OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

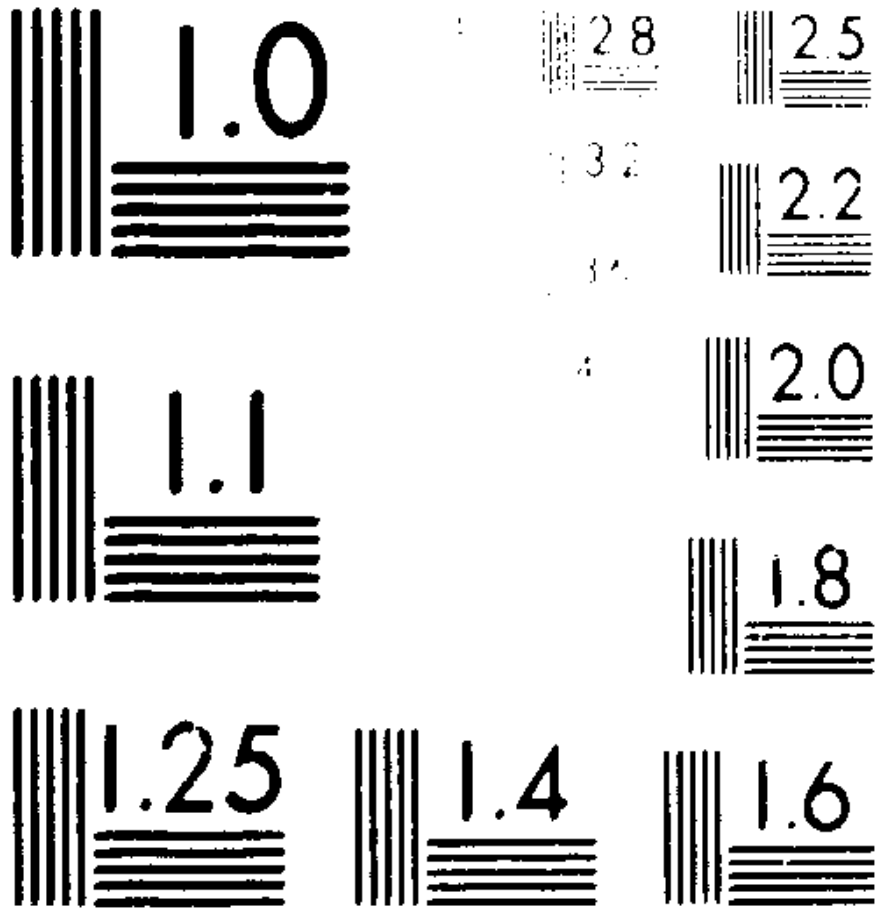
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

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


1.0
2.8
2.5
3.2
2.2
2.0
1.1
1.8
1.25
1.4
1.6

E.932

DP/ID/SER.B/245
14 May 1979
English

RESTRICTED

ASSISTANCE TO THE DAN DAN GARMENTS LTD. FACTORY
SI/STK/78/801
ST. KITTS-NEVIS-ANGUILLA

Terminal report

Prepared for the Government of St. Kitts-Nevis-Anguilla
by the United Nations Industrial Development Organization

Based on the work of Irma Grundstrom, expert in garment production

000879

United Nations Industrial Development Organization
Vienna

80-41614

Explanatory notes

A comma (,) is used to distinguish thousands.

A full stop (.) is used to indicate decimals.

The monetary unit of St. Kitts-Nevis-Anguilla is the East Caribbean dollar ($EC), composed of 100 EC cents. The value of the East Caribbean dollar in relation to the United States dollar during the period covered by this report was $US 1.00 = $EC 2.70 ($EC 1.00 = $US 0.37).

In addition to common abbreviations, symbols and terms and those accepted by the International System of Units (SI) the term m.p.p. has been used to indicate minutes per product.

CARICOM is used as an abbreviation for Caribbean Community.

ABSTRACT

The project entitled "Assistance to the Dan Dan Garments Ltd. factory" (SI/STK/79/901) began on 20 November 1979 and ended on 5 April 1979. The main object of the project was to provide assistance to the management of the factory in production methods, to answer questions related to product quality and to provide the company with the capability to expand rapidly.

The main activities of the mission were to:

(a) Rearrange the cutting room;

(b) Establish a training programme for operators;

(c) Reduce labour turnover and absenteeism;

(d) Make production line changes to give smoother and more efficient operation;

(e) Introduce time study and piece rate systems and provide training to implement and continue these systems;

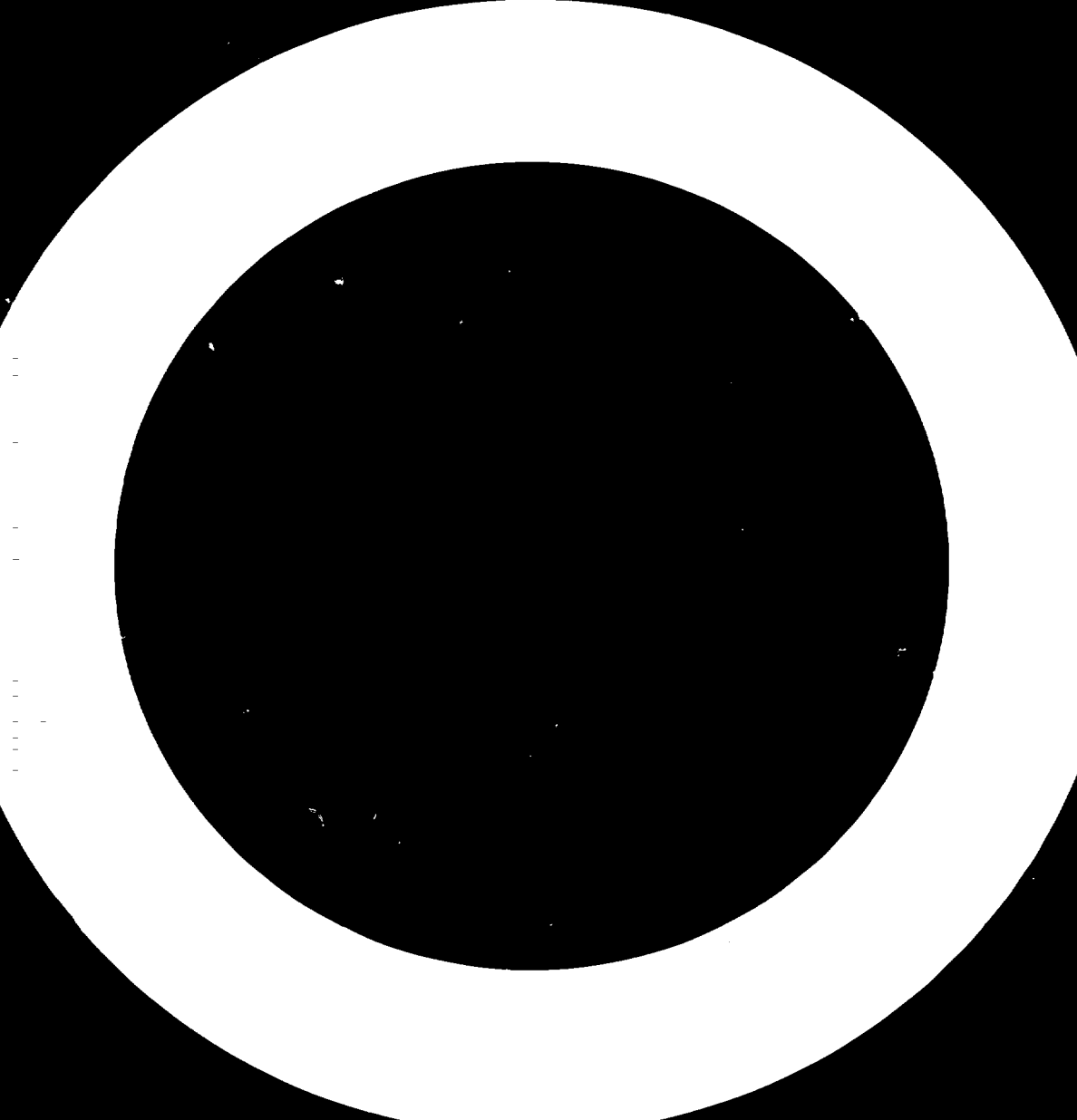
(f) Introduce new production records to record production times, productivity, absenteeism and labour turnover;

(g) Examine utilization of production space;

(h) Assist management to solve production problems work flow production-line, machinery, and personnel problems as these problems arose;

(i) Train a production supervisor, two other supervisors and a trainer.

Recommendations were made to improve plant organization, to further change production line sequences, to invest in new machinery to provide a training programme for staff and to institute a quality control programme.



CONTENTS

Page

I. INTRODUCTION

A. Project background

Dan Dan Garments Ltd. was founded in 1976. It is mainly owned by the St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd. (T.D.C.). Dan Dan was one of the earliest garment factories on the island. There are four clothing companies in St. Kitts with a total of 660 employees. Labour intensive industries are attracted to St. Kitts by the low labour costs. The average weekly salary in industry is now $EC 35 (about $US 13). Industries are also attracted by the 10 year tax holiday. During the tax-free period the Government allows the company to bring materials and equipment into the country duty-free.

The Government has also reserved an industrial area in the capital of St. Kitts. The area is next to the new deep water harbour, which is five minutes driving distance from the Golden Rock Airport.

There is little regular outside supply to the island, and the factory must stock three months of supplies. In general the lower the material costs, and the longer the time from order to delivery, the better the production is suited for the island. In the garment industry, material costs range from 30% to 50% of the total and thus labour costs are important. Thus this industry is well suited to the island. The higher fashion industries, in which the production cycle time is very short, are naturally out of the question. But standardized products which are bought a half a year in advance, can be produced very profitably.

The island garment industry is young and there are very few experienced operators. Thus training is needed. Transportation is also a problem. Most of the operators in industries come from the country. The bus connections are not too frequent, the fares are relatively high.

Although there are enough people available for training as operators there are no trained people available for supervision, training, quality control or work study. Lack of such personnel as well as the lack of knowledge of modern industrial production methods is the biggest problem faced by garment industry in the island. Unavailability of trained personnel was the main reason for Dan Dan Garments Ltd. applying for technical assistance.

B. Summary of official arrangements

The request for technical assistance for Dan Dan Garments Ltd. was made to UNIDO by the Government of St. Kitts-Nevis-Anguilla on 23 June 1978. The candidates were requested by the 18 August 1978.

The letter of appointment was signed by the expert in Vienna on 13 November 1978 and the work at Dan Dan Garments Ltd. started on 20 November 1978. The project ended in St. Kitts, on 5 April 1979.

The request from the Government of St. Kitts-Nevis-Anguilla for an Expert in Production of Garments is shown in annex I.

C. Aims and goals of the project

The aims and goals of the project were to provide assistance to the management in production methods; to answer questions related to product quality; to train supervisors; to help the company improve production time and product quality and to provide the company with the capability to expand rapidly.

II. FINDINGS

A. Main activities of the project

The main activities of the project were to:

(a) Rearrange the cuttingroom;

(b) Establish a training programme for operators;

(c) Reduce labour turnover and absenteeism;

(d) Make production line changes for smooth and efficient operation;

(e) Introduce time study and piece-rate systems and training for these systems;

(f) Introduce new production records to record production times, absenteeism and labour turnover;

(g) Examine production space utilization;

(h) Assist management to solve production problems, work flow, production-line, machinery, and personnel problems as these problems arose;

(i) Train a production supervisor, two other supervisors and a trainer.

B. Assistance in Production

1. Rearranging the cuttingroom

The cuttingroom arrangement resulted in many problems such as missing parts, miscuttings, much unnecessary recutting, delays in bundling etc. These problems led to delays, and often kept the sewing units waiting for work. The following steps were taken to solve these problems:

(a) The marker making operation was moved into a separate area. This freed space and allowed for continuous spreading and cutting. In the separate space it was easier for the person making the marker to concentrate on the work, which decreased the mistakes;

(b) A system to check the marker before starting to spread was instituted. This almost totally solved the problems of missing parts, wrong parts or parts laid upside down. To give importance to this checking operation, the checking was made the responsibility of the cuttingroom supervisor;

(c) The bundling operation was moved from the cutting table to a separate area. This gave more space for continuous spreading and cutting;

(d) Trolleys were used to remove material from the cutting table as soon as the bundles had been cut. This increased the capacity of the cuttingroom;

(e) The process of bundling the preparation (zip making and pressing) were merged - and the area for these operations was made a separate supervisory unit. This unit has improved the flow of work from the cuttingroom to the sewing units. After the introduction of this unit, there have only been minor delays in starting work in sewing units. Most of the cuttingroom mistakes are also discovered at the bundling process and corrected before material is forwarded into sewing units.

These steps have improved the operation of the cuttingroom. There is, (with present cutting heights, markers and personnel) a capacity of up to 1,500 pieces per day (9 h). This will be sufficient for the company for at least another two years.

2. A training programme for operators

The company expanded rapidly during the period of the project. During the first three months of 1979 42 new operators were employed and 20 left the company.

