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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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BRAZIL

Technical report: Assistance to SENAI/CETIQT
(First mission)*

Prepared for the Government of Brazil
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Ian Bastow
Expert in apparel production

Backstopping officer: J.P. Moll, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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BACKGROUND

The Center of Technology of the Chemical and Textile Industry (CETIQT) is a unit of the Serviço Nacional de Aprendizagem Industrial (SENAI) system, exclusively devoted to assist the textile and confection industry regarding education at 1st, 2nd and 3rd degrees in technological research, technological assistance and dissemination of technlogical information.

In order to keep pace with the significant technological developments in the textile industry and taking into account the importance of the textile industry for the international trade balance, CETIQT is steadily updating its curriculum. External assistance is being sought for providing its basis for specialized courses for textile technologists, as well as for advice in the research programmes in specific areas.

Advising services would be provided through lectures on advanced process control in dyeing and finishing, on changes of characteristics of materials during mechanical and chemical finishing techniques, in cotton spinning, weaving and knitting technology and by providing expertise in garment design and pattern and grading technology.

TERMS OF REFERENCE

Purpose of the Project

The strenghtening of the Center of Technology of the Chemical and Textile Industry (CETIQT).

The Duties

The consultant in co-operation with the responsible counterparts of CETIQT is expected:

- To conduct during his first mission an evening seminar of approximately 20 hours on modern apparel manufacturing (T-shirts, jeans), with special emphasis on: modern machinery, attachments and auxilliaries, internal transport systems, line balancing, optimum work place-layouts, quality requirements and machine settings;

- To repeat the seminars at 2 or 3 other locations (to be determined later);

- To visit and audit various small and medium garment factories and give in-the-spot recommendations for technical improvements;

- To prepare a technical paper (c. 45 min.) to be presented at the CETIQT 40th Anniversary Conference (Rio 18-21 July, 1989).

The consultant will also be expected to prepare a technical report setting out the findings of the mission and recommendations to CETIQT on further action which might be taken. The report has to include a tentative workplan for the anticipated second mission and the subject to be covered.

FACTORY VISITS IN RIO

In the first week of the assigment 3 factory visits were arranged in the Rio area, as follows:

Company: Green S.A. - Bangu, Rio de Janeiro.
Type of manufacture: men's jeans and shorts.
Number of employees: 800
Weekly production: 20,000
Sales: mainly export

The company was formed about 3 years ago and appears to be enjoying some success exporting to the U.S.A.. The company employs an in-house work study engineer and although a S.M.V. (Standard Minute Value) has been calculated for the jeans manufacture, the machine operators are paid a flat weekly/monthly wage. The machine room floor has an excessive amount of work in progress and would benefit from a materials handling system. Quality was controlled only at final inspection and so would benefit from intermediate quality control points within the production flow.

The second factory to be visited was:

Company: Fredvic
Type of manufacture: men's shirts
Number of employees: 240
Weekly production : 20,000
Sales: 98% local, 2% export.

The company was formed about 35 years ago and appears to have had a steady but unespectacular growth relying on local sales. The company has thoughtfully included many facilities to enhance the wellbeing of the employees. The company would benefit from a materials handling system, intermediate quality control and up-to-date sewing machines and cutting room plant. The Director President, Mr. Dieter - Misquey, would welcome an overseas partner who could promote sales and inject some capital.

The third company to be visited was:

Company: Nagle
Type of manufacture: men's high quality shirts
Number of employees: 600
Weekly production: 15,000
Sales: 100% local.

This company which was founded some 25 years ago has the reputation for producing some of the finest shirts in Brazil, using only top quality cottons, linens and silks. In this company quality is more important than quantity. Whilst some underbed trimmers are used in the machine room, the cutting room is in need of more adequate cutting tables and laying up machines.

The Machine Room

a - There should be intermediate inspection on the line;

b - There should be inspection sheets introduced to monitor faults more closely;

c - The under bed trimmers should be used in the correct manner;

d - A materials handling system should be introduced to speed up the manufacturing process and down work in progress;

e - Folder attachments to the machines should be used;

f - Some kind of financial incentive should be introduced to try to correct the poor operator performance (it was 65-70).

The second company visited was:

Company: Maju
Type of manufacture: T-shirts
Number of employees: 1,500
Weekly production: 20,000 in two shifts - 5 a.m. to 1:30 and 1:30 to 10 p.m.
Sales: 70% local and 30% export

This company was founded in 1958 and because it is progressive, it is enjoying success. There are 4 main sewing sections which were well served by a selector conveyor or transporter. There were 2 other sections which were worked on the progressive bundle system. It was noticed that the cutting room equipment, i.e., laying up machines, tables and cutting knives did not match the sophistication of the machine room equipment. The writer was informed that the latest in design of laying up machine together with a vacuum table and floating arm cutter was on order. It was pleasing to note the comprehensive quality control which was very effective. There did appear it was a problem with cutting and making orders containing several colours. On examination, it was discovered the fault lay with their own fabric knitting factory in that there was insufficient stock of fabric for the cutting room to cut all the required colours in an order at one time. A pin table would be useful when laying up stripped fabrics. Despite the observations above it was a well organised and well run factory.

THE SEMINARS IN RIO

There were 4 seminars attended by 7 people, 5 of whom were members of staff from CETIQT in Rio. The writer was again most ably assisted by Prof. Rose Rodrigues during the 20 hours of the seminars. The subjects were as follows: Quality Control, Line Balancing, Materials Handling Systems and Costing Analysis for Small Companies*. The latter subject was included because it was felt to be of great interest to the staff of CETIQT. Again there were many lively discussions indicative of the enthusiasm of the participants.

* See Annex I

THE CONFERENCE

The 40th Anniversary Conference at CETIQT took place in Rio on 18th July to the 21st July. There were 1111 subscribers who paid to listen to 116 speakers. This was a substantial increase over the last Conference. The writer's paper was entitled "Modern Jeans and T-Shirt Manufacture".* The paper gave consideration to methods applied in small and medium sized companies and the possible productivity gains achieved by proper application of attachments, workaids, workplace layout and different types of modern machinery. Slides were used to demonstrate different types of machines for particular operations and overhead projector slides used to illustrate SMV (Standard Minute Values) on a section of jeans manufacture and T-shirt manufacture. The session was attended by 80 people who showed their interest by asking many questions in the last part of the session. The writer was very well supported by Prof. Almir Teixeira de Souza, who not only acted as interpreter, but is very knowledgable on clothing matters.

* See Annex II.

THE TRIP TO BLUMENAU

The third week of the assignment was spent in Blumenau and during that time 4 seminars and 2 factory visits took place. The writer was accompanied by Prof. Rose Rodrigues from CETIQT in Rio and to complete the team was a local interpreter called Mr. Klaus Rehfeldt.

The 4 seminars were attended by 17 people from the immediate area and lasted a total of 20 hours. The subjects were as follows: — Quality Control, Line Balancing, Materials Handling Systems and Manufacturing of T-Shirts. At the end of each session there were many liverly discussions which was an indicator of the interest shown.

The two companies visited were as follows:

<u>Company</u>: Dudalina
<u>Type of manufacture</u>: men's and women's shirts
<u>Number of employees</u>: 540
<u>Weekly production</u>: 7,000 in two shifts - 5 a.m. to 1:30 and 1:30 to 10 p.m.
<u>Sales</u>: 97% local and 3% export.

The company was founded about 6 years ago and appears to be doing quite well although in the writer's opinion the whole factory performance would be increased substantially by the following means:

<u>The Cutting Room</u>

a - Should use a laying up machine with an electronic eye to ensure a straight-edge when laying up fabric;

b - Should use an end cutter in order to save fabric;

c - There should be twice daily testing of the fusing conditions on the fusing press to ensure correct adhesion.

OBSERVATIONS ON THE ASSIGNMENT

The assignment as a whole was well organised by the staff of CETIQT and all the facilities provided were excellent. It should be mentioned - that Prof. Almir Teixeira de Souza in particular was outstanding in giving his time to ensure tha assignment ran as smoothly as possible. It was a pleasure to work with Prof. Rose Rodrigues, who was assigned to work - with the writer. She showed a keen interest in all the subjects which arose.

