WORKSHOP ON PRODUCTIVITY IMPROVEMENT IN THE JUTE INDUSTRY

DHAKA 6 – 7 December 2003

INTERNATIONAL JUTE STUDY GROUP (IJS)
PROGRAMME

Workshop on Productivity Improvement in the Jute Industry

Date : 6 – 7 December 2003
Venue : IJSG Conference Room, Dhaka

□ Saturday, 06 December 2003

10.00 - 10.30 : Registration

Technical Session - 1

Chairman : Dr D Sur, Acting Director, Indian Jute Industries Research Association (IJIRA), India

10.30 – 10.40 : Inaugural Statement by the Secretary General, IJSG
10.40 – 11.25 : Strategy Formulation for Productivity Improvement in Jute Industry - Introduction and Overview
Dr Bikash Bhadury, Visiting Professor, IIT, Kharagpur, India
11.25 – 11.40 : Discussion
11.40 – 12.00 : Tea Break
12.00 – 12.45 : Maintenance Practice and Energy Management in Jute Mills
Dr Bikash Bhadury, Visiting Professor, IIT, Kharagpur, India
12.45 – 13.00 : Discussion
13.00 – 14.00 : Lunch Break

Technical Session - 2

Chairman : Dr D Sur, Acting Director, Indian Jute Industries Research Association (IJIRA), India

14.00 – 15.30 : Jute Mill Productivity Improvement - Detailed Process Study
Prof. P K J Mohapatra, IIT, Kharagpur, India
15.30 – 16.00 : Discussion
16.00 : Tea
Technical Session – 3

Chairman: Prof. Mustafizur Rahman, Head, Dept. of Textile Engineering and Technology, Ahsanullah University of Engineering & Technology, Dhaka

10:00 – 10:20: Resource Management for the Improvement of Total Productivity in the Jute Industry
Dr D Sur, Acting Director, IJIRA, India

10.20 – 10.30: Discussion

10.30 – 10.50: Effect of Speed and Twist on Productivity of Fine Jute Yarn Produced by Modified Ring Spinning Machine
Dr Md. Osman Ghani Miazi, Principal Scientific Officer, BJRI, Dhaka.

10.50 – 11.00: Discussion

11.00 – 11.15: Tea Break

11.15 – 11.35: Perspective in adoption of new technology in jute industry for diversified application towards productivity improvement
Mr. D Paul, Principal Scientist
NIRJAFT, India

11.35 – 11.45: Discussion

11.45 – 12.05: Productivity Improvement in Loom Shed
Mr. Swap an Kumar Ghosh
Senior Lecturer
IJT, India

12.05 – 12.15: Discussion

12.15 – 12.35: Possible Productivity Improvement Through In house Management of Working Environment in Jute Mills
Dr M M Mustafizur Rahman, General Manager (Research), BJMC, Dhaka

12.35 – 12.45: Discussion

12.45 – 14:00: Lunch Break

Technical Session – 4

Chairman: Prof. A M Azizul Huq, Ex-Head of the Dept. of Mechanical Engineering, Bangladesh University of Engineering & Technology, Dhaka

14:00 – 14.20: Improvement in Productivity through Induction of New Technology
Mr. S R Dasgupta
The Lagan Jute Machinery company ltd, India

14.20 – 14.30: Discussion
14:30 – 14:50 : Development of Up-gradation Kits for Existing Machinery: In Need of the Jute Industry
Mr. D K Mallik
Shinna Engineering Pvt. Ltd, India

14:50 – 15:00 : Discussion

15:00 – 15:20 : Introduction of Rotary Faller Gill Drawing System
Mr. Dinesh Khaitan
Hans Machineries Pvt. Ltd, India

15:20 – 15:30 : Discussion

15:30 – 15:50 : Performance of Newly Developed and Proposed Machines
Mr. S Manikandan
Milltex Machinery Pvt. Ltd, India

15:50 – 16:00 : Discussion

16:00 – 16:30 : Tea Break

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**Plenary Session**

16:30 – 17:30 : Recommendations and Concluding Remarks
TECHNICAL PAPERS

WORKSHOP
ON
PRODUCTIVITY IMPROVEMENT IN THE JUTE INDUSTRY

DHAKA
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International Jute Study Group (IJSG)
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➤ Jute Mill Productivity Improvement - Detailed Process Study by Prof. P K J Mohapatra Indian Institute of Technology (IIT), Kharagpur, India

➤ Resource Management for the Improvement of Total Productivity in the Jute Industry by T K Roy, G Chattopadhyay and Dr D Sur Indian Jute Industries’ Research Association (IJIRA), India

➤ Effect of Speed and Twist on Productivity of Fine Jute Yarn Produced by Modified Ring Spinning Machine by Md Osman Ghani Miazi, Latifa Binte Lutfar and A K M Mahabubuzzaman Bangladesh Jute Research Institute (BJRI), Dhaka

➤ Perspective in Adoption of New Technology in Jute Industry for Diversified Application towards Productivity Improvement by D Paul, A K Majumder and S K Bhattacharyya National Institute of Research on Jute and Allied Fibres Technology (NIRJAF), India

➤ Productivity Improvement in Loom Shed by S K Ghosh and Dr A K Samanta Institute of Jute Technology (IIT), India

➤ Possible Productivity Improvement Through in House Management of Working Environment in Jute Mills by Dr M M Mustafizur Rahman Bangladesh Jute Mills Corporation (BJMC), Dhaka

➤ Improvement in Productivity Through Induction of New Technology India by S Palit, and S R Dasgupta Lagan Jute Machinery Co. Ltd.,

➤ Development of Up-Gradation Kits for Existing Machinery : In Need of the Jute Industry by Shimna Engineering Pvt. Ltd India

➤ Introduction of Rotary Faller Gill Drawing System by Dinesh Khaitan and S K Sett Hans Machineries Pvt. Ltd., India

➤ Performance of Newly Developed and Proposed Machines by S Manikandan Milltex Engineers (P) Ltd., India
STRATEGY FORMULATION FOR PRODUCTIVITY IMPROVEMENT IN JUTE INDUSTRY
– INTRODUCTION AND OVERVIEW

Dr. Bikash Bhadury, Visiting Professor,
Dept. of Industrial Engineering & Management,
Indian Institute of Technology, Kharagpur, INDIA.
The Indian jute industry is more than one hundred years old and jute has played a major role in India's economy. Even today, not only is India the single largest producer of jute goods in the world, but the jute mills also provide employment to about two and half lakh workers. The industry was flourishing in pre-independence India and the golden days of the industry lasted up to the mid 1970's. However, since the early 1980's, it has gone through bad times due to a number of reasons, which include, among others, decline of demand in the export market, the stiff competition from other jute producing countries, rising cost of inputs, low productivity of mills, and ageing machinery. Of late, the domestic market of jute sacks has also been badly affected because of the serious threat from synthetics.

The traditional products include hessian, sacking, and carpet backing cloth (CBC). Sacking and hessian account for around 80 percent of the total production of the jute mills. Moreover, over 95 percent of the installed looms are engaged in the production of hessian and sacking. As noted earlier, the productivity of the mills has been inadequate and there is a significantly large room for improvement. Approximately 2,32,000 workers are employed in the jute mills and the average production of jute goods is 1,418 thousand tonnes per annum. This implies that one worker produces less than 7 tonnes in one year. Consider also the production of 1,418 thousand tonnes against the achievable spindle capacity of 1,725 thousand tonnes per annum (excluding the 100 percent export-oriented units and on the basis of 330 working days per annum). These factors led to the need for an intensive scientific study of the overall productivity of the jute industry.

This need was felt by the Jute Manufactures Development Council (JMDC) and the Ministry of Textiles, Government of India, and in March 1999, JMDC asked the Department of Industrial Engineering and Management of I.I.T., Kharagpur to carry out a comprehensive study and suggest strategies for improvement of productivity in the jute industry.

The term productivity is often confused with the term “production”. Many people feel that higher production means higher productivity. This is not necessarily true.

Production is concerned with the activity of producing goods/or services, whereas, productivity is concerned with the effective utilization of resources (inputs) in producing goods and/or services (output). In quantitative terms, production is the quantity of output produced, whereas productivity is the ratio of the output produced to the input(s) used.
Productivity is a function of the following factors:

(i) The capacity and limitations of the technology adopted.

(ii) Properly designed work methods in a conducive work environment by elimination of unnecessary work, avoidable delays and other types of waste.

(iii) Condition and availability of machinery and equipment, and use of effective maintenance practices.

(iv) Optimum man-machine ratio and effective use of available manpower.

(v) Availability and effective use of utilities, such as power, water, etc.

(vi) Material handling methods used.

(vii) Skill level of workers and maintenance technicians supported by adequate training.

(viii) Motivation of workers determined by labour-management relationship and systems of rewards and employee participation.

A study of overall productivity must address these issues.

1. Objectives of the Study

The following objectives were identified:

1. Assessment of the existing conditions in various jute manufacturing establishments/companies, and the present productivity of labour, material, energy, equipment and machinery, and the technology adopted.

2. Establishment of the various measures of performance to be used.

3. Formulation of the strategies to be adopted for improving the overall productivity in the jute mills.

The study was carried out by a team consisting of faculty members and graduate students of the department of Industrial engineering and Management.
2. Determination of sample size and selection of jute mills

Considering that there are a total of around 73 operating jute mills in the country, of which 59 are in West Bengal, the study team felt that a sample size of 10 percent should be adequate and a total of around 8 jute mills should be selected for detailed data collection. Moreover, since inter-firm comparison is an important feature of such aggregate studies, it was realized that in addition to an adequate sample size, it is important that the right mix of the mills be selected.

The sample size and the tentative list of jute mills had to be vetted and approved by JMDC. In a meeting, it was decided that eight jute mills, identified by JMDC, should be taken up for detailed study, and this list should include seven mills from West Bengal and one from Andhra Pradesh.

The work of detailed data collection was carried out in the above eight mills. The data collected from these mills were analysed using industrial engineering techniques.

3. Data collection

The various methods employed in this study for data collection were as follows:

3.1 Questionnaire Survey

Detailed questionnaires were sent to all the selected jute mills. The items included in the questionnaire were on various aspects of productivity such as production rates/targets, manpower allocation, maintenance practices, energy consumption, HRD practices, machine details, technology, etc.

3.2 Interview

During visits to the various jute mills, people from various levels of employees, starting from the GM to the shopfloor worker, were interviewed on different aspects of jute processing and on different management practices.

3.3 Study of Log Book & Manuals

Systematic record keeping is absent in most of the mills. The available log books and manuals had also been studied for data collection.

4. Industrial Engineering/ Productivity Analysis techniques employed

4.1 Method Study

Method study is the systematic recording and critical examination of the ways of doing things in order to make improvements. Method study is basically concerned with finding better ways of doing work and it helps to improve productivity by eliminating unnecessary work, avoidable delays and other types of waste. These are achieved by

- improved work procedures
• improved layout
• improved working environment
• improved product design

The following symptoms usually call for method study investigation:
• poor use of materials, labour and equipment
• poor layout
• bottlenecks
• excessive fatiguing tasks

The relevant facts are obtained by observations, studying the records and drawings, discussion with concerned persons in an appropriate form. Charts and diagrams are the most frequently used recording techniques. The following commonly used techniques of method study were employed in this study:
• Flow process chart
• Man-Machine chart
• Micro-motion study

4.1.1 Flow Process Chart

Flow process chart is a device for recording a process in a compact form, as a means for better understanding and improving the process. It shows the various steps or events (such as Operation, Inspection, Movement, Storage and Delay) that occur during the performance of work or during a series of actions.

The following symbols are used in constructing a flow process chart:

- **Operation** (ex: set up a job, softening of raw jute)
- **Transportation** (ex: move material by cart)
- **Inspection** (ex: examine parts for quality/quantity)
- **Delay** (ex: wait for material handling to next operation)
- **Storage** (ex: raw material in storage)

4.1.2 Man-machine Chart

Man-machine Chart describes the activities of a man and the machine(s) he is attending. The chart helps in determining the number of machines each operator should work, and it helps in
finding the optimum number of operators per machine. This chart helps in visualising the proportion of work cycle during which the operator(s) and machine(s) are busy or idle.

### 4.1.3 Micro-motion Study

Micro-motion study consists of taking motion picture of operations. The film becomes a permanent record of both method and time and can be re-examined whenever needed. Micro-motion study can be used for the following purposes:

- as an aid for studying the activities of a number of persons
- as an aid in studying the relationship of the operator and the machine
- as a means of timing operations (instead of time study)

### 4.2 Work Sampling

Work sampling is a fact-finding tool. It can be used to measure activities and delays of workers or machines (ex: the percentage of time the worker is working or idle). The work sampling procedure consists of making observations at random intervals of one or more operators/machines and noting whether they are working or idle. The ratio of the number of observations corresponding to working to the total number of observation gives the percentage of time the worker is working. Group time techniques, based on group sampling method, has also been used to study the utilization of operators and also the machines.

### 4.3 Production Study

Production study is carried out by continuously observing the workers and/or machines for a long period (up to 8 hrs) and noting the actual working and delay times. Following the study, the percentage of delay can be computed.

As production studies involve continuously observing a process, the exact events can be examined and the reasons for substandard performance determined therefrom.

### 4.4 Simulation

One of the most widely used Operations Research (OR) techniques, simulation is a process of experimentation with a model of some real system or situation in order to gain understanding of or solve a real-world problem. A simulation model is usually applied to evaluate alternative actions and determine which actions would be most effective in the real situation.

Analysis of data collected from the studies carried out in this project have been presented in the following ways:

1. Summary of observations with the help of tables and charts.
2. Delay analysis by causes.
3. Statistical analysis of numerical data.
5. Analysis of data obtained from the questionnaire survey

A questionnaire was designed to collect information from the eight identified ute mills on their products, production capacities, production targets, maintenance practices, energy consumption, and manpower used. This questionnaire was sent to the selected eight mills by IJMA.

Productivity figures in MT/ Machine/ Shift, or Kg./ Frame/ Shift for spinning, Kg./ Worker/ Shift for spool and cop winding, Kg./ Loom/ Shift for weaving, Metres/ Machine/ Shift for dampening, calendering, and lapping, Bags/ Machine/ Shift for cutting and sewing (hemming and herakling), and Bales/ Machine/ Shift for baling were collected from the eight mills, which were designated as mills A thru H. It was found that a wide variation in performance existed, pointing to the need to take necessary steps for productivity improvement.

5.1 Comparisons of Machine Utilization

Table 1 presents a summary of the machine utilization in various mills. The highest values and lowest values (in brackets) are likewise presented along with a mention of the mill which has the highest utilization. Machine utilization was calculated using the following formula:

\[
\text{Machine utilization} = \frac{\text{Average number of machines used/ shift}}{\text{Number of machines installed}}
\]

**Example: Softening Process.**

Best utilization of 66.66% is derived from the fact that out of 9 machines installed in mill H, and the pattern of use is 9 M/Cs in 1st shift, 9 M/Cs in 2nd shift and none in the 3rd shift. This is being cited only as an example to illustrate the method of calculation.

From Table 1, it is found that there existed large differences in the utilization of machines installed for different processes. This points out the need to take necessary corrective measures. Accordingly, work sampling and production studies were carried out with the purpose of identifying reasons for lower machine utilization in different processes. These studies, together with the proposed steps for improving machine utilization, will be presented in the two papers describing the detailed productivity studies.

**TABLE 1 : ANALYSIS OF MACHINE UTILIZATION FOR DIFFERENT PROCESSES**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>OPERATION</th>
<th>MILL</th>
<th>MACHINE UTILIZATION (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SOFTENING</td>
<td>H</td>
<td>66.66 (40.74)</td>
</tr>
<tr>
<td>2.</td>
<td>BREAKER CARDING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FINE</td>
<td>C</td>
<td>93.3 (70.7)</td>
</tr>
<tr>
<td></td>
<td>COARSE</td>
<td>H</td>
<td>100 (29.82)</td>
</tr>
<tr>
<td></td>
<td>INTERMEDIATE CARDING</td>
<td></td>
<td>FINISH CARDING</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------</td>
<td>---</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>FINE</td>
<td>B</td>
<td>100 (83.3)</td>
</tr>
<tr>
<td></td>
<td>COARSE</td>
<td>C</td>
<td>100 (41.66)</td>
</tr>
<tr>
<td>4</td>
<td>FINE</td>
<td>C</td>
<td>100 (66.66)</td>
</tr>
<tr>
<td></td>
<td>COARSE</td>
<td>C</td>
<td>100 (58.3)</td>
</tr>
<tr>
<td>5</td>
<td>FIRST DRAWING</td>
<td>C</td>
<td>100 (68.42)</td>
</tr>
<tr>
<td></td>
<td>FINE</td>
<td>H</td>
<td>100 (62.5)</td>
</tr>
<tr>
<td>6</td>
<td>SECOND DRAWING</td>
<td>C</td>
<td>100 (69.2)</td>
</tr>
<tr>
<td>7</td>
<td>FINISH DRAWING</td>
<td>C</td>
<td>98.48 (73.07)</td>
</tr>
<tr>
<td></td>
<td>FINE</td>
<td>E</td>
<td>100 (83.3)</td>
</tr>
<tr>
<td>8</td>
<td>SPINNING</td>
<td>H</td>
<td>100 (82.07)</td>
</tr>
<tr>
<td></td>
<td>FINE</td>
<td>F</td>
<td>100 (89.23)</td>
</tr>
<tr>
<td>9</td>
<td>SPOOL WINDING</td>
<td>H</td>
<td>100 (50.9)</td>
</tr>
<tr>
<td>10</td>
<td>COP WINDING</td>
<td>E</td>
<td>90.90 (69.23)</td>
</tr>
<tr>
<td>11</td>
<td>WEAVING HESS</td>
<td>C</td>
<td>100 (39.74)</td>
</tr>
<tr>
<td></td>
<td>SACKING</td>
<td>H</td>
<td>98.5 (24.17)</td>
</tr>
<tr>
<td>12</td>
<td>DAMPING HESS</td>
<td>A</td>
<td>66.66 (33.33)</td>
</tr>
<tr>
<td></td>
<td>SACKING</td>
<td>F</td>
<td>66.66 (33.33)</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Letter</td>
<td>Process</td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td>13.</td>
<td>CALENDERING</td>
<td></td>
<td>SACKING</td>
</tr>
<tr>
<td></td>
<td>HESS</td>
<td>A</td>
<td>63.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H</td>
<td>100</td>
</tr>
<tr>
<td>14.</td>
<td>LAPPING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HESS</td>
<td>C</td>
<td>58.33</td>
</tr>
<tr>
<td>15.</td>
<td>CUTTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HESS</td>
<td>D</td>
<td>66.66</td>
</tr>
<tr>
<td></td>
<td>SACKING</td>
<td>H</td>
<td>100</td>
</tr>
<tr>
<td>16.</td>
<td>SEWING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HEMMING</td>
<td>H</td>
<td>66.66</td>
</tr>
<tr>
<td></td>
<td>HERAKLE</td>
<td>H</td>
<td>66.66</td>
</tr>
<tr>
<td>17.</td>
<td>BALING</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HESS</td>
<td>E</td>
<td>88.88</td>
</tr>
<tr>
<td></td>
<td>SACKING</td>
<td>E</td>
<td>88.88</td>
</tr>
</tbody>
</table>
6. Aggregate study of jute processing

6.1 The sequence of operations involved in jute processing is presented in the following figure.

Raw Jute bales from Godown

- Selection
- Softening
- Piling/Conditioning
- Carding (2 or 3 stages)
- Drawing and Doubling (3 stages)
- Spinning
- Winding
- Beaming/Dressing
- Weaving
- Damping
- Calendering

For Hessian
- Lapping
- Packing in Hyd. press

For Sacking
- Cutting
- Sewing
- Hand Sewing/Bundling

4.2 FLOW
6.2 FLOW PROCESS CHART

The flow process chart for jute processing in one of the mills is shown in the figure below.

<table>
<thead>
<tr>
<th>SI No</th>
<th>Description</th>
<th>Qty</th>
<th>Dist (feet)</th>
<th>Time (min)</th>
<th>symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Travelling from godown to weighing machine</td>
<td>1 bale</td>
<td>73</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(150 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Weighing</td>
<td></td>
<td></td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Transport to selection dept (Hand Cart)</td>
<td>1 bale</td>
<td>36</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Selection of jute</td>
<td>1 Hand trolley (0.5 tonnes)</td>
<td>24/60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Transport to softening</td>
<td></td>
<td>60</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Storage at softening</td>
<td></td>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Softening process</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Transport to piling</td>
<td></td>
<td></td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Loading the jute in piling and adding emulsion</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Storage in piling</td>
<td></td>
<td></td>
<td>1440-4320</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Loading the truck from piling</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Transport to breaker carder</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Total: 4 6 - - 2

Remarks:
- 1 worker
- 2 workers
- 3 workers
- 1 worker
FLOW PROCESS CHART (Contd.)

