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

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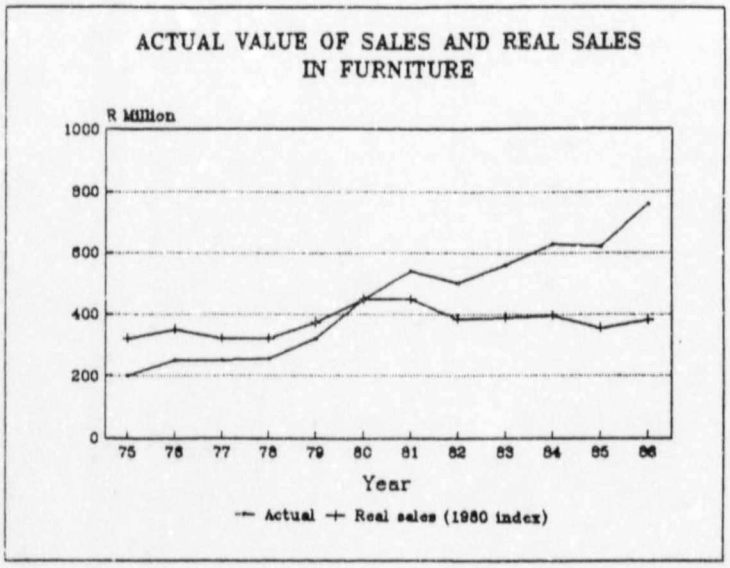

FIGURE 10: Actual value of sales and real sales in furniture.

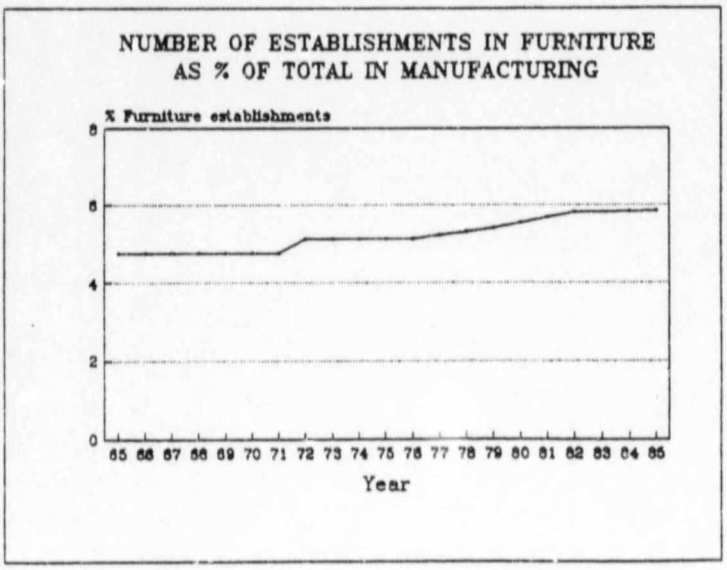

FIGURE 11: Number of establishments in furniture as a percentage of total manufacturing establishments.

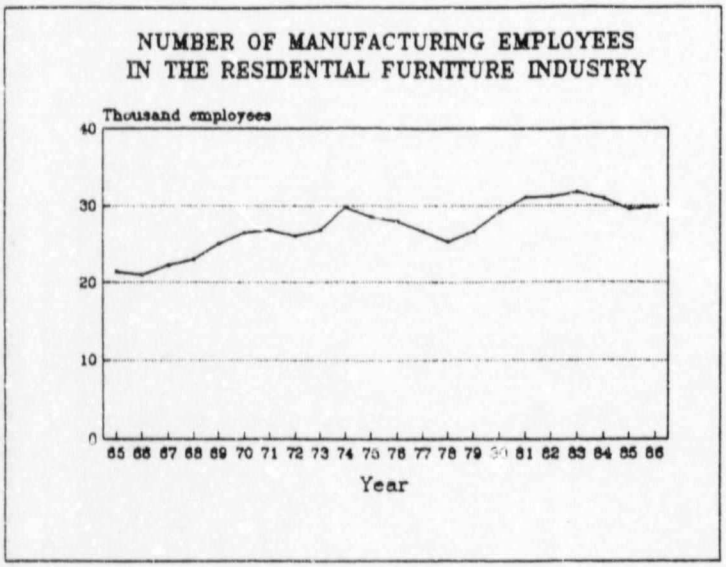

FIGURE 12: Number of manufacturing employees in the residential furniture industry.

and capital productivity, the problem in the industry must lie in the efficiency of the manufacturers since;

Productivity = Efficiency x Utilization.

"Efficiency is defined as the standard time per unit divided by the actual time per unit." [59] Efficiency measures the rate of work and in effect, it is a measure of labour motivation and planning abilities. This issue was made clear to the author during February 1987 at A.F. Dreyer & Co. It was an average day in terms of production activity when the production manager entered the production planner's office and stated, "My staff just don't have any go. There's no enthusiasm on the shop floor. They just can't be motivated to get the work done."

The furniture industry needs urgent attention if it is to provide employment for our growing population and not contribute to the growing unemployment problem. It is however, important to note that the furniture industry is very closely tied to the business cycle. During favourable economic times the consumer has more money to spend and furniture is often in the purchasing line, however, during times of depression furniture is often classified as a luxury. The consumer, to a large extent, manages with what he has until the recession is over.

3.4 The JIT Survey

3.4.1 Introduction

A total of 15 companies were approached and invited to participate in the survey. Of these 10 accepted and 5 declined the invitation for various reasons. Of the 5 companies that declined the invitation none were aware of the Just-in-Time philosophy.

The companies that participated in the survey were :-

- A.F Dreyer & Company
- Anglo Dutch Office Furniture
- Duncan Bayne
- Grant Andrews
- Grants Furnishers
- Gyro Designs
- Highpoint Furniture Industries
- Krost Brothers (Kitchen Units)
- Parker Knoll
- Star Furnishers

Of the companies surveyed five are part of the Afcol Furniture Group which is the largest consolidation of furniture manufacturers in the country. The remaining five are private manufacturers. 9/10 of the companies are of such size that the managerial and production functions have been departmentalized. The smallest company, Gyro Designs, is essentially a solid wood, craftsman-type, establishment. The field work for this survey was conducted between November 1987 and February 1988. The survey of the implementation and awareness issues of JIT in the industry involved three basic phases of data collection from each manufacturer.

Phase 1 involved an interview with either the production manager, the industrial engineer or the owner of each participating company. The interviewee's names and positions are indicated in Appendix A. The interviews were unstructured discussions which related to four key issues of JIT implementation. These issues were
- Education and training of staff
- Employee involvement
- Management commitment and style
- The management of change.