The fact that the seminars in Rio were so close to the Conference may have affected the numbers attending same but with a short assignment as this one it was unavoidable. The participants of the seminars showed a lively interest resulting in may discussions. Certainly, the members of CETIQT and seminar membrs all appeared to be open minded and receptive to new ideas. It was a little disappointing that only 5 visits to factories were organised and with such a low number it was difficult to draw meaningful conclusions.

FUTURE RECOMMENDATIONS

For the second half of the assignment it is recommended that there should be factory visits. Using local knowledge, SENAI should choose the companies which would benefit the most from a consultative visit.

It is recommended there should be further seminars, the locations to be selected by SENAI and the duration to be 20 hours on a number of the following subjects:

a - The merits of Gerber and Lectra Systems;

b - Production control documentation in the clothing factory;

c - Quality control specifically on the manufacture of jeans, shirts and T-shirts;

d - Video showing manufacturing process work - a view to increasing productivity and efficiency;

e - Efficient factory flow layout;

f - Personnel management and the clothing factory.

It is further recommended that the second assignment should commence no later than November, 1989.

ANNEX I - LINE BALANCING

Planning a sewing line requires detailed knowledge of the garment broken down into sewing elements, some knowledge of time study and a stop watch. I will be talking about Standard Times and that may not mean anything to you so I will give a short explanation. If time allows on another occasion I will give a much fuller explanation.
So, Standard Time is the adding together of:-

1. The basic time of each element.
2. The machine attention allowances i.e. a % of No.1 for changing needles, threads etc.
3. Relaxation allowances i.e. a % of No.1 for operatives going to the toilet, checking work tickets, standing etc.

For example onto the basic time of each element you would add machine attention allowance 10%, and relaxation allowance 12%. Either of these percentages could go up or down a little, depending on circumstances, but they do represent a good average.
The method of Line Balancing I am going to demonstrate can be most effective where the garment to be manufactured has a fairly stable future, where changes when they occur, occur slowly and where method changes of manufacture are more often due to cost reduction by management rather than style changes to satisfy market demands.
The information required is:-

1. A list of operations in sequence.
2. The standard time for each operation.
3. The length of the working day.
4. The planned level of production.

This information will be used to calculate the number of workplaces required for each operation. I would like to say at this point that I have been able to obtain standard times for T shirts or jeans. But in any case the standard times may not bear any relevance to the methods of manufacture here in Brazil. To continue-
For example: A production line includes the following operations

The production level planned is 180 garments per day and the length of the working day is 450 minutes. The number of work places may be found by multiplying the standard time for the operation by the daily quantity of garments to give the total daily work content required from the operation then dividing that total by the work content expected from one operator working at a standard performance throughout the day. For example:

To continue through the remaining five operations in this sequence would answer the question - how many work places? But for each operation two items in the sum are being repeated - the multiplication by 180 and division by 450. This seems a waste of effort. Therefore it is useful to replace the two items by one in order that fourteen calculations (two for each operation) may be replaced by eight (one for each plus one to find the replacement figure).

The daily working minutes divided by the required production equals the cycle time. Thus the two items in the sum may be replaced by 2.50 Another way of putting the arithmetical statement is to say that 2.50 minutes is the ideal cycle time. The cycle time is the time available for the worker at her machine to complete her work, which must be equal to, or greater than, the standard time required for the operation. The cycle time may be said to be ideal when it coincides with the standard time required for the operation. It is of course calculated in the same way as before -

$$\frac{\text{The length of the working day (total time available)}}{\text{Daily Production}}$$

or $$\frac{450}{180} = 2.50$$

The number of workplaces required for each operation may be found by dividing the standard time by the ideal cycle time.

In fact since it is possible to have only a whole number of workplaces the number will normally be the higher whole number.

However when the calculated number is very close to the lower number e.g. 1.02 2.02 it is normal in clothing manufacture to round down and not up. This is because the problems of production management arising from the inherent variability of most garment operations are far greater than the 2-3% of the working day involved or than the 2-3 points in the performance scale which might also express it. What I mean by that is 1.02 workplaces signifies an operator working at a performance of 102.

Thus the information for the production line may be set out as follows:

The above calculation defines merely the number of workplaces required at each operation to produce 180 garments in a 450 minute working day. It is now possible to consider the number of operators required to staff the line. Operations 1, 2 and 5 are well, or reasonably well balanced in terms of this line and may be left with the workplaces staffed by one, two and one operators respectively. Operation 3- underpress - and operation 7 - press off - together add up to 2.00 workplaces. It is reasonable to suggest that two operators would staff the three actual workplaces on the two operations, one operator working wholly at pressing off and the other operator spending 70% of the time at underpress and 30% of the time at press off. Operation 4- sew on collar- and operation 6- hem- together add up to 1.98 workplaces. It might seem reasonable purely on arithmetical grounds, that two operators would staff three actual workplaces on the two operations, one operator working wholly at sew on collar and one dividing the time between hem and sew on collar. This assumes that an operator can be made available and who can work at near standard performance on two jobs using different skills and using different machines, moving at the command of the supervisor from one workplace to another at a different place in the line.

Methods of achieving a better balance.

1. Combination considers two operations as one. There are two ways in which this might happen. Firstly a combination of two opeations to be carried out by one operator at one workplace, secondly requiring one operator to carry out two operations at two separate workplaces.

2. Transferring work content from one operator to another. A study of the work involved in two operations may enable some of the work in an overloaded operation to be transferred to an underloaded operation.

3. Selecting operators with a suitable level of performance. In the example just quoted, operation 5 - sleeve required 0.90 workplaces or one operator with a performance of 0.90 .If an operator with such a natural pace of working was available the production manager would try to fit her into that job.

4. Applying method study techniques to an overloaded operation. For example if an operation is 0.86 minutes and the other operations are timed at 0.70 minutes the output on this operation is likely to limit the output on the line as a whole. It then becomes a sound argument for selecting this operation for the application of method study to reduce the work content by approximately 0.16 minutes.

5. Routine balancing during the day by the supervisor. Operations designed with the aid of the above 4 techniques usually balance more or less imperfectly, owing to inflexible nature of sewing elements. For example, it is impractical for an operation to stop halfway down

a seam because it suits the ideal cycle time. The effect of operator performance adds a further variable to the balancing situation. Thus the supervisor has to regularly do more than ensure the achievment of planned output from the well-balanced operations - he has to ensure planned output from the badly balanced operations by directing operators to work temporarily on thos operations in order to make up the balance. This involves a knowledge of the output on all operations from hour to hour and to know whether the buffer stocks between operations are rising or falling.

Balancing in the short term is not always necessary if there are sufficient levels of work in progress at each operation.

An exception to the above method occurs in a fashion style situation where standard times are frequently not available. The only recourse is to take un-rated observed times, add allowances, strike an average and balance in that. It is imprtant to give individual operators a target which allows for progress up the learning curve. As a check on performance it is necessary to repeat the process the next day and at two or three day intervals until the timings remain constant. This does not use the whole apparatus of work measurement but it is fairly practical and gives us the best information in the time available. It requires a reasonable level of buffer stock between each operation and about supervision. It should also be noted that the start of the sequence of operations should be faster in order to ensure the input down the line and is a most important principle of all production processes.

