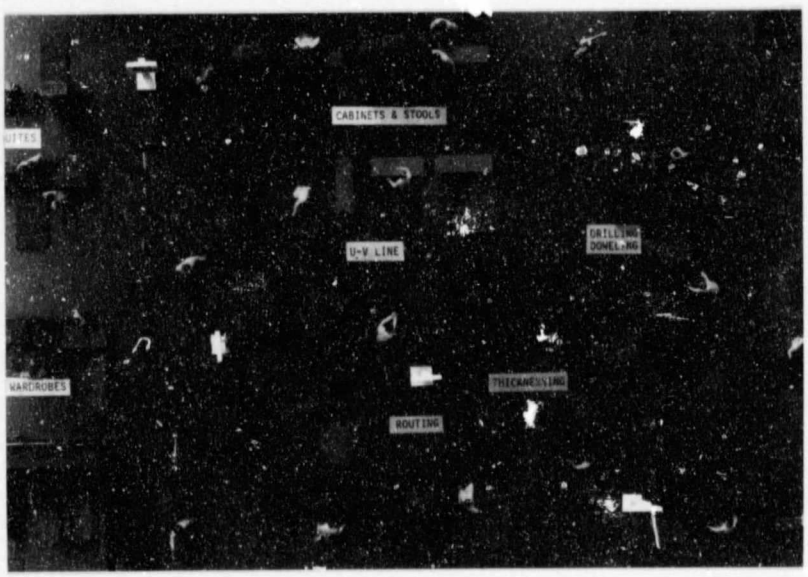
4.8.3. The Three Dimensional Scale Model

A short justification for the use of a three dimensional model is warranted. The model in three dimensions is the clearest device for layout planning. It affords the optimum in space visualization because it is an exact replica of each piece of equipment, material and labourer. Although it has its limitations in exact identification, it allows a very quick understanding of the planned layout, especially to non engineering trained people. It is these people who will finally approve the layout plan, install it and make it function as planned. The greatest value of the model is that it becomes easy for checking, revising and explaining the layout to others. Problems that may arise are often visible in the model thus the expense of implementing a real system relayout that is expensive and difficult to rectify is eliminated.

After identifying the requirements for cells and the necessary machinery and equipment to dedicate to each cell, the positioning, shape and size of each cell had to be evaluated. To do this effectively a replica of each piece of equipment in the plant was built to a scale of 1:85. In addition a basic frame and outline of the plant was constructed to the same scale. Numerous techniques, tools and various texts relating to group technology and general plant layout were used in the development of the final layout. The most relevant and important texts were

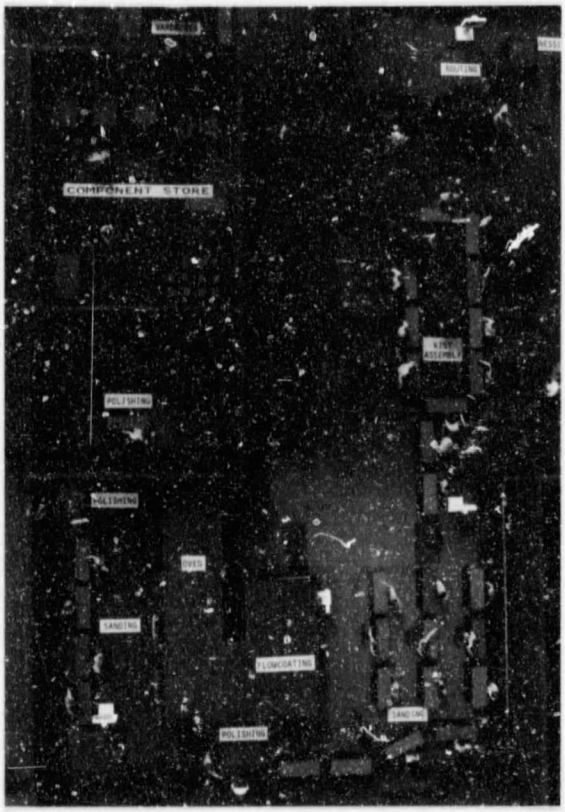
- Facilities Planning [92]
- Plant Layout Software [93]
- Zero Inventories [94]
- The Introduction of Group Technology [95].