There is a plan of further expansion, which means that during this further expansion the number of new operators will remain high.

As there are next to no experienced sewing operators available on the island, the factory must train the new operators.

The main system used for training was to have the individual trainees in the sewing units observe the operation. This system has two disadvantages. It disturbs the operator who cannot concentrate on the work; thus efficiency is lowered. The second disadvantage is that the trainee makes too many mistakes when beginning to work, before finding the right work-method. When the correct method is found, the efficiency of the trainee raises very slowly.

To establish a proper training system, which could provide the factory with efficient operators:

(a) A separate training group with six single needle machines was formed. This kept the trainees out of the production lines, allowing the operators in the lines to concentrate on their own work;

(b) A more systematic training system was adopted to teach the future operators the correct machine operation. A training manual from Manual Getan, Sewing Machine Operator's Training Handbook 1/, was used as guide and handbook for training. The training time is, however, too short. It is seldom even 2 weeks (12 needed). Thus the effect of the training is mtnimal;

(c) The trainer was taught training techniques, product analysis, production line sequencing layout techniques and work study;

(d) A training manual on each existing product group was prepared. Annex II shows an example of such a manual for corduroy jeans to help the trainer and supervisors during the on-the-job training.

1/ Columbia, South Carolina, Bobbin Publications Inc., 1979.

3. Turnover and absenteeism

Labour turnover was 60% in 1978. This high figure meant a large number of trainees and new operators. The result was that production efficiency was very low.

To reduce the high turnover:

(a) A record to find the reasons of leaving the company was begun;

(b) Company subsidized transportation was instituted;

(c) A decision was made to build a canteen to provide subsidized meals for the operators;

(d) A separate training unit was started to provide more experienced replacement operators.

From January through March of 1979 operators left the company for the following reasons:

(a) Three operators left for maternity leave;

(b) One operator left for a long sick leave;

(c) Eleven operators who had been working with the company less than three months left for various reasons. Three were fired. Two were not satisfied with the salary. One found the work too hard. Five did not give a reason for leaving;

(d) Two other operators were fired;

(e) Three other operators did not give a reason for leaving.

Although the period of the record is very short it shows certain patterns.

During this period 42 new operators were employed. The record shows that 26% of these new operators left the company after a very short period of time. A continuous training programme with a training time of 12 weeks would eliminate unsuitable operators before they start to work in the production. This would thus avoid disturbance of the production line.

The number of operators leaving for maternity leave is also quite high. So far there is no record showing how many of these operators return and after how long. The record will be continued by the production supervisor. A longer period of time (minimum one year) will give a more reliable picture of the reasons for leaving. Then action can be taken to cure the problem of high labour turnover.

Company subsidized transportation was introduced in February 1979, The majority of the operators live in the countryside. The bus rates are comparatively high and this seems to have an effect on their decision to stay with the company or not. It is very difficult to estimate the effect of the transportation costs on turnover. A longer period of study will show the importance of transportation costs.

To provide a company subsidized meal a company canteen was built in co-operation with a neighbouring company in March 1979. The food now available is served from a van that travels around the industrial area during break times. The capacity of the van seems insufficient and the variety cannot be the same as in a properly run canteen.

A training group was started to train the operators needed to replace those leaving. This method is the only way to train without disturbing production. The training group should be continuous both because of the high turnover and because of the constant production increases. An on-the-job training programme should be instituted. Then the replaced operators could reach the required production time level in a shorter period of time.

Absenteeism has caused a number of problems and management has been looking for cures. In 1978 the absenteeism was about 10%. A record of absenteeism was started in January 1979 for a three month period. From 15 January to 15 April 1979 the absenteeism was 8.15%.

This slight decrease is believed to be caused by the availability of transportation and the fact that there is enough work for almost everybody. This creates a feeling of being needed. The practice of changing operators from one operation to another was decreased in March 1979 and each operator was given her own work place. An operation was not moved without a decision made by the production manager. The feeling of being needed increased and the rate of absenteeism among key operators became very low.

The average of 8% absenteeism is not too high and can be considered as normal in an industry mainly employing women. The main problem of absenteeism is that the absenteeism varies quite a lot from day to day. To show this

variation and to find any underlying patterns a record was kept from 29 January 1979 to 20 April 1980.

Table 1. Percentage of absentees by week for the period 29 January 1979 to 20 April 1979

(Per cent absent)

Week	Monday	Tuesday	Wednesday	Thursday	Friday
1	5.1	11.4	6.2	7.4	9.2
2	9.9	9.7	5.9	14.2	3.9
3	6.8	9.7	5.2	10.7	3.9
4	7.7	4.46	13.2	7.2	7.7
5	7.5	-	5.5	6.4	6.1
6	8.1	9.2	8.1	15.4	3.2
7	9.3	6.0	7.8	9.2	6.7
8	21.0	5.2	11.67	5.5	3.0
9	7.4	8.9	8.7	29.1	8.3
10	13.5	6.7	4.2	8.8	3.0
11	7.9	5.2	3.8	16.4	-
12	-	5.4	7.6	5.1	2.5
Average per cent absent	9.5	6.8	7.3	11.3	5.2

The low absenteeism for Fridays is due to two reasons:

(a) Friday is the pay-day and the salary has to be collected at the factory;

(b) Friday is also a shorter work day and there is a short time allowed for shopping between the finishing of work and the time of departure of the company truck.

The record shows that there is a high variation in the absenteeism from day to day. When the absenteeism is between 5% and 8% the company produces most efficiently. When the absenteeism is higher than 8% and especially when higher than 10%, there is a drop in production. When absenteeism is lower than 5% there does not seem to be enough work for everybody and the productivity is low.

To avoid a drop in production caused by absenteeism spare operators are needed to replace the absent operators. The matter was discussed in March 1979 and a decision was made to train seven operators for this purpose.

Using spare operators takes care of normal absenteeism. In cases of very high or very low absenteeism a special production strategy should be instituted to avoid losses in production or production time.

The record shows that there is always one day in the week where absenteeism is significantly higher than on the other days of the week. Generally this day is Thursday. To be able to handle a situation like this, where the number of spare operators cannot cover the number of absent operators, a discussion should be held first thing in the morning to decide on the production strategy of the day. The discussion should take place between the production supervisor, line supervisors and the production manager. The aim of the discussion should be to allocate operators in such a way as to maximize production.

The low absenteeism needs a special strategy. When less than 5% of the operators are absent, a similar discussion should be held to find a solution to retain production time. The spare operators should be used to help to clear bottle-necks. All the operators should be fully occupied with productive work.

4. Production line arrangements

The problems in the area of production lines (sewing and finishing) were mostly due to the inbuilt inefficiency of the lines:

(a) The lines were not rearranged when the style changed; this means that the amount of work of individual operators varies and there always exists a certain amount of waiting;

(b) The lines were so small (4 to 6 operators) that most styles had to be passed back and forth between the same machines; this caused disturbance in the work flow;

(c) The work was done in singles, not in bundles, which meant that a constant work rhythm could not be created;

(d) Work sequences were not defined for some products. One operator made the whole garment from start to finish. The individual efficiencies were relatively low;

(e) The inefficiency of the machinery (tacking, trimming, needle positioning) due to age means extra work depending on the operation;

(f) There was a delay in production when new work was needed for the lines. The practice was that the line supervisor went to collect work from cuttingroom. If there were any delays in the cutting or bundling the supervisor had to wait.

To improve efficiency:

(a) The bundling was arranged to solve the problem of waiting while delivering work from cuttingroom to sewing units;

(b) Work was given to lines in bundles which contained an average of one hour's work. A bundle gives the operator a chance to repeat the same operation so often that the production speed is increased. The effect of this can be seen in shirt production where the hourly production is slowly increasing from 4 shirts to 9 shirts;

(c) A plan was made to distribute work evenly among individual operators and to make the flow of work continuous.

For line 6 (polyester pants), a production sequence was planned in co-operation with the production supervisor. The production was done by six operators. The lack of supervisory personnel restricted the duration of the trial to one month. The sequences have, however, been worked out, and as there are seldom changes in the style for the line, the line can easily be converted to the new sequence as soon as adequate supervision is available. Line 4 (skirt production) was in operation in January and February 1979, and was carried out in balanced sequences from bundles. Assistance was given in training of supervisors and operators, and in supervision. A training manual was written. Lines for shirt production were started in February 1979. After several trials with various operators finally a supervisor was found and trained to run the line in a properly sequenced manner. Shirt production came into full operation at the end of March with five operators for khaki shirts. The line was later rearranged for army shirts with eight operators. In March line 4 was converted to a jeans line. Each of the four jeans lines has six operators. There are four single needle machines and two double needle machines. After receiving material from special machines for sideseaming, inseaming and waistbanding these lines

make the zip and fly and carry out the pocketing operations. Several suggestions to properly sequence the jeans production were prepared for each style. So far these suggestions have not been implemented.

For a production of 750 jeans per 9 hour day, a layout was prepared (figure I). The same layout with minor changes could be used for any of the existing jeans styles - the only changes would be in the pocketing section. So far the plan has not been carried out as the extra machines for sideseaming, waistbanding and pressing have not yet arrived.

Assembly line

Beginning January 1979, the assembly of jeans was carried out with special jeans machines. To start with there were problems in balancing the line and the flow of work. To solve the problems:

(a) Incentives were suggested for sideseaming, inseaming, waistbanding and hemming and instituted for the waistbanding and hemming sections;

(b) The flow of work was studied and new arrangements were made so that the work now flows smoothly from one operation to another;

(c) Means to solve the bottle-neck were discussed and a new safety stitch machine brought into production in March. The ability to control and allocate work was improved by increasing the number and quality of operators.

Finishing line

The finishing line was rearranged to respond to increasing production. Purchase of a new bartack machine for attaching beltloops was suggested. The machine was brought into service in March. A layout for the line for smooth work flow was prepared and partly brought into practice. The work now flows continuously from one operation to another. A separate operator was employed to make the preparation work for the beltloop bartacks. This solved the problem of under-capacity of this operation. Operators were no longer allowed to change from one machine to another without the permission of the production manager, and a spare operator for the line was named. This created the constancy needed to increase production. The number of trimmers was increased and a close

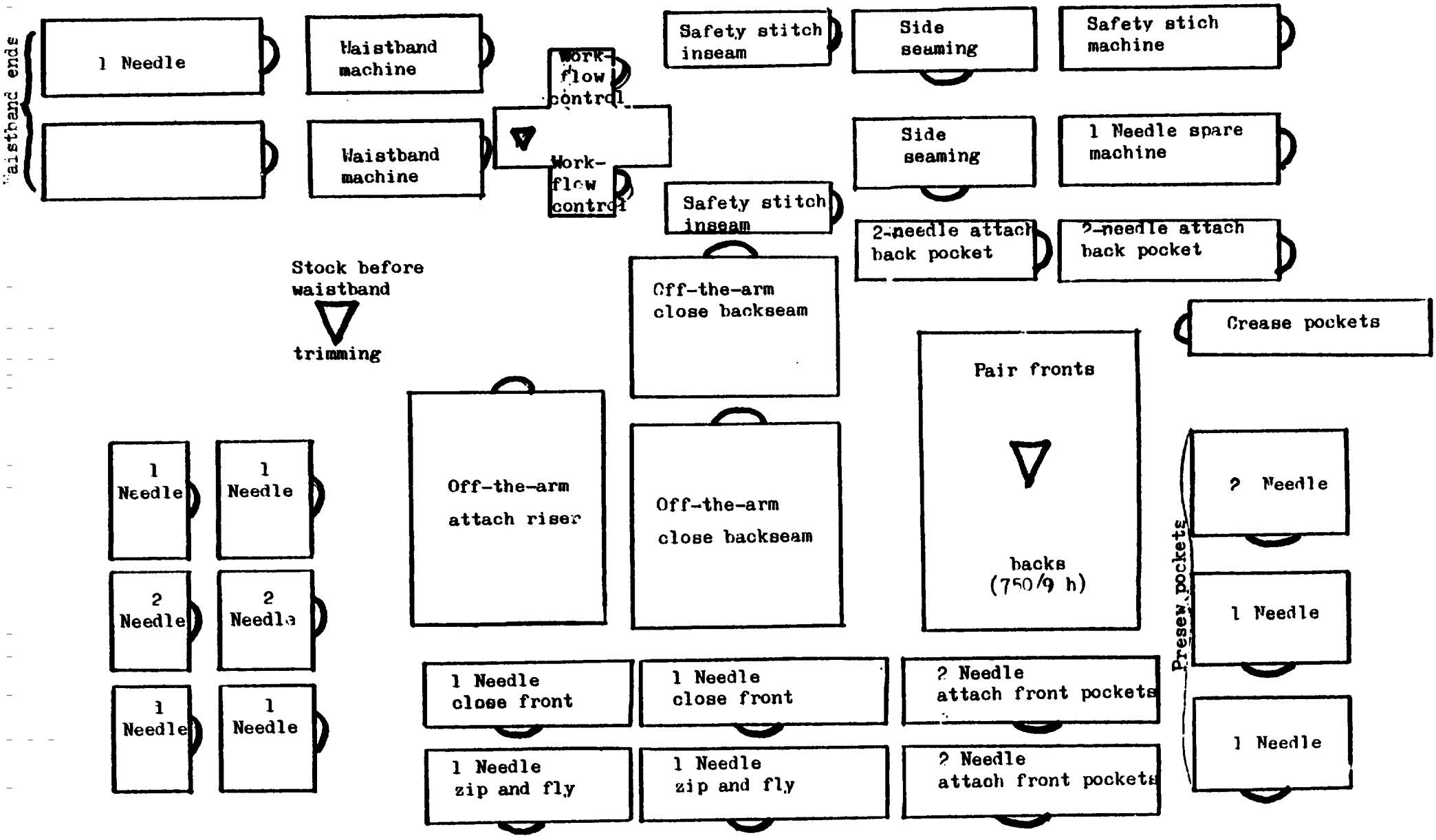


Figure 1: A proposed layout for production of 750 jeans in 9 h (style 202)

individual check made on trimming production. At the moment there seems to be a slight overcapacity in this operation. Measurement of the individual piece-rate would show the real individual capacity and extra persons could be trained for other operations. The output of final inspection was increased by an incentive plan that was introduced at the beginning of March.