QUALITY

I would like to start with an appropriate quote which H.R.H. Prince Philip, Duke of Edinburgh made to some British exporters some time ago. It goes " Manufacturers with a good reputation for quality and reliability have always found that this gives them a decided commercial advantage. At this particular moment, when exporting and the earning of foreign exchange is so vital to the Nation's prosperity, it is essential that all exporters should have a better reputation for quality and reliability than their competitors. A good reputation for well designed goods, or components, fit for the purpose, which don't fail or breakdown is the criteria for success. A bad reputation is a very costly luxury which this Nation cannot afford." End of quote. This is equally true here in Brazil. I will also add a little story of my own. Whilst visiting a third world country in the Indian sub-continent about 3 years ago, we were talking about exporting to the U.S.A. and my hosts were complaining about lack of response and enthusiasm from the U.S. buyers for their products. They were under the impression that because theirs was a poor country the Americans should be obliged to buy whatever they made. They could not understand that it is hard nosed buyers who actually do the buying on behalf of their organisations, and not the U.S. Government. They, the buyers, put their buying skills on the line and if they fail in any way, they personally reap the consequences. There is no obligation for a country to take shoddy goods from a third world country in order to help its balance of trade. If the goods are not up to the standards of design and quality there will be no sale. And so often quality is sadly neglected.

Clothing companies have to be market orientated. The fashion element ensures that all manufacturers must try to anticipate what the consumer will do next., and what the attitude of the buyers is for the coming season. The general principle that garments should be as good as they can be for the price, is forced on the clothing manufacturer by his competition.

Two themes should run through quality control in the clothing industry:

1. Quality control aids in the reduction of cost, just as does workstudy or other management techniques.
2. The implications of quality control should be traceable throughout the organisation as a whole, for instance- personnel policies, production planning, purchasing & stock control.

The Cycle of Quality Control

It is useful to begin by considering quality control as a closed cycle of eight steps.

1. A study of customer requirments in terms of performance and price. Also the study of customer requirements is made in terms of the company objectives which is expressed in the manufacture of a range of garments at a particular price range.

2. A satisfactory design of a garment, not only in relation to aesthetics but also in relation to the function it will perform. A satisfactory design of a garment also demands the right decisions concerning methods of assembly. The first and most important property of a seam is strength. The strength of a seam is governed by the thread strength, the size of stitch, the choice of stitch type, the choice of seam type, the characteristics of weave structure, yarn characteristics, the size of seam allowance and the resistance or proneness of the fabric to needle damage. Other design characteristics of a seam are elasticity, which should be slightly greater than that of the fabric it joins, durability which is affected designed strength and elasticity and security which largely depends on the resistance to unravelling following a break in the thread. It is particularly important for a satisfactory design of a garment that the design be thoroughly proved by adequate testing. The test for fit and size cannot be other than trying the garments on as many different shapes as possible to check that the desired effect is maintained. The test for seam strength is a test to destruction.

3. A full specification of the requirements of the design in a form whichcan be clearly understood by all concerned in the production of the garment. The garment specification should include:-

   a. A description of style features with drawings where appropriate.
   b. A definition of fabric limits - which fabrics may be made up into this garment style. Often the answer is one design of fabric in a range of colours but sometimes the answer is several hundred different fabric designs.
   c. The trimmings required - this includes both the exterior trimmings such as linings and buttons, and the interior tapes, threads and interlinings + fusibles.
   d. A size scale through which the style will be manufactured.
   e. Critical garment dimensions and tolerances. This is usually published in the form of a size chart covering all sizes and the garment dimensions which are held as critical in the achievement of fit etc. Tolerance is the amount by which a garment dimension may deviate from the correct and still be acceptable.

Following the continual introduction of new fibres, new fabric finishes and new methods of assembling fabrics, it is recommended that care labelling be made compulsory as is the case in all first world countries.

8. A study of user experience, feedback to the department concerned and rapid remedial action. Many companies respect customers complaints and generally reimburse the customer without question. The certainty of reimbursement should concentrate the efforts of the manufacturing department in trying to find the cause of the defect which led to the complaint. That one customers' complaint received represents many not sent back, should be the attitude of the quality manager until he can prove it is not an isolated case. Thus the cycle of quality control returns to its starting point, a study of customer requirements.

Manufacturing Specifications

In practice before any inspection can begin it is essential that two conditions are fulfilled:

1. That the operator understands precisely what is expected of her.
2. That the quality examiner knows how to examine the garments in such a way that all aspects of the operators work are covered.

Before either of these conditions can be fulfilled it is necessary to produce a comprehensive manufacturing specification which sets out in an agreed form the required dimensions of the operation and the tolerances allowed against a Specification Key. This has traditionally been a difficult area in clothing manufacture - not the setting of quality levels - but their description in words and numbers.

Before producing a manufacturing specification a Specification Key should be drawn up to cover all aspects of work in the sewing room. There will be a different key for the cutting room. This will act as a framework and check that all items have been covered in individual operations.

A comprehensive key can only be built up over a period as the short-comings of the existing key becomes apparent when it is found impossible to apply old key headings to new problems. An example of a Specification Key will be as follows:

a. Positioning of components.
b. Machining detail - position of seam and/or stitch.
c. Stitching detail.
d. Appearance of completed Operation.
e. Pressing Operations
f. Marking-Cutting-Notching Detail.
g. Customer requirements (Special Detail additional to/or outside standard specifications)

These headings are further broken down in the example of a Specification Key which I have set out and this is followed by an example of the key applied to an individual operation e.g. Machine Cuff Buttons.

INSPECTION

To control is to check what is actually happening, to find out whether plans and intentions are being fulfilled.

In quality control the specifications and tolerances represent one form of balance. With an individual garment the commonest method of gathering information is known as inspection which is almost wholly visual, occasionally tactual and sometimes involves tensioning the garment between the hands. Less frequently an inspector will use his body in trying on a garment to see how it feels. In addition there are many other tests which include physical and chemical testing. These can predict the performance of the garment to wearability, wash & cleaning.

In considering a batch or lot of garments another form of balance is the level of defects or the accept and reject levels. A reject level of say 10% (which is high) may represent a state of balance.

An increase will slow down production and increase alteration cost or the cost of seconds, a decrease may mask an unacceptable increase in quality prevention or appraisal costs. Taking action may involve requiring the garment to be altered, changing the specification when the tolerance is too tight, improving the performance of the operators by instruction, by the pressure of altering defective garments returned, or even by retraining, changing inspection procedures, and changing the process of improving the machinery, trimmings or the method of manufacture

Types of inspection available for use in the clothing factory come under the following headings:

1. Final viewing. This is the inspection of individual garments on completion of the manufacturing process. This is usually conducted on a 100% basis but need not be so. When a garm : passes the inspector it is accepted into the warehouse stock of the company. In final viewing the company has made an obvious and public effort to ensure the quality of outgoing garments. On the other hand final viewing exhibits a number of disadvantages.

a. If it is the sole inspection then the operator producing bad work continues for a long time before he/she is found out. The result is a sewing room containing a large quantity of defective garments.

b. It may be necessary to take the garments to pieces to make an alteration. This is, to say the least, expensive, and it also delays delivery. It may be possible however, to find a short cut by employing skilled hand sewers.

c. The process of alteration of a finished garment often results in an unsatisfactory product.

d. Routine alterations on finished garments often create an organisation to handle them. This includes a skilled employee to plan the alteration. De-routing it through the production line, re-inspection, paying for the alteration because the source of the defect could not be identified at this late stage and other operations ripped out must be resewn, and finally a proportion of garments lost through being damaged beyond repair.

e. The final outgoing quality level is rarely acceptable even with all the foregoing expense. Any inspection point can only cope with a certain level of defects, if the level rises above that then defects are passed on regardless. Quality cannot be inspected into garments. When the level of defects is high, which is probably most of the time when final viewing is the sole inspection, the majority of defects will be passed on to the customer because to reject all that should be rejected, as the specifications require, would close down the production line.

2. In-process Inspection. This is the inspection of incomplete garments at selected points in the cutting room, sewing room & pressing room. The quality manager selects those points after considering the manufacturing process and the way it is broken down into operations. The total number of inspectors is influenced by perhaps four factors. First is the basic skill level of the operators. Highly skilled, long service operators attract fewer inspectors than young unskilled operators with a high turnover. Secondly the level of production is usually higher in a well engineered sewing room, or it is more productive in terms of garments per head per day. The significant ratio may well be not inspectors to operators, but inspectors to daily volume of garments. On the other hand in a highly engineered sewing room the proportion of automatic machinery tends to increase thus eliminating some of the source of human error. Thirdly high price garments tend to incur more inspection than low price garments. Fourthly the end use of the garments affects the manufacturers attitude to quality and the amount of money he will spend in snspection. The decision where to place inspection points are affected by the following considerations - the incidence of natural breaks in the sequence of operations, the controlling of troublesome or key operations, the desire to spread inspection strength evenly along the production process, the importance of inspecting before irrevocable acts such as the cutting of a pocket mouth, or before a component is covered up, say by a fastening of a lining.