In addition, to obtain some practical guidelines, members of the production staff and shop floor workers were consulted regularly to obtain different opinions and ideas. The final layout which is basically an incrementally developed and improved layout is presented in print 29 which is an exploded plan view photograph of the model. The model itself is also presented with this report.



PRINT 30: Plan view of the U-V line.

Prints 30 and 31 show two close up views of two different areas in the GT plant. Print 30 shows the ultra violet polishing line which has been moved from the outer edge to the centre of the production facility. The ultra violet line is in fact the heart of the plant with almost all flat components being passed through this machine. The line is fed by the drilling and dowelling cell and the thicknessing and routing cells. Units are processed along the U-V line from right to left. At the end of this line



PRINT 31: Plan view of the kist assembly area.

the components are edged on machines M7 or M8 and then sent to one of the assembly cells via Kanban trolleys.

Print 31 indicates the model presentation of the kist assembly area that is presented in Figure 15. The kist assembly area receives goods via Kanban trolleys from various supply cells and it in turn supplies the sanding and polishing cells.

In order that the reader obtains a more integrative view of the entire factory layout it is suggested that the reader should have access to both this text and the 3 dimensional model.

4.9 An Evaluation of the Implementation Schedule

The JIT implementation schedule that was followed at A.F. Dreyer was presented in section 4.4, page 65, of this report but is presented again here to facilitate reading.

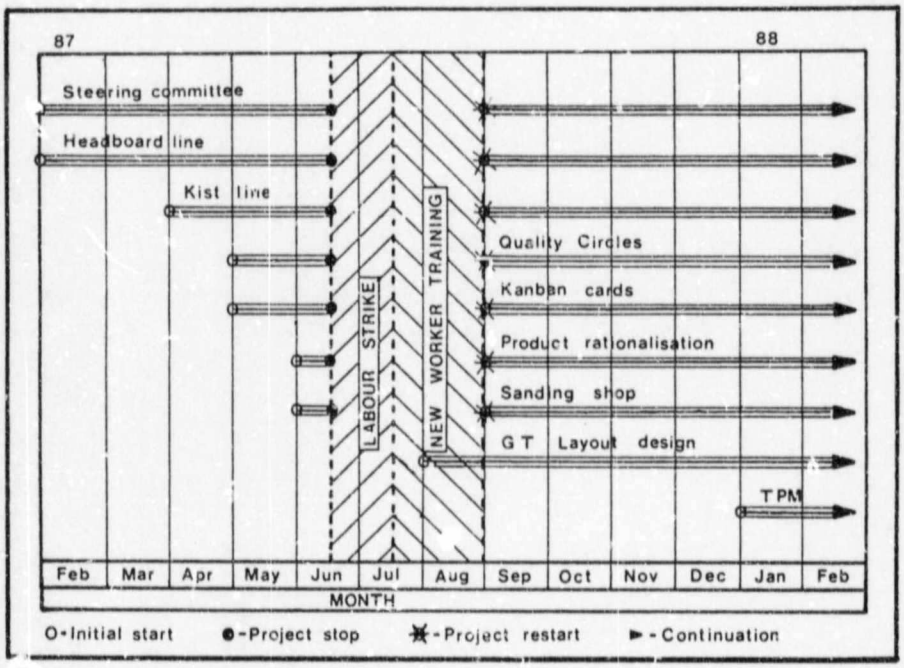


FIGURE 14: JIT implementation schedule

As has been discussed the program followed a "Pilot Project" approach and started in the assembly areas of the company. Although the implementation during 1987 was satisfactory the author believes that increased success could have been achieved if three primary changes to the program had been made. These possible changes are presented below.

The first change that would be made if the project were to be repeated would be that the GT principles should have been applied from the date of commencement of the implementation of JIT.

[February 1987] As has been already quoted, many of the principles of GT are in fact JIT principles thus early application of the GT principles would have aided in the adoption of the JIT philosophy. The GT principles were only applied on paper and in the form of a model during 1987. Had the GT principles been applied earlier, more progress would have been made in the design and debugging of the system and its associated cells. The author believes that the early application of these principles would have focussed the steering committees attention on the "factories within a factory" concept and possibly resulted in a better product flow through the plant. The current GT layout in some areas separates fabrication and assembly. [e.g. the Leg shaping cell is not part of or even close to the kist assembly cell.] Had the project been started before the Kist Pilot project attention would have been directed towards the elimination of separate assembly and fabrication areas.