5. Time study and piece rate

A time study system was started and taught to the production supervisor in order to analyse the work methods to improve the productivity of individual operations; lay a base for an incentive or piece-rate system; and solve the problems of low efficiency in individual operations that are specially important for the flow of production.

A time study was made in the operations of side seaming (see example, annex III), inseaming, waistbanding, hemming, bartack, beltloop bartack and back seam and riser.

The side seaming showed at the beginning of February an average production time of 1.5 m.p.p. Study showed that the method used was good and improvement could only be expected over a longer period of time or after introduction of a motivating piece-rate system. A suggestion for a piece-rate was made but so far has not been instituted. The production time at the end of April was 1 m.p.p.

The inseaming operation was not capable of handling the amounts produced by the sideseaming. A study showed that the method used by the operator was very time consuming and could be corrected by retraining. Also the work could be trimmed before the operation, thus reducing operation time. The output problem was solved by using a second safety stitch machine for inseaming.

A study of waistbanding showed that the operator could, under ideal conditions, complete the operation in 0.80 min. The rate of work of the operator was very low and a new operator was put on this operation. To further increase the output of this operation an incentive was started in March. The new operator and the incentive system used have decreased the output time to 0.80 min. A production time of 0.75 min per waistband may still be reached.

The hemming of jeans (single needle machine) was studied and it showed that a production time of 0.88 m.p.p. could be reached. An incentive system was instituted in March. This solved the output problem. By the end of April the operator attained a production time of 0.88 m.p.p. (628 pieces per 9 h).

The two bartack machines were not able to handle the required amount of 400 to 500 pieces per 9 h. A time study showed that one of the operators could actually, without any improvements in the method, produce 700 pieces in 9 h by working constantly. A more close record was kept of the operation. A piece-rate was suggested but so far has not been instituted. The output of the two bartack machines has increased to the required amount. With no other improvements in operation, these two machines should be able to produce 1,000 pieces daily.

The two bartack machines attaching beltloop had frequent output difficulties. A time study showed that the operation could be improved. The marking of the beltloop position was given to a separate person. Another problem was the high rate of machine breakdowns. A new machine was ordered and taken in use in March. A piece-rate system was suggested but so far has not been instituted. A closer record of the operation was kept and the average production time of 2.9 m.p.p. from February was improved to 2.1 m.p.p. (6 beltloops). The time study showed that with correct working method a production time of 1.7 min per 6 beltloops (317 groups of 6 beltloops per 9 h) may be reached.

There are three off-the-arm machines for attaching risers and closing back seams. There was with these three machines a constant need for overtime work. A study showed that the time used for this operation was 3.0 min. The work was not handled at this operation one bundle at a time, which leads to a need for matching of the colours of risers before attaching them to the backs. The problem of constant need for overtime was solved by changing the work procedure. The colours were matched before the risers were matched to the backs. This procedure gave greater efficiency of production per operator and the need for overtime was eliminated.

The time studies give a base to build a piece-rate or incentive system. To find the base for a piece-rate system a study was carried out using well serviced operations with experienced operators (hemming, sideseaming, waistbanding).

Several patterns for piece-rate were discussed and the incentive system for the jeans lines was used for the individual operations as well. The operator is given a daily target. If this target is reached the operator gets a certain amount per extra produced piece for that day.

The incentive is a very good guarantee for a minimum production level. The disadvantage of the system is that the more the operator produces the less he or she will get paid per piece.

A study on the existing incentive systems was made and is shown in figure II. The study shows that the incentives were not equitable and have to be corrected before further systems are begun.

A suggestion to make the incentives more equitable and to add a few new incentives is shown in figure III. The principle is that an increase in produced pieces should result in a proportionate increase in pay. As a base the existing incentive for hemming was used, as this seems to be most appropriate. Table 2 shows the total incremental allowances for the various operating lines.

Table 2. A proposed incentive system showing incremental allowances for different operating lines

Line	Number of operators	Target (pieces)	Incremental allowance per piece (cents EC)	Increment per individual per 100 pieces (¢EC)
Shirt	8	108	30	3.75
Jean	6	150	16	2.66
Beltloop	6	270	1.5	0.25
Bartack, inseam, sideseam	7	400	1.0	0.14
Final inspection	7	540	5.25	0.75
Waistbanding	7	550	0.72	0.10

The incentives that have been instituted so far show the advantages of the system. Where the system is used most of the output problems of individual operators have been satisfactorily solved. Only final inspection rates have not been improved by the incentive. This may be due to the low increase in pay compared to the other existing incentives.

6. Production record

Table 3 shows weekly production for the period 28 August to 11 November 1978. Table 4 shows weekly production for the period 22 January 1979 to 28 April 1979.

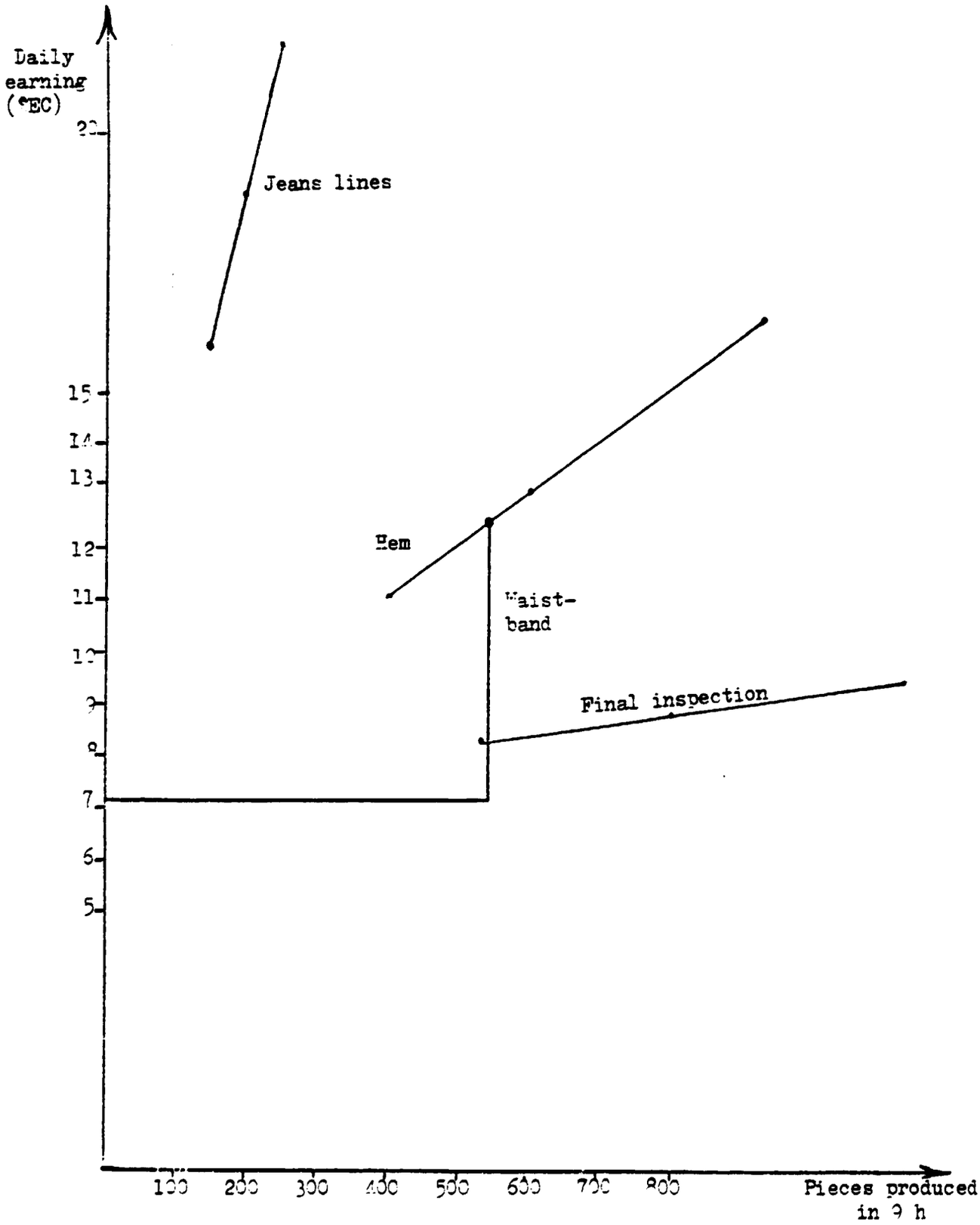


Figure II. Daily earnings as a function of pieces produced (current incentive system)

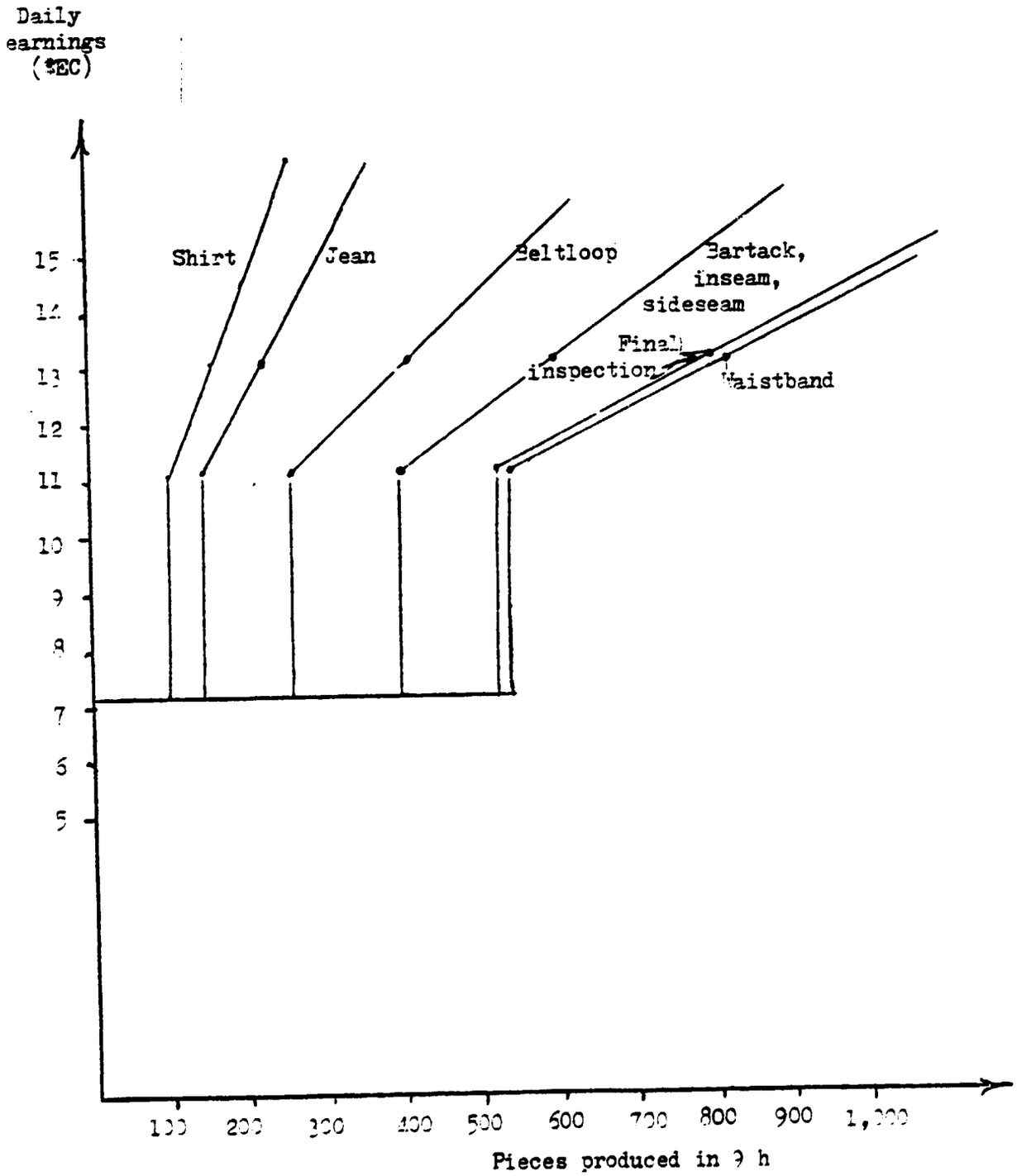


Figure III. Daily earnings as a function of pieces produced for various production lines. (proposed incentive system)

Table 3. Weekly production of Dan Dan Garments Ltd. during the period 28 August 1978 to 11 November 1978

Week	Total production time [a] (minutes)	Pieces produced into stock	Production time per product (minutes per product)
35	139 140	832	167
36	136 460	894	154 [b]
37	139 860	781	179 [b]
38	162 780	1 059	154
39	156 180	1 485	105
40	166 080	1 991	83
41	168 420	1 748	96
42	169 080	1 339	126
43	166 500	1 385	120
44	150 780	1 078	140
45	158 620	1 530	104
Totals	1 714 900	14 122	

[a] Production time per product (m.p.p.) is the ratio of production time (minutes) to produced pieces (into stock).