3. Centralised Inspection. To operate this system all the garments must be channelled through one inspection area where a team of inspectors inspect the work at agreed stages. It is a type of in-process inspection used perhaps in a factory where many styles, employing widely different

sequences of operations, are manufactured, and thus where it might be difficult to locate inspection points in a proper sequence. One example of this organisation might be found in a sewing room using a Transporter Line Storage system where the person who loads the tote boxes into the storage racks after return from sewing inspects the sewn parts before disposal into the storage racks.

4. Patrol Inspection by the Supervisor. In an uncontrolled situation, if evidence is to be believed, the time spent by a supervisor on checking quality is only 5%. On the other hand if all but quality duties are removed from the supervisor in oder that she might devote more time to checking quality, she rapidly feels less integrated with production and in a word, demoted. The only approach to an effective patrol inspection by the supervisor regularises the procedure of the patrol and produces a daily report on each operator and each operation.

5. Sampling Inspection. The purpose of sampling is to reduce the cost of inspection without losing knowledge of the quality of the product. A skilled inspector will know what to look for and how to look for it. She/He will know the troublesome operations, the difficult styles, the infrequent styles, the tricky cloths. Without the benefit of statistics she will give a fairly good indication of the major sources of defects. The use of statistical methods for determining sample size and reject levels makes the procedure more precise and therefore gives better value. In conclusion it is more important to control quality at the source of defects than to screen garments at final viewing where the control is very remote. The greatest emphasis should be placed on the prevention of defects during manufacture rather than altering defects discovered at final viewing. Inspection time should be reduced when quality is good i.e. defect levels are low, and increased when quality is poor i.e. defect levels are high.

The most telling control action is to insist that operators are paid to do their jobs correctly. When inspection operates at the source of the defects, prompt discovery enables supervisors to insist that operators should alter their own work in their own time. Although great emphasis on defect prevention throughout manufacture may greatly reduce the level of defects, it may still be impossible to guarantee that the resulting output is 100% good and that final inspection is unnecessary. Final inspection will be necessary when it is probable that some garments are defective in spite of well designed efforts to prevent this. The basic cost consideration is that the cost of customer complaint and the loss of goodwill added to the cost of final inspection should be the lowest possible. Another way of looking at final inspection is as a final check that the quality control system is working efficiently and not as the total quality system itself.

Internal Transport Systems

Materials handling methods are often presented as a system, especially when they employ complex mechanisms such as a conveyer. But here handling methods are analysed into a series of components. In deciding upon what form of handling to install it is often necessary to consider the components separately, although sometimes only the total system can be installed. The three components of any handling system are:

1. The handling unit
2. The power which drives the system
3. The path or route followed by the handling units.

The Handling Unit

What is actually transferred from one operation to the next may be any one of the following:

a. Tied bundles (or even untied)
b. Baskets or boxes
c. Hangers carrying either the garment or clips for unsewn garment parts
d. Bundle trucks of clamp trucks.

Tied bundles aim generally to keep similar garments together in order to shorten the handling methods. They provide the opportunity for chaining methods of sewing within the operation as well as for distributing the labour cost handling elements among a number of garments. The size of the bundle may vary from one garment up to as many as 100 garments. Where garments have many parts the incidence of parts lost may be high enough to cause hold-ups. Garments often become badly crushed and the sewing room becomes untidy and disorganized. It is sometimes difficult to estimate the size of individual buffer stocks from visual inspection. In addition, since identification of an individual bundle is not always possible at first glance, control of the work in progress, for progressing purposes is difficult. While the amount of handling might be less with single garments it is usually higher than other methods because of the tying and untying and the effort involved in sorting out parts before sewing.

Baskets or boxes may be used as tote boxes integrated with a conveyer system, they have the same general aims as tied bundles. Practical limits on the size of the boxes, also limits the size of the bundle which may be put in them. Baskets or boxes give the best advantage with bundles of standard quantity. Fewer parts get lost. If the garment parts can be well organized in the box

this improves the operators handling. The operator should be able to avoid handling those parts which are not sewn during the operation. If boxes are part of the system they can tidy up the sewing room, but if they are used separately as a handling unit the sewing room can be almost as untidy as with tied bundles since time and much effort must be used to keep the boxes in order. Smaller garments may be laid out neatly, but larger garments still become badly crushed in the boxes. It is easier to estimate the size of the buffer stock especially if the boxes contain a standard quantity.
Indentification of an individual box can become easier by means of a ticket displayed on the box.
Hangers may be simple like a conventional coat hanger whose hook slides along the top of a rail or it could be a more complex system with wheels and a carriage hanging from the rail. The garment may simply hang on a hanger after its shoulders are closed, or parts and whole garments may be hung from clips or clamps. The simple hanger means handling single garments. A carriage containing several hangers is the equivalent of a bundle, but the bundles can only be small, similarly a clamp or collection of clips limit the bundle to a very small quantity. Clips effectively limit the loss of small parts.
A most important benefit is that hanging garments do not become badly crushed. Supervisors can very easily estimate the size of buffer stocks by visual inspection. The biggest advantage however is the very low handling time. This involves slipping a garment off and onto a hanger, releasing parts from a clip and replacing them after sewing, or even with a garment like a trouser or jean when clamped at the bottom, sewing the garment without taking it off the clamp and this eliminates disposal time completely.
Trucks move around the sewing room on wheels or castors. One annoying difficulty is that from time to time the wheels become jammed by thread ends collected from the floor. The trucks may be designed to carry parts of a particular garment laid out neatly for the operator to make an easy pick-up. After sewing, disposal to the same or another truck should suit the next operators pick-up. Clamp trucks hold the bundle parts in a clamp and have the same advantage as hanging clamps. Clearly garments within the bundle are kept in the same sequence. The main advantage of both kinds of truck is that they can be designed to carry very large bundles with the minimum of handling. Trucks pose little problem in identifying and controlling work in progress but are often space consuming as they often cannot be stacked vertically.

2. The power which drives the system may be of three kinds - human, gravity, electrical/mechanical. It is mostly human. Operators carry tied bundles, and in some cases boxes or baskets, they push hangers along a manual rail, they push trucks around a sewing room. It becomes an expensive form of transport when the skilled operator rises from her work place and walks some way to fetch her next bundle of work. One degree less expensive is the employment of special handlers who distribute bundles, boxes or trucks to the operators at their workplace. Probably the most expensive is the supervisor who in many factories take the place of the special handlers. From a survey carried out in the USA it was estimated that a supervisor spent 40% of her time on average in the distribution of work as against 5% checking quality and 5% spent checking production. On the other hand it can be argued that operator movement while theoretically undesirable is useful in some ways if it breaks the monotony of the day. Again it can be argued that whilst the supervisor is distributing the work she is also controlling it and communicating with the operators.

One objective of sewing room efficiency is to reduce the time spent by operators in handling garments between operations which does not necessarily imply using other forms of power to replace human power. If trucks are used, the very large bundles they hold mean that operators pushing them around a sewing room employ very little time per garment. If the handling unit is the tied bundle then it may be possible to design a layout in such a way that where one operator disposes the bundle, the next operator picks it up. If the bundle must travel a few metres then an operator working on a standing job can more easily pass the bundle forward. If hangers hang from a continuous rail system then the time needed to pass the garment forward to the next operator may be very small indeed. Gravity may assist human power whenever convenient. A rail may dip slightly in order to assist the operator to push the garment over a longer distance. A roller conveyer may carry boxes or baskets. Chutes may connect one operator with another. Where human power is expensive, gravity is cheap.