During the months of September 1987 to December 1987 the load on the machine shop increased dramatically as a result of the pre-Christmas peak in furniture sales. The high load resulted in many major machine breakdowns and an unsuccessful but determined "firefighting" effort being made by the understaffed maintenance department. The small lotsizes and frequent setups aggravated the downtime problems. A total productive maintenance program would have been beneficial had this program been in operation prior to the implementation of Kanban cards and their associated small lot sizes. The author believes that early implementation of a maintenance program will result in faster progress in JIT implementation and in the long term will contribute significantly to waste reduction.

The third change (and probably the most imperative) that should be advocated is related to worker productivity and labour relations. Every effort should be made by management to avoid the situation of a labour strike and the dismissal of the labour force. This is of critical importance if a swift change to JIT is desired. The labour strike at the company gave a poor reflection to the JIT efforts at A.F. Dreyer and resulted in a total loss of commitment to the system by the middle management and numerous subsequent resignations. The loss of productive time, skilled and semi-skilled staff, and decline in customer service was totally unacceptable and prohibitively expensive.

As pointed out by the project supervisor [M.Karle] one of the fundamental management attitudes which successful companies have had to adopt (e.g. Toyota, Afrox, Coachbuild) is to declare that "No employees will be retrenched as a direct result of productivity improvements resulting from the implementation.". This declaration was unfortunately not made to the workers at A.F. Dreyer and could have been an underlying reason for some workers attempts to join a new union prior to the strike in June 1987. Although management assured the author that strike action was unrelated to the JIT program, it was clear that none of the benefits of the program were being passed on to the workers. For swift and successful implementation, management and workers should work together as a team and thus it is important to maintain good industrial relations with both the workers and their union. Retrenchment and benefit sharing agreements must thus be entered into prior to commencing implementation. Such agreements will undoubtedly promote a participative management style and have a teambuilding effect thus enhancing productivity.

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5.0. PROMINENT IMPLEMENTATION ISSUES

During the course of initial JIT implementation at A.F. Dreyer and from the information obtained from interviewees in the survey, four different issues emerged as primary for a successful conversion to JIT. These issues were :-

- Management commitment and style
- The management of change
- Education and training
- Employee involvement.

These four topics are interrelated and interdependent to a large degree and thus the author felt that it would be counterproductive to attempt to rate them in any order of importance. One example of their interdependence is the following. In order that a company successfully manage the massive change from a conventional system to a JIT system, it is important that the management staff are exposed to some type of training on the topic. For top management to give the go ahead for the training there must be some commitment to the JIT philosophy. This commitment can only stem from some type of input on the JIT philosophy which in turn, requires the involvement of the management who are in fact, employees. Which topic or issue should be approached first or which is more important is not crucial. The point is that each issue has a strong influence on the others and none of the issues stand alone. Thus in order for a company to successfully implement the philosophy there must be an understanding of the importance of all of the four issues. No one issue on its own will result in

successful implementation. If all four of the issues are handled positively then it will greatly improve the chances of implementation success.

5.1. Management Commitment and Style

The massive organisational change that occurs during the conversion from a conventional production system to a Just-in-Time system can only be successfully managed by a highly committed top management leadership. It is important at this stage to note that there are different degrees of commitment. Many managers in the South African furniture industry who are aware of JIT seem committed enough to try some pilot projects but not nearly committed enough to lead massive organisational change. In two of the companies interested in the survey, Krost Brothers and Anglo Dutch, the implementation process was in effect, handed over to appointed facilitators. The top, and to a large degree, the middle management of these two companies did not become personally involved in the implementation process. In order for a company to successfully initiate Just-in-Time techniques and eventually become world class manufacturers, both the top and middle management should a) become personally involved in the implementation program, b) be willing to spend a significant proportion of their time working with the JIT techniques such that they understand how they interrelate and the type of benefits that may be achieved and c) be willing to change their priorities and behaviour in such a way that they no longer consider short term targets and benefits to be primary.

In the discussion of the survey results it was noted that

although some companies were aware of the JIT philosophy they were uncommitted to it. These companies pointed out that they could not operate JIT as their suppliers were not JIT companies. The real problem here is that a tremendous amount of progress can be made without involving suppliers. Such an attitude from managers indicates that the JIT education base that they have is very narrow. JIT is not an inventory control system; reducing and controlling inventories is simply a by product of the philosophy. The importance of a secure education base is discussed in section 5.2.