[b] Four-day week.

Table 4. Weekly production of Dan Dan Garments Ltd. during the period of 22 January 1979 to 28 April 1979

Week	Total production time (minutes)	Pieces produced into stock	Production time per product (minutes per product)
4	212 775	1 909	111
5	243 840	2 264	113
6	241 350	1 968	123
7	263 880	1 807	146
8	263 290	2 002	132
9	224 280	1 877	119
10	269 480	2 769	97
11	283 240	2 946	96
12	266 280	2 728	98
13	267 180	2 436	110
14	289 410	3 099	93
15	241 770	2 394	101 b/
16	244 500	1 951	125 b/
17	312 990	2 675	117
Totals	3 624 265	32 725	

a/ Production time per product (m.p.p.) is the ratio of production time (minutes) to pieces produced (into stock).

b/ Easter week.

A slight improvement can be seen when comparing the 11 week period at the end of 1978 to the 14 week period at the beginning in 1979. An increase of 80% in produced pieces can be seen. During the same time the number of employees has increased by 41%. In spite of this rate of high expansion the production frequency has improved from 121 m.p.p. to 110 m.p.p. (figure IV).

By the end of April the factory seemed to be slightly over-employed, especially in the assembly line and finishing line where the production time per piece did not improve even if the individual operators increased their output.

With the current number of operators and with another sideseaming machine and a second steam press the daily production will soon increase to 750 to 800 pieces in 9 h. This would mean a production time per piece of about 70 m.p.p.

7. Production space

The number of employees at the end of April was 123. This meant production space of 28 square feet (2.6 m^2) per sewing operator. Eighty square feet (7.4 m^2) per operator would be needed for proper operation. This increase in production also requires more space for stock-rooms and packing.

To solve this problem the management decided that an extension to the factory be built. The area of the extension is 2,000 square feet (186 m^2). The building was started in March and use of the new stock-room began in the beginning of May. The whole area is to be used for ready garments and shipping and the area of the old ready garments stock taken for production space.

With this increase in space the space per sewing operator is 33 square feet (3 m^2).

Figure V shows a layout for the new production space which is to be used for bundling, preparation and final inspection.

Before further production increases (over 750 pieces per 9 h) more production space should be found and the factory floor better organized.

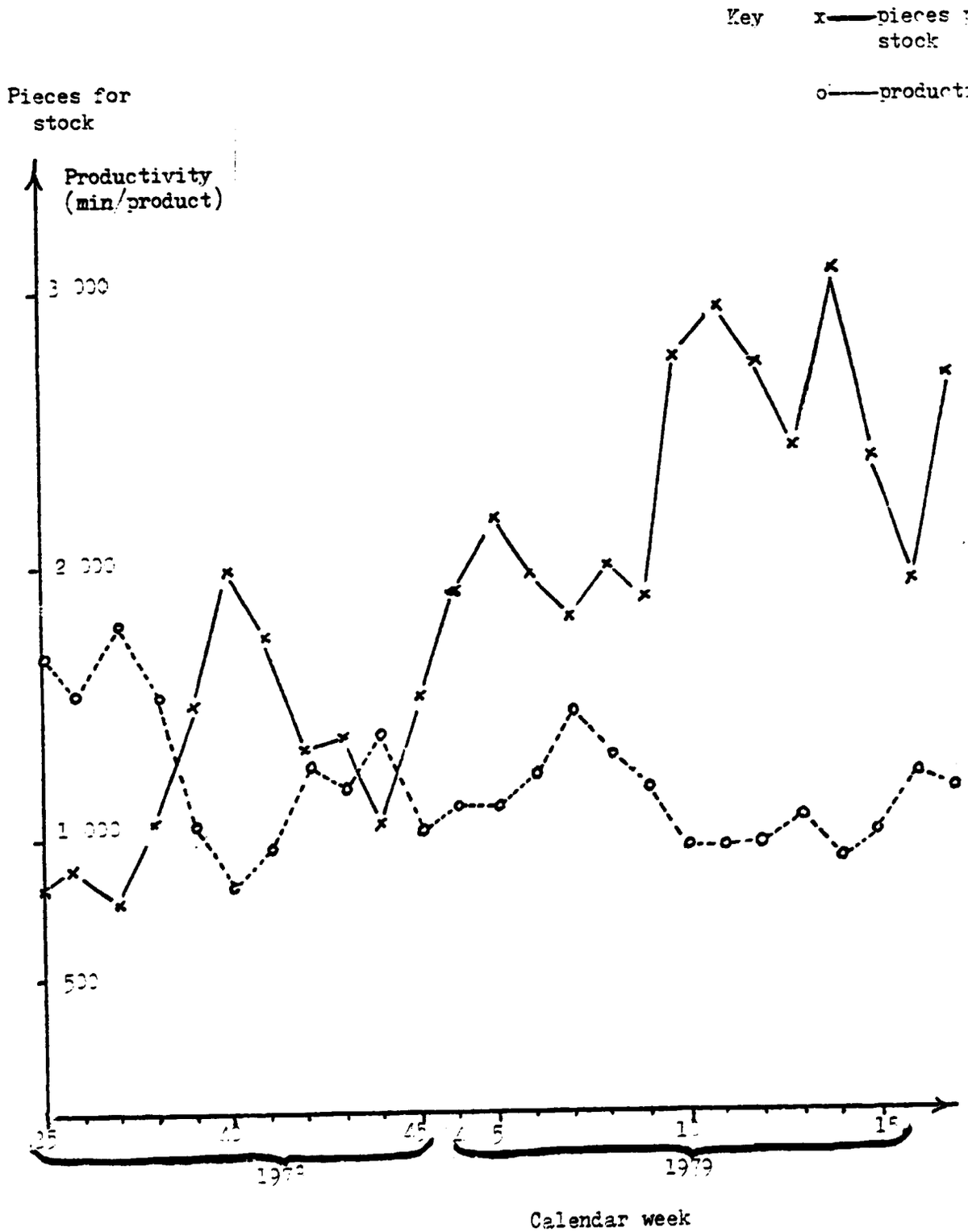


Figure IV. Pieces produced for stock and Production time during project duration

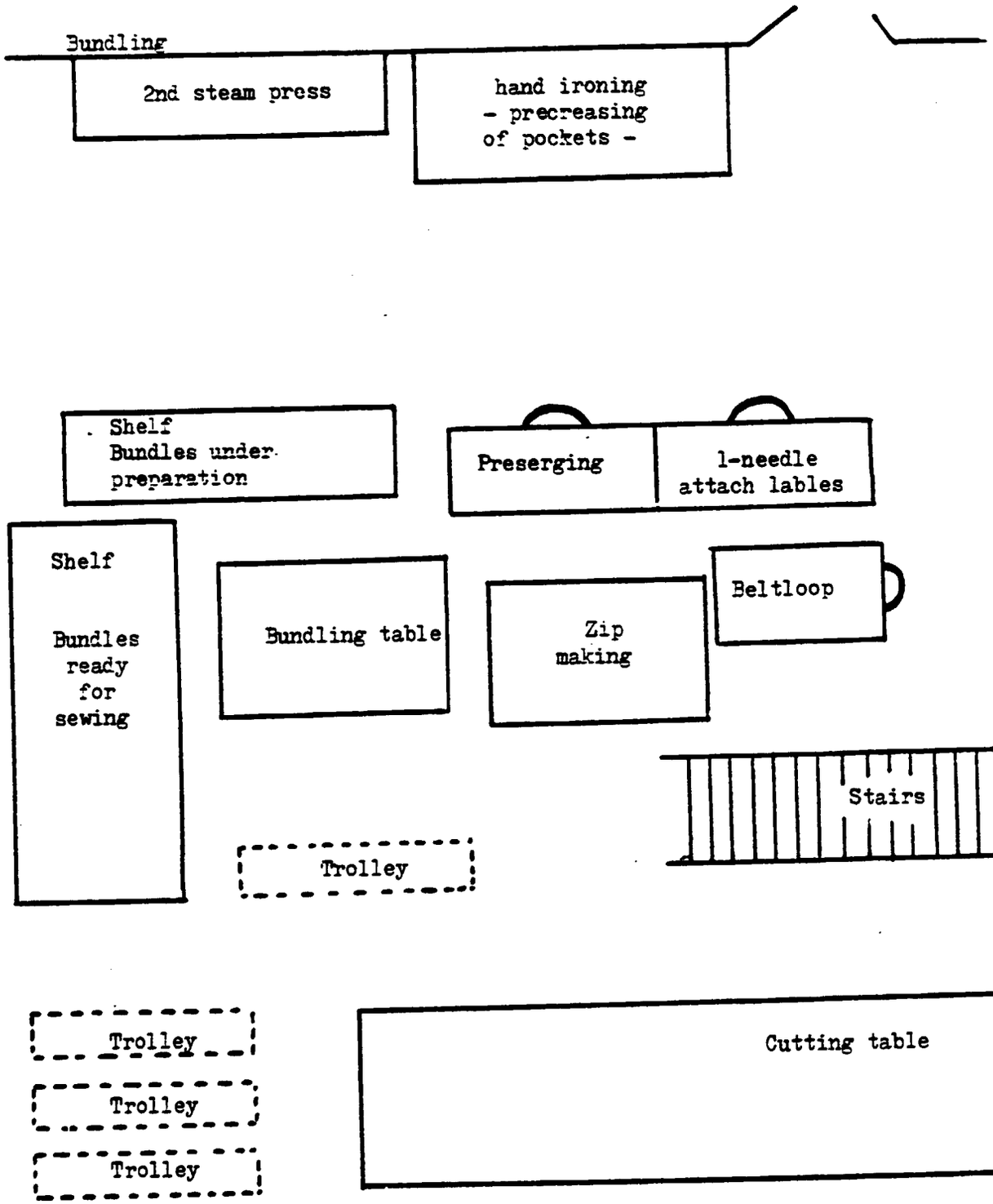


Figure V. Layout for new production space

8. Assistance in production problems

During the time of the project production was closely monitored and problems were discussed daily with the production manager. The problems included production systems as well as minor questions about production techniques. Most of these problems could have been solved had there been a sufficient number of trained supervisors.

9. Training

All the training given during the project was on-the-job training. The supervisor for bundling and preparation was trained during February 1979. After a few trials in the skirt and shirt production a supervisor was found and trained for line 5. Supervisory work began in the beginning of April and the training was carried out during a change of style in the shirt line.

The trainer was retrained in training techniques and in areas of product analysis, production line sequencing, layout techniques and elementary work study. The production supervisor was trained in production techniques to solve production bottle-necks, to solve work-flow problems, to solve problems in individual operations, to improve work methods and to calculate incentives.

Training was also given in product analysis and development as well as in sequencing production lines.

C. Summary

Dan Dan Garments Ltd., founded in 1976, has been able to show a profit in 1977 and 1978 after having had difficulties during its first year.

The company now produces only to order and no longer produces into stock. The orders received have resulted in a need for rapid expansion.

The production costs at the moment are very low due to the low labour costs, the use of inexpensive materials and the use of second-hand machinery Low production costs put the company in a good competitive position for the market.

The styles and fittings have generally been very satisfactory. Few complaints have come back from customers. Also the shipment procedure has been relatively satisfactory.

An advantage that the company has is the 10 years' tax free period that the Government offers to new companies. This enables the company to bring machinery, equipment, material and trimmings duty-free into the country.

The company faces the problem of improving production efficiency. Lines have not been properly sequenced and the company is not able to institute sequencing. Another reason for inefficiency is that the machinery is old. A proper piece-rate system, on-the-job training, work study and production engineering would improve production time.

As the tax-free period will very soon be over, more money will be needed for capital investment and increasing production costs.

The project, which lasted from 18 November 1978 to 5 May 1979, was designed to assist the company in rearranging the production for rapid expansion. Training has been provided in supervisory, training and work study techniques and for individual operators. The expert worked closely with the production manager of the company, and provided engineering services for the company.