<table>
<thead>
<tr>
<th>SI No</th>
<th>Description</th>
<th>Qty</th>
<th>Dist (feet)</th>
<th>Time (min)</th>
<th>symbol</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.</td>
<td>Cutting before B/C</td>
<td>2 truck</td>
<td>87.6</td>
<td>2 workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>B/C operation</td>
<td>..</td>
<td>79</td>
<td>2 workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Unloading B/C</td>
<td>32 rolls</td>
<td>7</td>
<td>1 worker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Loading the F/C</td>
<td>11 rolls</td>
<td>5.5</td>
<td>1 worker same as 15 at 2 m/c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>F/C operation</td>
<td>..</td>
<td>27.4</td>
<td>..</td>
<td>..</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Unloading F/C</td>
<td>..</td>
<td>4.4</td>
<td>..</td>
<td>..</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Loading first drawing</td>
<td>20 rolls</td>
<td>9.10</td>
<td>1 worker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>First drawing operation</td>
<td>20 rolls</td>
<td>45</td>
<td>1 worker at 2 m/c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Unloading 1st drawing and loading empty drums</td>
<td>6 drums</td>
<td>1</td>
<td>1 worker at 2 m/c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Loading 2nd drawing</td>
<td>40 drums</td>
<td>16</td>
<td>..</td>
<td>..</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>2nd drawing operation</td>
<td>..</td>
<td>63.3</td>
<td>same as 21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Unloading 2nd drawing</td>
<td>10 drums</td>
<td>1.5</td>
<td>1 worker at 2 m/c</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL 6
<table>
<thead>
<tr>
<th>SL No</th>
<th>Description</th>
<th>Qty</th>
<th>Dist (feet)</th>
<th>Time (min)</th>
<th>Symbol</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.</td>
<td>Loading finish drawing</td>
<td>40</td>
<td>16</td>
<td></td>
<td></td>
<td>1 worker at 2 m/c</td>
</tr>
<tr>
<td>26.</td>
<td>Finish drawing operation</td>
<td></td>
<td>151.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>Unloading finish drawing</td>
<td>20</td>
<td>3</td>
<td></td>
<td></td>
<td>1 worker (m/c running)</td>
</tr>
<tr>
<td>28.</td>
<td>Transport of drum to spinning m/c</td>
<td>13</td>
<td>95</td>
<td>3.53</td>
<td></td>
<td>1 worker (m/c not running)</td>
</tr>
<tr>
<td>29.</td>
<td>Loading spinning machine</td>
<td>100</td>
<td>15</td>
<td></td>
<td></td>
<td>1 worker at 2 m/c</td>
</tr>
<tr>
<td>30.</td>
<td>Spinning operation</td>
<td>98</td>
<td>494.6</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>31.</td>
<td>Unloading spinning bobbin</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>32.</td>
<td>Transport the bobbins to cop winding</td>
<td>108</td>
<td>80</td>
<td>1</td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>33.</td>
<td>Cop winding operation</td>
<td></td>
<td>7.75</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>34.</td>
<td>Unloading of cops</td>
<td>7</td>
<td>3</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>35.</td>
<td>Storing of cops</td>
<td>1</td>
<td>1.5</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>36.</td>
<td>Transport the bobbins to spool winding</td>
<td>108</td>
<td>30</td>
<td>3.2</td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>37.</td>
<td>Spool winding operation</td>
<td>36</td>
<td>58.33</td>
<td></td>
<td></td>
<td>5 worker</td>
</tr>
<tr>
<td>38.</td>
<td>Unloading spools</td>
<td>12</td>
<td>2.33</td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>39.</td>
<td>Storage of spool and cops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>40.</td>
<td>Transport spools to beaming</td>
<td>24</td>
<td>140</td>
<td>3.75</td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>8</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Note: collection of container/stoke/bobbin/cop bin/empty beam/full beam has not been included.
# FLOW PROCESS CHART (Contd.)

<table>
<thead>
<tr>
<th>Activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
<th>Dist (ft)</th>
<th>Time (min)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading the beaming m/c</td>
<td>300</td>
<td>spools</td>
<td>6.33</td>
<td>3 workers</td>
</tr>
<tr>
<td>Beaming operation</td>
<td>1 beam</td>
<td>89.5</td>
<td></td>
<td>sale yarn</td>
</tr>
<tr>
<td>Unloading</td>
<td>1 beam</td>
<td>5</td>
<td></td>
<td>480 ends</td>
</tr>
<tr>
<td>Transport the beam to weaving m/c</td>
<td>1 beam</td>
<td>0.5</td>
<td></td>
<td>3 workers</td>
</tr>
<tr>
<td>Transport the cops to weaving m/c</td>
<td>100</td>
<td>45</td>
<td>1</td>
<td>1 worker by hand</td>
</tr>
<tr>
<td>Weaving operation</td>
<td>1 beam</td>
<td>300</td>
<td></td>
<td>1 worker at 2 m/c</td>
</tr>
<tr>
<td>Inspection of cloth</td>
<td></td>
<td></td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>Transport the cloth to damping</td>
<td>1 roll</td>
<td>90</td>
<td>1.2</td>
<td>1 worker</td>
</tr>
<tr>
<td>Damping operation</td>
<td>2 bundle</td>
<td>0.85</td>
<td></td>
<td>1 worker</td>
</tr>
<tr>
<td>Calendering</td>
<td></td>
<td>5.2</td>
<td></td>
<td>2 workers</td>
</tr>
<tr>
<td>Lapping</td>
<td>61 pcs</td>
<td>2.55</td>
<td></td>
<td>2 workers</td>
</tr>
<tr>
<td>Cutting (70 bags)</td>
<td>140 cuts</td>
<td>2.45</td>
<td></td>
<td>4 workers</td>
</tr>
</tbody>
</table>

**TOTAL:** 6 5 - 1
The entire process of manufacture of hessian cloth and sacks was studied before undertaking detailed analysis of the different operations in the process.
Analysis of the flow process chart for the jute processing gives the following results:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>30</td>
</tr>
<tr>
<td>Transportation</td>
<td>26</td>
</tr>
<tr>
<td>Storage</td>
<td>05</td>
</tr>
<tr>
<td>Inspection</td>
<td>02</td>
</tr>
<tr>
<td>Delay</td>
<td>00</td>
</tr>
</tbody>
</table>

A close look at the magnitude of the activities in the flow process chart reveals that the time spent on loading, unloading as well as transportation during a cycle is around 110 minutes. These activities use individual labour. Moreover, transportation alone accounts for 41.26 percent of the activities (26 out of 63). This shows that there exists a scope for improving the use of indirect labour in activities involved in jute processing. Accordingly, a number of studies were carried in the areas of loading, unloading and transportation, such as unloading, stacking, piling and pile breaking, etc. These studies and the recommendations are given in the following paper, that is, Detailed Productivity Studies I.

7. Strategies for improvement of productivity

The cost of wages paid to labour accounts for 36.4 percent of the total manufacturing cost. The high wage cost is one of the main problems faced by the jute industry. Moreover, the traditional methods of productivity improvement are ineffective since the wages are not linked to productivity. Therefore, in addition to (i) motivating the workforce, and (ii) training, attempts at improvement of labour productivity must concentrate on work methods and redesign of work systems. The entire process of conversion of raw jute to hessian and sacking was analysed in detail by the study team. The focus of this study was to find strategies of improvement of productivity in the various operations/activities involving both direct and indirect labour. The objective was maximization of labour utilization and productivity for direct operations like carding, spinning, winding, and weaving, and improvement of labour productivity for indirect activities, as noted above. The recommendations for both the indirect and direct labour operations/activities are given in the papers entitled Detailed Productivity Studies- I and II.

The recommendations with regard to improvement of productivity of machinery/equipment and maintenance practice are given in the fourth paper. Moreover, strategies for energy management and effective use of electrical energy are also given in the fourth paper.
FOR NOTES
MAINTENANCE PRACTICE AND ENERGY MANAGEMENT IN JUTE MILLS

Dr. Bikash Bhadury, Visiting Professor,
Dept. of Industrial Engineering & Management,
Indian Institute of Technology, Kharagpur, INDIA.
MAINTENANCE PRACTICE AND ENERGY MANAGEMENT IN JUTE MILLS

By
Dr. Bikash Bhadury, Visiting Professor,
Dept. of Industrial Engineering & Management,
Indian Institute of Technology, Kharagpur, INDIA.

The primary function of maintenance of a mill can be regarded as the complete up-keep of all the equipment and machinery so that the working force can operate under the best conditions with minimum disturbances. Ideally, there should be no failures during the operating shifts. In actual practice, there will be some failures and therefore repair activities must be carried out so that the downtime is minimized. There should also be Preventive Maintenance (PM), Condition Based Maintenance (CBM), Opportunistic Maintenance (OM), and Total Productive Maintenance (TPM) for minimizing the occurrence of unexpected failures. Therefore, maintenance and repair activities are essential components for production and productivity. However, many think that expenditure on maintenance is unproductive since there is no direct income from the maintenance department. But inadequate maintenance will finally result in total collapse of the machinery, and in many cases it may not be possible to reuse the equipment without spending a considerable amount of money. It is worth mentioning here that the developed countries spend approximately 10-15% of their total investment on maintenance every year. They consider maintenance as an activity, which is as important as production. As a result they are able to minimize the downtimes and unexpected failures. Moreover, they produce better quality (lesser rejections) products because the machines are in better condition. However, proper accountability and effectiveness of maintenance inspection and checks are essential for its success. The following observations have been made after visiting a number of jute mills and discussing with maintenance personnel, operators, supervisors and managers at various levels:

- Machinery and technology used in jute mills are very old, and accordingly the up-gradation of both is essential for productivity improvement of the production process.

- The age of machinery varies from 30 years to more than 100 years, in some cases.

- Jute mills require only a few types of machines for the main processes (about half a dozen). Thus there are a number of similar machines in each section. Therefore, any improvement of a machine will result in a significant improvement of productivity, since changes required for all the machines in a section are the same.

- The main frames of these machines are very rigid, but some parts are vulnerable to frequent problems and failures. This indicates that a little extra care will result in many more years of good service.

- Most of the machines are driven by common or group drives while a few are driven by individual drive and motor

- Most jute mills use maintenance logbooks, but the data entry is not done properly. Hence these documents are not useful for a fruitful analysis of downtimes of each type of machinery and also analysis of maintenance effectiveness and machinery productivity.
• In general, the spare parts consumption is very high.
• The quality of spares available is not satisfactory, in most cases.
• Preventive Maintenance and periodic overhauling are practiced in all the mills.
• Effective maintenance is vital for keeping these old machines in good working condition

Based on these observations, it is felt that strategies for productivity improvement of machinery should be attempted in three stages namely:

(a) Improvement of maintenance practices of the existing machinery
(b) Improvement of some vulnerable parts through design
(c) Gradual replacement of these machines by new ones with better technology

1. IMPROVEMENT OF MAINTENANCE PRACTICES OF THE EXISTING MACHINERY

First step towards this is to study the present state of maintenance practices followed in jute mills. Usually, the main source of data for this study is the maintenance logbook. As mentioned earlier, data in logbooks are not kept systematically. Therefore it was decided that the data collection be done by direct observation and also through discussions, and interviews with maintenance managers, engineers and other maintenance personnel and a questionnaire survey. Following parameters were considered.

1.1 Machinery Age

As mentioned previously, the range of machinery age is 30 years to more than 100 years, in some cases. This necessitates consumption of more spare parts, greater loss due to friction, over consumption of energy, more downtime, and frequent preventive maintenance and thorough overhauling.

1.2 Number of Personnel in Maintenance Department

Following is the result of analysis of manpower employed in maintenance department of jute mills.

Number of personnel in maintenance / MT of Capacity = 3.16 to 4.36 (A)
Total number of employees/Number of personnel in maintenance = 12.31 to 18.66 (B)

Analysis of these figures together with the machinery performance in corresponding mills shows that the particular mill with highest value of ‘A’ and lowest value of ‘B’ is doing very well. Even though this is an overall estimate, the fact is that to improve the effectiveness of maintenance in jute mills, the ratio ‘A’ should be improved (that means more number of maintenance personnel to be employed) and the ratio ‘B’ should be reduced. This indicates that in many jute mills, the number of men in maintenance is not adequate to handle the total activities of maintenance. However, this problem will be automatically sorted out if TPM activities are implemented and condition based overhaul is practiced. This may be achieved by training the machine operators in maintenance for minor maintenance activities such as routine greasing/oiling, cleaning and minor repairs and by imparting condition based maintenance (CBM)/condition monitoring training to maintenance supervisors.
1.3 Percentage Availability of Each Type of Machinery

Availability is the most important term for measuring the effectiveness of maintenance and the state of health of machinery. Availability is the ratio of the total time during which machinery is readily available for production to the total time period.

\[
\text{Availability} = \frac{\text{Total up time over a period of time}}{\text{Total (up time + down time) over the same period}}
\]

Maintenance logbook is the main source of data required for analysis of availability. Since the logbooks available in all the jute mills do not indicate actual downtime of machinery, we have followed another approximate method for availability analysis. Here we have used the method: ratio of average actual rate of production to the expected rate of production for evaluating the machinery production ratio. In this context, it is assumed that the production is not affected by non-availability of input material, manpower or electrical power. Mathematically,

\[
\text{Machinery Production Ratio} (\%) = \frac{\text{Average Actual Production / shift} \times 100}{\text{Expected Production / shift}}
\]

These data were collected from a particular jute mill and the machinery production ratio was calculated for various types of machines. Based on the evaluated values of this ratio we have graded the machinery from very poor to very good. Following is the scale used for the grading.

<table>
<thead>
<tr>
<th>MPR (%)</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59.9</td>
<td>Very Poor</td>
</tr>
<tr>
<td>60-69.9</td>
<td>Poor</td>
</tr>
<tr>
<td>70-79.9</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>80-89.9</td>
<td>Good</td>
</tr>
<tr>
<td>90-94.9</td>
<td>Very Good</td>
</tr>
<tr>
<td>95-100</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

The result of this analysis is given in Table 2
TABLE 2: PRESENT STATUS OF MACHINERY PRODUCTION RATIO, PM AND OVERHAUL SCHEDULE IN JUTE MILLS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Machine</th>
<th>Machinery Production Ratio (%)</th>
<th>P.M. Schedule</th>
<th>Overhauling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grade</td>
<td>Frequency</td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(%)</td>
<td>Time</td>
<td>Grade</td>
</tr>
<tr>
<td>1</td>
<td>Softener</td>
<td>58.33 Very Poor</td>
<td>1 month</td>
<td>8 hrs</td>
</tr>
<tr>
<td>2</td>
<td>Jute Goods Spreader</td>
<td>64.44 Poor</td>
<td>½ month</td>
<td>8 hrs</td>
</tr>
<tr>
<td>3</td>
<td>Breaker Card</td>
<td>88.24 Good</td>
<td>2 months</td>
<td>2 day</td>
</tr>
<tr>
<td>4</td>
<td>Finisher Card</td>
<td>90.91 Very Good</td>
<td>4 months</td>
<td>4 day</td>
</tr>
<tr>
<td>5</td>
<td>First Drawing</td>
<td>69.57 Poor</td>
<td>2 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>6</td>
<td>Second Drawing</td>
<td>69.58 Poor</td>
<td>2 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>7</td>
<td>Finish Drawing-Fine Side</td>
<td>83.33 Good</td>
<td>2 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>8</td>
<td>Finish Drawing-Coarse Side</td>
<td>75.00 Satisfactory</td>
<td>2 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>9</td>
<td>Spinning – Fine Side</td>
<td>87.50 Good</td>
<td>3 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>10</td>
<td>Spinning – Coarse Side</td>
<td>75.00 Good</td>
<td>3 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>11</td>
<td>Pre-Beaming</td>
<td>60.00 Poor</td>
<td>3 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>12</td>
<td>Dressing</td>
<td>55.00 Very Poor</td>
<td>6 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>13</td>
<td>Mackroll Winder</td>
<td>88.89 Good</td>
<td>2½ months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>14</td>
<td>Ring Twisting Frame</td>
<td>90.36 Very Good</td>
<td>2½ months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>15</td>
<td>Precision Winder</td>
<td>84.27 Good</td>
<td>3 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>16</td>
<td>Broad Loom</td>
<td>89.47 Good</td>
<td>3 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>17</td>
<td>Rolling</td>
<td>70.00 Satisfactory</td>
<td>6 months</td>
<td>8 hrs</td>
</tr>
<tr>
<td>18</td>
<td>Cope Winding</td>
<td>74.44 Satisfactory</td>
<td>2 months</td>
<td>1 day</td>
</tr>
<tr>
<td>19</td>
<td>Roll Winding</td>
<td>80.92 Good</td>
<td>3 months</td>
<td>1 day</td>
</tr>
<tr>
<td>20</td>
<td>Beaming-Sacking</td>
<td>86.11 Good</td>
<td>6 months</td>
<td>1 day</td>
</tr>
<tr>
<td>21</td>
<td>Loom – Sacking</td>
<td>87.23 Good</td>
<td>2 yrs</td>
<td>8 hrs</td>
</tr>
<tr>
<td>22</td>
<td>Loom –Hessian</td>
<td>84.14 Good</td>
<td>2½ yrs</td>
<td>8 hrs</td>
</tr>
<tr>
<td>23</td>
<td>Damping</td>
<td>68.33 Poor</td>
<td>1 yr</td>
<td>1 day</td>
</tr>
<tr>
<td>24</td>
<td>Calender</td>
<td>86.96 Good</td>
<td>1 yr</td>
<td>1 day</td>
</tr>
<tr>
<td>25</td>
<td>Lapping</td>
<td>75.00 Satisfactory</td>
<td>6 months</td>
<td>1 day</td>
</tr>
<tr>
<td>26</td>
<td>Cutting</td>
<td>86.67 Good</td>
<td>2 months</td>
<td>1 day</td>
</tr>
<tr>
<td>27</td>
<td>Hemming</td>
<td>75.00 Satisfactory</td>
<td>2 months</td>
<td>1 day</td>
</tr>
<tr>
<td>28</td>
<td>Herakle</td>
<td>64.62 Poor</td>
<td>2 months</td>
<td>1 day</td>
</tr>
<tr>
<td>29</td>
<td>Press/Pump</td>
<td>83.33 Good</td>
<td>1 month</td>
<td>1 day</td>
</tr>
</tbody>
</table>

Since the actual data are not available, these results may not be representing the actual status of downtime and machinery availability. The PM and overhauling schedules also vary from mill to mill. In actual practice, these schedules should be decided based on the downtime data as well as the condition of each machine. A format for failure and repair data entry in maintenance logbook has been proposed for this purpose.

1.4 PROPOSED MAINTENANCE SCHEDULE

As mentioned in previous sections most of the jute mills do not have downtime and maintenance records. Therefore, we are unable to provide a final maintenance schedule. However, we propose a tentative schedule for preventive maintenance based on our observations, discussions and available literature. The effectiveness of this should be evaluated after six months, based on
which a new schedule can be formulated for final implementation. We also provide a format for this purpose.

We propose that the maintenance activities in jute mills be classified into three categories:

1. Cleaning and minor lubrication
2. Preventive maintenance - weekly, and half yearly
3. Predictive maintenance – based on condition of machine

1.4.1 Cleaning and Minor Lubrication

Machinery in jute mills are operating in extreme environmental conditions of dust and fibers. Majority of the failures and the associated down times of these machines can be attributed to these two factors. Not only these particles cause jamming of moving parts, but also they cause the drying up of the applied lubrication resulting in additional friction. Since total elimination of these factors is not feasible, attempt can be made to minimize their effect in two ways. First one is to install dust collectors and dampeners in the shop floor. Second method is by regular cleaning of machines and lubricating the external moving parts. Since there are large number of machines in jute mills, it will be ineffective to operate a centralized cleaning and lubrication section. However, if these activities can be decentralized, the results will be very encouraging. For this we propose that the time tested methods of Total Productive Maintenance (TPM) may be carried out.

Total Productive Maintenance has the objective of zero break down and zero defects. This is the ultimate goal. In jute mills, we can not expect that this will happen in 100 % cases. But definitely it will reduce the problems considerably. Gradually, over a period of time we can expect to reach the final goal. The fundamental concept of TPM revolves around the fact that the operators are given the freedom to think that the machines they use daily are their own. So they should be told that it is very much essential to keep their machines in good condition. By introduction of this concept, the maintenance personnel can be freed from routine maintenance tasks such as cleaning and lubrication, and they can better concentrate in dealing with essentials tasks of maintenance planning, scheduled mechanical maintenance, possible redesigns and modifications of some parts, and overhauling. This will result in better reliability, availability and maintainability of the machines.

Motive behind TPM is improving productivity through highly motivated workforce which can be achieved through job enlargement in which all the workers are given a range of challenging jobs, in order to develop their skills in different crafts. A voluntary small group is formed for identifying the likely causes and frequency of failure of critical equipment, possible plant and equipment modification which will result in significant savings and efforts required to fully utilize existing equipment through improved availability.

In Jute mills we understand that there is loss of performance due to defective products. Moreover, TPM recognizes that there are four other kinds of losses, due to setup, adjustment, idling, and minor stoppages. All these losses may seem small as compared to breakdowns and defective products in actual practice, they add up to a significant loss of the productive capacity. Moreover, these losses do not come under the purview of preventive maintenance. In a nutshell TPM advocates the relieving of the mechanical maintenance personnel from routine activities which do not require any specialized skill. Some of these are cleaning of machines, periodic lubrication of external moving parts, periodic checks, inspections and minor adjustments, and problem reporting. So a situation is to be created wherein the production operators perform these
basic maintenance activities on their own machines. They must not only do these simple activities as part of their daily job, but also must be capable of detecting and reporting potential problems at incipient, or initial, stages before a major breakdown occurs. Based on the observations of the operator, maintenance department shall be called in to take necessary preventive actions to avoid breakdowns, with large downtime. This will considerably reduce the time for fault location, which is about 75% of the total down time in general. This is also based on the fact that the operator is more knowledgeable about his machine compared to the maintenance man since the former is always with the machine while the latter only visits as per requirements. Hence operator will be able to provide valuable suggestions for better maintenance.

The pre-requisite for the implementation of Total Productive maintenance in Jute Mills include the following:

1. Recognition of the need for planning in maintenance and implementation of planned maintenance
2. Use of a maintenance planning and control system based on a work order
3. Systematic collection of failure data, cost of down time, breakdown and preventive maintenance, spare parts consumption
4. Analysis of cost of maintenance and spare parts consumption
5. Analysis of failure data and failure modes for maintainability and design improvement
6. Re-structuring the maintenance department to give it the required importance power, and personnel
7. An attitude of pro-action as opposed to reaction and fire-fighting

These changes will demonstrate to the employees that the management is serious about the maintenance activities and wants to bring major changes in the way the plant is being operated and maintained. Herein it should be noted that there is no need for major investments for these efforts only proper direction, support and systematic approach are required. The benefits of these actions should be explained to the employees. The fact that better maintenance will lead to higher equipment availability and effectiveness, and this in turn, will lead to greater revenues and higher profits must be explained to the employees. It is suggested that the results be quantified as far as possible and the employees and their unions be taken into confidence. The attitude of employees will gradually change from confrontation to understanding and cooperation. Management’s support and employee’s cooperation are essential for the success of autonomous maintenance and the Total Productive Maintenance programme.