There are certain pointers which indicate when a management team is committed enough such that JIT efforts will have a stronger chance of success. When a management team is committed sufficiently the values and principles of the JIT philosophy will be reflected in their behaviour. They are actively involved in dealing with the changes which must be made. They invest considerable time educating themselves and training staff. They personally lead and audit the change process by which the thinking of the company is being transformed. They view ultimate competitive advantage to be an environment in which the creative energies of all people are better utilized than they are by the competition. They believe that most people have both the capability and the will to improve operations. They value and genuinely respect all people. To this end they ensure that there is an ongoing commitment to develop people as individuals and as a team to accomplish the JIT turnaround. They should thus believe that the development of leaders who work at creating an environment where all people can be utilized as problem solvers and so ution implementors is the foundation for making the

massive transformation happen. [96]

Although none of the manufacturers surveyed displayed such dedicated commitment the author believes that commitment will follow from constant involvement. If people are involved intensely enough with the system for a long time they improve their education base and ultimately become committed to it. If middle management are not committed enough then it is up to the top management to provide a structure to ensure that they become more involved. In addition top management must provide the opportunity for furthering education and training of staff.

Without a sufficient level of commitment to JIT there will be a series of compromises which will eventually result in a collapse in the system and a loss of the potential benefits which could be achieved. As pointed out by one JIT consultant, "A partial conviction to the Just-in-Time ideal is a liability to achieving success." [97]

In addition to a high level of commitment the management style should be participative rather than autocratic. In the majority of the furniture manufacturers surveyed the management style is to a large degree autocratic. Whether this autocratic style is a direct consequence of the black-white political and cultural differences on a national scale is beyond the scope of this work. However in order that the substantial benefits of teamwork and employee involvement be achieved it is important that shop floor personnel not conceive the management to be an autocratic governing body but rather a facilitator that guides the implementation of solutions.

An autocratic management style is extremely harmful to the communication bridge between management and worker. In order for constructive communication to occur between these two groups the destructive concept of two separate groups must be discouraged. JIT will thrive in a "Theory Z" type environment where there are three basic concepts : the collective work ethic, trust and loyalty. [98] At the organisational level this translates into teamwork, the merging of individual and organisational goals, collective decision making, group sacrifice in terms of adversity and implicit group control of each employee. [99] A few companies that practice this philosophy are IBM, Hewlett-Packard, Toyota and Coachbuild. To implement a satisfactory participative management style will take years of patience as trust and loyalty will have to be built between the workers and the management. The sooner the company starts the sooner the system will be in place.

5.2. The Management of Change

During the implementation of JIT at A.F. Dreyer it became apparent that the amount of change being introduced was of a magnitude significant enough to warrant special attention. At one stage during the program any introduction of even minor change was met with considerable resistance especially from middle management. Prior to discussing why there was resistance and how to handle this resistance two points should be made regarding technological change. "1) Technological change has, in the past, been the major source of increased employment and prosperity, making possible real rises in living standards as well as shorter working hours and working lifetimes. 2)

Technological change is essential in order to increase competitiveness and provide a stable base for future employment. Industries which fail to keep pace with new technology will lose competitiveness and be unlikely in the longer run to survive, with the result that further jobs will be lost." [100]

Resistance is formed for a variety of different reasons and is expressed in different ways that all result in destructive behaviour towards the intended change. Most problems occur because : the purpose for the change is not clear; people are not involved in developing and implementing the change; the change requires a radical habit pattern to be broken; communication regarding the change is channelled to only a few individuals; an excessive work load is implied with the introduction of the change and rewards gained by implementing the change are considered to be inadequate. [101] This resistance can be counteracted to a large degree through education. The topic of education is covered in section 5.3.

The basic reason for resistance to change among middle and shop floor management at A.F. Dreyer related to a "fear of the unknown". This basic fear and subsequent resistance was also more noticeable in those individuals who had received very little or no introduction to the new system. In order to avoid this resistance to the change that will result when JIT is implemented both management and shop floor staff should become involved in a) educational and training programs and b) the development of the implementation programs. The responsibility for involving the employees in the above must lie with those that which to initiate change. At A.F. Dreyer it lies with top management.