The company has been able to expand its production from 1,700 pieces per week at the end of 1978 to 2,700 pieces per week at the end of April 1979. The time required to manufacture a product decreased from an average of 121 m.p.p. to 109 m.p.p. Quality remained constant.

Productivity is increasing and a production rate of 3,500 pieces per week can be reached. A new steam press is on order to permit this level to be attained. The weekly production of 3,500 pieces would mean a production time per piece of 83 m.p.p.

To continue its succesful operation the company should use the remaining tax-free period to train supervisors and trainers to make work studies engineering and maintenance improvements, to allocate sufficient production space for future needs, to obtain modern machinery with tacking, needle positioning and trimming, and finally to improve product quality.

III. RECOMMENDATIONS

The company is now in a very good situation. Its fourth year of operation has started with increased production without increased production time or loss of quality.

After the first year's losses the company has operated profitably in 1977 and 1978. As the year 1979 is the fourth of the 10 tax-free years the company should make all possible capital investment to build the company in so that it can answer the challenges of the coming taxation and duties, increasing labour costs and the increasing market competition.

The following recommendations will help achieve those goals:

A. Organization

To be able to run the factory smoothly and solve problems as they arise and to continue production during disturbances (expansion, change of style, major absenteeism etc.), the organization should be able to adapt itself to solve these problems. A succesful garment operation must have proper organization and be adequately staffed. Two patterns of organization are possible. The choice will depend on the production manager. These are shown in figures VI and VII.

For either organization pattern the required persons should be selected and trained, the responsibilities of each position in organization should be defined, and each person made responsible for her or his job.

The very first thing to do is to select supervisors and provide the basic training for them. In Basseterre, the capital of St. Kitts, there is a University Centre providing supervisory training. According to the head of the University Centre, the Centre tries to provide courses on topics of use to the island. At the end of April a 12 week course for middle management was begun at the University Centre. Discussions with the head of the Centre were carried out to arrange for basic supervisory training at the University Centre. It was estimated that there would be a need of training about 10 supervisors per year in St. Kitts.

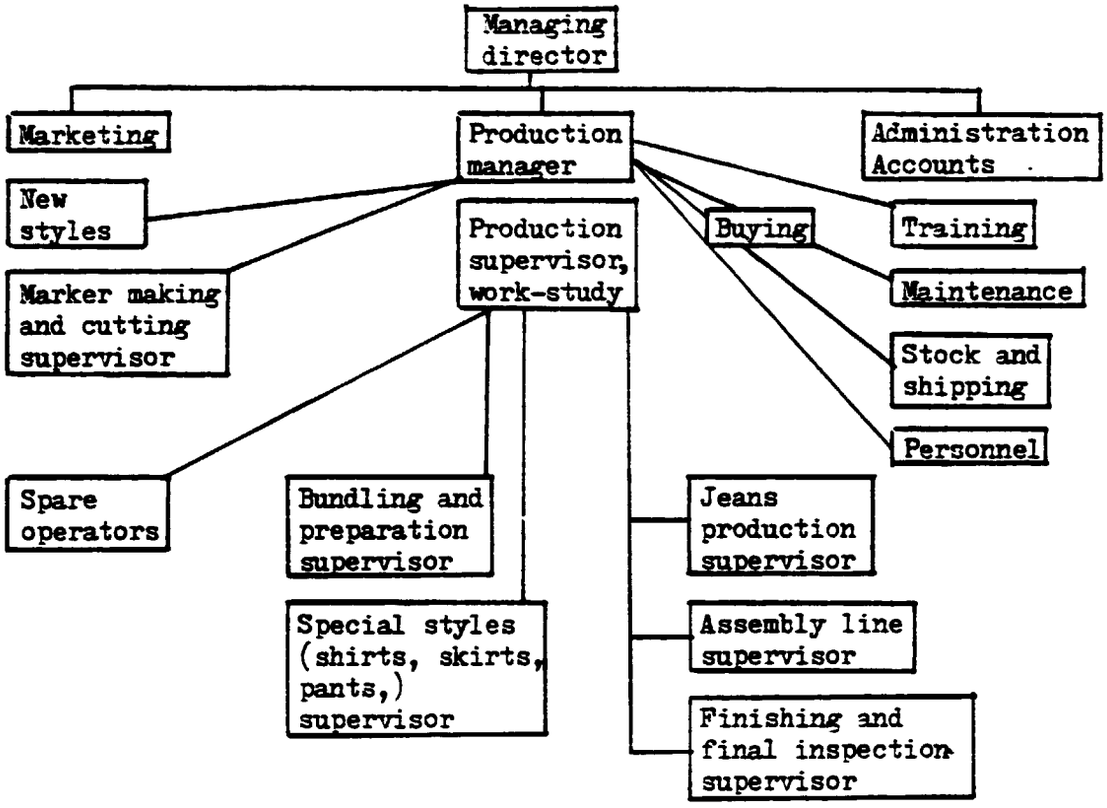


Figure VI. Possible organization of the Dan Dan Garments factory, showing relatively wide responsibility for the production supervisor

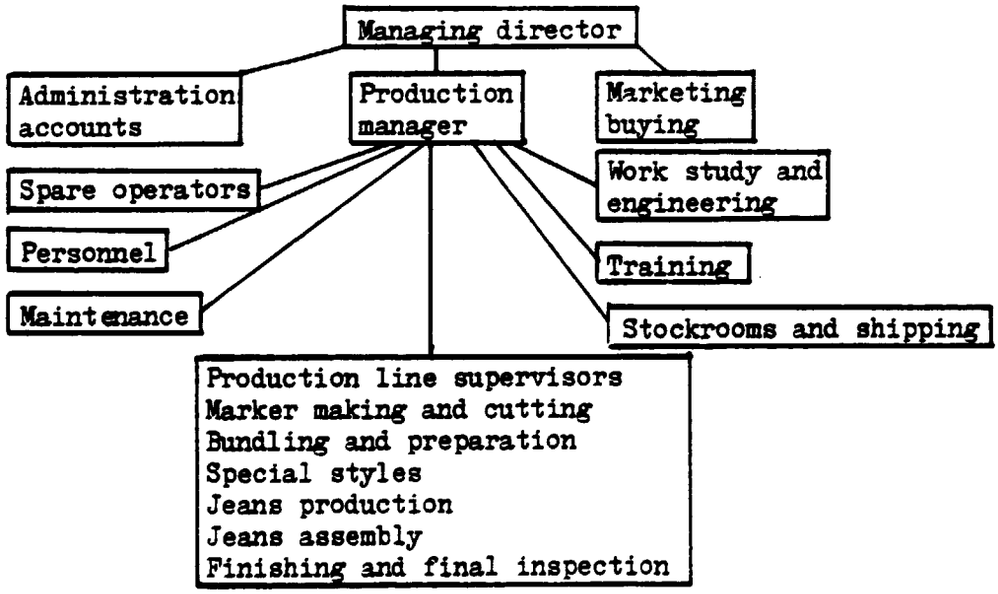


Figure VII. Possible organization of the Dan Dan Garments factory, showing relatively narrow responsibility for the production supervisor

Note: The production supervisor has less responsibility than in the previous diagram (figure VI).

Training should cover:

Industrial organizing
Working in an organization
Supervisory responsibilities
Productivity
Production planning
Work flow bottle-necks in production
Hiring and firing
Pay techniques, piece-rate systems
Work study
Quality control motivation
Law, authorities and industry

To carry out a programme such as this the University Centre would need technical assistance to train personnel and to provide financial support.

This type of technical aid through UNIDO would help the industry of the island in its development more than individual scholarships or expert assistance in individual enterprises.

After such basic training the best of thus trained persons with sufficient industrial experience could then be trained abroad for work study and engineering as well as special industrial techniques.

The second step in building the organization is to train a sufficient number of spare operators. No sequenced production can be handled without spare operators unless there is a large buffer stock for each operation. The spare operators should know all operations from a certain area of production. They should be under the production supervisor or production manager and the first task of the day should be arranging the replacement of absent operators by the spare operators. The number of spare operators should be determined by the average absenteeism.

The third step in building the organization would be to institute work study and engineering operations. Future increases in productivity will depend on this work study and engineering operations. Organization of this operation depends very much on the capabilities and responsibilities of the production manager. Presently the production manager has so many responsibilities that he cannot handle the work study. If the new production manager is responsible only for production and has a sufficient number of supervisors for the normal flow of work, the work study and engineering

could be done by the new production manager. Supervisors or trainers could be used to assist in such studies.

The work study should cover:

(a) Analysis of products and separating the production of each new style into efficiently organized sequences;

(b) Making lay-out plans and carrying them out whenever changes in production occur (expansion of production, new machinery, new work methods, new styles etc.)

(c) Making studies of individual operations to establish a piece-rate;

(d) Making studies of work methods and making plans to improve these in order to increase individual efficiency and to avoid loss of production time;

(e) Studying production times for different product groups and for individual products to estimate the labour costs of products;

(f) Monitoring production costs to be able to adjust production strategies with respect to actual costs. The higher the labour costs the more important this task will become;

(g) Monitoring the efficiency of new operators and production lines and assisting supervisors to improve efficiency;

(h) Assisting the supervisors in solving production problems;

(i) Carrying out work-place engineering in order to avoid bad working conditions. A properly engineered work place will result in higher efficiency;

(j) Planning work methods, especially during the introduction of machines, or new products and the teaching of these methods to supervisors and trainers. On-the-job training should be established.

There will always be a need for retraining operators that have already been trained. Such cases as changing style, correcting wrong work methods, increasing individual efficiencies, bringing new machines or work methods into use, are a few cases which require retraining to avoid production losses. The best alternative is to include the on-the-job training as a formal responsibility of a supervisor.

Another solution would be to have separate trainers for this purpose. The trainers could also be used for minor work studies and in various production capacities. At present two trainers would be needed.

B. Sequencing production lines and implementing a piece-rate system

After establishing the new personnel organization scheme, production should be organized into sequences. This can be done, before the basic training for the personnel has been given, by the production manager, or by another person, who is capable of handling the required work study and engineering work. The only way to increase efficiency is to have the whole production sequenced and the operators motivated with individual piece-rates. The jeans production should be formed into one large jeans line. The assembly line and finishing are already basically organized this way. As the products are well standardized, the needs to rearrange the line with style changes would be very small. Actually only the pocketing of the jeans is changed from style to style. A large jeans line could also be planned so that two or three styles could be produced at the same time.

The steps to be taken would be:

(a) To make the operations shorter. By repeating a short operation often enough efficiency is slowly increased;

(b) To work in bundles of 10 to 20 pieces. The handling time per piece is shorter for bundles than for single pieces. A bundle helps to keep the work in order and saves the operators from the extremely time-consuming operation of colour matching. The pieces in a bundle would be kept together as they were when they left the bundling operation. This would solve the problem of missing parts;

(c) To form a straight flow-of-work. This way it is easier to keep order in production and bottle-necks can be discovered as soon as they occur;

(d) To start an individual piece-rate system. The few individual incentives that have been instituted show clearly that the individual output can be doubled compared to that for a weekly salary system. Individual piece-rate is more efficient than a group incentive; a group is only as effective as the slowest operator of the group.

The argument to not adapt this production practice has been the low labour costs. The cheapness of labour is, however, very relative. The company is competing in the market with products that also come from factories with low labour costs. The wages on the island will slowly increase along with developing industry and tourism. Cheap labour becomes expensive if inefficiently used.

C. Investments

The tax free period should be used to train personnel, increase production space and to provide for future needs and provide modern machinery.

The existing machinery should be changed into modern machinery during the remaining tax-free period.

New machines should be bought. The new machines should have needle positioning, and provision for automatic tacking and trimming. A compressor is needed for the equipment operating with compressed air. There are a large variety of specialized jeans machines. The most time saving of these are the automatic beltloop machine, the pocketing machine for attaching patch pocket and the steaming unit for pressing jeans. So far it is not advisable to invest in these types of machines. This is particularly so when the training of the operators is still at a very early stage. Investments into these and other automatic machines should be made, when the labour costs increase to a point where their impact cannot be decreased by changes in production or the work-methods.