The author worked as a part-time JIT consultant at A.F Dreyer & Co. from February 1987 to February 1988. It was from his experience in the implementation of JIT concepts at this company that the above four issues emerged as important. During the survey of the 10 companies the unstructured discussions relating to the key issues were recorded on audio tape for analysis after the interview. The input obtained from this phase of the survey is presented in Chapter 5.

Phase 2 of the survey required that each interviewee complete a structured closed questionnaire. This questionnaire [Appendix B] was designed to collect information from each company regarding the following five areas - Specific company details

- Manufacturing planning and control
- Just-in-Time awareness
- Just-in-Time implementation
- Industrial relations.

The results of these questionnaires were collated and summarized and are presented in Table 1 with its associated list of notes in section 3.4.2 of this project report.

Phase 3 of the survey involved collecting data regarding the state of the production facilities by means of a guided tour of each of the 10 manufacturing facilities. In addition to input from these guided tours the author was involved in the design of a Just-in-Time polish shop for a furniture manufacturer in an undergraduate project in 1986. [60] Visits were also conducted to the Edblo, Bronzart and Grafton Everest production facilities. An overview of the state of the production facilities is presented in section 3.5. In addition to the above survey, the Furniture Unit of the National Productivity Institute was approached to obtain information relating to productivity levels of companies in the industry. The NPI had conducted a survey relating to productivity in the industry during 1987. [61] The data obtained from the NPI are averages of various ratios from a sample of 28 companies. The presentation of this data is beyond the scope of this report.

3.4.2. Questionnaire Results

The questionnaire that was used to gather data is presented in Appendix B. The results obtained from the questionnaire are presented in summarized form in Table 1.

It must be appreciated that the results presented cannot support detailed and rigid statistical analysis since the sample presented represents mainly the larger furniture manufacturers. The results rather infer certain trends and scenarios in the furniture industry.

Table 1 Summarized Questionnaire Results

NAME OF COMPANY	A.F. DREYER	ANGLO DUTCH	DUNCAN BAYNE	GRANT ANDREWS	GRANTS FURNISHERS	GYRO DESIGNS	HIGHPOINT FURNITURE	KROST BROTHERS	PARKER KNOLL	STAR FURNISHERS	COMMENTS
1.0 Type of Furniture	Wooden home and bedroom	Metal and wood office	Metal and wood office	Metal and wood office	Lounge, bar & bedroom	Oregan pine cottage	Wooden office and home	Wood & metal office and kitchen	Upholstered lounge and occasional	Wooden residential	Good cross section. (1)
1.1 Product Category	Multiple Low volume	Few major, High vol.	Few major, High vol.	Few major, High vol.	Multiple Medium vol.	Multiple Low Volume	Few major, High vol.	Few major, High vol.	Few major, High vol.	Commodity High vol.	6/10 have a few major product lines.
1.2 Process Category	Batch	Batch	Batch	Batch	Batch	Job shop	Batch	Batch	Batch	Batch	9/10 are batch producers.
1.3 Total employees	120	250	150	150	120	30	150	350	350	450	Sample average 212.(2)
1.4 Employee turnover	80 %	25 %	25 %	30 %	10 %	6 %	7 %	15 %	25 %	20 %	Sample average 24.3%.(3)
1.5 Frequency of manufacturing planning	Annually Monthly Daily	Annually Monthly Weekly	Annually Monthly Weekly	Annually Monthly Weekly	Monthly Weekly	Monthly Weekly	Monthly Weekly	Monthly Weekly	Monthly Weekly	Monthly Weekly	10/10 Monthly. 9/10 Weekly. 1/10 Daily.
1.6 Computer based planning	Orders only (4)	Orders only	Orders only	Orders only	Orders only	No	Orders only	Orders only	Orders only	Orders only	9/10 Order processing only.
1.7 Maintenance	PM program (5)	Firefight	Firefight	Firefight	Firefight	PM program	Firefight	Firefight	Firefight	Firefight	8/10 Firefight.
1.8 Quality Control	TQC prog. (6)	Inspection	Inspection	SABS 0157 (7)	Inspection	Inspection	Inspection	Inspection	Inspection	Inspection	8/10 Informal inspection. (8)
1.9 Time Allocation											
1.9.1 Labour	60 %	50 %	60 %	80 %	40 %	70 %	60 %	50 %	60 %	70 %	Sample averages:-
1.9.2 Materials	20 %	5 %	5 %	5 %	10 %	5 %	15 %	10 %	20 %	5 %	Labour 60%
1.9.3 Overheads	20 %	45 %	35 %	15 %	50 %	25 %	25 %	40 %	20 %	25 %	Materials 10% (9)
											Overheads 30%
1.10 Lot sizing procedures	Daily basis (10)	Informal Monthly basis	Informal Monthly basis	Informal Monthly basis	Informal Monthly basis	Informal Weekly basis	Informal Monthly basis	Informal bi-weekly basis	Informal Monthly basis	Informal Monthly basis	7/10 Informal lotsizing on a monthly basis (11)
1.11 Average lead time	2 week	16 weeks	16 weeks	10 weeks	4 weeks	2 weeks	5 weeks	2 weeks	5 weeks	3 weeks	Sample ave 6½ weeks
1.12 Marketing Advantages	Product, Range (12)	Range, Design	Range, Price	Design, Reliability	Product type	Product Type	Range, Price	Reputation Reliable	Price Volume	Price Service	

Table 1 Summarized Questionnaire Results. (cont.)