It is important that the company adopt a systematic and planned approach to the introduction of JIT concepts and that employees are involved and encouraged to participate in the changes. The importance of involving all employees and their trade union representatives in the planning and decision making process cannot be over emphasized. By not including trade unions' participation, management run the high risk of alienating workers from the system, especially in the current environment. This will contribute to poor employee involvement, communication and a wider gap between management and workers. Results of the survey indicated a generally poor relationship between management and trade unions. This could in the long term slow productivity improvements in the industry. Some attention must thus be paid to industrial relations.

A few general guidelines for the management of the change to JIT in the furniture industry are necessary to improve implementation success. 1) It is important for top management to strike a balance between securing middle and shop floor management commitment to the change and an acceptance that it is all part of normal working conditions i.e. a participative rather than an authoritarian approach is necessary. 2) It is essential for there to be a visible unity of purpose among the steering committee underlining the importance of effective communication. However, since employee reactions are often unpredictable when faced with massive change, it is advisable to allow for the possibility of disputes and a consequent delay in JIT implementation. This can be overcome to a large degree by education and training and by commitment from the steering committee. Management should also make a declaration stating

that no workers will be retrenched as a result of productivity improvements. There should also be some form of profit sharing since the benefits that will be achieved will be the result of effort from both management and workers and should be shared as such.

5.3. Education and Training

It is important for the JIT implementor to be aware of the difference between education and training. Training is instruction or teaching and is related to skills. It is aimed at improving usable skills. Education is schooling or development related to changing peoples' attitudes. In order to introduce JIT into the South African furniture industry it is first necessary to educate manufacturers as regard JIT benefits and techniques, since a large scale change of attitudes is necessary. Only after the attitudes of top and middle management have been changed, such that they believe in JIT, will training be of any benefit. Once attitudes have changed both on the shop floor and in management positions, training may be introduced to improve the usable skills of the managers and the workers.

Before any progress can be made in the conversion from conventional manufacturing to Just-in-Time manufacturing there must be a total understanding of how the techniques of the new system work, how they will change present operations, how the conversion will be managed and how it will affect the users.

"The intensity with which top management investigates JIT is an excellent early indication of the likelihood that implementation

will succeed..... Where can top management gain the understanding it needs? Books, tapes and seminars are the obvious answers. How much education is required? Probably 200 points worth where one seminar hour equals 10 points, one tape hour equals 6 points and one book hour equals 4 points. Conviction comes fairly early in the process. Understanding the implications necessary to appreciate and commit to the kind and magnitude of the change takes a while." [102]

During implementation at A.F. Dreyer there were four target areas for education and training. These were a) top management, b) steering committee, c) middle and shop floor management and d) workers. The emphasis was placed on education for top management and on training for the workers but all groups received both to some extent. The author felt that on the whole not enough time, funds and effort was geared towards training and education in the lower ranks of the companies hierarchy. It is important for the management of all interested furniture manufacturers to note that little will work on the plant floor if the workforce oppose it. In JIT the middle and shop floor management have to take an active part in improving the system and thus a large amount of education and training has to be directed towards these groups. It has already been pointed out that one of the reasons for the failure of the Anglo Dutch program was a low emphasis on education of employees in the lower hierarchical ranks. As an additional comment, it was noted that the operators and line staff were easier to train than the foremen. An explanation of a possible reason for this is presented in the following paragraph.

An additional factor which is particularly valid in the South

African furniture industry, at the lower hierarchical levels is the following. "First line management in the majority of the surveyed companies are predominantly conservative white employees. The next lower level in the hierarchy is the shop floor workers who are predominantly liberal black employees." [103] At A.F. Dreyer there was a strong resistance by the first line management to become involved in participative management or to encourage training and education at lower levels in the company structure. This resistance is caused by a legitimate fear of loss of job security and a fear of the aspirations of the black worker. In order to overcome this politically related problem training must be geared towards both groups to the same extent, but not towards one particular group. In addition more attention should be paid to industrial relations; an area that is sorely neglected at present. [104]

Nestadt [105] in his work on Just-in-Time implementation in the South African environment, indicated that "in a JIT shop floor environment, continuous feedback, step by step paced training with an emphasis on "see and do" type experimentation, incentives which motivate, and job flexibility, i.e. movement to confront a variety of situations, are the fundamental characteristics if JIT/Productivity improvement training plan." To support this, the initial worker training at A.F. Dreyer followed this pattern with encouraging results.