One specialised and less common use of gravity is an extended form of chaining which is suitable only for small garments and short lines of operations. Here the operator passes the garments forward down a chute without cutting the thread. Thus the garments form a long chain held together with uncut thread. The next operator works on the garment at the other end of the chain, cutting the threads where necessary at the start of her operation. Here the job of disposal is almost eliminated and handling becomes very simple. The method is limited to large quantities of precisely similar and relatively small garment parts.

Electrical power transmitted through mechanical devices may suitably replace human power and gravity when the reduction of labour cost from simplified handling is judged sufficient to offset the capital cost of the equipment. This may be a direct and easily measured reduction in inter-operation handling time or handling time at the workplace or alternatively a means of keeping the garments in order, an aid to processing the work and a method of reducing work in progress which implies an indirect and less easily measured reduction in handling time.

3. The Path or Route followed by the Handling Unit may be discontinuous, between one operation and the next, across the floor of the sewing room, or continuous - constructed independently of the work places, but with feed-off points to them. Continuous paths fall basically into two categories - conveyors carrying tote boxes at elbow level to seated operators, and rails at generally shoulder level, sometimes floor mounted and sometimes roof mounted, delivering garments to seated or standing operators at various levels of height. The position of the operators can be altered by placing the work place on a built-up platform or at general floor level, whichever is the most convenient for the handling of the garment.

Conveyors used in sewing rooms offer three types of path or route. First is the simple paced straight line conveyor which was developed as a reaction to the high work in progress, long through-put time and lack of control over progressing, typical of conventional bundle sewing rooms. Operators handle not large but individual garments, often in trays which pass down a conveyor moving either continuously or the length of one tray at fixed intervals. The work in progress consists of two or three trays at each operation. The operations are designed to fit as nearly as possible an agreed cycle time and the conveyor paced to suit that cycle time. It has the advantage of a very rapid throughput and complete control over the work in progress. In this sense the system runs itself and it needs positive effort to alter the order in which the garments are made. The advantage is gained at the expense of a number of drawbacks. It is inflexible, since when the style or process changes, the line must be re-arranged and re-balanced. Although the process may be broken down into short operations, there is little effective specialisation since the need to design operations to a predetermined standard time means that non-specialist elements may be added to specialised jobs to make up an agreed time. For example, the sewing of a label may be included into the closing of a seam.

From a production point of view the line is relatively easy to supervise because a conveyor is self-pacing, but it is less easy to control quality as the supervisor dare not give rejects back to the operator because it would cause the line to stop.

A machine breakdown, an unskilled operator, slight cutting errors or an operator who feels unwell, can all throw a conveyor out of balance. Specialised work places are impractical because of the proximity of the machine to the conveyor. Individual piece work is also out of the question.

Second is the selector conveyor, or transporter, it consists of a moving belt at two levels. The top level which is machine table height takes the boxes from a control point to the individual work places. The bottom level takes the boxes back to the storage area. Each work place holds two boxes, one box from which the operator works and one in reserve. When the operator completes the sewing operation from the first box and dispatches it back to the control point, an indicator light goes on in the console of the control point. This alerts the feeder to dispatch another box to that operative. The display board in the console is the means by which the operator and the feeder communicate. When the box arrives at the work place it stops automatically. The operator takes the box from the reserve position to work on, and places the newly arrived box into the reserve position. It is claimed that one feeder can select and feed up to 280 boxes per hour. This method of transportation does not eliminate handling by the operator. In addition to removing boxes from, and returning boxes to the conveyor, the operator must lay out the garment parts ready for sewing, prior to sewing. Therefore a manager would not choose this method of processing garments if he wanted to save handling costs. Further, the cost of installation and maintenance of this type of unit is high. The chief reason for the popularity of this type of transporter lies in its ability to cope with differing styles and work content. This type of transportation system was popular up to a few short years ago. Two additional factors could account for the vogue of manufacture - one the extremely tidy apperance it portrayed and the opportunity given to the company to engineer its way out of the usual sewing room confusion.

The third type of conveyor is the transporter-selector. Theoretically no feeder is required as with the latter type of transporter, but the supervisor or the first operative feeds on the first operation from time to time from a supply rack. The transporter-selector consists of a carousel conveyor going round a static shelf or platform. The roundabout is a series of sections or trays each of which carries its own box which can be addressed to any workplace. These trays carry the tote boxes. All the trays can be addressed to any of the workplaces situated at regular intervals adjacent to the outer shelf. When in motion and when the tray arrives at the workplace the tray stops and then either the operator removes the box onto the shelf or the tray tilts to allow the box onto the shelf. After completing the sewing operation the operator returns the box to the carousel addressing it to the next workplace in sequence on the work ticket. If the workplace is full then the tray continues around the carousel until there is a space available. When all the operations are finished the last operator addresses the tray to the feed-off station.

This type of conveyor can cope with rapidly changing style conditions, it also considerably reduces the need for a feeding operator. The volume of work in progress is low because the capacity of the carousel limits the number of garments which can be carried. Throughput time is short but routine balancing by the supervisor is more difficult. Finding individual bundles can be difficult and the supervisor cannot easily assess where the buffer stocks lie between the operations. It is an expensive type of transporter compared to others mentioned before. It obviates the need to make new layouts for every new style which comes along because the carousel takes care of all the sequencing problems.

One general comment must be made about all the three types of conveyors and that is that workplaces must be positioned within easy reach of the moving belt otherwise all the handling advantages will disappear. To make the best use of space workplaces must be positioned as closely as possible alongside the belt. In practice the construction of specially designed workplaces whose object is to reduce handling time within the operation is severely limited.

Overhead rail systems used in sewing rooms also come in three systems. First is the Powered Rail-Line Storage. The characteristics of this system closely resembles the Transporter Line Storage except of course the garment arrives hanging to the workplace instead of on a conveyor belt in the tote box. This system consists of an overhead powered chain drive which moves the trolleys holding the hanging garments around the rail system. A series of bays each containing up to five workplaces are situated between the lines of the system, thus one line feeds and one returns.

Second is the Powered Rail-Selector which has the same characteristics as the Transport Selector with the exception that the garment is hanging. It consists of a single power driven loop with the workplaces spaced at regular intervals on the outside of it. Cut work is fed onto the line, a bundle to each hanger (this is assuming the bundle does not exceed 10) with perhaps baskets for the small parts. After the parts are assembled the garments are transferred to single hangers. The hangers are addressed to the operators in a similar way to the Transporter Selector method.

On arrival at the operator's position the hanger is automatically diverted onto the storage line ready for the workplace. The operator sews the portion of the garment and then addresses it to the next operator's workplace. After the last operation the operator addresses the hanger to the feed-off area. One storage line at a workplace may hold up to 50 hangers. If there is a pile up of work where is a real chance that garments could get out of sequence. Automatic garment despatch from the workplace could be included in the system. An extra feature is an electric counter which may be fitted to each workplace and connected to a central control centre in the manager's office. This will not only keep a tally of the through-put of garments but also highlight any hold-up of work and so avoid garments being made out of sequence. Of all the methods of material handling available for use in the sewing room, at this moment in time, this method is the most expensive.