1.4.1.1 An outline for TPM implementation in jute mills

This section gives an outline for TPM activities in Jute Mills. Based on past experience, we suggest that TPM implementation be done stage by stage. This means that all the machines in the mill should not be included for this purpose at once. Select a few of them initially, put colour marks for identification ("UNDER TPM" may be written for reminding every one concerned), and explain the operators what they have to do. They should be given training before it is actually implemented. Table 3 shows tentatively the activities to be included in TPM for major types of machines.
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Machine</th>
<th>Proposed TPM Activities</th>
<th>Time Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Softener</td>
<td>1. Remove the caddis and dirt from all sides of the machine&lt;br&gt;2. Check the external oil and grease points&lt;br&gt;3. Visual check of conveyor, feed and delivery rollers&lt;br&gt;4. Check/clear the choking of nozzles</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>2</td>
<td>Carding</td>
<td>1. Remove dirt and caddis from and around the machine&lt;br&gt;2. Clean all the rollers&lt;br&gt;3. Check oil and grease points</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>3</td>
<td>Drawing</td>
<td>1. Blow off dirt and caddis from the machine&lt;br&gt;2. Clean delivery drawing pressing roller and delivery pressing roller&lt;br&gt;3. Clean carriage, check front and back faller springs, and missing faller bars&lt;br&gt;4. Apply oil to faller screws and other points</td>
<td>15 minutes at the end of shift</td>
</tr>
<tr>
<td>4</td>
<td>Spinning Frames</td>
<td>1. Clean bobbin rail rack and pinions, slide rods and blow off dirt and fluff&lt;br&gt;2. Apply grease to the idle spindles and graphite powder to slide rods&lt;br&gt;3. Clean and oil bearing points and journals of rollers</td>
<td>15 minutes at the end of shift</td>
</tr>
<tr>
<td>5</td>
<td>Roll Winder</td>
<td>1. Remove dirt and caddis from the machine&lt;br&gt;2. Check bobbin plate alignment visually&lt;br&gt;3. Check oil and grease points</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>6</td>
<td>Cop winding</td>
<td>1. Remove dirt and caddis from the machine&lt;br&gt;2. Check oil and grease points&lt;br&gt;3. Check the belt tension visually</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>7</td>
<td>Beaming</td>
<td>1. Remove dirt and caddis from the machine&lt;br&gt;2. Check oil and grease points and oil level in gear box</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>8</td>
<td>Looms</td>
<td>1. Remove dirt and caddis from the machine&lt;br&gt;2. Check oil and grease points&lt;br&gt;3. Eccentricity in all motions, visually</td>
<td>10 minutes at the end of shift</td>
</tr>
<tr>
<td>9</td>
<td>Calender</td>
<td>1. Remove dirt and grease from the machine&lt;br&gt;2. Lubrication points</td>
<td>10 minutes at the end of night shift</td>
</tr>
<tr>
<td>10</td>
<td>Press</td>
<td>1. Remove dirt and caddis from the machine&lt;br&gt;2. Check oil level in hydraulic system</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

This table only shows a tentative list of activities to be included in TPM. The maintenance department and the production department persons should meet and discuss for finalization of the activities. However, it is proposed that the time required for TPM activities should not exceed 15 minutes. Activities, which require more time and engineering skill, should not be included in TPM under any circumstances.
considerably improved after the implementation of TPM. Table 7.4 shows this improvement over a span of 7 weeks of implementation of TPM.

1.4.2 Proposed Weekly Preventive Maintenance Schedule

This activity should be carried out centrally with proper manpower planning in the maintenance department. Removing dirt and caddis and thorough cleaning of machine should be part of weekly maintenance. Following are the other activities proposed for weekly maintenance [Table 4].

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Machine</th>
<th>Activities</th>
<th>Time Required</th>
<th>Hands Required</th>
</tr>
</thead>
</table>
| 1      | Softener | 1. Clean all the fluted rollers  
2. Check all the bolts and nuts  
3. Check oil and grease points are checked.  
4. Check reduction gear box oil level  
5. Check chain drive  
6. Check pressure of fluted rollers  
7. Check Bevel pinions | 4 Hours | 1  
1 | 1 |
| 2      | Carding | 1. Check studs of gears, bushes, bearings and arbors  
2. Check stripper and worker roller drives | 3 Hours | 2  
2 |
| 3      | Drawing | 1. Take out all the faller bars, clean off the caddis and dust. replace broken gill pins  
2. Clean revolving rubber roller of drawing rollers and retaining rollers  
3. Check gearing sides, studs, oil and grease pipes  
4. Wash gear pinions in kerosene and apply grease  
5. Check pressing roller caps and bearings  
6. Check and set conductor chutes and base for all slivers & guides  
7. Clean coiler plates & apply oil  
8. Fix faller bars on position | 4 Hours | 2  
2 |
|   | 4 Spinning                                                                 | 5 Roll Winder                                                                 | 6 Cop Winding                                                                 | 7 Pre Beamer                                                                 | 8 Loom                                                                                        | 9 Calender                                                                                   |
|---|---------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
|   | 1. Clean mackdraw pressing rollers                                         | 1. Check yarn tension, roll pressure, and belt drive assemblies               | 1. Clear all gears and studs                                                 | 1. Set the gear box oil level                                                      | 1. Clean paper bowls                                                                         |
|   | 2. Replace bobbin carriers if necessary                                    | 2. Align bobbin plate                                                         | 2. Check belt tension                                                         | 2. Check yarn measuring assembly, traverse motion assembly, creels and gears, adjust if necessary | 2. Check lubrication oil pump, oil level in hydraulic system, pressure control assembly, pressure on cloth and stop motion, oil filter, bearings |
|   | 3. Clean and oil bearing points and journals on rollers (Top, bottom and fluted) | 3. Check the detector motion                                                  | 3. Set the length and cop diameter                                           | 2 Hours                                                                         | 3 Hours                                                                                      |
|   | 4. Remove caddis and dirt from tension pulleys, tension pulley bush housing and from under the machine |                                                                             |                                                                               |                                                                                |                                                                                             |
|   | 5. Clean idler rollers and their levers and adjust nuts and washers        |                                                                              |                                                                               |                                                                                |                                                                                             |
|   | 6. Check gearing side                                                       |                                                                              |                                                                               |                                                                                |                                                                                             |
|   | 4 Hours 2 2                                                              | 2 Hour 1 1                                                                   | 2 Hours 1 1                                                                  | 2 Hours                                                                         | 3 Hours                                                                                     |

1.4..3 Proposed Half Yearly Preventive Maintenance

This should be a major activity of the maintenance department. The production personnel should give proper feedback about the condition of the machine to the maintenance department prior to this activity. This will help the maintenance personnel to carry out maintenance/ replacement with high efficiency. Following activities are proposed for half yearly maintenance [Table 5]:

- 9 -
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Machine</th>
<th>Activities</th>
<th>Duration</th>
<th>Hands Required</th>
<th>Mechanic</th>
<th>Cleaner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Softener</td>
<td>1. All activities mentioned under weekly maintenance schedule</td>
<td>8 hours</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replacement of broken or worn-out parts:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Fluted roller bushes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Delivery and feed conveyors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Change Reduction gear box oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Adjust Chain drive tension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Adjust bevel pinion drive with fluted rollers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Thorough cleaning of machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Carding</td>
<td>1. All jobs mentioned under weekly maintenance</td>
<td>16 Hours</td>
<td>2</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2. Strip off the machine covers</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3. Check and replace all the staves, if necessary</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4. Take out and clean all the gears</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Repair/replace bushes and studs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Re-staving and re-setting of rollers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Drawing</td>
<td>1. All the work listed under drawing frame weekly cleaning schedule.</td>
<td>8 Hours</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replacement of broken and worn-out parts check list:</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>♦ Front &amp; back faller spring rollers and their coil springs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>♦ Top and bottom screw &amp; slides</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Screw bevels</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>♦ Short &amp; long back shaft spur and bevels and pinions</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Pitch pin collar</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>♦ Can packer runner and cam</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>♦ All studs and pinions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Can turning coiler plates and its driving arrangements</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Setting of front faller spring and back faller springs</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>4. For Mackhigh first drawing check list</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>♦ Faller track adjustments.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>♦ Faller bars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>♦ Oil feeder over faller tracks</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Spinning Frame</td>
<td>1. All the items of work listed in weakly maintenance</td>
<td>8 Hours</td>
<td>2</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>2. Check the condition of bobbin rail plates and pins</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3. Condition of builder chains and chain runner are checked to ensure free movement</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4. Rod gauge setting are checked and corrected where necessary</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>5. Condition of dead spindles is examined followed by necessary replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dead spindle gauging is effected with dial gauge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Looms</td>
<td>1. Remove dirt and grease from the machine</td>
<td>8 Hours</td>
<td>2+1</td>
<td>(one carpenter)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Check the followings ◆ Bolts and keys ◆ Sley keys, picking motion, crank shaft motion, shedding motion, stop and start motion, protection motion ◆ Oil points and settings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roll Winder</td>
<td>1. All the work under weekly maintenance schedule is to be done</td>
<td>4 hours</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replacing worn-out and broken part of the following: Bearings, lenix belts, yarn tension assemblies, scrolls, and swivel assemblies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cop Winder</td>
<td>1. All the work under weekly maintenance schedule.</td>
<td>8 Hours</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replacement of worn out and broken parts of the following ◆ COP spindle and bearings ◆ Bobbin spindle assembly yarn tension assembly, traverse guide assembly, ratchet trip assembly, K.C lever assembly, rope pulley assembly Doffing arm, Detected link, Belts and stop motions, buttress locating runner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. All the work under weekly cleaning schedule

2. Replacement of broken or worn out parts of the following:
   - P.I.V gear box, traverse motion assembly, beam in and out assembly, beam prenure assembly, beam drive assembly, machinery counter assembly, Duplex chains

---

1. All the job mention in weekly maintenance schedule

2. Replacing worn-out and broken part of the following:
   - Oil tank, oil pump, Hydraulic pipe lines
   - Ram assembly, top platform assembly, bottom platform assembly
   - pressure valves
   - Reduction gear box

---

1.5 Proposed Overhauling Practice

Assuming that all the activities suggested in TPM, weekly and half-yearly maintenance are properly implemented, overhauling practice can be based on the health of individual machines rather than the scheduled (time-based) overhauling practice. Thus it is suggested that overhauling be done based on condition of each machine. The condition of machines can be assessed through periodic measurements of some of the auxiliary variables of machinery (called prognostic parameters). Vibration, temperature, noise, power consumption, poor product quality, speed, etc are examples. One or more of these variables may be considered for each machine.

The first step in implementation of the methodology is to establish base-line (bench-marking) values of these variables for each type of machine. This is done either by taking readings on a new machine or on a machine, which is in very good condition. Once this is established, these variables must be measured periodically on each machine and then compared with the base-line values. If these are higher than the base-line values, overhauling may be planned accordingly.

For example vibration monitoring can be implemented on all the machines. The essential instruments for this are:

(a) Vibration sensor (velocity meter or accelerometer)
(b) Vibration Analyzer (an overall level indicator may be enough initially. Later on for better results, FFT (Fast Fourier Transform) analyzers may be used for frequency analysis)
(c) Tachometers (Non-contact type is preferred) for shaft speed measurement

Locations for vibration measurements are: all bearing points of major shafts, gears, and electric motor (if directly connected through coupling/gears). These points should be marked on all machines for easy identification. Base-line vibration levels should be established on all location points for all machines. This should be done when the machines are running healthy (either on
new machines or on machines just after a major overhauling). Once this is done, we are ready to implement vibration monitoring as a strategy for fault prediction and assessment of machinery health. For this purpose, a health card should be prepared for each machine as given in the following Table 6 (breaker carding machine is taken as an example):

**TABLE 6: VIBRATION MONITORING AND HEALTH ASSESSMENT CARD**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Location Code</th>
<th>Location</th>
<th>Base Line Vibration Level</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C-1</td>
<td>Cylinder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C-2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>F-1</td>
<td>Feeder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>F-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>FW-1</td>
<td>1st Worker</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fw-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>SW-1</td>
<td>2nd Worker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SW-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>TW-1</td>
<td>3rd Worker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>TW-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>FS-1</td>
<td>1st Stripper</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>FS-2</td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>SS-1</td>
<td>2nd Stripper</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>SS-2</td>
<td></td>
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</tr>
<tr>
<td>15</td>
<td>TS-1</td>
<td>3rd Stripper</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>TS-2</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>17</td>
<td>D-1</td>
<td>Doffer</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>D-2</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

If the vibration levels measured periodically are less than the base-line values, then there is no need of any overhauling. If the vibration level is high at a few locations, overhauling may be done only for these shafts and bearings. If majority of the locations show higher vibration levels compared to corresponding base-line values, complete overhauling of the machinery is suggested.

1.6 Condition Monitoring of Electrical Motors

The electric motors, especially those used as prime movers for the common overhead shafts, should be periodically monitored. Current, temperature, vibration, and shaft speed can be considered for health monitoring. As suggested previously, base line values should be established for all these parameters for the selected locations. If current monitoring is selected for implementation, all the three phases should be considered separately. Vibration and temperature monitoring should be carried out at two locations, viz., bearings on both sides of the shaft. Speed monitoring can be done using a non-contact type tachometer. As an initial step, only current and temperature monitoring may be implemented. Other techniques may also be followed in the next stage.

Majority of the failures of electric motors in jute mills can be attributed to the following causes:
(a) **Motor getting burnt:** This problem is mainly due to overheating of the windings. Overheating takes place because it draws more current. More current is drawn because some conductors are short-circuited due to winding damage. This may also occur if the winding insulator (varnish) used is of bad quality. Therefore it appears that the quality of insulating varnish used for rewinding should be strictly controlled for improving motor life.

(b) **Bent/eccentric shaft:** This problem is also frequently reported. This occurs mainly during the assembly of pulley with the motor shaft. This can be overcome by using a pulley of the right size (diameter), correct method of assembly and usage of proper tools. The motor bearings may also get damaged if assembly is not carried out properly.

### 1.7 OPPORTUNISTIC MAINTENANCE PRACTICES

This is another most efficient method for maintenance. In this method, machine maintenance is carried out whenever an opportunity becomes available. Whenever a machine is down (due to PM schedule, unexpected failures etc.), the PM personnel can carry out some of their activities parallel to the repair activities. The greatest advantage of this method is that it will considerably save the downtime of the machine and therefore minimize loss of production.

One good example for this in jute mills is that of the picking operation on Carding machine. This activity is necessary after every few hours of operation. Some essential PM activities can be carried out during the picking operation.

### 1.8 SPARE PARTS CONSUMPTION

It has been observed, in general, that the consumption of spare parts is very high in all the jute mills. Main reasons for this are:

- (a) The quality of spare parts available is bad
- (b) Since the machines are very old, spare parts wear out very fast
- (c) Lubrication of moving parts is poor
- (d) In many cases, poor quality lubricants are being used
- (e) The dusty environment near machines causes more friction, consumption of larger quantity of lubricants and higher failure rate of parts
- (f) Periodicity of cleaning of dust and waste material from machine is not adequate
- (g) Usage of non-standard parts in some cases
- (h) Inadequate material feed to machinery (Under-softened raw jute, especially in carding and drawing)
- (i) Rate of input material feed is non-uniform and as a result overloading of some machine parts
- (j) Skill of most maintenance workmen is inadequate
- (k) Rough usage by some operators

The amount spent on spares, lubricants, and grease has to be studied by individual mills for further analysis.
2. SOME GENERAL PROBLEMS IN MAINTENANCE

Following are some important problems facing the maintenance department:

(a) Backlog in Maintenance Schedule
(b) Improper input (processing material) to machinery
(c) Mishandling of machinery
(d) Poor workmanship in maintenance
(e) Lack of lubrication / use of improper lubricant
(f) Non-availability of good quality spare parts

3. IMPORTANT MACHINERY PROBLEMS IN JUTE MILLS

In this section, the focus is on identifying engineering problems in jute machinery, and suggesting modifications for improvement. Following are the results of our analysis:

3.1 Softener

Softening is the first mechanized operation in jute mill. When raw jute is passed through this machine, it is softened. Proper softening of raw jute is essential for improving the performance of subsequent operations. In this sense, we can say that the softening is a preparatory operation. The main problems of the softener machine are:

(a) Bevel gear jamming
(b) V-belt drive problems
(c) Mismatching of gear meshing
(d) Pinions and bushes on side shafts

V-belt is used for transmitting mechanical power and rotary motion from the drive motor to the cross shaft. The cross shaft is connected to the side shaft (90° angle) through bevel gears. There are two side shafts for a softener on either side of the machine. Working rollers are connected to the side shafts through bevel gears. Each of these rollers is connected to the side shaft only from one side such that alternate rollers are driven by side shafts on opposite sides. These are generally the problems encountered on the softener machines.

The existing problems in this machine can be eliminated/minimized by simplification of the design, especially the torque transmission path. It is noted that the direction of torque transmission takes a turn of 180° from the motor to the working rollers (motor to cross shaft 90° and cross shaft to working rollers 90°). This necessitates usage of large number of bevel gears in the design. This is the main reason for most of the problems of this machine. Therefore, strategies for design modifications with ordinary (simple) gear mechanism (instead of bevel gears) should be tried. The motor shaft can be directly connected to a main shaft and the working rollers may be connected to the main shaft through simple gears. This will also result in zero degree phase difference between the working rollers and motor shaft.

3.2 Jute Goods Spreader

This is a substitute for the softener machine. Most jute mills use a few spreader machines, with a larger number of traditional softener machines. Most important advantage of the spreader
machines is that it simultaneously does the softening and breaker carding operations. Moreover, this machine is much faster than the traditional machines. These machines have two operating sections namely, slow section and fast section. The slow section uses chain sprocket mechanism for transmitting motion whereas the fast section uses another mechanism. Some potential problems of these machines are:

(a) Faller bar jamming – most frequent
(b) Wearing out of tracks for faller bars
(c) Jamming of delivery rolls
(d) Lapping in bar
(e) Failure of hydraulic roll former

Jamming is the major problem in this machine. Failure analysis has revealed that this is mainly due to jute material getting stuck in the machine part, lack of lubrication and usage of bush bearings without proper maintenance. Frequent cleaning of material flow path, usage of correct grade of lubricant regularly and changing from bush bearings to roller bearings are some remedies to minimize these problems. Failure of hydraulic roll former is mainly due to oil leakage, and lack of sufficient fluid pressure. Weekly cleaning and monitoring of the hydraulic circuit is the remedy.

3.3 Carding Machines

Next to softening is the carding machine. This machine may be either roll fed (if input is from the spreader) or hand fed (if input is from the softener). There are two stages of carding operation, namely breaker carding and finisher carding. Both machines are similar in operation and construction. These machines use a number of rollers and cylinders. The rollers are used as pairs consisting of worker rollers and stripper rollers. Finisher carding machines require more number of pairs of rollers compared to the breaker carding machines. The cylinders are fitted with wooden staves. Each stave is fitted with a number of pins for the combing operation. Following problems are observed in these machines:

(a) Jamming of rollers and cylinders
(b) Jamming of staves and pins
(c) Breaking of staves
(d) Bending and shearing of pins, and
(e) Bracket, and arbor of roller plates are also getting affected and the steel cover is getting damaged frequently, due to jamming of cylinders (secondary problems)
(f) Jamming of shrouding plate
(g) Gear slackness, pin breaking/shearing

All these problems are due to non-uniform flow of material, usage of under softened jute feed, low quality safety pins and lubrication. Care should be taken to ensure that the feed material supplied to carding machine is properly softened as per the design requirements. Under softened material results in extra pressure on wooden staves and pins, resulting in their failure. The quality of wood used for making staves should be good enough to withstand this force. Safety pin breakage in many cases occurs without much jamming and overloading. It appears that the shear strength of safety pins is not properly controlled by the vendors. First of all the allowable overloading should be established and the pin should be designed and manufactured according to the requirements of shear strength. Therefore, shear strength should be experimentally tested as per the design requirements. It also appears that shear pin breaking in some cases are due to repeated application of impact loads (not due to pure shearing) resulting from mechanical
slackness during starting and stopping of machine. This possibility can be eliminated by usage of a pair of pins (at 180° apart), instead of a single pin.

3.4 Drawing Machines

The next operation is on the drawing machines. These machines use the output of carding machines as input. There are three stages of drawing in the fine section, whereas the coarse section requires only two stages. These machines basically do fine combing of the jute fiber so that all the dirty materials included with the fiber are removed. The output of these machines is called sliver, which is ready for the spinning operation. These machines use faller bars made of steel instead of wooden staves in carding machines. Also there are a number of rollers in the machine. Following are the main problems of the drawing machines:

(a) Bar damaging & drawing pin breakage/ snapping/ shearing
(b) Carriage problems
(c) Roller wearing
(d) Jamming of rollers

Regular cleaning and proper lubrication are essential. Bending and shear strength analysis of incoming drawing pins must be tested periodically to ensure that they are supplied according to the design standards. All machinery vibrations should be minimized for longer life of pins and rollers.

3.5 Spinning Machines

These machines produce jute thread, or yarn, from the sliver by spinning operation. These machines are very rigid in construction and reliable in operation. Important problems of this machine are:

(a) frequent shearing of lower rollers
(b) vibration of bobbin rail
(c) wearing of felt bob
(d) rubber pressing roller eccentricity
(e) bottom roller shaft failure

These failures are not very frequent. Regular cleaning and lubrication will minimize these problems to a great extent. From the design point of view, there is no much room for improvement.

3.6 Looms

Weaving operation is carried out in looms. Following problems are observed in looms:

(a) Cast iron parts such as pinions, brackets, bushes, etc are breaking frequently,
(b) Some spare parts are difficult to obtain and the quality is very poor,
(c) Fast wearing of parts due to improper oiling
(d) Crank shaft breaking
(e) Centre Shaft Breaking

Crank shaft controls (actuates) the beating motion of the looms and uses a pair of crank and follower mechanism. Beating motion is a to-and-fro motion for compacting the cloth after
passing warp. One of the crank and follower mechanism is near the driven end of the shaft while the other one is near the free end. Majority of the failures is reportedly near the driven side of the shaft. This shaft is connected to the centre shaft through a gear mechanism. The centre shaft is connected to the common overhead shaft through belt and pulley. This shaft controls (actuates) picking motion (shutting of copes) and shedding motion (up and down motion of thread). The number of crankshaft breakage is more in sacking looms than in hessian looms. This may be attributed to higher speed of sacking looms. The crankshaft is rotating on bush bearings on either side of the shaft. The possible reasons for the shaft failures are analyzed and attributed to the following:

1. Eccentricity of crank shaft motion. The gap between the shaft and bush near the driven end is larger in most cases, resulting in eccentric motion of the shaft. This bush is wears much faster than the bush on the free end of the shaft since the gear mechanism is nearer. Therefore, extra lubrication and more frequent replacement of this bush are essential to minimize the eccentricity.
2. Gear problems such as irregularity, incorrect meshing, wearing of teeth and eccentricity also affect the motion of the shaft.
3. The gap between follower and crank shaft is large, resulting in mechanical shocks.
4. Hair cracks in the original shaft and improper heat treatment methods for relieving stress concentration of the shaft near the bend section are also causing this failure.
5. Eccentric motion of centre shaft is getting transmitted to the crankshaft through gear mechanism.