It is unfortunate that many worker training programs seem doomed to fail because trainers are more interested in conducting the training program itself rather than first assessing the particular needs of the organisation and the workers. The

Furniture Industry's Training Board (FITB) conducts a variety of different training programs ranging from basic woodwork to detailed machine operations and materials handling. There is no Just-in-Time training course. There is a basic need in industry for JIT training programs for shop floor workers up to middle management. At this stage shop floor workers must rely on in-house training sessions which are often presented by middle management who themselves are not fluent with the concepts of JIT.

The training plan must have the potential to move the trainee through "four levels of learning". The four levels of learning which must be reached to cause voluntary and rational behavioural change, are : a) knowing about, b) understanding, c) acceptance and d) ability to apply. [106] Since only 8/15 companies originally approached in the survey were not aware of JIT, organisations such as NPI and FITB should focus attention on the introduction of JIT to the furniture industry. It is only after an initial awareness has been created that more productive and directed training can be introduced. It is not sufficient to direct training courses to top and middle management only. During interviews that were conducted in the survey for this project [See Appendix A] it became apparent that companies had perceived a necessity to improve their manufacturing performance but did not know how to go about it. The NPI and the FITB should thus gear their training efforts towards the "How to" and "Why" issues of system implementation.

JIT experts agree that education is certainly key to the success

of implementation and operation efforts. Each company is unique, thus each company has unique educational needs. The majority of South African furniture manufacturers require similar training and educational programs since they are all part of the same industry. It would be beneficial to the industry as a whole if one central productivity improvement body such as the NPI Furniture Unit of the FITB could develop and present such a program. Such an educational program must consider the different needs of each of the hierarchical groups involved, as well as appropriate educational and training media for each group.

"From conversion to process refinement, JIT is a learning process. JIT education can make that learning experience less painful and certainly less costly." [107]

5.4. Employee involvement

Just-in-Time works on the concept that a lot of "little" brains are superior to a few "big" brains when it comes to making organisations work properly. It is well accepted in manufacturing organisations world wide that the top companies are those companies that encourage the full participation of all employees. Most of the companies surveyed accepted and respected this view but few could put into practice the concept of a "thinking worker". Some manufacturers felt that with the present level of education among black shop floor workers such a concept would not help South African manufacturers in any way. This view was proved incorrect in that many South African manufacturers for example Toyota SA, Rowen Engineering and GEC Small Machines have obtained significant benefits from employee involvement. The

author believes that the real problem is that furniture manufacturers have not attempted to tap this tremendous productivity well, and many managers have never thought seriously about employee involvement programs. Employee involvement does not mean worker participation only, it means encouraging all the employees of the company to become involved in improving the system.

JIT represents a total attitude change and systems change for an organisation. Faced with this extensive change employees often become anxious particularly when the reasons for the change are not understood. There is thus a need to manage the change correctly. One of the best ways to dispel the anxiety is to provide explanations. This is carried out through education and training. In order to improve the process, effective work teams must be developed, communication channels restructured and authority and responsibility assignments revised. All these changes can be accomplished in only one way - through involved people.

The primary task at hand for those manufacturers who wish to introduce "thinking worker" concepts is to understand a) how to motivate people, b) how to change their behaviour and c) how to manage teams that work together.

At A.F. Dreyer problem solving groups were introduced. It was noted that the best motivating factors were a) involvement i.e. making the people a part of the process, b) control i.e. managers gave up some of their control to line workers such that the line workers had greater control of their environment and had

freedom to make small decisions, c) feedback i.e. workers received weekly feedback from management regarding their progress; this feedback was both positive and negative and d) recognition i.e. although no formal recognition program was developed workers with improvement ideas were congratulated and encouraged. It was felt by the JIT steering committee that monetary recognition would be difficult to install justly and could have counter productive side effects. According to Mol, [108] subordinates will only function at a maximum level, i.e. do more than is expected of them, when the task itself provides job satisfaction. He also indicates three areas that promote job satisfaction they are 1) A sense of achievement, 2) The transferal of responsibility to the subordinate and 3) Recognition.

As regards changing behaviour, this was accomplished to a small degree through training.