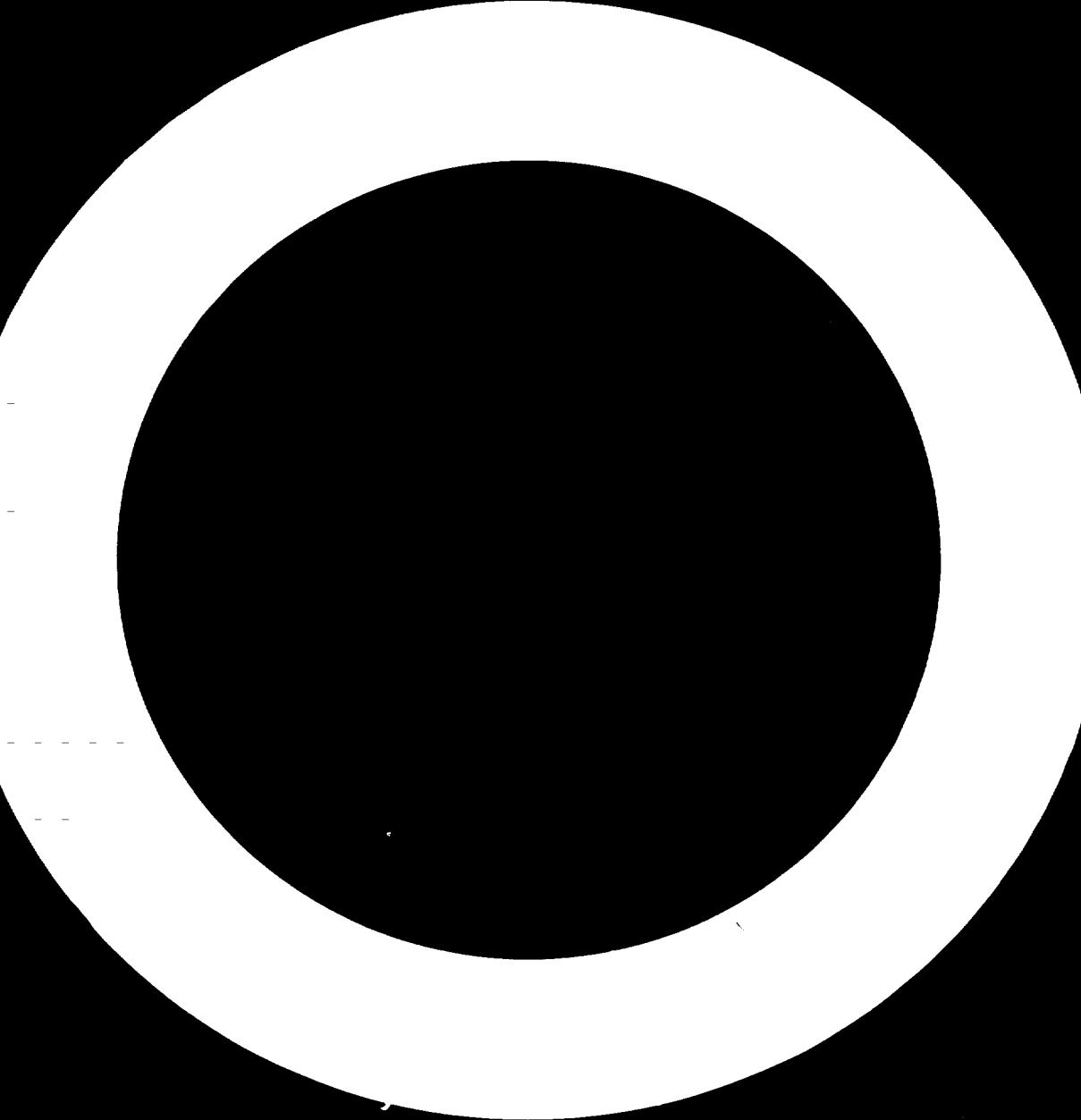
D. Quality

To be able to better compete in the market special emphasis on the quality of the products should be made. Reliable quality makes it easier to market the products.

The first step in establishing reliable quality is to determine the quality required. This can be done by applying general rules to production of a required standard. This quality standard product should be prepared for the production before starting production. The standard should be discussed with the trainers and supervisors and operators. Quality can only be obtained if all the people involved in producing the product know what is expected.

A quality control system should then be instituted for each operation. This should be included in the responsibilities of the line supervisor. Thus poor work methods can be corrected and the quality level improved. The repairs should be made by the person who made the mistake, which is a very effective method of teaching correct work methods.

After a reliable, standard quality level has been reached it should be considered whether to improve the quality or not. It should be remembered that the quality of a product is only as good as the weakest part of the product.



Annex I

JOB DESCRIPTION
SI/STK/78/801/11-01/31.7.B

POST TITLE	Expert in Production of garments
DURATION	Six months
DATE REQUIRED	As soon as possible
DUTY STATION	Basseterre
PURPOSE OF PROJECT	To introduce modern methods of production, to improve productivity and quality of garments.
DUTIES	The expert will advise the Dan Dan Garment enterprise and will specifically be expected to: 1. Assist the management in the production of garments (e.g. design patterns, cutting operations, flow of work, time study, industrial organization etc.) in order to improve both productivity and quality. 2. Advise the management on different sources of supplies for importing raw materials. 3. Train the production manager and two foremen in order to allow the enterprise to expand rapidly (double shift or new line of production). The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.
QUALIFICATIONS	Engineer or experienced manager in industrial organization of garment production (designing, quality control etc.).

LANGUAGE	English
BACKGROUND INFORMATION	Dan Dan Garment produces mostly blue jeans and school uniforms from the denim and khaki imported cloth from the United States of America. Eighty five per cent of the production is exported to CARICOM countries (except Guyana). The equipment (55 full range sewing machines and one steam press) is both new and second hand, well maintained by a well experienced production manager (over 12 years experience in Trinidad and Tobago). However, due to low productivity (apparently one third of normal productivity) Dan Dan Garment is requesting a garment expert for a period of six months in order to improve this low productivity as well as the quality for penetrating more sophisticated markets.

Annex II

TRAINING MANUAL FOR CORDUROY JEANS

Preserge flies.

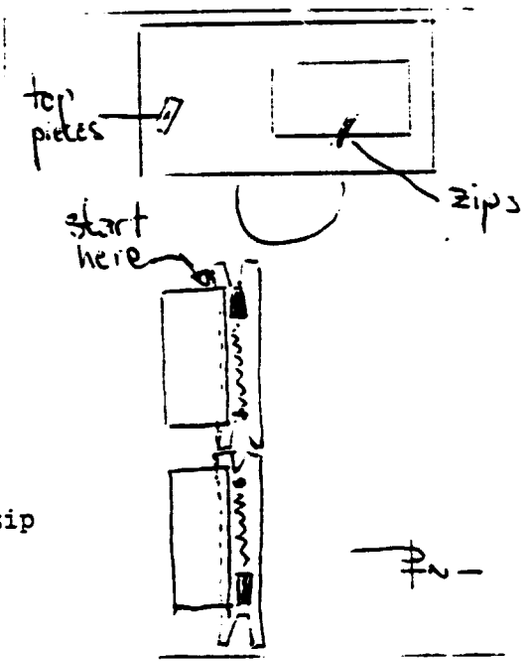
I Attach zip to front pocket, attach stay to back pocket

1) Attach zip to top piece of pocket.

Place bundle of top pieces on machine table within easy reach, with the x on top.

Place zips on your right hand side

Pick up first zip and place on table slide up



Pick first top piece and place it on zip face up and fold the edge

Place work under pressure foot

Sew in chain

The cloth is spread face to face so that the first piece in the bundle is the left pocket and the second piece the right. Therefore the zips have to be placed on table. The first one slide away from the operator; the second one slide next to the operator and so on.

2) Cut to make a bundle

3) Attach bottom piece of pocket to zip

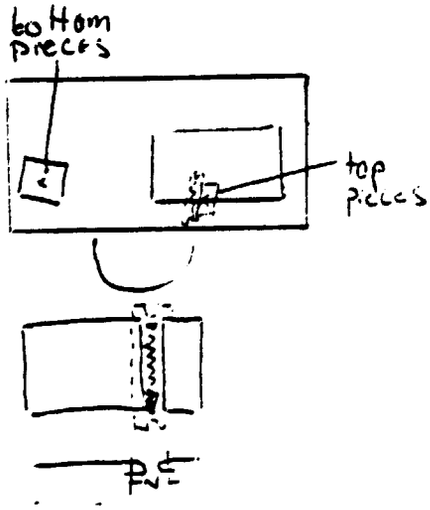
Place the bundle with the top pieces on your right hand side with the x on top

Place bundle of bottom pieces on your left hand side with the x on top

Pick first top piece and place on table face up and slide next to the operator

Pick first bottom piece, fold and place on top of zip, place under pressure foot

Sew in chain, remember to form pairs



4) Cut to make a bundle

Keep the bundle with the piece marked with an x on top

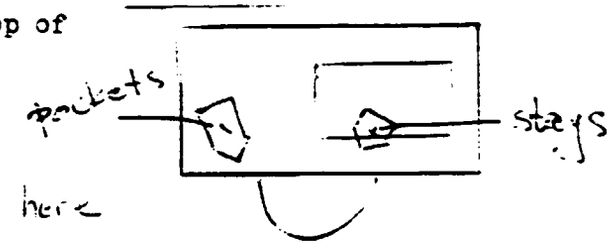
Tie the bundle

5) Attach stay to back pocket

Place bundle of stays on your right hand side and bundle of back pockets on your left hand side, both with the x on top

Pick up first pocket and place it on the table face down

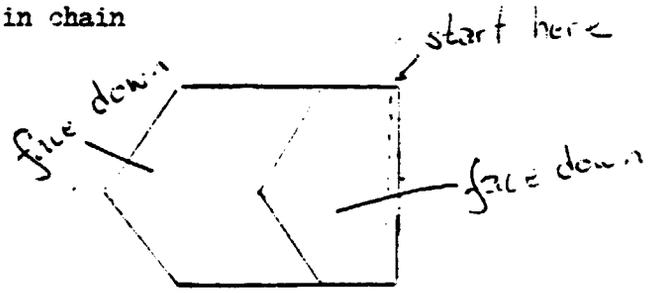
Pick up first stay and place it on top of the pocket



Align the edges

Place work under pressure foot

Sew in chain



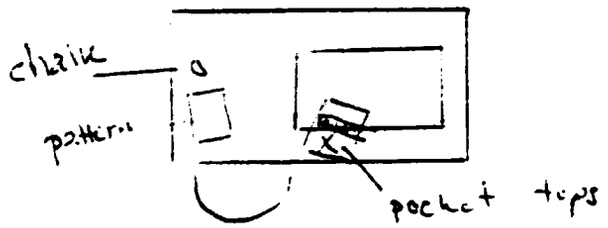
6) Cut to form a bundle

7) Pass the whole bundle on to the next operator

II Mark and make front pocket

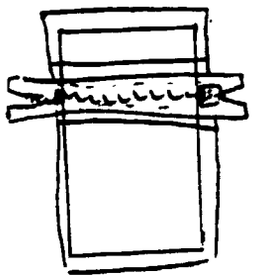
1) Mark the pocket tops

Place the bundle of pocket tops on table within easy reach with the x on top



Use pattern and chalk for marking

Pick up first pocket and place on table face down



Place the pattern on top of the pocket top so that the zip lays straight and the seam allowance is same all around the pocket

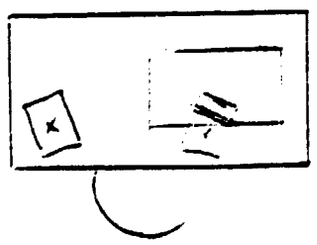
Mark a sharp line for sewing

Lay piece aside face up

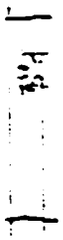
Pick the second pocket and continue through the bundle as with the first one

2) Sew the front pocket

Place the bundle of pocket tops on your right hand side with the x on top



Place the bundle of pocket backs on your left hand side, also the x on top



Pick first back piece and place on table face down

Pick up first pocket top and place on top of back piece face down

Align and position under pressure foot

Sew along the market line, sew in chain

3) Cut to form a bundle

Tie the bundle

See that the pocket with the x comes on top

4) Pass the whole bundle to the next operator

III Turn front pocket, topstitch back pocket - double needle machine

1) Turn front pockets

Use scissors to help turning at corners

Start the bundle with the pocket with x

After turning the first pocket lay it aside top piece up

Do not mix the bundle

After turning all pockets, tie the bundle and handle with the x on top

2) Topstitch the back pocket mouth

Place the bundle of back pockets on your left hand side with x on top

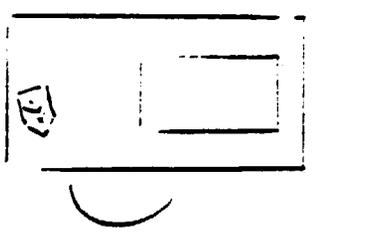
Pick up first pocket

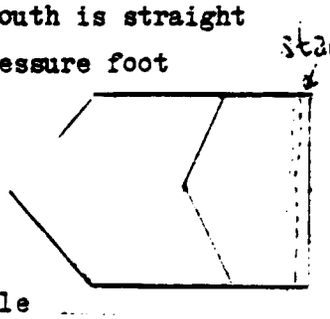
Turn the stay to the right side of pocket