4. Maintenance of Overhead Line Shafts

The overhead line shafts are very important and critical parts of jute machinery. Failure of this shaft is very serious since this will result in failure of large number of machines connected to the shaft. The total down time and loss of production due to line shaft failures is very large. Following activities are suggested for better condition of these shafts.

a. Daily cleaning and external lubrication be carried out
b. Weekly vibration levels should be taken on four bearings, selected randomly on each shaft and compared with acceptable levels and thorough lubrication of bearing points
c. Monthly vibration levels should be taken on all bearings for all line shafts and corrective actions be taken if required
d. Monitor the vibration level and temperature of motor on a daily basis
e. Keep at least one spare motor ready to replace a failed motor. This stand-by motor should be kept at the same level of the line shaft so that replacement takes only a few minutes. It is experienced that the time taken to bring a spare motor from the electrical maintenance shop and lifting it to the required height of line shaft takes most of the down time. This should be avoided at any cost.

5. ELECTRICAL MAINTENANCE AND ENERGY MANAGEMENT

Jute mills are highly energy intensive. They consume energy in the form of coal, HSD and electricity. The total energy bill of a mill is in the range of Rs. 4 to 6 crores, and this imposes a heavy burden on the individual mills and the industry, as a whole. Electrical energy accounts for the largest portion of this cost. An interesting point, in this regard, is that, to the mills, the cost of own generation of electricity is at present approximately the same what they have to pay for power to the state electricity boards. The average consumption of 490-500 KWh / MT for a normal product mix (60% sacking and 40% Hessian) is estimated. Most of the mills have their
own diesel generating sets to meet a large portion of the total power requirement. The mills are being forced to buy power from the state boards. However, the decision to set up their own captive power plants or to purchase power from electricity boards depends upon the power tariff and the market diesel prices. This matter needs consideration, by considering the uncertainties associated with these parameters.

There is a large variation in the electrical energy requirement between mills. In general, the maximum demand is more during the winter months as compared to the summer months and about 40% of total energy consumption is in the spinning section. The trend in electricity consumption by the mills reveals that there is an increase in the annual consumption. Thus energy conservation efforts assume greater importance and a number of steps can be taken in the area of energy management.

The electrical distribution network in all the mills is spread over a large area and there are long feeders because the substation is localized in one area of the mill. Further, in some mills, with the increase in the load, additional cables are connected rather than strengthening of the existing cables. In addition to the feeder and cable system, areas such as rewinding of electrical motors, lighting load, power factor correction, rearrangement of drives and maintenance of machines (to reduce consumption) require special attention.

5.1 ELECTRIC MOTORS

The measurements related to motor performance, i.e. power factor, load current and no load current, were carried out at two mills, in the plant and in the rewinding section. Following observations are made:

1. The capacity of motors of spinning section may be optimised.

   RATING: The machines running with 15 HP motors are found to have better efficiency as compared to 20 HP rating motor driven machines. Similarly, 15 HP motors connected to slip draft machines may be replaced by 12.5 HP motors to obtain better efficiency. The majority of the motors are of 20 HP rating, whereas only few motors are of 15 HP.

   Savings of about Rs. 25,900/- per motor per year is achievable by replacement of 20 HP motors with 15 HP motors. Similarly, saving of Rs. 7,770/- per motor per year may be achieved by replacement of 15 HP motors with 12.5 HP motors. Annexure-I on page 172 provides detailed calculations.

2. The motor burning phenomenon is due to following reasons:

   (a) Low voltage at the motor terminals,
   (b) Improper maintenance coupled phase current imbalance due to improper rewinding,
   (c) Unbalanced supply voltages, and
   (d) Single phasing

   The practice of motor rewinding to replace only the burnt-out coils being practiced by all the mills is faulty. At the time of rewinding, usually the gauge of wire, number of turns and the weight of the wire per phase is to be maintained. However, inspection of rewinding shop at some of the mills visited revealed that this normal practice of rewinding is not followed and the measurements of currents drawn by various phases of
the rewound motors, in rewinding shop, showed a condition of imbalance of motor operation. Further, the unequal gap between stator and rotor also causes imbalance operation of the motors and this fact is not taken into consideration while rewinding of the motors. The phase imbalance causes flow of circulating currents, which heat up the motor winding resulting in power loss. The current drawn by the motor increases and, this causes higher losses in the distribution network. Considering about 50% imbalance for a partially rewound motor and about 10% imbalance (due to unbalanced supply voltages) for a motor of 20 HP, it is found that approx. Rs.3626/- per motor can be saved annually (please see Annexure – II on page 180). Also considering 8 years life of a motor, the accumulated savings will be about Rs. 29,000/- per motor at present tariff. Thus the saving potential is too large as compared to the saving of few hundred rupees obtained in cost of copper during partial rewinding.

3. Complete rewinding of the motors should therefore always be done in jute mills and existing practice of partial rewinding must be discontinued. In addition, the rewinding shop should be provided with a measuring instrument, such as demand analyser or a three-phase power measurement device, so that no-load parameters of the motors may be monitored in the rewinding shop to avoid phase imbalance.

4. In case of fan cooled motors, the fan replacement is being done with locally made fans which are heavier than the original. This type of replacement proves very costly in the long run as the additional power requirement outweighs the cheaper initial cost in about a years time.

5. Bearing condition is not being monitored, regularly, and therefore there is more power consumption due to defective bearings. Proper maintenance/replacement policy will reduce power consumption of the motors.

5.2 THE LIGHTING LOAD

The lighting load of various mills lies in the range of 6-9% of average daily load. The environment inside a jute mill is full of dust and therefore the lighting efficiency is low. Further, all the fluorescent lamps use conventional chokes which consume approximately 50% of the rated power of the lighting fixture. Substantial amount of electricity savings may be achieved by replacing conventional chokes by electronic chokes (as these days reliable electronic chokes are available in the market) in the mills. Considering the difference in the wattage of ordinary and electronic ballast of 8 watt operating at a power factor of 0.95, annual saving per tube light is approximately 67.2 KWh and if there are 600 fixtures then there exists a saving potential of Rs. 1,49,184/- per annum. Further, the payback period for this alternative is less than a year (please see Annexure –III on page 181).

5.3 ENERGY MANAGEMENT PROGRAMME

Each mill should have an energy conservation cell chaired by head of the mill and consisting of an in-charge and members drawn from various departments like production, maintenance, administration, stores and finance, besides its support staff to monitor energy consumption, identify the high energy consuming areas/machines and develop and implement the ways to achieve energy conservation. The group should formulate energy conservation programmes, involve employees in the programmes and monitor the progress continuously. Further, monitoring instruments like, tachometers, load analyser, static energy meters, etc should be
made available to the energy management group. The study team noted that most of the jute mills do not have any instrument for power factor or energy measurement.

The energy management group should carry out energy audits at regular intervals, short list the area for achieving energy efficiency, find out ways and implement them to reduce the energy consumption.

5.4 TRANSFORMERS AND SUBSTATIONS

There is only one sub-station in each mill and the distribution area in some cases is quite large. The cable system is also faulty as the additional load to any shop has been connected through additional cables rather than providing a single cable of higher capacity. There is a scope of achieving reduction in cable losses \( (I^2 R) \) by locating the transformers at load centers and selection of proper cable size. The transformer location for future expansion should be chosen keeping this fact in mind.

It is also observed that at few places in some jute mills, the voltage is in the range of 350-390 volts. This may be due to inadequate cable size, overhead cables with joints and cables with burnt out insulation. Transformer tap changing is to be looked into and in some cases even on load tap changing may be incorporated to reduce power consumption. In addition, a thorough cable inspection is essential for each jute mill.

5.5 POWER FACTOR CORRECTION

Usually the power factor correction is being obtained at the bus. It is observed during the measurements that the no load currents of various drives can be reduced by installing capacitors at the drive terminals. This will also reduce the cable losses in addition to achieving the reduction in no load current.

5.6 MAINTENANCE

Measurements were carried out to study the effect of proper maintenance (cleaning, oiling, etc.) on the power consumption of the machines. Cleaning in the mills is being carried out for house keeping purpose and not from energy saving point of view. It was observed that approx 1-2 Amp reduction in load current is achieved per carding machine by proper maintenance. Power saving of about 2% may be achieved by proper maintenance of the machines. The total savings obtained by implementing this decision will be in the range of Rs. 40,000/- – 50,000/- per annum. Further, proper maintenance will reduce the frequency of occurrence of motor burning due to over current caused by jamming of the machines, particularly in the batching section.

Similarly, in the drawing department savings of approx 1.0 Amp of current per machine is achievable by carrying out proper maintenance. Moreover, measurements of load currents indicate that overall approx 1% saving can be achieved by just proper cleaning of machines.

5.7 REARRANGEMENT OF DRIVES

Group drives, as well as individual drives are present in all the jute mills. Usually the machines in the spinning and weaving section have individual drives whereas carding and weaving machines in some mills also have group drives. It is well known that group drives are efficient in comparison with individual drives but it becomes uneconomical if it is not connected with proper load. Following observations are made:
1. The rating of the group drive motor is invariably more than the connected load. In some cases the loading is as low as 40% of the rated motor power. The efficiency of induction motors at such a low load is very poor.

2. There are spare pulleys on some of the group driven shafts. These idle pulleys cause power loss.

3. In many cases motors have come with the machine as its integral part. The manufacturers of the machines have provided over-rated motors with machines without any consideration of the energy efficiency.

4. A through evaluation of power requirement for group as well as individual drive is necessary in each Jute mill. This evaluation will reduce power requirement substantially.

Following table provides a comparison for one mill if individual drives are properly converted to group drive of appropriate rating.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Group drive</th>
<th>Individual drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No. of machines</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Motor HP</td>
<td>50</td>
<td>7.5 each</td>
</tr>
<tr>
<td>3</td>
<td>Average power consumption</td>
<td>15 KW</td>
<td>4.8 KW each</td>
</tr>
<tr>
<td>4</td>
<td>Power consumption per year</td>
<td>72000KWh</td>
<td>92160 KWh</td>
</tr>
<tr>
<td>5</td>
<td>Cost per year considering power tariff @ Rs. 3.70 per KWh</td>
<td>2,66,400</td>
<td>3,40,992</td>
</tr>
<tr>
<td>6</td>
<td>Savings per year</td>
<td>Rs. 74,592</td>
<td></td>
</tr>
</tbody>
</table>

The above calculations are based on 16 hours per day of running for 300 days in a year and the saving per year will be more if more number of operating hours are considered in a year.

5.8 RECOMMENDATIONS

The study has identified several areas where substantial saving potential exists and there could be appreciable saving in the energy bills. The specific recommendations are given below:

1. There must be a commitment on the part of management to devote the time, personnel and money to the energy management program.
2. Setting up of energy management group, chaired by head of the organisation, to continuously monitor and implement energy management programs
3. Loading of group drives to be improved to get energy efficiency.
4. Over-rated individual drives are to be changed.
5. Power factor correction to be achieved at drive terminals to reduce distribution losses.
6. Restructuring of distribution network.
7. Rewinding procedure for the burnt motors to be modified to avoid imbalance among the phase currents.
8. Redistribution of some heavy load, e.g. pumping etc such that it takes place during low demand period.
9. Regular cleaning of machines.
10. Replacement of conventional chokes in light fixture with electronic chokes.
11. Removal of idle pulleys from the group driven shafts.
12. Replacement of fan impeller for fan cooled motors, with impeller of correct weight rather than to go for a cheaper one that is heavier.
FOR NOTES
TECHNICAL SESSION - 2
JUTE MILL PRODUCTIVITY IMPROVEMENT
- DETAILED PROCESS STUDY

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A paper by Professor Bhadury has given an overview of the work we have done in the area of improvement of jute mill productivity. Here, we give the details of the study with regard to each process, stacking of raw jute bales through baling of sacks and hessians.

A. Stacking

Three forms of stacking are in use in the industry: (1) Manual stacking, (2) Stacking with the help of jib crane, and (3) Stacking with the help of forklift. Various alternatives are considered for each form of stacking. We give estimates of investment and payback period (Table 1) when manual stacking is replaced by each of the proposed alternatives. The following assumptions are made here:

1. Average salary of a worker is Rs. 5,500/- per month

2. The average operating and maintenance expenses of material handling equipment (jib crane and forklift) are taken as 30% of the capital cost per year, or 2.5% of the capital cost per month.

3. The cost saving per month is estimated as money saved per month due to a reduction in the number of workers less the average operating and maintenance cost of the material handling equipment.
TABLE 1: COMPARISON OF ALTERNATIVES IN STACKING

<table>
<thead>
<tr>
<th>Stacking alternatives</th>
<th>Height of the stack (ft)</th>
<th>number of workers</th>
<th>Bales stacked/shift</th>
<th>Productivity bales/man-shift</th>
<th>money saved per month (taking manual stacking as reference)</th>
<th>initial investment (lakh Rs.)</th>
<th>Pay-back period (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual stacking</td>
<td>25</td>
<td>25</td>
<td>300</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jib crane (unloading in one side of godown)</td>
<td>25</td>
<td>13</td>
<td>525</td>
<td>40</td>
<td>Rs. 53,500</td>
<td>5</td>
<td>9.34</td>
</tr>
<tr>
<td>Jib crane (unloading both side of godown)</td>
<td>25</td>
<td>10</td>
<td>525</td>
<td>52.5</td>
<td>Rs. 70,000</td>
<td>5</td>
<td>7.14</td>
</tr>
<tr>
<td>Jib crane with telescopic arm</td>
<td>25</td>
<td>8</td>
<td>525</td>
<td>65.63</td>
<td>Rs. 72,250</td>
<td>8.5</td>
<td>11.76</td>
</tr>
<tr>
<td>Jib crane with inclined roller conveyor</td>
<td>25</td>
<td>7</td>
<td>525</td>
<td>75</td>
<td>Rs. 82,750</td>
<td>6.5</td>
<td>7.85</td>
</tr>
<tr>
<td>Jib crane with inclined roller conveyor and telescopic arm</td>
<td>25</td>
<td>5</td>
<td>525</td>
<td>105</td>
<td>Rs. 85,000</td>
<td>10</td>
<td>11.76</td>
</tr>
<tr>
<td>Jib crane with direct loading from truck inside the godown</td>
<td>25</td>
<td>5</td>
<td>525</td>
<td>105</td>
<td>Rs. 88,750</td>
<td>8.5</td>
<td>9.57</td>
</tr>
<tr>
<td>Jib crane with direct loading from truck inside the godown and using telescopic arm</td>
<td>25</td>
<td>3</td>
<td>525</td>
<td>175</td>
<td>Rs. 96,000</td>
<td>10</td>
<td>10.41</td>
</tr>
<tr>
<td>Fork lift</td>
<td>14</td>
<td>9</td>
<td>525</td>
<td>58.33</td>
<td>Rs. 73,000</td>
<td>6</td>
<td>8.21</td>
</tr>
<tr>
<td>Fork lift with guided unloading from truck</td>
<td>14</td>
<td>5</td>
<td>525</td>
<td>105</td>
<td>Rs. 95,000</td>
<td>6</td>
<td>6.31</td>
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</tbody>
</table>

We recommend that manual stacking of raw jute bales should be replaced by the use of either a jib crane with telescopic crane arm or a forklift, depending on whether the truck carrying the bales can be brought inside the godown or not. Further, of these two alternatives, the use of forklift is preferred, since it has a much lower payback period.
B. Feeding Selection Section from Godown and Truck

This study has been carried out in a mill where the Selection Section is fed with jute bales both from the godown and directly from the truck. Time study is conducted for both the feeding methods. The productivities of a trolley man for both the cases are 35 and 95 bales per shift respectively.

C. Selection

Two cases are considered: (1) Selection of bales that does not involve cutting of top portion, and (2) Selection of bales that involves cutting of top portion. The achievable productivities are determined using work measurement principles (Table 2).

<table>
<thead>
<tr>
<th>Process</th>
<th>Weight of bales</th>
<th>Present productivity</th>
<th>Proposed productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of bales without top portion cutting</td>
<td>150 kg</td>
<td>23.08 bales/shift</td>
<td>27.2 bales/shift</td>
</tr>
<tr>
<td></td>
<td>180 kg</td>
<td>19.2 bales/shift</td>
<td>22.7 bales/shift</td>
</tr>
<tr>
<td>Selection of bales with top portion cutting (6.5 lb jute)</td>
<td>150 kg</td>
<td>--</td>
<td>19.33 bales/shift</td>
</tr>
</tbody>
</table>

D. Material handling from the Selection to the Softening Section

The workers involved in handling selected materials from the selection section to the softening section are of two types:

1. Gariwala [persons who carry selected materials from the selection section to the softening section]
2. Bojawala [persons who pick up the material unloaded by gariwalas and place it on the softener machine feed table]

A work sampling study with 387 observations over a period of 3 days (72 hrs) was carried out on the gariwallas. The study gave the following results:

- Working: 62.27%
- Idle: 37.73%

A work sampling study is carried out on the bojhawalas. The study gives the following results:

- Working: 36.95%
- Idle: 63.05%
We note the very high idle times of the workers.

We recommend an alternative method. This method has the following features:

1. There is no necessity for employing bojhawalas.
2. The cart should be of smaller size with a capacity of 320 kg so that such a cart can be pushed by only one garhiwala.
3. There is no necessity of the softener feed table.
4. The gariwall leaves the loaded cart near the softener machine and returns with the empty cart previously left at the machine.
5. The worker at the softener input side takes the material from the cart and places on the softener machine.

A comparison is made between the existing method and the suggested method (Table 3).

### Table 3: Existing and the Suggested Method of Material Handling

<table>
<thead>
<tr>
<th></th>
<th>Existing method</th>
<th>Suggested method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of softener machines</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2. Cart capacity</td>
<td>600 kg</td>
<td>320 kg</td>
</tr>
<tr>
<td>3. Number of carts required</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>4. Number of workers per day</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>5. Money saved per month</td>
<td>Rs. 82,500 (=[21-6] person) * 5,500Rs./person-month)</td>
<td>Rs. 48,000 (=[14-2] carts) * 4,000Rs./cart)</td>
</tr>
<tr>
<td>6. Initial investment</td>
<td>-</td>
<td>Rs. 48,000 (=[14-2] carts) * 4,000Rs./cart)</td>
</tr>
<tr>
<td>7. Payback period</td>
<td>-</td>
<td>18 days          (=[48,000/82,500] * 30)</td>
</tr>
</tbody>
</table>

### D. Softening Using the Softening Machine

This process involves two operators and one softening machine. One operator feeds the raw jute to the machine, while the other collects the output of the machine. A continuous production study was carried out in a mill on one cart of raw jute of approximately 500 kg. The analysis of data, thus obtained, showed that the utilisation of man 1 was 97.1% and that of man 2 was 71.53%. The machine utilisation was found to be 73.47% with the following break-up of machine idle time:

(i) Idle time due to cleaning of nozzles through which emulsion is applied = 3.7%
(ii) Idle time due to jamming = 2.8%
The utilization of 73.47 percent can be significantly improved by replacing the nozzle system by a container on which emulsion overflows and spreads along the width of the softening machine, as is being done by some mills. This will avoid altogether the idle time incurred for cleaning of nozzles.

E. Piling and pile breaking

In this process, workers place the softener machine output on a car. Pilemen carry the carload of materials to the pile place for piling. After piling for 24 hours, the pile breakers carry the material to the carding machines.

Analysis through a flow process chart indicates that one can do away with the following activities:

1. Taking the softener output from the car and putting it on the floor for piling.
2. Breaking the pile and putting the pile material on the car (by the pile breakers) for serving the carding machines.

We suggest the use of a cage on wheels. Piling should be done on the cage itself and not on the floor, so that while the transportation time remains unaffected, the remaining portion of the piling time and the pile breaking time will be saved. A comparison of the two methods is given in Table 4.

F. Carding

Production studies on breaker and finish-carding machines, carried out in three mills, show that:

(i) JF card machines give higher productivity.

(ii) Roll-feed breaker carding gives higher production than hand feed breaker carding machine.

(iii) Major causes of idleness of machines include mechanical problems and jamming, caused by pin breakage, and irregular gap between rollers.

(iv) At finisher carding, there is a loss of machine utilization due to stock build at output.

The productivity of the existing machines can be significantly improved by regular check ups, which can be carried out during picking time.
### Table 4: Present and Suggested Method of Piling

<table>
<thead>
<tr>
<th>Cage dimension (l<em>w</em>h cu ft)</th>
<th>Present method</th>
<th>Suggested Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>4<em>4</em>3</td>
<td></td>
<td>6<em>5</em>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacity (kg)</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td></td>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total no of workers required per day</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No of cages required per day</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>*Initial investment (@ Rs. 4,000/- per cage)</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rs. 4,00,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount of money saved</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rs. 1,48,500 (= [36-9] persons * Rs. 5,500/person)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Payback period</th>
<th>Present</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.7 months</td>
</tr>
</tbody>
</table>

### H. Batching Section

We have made a detailed comparison study of the two different processes used in the batching section. In process A the material passes through the softener machine, then it goes to the piling section for 24-36 hours after which it goes to the hand-feed carding machine to produce sliver for finisher carding. In this process root cutting is necessary before feeding the material to the hand-feed breaker-carding machine.

In process B the material passes through the jute good spreader, then it goes to the piling section in roll form, and after 12 hrs. it goes to the auto-feed breaker carding machine for producing sliver for the inter carding machine, and then to the finish carding machine. In this process root cutting is not necessary.