At A.F. Dreyer teams were assembled according to work areas and leaders were chosen to guide the teams from the workers themselves by the workers themselves. Although this did not ensure a team that worked well together it kept those people who had been working together in the same groups. This encouraged better participation from each member and a higher worker morale.

There are numerous tools which will encourage employee involvement especially at the shop floor level. Programs such as a suggestions scheme, problem solving groups, quality circles, small group improvement activities, work simplification, and quality of work life programs encourage participation. Such

programs will only work well in an environment where the attitudes held by management are progressive and participative. This management style should have positive reflections in terms of respect for people and thus trust and honest two way communication, patience, supportive policies and procedures and shared responsibility and authority.

Management support must be exhibited through patience. JIT implementation takes years and is an involved process. People cannot adapt to the changes quickly and new skill development is not instant. Management must thus patiently ensure that workers are sufficiently educated, communication channels are open and workers are encouraged to participate. The same holds for top management's control over middle management.

Management must accept workers as appreciating assets - teammates not machines. Workers attitudes must change but that can only happen after management exhibits true commitment to worker participation. There must also be something in the exchange for the workers' efforts and accomplishments. Nothing for nothing.

6.0. Conclusions

Furniture manufacture is one of the oldest industries in South Africa. Up to the end of World War II furniture production was largely a craft. Although mechanised systems were already in use it was only in the decades of the 1950s and 1960s that mass production became a characteristic of the industry. Nevertheless, the industry has retained its dualistic nature combining mass production of medium and cheap grade furniture with production of handmade, craftsman's furniture in the high price group. It is a discreet product industry with units being produced repetitively in relatively high volumes and as such it is an ideal environment for the application of the Just-in-Time manufacturing philosophy.

It was noted that any attempt to implement a Just-in-Time system into the furniture industry cannot be isolated from the overall socio-political environment since 1) the South African labourforce is currently in a state of crisis and 2) there is an inextricable link between shop floor politics and politics on a national scale. The present level of labour unrest, frequency of labour strikes and the high degree of functional illiteracy due to poor education levels were identified as areas which needed special attention before full scale JIT could operate efficiently in the country. However, tremendous operational and systems improvements could still be made through the application of some of the many JIT techniques if applied at present.

In terms of productivity performance on the whole, and compared to other South African industries, the furniture industry has

been performing exceptionally poorly over the past decade. The average annual growth rate of productivity between 1976 and 1985 was -0,4%. Capital return on investment during 1985 was the second lowest in manufacturing at -1,9%. In terms of value added per employee in 1986 the furniture industry is rated as the third lowest of all South Africa's industries. Although labour productivity improved by 2,8% between 1985 and 1986 unit labour costs rose 20,5% over the same time period indicating an extremely poor relationship between productivity improvements and wage rates.

Due to the poor productivity performance and high labour costs in the industry, as well as a declining availability and increasing costs of good quality furniture timber, the industry has suffered declining sales per employee. Sales in furniture as a percentage of total sales in manufacturing have also been declining and thus the declining sales are not only a result of the wider issue of the poor national economy.

Despite the poor performance of the industry on the whole, manufacturers have directed very little attention towards productivity and quality improvement programs to rectify the trend. Although the furniture industry is an excellent environment in which the Just-in-Time philosophy could be applied almost no progress has been made as regards awareness of JIT let alone implementation of JIT.

The project has considered the implementation issues of JIT manufacturing in the South African furniture industry. It presents an analysis of the present state of awareness of JIT and

the attitudes of employees and companies in the industry towards the implementation of JIT. In addition it documents in a detailed case study, the JIT implementation effort followed by one manufacturer, in an attempt to provide a success story and encourage further implementations.

The survey of the furniture industry indicated a low level of awareness of the Just-in-Time philosophy. Less than 50% of the manufacturers who were originally approached were aware of JIT. Although this figure may seem high when compared to other industries it must be borne in mind that the survey was directed primarily towards the large companies and the market leaders in the industry. Before 1987 only one out of 868 registered companies had attempted JIT and this companies efforts had failed. By 1988 very little progress had been made by the NPI and the FITB in promoting JIT in this industry. During 1987 only two manufacturers were involved in JIT implementation.