The third type is the Manual Overhead Rail System. Here the path or route ranges from the simple straight line of rail, to fairly complex systems similar to a railway, with points and parallel tracks to feed the garments to the workplaces. The rail system may be built from a number of standard components, i.e. uprights at intervals carrying straight sections, curved sections, short hinged sections to allow diversion of hangers between two routes, and junctions to allow two routes to join into one. By the use of hinged sections and junctions the problem of feeding multi-operator operations is overcome. The operator receives the garments hanging as with the other two systems. Similarly the work places may be raised to the best handling position to suit the operator for the best sewing position without taking the garment off the hanger. The operator sews the garment whilst it is suspended and despatches it to the next operator/workplace by pushing it forward along the rail. A sharp push even without the aid of gravity can send the hanger a surprisingly long way. Operators move hinged sections to divert work either manually or by a pedal operated by a compressed device. Small screw powered sections may be built into the system to move the hangers spaces where operators are not working or up over some obstacle such as a gangway and using gravity down the other side. Although screw conveyors are relatively costly if used for a total system, they fit well into a manual rail installation and do not increase overall cost per workplace significantly. A manual rail system does not cope with the problem of handling garments between operations as well as the Powered Rail Storage and the Powered Rail Selector, but it covers perhaps nine tenths of the problem at a much lower cost. It can be fitted into the same or very little more space that occupied by a progressive bundle unit. Like the progressive bundle system it is a floor production layout suitable for one basic garment at a time e.g. a trouser or a jacket. It does mean one can be flexible with the machine layout and the system will allow a certain amount of style variety by diversion onto parallel rails but not different sequences of operations. As with the progressive bundle system there is more freedom to develop specialised and multi-machine workplaces. All the work in progress hangs from the rails. If single hangers are used 30-50 garments may hang between workplaces without undue crushing, if the garments are in carriages there will be less. The garments stay in the order in which they are fed onto the line unless a positive effort is made to change the order. There must be strict supervision to ensure that there are no bottle necks and should it occur, extra manpower and machinery employed to reduce same. The feeding of the rail with work may become part of another job or become a separate job where the volume of produce demands it. The system, like all other rail systems is not designed to progress large bundles, nor is it suitable for very small garments. It is the vogue in the men's outerwear industry which characteristically handles large garments in small bundles. One of its attractions is in the flexibility of installation. It can be installed piece by piece, even experimentally tc give time to discover its effect in the sewing room. Management feel in command of the situation because they design the system, purchase the components and assemble it themselves and therefore have the power to change it to suit the changing production circumstances. Homemade components can to some extent be used but care should be taken because a mass of garments hanging on a rail can be very heavy and a badly designed/constructed system could lead to an embarrassing collapse.

ANNEX II

MANUFACTURING T-SHIRTS/JEANS
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NO MATTER WHAT ONE IS MANUFACTURING, THE DIFFERENCE BETWEEN AN EFFICIENT METHOD OF MANUFACTUARE AND ONE THAT ISN'T EFFICIENT IS THE ONE WHICH MAXIMISES THE MACHINISTS TIME THE FULLEST. THAT IS THE TIME ACTUALLY SPENT SEWING. ONE SHOULD ACCEPT THE PREMISE WHEN THE SEWING MACHINE IS NOT SEWING, THAT IS, NEEDLE THROUGH FABRIC, NEITHER THE MACHINE NOR THE MACHINIST IS MAKING MONEY FOR THE COMPANY. THIS MEANS CUTTING DOWN ON ALL EXTRAVENOUS HANDLING TIME AND MAXIMISING ON MACHINE TIME.

IN THE YEARS I HAVE WORKED AS A CONSULTANT, I HAVE VISITED MANY FACTORIES AROUND THE WORLD. IN MOST OF THOSE FACTORIES, I HAVE OBSERVED THE ACTUAL MACHINING TIME TO BE VERY LOW - SOMETIMES AS LOW AS 25% OF THE WORKING DAY. IN SOME CASES, THE LOW PRODUCTIVITY HAS BEEN OFFSET BY LOW WAGES. OBVIOUSLY, THAT IS NOT THE ANSWER.

ON THE OTHER HAND, ONE CAN HAVE A HIGHER MACHINING TIME OF ABOUT 45 - 50% OF THE WORKING DAY AND STILL NOT BE EFFICIENT, E.G., IF YOU HAVE OPERATORS WHO ARE SLOW AT THEIR WORK. IN THE IDEAL WORLD, YOU WOULD HAVE A PERFECT THREE-PART INTERACTION BETWEEN A WELL ENGINEERED WORK PLACE USING THE MOST EFFICIENT PLANT AND MACHINERY, AN EFFICIENT MATERIALS HANDLING SYSTEM TO DELIVER THE CUT PARTS TO THE MACHINIST AND FINALLY, A FINANCIAL INCENTIVE SYSTEM WHICH GIVES BENEFITS TO THE MACHINEST WHO WORK HARD AND TO THE COMPANY.

LET ME JUST ELABORATE A LITTLE ON WHAT I HAVE JUST SAID. ONE COULD HAVE THE MOST EFFICIENT AND MODERN PLANT AND MACHINERY IN THE WORLD BUT IF THE CUT WORK DOES NOT ARRIVE TO THE MACHINIST AS AND WHEN REQUIRED, THE MACHINERY WILL NOT BE FULLY UTILIZED. OR IF THE CUT WORK ARRIVES TO THE MACHINIST AS IS REQUIRED AND IS MACHINED ON THE MOST EFFICIENT MACHINERY BUT THE MACHINIST HAS NO INCENTIVE TO WORK HARD, THE COMPANY WILL NOT MAXIMISE ON THE CAPITAL OUTLAY SPENT ON MATERIALS HANDLING SYSTEMS AND MODERN MACHINERY. CONVERSELY, IF THE COMPANY HAS A GOOD FINANCIAL INCENTIVE SCHEME BUT HAS DIFFICULTY IN TRANSPORTING THE CUT WORK TO THE MACHINES OR THE MACHINES KEEP BREAKING DOWN, THERE IS STILL A BIG PROBLEM. UNFORTUNATELY, WE CAN ONLY GO A LITTLE WAY IN THIS SESSION TO ADDRESS A LITTLE OF THE FIRST OF THE THREE DISCIPLINES MENTIONED BEFORE, THAT IS, EFFICIENT MACHINERY.

GENERALLY SPEAKING, THERE ARE TWO DISTINCT METHODS OF PRODUCING JEANS LEG WEAR - THE FIRST, USING FEED-OFF-THE-ARM TWIN NEEDLE MACHINES FOR THE LONG SEAMS AND THE SECOND, USING SINGLE NEEDLE AND TWIN NEEDLE LOCKSTITCH FLAT BED MACHINES. BOTH METHODS HAVE THEIR PROPONENTS AND THERE ARE ADVANTAGES AND DISADVANTAGES ON EITHER SIDE. NOT TOO SUPRISINGLY, THE STANDARD MINUTE VALUE OF EACH METHOD IS VERY CLOSE, ACCORDING TO THE MACHINERY MANUFACTURERS. (Show the machinery on the slide projector).

BASED ON THE LATTER TYPE OF MACHINERY WHICH IS MORE MULTI-PURPOSE THAN SPECIFIC FOR THE MANUFACTURER OF JEANS WE CAN MAKE THREE CATEGORIES.

CATEGORY ONE

THIS GENERALLY CONTAINS BASIC HIGH SPEED LOCKSTITCH FLAT BED SEAMERS SEWING AROUND 5,000 STITICHES PER MINUTE, A NUMBER OF ROBUST TWO NEEDLE MACHINES, SOME OVERLOCK MACHINES AND SOME LOCKSTITCH AND CHAINSTITCH AUTOMATIC MACHINES SUCH AS BAR-TACK, BUTTON HOLE AND BUTTONING MACHINES. ALL THESE ARE BASIC MACHINES, THAT IS TO SAY WITHOUT ADDITIONAL EQUIPMENT SUCH AS THREAD TRIMMERS, QUICK STOP MOTORS AND OTHER CONTROL MECHANISMS.

THE AVERAGE TIME TO MAKE A BASIC JEAN USING THE MACHINERY JUST MENTIONED WOULD BE IN THE ORDER OF 23 - 25 MINUTES.

THE NUMBER OF OPERATIVES REQUIRED TO PRODUCE
500 JEANS DAILY WOULD BE 24
1200 JEANS DAILY WOULD BE 54
2500 JEANS DAILY WOULD BE 124

CATEGORY TWO

THIS WOULD COVER ALL THE MACHINES IN CATEGORY ONE PLUS WORK AIDS SUCH AS AUTOMATIC THREAD TRIMMERS (DESCRIBE HOW THE OPERATORS USE THE TRIMMING DEVICE), NEEDLE POSITIONING AND OTHER CONTROL MECHANISMS AND USING ULTRA HIGH SPEED SINGLE NEEDLE SEAMERS WITH SPEEDS OF 6000 STITCHES PER MINUTE.
A SAVING OF UP TO 25%.