When a mill uses process B instead of process A, the saving due to saving in amount of material only is Rs. 0.81 lakh per month. A comparison of number of hands required for process A and process B is made in Table 5.

### Table 5: NUMBER OF HANDS – PROCESS A VS. PROCESS B.

<table>
<thead>
<tr>
<th>HANDS REQUIRED IN PROCESS A</th>
<th>HANDS REQUIRED IN PROCESS B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeder/machine/shift</td>
<td>Feeder/machine/shift</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Receiver/machine/shift</td>
<td>Receiver/machine/shift</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Pileman/machine/shift</td>
<td>Auto feed carding machine</td>
</tr>
<tr>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Hand feed carding machine</td>
<td></td>
</tr>
<tr>
<td>1st Machine</td>
<td></td>
</tr>
<tr>
<td>Feeder/machine/shift</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Feeder/machine/shift</td>
</tr>
<tr>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td>Root cutter/machine/shift</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pile carrier</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>Note: Root cutting is not</td>
<td></td>
</tr>
<tr>
<td>necessary</td>
<td></td>
</tr>
<tr>
<td>Hand feed carding machine</td>
<td></td>
</tr>
<tr>
<td>2nd Machine</td>
<td></td>
</tr>
<tr>
<td>Feeder/machine/shift</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Feeder/machine/shift</td>
</tr>
<tr>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td>Root cutter/machine/shift</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Receiver/machine/shift</td>
</tr>
<tr>
<td></td>
<td>0.20</td>
</tr>
<tr>
<td>Pile carrier</td>
<td></td>
</tr>
<tr>
<td>0.25</td>
<td>Roll carrier</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
</tr>
</tbody>
</table>

| Total hands/shift | 12 | Total hands/shift | 2.86 |
Total savings in number of hands in process B = 12 - 2.86 = 9.14 persons.

Since process B takes only 12 hrs whereas process A takes 24 to 36 hrs to pile, process B is better compared to process A also with respect to processing time, although there is no major variation in production. Thus it is recommended that a mill traditionally using process A should change over to process B.

One jute goods spreader can serve material to two auto-feed breaker carding machine and one auto-feed breaker-carding machine serves material to one inter-carding machine. So the installation of one jute good spreader will call for two auto-feed breaker carding and two inter-carding machines.

Estimated initial investment = (cost of jute good spreader + cost of two auto-feed breaker carding machines + cost of two inter-carding machines) = 63 lakhs (approximately). Assuming the salary of each worker as Rs 5,500 p.m., the total savings in process B as compared to process A per month

\[= \text{saving due to reduction in number of hands} + \text{saving due to avoidance of root cutting} = (3 \times 9.14 \times 5500) + Rs. 81000\]

\[= Rs. 1,50,810 + 81,000 = Rs. 2,31,810.\]

Payback period = Initial investment/total savings = 2.26 year.

I. Drawing

Sliver is reduced in width and thickness through the use of three stages of drawing. Production studies were carried out in two mills and reasons for machine idleness were identified. The reasons for machine idleness in drawing section are: Pm breakage, Jamming, Non-availability of the operator, Shortage of material, and Miscellaneous (e.g., maintenance practices like cleaning, oiling, power failure etc., which causes the machine to be idle for some time).

The following recommendations have been made:

(i) Machine operator should replace the broken pin by the new pin himself.
(ii) Operator should be alert to repair sliver breakages at input side.
(iii) Operator should hand over the machine in running condition at shift change.
(iv) Operator should be trained to do on-line loading and unloading of drums.

The implementation of these recommendations will result in substantial gains in efficiency (from 55, 64 and 67 to 85 percent) and productivity (from 1.75, 1.62 and 1.31 to 2.6, 2.2 and 1.7 MT/machine/shift) for the first, second and third drawing machines. This brings out the need for and the advantages of implementing the concept of autonomous maintenance - the basic foundation of total productive maintenance (TPM).

J. Spinning

We have carried out a production study in order to identify various reasons for machine idleness. The reasons are: Doffing, Yarn breakage, and Miscellaneous.
There are two practices that prevail in the industry for cutting yarn during doffing: (a) Using manual cutter, and (b) Using semi-automatic cutter. A stopwatch time study indicates that the doffing time for manual cutter is 91.13 seconds, whereas it is 57.46 seconds for the semi-automatic cutter.

Yarn breakage mainly depends upon the quality of jute. The number of yarn breakages varies from 3.73 for export quality Hessian 12 lb (100 spindles) to 15.13 for Sacking weft 26lb (100 spindles). Breakage repair rate is standardised and the standard value is 4 breakage repairs/min.

From a production study, it is found that machine idle time due to miscellaneous reasons (such as mechanical faults, and non-availability of operators and materials, etc.) is about 5%.

The industry uses two types of spinning machines: (1) the two-legged flyer machines and (2) the Bauxter flyer machines. A comparison of the spinning productivity and the spinning efficiency of the two machines shows that there is an increase of 12.86 percent in productivity and 7 percent in efficiency, when Bauxter flyer machine is used in place of the two-legged flyer.

Recommended efficiency is computed as

\[
\text{Recommended efficiency} = 1 - \left( \frac{\text{doffing time}}{\text{cycle time}} + \frac{\text{average no. of breakages}}{\text{total no. of spindle}} \right) + \frac{\text{percentage of idleness due to miscellaneous reasons}}{}
\]

The recommended efficiency and productivity for different quality of jute in different machines are given in Table 6. The payback period for investing in Bauxter Flyer machine is shown to be about 1.11 years when even saving due to reduction of wastages, improved beaming and weaving aspects and workload of bobbin carriers, mazdoors, etc., is not considered.

A number of observations have been made for spinning for the following types of yarn as a part of a work sampling study:

1. Food-Grade HCF 14 lb Bobbins (2 x 100 spindles)
2. Sacking Warp 10.5 lb Bobbins (2 x 100 spindles)
3. Hessian Warp 8 lb Bobbins (2 x 100 spindles)
4. Hessian Weft 8.25 lb Bobbins (2 x 100 spindles)

Note: 1 operator for 2 frames and 1 helper for 6 frames for all the cases.
Table 6: Recommended Efficiency and Productivity for Spinning Machines

<table>
<thead>
<tr>
<th>Type of machine</th>
<th>Quality</th>
<th>Rpm</th>
<th>TPI</th>
<th>Avg. Cycle time</th>
<th>Avg. No of idle spindle</th>
<th>Total no of spindle</th>
<th>Actual efficiency</th>
<th>Productivity at 100% efficiency in kg/machine-shift</th>
<th>Recommended efficiency (in %)</th>
<th>Recommended productivity in kg/machine-shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD bauxter flyer</td>
<td>Export 12 lb hessian</td>
<td>3900</td>
<td>3.78</td>
<td>34.5</td>
<td>4</td>
<td>100</td>
<td>77.37</td>
<td>520</td>
<td>88</td>
<td>86.6</td>
</tr>
<tr>
<td>AD bauxter flyer</td>
<td>Bright hessian 8 lb</td>
<td>3900</td>
<td>4.53</td>
<td>55</td>
<td>4</td>
<td>100</td>
<td>80.00</td>
<td>290</td>
<td>89</td>
<td>88.3</td>
</tr>
<tr>
<td>SD bauxter flyer</td>
<td>Bright hessian 8 lb</td>
<td>3900</td>
<td>4.28</td>
<td>50</td>
<td>7</td>
<td>100</td>
<td>81.35</td>
<td>305</td>
<td>86</td>
<td>85.0</td>
</tr>
<tr>
<td>SD bauxter flyer</td>
<td>Hessian 8.5 lb</td>
<td>3800</td>
<td>4.28</td>
<td>45</td>
<td>6</td>
<td>100</td>
<td>80.2</td>
<td>315</td>
<td>87</td>
<td>86.0</td>
</tr>
<tr>
<td>SD bauxter flyer</td>
<td>Sacking 10.5 lb</td>
<td>3600</td>
<td>4.0</td>
<td>32</td>
<td>12</td>
<td>100</td>
<td>78.4</td>
<td>398</td>
<td>81</td>
<td>80.0</td>
</tr>
<tr>
<td>SD bauxter flyer</td>
<td>Sacking 26 lb</td>
<td>2250</td>
<td>2.57</td>
<td>22</td>
<td>14</td>
<td>80</td>
<td>70.15</td>
<td>576</td>
<td>77.5</td>
<td>75.0</td>
</tr>
<tr>
<td>SD 2 legged flyer</td>
<td>Sacking 11 lb.</td>
<td>3600</td>
<td>4</td>
<td>32.38</td>
<td>16.67</td>
<td>100</td>
<td>69.2</td>
<td>416.66</td>
<td>73.67</td>
<td>306.9</td>
</tr>
<tr>
<td>SD 2 legged flyer</td>
<td>Sacking 28 lb</td>
<td>2300</td>
<td>2.25</td>
<td>24.34</td>
<td>12.57</td>
<td>80</td>
<td>62.25</td>
<td>963.71</td>
<td>73.10</td>
<td>704.4</td>
</tr>
</tbody>
</table>

X: indicates when semi-automatic cutter is used, Y: indicates where manual cutter is used

Based on the data, we feel that excepting for Hessian warp, the number of bobbins waiting for repair is large. We conduct a simulation study to experiment on the nature of influence the manpower deployment will have on the number of working bobbins.

A simulation study has been carried out. The following input data are taken for the purpose:

- **Yarn breakage rate:** Poisson distributed. The mean values of the yarn breakage rate are indicated in the earlier table.
- **Mending rate:** 5th-order Erlang distribution. The order and the mean values have been determined by a process of trial and error during calibration.
- **Sliver replenishment time:** Obtained by a process of trial-and-error during the calibration phase.
- **% of bobbins stopping due to stockout and that due to yarn breakage:** Have been calculated during the computation of sliver consumption rate and the yarn breakage rate.
Simulation has been carried out for a period of 10,000 minutes. We have assumed that all the 200 bobbins are working at the start of the simulation. The model was simulated for different frame assignments of the helper and the simulation results for average values of utilization of the workers (based on full time of the operator and part of the time of the helper spent on a machine), yarn breakages, and total bobbins down were noted.

The simulation results (Table 7) indicate that as the number of frames assigned to a helper is increased, the productivity measured in terms of number of working bobbins per a worker increases, and the worker utilization increases. But the number of down bobbins increases, leading to loss in production that can adversely affect the profitability of the mill.

We take 80% utilization of the workers as an acceptable figure. We note that the current worker assignment in Hessian Warp is optimal, but that for other yarn types, less number of frames should be assigned to one helper in order to reduce the number of down bobbins and increase the production rate.

<table>
<thead>
<tr>
<th>Yarn type</th>
<th>Hessian warp</th>
<th>Hessian weft</th>
<th>HCF 14</th>
<th>Sacking warp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal assignment of helpers</td>
<td>Current is optimal</td>
<td>1 helper in 4 frames</td>
<td>1 helper in 3 frames</td>
<td>1 helper in 3 frames</td>
</tr>
<tr>
<td>Increase in manpower per machine</td>
<td>---</td>
<td>1/6</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>Increase in number of working bobbins/machine</td>
<td>---</td>
<td>1.49</td>
<td>8.6</td>
<td>5.16</td>
</tr>
<tr>
<td>Increase in production per machine per month</td>
<td>---</td>
<td>503 kg</td>
<td>2903 kg</td>
<td>1742 kg</td>
</tr>
<tr>
<td>Increase in production per unit increase in manpower</td>
<td>---</td>
<td>3018 kg</td>
<td>8709 kg</td>
<td>5226 kg</td>
</tr>
</tbody>
</table>

K. Winding

There are two types of winding processes: spool winding and cop winding. Spool winding produces yarn for warp (the longitudinal yarn) whereas cop winding produces yarn for weft (the transverse yarn) of the weaving operation.

In order to know the present machine utilisation and the reasons for idle time of the machine, a production study was carried out for an uninterrupted period of four hours. A machine of 24 spindles, in which 12 spindles are assigned to one worker, was studied and the result of the study is as under:

Working time is 45.02 per cent.

Idle time is 54.98 per cent:
Interference = 32.87 %
Non availability of material = 15.22 %
Miscellaneous = 6.89 %

Machine idle time due to interference reflects improper man-machine allocation.

Optimum number of spindles per worker can be found from a sample of 10 observations. For this calculation two values are required. One is the time required to consume one bobbin by spool. It varies with the surface speed of machine and quality of yarn

In thus study, we are assuming that the bobbin is full and the average time to consume one bobbin is 105 seconds. Loading time of bobbin, assumed constant for all types of machine and for all qualities of yarns, is taken as 18.7 seconds. Therefore, Maximum number of spindles one can attend with minimum interference is 6 (~ 105/18.7) spindles. Six spindles per worker increases working time to 77.89% from the existing 45.02%.

Generally cop-winding machines consist of 120 spindles. Number of spindles per worker depends on the count of yarn produced. For example: for 221b, 261b, 281b count of yarn, manning is 15-20 spindles per worker, and for 7.51b, 81b, 91b, 121b, 131b count of yarn, manning is 20-30 spindles per worker.

A production study carried out on the cop-winding machine shows machine-working time as 41.545 %. Major cause of idleness is interference. Idle time due to interference is 54.165 %. This interference can be divided into two parts. They are waiting for unloading the cop is 41.04 % and waiting for unloading the bobbin is 13.125 %. Idle time due to miscellaneous causes is 4.29 %.

Determining optimum man-spindle allocation can eliminate idle time of machine due to interference. This can be determined as follows:

\[
\text{Average time required to complete one cop is } = 78 \text{ seconds} \\
\text{Average loading and unloading time for cop } = 6 \text{ seconds.}
\]

By taking 25% allowance standard time for loading and unloading cop is 8 seconds. So maximum number of spindles one can attend with minimum interference = 8 - 10 spindles. Assigning 10 spindles per worker increases the working time of a spindle increases from 41% to 95.705%.

By the proposed methods, the machine utilisation in both spool and cop winding is significantly improved (by 32.87 and 54.16 percent respectively). The increase in the number of workers, due to the proposed method, is more than offset by this gain in machine utilisation, since spinning and winding supply yarn to the looms and weaving is the largest cost centre.

L. Beaming

Production study was carried out for an uninterrupted period of four hours and during this study 460 ends were studied. The result of the study is as under:

\[
\text{Machine utilisation } = 91.35 \% \\
\text{Idle time } = 8.65 \%
\]
Causes of idle time are as under:

- Minor mechanical problems = 3.4%
- Jam of yarn = 5.25%

It is recommended that:

(i) Frequency of cleaning at the slit should be increased, preferably once every 5 minutes, and this will minimize incidents of jamming, and

(ii) Care should be taken while loading of the beam, since mechanical problems are related to the adjustment of the beam on the machine.

M. Weaving

A Group time technique (GTT) was conducted for a set of thirty machines (around 10 percent of the total machines) for sacking along with fifteen men. The following were found to be the primary causes of machine idleness:

a. Warp and weft breakage, which, in turn, depends on condition of loom, uniformity of yarn, size of knot (in spinning and winding operations), uneven tension of yarn at beaming, irregular mixing of starch at beaming, and quality of yarn,

b. Beam change,

c. Minor repair and mechanical problems

To reduce machine idleness, the following recommendations have been made:

(i) Better preventive maintenance of the looms,

(ii) Proper care taken during the preceding operations, namely spinning, winding and beaming,

(iii) A detailed work sampling study carried out simultaneously for the operator and machine shows that the operator was idle for a substantial amount of time. This points to the possibility of changing the assignment from the present one operator for two looms to one operator for three looms, or even two operators for seven looms. However, these changes should be made in phases, since they require proper maintenance of machines.

N. Damping

One man is engaged at the input side of the damping machine to load two rolls and another man is engaged at the output side. A stopwatch time study indicates that normal time is 55 seconds. Taking the allowance of 15% the standard time is 64.7%.
The maximum production is 60,000 meters per machine per shift. Time required to produce 60,000 meters of cloth is 20,410 seconds (= 5.66 hr).

Further, machine utilisation is low at 70.8%. This is because calendering, the next operation, is very slow. The input requirement for calendering per shift is very less compared to the output capacity of the damping machine.

It is suggested that the damping machine should run alternately 2 shifts on one day, followed by 1 shift on the next day.

A comparison between the present and the proposed method (Table 8) shows that the proposed method considerably improves machine productivity and labour working time. It is to be noted, however, that there should be enough space to store one shift requirement of calendering machines. Lack of adequate space may, however, make this suggestion difficult, or even impossible, to implement.

**Table 8: Existing and Proposed Methods for Damping**

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Existing method</th>
<th>Proposed method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine runs two shifts daily</td>
<td>Machine alternately runs two shifts a day and one shift the next</td>
<td></td>
</tr>
<tr>
<td>Number of workers</td>
<td>One worker at input side and one worker at output side</td>
<td>One worker at input side and one worker at output</td>
</tr>
<tr>
<td>Machine utilization</td>
<td>70.8%</td>
<td>94.33%</td>
</tr>
<tr>
<td>Labour working time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input worker</td>
<td>27.35%</td>
<td>36.44%</td>
</tr>
<tr>
<td>Output worker</td>
<td>21.88%</td>
<td>29.15%</td>
</tr>
</tbody>
</table>

**O. Calendering**

Manning pattern for this operation is: one man at the input side and another at the output side of the calendering machine. A stopwatch time study was conducted to find elemental times of the operation. The elemental times are:

- **Loading** = 75 seconds
- **Operation** = 247 seconds

From the man-machine chart the input worker working time is obtained as 30.58%.

We propose that one man can attend two machines at the input side. The input worker working time is obtained as 66.66%. The proposed manning pattern increases the labour productivity considerably (Table 9).
Table 9: Productivity for Existing and Proposed Manning Pattern for Calendering

<table>
<thead>
<tr>
<th></th>
<th>Existing method</th>
<th>Proposed method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of workers</td>
<td>One man for one machine at input, one man for one machine at output</td>
<td>One man for two machines at input, one man for one machine at output</td>
</tr>
<tr>
<td>Machine productivity Mts/machine/shift</td>
<td>22,902</td>
<td>22,902</td>
</tr>
<tr>
<td>Labour productivity Mts/man/shift</td>
<td>11,451</td>
<td>15,268</td>
</tr>
</tbody>
</table>

P. Inspection and Repairing

Inspection and repairing are carried out as separate operations (Practice 1) by certain mills, whereas they are carried out along with the calendering operation (Practice 2) in certain others. We consider both the practices.

Practice 1

Here inspection and repair are considered as separate operations. Five workers inspect and repair the cloth and one worker carries material from the inspection and repairing section to the calendering machines. From a sample of observations, it was found that the average cycle time was 137 seconds, with 80 seconds for inspection and 57 seconds for repair. Standard time (by taking allowance as 20%) is 171.25 seconds.

Considering that 95.0976 meter length of cloth is inspected and repaired by one worker in 171.25 seconds, the worker productivity can be estimated as 15,993 (= 8 * 60 * 60 * 95.0976 / 171.25) meters/machine/shift.

From the questionnaire survey, we note that the requirement of cloth for one calendering machine per shift is 30,000 meters. So it is concluded that two inspection and repair workers for one calendering machine constitute the optimum manning in the inspection and repairing section.

Practice 2

Here the worker at the output side of the calendering machine carries out the inspection. Whenever the cloth has to be repaired, the worker pulls the cloth a little more than required, then the repair worker repairs the defects. Here the inspection time is part of the calendering operation. So the time for inspecting and repairing is only the time for repairing, and one repair worker can attend to the output of one calendering machine.

For the same output, Practice 1 requires double the number of workers required in Practice 2. Also, transporting the material, which is a non-value-adding activity, is eliminated in Practice 2. However, since inspection is done at two stages in Practice 1, there is less possibility of passing defective cloth in the final product, when this practice is followed.

In general, if quality is the prime concern to the manufacturer, Practice 1 is better, otherwise Practice 2 is better because it does not involve transportation, a non-value-adding activity.
Q. Lapping

Two methods are in use in the industry.

Method 1:

There are two workers for each machine. One worker loads the cloth on to the lapping machine, and thereafter he goes to the output side. After lapping is done, the two workers collectively collect the output. Thereafter the first worker returns to the front and loads the machine for the next cycle.

The cycle time was observed as 160 seconds for a cloth of 157 yards (143 meters). Standard time for one cycle, with an allowance of 20%, is 200 seconds. Therefore,

\[
\text{Machine productivity} = (8 \times 60 \times 60) \times \frac{143}{200} = 20,672.7 \text{ meters/machine/shift.} \\
\text{Labour productivity} = 20,672.7 / 2 = 10,336 \text{ meters/worker/shift.}
\]

Method 2

There are three workers for every machine: One at the input side to load the cloth on the machine and two at the output side. Cycle time for producing 119.5 meters cloth was observed to be 100 seconds. Standard time for one cycle, by taking 20% allowance, is 125 seconds. Therefore,

\[
\text{Machine productivity} = (8 \times 60 \times 60) \times \frac{119.5}{125} = 27,532 \text{ meters/machine/shift} \\
\text{Labour productivity} = 27,532 / 3 = 9,127.6 \text{ meters/worker/shift.}
\]

A Proposed Method

It is proposed that at the input side one worker can be engaged for loading two lapping machines and two workers can be engaged at the output side of one lapping machine. Input worker working time is very less (20% as in existing method 2). So one worker can easily attend to two machines, thus improving labour productivity.

\[
\text{Labour productivity} = \frac{27,532}{2.5} = 11,012 \text{ meters/worker/shift.}
\]

Cycle times and machine productivity are the same as in the method 2.

R. Cutting

The cutting process consists of one worker at the input side of the machine and two workers at the output side. A stopwatch time study was conducted that led the following loading and operation times for 84 sacking bags:

Loading time = 70 seconds. 
Operation time = 112 seconds.
In this process loading is done concurrently with the cutting operation. So there is no need to stop the machine to load the cloth.

An alternative manning of two input workers for three machines was considered. A comparison between the existing and the proposed method is given in Table 10.