Of the 15 companies originally approached three had started JIT programs and one of these programs had failed. Eight were unaware of JIT, two were not committed to the philosophy and two were satisfied with their present system and did not regard JIT as a priority. Those companies that were not committed to the system held the view that they could not benefit from JIT as their suppliers were not supplying JIT. This attitude essentially indicated a poor understanding of the philosophy and highlights the need for further education on conceptual grounds. Many manufacturers believed that full scale JIT implementation would not be possible until labour unrest settled and were

presently not prepared to start a program.

More generally the survey indicated that :-

- the majority of manufacturers are batch producers
- manufacturing planning is carried out mainly on a monthly basis
- planning is complex and carried out by hand
- maintenance teams follow the firefighting approach
- quality control is neglected to a large degree
- lot sizing procedures are informal, variable and result in large lot sizes
- average production lead time is over six weeks
- little constructive attention is directed towards industrial relations and subsequently a substantial amount of production capacity is lost annually due to labour strikes.

The industry is in poor shape and it is only recently that surveys have indicated this poor performance to the manufacturers. Prior to this indication there has been little impetus for new and better systems, technologies and productivity improvements in the industry. The industry is presently characterised by low technology products manufactured in discrete units through medium to low technology processes, by an unskilled and semi-skilled labour force, in relatively low volumes. Very few of the middle management positions, even in the larger companies, are filled by people qualified in production management and inventory control principles. In addition, the top management generally have financial backgrounds. This has

had the unfortunate result that many companies are severely lacking in production engineering and industrial engineering skills, knowledge and expertise.

In attempting to provide encouragement for manufacturers to adopt JIT the project has documented the initial implementation of the philosophy at one particular plant. This case study also helped to identify those factors which are prominent in the implementation process of JIT in the South African environment and in particular, in the furniture industry. The JIT implementation at this plant resulted in reductions in lead time, inventory levels and an improvement in quality levels. It was however, difficult in the short term to quantify the overall financial or market related extent of these improvements but management indicated that the progress had been encouraging.

The JIT implementation did not reduce the labour strike problem at this company although the employee involvement program did contribute positively towards labour motivation and productivity on the shop floor.

In total three pilot projects were completed which all improved operations and productivity levels. Numerous spinoffs resulted from the pilot projects including a product standardisation program, an employee involvement program, a preventative maintenance program, Kanban systems, improvements in housekeeping and visibility, setup reductions and the development of a new plant layout according to GT principles. The Just-in-Time philosophy at this company contributed to reducing overall manufacturing costs, lead times and system complexity.

Although the group technology layout was not implemented due to project time limit and a constraint limiting capital expenditure, the design of the layout was completed. A 1:85 scale model of the proposed layout was constructed in order to provide a clear understanding of the layout and how the system will function. This model was geared towards improving the understanding of non engineering trained employees.

From a review of the implementation program at A.F. Dreyer the author noted three important changes which would be made if the implementation were to be (hypothetically) restarted. They were :-

- A GT implementation program would be initiated early in the JIT implementation progrem.
- A Total Productive Maintenance Program would be initiated and working effectively before lotsizes were reduced.
- A declaration would be obtained from management stating that benefits would be shared with all employees and that no employees would be retrenched due to productivity improvements .

From the work carried out during system implementation and the attitudes of interviewees in the survey, four key success factors were identified. These are :-

- management commitment and style
- the management of change
- education and training
- employee involvement.

The management style of the majority of the surveyed companies was autocratic and conservative in that very few new ideas

reached the shop floor. For JIT techniques to function effectively the management of implementing companies should pursue a participative and progressive management style.

The implementation of JIT requires a very high level of commitment not only from top management but from management at all levels down to first line supervision. This high level of commitment will stem primarily from a broad education base where JIT education is geared towards changing people's attitudes. If the management is sufficiently committed to the change they will become actively involved in dealing with the changes which must be made. They will invest considerable time educating themselves and training their staff. They will personally lead and audit the change process. They will view the ultimate competitive advantage to be an environment in which the creative energies of all people are better utilised than they are by the competition. To this end they will ensure that there is an ongoing commitment to develop people as individuals. Although none of the manufacturers surveyed displayed such dedicated commitment, the author believes that commitment will follow constant involvement and education.

Without a sufficient level of commitment to change there will be a series of compromises which will eventually result in a collapse of the system.

In order to reduce the degree of resistance to change, management should ensure that employees are aware of what changes are to made, be trained in how to operate the new system, be allowed to participate in the changes and above all, understand why changes

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