NAME OF COMPANY	A.F. DREYER	ANGLO DUTCH	DUNCAN BAYNE	GRANT ANDREWS	GRANTS FURNISHERS	GYRO DESIGNS	HIGHPOINT FURNITURE	KROST BROTHERS	PARKER KNOLL	STAR FURNISHERS	COMMENTS
2.0 Aware of JIT	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	7/10 are aware of JIT.
2.1 Who											
1) Top management	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	7/10 Top management.
2) Mid management	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	7/10 Middle management.
3) Shop floor mgmnt.	Yes	Yes	Yes	No	No	No	No	Yes	No	No	4/10 Shop floor mngmt.
4) Blue collar	Yes	No	No	No	No	No	No	Yes	No	No	2/10 Blue collar workers.
5) Purchasing	Yes	No	No	No	No	No	No	No	No	No	1/10 Purchasing staff.
6) Sales-marketing	Yes	Yes	No	No	No	No	No	No	No	No	2/10 Sales/Marketing.
7) Design	Yes	No	No	No	No	No	No	No	No	No	1/10 Design.
2.2 JIT Program	Yes (13)	Yes (14)	No	No	No	No	No	Yes (13)	No	No	3 have started Jit Prog.
2.3 Techniques tackled											(15)
1) Inventory reduction	Yes	Yes	-	-	-	-	-	Yes	-	-	3/3 tackled.
2) Lot size reduction	Yes	Yes	-	-	-	-	-	Yes	-	-	3/3 tackled.
3) TQC	Yes	No	-	-	-	-	-	No	-	-	1/3 tackled.
4) TPM	Yes	No	-	-	-	-	-	No	-	-	1/3 tackled.
5) Setup time reduct.	Yes	Yes	-	-	-	-	-	Yes	-	-	2/3 tackled.
6) Layout	Yes	No	-	-	-	-	-	No	-	-	2/3 tackled.
7) Group Technology	No	Yes	-	-	-	-	-	No	-	-	1/3 tackled.
8) Sync. Scheduling	Yes	No	-	-	-	-	-	No	-	-	1/3 tackled.
9) Quality circles	Yes	No	-	-	-	-	-	No	-	-	1/3 tackled.
10) Kanban	Yes	No	-	-	-	-	-	Yes	-	-	2/3 tackled.
11) Data Collection	Yes	No	-	-	-	-	-	No	-	-	1/3 tackled.
12) Multifunction wkrs.	Yes	No	-	-	-	-	-	Yes	-	-	2/3 tackled.
13) Standardization	Yes	No	-	-	-	-	-	Yes	-	-	2/3 tackled.
14) Jit Purchasing	No	Yes	-	-	-	-	-	No	-	-	1/3 tackled.
2.4 Training material											(16)
A) Videos	abcdefg	abc	-	-	-	-	-	abcd	-	-	
B) Books	abc	ab	-	-	-	-	-	ab	-	-	
C) Games	abcde	-	-	-	-	-	-	ab	-	-	
D) In house lectures	abcdefg	abcd	-	-	-	-	-	abcd	-	-	
E) External lectures	ab	ab	-	-	-	-	-	ab	-	-	
Training target											
a) Top management	ABCDE	ABDE	-	-	-	-	-	ABCDE	-	-	
b) Middle management	ABCDE	ABDE	-	-	-	-	-	ABCDE	-	-	
c) Shop floor mgmnt.	ABCD	AD	-	-	-	-	-	AD	-	-	
d) Labour force	ACD	D	-	-	-	-	-	AD	-	-	
e) Purchasing	ACD	-	-	-	-	-	-	-	-	-	
f) Sales-marketing	AD	-	-	-	-	-	-	-	-	-	
g) Design	AD	-	-	-	-	-	-	-	-	-	

Table : Summarized Questionnaire results. (cont.)

NAME OF COMPANY	A.F. DREYER	ANGLO DUTCH	DUNCAN BAYNE	GRANT ANDREWS	GRANTS FURNISHERS	GYRO DESIGNS	HIGHPOINT FURNITURE	KROST BROTHERS	PARKER KNOLL	STAR FURNISHERS	COMMENTS
2.5 Black worker training No training On the job Informal talks Formal internal Formal external	 No Yes Yes Yes No	 Yes No No No No	 - - - - -	 - - - - -	 - - - - -	 - - - - -	 - - - - -	 No Yes Yes Yes No	 - - - - -	 - - - - -	(17)
3.0 Reasons for not attempting JIT	-	-	No commitment	No commitment	Unaware	Unaware	Unaware	-	Not present priority	Satisfied at present	3/10 unaware. 2/10 no commitment.
3.1 Other productivity programs under way	Mgmnt courses	None	None	SABS0157	None	None	None	Mgmnt courses	Mgmnt courses	Mgmnt courses	5/10 no training. 4/10 management courses. (18)
3.2 Most pressing problem in system at present	Labour training	Planning, Inventory holding	Planning, Inventory holding	Planning	Inventory holding	Planning	Scheduling	Overheads	Labour Motivation	Poor floor management	5/10 Planning. 3/10 Inventory. 2/10 Labour.
4.1 Unionized labour force	Yes FWU PWAWU	Yes MAWU PWAWU	Yes MAWU PWAWU	Yes NUFOR	Yes FWU	Yes FWU	Yes FWU PWAWU	Yes NUMSA	Yes PWAWU FWU	Yes PWAWU FWU	All unionized to a large degree. (19)
4.2 Working days lost in strikes during 1987	30	10	10	4	4	2	10	3	27	6	(20)

Notes to Table 1

1) The survey does not include glass, cane or plastic furniture manufacturers. In addition garden furniture is not included. However the author did visit a foundry which produces garden furniture viz. Bronzart Garden Furniture.

2) The total employee headcount is based on an approximated yearly average for the period 1 January 1986 to 1 January 1987.

3) The employee turnover figures quoted are an approximated average over a two year period from 1 January 1985 to 1 January 1987.

4) "Orders only" refers to the use of a computer, either mini or micro, for the processing of sales orders only.

5) PM Program refers to a preventative maintenance program and not a total productive maintenance program.

6) The TQC Prog. or total quality control program detailed here is still in its infancy.

7) SABS 0157 is a quality control code set up by the South African Bureau of Standards.

8) Although goods were inspected, the inspections were merely

checks for surface scratches and missing fittings such as door handles, door knobs etc..

9) This is a measure of how the production managers felt they were spending their time. This measure is subjective.

10) Lot sizing at A.F. Dreyer follows a period order quantity type order model where the period between orders is one day.

11) The majority of the surveyed companies processed orders on a monthly basis and then proceeded to cut one lot of each component required for the month.

12) A.F Dreyer cited a "large range of products" as a marketing advantage prior to the implementation of JIT. The product range was trimmed substantially with the introduction of JIT concepts.

13) The A.F. Dreyer JIT implementation project started in February 1987. Krost Brothers started implementing JIT concepts into their kitchen units department in June 1987.

14) Anglo Dutch Office Furniture initiated a JIT implementation program at their Tulisa Park premises in January 1984. This program however, lasted only 2 years before the company reverted back to their original informal system. No long term benefits resulted.

15) Since only 3 out of the 10 surveyed companies attempted JIT implementation the summarized results for question 2.3 are

presented on an "out of 3" basis rather than on an "out of 10 or "x/10" basis.