**Table 10: Productivity for Existing and Proposed Manning Pattern for Cutting**

<table>
<thead>
<tr>
<th></th>
<th>Existing method</th>
<th>Proposed method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of workers</td>
<td>One input worker for one machine and two output workers for one machine</td>
<td>Two input workers for three machines and two output workers for one machine</td>
</tr>
<tr>
<td>Machine productivity</td>
<td>17,280</td>
<td>17,280</td>
</tr>
<tr>
<td>(bags/machine/shift)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor productivity</td>
<td>5,760</td>
<td>6,480</td>
</tr>
<tr>
<td>(bags/worker/shift)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At present, two workers are employed at the output side of the machine. It is possible to reduce or even get rid of these two output workers if some mechanical attachment is used instead. Such a possibility is worth investigating. With this attachment, labour productivity is likely to increase by about 66 percent.

**R. Hemming – (hemstitching)**

The manning pattern consists of one operator and one receiver for one machine. The operator and the receiver together go to the cutting machine and drag a heap of cut cloth near to the hemming machine. The operator picks up an arbitrary number (about 20-40) of bags and places them on a stool. He picks up one bag at a time, hems the two sides of the bag, and repeats these operations. The hemmed bags fall to the ground, the receiver cuts the thread joining the next bag, and places them on the ground/trolley one above the other.

We conducted time study hemming 100-kg B-Twill (119.87 x 67 cm) cloth. The normal time for loading comes to 27.5 sec and the normal time for hemming a bag 8.05 seconds. Thus the normal time to hem 30 bags is 30 x 8.05 = 241.5 sec.

Assuming that the various allowances amount to 20%, the standard loading and hemming times are given as

\[
\text{Loading time} = \frac{27.5}{1-0.2} = 34.375 \text{ sec.}
\]

\[
\text{Hemming time} = \frac{241.5}{1-0.2} = 301.875 \text{ sec.}
\]

We estimate that, with the present practices the company should target at a production figure of 34.375 + 301.875 = 336.25 seconds for 30 bags which is equivalent to

\[
\left(\frac{8 \text{ hrs/shift} \times 3,600 \text{ sec/hr}}{336.25 \text{ sec}}\right)/30 \text{ bags} = 2,570 \text{ bags/shift/machine.}
\]

It may be mentioned here that the mill where the study was undertaken had mentioned in its response to the questionnaire survey that it has already achieved 2,275 bags/shift/machine and
that the target production they are aiming at is 3,000 bags/machine/shift. This target appears to be ambitious when the existing method is used.

Proposed Improvement

We propose that the cloth being supplied to the hemming operators should not just be thrown on the ground; instead it may be kept on a table adjacent to the hemming machine, so that the loading time is brought down to zero. With this arrangement the standard time for 30 bags is estimated as $241.5/(1-0.2) = 301.87$ sec. The standard production can thus be estimated as $(8\times3,600)/(301.87) \times 30 = 2,862$ bags/shift/machine.

IJIRA has suggested a method of estimating efficiency. The method considers Stitches per minute, Stitches per inch, and Total length of stitched bag. IJIRA also suggests that efficiency depends on various factors relating to management and workers – operational losses and mechanical losses – and that its industry average value of 42% according to them can be increased to 61% when different improvement methods are implemented. Using IJIRA’s formulae, we estimate that the mill’s efficiency is $0.886$, which is high compared to the industry average, reported by IJIRA. With the proposed productivity of 2,862 bags/shift/machine, the efficiency rises to 98%, which is indeed an extremely high value.

The receiver is idle for nearly 30% of the time. For this, he bends his body by about $150^\circ$ to pick the hemmed cloth from the ground. We propose that the receiver attends to two machines, sitting on a rotating stool and picking of the ends of the hemmed sacks hooked on to a stand. We estimate that the productivity of this arrangement will increase the worker productivity from the existing 1,285 bags/worker/shift to 1,908 bags/worker/shift.

S. Heracle

There are two methods in the industry.

The Existing Method 1

It consists of one operator and one receiver for one machine. The operator picks up an arbitrary number of bags and places them on a stool. He picks up one bag, stitches one side of the bag, picks up another bag, and repeats the operations. One-side-stitched bags fall to the ground. The receiver picks up one bag from the ground and cuts the thread joining next bag, then places them on the ground one above the other. After receiving a certain number (between 20-40) of bags, he places them near the operator for stitching their second sides. Then the same process is repeated.

We find the following times for 25,100-kg B-Twill bags:

- Average set-up time = 35 seconds.
- Average operator work time = 248 seconds.
- Average receiver work time = 165 seconds
- The busy time for the receiver = 65 percent of that of the operator.
- Average cycle time = 283 seconds
By taking 20% allowance, we estimate the following:

Standard time is 353.75 seconds.
Machine productivity = \((8 \times 60 \times 60) \times 25 / 353.75 = 2,035\) bags/machine/shift.
Labour productivity = \(2035 / 2 = 1,017.5\) bags/worker/shift.

**Existing Method 2**

It consists of one operator for one machine and two receivers for three machines. This method differs from the earlier method as far as the operator's job is concerned. The operator picks up one bag at a time from the stool, stitches one side of bag then immediately stitches the other side of the bag.

We find the following times for 25,100-kg B-Twill bags:
- Average set up time = 35 seconds.
- Average operator work time = 336 seconds.
- Average receiver work time = 155 seconds.
- Average cycle time = 371 seconds.
- Standard time by taking 20% allowance is 463.75 seconds.

Machine productivity = \((8 \times 60 \times 60) \times 25 / 463.75 = 1,552.56\) bags/machine/shift.
Labour productivity = \(1,552.56 / 1.66 = 931.2\) bags/worker/shift.

**Proposed Method**

We propose that while one operator can be assigned to one machine, two receivers can be assigned to three machines. The whole process is same as that in the existing method 1. In the existing method 1, we find that the receiver is idle for 35 percent of the busy time of the operator. So by assigning the output of three machines to two receivers, busy times of the receiver and that of the operator are balanced.

By this manning pattern, labour productivity in herackle is increased by 20 percent and is estimated at 2,035/1.66 = 1,221 bags/worker/shift.

**T. Baling**

It consists of four workers for one machine and one pump operator for two pressing machines. Four workers first arrange the bags or cloth on pressing machine table. Then pressing is done for some time, and then the bale is tied with clip belts. Stitching of sides is done while lowering the table.

We find the cycle time by a stopwatch time study for sacking as well as for hessian:

- Cycle time for sacking is 350 seconds.
- Cycle time for hessian is 426 seconds.
- Standard times, by taking 20% allowance, are
For sacking: 437.5 seconds.
For hessian: 532.5 seconds.

**Sacking:**

Machine productivity = \( \frac{8 \times 60 \times 60}{437.5} = 65 \text{ bales/machine/shift} \).
Labour productivity = \( \frac{65}{4.5} = 14.4 \text{ bales/worker/shift} \).

**Hessian:**

Machine productivity = \( \frac{8 \times 60 \times 60}{532.5} = 54 \text{ bales/machine/shift} \).
Labour productivity = \( \frac{54}{4.5} = 12 \text{ bales/worker/shift} \).
TECHNICAL SESSION - 3
RESOURCE MANAGEMENT FOR THE IMPROVEMENT OF TOTAL PRODUCTIVITY IN THE JUTE INDUSTRY

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RESOURCE MANAGEMENT FOR THE IMPROVEMENT
OF TOTAL PRODUCTIVITY IN THE JUTE INDUSTRY

by
T. K. Roy, G. Chattopadhyay & Dr. D. Sur
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1.0 INTRODUCTION

The cost reduction is a prime issue for many of the jute products. Although the emerging concern for the environment all over the world will favour more and more the natural fibre products over their synthetic counterparts, jute will have to compete with other natural fibre in terms of performance-cost ratio for the products. Jute is a labour-intensive crop being cultivated mostly by small farmers in the producing countries. Since both the cost of labour and agricultural inputs are on the rise, the possibility of reduction on the raw jute price seems unlikely unless significant increase in the yield of jute per acre of land is achieved. Thus, only alternative route to enhance the cost competitiveness of jute products is through cost reduction of the industrial processing of jute both in the organized and decentralized sectors.

Productivity improvement is a perpetual endeavour for every manufacturing organisation for cost competitiveness of the products as well as the survival of the organisation itself. By saying so, it may be argued that what should be the rational target for productivity. Each individual Jute mill sets its own target of productivity based on the product-mix, machinery and technology available, skill of the man power available and other necessary resources at their disposal. This target varies appreciably among the mills due to variation in the entire gamut of input resources available. Hence, a common target of productivity applicable to all the mills is difficult to design. In order to overcome this difficulty, a hypothetical target (norms) for each individual product can be designed based on the best available machinery and technology vis-à-vis optimising the man-machine ratio, workload, energy consumption and consumption of other resources. Performance of the mills can be compared by their extent of achievement of the target through periodic Inter Firm Comparison Survey. By analysing the achievement gap, individual mill can adopt proper measures to bridge the gap.

An Inter-firm Comparison Study was conducted by IJIRA over five years (1993-'97) on Indian jute mills at Carding, Drawing and Spinning and also on Labour Productivity. The study revealed that with the available machinery and product-mix both the Machine productivity index (MPI) and Man-days per Metric Ton Index (MTI) had remained almost unchanged during the period. This indicates that the technology of the machinery vis-à-vis man-machine ratio needed to be changed for achieving any improvement in productivity. Indian jute industry also felt the need of productivity improvement and need for high productive machinery gradually emerged toward the latter part of 1990's. Besides, the industry felt the urgent need to harness the spiraling cost of manpower and energy. Individual and collective efforts are being made in this regard. IJIRA is playing a vital role in these exercises.
2.0 RESOURCE MANAGEMENT

Productivity is a synergistic function of all resources. Hence, for the improvement in productivity, improvement in utilisation of the input resources is needed and can be brought about in the following way.

Machine & Technology

- Upgradation and modification of existing machinery and equipment through proper R&D.
- Adoption of suitable high productive machines and equipment.

Man

- Optimisation of man-machine ratio at different stages of processing and for different product-mix through Industrial engineering tools.
- Standardisation of work load of workers commensurate with the machinery and product - mix vis-a-vis ensuring job security.
- Enhancement of skill through on-the-job training.
- Motivational change through Quality Circle.
- Improvement of Supervisory skill through HRD programme.

Method

- Process optimisation through machinery balancing.
- Machine auditing through workers participation and autonomous maintenance practice.
- Method improvement in various operations for elimination of redundant work and process delay.
- Introduction of Enterprise Resource Planning (ERP) for production control and planning, performance evaluation, etc.
- Introduction of effective productivity-link-wage scheme.
- Optimum utilisation of man, machinery and material to make each processing stage as individual profit centre.

Material

- Quality assurance of input materials.
- Effective waste control regime.
- Standardisation of spare parts.

Service

- Effective maintenance practice for enhancement of machine utilisation and elimination of defective products.
- Frugal and effective utilisation of energy, water and other inputs.
- Effective process and Quality Control to ensure quality of product for customers' satisfaction.

Keeping these in view, a mill can prioritize the objectives and draw out plan for achieving the targeted improvement in productivity and quality.
3

Saddle with the problem of stagnation of productivity Indian Jute Industry and IJIRA started making sincere efforts to improve the situation through improvement in resource management. The major thrust areas of resource management are discussed below.

2.1 Machine

Indian jute industry started between 1855 - '59 with 8 Tonne spinning capacity and 192 looms. Presently, there are 73 jute mills producing over 1.6 million Tonnes of jute goods per annum. However, the associated improvement in the state-of-the-art machinery has taken place at a very slow pace. Moreover, most of the machinery improvement has taken place in the spinning preparatory and spinning stage only.

IJIRA initiated upgradation and innovation of the existing machinery for improving the productivity of the machines. IJIRA also jointly worked with the indigenous machine manufacturers and the industry to develop some high productive machines. Upgradation and modification of existing machinery through R & D of IJIRA and adoption of new commercially successful machinery are summarised below.

A. Upgradation and Modification through R&D of IJIRA

<table>
<thead>
<tr>
<th>Stages</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduction of softener rollers to 16 pairs.</td>
<td>- Saving of energy, space</td>
</tr>
<tr>
<td>2. High speed stirrer for emulsion preparation</td>
<td>- Reduction in Time, - Uniform emulsification</td>
</tr>
<tr>
<td>3. Sliver Grist Monitor at Breaker Card</td>
<td>- Reduction in man power - Better feed control - Better Sliver regularity</td>
</tr>
<tr>
<td>4. Auto-leveller at Finisher Card</td>
<td>- Better sliver regularity</td>
</tr>
<tr>
<td>5. Spinning breaks detector assembly</td>
<td>- Reduction in ends down rate at spinning</td>
</tr>
<tr>
<td>6. Self rotating bobbin holder for scroll winding machine</td>
<td>- Reduction of thread waste</td>
</tr>
<tr>
<td>8. Beaming Tension Controller</td>
<td>- Better weavers beam with improved individual yarn Tension. - Better weaving efficiency</td>
</tr>
<tr>
<td>9. Raw Jute Strength Tester</td>
<td>- Quick testing at mill level</td>
</tr>
</tbody>
</table>

Indian Jute Industries' Research Association
B. Adoption of New Machine & Equipment

<table>
<thead>
<tr>
<th>Stages</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jib crane / Fork lift at Jute and Finishing godown</td>
<td>• Reduction in manpower.</td>
</tr>
<tr>
<td></td>
<td>• Faster handling.</td>
</tr>
<tr>
<td>2. High speed Spreader</td>
<td>• Higher production per machine.</td>
</tr>
<tr>
<td>3. High speed Card</td>
<td>• Higher production per card.</td>
</tr>
<tr>
<td>4. Rotary Gili Drawing</td>
<td>• Higher production per machine</td>
</tr>
<tr>
<td>5. Use of Bauxter Flyer and larger bobbin in spinning</td>
<td>• Higher yarn content / bobbin.</td>
</tr>
<tr>
<td></td>
<td>• Higher Spinning efficiency</td>
</tr>
<tr>
<td>6. Ring Twisting</td>
<td>• Higher production</td>
</tr>
<tr>
<td></td>
<td>• Larger bobbin size</td>
</tr>
<tr>
<td>7. Herakle Sewing replacing Overhead Sewing</td>
<td>• Higher productivity than overhead</td>
</tr>
<tr>
<td>8. Oil Press for baling replacing Hydraulic press.</td>
<td>• Higher productivity</td>
</tr>
<tr>
<td></td>
<td>• Less energy consumption</td>
</tr>
</tbody>
</table>

Moreover, efforts are being made to develop / adopt high speed rapier looms for both conventional and diversified product. Efforts have also been made to develop Ring Spinning frame and Intersecting Gili drawing frame for jute by technical collaboration of IJIRA and indigenous machine manufactures. However, the commercial success of these machines are yet to be established.

2.2 Man

Since jute machinery are mostly non-automatic in type, these require constant servicing from the operator to deliver output. Hence, the operator as well as the support service providers play the most vital role in improving machine productivity. It has been observed through various studies that work load on jute mills workers are not evenly distributed resulting in loss of productivity in either case. Hence, work load on the workers are to be standardised and man-machine ratio is to be optimised and standard machine and labour productivity are to be determined by applying Industrial Engineering tools. IJIRA has already undertaken these works in the areas Winding, Weaving, Sack sewing and Finishing.

In jute industry, training of workers is grossly ignored. The employment pattern is dynastic in nature. The workers inherit the skill from his ancestors. As a result, the work method is very primitive and there is no effort from the management to improve upon the same. This has resulted in unnecessary
work, repetitive work and wastage of time and materials. This lacuna can be well taken care of by periodically conducting training programme where the workers will be exposed to improved method for honing their skill and expertise. Modules for the on-the-job vis-à-vis class room training programmes can be well designed to suit the need.

One of the major impedance of productivity improvement is the workers' attitude of adherence to quota production. Moreover, due to lack in the sense of belongingness to the organisation the workers are always skeptical about the management's attitude. These maladies can be overcome through Quality Circle which has proven records for bringing attitudinal change of the worker.

Supervisors are the interlocutor between the management and the workers. However, it has been observed that most of the supervisors employed in the jute industry do not possess the adequate technical knowledge nor the initiative. In absence of any defined job description, the supervisors in most of the time are chasing wild geese. The quality of supervisor should be improved through HRD programme. IJIRA has developed modules for such programme and periodically imparts training.

2.3 Method

The following methods can be adopted for improvement in productivity.

i) Process optimisation, through linear balancing of machinery. This will eliminate the problems of jute loss, process wastes, heavy / light etc. Based on the length of warp and weft required in weaving for a specific number of looms, machinery required in up stream and down-stream processes can be worked out.

ii) Process improvement at various stages by adopting various R & D package developed by IJIRA, like –

   a) Enzymatic upgradation of low grade jute fibre
   b) Optimisation of sliver evenness through improved gauging of card
   c) Use of Bio-modified TKP
   d) Loom modification and tuning
   e) Energy audit
   f) Improved count CV% and strength CV% of yarn
   g) Retention of higher moisture during jute processing

iii) Improved material handling systems are to be introduced for better handling of material at a quicker pace and at lower cost. Scope of improved material handling are to be assessed keeping in view of the lay out, floor condition etc. IJIRA has been able to propagate the concept of improved material handling in the jute mill for reduction of operations cost. Indian jute industry has already successfully introduced Fork lift in jute godown and Finished godown. Scope for extending the improved handling system in other areas are to be explored.

iv) Machine auditing is an important activity for assessing the health of the machines. It is a precursor to the good maintenance. Machine auditing is the gradation of machines according to their performance. The
gradations are done jointly by the production and maintenance personnel. On the basis of this assessment machines lying in the lower grades are updated through maintenance and extent of improvement are again assessed on the basis of performances.


vi) In Indian jute industry a worker earns his daily wages by mere attendance and not by production. The part of the wages linked to the production is so trivial that a worker does not feel any compulsion to produce more. This has resulted in variation in output among the same category of workers within a same mill. The helpless supervisor spend torrid time in chasing the workers for more production. However, no amount of chasing or coercion can sustain improve output from worker. Hence, an effective productivity-link wage is a long overdue. By this system an efficient worker will be rewarded with higher income and an errant worker will be penalised. However, management is to ensure the proper inputs and machinery condition. Indian Jute Mills were trying for some years to implement this scheme but could not devise a successful scheme. Hitherto, only one mill has been able to successfully implement this scheme. It has been reported that more than 80% of the workers are being benefited by this scheme.

2.4 Material

A productive system thrives on the quality of material inputs. Substandard and spurious materials of cheaper cost can prove dearer in the long run. Hence, quality of all incoming materials used in jute mills are to be properly assessed to commensurate with the final products.

Since the mills have little control over the quality of the fibre, the available fibres are to be upgraded. IJIRA has developed enzymatic upgradation of low grade jute fibre which can be helpful in this respect. Moreover, Jute Industry should come forward to sponsor projects for developing high yielding genetically improved fibre.

Waste generation in jute processing is unavoidable but generation of excessive waste is an attitudinal aberration. A successful waste control regime involving management, supervisors and workers can reduce the wastage substantially. Reduction of wastage should be everybody's business.
2.5 Service

2.5.1 Maintenance

Maintenance and repair activities are integral parts of production and productivity. The primary function of maintenance is the up-keep of all the machinery and equipment so that down time for failures can be minimised. The notion that expenditure on maintenance is unproductive as there is no direct income from maintenance is to be obliterated from the psyche. Inadequate maintenance will result in total collapse of machinery and may invite much higher investment.

Apart from the routine maintenance, there should be Preventive Maintenance, Condition Based Maintenance, Opportunistic Maintenance, Total Productive Maintenance and Autonomous Maintenance.

2.5.2 Energy Management

Jute mills are energy intensive. Energy cost accounts for 8.5 - 10.5% of the product cost depending on the product mix.

About 40% of the total energy consumption is in the spinning followed by weaving (25%) preparing (15%) and winding-beaming (10%). About 85% of the electrical energy consumed in jute mill is directly engaged in production, 12% in auxiliary section like workshop, water supply, etc. and 3% is consumed in lighting. The trend in electrical consumption in mills reveals that there is an increase in the annual consumption. Thus energy conservation efforts assume greater importance.

Energy Management is a disciplined activity organised for the more efficient use of energy without reducing the production level or lowering product quality, safety or environmental standards. The principle underlying all energy management must be cost effectiveness.

IJIRA has a team of experts who are regularly conducting energy audit in jute mills and also providing necessary consultations to mills for energy savings.

2.5.3 Quality and Process Control

The role of quality and process control in any manufacturing organisation need not to be over emphasized. It serves dual function of minimising the rejection and improving the quality of the products during manufacturing in one hand and ensures the customers' satisfaction through inspection of finished goods on the other hand. Though the jute industry had an established Quality and Process Control system, much of its activities have been discontinued and the system has been relegated to 'Product-Passing' only. However, any effort to improve the productivity and quality will be futile without a sound Quality and Process Control system.
3.0 CONCLUSION

Productivity is a function of various input resources and improvement in productivity can be achieved by maximising the utilisation of these resources. Productivity improvement should be a never ending motto. Stagnation in productivity in Indian jute industry can be attributed to various factors which are not insurmountable. Proper attitude and adaptability to accept charges are necessary. However, industry alone, in isolation can not bring about this change. A strong linkage with mutual trust and respect on continuous basis, could be established among the industry, the employees, the market and last but not the least the R & D.
Effect of Speed and Twist on Productivity of Fine Jute Yarn Produced by Modified Ring Spinning Machine

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Effect of speed and twist on Productivity of fine jute yarn Produced by modified Ring Spinning Machine

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ABSTRACT

An Apron Draft spinning machine was modified into ring system by incorporating rings and travelers instead of flyers. In this modification delivery zone of the machine was left unchanged. Two rails were incorporated, one for carrying spindle and another one for carrying rings. An idle roller was installed at the rear end of the machine for transferring power from main roller to the spindles. The input sliver of the machine was varied from 2412 tex to 2756 tex (70 to 80 lb/spy). The speed of the spindles was increased upto 9000 rpm from its original flyer speed of 4250 rpm. Twists of the yarn were inserted from 236 to 394 tpm (turns per meter). A good number of trial runs were performed for determining the productivity of the machine at different speeds and twists.

Productivity of yarn of 103 tex and 138 tex through the machine were observed at different speeds and twists. It was observed that speeds and twists have important influence on the productivity.