Make sure the pocket mouth is straight

Position work under pressure foot face up

Sew in chain





3) Cut to form a bundle

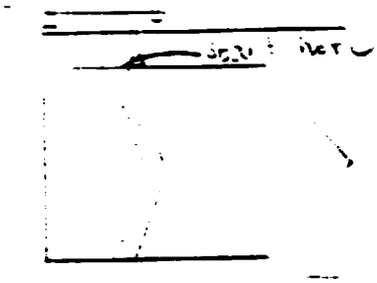
4) Topstitch the edge of stay

Place the bundle of back pockets on your left hand side with x on top

Pick up first pocket and place on table face up

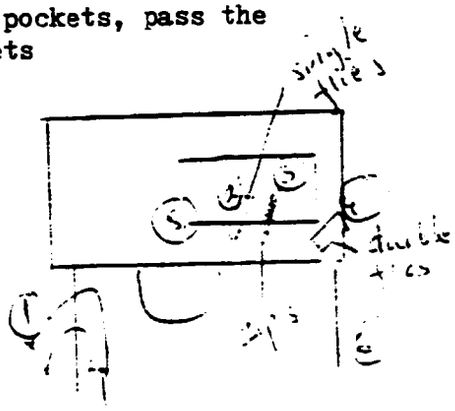
Fold the edge of stay and position work under pressure foot

Sew in chain



5) Cut to form a bundle

6) Pass the back pockets to the operator creasing pockets, pass the front pockets to the operator attaching front pockets



IV Attach zip and flies

1) Attach single fly

Place bundle of left fronts at easy reach (1) outside the working area and with the piece with x on top

Place the bundle of single flies with x on top at your right hand side (2)

Place zips at easy reach outside working area (3)

Place double flies with x on top at easy reach outside working area (4)

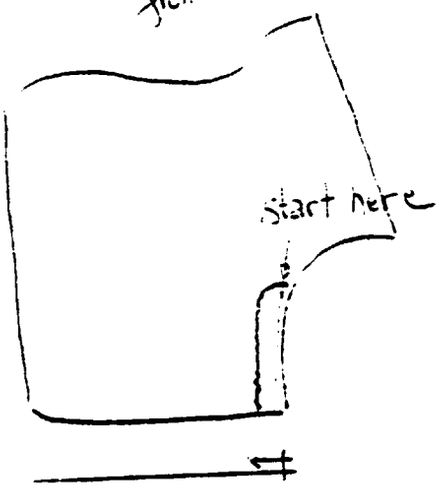
Pick up first left front and place on table face up

Pick up first single fly and place on top of front face down

Align the unserged edge of fly and the front edge of left front

Position under pressure foot (5)

Sew and cut thread

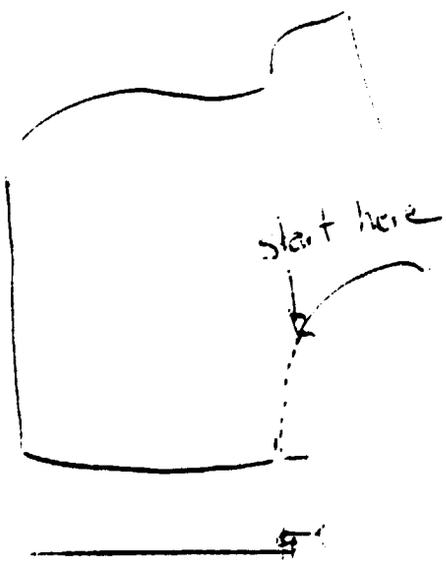


2) Topstitch single fly

Turn the fly face up and see that the seam allowance stays under fly

Topstitch on the fly side

Cut thread



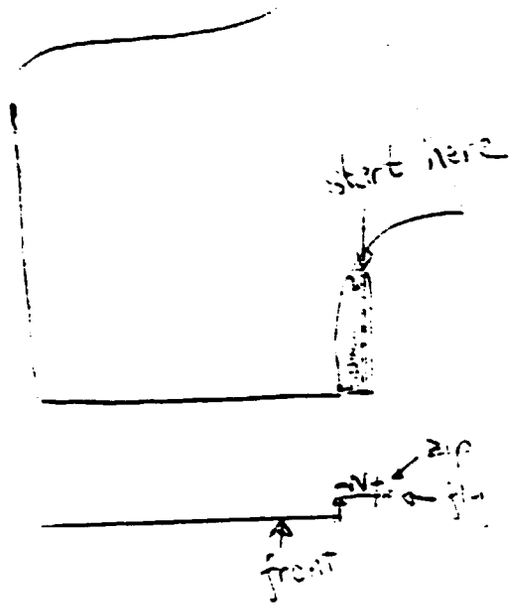
3) Attach zip

Keep the front as by topstitching the single fly

Pick zip and place on top of fly face down, slide next to operator

Place the zip so that it covers the previous topstitching but stays only on top of fly (not front)

Sew and cut thread



4) Topstitch fly

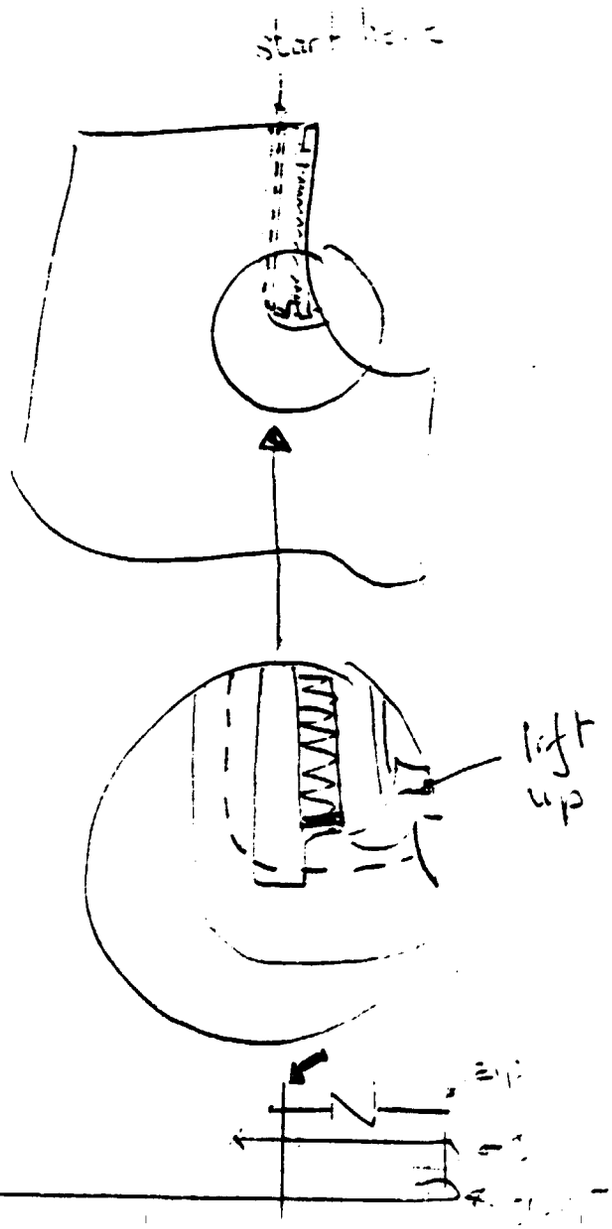
Turn the work so that the front lies face down and leg next to operator

Turn the fly so that it comes face up on top of the wrong side of the left front

Make sure the fly is not showing on the right side of front

Topstitch as shown on draft

Cut thread



5) Attach double fly

Turn the work so that front is face up

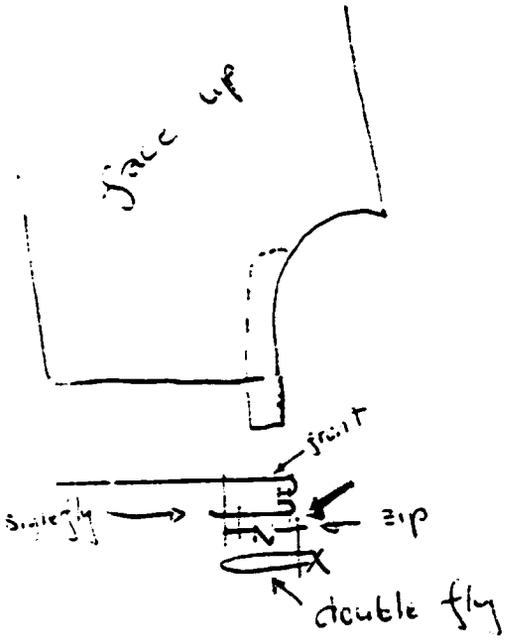
Place the double fly with serged edge to the right under zip

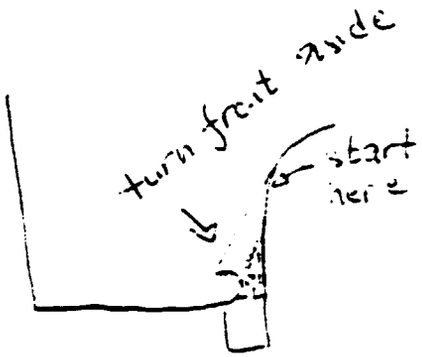
Align the edge with the edge of front

Lift the edge of front out of way and stitch zip and double fly together

Cut thread and put piece aside

Continue through the bundle. When finished pass the whole bundle with x on top to the next operator





V Attach right front and close front

1) Attach right front

Take the bundle of left fronts and place on easy reach with x on top

Place the bundle of right fronts in lap with x on top

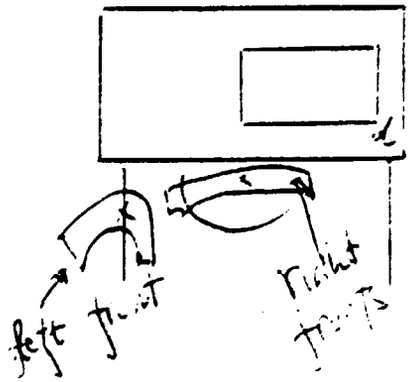
Pick up first left front and place on table face up

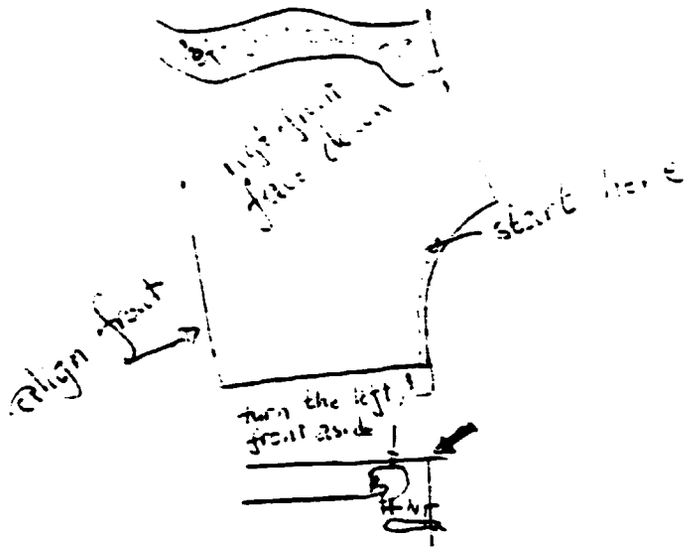
Pick up first right front and place on top of left front, face down

Align

Turn the edge of left front at fly aside and stitch through right front, zip and double fly

Cut thread



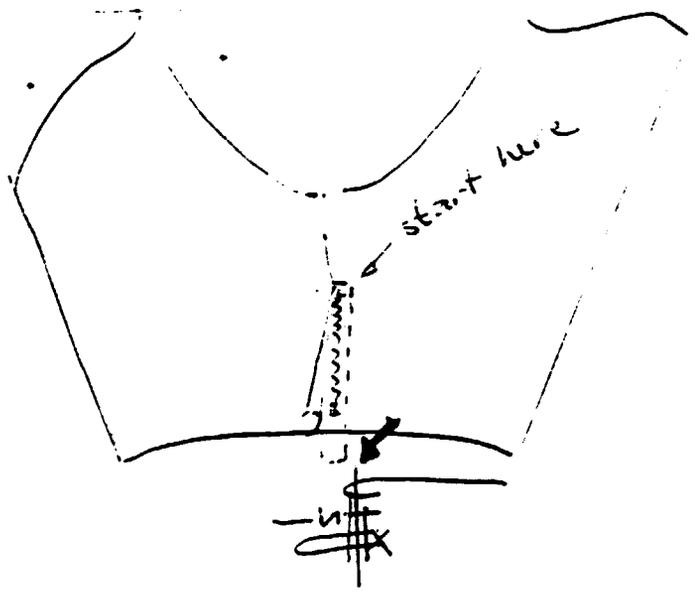


2) Topstitch double fly

Turn the work so that both fronts are face up and the seam allowance of the above seam under the right front

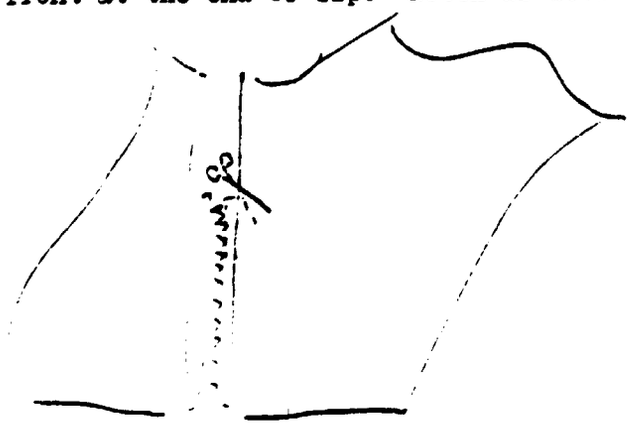
Topstitch at the right front's side

Cut thread



3) Notch the right front

Notch the right front at the end of zip. Notch as deep as the zip goes under the front