16) In question 2.4(i) the small letters which appear in the company columns refer to the training target e.g. c refers to shop management. In question 2.4(ii) the capital letters which appear in the company columns refer to the training material used e.g. A refers to the use of videos for training.

17) Note that Anglo Dutch did not attempt to train their black workers.

18) Training is carried out by the Furniture Industries Training Board under the supervision of the Furniture Manufacturer's Association.

19) Many of the production managers were uncertain of the union membership of their employees.

20) Days quoted are days of work lost, due not only to strikes but also to political stayaways. No attempt has been made to qualify the extent of 'go slow' strikes, however their effect was pronounced.

3.4.3 A Discussion of the Survey Results

The cross section of the type of furniture produced by the companies that participated in the survey included wooden, solid and case furniture, home and bedroom furniture, metal and wooden

office furniture, lounge and bar furniture, Oregan Pine cottage furniture, kitchen units and upholstered lounge and occasional furniture. The wooden furniture ranged from solid imbuia, mahogany and oak units through veneered case goods to duco finished supawood and bisonboard units. The survey included sheet metal cabinet producers but not cast iron aluminium, steel, asbestos or extruded or molded plastic outdoor furniture. Glass and cane furniture manufacturers were also not represented as this industry's manufacturing techniques and systems are very different.

Figure 13 indicates the positions of the surveyed companies on a product-process matrix. 9/10 of the surveyed companies are disconnected line flow, batch producers. Of these 3/10 fall into the few major products medium volume category, 4/10 into the many major products, high volume category and 2/10 into the high standardisation, high volume category. A medium volume manufacturer produces approximately 3500 units per month. The JIT concepts attempt to move a manufacturer towards the continuous flow process and win him market share, thus increasing production volume. Volumes of units produced in the industry will help in the application of JIT and some manufacturers have sufficient volume such that dedicated production lines could be installed.

The companies surveyed ranged in size from 30 employees (Gyro Designs) to approximately 450 employees (Star Furnishers). The sample average is 212 employees. The furniture industry average is far lower at approximately 35 employees per manufacturing establishment. The companies represented in the survey are generally the larger and better known furniture producers.

Product Process Matrix of Surveyed Companies

PROCESS \ PRODUCT	LOW VOLUME AND STANDARDISATION	MULTIPLE PRODUCTS LOW VOLUME	FEW MAJOR LINES MEDIUM VOLUME	MANY MAJOR LINES HIGH VOLUME	HIGH VOLUME AND STANDARDISATION
JUMBLED FLOW. (JOB SHOP)		Gyro Designs			
DISCONNECTED LINE FLOW (BATCH)			A.F. Dreyer Duncan Bayne Grants Furniture	Highpoint Furniture Grant Andrews Anglo Dutch Krost Brothers	Parker Knoll Star Furnishers
CONNECTED LINE FLOW (ASSEMBLY LINE)					
CONTINUOUS FLOW (PROCESS)					

FIGURE 13: Product-process matrix of surveyed companies.

The average employee turnover figure for the sample is 24,3%. Since the average number of employees is over 200 it indicates that the average employee remains in his job for approximately ten years.

All of the companies carry out monthly order processing and planning, however only 4/10 companies carry out longer range planning in the form of Master Production Scheduling. The level of long range forecasting accuracy is generally poor i.e. ±2000 units is as accurate as some companies can forecast one year into the future (approximately 25% error). Some manufacturers do not attempt to forecast further than one month into the future. In addition to the poor techniques used to forecast future orders, there is the added complication that the furniture industry is seasonal with a small increase in sales around winter and a large peak around the end of October to middle of December.

9/10 companies schedule work through their production facilities on a weekly basis. One company, A.F. Dreyer, changed their scheduling from a weekly basis to a daily basis during JIT implementation in 1987.

Although 9/10 companies use computers in their manufacturing plants, these machines are only used for order processing. None of the companies use computers for functions such as Resource Planning and Master Production Scheduling, nor do any of the companies have up-to-date bills of materials, routings or inventory status data held in computer files. The use of computers is generally left to secretarial and accounting

functions. Material ordering is carried out by all of the companies by hand following reorder point logic, however only one company could produce formal lists of the reorder point quantities for stocked materials. None of the companies use an ABC analysis on stocked inventories.

The industry adheres strongly to the "If it ain't broke don't fix it" attitude, with the natural result that no preventative maintenance is carried out. The result is a relatively high level of machine breakdowns. Many of the larger machinery is imported. Spare parts, especially on the electronics side, are generally not kept, and it is not unheard of for a machine to break down and stand idle for up to 4 months before replacement parts are obtained. In the JIT environment of low inventories such a situation is totally unacceptable. 8/10 of the surveyed companies followed a typical fire fighting approach to maintenance. 2/10 companies have preventative maintenance programs currently in use, however these two programs are still in their infancy and are not yet profitable. [62]

8/10 companies have not considered any type of formal quality control procedures. A.F. Dreyer is currently involved in the design and implementation of a TQC program but little headway has been made. Grant Andrews is currently implementing the SABS 0157 code of quality control through external consultants. This system is also in its infancy and is not yet profitable as little time has been spent on the project. [63] In a conference held in Cape Town in March 1988 it was decide by the Furniture Manufacturers Association, the Furniture Traders Association, the National Productivity Institute's Furniture Unit and

representatives of the South African Bureau of Standards that a SABS code would be set up for furniture. [64] This was to be carried out in view of the declining sales per employee in the furniture industry. Although most companies do conduct inspections of completed items these inspections are not based on a particular quality code nor on any form of statistical or sample type inspection. These inspections are merely informal checks for scratches, dents or missing components.

During the survey, production managers were asked what percentages of their time they estimated to be spent on the three areas of labour, materials, and overhead problems. [Appendix B Question 1.9] From the survey results they estimated that on average, 60% of their time is spent on solving labour problems, 10% on materials problems and 30% on overhead problems. Bicheno [65] indicates that on average production managers attack problems in the ratio of labour 70%, materials 10% and overheads 20%. He believes that labour actually contributes 10% of the problems, materials 60% and overheads 30%. The author however, believes that the current labour unrest as well as low labour education levels has led many production managers to devote large amounts of time to rectifying labour related problems on the shop floor. As a direct consequence little time is allocated to material and overhead problems, both in planning and execution which results in low efficiencies in these areas. The low efficiencies in the labour area, is however, a direct result of unrest and poor education which contributes to the poor motivation and low labour productivity levels. [66]

The adaptation of the JIT philosophy will force production

managers to devote time to the actual problem areas rather than to the apparent problem areas.