Key words: Apron Draft, Spindle Speed, Twist, Fine Yarn

1. INTRODUCTION

Jute is a natural cellulosic bast fibre [1]. It is a textile fibre of good spinable character. At present there is a large number of man - made fibres in the world textile market. Jute fibre has been facing a tough competition with man-made fibres since their emergence in the world textile market. To overcome this competition it is necessary to produce fine jute yarn by developing / modifying the existing jute machinery. Through this development it may be possible to spin fine jute yarn, which can be used for diversification of jute, such as lightweight shopping bag, furnishing fabric, decorative fabric etc. As a result, jute fibre may be used in the production of fabric that may further enhance its uses in various fields of textiles.

Different organizations both home and abroad are trying to introduce diversified jute products in the market [2, 3, 8,11]. With a view to earning foreign currency in substantial amount, fine jute yarn is very essential for the production of diversified jute goods. In this regard Bangladesh Jute Research Institute has carried out research works in the
development of a process for production of fine yarn [2,3,4]. In these works Gardella spinning machine has been used [2,4,10]. Moreover, the machine manufacturer is not making these machines for a long time. French Textile and Clothing Institute (IFTH) is doing research for production of fine and quality yarn from jute and other natural fibre like flax. N.S.C. (Schlumberger) a machine manufacturer of France is making some machines for producing fine jute yarn, for example N.S.C. 232 ring spinning frame[5]. But all these machines are not cost effective for jute fibre[11]. Mechanical Engineering Department of Bangladesh University of Engineering & Technology has carried out a research work under Ph. D programme for production of fine yarn by using Apron Draft spinning machine [9]. In this work, adaptation of ring spinning in the flyer spinning system was studied and different parameters were optimized for production of fine jute yarn.

There are various methods of jute spinning[6] such as, Flyer spinning, Ring spinning, wrap spinning, Centrifugal spinning etc. Modified Apron Draft flyer spinning machine was used in this study [9, 4].

Productivity is an important factor for any production-oriented industry. In this view for achieving maximum productivity it was necessary to determine and know the optimum parameters.

The aim of this study was to determine the spindle speed and twist for maximum productivity of fine jute yarn of 103 tex (3 lb/spy) and 138 tex (4 lb/spy) from the developed spinning system.

2. EXPERIMENTAL PROCEDURE

BWB (Bangla white B) grade jute fibre was used in conducting the experiment. Yarns of linear density 103 tex (3 lb/spy) and 138 tex (4 lb/spy) were produced at various spindle speeds and twists. Spinning performance of the machine as well as mechanical properties of the produced yarns was analyzed.

The back processing of the system was same as jute processing system. But linear density of the input sliver of the experimental machine was controlled within 2412 tex to 2756 tex (70-80 lb/spy) for smooth running of the machine for production of fine yarn. In each experiment spindle speed was varied keeping draft, twist, ring size, traveler size constant. Yarns of 103 tex (3 lb/spy) and 138 tex (4 lb/spy) were produced to study optimum speed for different productivity.

Similarly inserted twist was varied keeping draft, spindle speed, ring size, traveler size constant. The experiment was carried out at standard atmospheric condition of 65± 2% RH and 20° C at experimental spinning mill of Bangladesh Jute Research Institute.
3. RESULTS

Yarns of 103 tex and 138 tex were produced at spindle speeds of 5000 to 9000 rpm at 500 rpm interval. Similarly twists inserted in the yarns were 236, 275, 315, 354 and 393 tpm. At each speed and each twist yarns were produced.

3.1 Effect of Spindle Speed on the Productivity of the Experimental Machine

The spindle speed is an important factor for production of fine yarn. The spindle speed has various effects on productivity. It is directly related to the yarn tension during the winding of yarn on a bobbin. In spinning on-winding tension and spindle speed are two closely related parameters. It is a known fact that higher the spindle speed higher the yarn breaks during spinning.

The original Apron Draft Spinning machine is a machine of flyer speed in the range of 3500 rpm to 4750 rpm. In the machine, power was shifted to wharf through belt from the tin roller which received power from the main motor. In the modified machine power was transmitted directly to the spindle and the speed was increased. The machine was workable from 5000-9000 rpm. From this available speed range, it was necessary to select an optimum spindle speed for the production of fine count jute yarn through experimental study. The operating spindle speed of the machine was varied from 5000 rpm to 9000 rpm for determination of optimum spindle speed keeping all other parameters constant.

Spindle speed for the production of 103 tex jute yarn was found to be 8000 rpm whereas for 138 tex jute yarn it is 7000 rpm for maximum productivity. The results are plotted in figure 1. Production of yarn through higher speed than the optimum spindle speed increased the number of yarn breaks which reduces the production rate. On the other hand lowering the speed automatically lowers the productivity.

Quality ratio of the produced yarn decreased with increasing spindle speed. In the experiment twist inserted in the yarn was found to have released with the increase of speed, although a fixed twist was inserted and that reduced the strength of the yarn consequently reducing the quality ratio of the yarn.
3.2 Effect of Twist on the Productivity of the Experimental Machine

Twist is an important criterion for a yarn of particular linear density. Purpose of twist is to bind the fibres together and hold in the ends of fibre. Appropriate twist is required for optimum strength. Insertion of more or less twist decreases the yarn strength up to a level. If a yarn is examined closely it will be found that the number of turns or twist varies from point to point along the length. This arises mainly from the fact that the yarn mass itself fluctuates from point to point. Yarn twist is inserted by rotating the lower end of the yarn about the upper end and the twist actually ascends from below into the upper portions of the yarn and in this way runs up towards the drawing nip. The twist is transmitted by the lower fibres taking up a spiral formation and forcing those above them to conform to the same configuration. The fewer the number and less rigid the fibres, it is easy for the lower ones to force the upper ones to take up the same twist angle as themselves. It is the twist angle, which is the same along the length of the yarn. Because the twist angle is
constant (or in more practical terms, the twist factor is constant) those parts of the yarn that are thin have more turns per unit length than those are thick.

It was necessary to establish the optimum twist for fine yarn although twist varied with the variation of linear density of the produced yarns. In this study, the twist was optimized for 103 and 138 tex jute yarns. Twists of the yarns were inserted from 236 tpm (turns per metre) to 394 tpm for the determination of optimum twist for 103 tex and 138 tex jute yarn keeping all other parameters constant. There are two types of twist namely S-twist and Z-twist. The machine is capable to insert any kind of twist in the yarn. In the experiments S-twist was inserted.

Results obtained in the experiment are plotted in figure 2. It is shown that optimum inserted twist for maximum productivity is 315 tpm for 103 tex jute yarn and 275 tpm for 138 tex jute yarn. Insertion of more or less twist than the optimum twist in the yarn increased the number of yarn breaks, which ultimately reduced the productivity. Moreover better quality ratio of the yarn was found at the maximum productivity region, below that region the quality ratio decreased with the decrease of productivity. It indicates that twist of maximum productivity produces better yarn through the experimental machine.
3.3 Comparison of quality ratio of yarns produced by the modified ring spinning machine and other fine jute yarn producing machinery from BWB grade jute fibre.

Quality ratio is one of the criteria to assess a yarn. Higher quality ratio means a yarn of higher strength. Higher quality ratio is always preferred. Quality ratios of yarns produced by the modified ring-spinning machine were compared to the yarns produced by other fine jute yarn producing machinery.

In this comparison it was shown that the quality ratio of yarn produced by the Spingard spinning machine is 76.33 %, the quality ratio of yarn produced by the Bolleli ring spinning machine is 79.36 % and the quality ratio of yarn produced by the N.S.C. ring spinning machine is 76 %. On the other hand the quality ratio of yarn produced by the modified ring spinning machine is 72 %. The quality ratio of yarn produced by the experimental machine is nearly the same as that for the yarns produced by other jute yarn producing machinery. Gardella, Bolleli, N.S.C. ring spinning machines are not cost effective for jute industry. Comparison of quality ratios of yarns produced by the different machines is shown in figure 3.

![Figure 3: Comparison of Quality Ratio of Yarns Produced by the Modified Apron Draft Ring Spinning Machine and Other Machines](image-url)
CONCLUSIONS

The following conclusions can be drawn from the study:

- Apron Draft spinning machine can economically be converted into ring spinning.
- The machine is capable to produce jute yarn of 103 tex to 138 tex (3 lb/spy to 4 lb/spy).
- Optimum spindle speed and twist is essential for higher productivity.
- Application of spindle speed and twist other than optimum speed lowers the productivity of the machine.
- It was shown that possible optimum spindle speed is 8000 rpm for production of 103 tex (3 lb/spy) jute yarn.
- It was shown that possible optimum spindle speed is 7000 rpm for production of 138 tex (4 lb/spy) jute yarn.
- Optimum twist is 315 tpm for 103 tex and 275 for 138 tex yarn.
- Quality ratios of the produced yarns are satisfactory.

ACKNOWLEDGEMENTS

The authors are pleased to acknowledge the support of Bangladesh Jute Research Institute, Bangladesh Agricultural Research Council, Bangladesh University of Engineering & Technology and French Textile and Clothing Institute (IFTH), Lille, France for this study.
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PERSPECTIVE IN ADOPTION OF NEW TECHNOLOGY IN JUTE INDUSTRY FOR DIVERSIFIED APPLICATION TOWARDS PRODUCTIVITY IMPROVEMENT

D. Paul, A. K. Majumder and S. K. Bhattacharyya
Perspective in adoption of new technology in jute industry for diversified application towards productivity improvement.

D. Paul, A. K. Majumder & S. K. Bhattacharyya

Jute is being cultivated in India for centuries. The landmark in the history of jute industry dates back to 1854 when the first jute mill was set up by George Auckland at Rishra in West Bengal. In India about 100 thousand hectare of land is covered under jute and mesta cultivation. The total production of jute in the country is around 1800 thousand tonne (100 laks bales). However, the golden fibre started losing its glitter during the latter period of the 20th century due to influx of synthetic fibres by eroding a portion of the market for traditional packaging products. Fortunately, jute is being presently appraised as a material for new engineering application areas due to its intrinsic characteristic properties with its versatility in innumerable end uses. The world jute scenario has significantly changed during the last two decades presenting the ambience of jute producing countries to new mindset for identifying alternate uses of jute in order to sustain the production and demand for jute and ensure fair price to the poor farmers. The dawn of the new millennium reeling over cleaner - greener earth has set the golden fibre jute as an appropriate medium for balanced ecology.

Present scenario: Jute industry

India is the largest producer of raw jute in the world contributing about 40 per of the world crop followed by Bangladesh, China, Myanmar, Nepal and Thailand. It is also the largest manufacturer of jute goods contributing around 45-45% of total world production of the commodity which is followed by Bangladesh with its contribution of 16-20%. Traditionally, the major production in jute industry constitutes the packaging materials, viz, sacking and hessian covering about 75-80% of total production of jute goods in the country. It has been observed from the trend of production, internal consumption and export of jute goods during last five years from 1995-96 to 2000-01 while the production of sacking has increased during this period. It is significant to note that the country has witnessed a remarkable growth in record production of food grain which has possibly created a rise in demand of packaging materials for food grains. However, a severe decline in production of carpet backing cloth is observed during the period due to fall in export of the item.

The other products manufactured by jute include twine, canvas, webbing, soil saver, felt, decorative fabric, carpet, floor covering, blanket, wall hanging, shopping bag etc. The figures pertaining to production, internal consumption and export of jute goods show that 80-90% of jute goods manufactured is consumed domestically. On an average 10-12 percent of total production of jute goods in India is exported to all over the world. The countries in Latin America and Europe are the major importers of jute goods.

Table 1 Production, Internal consumption and export of Jute goods in India

<table>
<thead>
<tr>
<th>Period</th>
<th>Production</th>
<th>Internal Consumption</th>
<th>Export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-96</td>
<td>1433.0</td>
<td>1161.3</td>
<td>218.1</td>
</tr>
<tr>
<td>1996-97</td>
<td>1400.9</td>
<td>1136.0</td>
<td>155.0</td>
</tr>
<tr>
<td>1997-98</td>
<td>1678.4</td>
<td>1387.2</td>
<td>240.0</td>
</tr>
<tr>
<td>1998-99</td>
<td>1596.2</td>
<td>1404.3</td>
<td>172.0</td>
</tr>
<tr>
<td>1999-2000</td>
<td>1590.2</td>
<td>1426.7</td>
<td>147.0</td>
</tr>
<tr>
<td>2000-01</td>
<td>1624.9</td>
<td>1435.1</td>
<td>255.1</td>
</tr>
</tbody>
</table>
### Table 2
#### Export of Jute Goods

<table>
<thead>
<tr>
<th>Period April-March</th>
<th>Hessian</th>
<th>Carpet Backing Cloth</th>
<th>Sacking</th>
<th>Yarn</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qty.</td>
<td>Value</td>
<td>Qty.</td>
<td>Value</td>
<td>Qty.</td>
<td>Value</td>
</tr>
<tr>
<td>1997-98</td>
<td>103.5</td>
<td>294.24</td>
<td>13.5</td>
<td>40.70</td>
<td>17.9</td>
<td>40.59</td>
</tr>
<tr>
<td>1998-99</td>
<td>65.3</td>
<td>199.39</td>
<td>15.3</td>
<td>46.87</td>
<td>8.0</td>
<td>20.45</td>
</tr>
<tr>
<td>99-2000</td>
<td>52.4</td>
<td>192.00</td>
<td>6.1</td>
<td>20.60</td>
<td>2.5</td>
<td>9.25</td>
</tr>
<tr>
<td>2000-01</td>
<td>86.0</td>
<td>317.60</td>
<td>8.1</td>
<td>24.28</td>
<td>3.1</td>
<td>10.45</td>
</tr>
<tr>
<td>2001-02</td>
<td>51.6</td>
<td>187.36</td>
<td>2.9</td>
<td>9.86</td>
<td>21.1</td>
<td>7.36</td>
</tr>
<tr>
<td>2002-03</td>
<td>27.2</td>
<td>99.05</td>
<td>1.5</td>
<td>5.40</td>
<td>1.2</td>
<td>4.80</td>
</tr>
</tbody>
</table>

Value: Rs. Crores

(Source: DGCI & S, Kolkata)

### Table 3
#### Export of Jute Goods Other Than Hessian, Carpet Backing Cloth, Sacking and Yarn

<table>
<thead>
<tr>
<th>Period April-March</th>
<th>Canvas Tarps &amp; Twine</th>
<th>Webbing</th>
<th>Soil Saver</th>
<th>Felt</th>
<th>Floor Covering</th>
<th>Shopping Bag</th>
<th>Deco. Fab.</th>
<th>Wall Hanging</th>
<th>Blanket</th>
<th>Any Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>1.94</td>
<td>2.10</td>
<td>3.82</td>
<td>0.37</td>
<td>34.59</td>
<td>16.12</td>
<td>5.67</td>
<td>3.89</td>
<td>0.42</td>
<td>18.29</td>
<td>87.21</td>
</tr>
<tr>
<td>1998-99</td>
<td>2.78</td>
<td>1.04</td>
<td>4.02</td>
<td>0.28</td>
<td>54.23</td>
<td>19.08</td>
<td>4.95</td>
<td>5.58</td>
<td>0.85</td>
<td>37.34</td>
<td>131.15</td>
</tr>
<tr>
<td>99-2000</td>
<td>2.67</td>
<td>2.74</td>
<td>6.24</td>
<td>0.45</td>
<td>48.71</td>
<td>28.62</td>
<td>2.79</td>
<td>7.36</td>
<td>1.03</td>
<td>3.65</td>
<td>138.26</td>
</tr>
<tr>
<td>2000-01</td>
<td>4.13</td>
<td>3.09</td>
<td>9.75</td>
<td>0.54</td>
<td>66.31</td>
<td>54.53</td>
<td>4.21</td>
<td>5.67</td>
<td>0.43</td>
<td>90.07</td>
<td>238.73</td>
</tr>
<tr>
<td>2001-02</td>
<td>2.33</td>
<td>2.45</td>
<td>6.11</td>
<td>0.57</td>
<td>76.63</td>
<td>39.97</td>
<td>2.52</td>
<td>6.38</td>
<td>0.77</td>
<td>49.77</td>
<td>187.50</td>
</tr>
</tbody>
</table>

### Table 4
#### Unit Value of Export of Jute Goods

<table>
<thead>
<tr>
<th>Period: April-March</th>
<th>Unit: Per M.Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rs.</td>
</tr>
<tr>
<td>1. Hessian</td>
<td>28429</td>
</tr>
<tr>
<td>2. Carpet Backing Cloth</td>
<td>30148</td>
</tr>
<tr>
<td>3. Sacking</td>
<td>22670</td>
</tr>
<tr>
<td>4. Yarn</td>
<td>24316</td>
</tr>
<tr>
<td>5. Can/Tarp/Twine</td>
<td>29485</td>
</tr>
<tr>
<td>6. Webbing</td>
<td>38510</td>
</tr>
<tr>
<td>7. Soil Saver</td>
<td>12292</td>
</tr>
<tr>
<td>8. Decorative Fabrics</td>
<td>55147</td>
</tr>
</tbody>
</table>

Source: DGCI & S, Kolkata
Jute industry: Global scenario

Now, a close look at this industry in global perspective would help find its future and right position of India in jute industry. The following Tables show the actual export of jute goods of traditional viz. hessian, carpet backing cloth, sacking, yarn and other items viz. canvas tarp., webbing, soil saver, felt, floor covering, shopping bag, decorative fabric, wall hanging, blanket etc.

The pervasive strength and potential of this intrinsically ecofriendly fibre is evident from its use over a large number of countries including Latin America, Europe United States, Near East and Far East countries.

The Tables on export of jute goods show promising growth in some specific product items viz. yarn, soil saver, floor covering, wall hanging, shopping bag and others indicating a significant rise in the value of jute goods.

It is also noted from the Table pertaining to unit value of export of jute goods that except the decorative fabric item there is no significant rise in unit value of other products. No doubt this calls for urgent and special attention towards value addition to traditional products through qualitative improvement.

Profits, Prices and Productivity

The growth is productivity makes a country more competitive in world markets. But a high productive process is not always a highly profitable process although there is usually a positive correlation with success. There are exceptions when shortage or inflationary economy masks and when the output of an efficient process is unwanted, regardless of attractive price and quality. The conventional relation between changes in profitability, price contribution and productivity are shown in the figure below.

\[
\begin{align*}
\text{Change in PRODUCT QUANTITY} & \rightarrow \text{Change in REVENUE} & \rightarrow \text{Change in PRODUCT PRICE} \\
\downarrow & \downarrow & \downarrow \\
\text{Change in PRODUCTIVITY} & \leftarrow \text{Change in PROFIT PRICE} \\
\uparrow & \uparrow & \uparrow \\
\text{Change in RESOURCE QUANTITY} & \rightarrow \text{Change in COST} & \leftarrow \text{Change in RESOURCE PRICE}
\end{align*}
\]

*Fig. : Interrelationship of the prices and quantities of resources and products to profit.*
The centre column shows how profit variations are driven by changes in revenue and cost. The top and the bottom rows respectively link changes in product quantity & price to revenue, and changes in resource quantity & price to cost. The outside columns indicate that productivity change is a function of changes in production quantities and resource consumption and that price contribution depends on changes in the price of products and resources. Productivity is thus the ratio of output products to input resources. Price contribution measures how the resource price increases are compensated by higher prices for products sold. When the price of a product goes up faster than the cost of the resource to produce it the profit probably climbs, even without a productivity increase which is inflationary pricing.

The traditional equation of profitability is considered as:

\[
\text{Profitability} = \frac{\text{Revenue}}{\text{Expenses}}
\]

which can be expanded to

\[
\text{Profitability} = \frac{\text{Output quantity} \times \text{Unit price}}{\text{Input quantity} \times \text{Unit cost}}
\]

which leads to

\[
\text{Profitability} = \frac{\text{Output}}{\text{Input}} \times \frac{\text{Price}}{\text{Cost}}
\]

\[
= \text{Productivity} \times \text{Contribution factor}
\]

The contribution factor is also called a price recovery factor to characterize an ability to pass input price increases the customer as a higher output price. Thus the unit price and unit cost are significant factors governing the profitability of an organization.

In jute industry value addition processing to produce diversified products contributes towards higher unit price resulting in higher profitability. Some of value added diversified products like decorative fabrics, handicrafts have been fetching higher unit value in overseas market compared to traditional goods. Such products no doubt call for high grade quality jute fibre which is not available adequately in India due to lack of appropriate retting facility in village areas.

Perception of quality in processing of jute for manufacture of value added diversified products must integrate improved practices & technologies of retting & fibre extraction with appropriate mechanization, efficient planning, scheduling & control in multiple product mix production system with a holistic approach to achieve higher productivity. At present the major quantity of fibre available at jute mills belong to TD4-TD6 or W4-W6 requiring root cutting before feeding the material to breaker card to the extent of about 15-20% of fibre reed by weight. The quality attributes need to be contemplated right from the farmer’s level in order to sustain the quality at all stages of life cycle of jute processing. In organization working with a specified goal or objective any activity that contributes to its achievement is
known as value adding activity while any activity being carried out by ignorance or compulsion in order to rectify detects or faults occurring in the product somewhere in the production system is considered as non-value adding because had the process generating such defects been operated in fault-free manner, there would have been no defect in the product for removal of which such work became necessary. The cost incurred in such activity is also known as Cost of Non-quality. The concept of Cost of Quality (COQ) which had taken birth after the advent of Total Quality Management (TQM) in industries is very much relevant in today’s scenario of global competitiveness.

Call for qualitative improvement of traditional products

The qualitative improvement in fibre is the urgent need in today’s world of competitive market for producing finer yarn and fabric with superior finish leading to value added diversified jute products. The technologies developed on chemical processing for bleaching and dyeing have considerably contributed towards value addition to yarn and fabric produced. This is being will utilized to produce home textiles, decorative fabrics and fashionable products as new diversified items. The hessian fabrics of superior finish is now the major raw material for producing a variety of bags, briefcases, shopping bags, office stationery and other various applications. The fine yarn is also being used in making various decorative handicrafts and fashion items which have a good market potential within the country and overseas. Improvement in appearance of traditional jute products is much needed so that it becomes less hairy, brighter, lighter, coloured printed with desirable functional property i.e., odourless jute packaging for sensitive food products such as rice, tea and rot/mildew/moth-resistant/fire-resistant/water-resistant jute packaging products.