THE AVERAGE TIME USING THE ENHANCED MACHINERY WOULD BE IN THE ORDER OF 20 to 23 MINUTES, A SAVING OF NEARLY THREE MINUTES MACHINERY TIME ON CATEGORY ONE.

THE NUMBER OF OPERATIVES REQUIRED TO PRODUCE

500 JEANS DAILY WOULD BE 22. A SAVING OF 2 OPERATIVES OVER CATEGORY 1.

1200 JEANS DAILY WOULD BE 51. A SAVING OF 3 OPERATIVES OVER CATEGORY 1.

2500 JEANS DAILY WOULD BE 106. A SAVING OF 18 OPERATIVES.

CATEGORY THREE

THIS CATEGORY WOULD COVER THE OPTIMUM IN SEWING ENGINEERING AND WOULD INCLUDE EQUIPPING THE MACHINES WITH WORK AIDS SUCH AS AUTOMATIC PRESSER FOOT LIFT, AUTOMATIC BACK TACKING AND NEEDLE POSITIONING AND PHOTO CELL CONTROL FOR ALIGNING THE FABRIC EDGE TO THE NEEDLE, ENGINEERED WORK PLACES TO FACILITATE EASY HANDLING OF GARMENT PARTS WITH MINIMUM EFFORT AND INTEGRATED SEWING STATIONS AND MECHANISED SEWING UNITS, E.G., SETTING UP AUTOMATIC MACHINES SUCH AS BUTTON HOLE OR SERGING MACHINES IN TANDEM - WHILST ONE MACHINE IS GOING THROUGH ITS SEWING CYCLE THE OTHER MACHINE IS BEING LOADED.

THE AVERAGE TIME IN THIS CATEGORY WOULD BE IN THE ORDER

1200 JEANS DAILY 16.35 MINUTES MACHINING TIME.

2500 JEANS DAILY 15.25 MINUTES

THE NUMBER OF OPERATORS REQUIRED TO PRODUCE

1200 JEANS DAILY 41 . A SAVING OF 10 OPERATORS OVER CATEGORY 2.

2500 JEANS DAILY 84 . A SAVING OF 22 OPERATORS OVER CATEGORY 2.

THE POINTS THAT SPEAK FOR THE CHOICE OF CATEGORIES TWO AND THREE ARE NOT ONLY THE DECIDED INCREASE IN PRODUCTION ECONOMY AND OUTPUT, BUT ALSO THE IMPROVEMENT IN QUALITY AND THE FACT THAT ALL THIS IS OBTAINED WITH BRIEFLY TRAINED AND NON-SKILLED STAFF. A NOTE OF CAUTION SHOULD BE ENTERED HERE. BEFORE EMBARKING ON PURCHASING MODERN SOPHISTICATED MACHINERY, THERE ARE TWO IMPORTANT POINTS TO BEAR IN MIND: 1) DO YOU HAVE THE MECHANICS TO MAINTAIN, SERVICE AND REPAIR THE MACHINES; 2) CAN YOU PURCHASE THE SPARE PARTS EASILY. A PFAFF PLAIN SEWER WOULD COST $ 964 AND A PLAIN SEWER WITH UNDERBED TRIMMER ETC WOULD COST $ 2633.

I HAVE SOME COMPARATIVE STANDARD MINUTE VALUES WHICH SHOW THE DIFFERENCES BETWEEN THE THREE CATEGORIES - WE WILL TAKE THE OPERATIONS WHICH GO TO MAKE UP THE FLY.

OPERATION	CATEGORY ONE	CATEGORY TWO	CATEGORY THREE
1) SERGE FLY	0.15	0.10	0.10
2) FOLD RIGHT FLY AND SERGE EDGES ADDING CUT TO LENGTH ZIP	0.30	0.25	0.25
3) SEW ON LEFT FLY FACING	0.35	0.30	0.25
* 4) FOLD DOWN LEFT FLY AND LEFT FLY PIECE SIMULTANEOUSLY AND TOP STITCH	-	-	0.35
5) TOP STITCH LEFT FLY FACING SEAM	0.35	0.30	0.25
6) TOP STITCH FLY SEW ZIP TO LEFT FLY	0.55	0.45	0.40
7) TOP STITCH RIGHT FLY TO RIGHT TROUSER FRONT	0.60	0.50	0.45

* Note: In category three if using operation 4, omit operations 3 and 5.

OPERATION	CATEGORY ONE	CATEGORY TWO	CATEGORY THREE
8) SEW TOGETHER CRUTCH POINTS IN TROUSER FRONTS	0.70	0.55	0.50
9) BAR TACK FLY TWICE	0.35	0.30	0.30
	3.35	2.75	2.35

AS WE CAN SEE FROM THE SMALL SAMPLE, THE CHOICE OF SPECIALIST MACHINERY CAN MAKE QUITE A DIFFERENCE IN MACHINE TIME. IT SHOWS THAT MACHINERY FITTED WITH UNDER-BED TRIMMERS AUTOMATIC BACK TACK START AND FINISH AND NEEDLE POSITION FACILITY ARE IDEAL FOR SHORT SEWING OPERATIONS. (GIVE DESCRIPTION OF HOW THIS WORKS IF NECESSARY.

THEN THERE ARE THE SPECIALIST MACHINES FOR JEANS MANUFACTURE. THESE MACHINES ARE DESIGNED AND BUILT TO HANDLE THE HEAVIEST OF DENIM FABRIC AND HAVE SINGLE NEEDLE MACHINES WITH SPEEDS UP TO 9000 STITCHES PER MINUTE, WHICH THE MANUFACTURERS CLAIM DRAMATICALLY INCREASES OUTPUT WITHOUT ADDING A SINGLE OPERATOR.

THERE IS A PEDESTAL MOUNTED FEED-OFF-THE-ARM THREE NEEDLE MACHINE FOR THE OUTSIDE LEG SEAMS.

A FLAT-BED THREE NEEDLE 6 THREAD LAP SEAMER FITTED WITH A LAP SEAM FOLDER FOR ATTACHING RISERS.

A VERTICAL NEEDLE 5 THREAD SAFETY STITCH MACHINE FOR SEWING INSIDE LEG SEAMS.

A SINGLE NEEDLE CHAIN STITCH MACHINE FOR HEMMING LEGS OF JEANS.

A HIGH SPEED FLAT-BED LOCK STITCH SINGLE NEEDLE MACHINE FOR ALL SINGLE NEEDLE OPERATIONS.

A TWIN NEEDLE FLAT-BED GENERAL STITCHING MACHINES.

SINGLE NEEDLE THREE THREAD OVER LOCK FOR TRIMMING AND SEAMING OPERATIONS.

THE PRODUCTION AIDS FOR THE ABOVE MACHINERY INCLUDES A CHAIN-CUTTER WHICH IS AIR OPERATED, AUTOMATIC FOR NEAT, CLOSE CUTTING OF THE THREAD.

A PNEUMATIC FOOT-LIFTER WHICH IS ALSO AIR OPERATED AND ALLOWS THE OPERATOR TO RAISE THE PRESSER FOOT FOR POSITIONING WORK BY SIMPLY HEELING THE FOOT TREADLE.

AN ELECTRONICALLY CONTROLLED STOP-START SYSTEM PROVIDING AUTOMATIC STARTING AND STOPPING WHICH INCREASES OPERATOR EFFICIENCY AND DECREASES WASTE THREAD.

BECAUSE OF THE MANY THICKNESSESS OF FABRIC, THERE IS THE DANGER OF NEEDLE HEAT WHICH RESULTS IN THREAD BREAKAGE; TO OFFSET THIS THERE IS A NEEDLE COOLER WHICH IS A JET OF AIR TO COOL THE NEEDLE OF VIRTUALLY ANY KIND OF SEWING HEAD.

USING THE BASIC MACHINERY OF THE ABOVE, THE S.M.V. TO MAKE A PAIR OF JEANS WOULD BE IN THE ORDER OF 23 MINUTES. WITH ALL THE ATTACHMENTS, IT WOULD BE IN THE ORDER OF 11 - 12 MINUTES.