Question 1.10 of the survey questionnaire [Appendix B] relates to lot sizing procedures. 7/10 companies carry out informal lot sizing on a monthly basis . The procedure at these companies is to base the lot size on the monthly order total. Thus, if a total of 500 desks is ordered for the month the lot size is set at 500 (with appropriate multiples according to the BOM quantity). Any component is produced only once during a particular month. This results in high utilization of machinery, few setups but exceptionally large lot sizes and high inventory levels. This lot sizing procedure is used whether the company is fabricating items to fill stockrooms (Make-to-stock Assemble-to-order) or whether fabricated items are shipped directly to customers (Make-to-order). The lot sizing procedures are informal in that changes could be made by the production foreman or machine shop supervisor at his own discretion and without any explanation. Lot sizing requirements in these companies generally does not relate to economic or financial considerations but rather to convenience and expediting requirements.

The 3/10 remaining companies favour smaller lots. Krost Brothers, at the time of the interview, sized lots on a bi-weekly basis in a bid to reduce inventory holding and Gyro Designs did so on a weekly basis. A.F. Dreyer size lots on a daily basis. This is be discussed in detail in the case study in chapter 4. Basically it means that enough of each component is cut such that it will supply the assembly lines for a period not exceeding one

day. The lot sizes at A.F. Dreyer are generally very small and range from 10 units to 100 units.

The average lead times of the surveyed companies range from 2 weeks to 16 weeks with an average of 6,5 weeks. 2 of the 3 companies that cite a 2 week lead time are implementing the JIT philosophy, viz. A.F. Dreyer and Krost Brothers. The third is Gyro designs which is a small company with a relatively low turnover.

Of the surveyed companies 3/10 indicate that their product range is a marketing advantage. 3/10 indicate price as a competitive advantage and 3/10 cite design or product type. 1/10 feels that reliable deliveries is its strongest advantage. The JIT philosophy will improve the competitive position of all of the companies if adopted, however, substantial changes will have to be made especially in the two areas of product range and product design. In terms of product range the factory will have to follow a "focused factory" concept. [67] Although a large range of products could still be manufactured by a particular company, a high degree of component standardisation would have to be carried out. A company with a very wide product range would find it difficult to compete with the focused factory in terms of price. [68] The focused factory would have a volume advantage and thus gain "economy in volume" advantages. Chapter 4 points out some changes that were made at A.F. Dreyer who cited that product range was one of the company's strongest marketing advantages. This company kept an exceptionally large range of end items in stock, both in finished goods and component form before JIT implementation. During JIT implementation the product

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range had to be trimmed. This resulted in large s le standardisation and the a subsequent development of a short term conflict between marketing and production staff.

Initially fifteen companies were approached to participate in the survey. Five declined. None of these 5 were aware of Just-in-Time. In addition 3/10 of the participating companies are not aware of JIT. Thus 8/15 or over 50% of furniture manufacturers that were originally approached were totally unaware of JIT. Considering only the 10 companies that participated in the survey, 7/10 companies' top management and middle management are aware of the JIT concepts. Shop floor management is aware in only 4/10 companies, and blue collar workers and sales/marketing staff in only 1/10 company.

JIT was originally introduced into South Africa by George Davidson, Manufacturing Director of Toyota S.A. in 1982. [69] Since then the philosophy has reached many manufacturers but JIT awareness in the furniture industry is relatively poor. The JIT concept was spread in two main streams a) from university courses and b) through consultants and production professionals in societies and conferences. [70] Since the South African furniture industry is a very low tech environment there is very little emphasis in the industry itself to keep abreast of the latest technological developments. The industry is generally in poor shape and it is only recently that surveys [71] have indicated the industry's poor performance to manufacturers. The competition is generally weak especially for the larger companies with the result that there has been little impetus for new and better systems and technologies.

Only 3/10 companies have attempted the implementation of JIT, Of these 1 has failed and the other two programs are still in their early stages. Anglo Dutch Office Furniture initiated a JIT implementation program at their Tulisa Park premises in January 1984. The initial aim of the project was to reduce the inventory levels. This program lasted only 2 years before the company reverted back to its old system. The reasons for the failure of the program were cited by the current production manager as :-

1) lack of commitment from top and middle management,
2) a severe lack of understanding of the system and little attention given to training of production employees,
3) no attention directed towards employee involvement. [72]

Question 2.3 of the survey serves as an indication of the various Just-in-Time techniques that are being, or have been used by the 3 implementing companies. All 3 companies have attempted inventory reduction and lot size reduction. 2/3 companies tackled the areas of setup time reduction, layout, Kanban multifunction-workers and standardisation. Only 1/3 companies attempted TQC, TPM, Group Technology, Synchronised Scheduling, Quality Circles, Process data collection or JIT purchasing. It is noticeable that there is a very narrow focus on inventory reduction. Also very little attention has been directed towards employee involvement.

As regards the training of employees, various techniques are used by the implementors including videos, books games, in-house lectures and external lectures. Videos have had a relatively wide field of application as have in-house lectures. External lectures and books are generally directed towards top and middle

management. At the time of the interview 2/3 companies had not attempted to introduce the JIT concept to people not directly involved in manufacturing. Thus finance, design, sales, marketing and purchasing departments have been excluded from the training and introductory lessons. This may cause a break down in teamwork and interdepartmental communication and should thus be avoided.

The most popular forms of training of black workers is the "sit by Nelly" or on-the-job training, informal talks and formal internal discussions. No companies carry out formal external training for black shop floor workers with respect to JIT. Anglo Dutch did not carry out any black worker training at all. This neglect could have been the major barrier to successful implementation at the company.

Of the companies that have not attempted implementation, 3/10 are unaware of JIT, 2/10 are not committed to the philosophy because they felt it is "irrelevant to the S.A. environment", and 2/10 are satisfied with their present systems. The 2 "satisfied at present" companies, Star Furnishers and Parker Knoll, are also the 2 largest manufacturers surveyed. In addition, due to volume economies, these 2 companies described price as their strongest marketing advantage. Both of these companies are following a high volume low variation production process and are essentially focused factories even though their production processes and systems could however still be improved by adopting a JIT strategy.

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programs at all, and only 4/10 are participating in management training courses. This emphasizes the general indifference of many of the manufacturers in the industry towards latest developments and employee education.