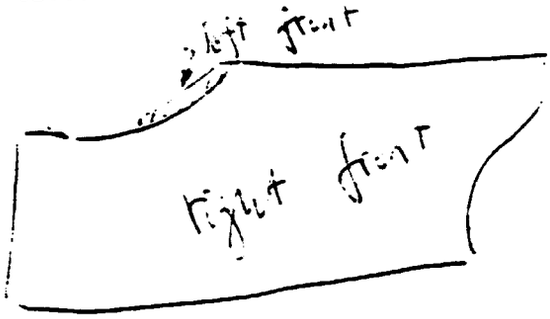


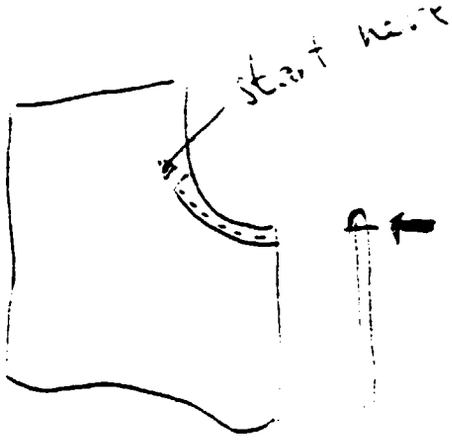
4) Close front

Turn the fronts on top of each other, right front on top and face up

Align at side and waist

Turn the excess crotch of left front on top of the right front and close crotch





5) Topstitch crotch

Turn the work so that both fronts are face up (as when topstitching double fly)

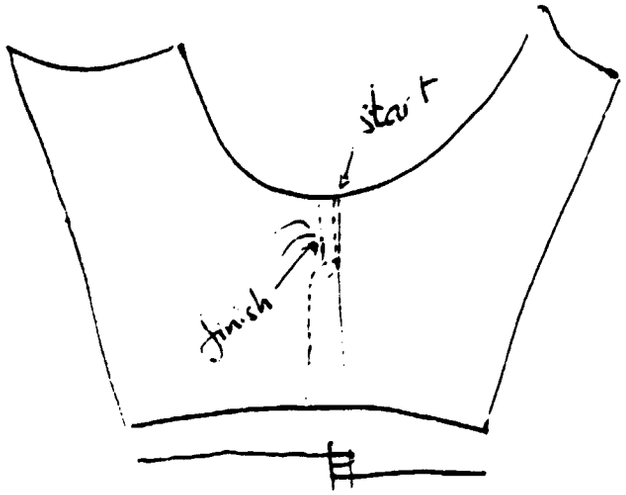
Turn the above sewn seam on top of right front

Topstitch; stitch a few stitches over the topstitch on left front, turn 90^{0} and sew two stitches, turn 90^{0} and finish on top of the seam closing crotch

Cut thread and put piece aside

Continue through the whole bundle

When finished pass the whole bundle to the operator attaching front pockets. Make sure the piece with x is on the top



VI Attach front pockets - double needle machine

Place the bundle of front pockets on table outside working area with x on top

Place the bundle of fronts at easy reach with x on top

Pick up first front and place on table face up

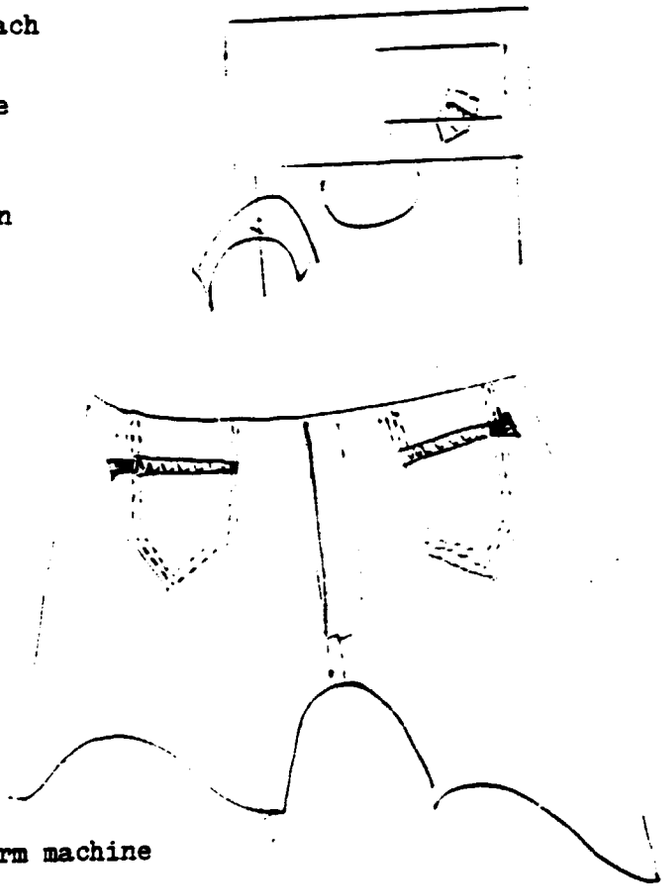
Measure 2" from the sideseam and place first pocket on its place, align at waist

Make sure the slide is at the side of side seam when pocket zip is closed

Use a pressure foot with guide

When sewing stop only at corners. Don't round the corners: sew, stop, turn the work and sew to make sharp corners

Use knee lift for lifting pressure foot and hands for handling the work



VII Attach riser - off the arm machine

Place the bundle of backs at easy reach with x on top

Place the bundles of risers at machine table with x on top

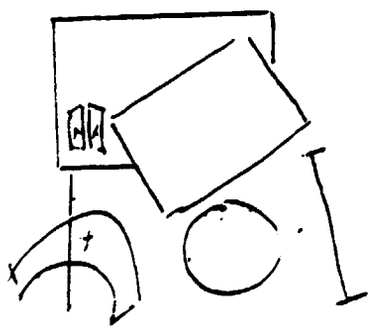
Pick first back and place it face up on the arm of the machine, hold with left hand

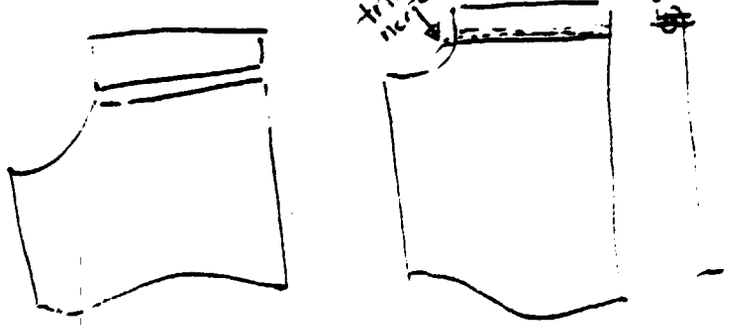
Pick up first riser and place face up in folder together with back

Sew

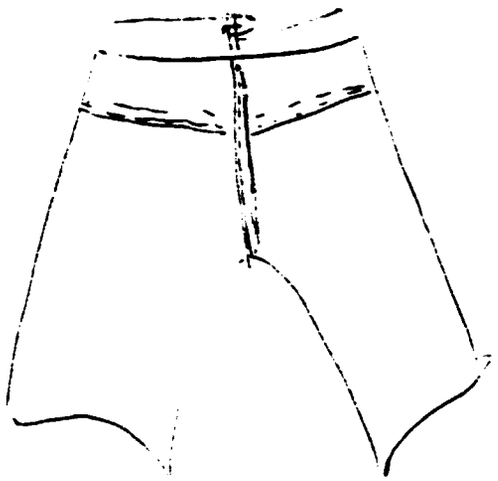
Pick the pair back and riser and place in folder. Sew

Cut thread and trim for back seaming





VIII Close back seam - off the arm machine



Place the bundle of backs at easy reach

Pick first backs: right back with right hand, left back with left hand, face up

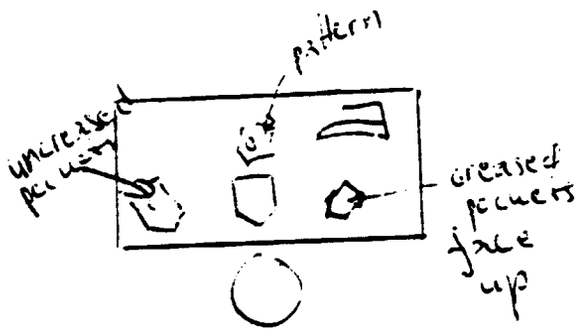
Place backs in folder

Sew, cut thread and check the seam. If seam not correct, ment immediately

Put work aside face up

When bundle finished, pass the whole bundle to the operator attaching back pockets

IX Crease back pockets - hand iron



Place the bundle of back pockets on easy reach with x on top

Use the metal pattern as guide for creasing

Pick first back pocket and place on table face down

Place the pattern on centre of pocket so that the seam allowances showing under pocket are similar around the pocket

Fold the seam allowance on top of pattern with your left hand, make sure the pattern does not move

Crease pocket hand iron in right hand, keep the pattern in its place with your left hand and fold with your left hand

After creasing put pocket aside face down. Do not mix the bundle

After finishing the bundle, tie it, and pass it to the operator attaching back pockets. Make sure the pocket with x is on the top of the bundle

X Attach back pockets - double needle machine

Place the bundle of backs at easy reach with x on top

Place the back pockets outside work area with x on top

Pick the first back and place on table face up

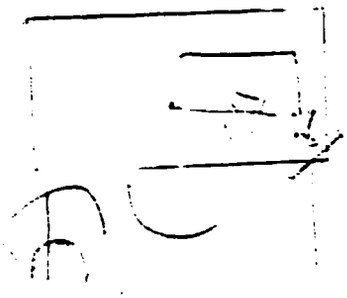
Measure 2" from the side seam and place the first pocket with the pocket mouth parallel to the riser seam

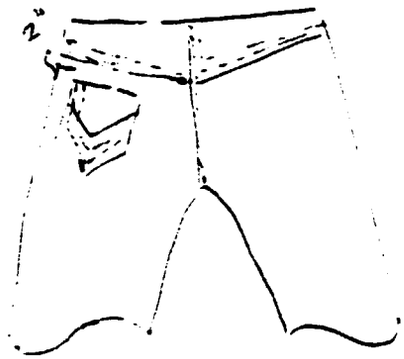
Attach pocket and cut thread

Attach the other pocket in symmetrical position

Cut thread and lay piece aside face up

When finished pass the whole bundle with x on top to the operator pairing fronts and backs for side seaming

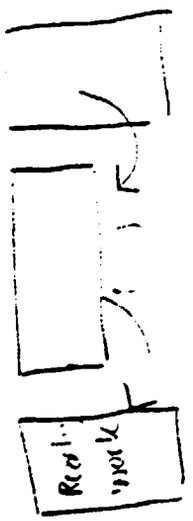




TIME & MOTION STUDY

Plant: DenDar Co.	Dept.	Article: Jeans	Date: 1979-03-06	Study No.	
Clock No.	Operator: E. WARNER	Length of Service	Hourly Earned Average $	Hourly Rate $	
Style No.		Material: KHAKI	Size	Units Per Hour	
Operation No.	Operation: SIDE SEAMING			Project Rate: $	
Equipment	Attachments		RPM	Sp:	Stitch Type
Thread: Upper: Lower:	Needle Gauge	Observer: 19		Reviewed	

CYC	ELEMENT: 1 Pick Work	2 Place in folder	3 Sew (1 seam)	4 Handle between the two seams	5 Cut thread and put work aside	6	7 Stops at seaming	8	9	10	11	12	SKETCH, ETC.
1	.12	.05	.36	.14	.04								
2	.10	.04	.21	.15	.03								
3	.12	.04	.21	.12	.02								
4	.13	.04	.31	.21	.02								
5	.14	.04	.31	.19	.04								
6	.12	.06	.27	.14	.05								
7	.16	.04	.22	.17	.04		5						
8	.12	.04	.23	.15	.02		5						
9	.13	.05	.17	.15	.03		5						
10	.14	.05	.21	.20	.04		6						
11			.21				6						
12			.21				6						
13			.17				4						
14			.27				8						
15			.20				6						
16			.21				6						
17			.20				6						
18			.21				6						
19			.35				9						
20			.20				6						
TOT	1.29	.45	4.85	1.62	.33		84						
NO.	10	10	20	10	10		14						
AV.	.129	.045	.241	.162	.033		6						
OF.													
TST													



BUNDLE & RECORD	
TOTAL TIME	1.30
NO. UNITS	
TIME/UNIT	
G/T	
TST/UNIT	

ELEM.	TST	ALLOWANCE			TOT	SAM
TOTAL SAM/						

PRODUCTION CALCULATION

RATE CALCULATION