I HAVE SELECTED THE MAKING UP OF THE FLY TO GIVE IDEA OF THE S.M.V. THERE ARE SOME OPERATIONS WHICH ARE SIMILAR TO THE FIRST TYPE OF MAKE UP BUT THERE ARE MORE WHICH ARE DISSIMILAR NOT TO BE ABLE TO MAKE A DIRECT COMPARISON. PERSONALLY, I THINK THE DIFFERENCES BETWEEN THE TWO TYPES OF MANUFACTURER ARE TOO SMALL FOR US TO CONTEMPLATE.

	S.M.V.	EST. DOZ/HR
1) SERGE RIGHT FLY FACING	.14	35
2) SERGE LEFT FLY FACING	.14	35
3) SEW ZIPPER TAPE TO RIGHT AND LEFT FLY FACING	.33	15
4) SERGE RIGHT AND LEFT FLY OPENINGS	.38	13
5) ATTACH LEFT FLY AND EDGE STITCH	.41	12
6) TOP STITCH LEFT FLY	.27	18
7) SEW ON RIGHT FLY AND HEM CROTCH OPENING	.41	12
	2.08	

JUST TO HIGHLIGHT WHAT CAN BE ACHIEVED WITH THE CORRECT MACHINERY, A GOOD MATERIALS HANDLING SYSTEM AND A GOOD FINANCIAL INCENTIVE SYSTEM. WE HAD IN THE U.K. A FEW YEARS AGO, A LEVIS JEANS FACTORY WITH A TOTAL STAFF, NOT JUST MACHINISTS, OF 240 PEOPLE. THEY PRODUCED 57,000 PAIRS OF JEANS PER WEEK.

T-SHIRT MANUFACTURE

THE MANUFACTURING OF T-SHIRTS MUST BE ONE OF THE EASIEST OF GARMENTS TO MANUFACTURE PROVIDING YOU HAVE THE CORRECT PLANT AND MACHINERY. IT IS A HIGH VOLUME PRODUCT THAT DOES NOT LEND ITSELF TO SOPHISTICATED MATERIALS HANDLING SYSTEMS BECAUSE OF IT'S LOW S.M.V. AND QUICK THROUGH PUT TIME. IT WOULD BE TRUE TO SAY THERE ARE MORE PROBLEMS WHEN THE GARMENT COMES OFF THE MACHINES AS IT GOES THROUGH THREAD CUTTING, SMOOTHING AND PACKINGS BECAUSE OF THE SHEER VOLUME. BY THE VERY NATURE OF THE PRODUCT, THERE WILL BE MORE WORK IN PROGRESS THAN WITH GARMENTS WITH MORE WORK CONTENT. FOR INSTANCE IF ONE HAS A SEWING SEQUENCE OF .20 OF A MINUTE AND THE OPRATIVE REQUIRED 30 MINUTES WORTH OF WORK,THEN ONE IS TALKING ABOUT AT LEAST 150 GARMENTS AT THE SIDE OF THE OPERATIVE. IF THE SEWING SEQUENCE IS 1.50 MINUTES, THEN THE NUMBER OF GARMENTS BY THE OPERATIVE IS ONLY 20. WHILST THE GARMENT IS AN EASY ONE TO MAKE, ONE WOULD REQUIRE EXTRA SPACE TO DEAL WITH THE SHEER VOLUME OF GARMENTS FLOWING THROUGH.

THE ACTUAL MACHINING OR MAKING OF THE T-SHIRT IS VERY SIMPLE WITH A MINIMUM OF VARIETY OF MACHINES. FOR THE ACTUAL SEAM CONSTRUCTION, ONE CAN USE ANY ONE OF THREE STITCH TYPES.

THE FIRST STITCH TYPE IS THE THREE THREAD OVER EDGER OR OVERLOCK. THIS GIVES RAW EDGE COVERAGE BUT WITH A MINIMUM DEPTH OF STITCH. IF ONE IS MANUFACTURING A CHEAP GARMENT WHICH IS NOT

EXPECTED TO TO HAVE A LONG LIFE, THEN THE THREE THREAD OVER-EDGER WOULD BE THE MACHINE TO USE. THE DRAW BACK IS THE SHALLOW BITE OF THE STITCH WHICH, IF MUCH STRAIN IS PLACED ON IT, COULD RUPTURE THE FABRIC. ALSO, IF THE THREAD BREAKS, ONE IS LEFT WITH A HOLE IN THE SEAM.

THE SECOND MACHINE IS THE FOUR OR FIVE THREAD OVER-EDGER WHICH GIVES AN OVEREDGE STITCH AS THE FIRST MACHINE BUT HAS THE ADDITION OF A SAFETY STITCH WHICH LOOKS LIKE A FLAT BED LOCK STITCH. THE OBVIOUS ADVANTAGE, OF COURSE, IS THE SAFETY STITCH WHICH GIVES THE SEAM ADDED STRENGTH AND SO HELPS PROLONG THE LIFE OF THE GARMENT. THIS MACHINE IS SLIGHTLY MORE EXPENSIVE THAN THE FIRST (*find out relative costs) 3 THREAD $ 2332; 5 THREAD $ 2592 AND BECAUSE THE MACHINE IS A LITTLE MORE COMPLEX, IT REQUIRES A HIGHER DEGREE OF SEWING MACHINE MECHANIC SKILLS TO MAINTAIN AND REPAIR IT. THE STITCH ALSO USES MORE THREAD FOR INSTANCE, THE THREE THREAD USES 14CMs OF THREAD PER 1CM OF STITCHING; THE FOUR TO FIVE THREAD WILL USE 20CM OF THREAD PER 1CM OF STITCHING. THIS MACHINE IS USED MAINLY IN UP MARKET GARMENTS.

THE LAST MACHINE IS THE HIGH SPEED CYLINDER BED INTER-LOCK MACHINE. THIS MACHINE MAY HAVE TWO OR THREE NEEDLES WHICH SHOWS A ROW OF TWO OR THREE LOCKSTITCH TYPE STITCHES ON ONE SIDE AND A COVER THREAD ON THE OTHER SIDE. THE MACHINE RUNS AT SPEEDS UT TO 6000 SPM. THERE IS USUALLY A STITCH LENGTH CONTROL AND IT CAN HAVE A SPECIAL NEEDLE COOLER AND THREAD LUBRICATOR WHICH PERMITS CONTINUOUS SEWING AT MAXIMUM SPEEDS EVEN WITH DIFFICULT SYNTHETIC THREADS.

JUST TO DIGRESS A LITTLE. I CAN REMEMBER BUYING TENNIS SHIRTS MADE BY THE ITALIAN COMPANY FILA. THEY SOLVED THEIR SIDE SEAM STITCHING PROBLEM BY ELIMINATING IT COMPLETELY. THEY HAD THEIR SHIRTS KNITTED ON THE ROUND TO THE VARIOUS SIZES REQUIRED AND SO THE SHIRT DID NOT HAVE ANY SEAMS AT THE SIDES OF THEIR GARMENTS. AND IF YOU THINK ABOUT IT, IT MAKES A LOT OF SENSE.

HERE IS A BREAKDOWN TO PRODUCE A GENTS ROUND NECK SHORT SLEEVE T-SHIRT AT A RATE OF 12,000 UNITS PER DAY - 60,000 PER 39 HOUR WEEK.

OPERATION NUMBER	OPERATION DESCRIPTION	EST SMV	MACHINES REQUIRED PER WEEK
1	CLOSE FIRST SHOULDER SEAM	.20	7
2	BIND NECK INSERT LABEL	.35	12
3	BIND TWO SLEEVES	.20	7
4	CLOSE SECOND SHOULDER SEAM	.20	7
5	OVERLOCK ATTACH SLEEVES	.40	13
6	OVERLOCK CLOSE THRO SLEEVE AND SIDE SEAMS	.60	20
7	COVERSEAM BOTTOM HEM	.50	16
		2.45	