Question 3.2 of the questionnaire relates to the most pressing problems in the various companies. 5/10 companies indicate that planning of material flows is the most pressing problem, 2/10 point out labour problems as primary, and the remaining 3 cite inventory holding, scheduling and overheads as major concerns. The interviewees' replies to this question should have been closely tied to replies to question 1.9 concerning time allocation, however confirmation is poor. e.g. On average labour accounts for 60% of production managers' time allocation but only 3/10 companies cite labour problems as the most pressing problem area. The problem areas cited relate mainly to material problems e.g. 4/10 cite planning problems, 1/10 cite scheduling and 1/10 inventory holding.

All of the companies surveyed were unionised to a large degree. The major unions involved in the industry are the Furniture Workers Union (FWU), the Metal and Allied Workers Union (MAWU) and a larger union which is part of the Congress Of South African Trade Unions (COSATU) viz. the Paper, Wood and Allied Workers Union (PWAWU). It is disconcerting to note that most of the interviewees were unsure a) as to what unions represented their labour force, b) as to what agreements, other than wage agreements, had been made, and c)the unions position on productivity improvement issues. It is apparent that there was very little attention given to unions and industrial relations by

production managers despite the obvious importance of this area in the current South African environment.

The final question on the questionnaire relates to the number of working days lost due to strikes and unrest related stayaways during 1987. This ranged from 2 days at Gyro Designs to 30 days at A.F. Dreyer. For the 10 companies surveyed a total of approximately 23 440 man days were lost. This represents ±5% of the sample's total labour capacity. This figure does not include the loss of capacity due to go slow strikes. It was conservatively estimated by the Parker Knoll production manager that twice as much capacity was lost due to go slow strikes in his company. [73] A similar situation occurred at A.F. Dreyer during 1987.

The implications of such a severe loss of productivity due to strike action is critical to the implementation of JIT in the industry. Many manufacturers are under the impression that full scale JIT implementation would not be possible until the labour unrest in the country settled down. [74] It was however, felt by some that many benefits could still be obtained through JIT. This has resulted in A.F. Dreyer and Krost Brothers continuing with their implementation programs.

3.5 An Overview of Furniture Production Facilities and Systems.

There are a total of 868 registered furniture manufacturers in the country. Of these only 54, or ±6%, are large enough to warrant separate management departments. 9/10 of the surveyed companies have separate management departments. Although the

sample is not representative of the furniture industry in this respect, the author believes that if the larger companies could adopt the JIT philosophy then the smaller companies will follow, firstly in order to remain competitive, and secondly, implementation would be easier in smaller companies because they are more flexible and dynamic. The overview given in this section thus relates closer to the larger companies in the industry since it is based on information that was gathered during a survey of predominantly large manufacturers.

Those companies that are departmentalized have separate functional departments consisting of

1) Finance
2) Production
3) Design
4) Purchasing
5) Sales and Marketing
6) Personnel.

The smaller the company, the fewer functional departments. Within the larger companies interdepartmental communication is poor especially between finance, production and marketing, and it is generally carried out on a "need to know" basis.

The factory areas are generally physically divided into the following functional zones

- machine shop for wood or sheet metal fabrication
- assembly shops and cabinet making
- upholstery department
- finishing shops for lacquer polishing or powder coating

- prototypes and new designs
- stores - raw materials
  - components
  - finished goods
  - old stock and scraps for reworking.

The size and degree of development of each of these facilities is dependent on the type of furniture that is being produced (e.g. case goods, solid units, kitchen or office, wood and steel etc.) as well as the size of the company.

The majority of the surveyed companies process orders on a monthly basis by means of a mini or micro computer. The resulting "order lists" are then sent to production control for order filling. Production control writes out job cards for large batches of components. These batches are generally drawn from large component stores and sent to assembly points. The machine shop then fills the component stores. In the machine shop production is based on what is known as a "cutting". In this "cutting" approach if a lot of 100 chairs are to be assembled to fill the monthly order total, then 100 of each part (with appropriate BOM multiples) are drawn from the stockroom. The production facility then starts cutting all the replacement components at the same time. This approach which starts all parts as soon as possible, without consideration for the manufacturing lead time of each component, leads to unnecessarily high work-in-process inventories as it follows a front schedule rather than a back schedule or MRP logic. [75]

Large South African furniture manufacturing plants, especially their machine shops, are characterised by noisy, dusty, untidy

environments with excessive work-in-progress queues. Final products are produced to order from highly unstandardised components. On average end items contain 20 to 30 components excluding fasteners. The average furniture manufacturer produces about 65 different end items. [76] Machine shops must therefore fabricate in the order of 1300 to 2000 different components. Most planners control and schedule these components through various length routings (2 to 15 machines) by hand. Since this planning is carried out by hand, back scheduling would be exceptionally time consuming for 2000 parts. Due to the low technologies used in the industry, little effort has been directed towards the use of computers for planning purposes. This is probably the reason why the easier "cutting approach" is used.

Production and materials handling staff are mostly black labourers whereas from the production supervisory level upwards, white staff predominate. Workers are essentially materials handlers, operators, journeymen, cabinet makers or general assistants. Pallets and pallet trolleys are the main tools for materials handling with conveyers rarely used in stockrooms, loading docks, fabrication shops or assembly zones. Floor level chain conveyers as well as suspended chain conveyers are common through finishing shops and drying ovens.

Attitudes towards quality control are very unsophisticated and informal inspections for surface scratches etcetera are the order of the day. This unprofessional approach and lax attitude to quality control has resulted in

- high levels of returns and rework

- low sales growth
- low productivity
- poor quality levels.

Very few attempts have been made in the industry to improve quality at the source. Any quality still present in furniture is "inspected into the units" and not "built into the product".

Setups and changeovers are generally the responsibility of the setup crew (for the larger machines). This setup crew normally comprises one machine technician and 1 to 3 assistants. Smaller machines and large machines in the smaller companies are setup by the operators themselves. Few attempts have been made to reduce setup times and in most cases, setup times are not documented.

The industry is 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 personnel generally have financial backgrounds. This has the unfortunate result that many companies are severely lacking in production engineering and industrial engineering skills, knowledge and expertise.

4.0 THE ROAD TO IMPLEMENTATION FOLLOWED BY A.F. DREYER AND COMPANY A CASE STUDY

Before continuing with a discussion of JIT implementation at A.F. Dreyer, it is important to define the word "implement" as it is used in the Just-in-Time context. The word implement connotes finality, a project which begins and ends. Such is not the case with Just-in-Time. Just-in-Time is an infinite process, a journey to an ideal which may never be reached. JIT is synonymous with "perpetual improvement" and as such, JIT can never be fully implemented. JIT implementation may have a start date but never a completion date unless the project is abandoned. For this reason, the author believes it to be critical for an implementor to set targets and goals in order that he may gauge implementation progress.

This chapter documents the work carried out by the author while working as a part-time JIT consultant between February 1987 and February 1988 at A.F. Dreyer & Co. In addition to presenting an outline of the implementation procedure, it identifies and discusses the various problems that were encountered during implementation. Some of these problems or issues that emerged in the implementation were considered by the author to be critical to successful JIT implementation. These issues were identified as those that had the most pronounced effect on the way the implementation program was approached. They were also identified by the views of interviewees of the furniture industry survey. These issues are - Management commitment and style

- Management of change
- Education and training

- Employee involvement.

These issues are discussed each in more detail in the following chapter. No attempt has been made to classify them in any order of importance as they are interrelated in much the same way as the actual techniques of Just-in-Time.

The chapter culminates in a critical analysis of the implementation program. This section (4.9) identifies the changes that would be made if the overall project were to be repeated.

Just-in-Time is deceptively simple in concepts, but difficult to install. JIT is not a quick technological fix nor is it a system to be brought in overnight by top management. The process is lengthy and shortcuts will probably result in failure. In fact, much of JIT can be carried out by a company internally without considerable investment. Just-in-Time implementation however, requires the commitment and leadership of top management and, at the same time, the understanding and full dedication of every individual in the process.

There is no specific recipe or blueprint for success. Understanding the philosophy comes first, before determining the applicability or planning the attack. Each company must then address the implementation in its own way, with its own degree of commitment which will largely determine its order of success. There may also be some companies that experience failure initially with JIT, such as Anglo Dutch. However, such companies and others can learn from failure and proceed towards incremental

success.

Most of what has been written about JIT has been devoted to describing the philosophy, ingredients and benefits. Now more detail is needed, with attention given to what was done, how it was done and how to start. [77]

A case study and success story about JIT implementation in the South African furniture industry will eliminate any reservations or misunderstandings about JIT techniques and how they can be applied. This case is designed to indicate one way that JIT may be implemented, it is not intended to be a "rule book" or "blueprint".

4.1 Introduction to A.F. Dreyer & Co.

A.F. Dreyer & Co. is a privately owned South African manufacturer of occasional furniture for the middle price range residential market. The business was started in 1946 as a one man show. Over the past 30 years the company grew substantially and by February 1987 it employed close to 150 people at its manufacturing facility in Alberton. No formal manufacturing planning and control system was then in use. The company, originally a make-to-stock manufacturer, altered its strategy to that of a make-to-order company in a bid to decrease finished goods inventory holding. This change resulted in a critical escalation of supply lead time and forced the company to consider a complete "about face" in their manufacturing plant.

The company was experiencing a severe build up of common

manufacturing problems in the form of :

- excessive lead times (sometimes up to 3 months)
- unacceptable inventory levels (investment over R2,000,000)
- poor quality and excessive customer returns (30% returns on some products)
- labour strikes
- low levels of labour motivation
- poor delivery performance records (±40% orders shipped on time)
- difficulty in machine shop scheduling and planning
- resultant low efficiency and productivity
- poor return on investment (less than 5%)
- escalating cost of manufacture and selling prices
- resultant loss of market share.

An attempt had been made (starting in December 1984) to implement a Materials Requirements Planning (MRP) system to regain control of the manufacturing plant and its associated activities. By June of 1986 the attempt had been abandoned as it generated excessive amounts of paperwork, was very dependent on high data input accuracy and did not involve employees. The MRP system on its own, did not concentrate its efforts on the eradication of the problems, but rather concentrated on the computerisation of an already poor system. The MRP system had aggravated the already acute problems.

The owner and his manufacturing staff, who were now searching for a solution, heard about the JIT philosophy and attended an introductory course towards the end of 1986. The "JIT crusade" then got under way at the start of the financial year in February

1987 with the employment of the author on a part time basis as a student consultant.

4.2 Problem Definition

4.2.1 Problem Statement

In view of the numerous problems facing A.F. Dreyer & Co. a Just-in-Time system was to be developed and implementation started. The JIT system was to be aimed at reducing the problems as detailed in the introduction [section 4.1], so as to improve the operating characteristics of the company.

4.2.2 Requirements

- The proposed system is to consider the entire planning and production processes from purchasing of raw materials to dispatch of completed goods.
- The system is to use the basic principles of JIT, TQC and TPM. These principles should be built into the process.
- The system should consider factors such as space and labour available, as presented in the constraints, but should leave room for future expansion.
- Approximately 3000 units are to be produced per month. The details of these units are presented in the product quantity charts [Appendix C].
- The system must cater for a large product range produced in a mixed model fashion.
- The direct aims are

    1) to reduce inventory levels

2) to improve and simplify planning processes

3) to improve quality levels

4) to reduce lead times.

4.2.3 Constraints

- The space required by the new system must not be more than 2700 square meters.
- The human requirements must not be more than 150 employees.
- Available equipment and facilities should be used as there will be no large capital expenditures during the short term (less than 1 year), from the start of implementation.

4.2.4 Criteria

- The system must focus on the elimination of waste.
- It must be practical and easy to understand and use as it will be used by shop floor personnel.
- The JIT system must provide information to the system users in such a way as to enhance visibility.
- The direct aims, as indicated in the requirements, must be met.

4.3 The Just-in-Time Steering Committee

A Just-in-Time team, otherwise known as a steering committee, was set up in February 1987. Since the company employed only 150 people it was decided that the steering committee would direct all JIT implementation projects rather than have separate project teams for each project. The steering committee had representatives from manufacturing, purchasing, design, quality,

finance and sales/marketing. Some of the members on the team however, represented more than one functional area due to the small size of the company e.g.. the production manager and production foreman together represented design, quality and manufacturing. The team was to meet on a weekly basis from February to June 1987 to discuss various aspects of the program.

At the first steering committee meeting it was noted that there was some resistance to the program by members of the team who had not attended the Wits Industrial Engineering course. [78] This initial resistance to change within the steering committee was overcome to a large degree but not totally, by supplying additional educational material to the team in the form of videos, books, games, papers, lectures and informal discussions between the group members. Although not all the members were 100% committed to JIT, it was decided that implementation would begin. It was also realised that progression would initially be slow until the benefits became more obvious. Since all the members of the steering committee, apart from the author, were either top or middle management, implementation was to be a top-down process.

4.4 JIT Implementation Schedule

Prior to discussing the actual implementation projects a summary of the JIT implementation sequence is presented in Figure 14. The figure shows each of the projects that were tackled as well as their start dates. From mid-June to the end of August, little progress was made concerning JIT implementation due to a labour strike. This is indicated on the figure by a hatched area. The

labour strike and the various projects noted in the figure are discussed in more detail in this chapter.

The implementation schedule presented below is evaluated in section 4.9. It is presented here in order to provide the reader with an overview of the implementation sequence prior to the individual project discussions.

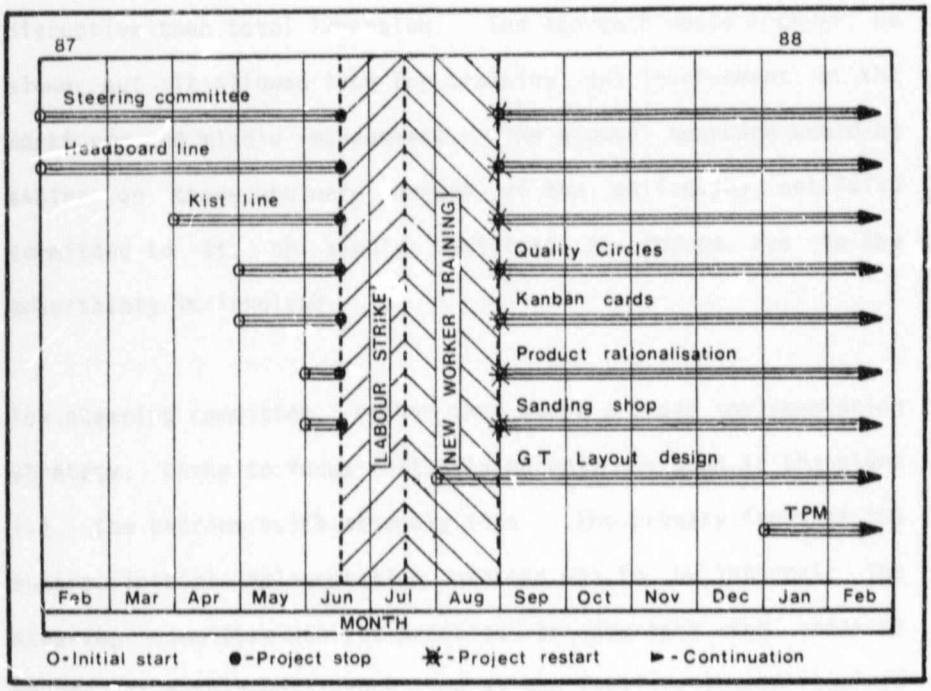

FIGURE 14: JIT implementation schedule

4.5 The Pilot Projects

Since there was resistance to change within the steering committee, as mentioned above, it was decided that a "pilot project" approach would be followed during implementation, rather than a "total immersion" approach. The pilot project system follows the "let's get a success story and then repeat it"

approach advocated by R.J. Schonberger [79]. In addition, the steering committee decided on a back-to-front approach i.e.. the pilot projects would start at the tail end of the manufacturing process i.e.. final assembly. "The idea is to get the end of the process in tune with the daily sales rate. Then back up one step to subassembly; get that right. Then back up further to fabrication and beyond." [80] It was believed that this type of approach would have less risk attached to it, and would be less disruptive than total immersion. The approach would however, be slower but it allowed time for training and involvement of the workforce and middle management. The slower approach would be easier on those who were unsure of the philosophy, not fully committed to it, or simply resistant to change due to the uncertainty it involved.

The steering committee, rather than adopt a broad implementation strategy, chose to focus initially on only one area in the plant i.e. the bedroom suite assembly line. The primary focus of the entire initial implementation process was to be internal. The steering committee was not prepared to approach the areas of vendor JIT supply until such time as the facility itself required such action to continue improvements. The steering committee were of the opinion that the "JIT crusade" should start within the company and then progress back to the companies suppliers and forward towards the companies customers. The reasoning behind this attitude was that the majority of the A.F. Dreyer's suppliers were large companies who were themselves not JIT producers. The conversion of supplier plants, who were in some cases monopoly groups (e.g. Plascon and Bisonboard) would be a lengthy and difficult project. Management felt that many

benefits could still be achieved through the application of the JIT philosophy within A.F.Dreyer without involving the large supplier companies during the initial implementation program (within the first year). The preparation of the A.F. Dreyer facility internally, and its workers, was thus of primary importance.

4.5.1 The Bedroom Suite Line

The first pilot project was the application of the Just-in-Time techniques and principles to the bedroom suite assembly line. This line was chosen because it was felt that substantial improvements could be made. All of the assembly work on the line was carried out on light movable benches with manual hand tools, light presses, table clamps, portable compressed air drills, and screw guns. Relayout would thus be easy. The assembly process was simple and inventory and work-in-progress levels at the assembly lines were excessively high. (12000 components) Prior to any changes being made to the line some counts were made. The production rate of the team of workers was ±15 units per day where one unit included one dressing table, one stool and one headboard. A rough count of the inventory in the vicinity of the bedroom suite assembly zone indicated approximately 30 different components in average lot sizes of approximately 400 units. (30 x 400 = 12000 components) In addition to the 15 units per day an average of 2 units per day required either repairs or rework.

Product-quantity charts for headboard and dressing table assembly were constructed from a summary of unit sales analysis figures from the previous 15 months. The average monthly production

figures are shown on the Product-Quantity or P-Q charts. [Appendices C3, C4 and C5] An analysis of the quantities indicated that 9 of the 50 headboards and 3 of the 40 dressing tables accounted for over 80% of the flow volume through the bedroom suite assembly zone. It was also apparent from the P-Q charts, referred to above, that the charts were very steep. According to Muther "When the P-Q curve is 'deep' a split or division of the products and their assembly line layouts tends to be warranted." [81] For this reason, time studies were carried out on the high flow volume items and a new assembly line was designed. The line was designed such that it would be able to accommodate over 80% of the bedroom suite sales volume. This accounted for approximately 14% of the bedroom suite product range.

Prior to physically relaying out the line, the machine shop foreman, the bedroom suite supervisor and the group of 8 cabinet makers and assistants working on the assembly line were taken into the company's training centre for an introduction to JIT. The initial introduction included an in-house lecture which covered JIT objectives, the role of inventory and an introduction to some of the JIT techniques. The lecture, which was translated into Zulu by the in-house training manager, was followed by a screening of the Hewlett-Packard JIT video and an in-house JIT game with Lego. The workers were then allowed to ask questions before being taken back to the shop floor where they participated in the relayout of the line.

On-the-floor training then followed. Although only six hours of training had been completed four hours of that training had been

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