Quality Management at Farm level

The issues concerning the growing of quality jute by the farmers are manifold. The major constraints in jute production centre around technical, climatic, socio-economic, economic and policy matters in nature.

Retting of Jute

Retting ranks as the single most important factor governing quality of fibre. Retting is the microbial process of separating the embedded fibre from the stem through partial rotting (biodegradation) by immersion in water which is brought about by a complex enzyme action of microbes naturally present in retting water. The environment plays an important role in governing the presence or absence of retting microbes and their functions. Besides the varying conditions of retting, a large number of interacting factors are responsible for variation in fibre quality. For retting the water is of paramount importance. But the farmers in all jute growing countries depend almost entirely on the facilities available in nature. As a result, jute is mostly retted in ponds, roadside ditches, canals, tanks and rivers. Retting is best performed in clear, slow flowing water. Areas suffering from paucity of retting facilities invariably produce fibre of low grade with one or more defects, despite the use of the best variety and the application of agronomic skill.
Ribboners for Extraction of green bark

Manual Ribboner
In manual ribboning simple country devices could be improvised for stripping the green bark from single plant. For this, a vertical pole, bamboo hook and bicycle hub can well be used for extracting the green ribbon by manual operation.

Power Ribboner
Jute Ribboners developed by NIRJAF can be operated by power for extracting the green bark free from sticks. Keeping in view the feedback from the cultivators the institute has designed and fabricated the prototype ribboners of two models for laboratory trial and field level trial. The fibre extracted by retting the ribbons is free from roots and thereby upgraded. The improved ribboners were designed with unique feature that the ribbons can well be extracted from jute stems maintaining the full length sticks which are much needed by the farmers for using it as fuel, fencing, beetle leaf cultivation and reinforcing material for construction. The improved ribboners have been demonstrated to the jute growers.

Post retting fibre quality improvement
NIRJAF has developed a fungal culture (Aspergillus sp.) which can be applied on the barky fibre for post retting treatment softening the barky root thereby improving the quality of fibre by 2-3 grades. A novel method of preserving the culture in a solid carrier has also been developed. The solid culture can be packed and supplied to the farmers conveniently. The fibre thus treated by the culture fetches remunerative price and the low grade barky fibre becomes worthy of selling. The culture is being produced commercially.

Another fungal culture (Penicillium sp.) has been developed in the institute laboratory for softening the root cuttings and barky jute in the industry. The method has also evoked good response from the users. It has been shown that waste root cuttings and barky fibre can be utilized for making finer products such as hessian and carpet backing. The culture can be prepared in the mills without affecting the conventional production system.

Quality Management at mill level
It has been observed that high grade quality, specially fine quality fibre can be processed in Breaker Card, Intermediate Card, Finisher Card and First Drawing machining with higher productivity compared to that of coarse fibre. As such the operational efficiency can also be improved with the processing of better quality fibre.

Production & Operation Management
In jute industry the efficient management of total production operation system needs to reexamined for appropriate production planning & scheduling, logistics management, resource management for materials, machines & manpower. In liberated economy the withdrawal of all types of subsidies under Jute Packaging Act in future will lead to new situation for marketing of packaging materials. Under the circumstances the planning for multiple product mix production system needs to be exploded with the new products in view. It is envisaged that the industry would look ahead with new vista for a paradigm shift in application of jute diversified products.
Diversified products – New paradigm in perception

During the last decade research conducted in post harvest processing of jute has proved enormously beneficial so far as the improvement in fibre quality is concerned. The qualitative improvements have much bearing towards contribution to superior finish and value enhancement in finished products. Through these technological explorations, an array of innumerable jute diversified products have emerged. Many of the new diversified products have already proved gainful for commercial exploitation. The major jute diversified products (JDP) developed successfully in India include the following items:

- Jute fine yarn (6 lbs & below) from jute fibre for production of jute fabric in handloom/powerloom.
- Jute blended fine yarn (with viscose, polypropylene, acrylic, wool, cotton, etc.) from jute fibre for production of blended fabric.
- Jute-acrylic knitting yarn.
- Handbags and shopping bags using 100% jute fabric.
- Soft luggage, brief case, travel kits using 100% jute fabric and also jute blended fabric.
- Jute blended woven fabric containing more than 50% and less than 100% jute for apparel industry, home furnishings, upholstery products.
- Food grade odourless (hydro-carbon free) jute bags for tea and coffee packaging.
- Woolenised jute blanket.
- Polypropylene blended jute blanket.
- Woolenised jute carpet.
- Polypropylene blended jute carpet.
- Jute geo-textiles for application in soil erosion control, weed control and mulching in tea gardens, civil construction (in construction of roads, bridges, etc.)
- Jute based floor coverings.
- Jute stick particle board for such applications as false ceiling, office panel/partition board, sound box, TV/Radio cabinet, etc.
- Jute-Polyester composites for manufacturing such products as chair shell, door & partition, instruction panel, kitchen sink, car body panel, home furnishing, etc.
- Jute thermosetting composite boards for applications as vertical panelling, roof ceiling, coach building, furniture, door & window, etc.
- Jute-Polypropylene composites for such applications as automotive interiors, textile bobbins & spools, flower pots, toys, furniture, shipping pallets, etc.
- Jute based handmade paper.
- Apparel/fashion garments, home furnishing, upholstery products, etc. based on jute fabric/blended jute fabric.

Golden fibre – New perception under liberalisation and globalisation on agricultural sector

The National Agriculture Policy framed in new millennium has taken into account the integration of agriculture trade in the new global programme under World Trade Organisation (WTO). The policy envisages a long-term annual growth based on efficient use of resources, growth with equity, growth that is sustainable and growth that is demand driven and caters to domestic markets and derives benefits.
The policy broadly focuses on productivity, diversification, sustainability, decentralization, reducing regional imbalances, extension, exports, marketing, investment in agriculture and globalisation & commercialization. The objectives of the policy emphasizes to actualize the untapped potential of the farm sector, strengthen rural infrastructure to support faster development, promote value addition, accelerate the growth of agro business, create employment in rural areas, ensure household food and nutritional security, secure a fair standard of living for farmers and agriculture workers and discourage migration to urban areas.

The policy envisages as a goal the need for the agriculture sector to meet the challenges arising from economic liberalization and globalisation, particularly with reference to the World Trade Organisation. It notes the strides taken by the agriculture sector in moving from food shortage and imports to self-sufficiency and exports. It recalls the green revolution in foodgrain production, the yellow revolution in edible oils, the white revolution in milk production and the blue revolution in fish production while admitting the inadequacy of resource availability, lack of infrastructure development, institutional and technological support and policy induced limitation but commits to ushering an era of rainbow revolution embracing all aspects of agriculture growth including growth of commercial fibre crops such as jute.
FOR NOTES
PRODUCTIVITY IMPROVEMENT IN LOOM SHED

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Productivity Improvement in Loom Shed
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Long Abstract

This paper deals with international and national scenario of production and market share of jute goods, more particularly the present situation of Indian and Bangladesh Jute Industries, as represented by a part of sample survey report of Institute of Jute Technology (IJT) with particular reference to weaving production in few mills of India and Bangladesh. An average snap study report based on a study covering a few mills has been prepared by IJT for identifying the percentage loss of conventional hessian and sacking loom efficiency for different causes, which indicates the major technical reasons for low efficiency in loom shed. From this snap study as well as from survey and visits of IJT faculty in last three years during conducting workers' training in different jute mills in India, all responsible factors for loss of productivity in loom shed have been identified and reported. The major factors for such loss in productivity of loom shed are-(a) improper warp and weft yarn quality, (b) poor supply/shortages in warp and weft yarns, (c) improper sizing of warp yams, (d) improperloom tuning and setting, (e) undesirable loom stoppages including knock-off, (f) undesirable speed loss in the loom, (g) improper quality control measures for fabric production, (h) ineffective and inadequate process control measures, (i) higher wastage in loom shade, (j) improper or inadequate maintenance, (k) improper or less efficient organizational policy (l) improper skill and work method of weavers, weaving sardars and loom-fitters and (m) Inadequate mind setup, training and HRD activity. Each of these factors are discussed separately with specific suggestions for necessary strategy, care and actions to be taken for improving the productivity in conventional hessian and sacking looms. Our experience and feed back from Industry on these issues were discussed and need of appropriate technical studies, sustainable HRD activity and standardization of labour productivity norms are felt to be essential. Most of the jute mills of India and Bangladesh still run conventional hessian and sacking jute looms. A few mills are using shuttleless automatic looms aiming at higher productivity, but they are getting less than expected level of productivity in most of the cases. The factors for lower productivity in shuttleless looms are also highlighted. IJT's role in terms of offering all types of technical consultancy and HRD services for productivity improvement in loom shed is also focused for the benefit of user industry. These services include tailor made training modules for weaving supervisors, weaving sardars, weavers and loom-fitters for attaining proper knowledge, skill and work method, as well as technical consultancy in attaining proper quality of warp and weft yams and their testing, proper loom tuning and settings and consultancy for proper loom maintenance etc. for efficient weaving and overall productivity improvement in loom shed. However, no piece meal action will serve the purpose and it needs actions in totality considering all the above discussed issues.

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Productivity Improvement in Loom Shed
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Abstract

This paper deals with international and national scenario of production and market share of jute goods of Indian and Bangladesh Jute Industries, as represented by a part of sample survey report of Institute of Jute Technology (IJT) with particular reference to weaving production in few mills of India and Bangladesh. An average snap study report has been prepared by IJT for identifying the percentage loss of conventional hessian and sacking loom efficiency for different causes, which indicates the major technical reasons for low efficiency in loom shed. From this snap study as well as from survey and visits of IJT faculty in last three years during conducting workers’ training in different jute mills in India, all responsible factors for loss of productivity in loom shed have been identified and reported. Each of these factors are discussed separately with specific suggestions for necessary strategy, care and actions to be taken for improving the productivity in conventional hessian and sacking looms. Our experience and feed back from Industry on these issues were discussed and need of appropriate technical studies, sustainable HRD activity and standardization of labour productivity norms are felt to be essential. Most of the jute mills of India and Bangladesh still run conventional hessian and sacking jute looms. A few mills are using shuttleless automatic looms aiming at higher productivity, but they are getting less than expected level of productivity in most of the cases. The factors for lower productivity in shuttleless looms are also highlighted. IJT’s role in terms of offering all types of technical consultancy and HRD services for productivity improvement in loom shed is also focused for the benefit of user industry. However, no piece meal action will serve the purpose and it needs actions in totality considering all the above discussed issues.

1.0 Introduction

1.1 International and National Situation

The Indian Jute Industry was established around 150 years back by colonial rulers seeing the excellence of jute fibre that can be used for packaging various commodities like food grains, cereals, sugar, cement, fertilizers etc, as substitute of flax and/or cotton packs.

Jute bags are mainly for packaging medium to heavy duty packs. Besides, it also produces hessian fabric meant for wrapping and medium duty packs. The total production of jute goods in India was stagnant in and around 12-13 lakhs metric ton per year during 1990 – 2000, while in last three years it has grown to around 17 lakhs metric ton per year. In last two years, 4 – 5 number of new jute mills have been established in and around West Bengal.

Today, in India, the production of hessian and sacking is around 74.6% of the total production of jute goods with a share of about 16.7% and 57.9% for hessian and sacking respectively.

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About 72 mills (57 mills in West Bengal and other mills in neighbouring state and also in south Indian state) are engaged in the production of jute goods in India. The Indian jute industry employs around 1.5-1.6 lakh workers directly and 0.5 lakh workmen indirectly and another 0.5 lakh workmen in ancilliary workmen in feeder industries\(^1\). Besides, the livelihood of about 40 lakhs people of jute farmers and their family are dependent on cultivation and production of raw jute in West Bengal, Assam, Orissa, Bihar and Andhrapradesh mainly.

World wide use of jute and jute like fibres was grown up to 3.8 million ton in the year 1980, and after that it is gradually declining so far. However, presently about 2.5 -2.7 million ton jute fibre growing and processing industry remains a major business for India and Bangladesh\(^2\). Synthetic polyolefin substitute has eroded jute’s market share particularly for jute sacks. In China, where the output and consumption of jute sacking reached almost one million ton in the year 1980, has now been collapsed, when woven polypropylene (PP) was permitted there to absorb an unrestricted market share. Secondly China having short of agricultural land for food, obviously has no incentive to encourage jute growing and many of the jute mills in China have been wind up. While in India, having excess of land, Govt. supported the farmers for the cash crop to assist and to secure the domestic market share by introducing mandatory jute packaging materials act, 1987. Presently in terms of final consumption, Indian internal market absorbs more than half of the total world output of jute products

World jute and allied fibre production is around 2.7 million ton, out of which India produces 1.74 million ton (65%) and Bangladesh produces 0.88 million ton (28%)\(^3\). Production of other jute producing countries has gradually declined (particularly in China) excepting India, rather it has shown some incremental trend in domestic market.

In case of Bangladesh, export of raw fibre and jute goods are in the order of 95.6% of total production of jute goods of Bangladesh ; while for India it is only about 11.2% of total production of jute goods in India. It means about 88.3% of total production of jute goods is consumed in the Indian domestic market. Thus sets two different marketing strategy/management for these two major jute producing countries, as one has to depend on export and other on domestic market.

1.2 Survey on Weaving Production Performance in Different Jute Mills of India and Bangladesh

IJT made a sample survey of few jute mills of India and few jute mills of Bangladesh, with predesigned set of questionnaire and observed results are summarized in Table – 1 with particular reference to production performance as analyzed below.

Most of the machinery of Indian jute mills including the conventional hessian and sacking looms are quite old and maintenance activity is not upto the expected level\(^5\). Spinning efficiency of most of the Indian jute mills is in the range of 75-82% and that of weaving is in the range of 49-65% for hessian and ranges 66-72% for sacking with definite exceptions in few mills. Actual average productivity index of these mills is around 85.2 (ranging 78-92). Many mills are trying to improve their productivity in pre-loom process by incorporating new control accessories and/or by installing modem machinery like grist monitor for breaker card, auto leveller for finisher card, draft-o-matic monohead draw frames to produce regular slivers etc. to get regular yarn for better weaving. Some mills have installed machinery including ring spinning frame for producing finer counts of yarns, but are not much satisfied with its performance. In weaving section, a few mills have installed shuttleless automatic looms from Sulzer, STB, Dornier, ATPR and Himson Co etc. to improve the productivity and quality as well ; but mills are not getting expected level of productivity in these looms. The industry requires trained workers, fitters, sardars and supervisors/ technicians with enriched skill and knowledge for handling the new equipment and also for removal of orthodox ideas to derive real benefits from new type of machinery. Though
some mills have qualified technologists and managers, but quiet a number of mills have supervisors without adequate qualification and knowledge. It is a fact, that some technologists and engineers have introduced many successful ideas and innovations in some jute machinery and processing systems but the overall situation is very gloomy. Careful maintenance and continual HRD programme are the two neglected areas except in one or two jute mills. However, a few jute mills in India are now running continuous counselling, quality circle meeting, or interaction programmes with the workers for improving their operational efficiencies and performance. They have introduced 'Quality Circle' technique for their workers, which helped them to achieve higher productivity and to create a better working environment.

However, the situation is slightly different for jute mills in Bangladesh. All the mills were established between 1952 and 1970 and therefore are having comparatively modern jute machinery. Around 90-95% of its total production is exported and hence they give utmost importance on quality. They also give prime importance on machinery maintenance though their machines are relatively newly installed and are in a comparatively better condition. Various quality control measures are also taken regularly to meet the requirements of the foreign buyers. However, there is enough scope to improve the skill of the workers and supervisors and thereby productivity and quality. Most of the supervisors are science graduates and have been trained on job by the respective mills before their induction. Hence, there is essential need of HRD training both at worker and supervisor level in Indian and Bangladesh jute mills, which may bring a partial improvement in overall productivity including that of loom shed.

It may be seen from data in Table-1, that the product mix followed in the mills do not vary much except mill D where hessian percentage is predominantly high whereas in mill E, it is predominantly sacking product. In the weaving section, the production seems to be quite low in mill B, where the weaving efficiency is the lowest. Regarding loom efficiency of mill B, C and D, there is certainly scope of improvement. Of course, the number of sacking looms in mill B is less compared to other mills, which accounts to a certain extent, the less overall tonnage, but the hessian loom efficiency in this mill is also found below the expected level.

Correspondingly, in the spinning section (Table-1), the spinning efficiency is lowest in mill B, particularly in the coarser product section. Due to low spinning efficiency, the average number of spindles per loom per shift in the fine side (hessian) is as high as 16.82 in mill D and is nearly 8 in the coarser product section (sacking) in mills B and D. There is not much difference of the wastage % in loom shed of different mills but the wastage are on little higher side; though the data supplied do not tally when a deeper look is taken in the total weaving productions indicating probable jute loss due to overweight of fabrics in mills B and C. The material input-output ratios supplied by the mills are more or less comparable except mill D where jute loss is on the higher side.

Man-days per ton of production is highest in mills B and this is also on much higher side in the mills C and D, suggesting ample scope of improvement in production to bring down the man-days per ton.

It is reported that all the above sample mills are more or less following their own production and process norms, machine standardisation, testing and quality control activities, waste control measures and machine auditing system quite scrupulously, where the productivity levels talk otherwise. Productivity index is found highest in mill A and lowest in mill B, having nearly 8-22% shortfall from standard productivity achievable in these two mills, which can be further improved with proper care and necessary strategy and actions. The total average productivity index of five sample mills is found around 85% and thus there is about 15% shortfall, showing the further scope of improvement.
Finally, it is to be mentioned that the experience of I.J.T-survey team during their mill visits and also from their discussions held with supervisors and managers on the mill-floor is not heartening as far as the technical knowledge of the working personnel is concerned. It is to be expected therefore that a systematic and planned HRD Training Programme is imperative in achieving overall improvement in the performance level of all the mills. When one talks about productivity, it evidently takes into account about the raw material cost, labour cost and other production cost factors; which, if can be reduced, there is a rise in overall productivity index. Bangladesh Mills are in better condition in this matter as the batch cost is found to be much lower in Bangladesh mills, whereas the labour cost is slightly higher there compared to India but all other costs are remaining same in Bangladesh and Indian jute mills.

2.0 Measurement of Productivity

It is common concept to estimate productivity index by calculating output/input ratio. The input may mean any single factor, such as, man-hour, machine-hour, raw-material weight or volume, capital invested, energy input or fuel-hour, etc. or an overall combination of all the inputs taken together. Comparison of output with all input factors taken together is used to calculate overall Productivity index. Comparison of output with any one of the input factors, keeping all other factor constant, is considered to calculate Partial Productivity index for a particular input factor only. But, there are many production factors (say, managerial skill), which are not measurable in reality and hence partial productivity in terms of those factors can not be assessed. The common measurable factors are man-hour, machine-hour or capital investment and sale turnover or units of raw materials used for a particular production volume etc. Hence, commonly measurement of productivity index (partial productivity) is done in an industry mainly by calculating the production output per unit of man-hour or machine-hour (sometimes, also assessed considering the capital input or raw material input). However, in many situations, it become difficult to convert the output or input items to some standard forms to compare. Under such situation price is a common denomination that can be used, provided all expressed at constant prices. But prices do not remain constant and direct physical measurement of input and output in the same unit is preferable.

British Institute of Management has considered the following definition of productivity

\[
\text{Plant productivity} = \frac{\text{Production in unit value or standard-hours}}{\text{Total man-hours or machine-hours used}}
\]

However, one can calculate net productivity and overall productivity as follows:

\[
\text{Net labour productivity} = \frac{\text{Production output in unit value}}{\text{Total net man-hours used}}
\]

\[
\text{Overall labour productivity} = \frac{\text{Production output in unit value}}{\text{Gross man hours used}}
\]

The differences in net labour productivity and overall labour productivity is due to idle man-hours for various reasons, such as, machine breakdown, delay of supply in raw material, lack of power, lack of tools, delay in required instructions or idle hours due to other reasons and it indicate the extent of total idle time. Factory attendance is used to estimate gross man hours and the recorded actual working time is the net man-hours. Sometimes, depreciation and maintenance cost of the machinery are greater than wage bill and hence it is preferable to use machine hours in the denominator instead of man hours. Moreover, the term labour productivity is a misnomer, as an absolute measurement of net labour hour involved is practically impossible, because it is difficult to segregate exact part labour/workers involved in the production output. There are so many other organizational policy factors for higher
or lower overall productivity. It may be failure of sales personnel in marketing the products produced with high production performance even with attractive labour productivity index or machine productivity index. Low productivity may also be due to obsolete technology or low productive machines, or improper product mix, sudden fall in market demand and consequent less capacity utilization of machine, poor investment decision and what not. However, the labour productivity index is still assessed as this factor is used for convincing labour unions (as a factor for reckon) to understand their performance and role in the production unit as well as to calculate productivity linked wages wherever applicable. In such assessment, management ignores the reality as economists also do in many cases to make analysis in largely academic way.

So, a number of productivity index may be defined in partial productivity term separately i.e., labour productivity index, machine productivity index, material productivity index, capital productivity index, land productivity index etc.

It may also be seen in a mill that for use of automatic shuttleless looms, the labour productivity index has risen, but this is not the true picture of the overall productivity index in the organization. So, in the scheme of profit planning, management has to do proper resource allocation and utilization. If the full machine capacity is not utilized and if the product mix and machine balancing and scheduling are not done scientifically there may arise a situation where even with increase in labour productivity, profit ratio may goes down. The computation of labour productivity alone will hardly be adequate or purposive enough for a mill management in realistic term. However, in jute mills, presently the following indices are being considered 6.

Machine productivity index (MPI) = \[ \frac{\text{Actual Production}}{\text{Standard Production}} \times 100 \]

Labour employment ratio (LER) = \[ \frac{\text{Actual number of hands employed}}{\text{Standard number of hands required}} \times 100 \]

Or, man days per metric ton Index (MTS) = \[ \frac{\text{Actual man-days per metric ton}}{\text{Standard mandays per metric ton}} \times 100 \]

Productivity index (PI) = \[ \frac{\text{MPI}}{\text{LER}} \times 100 \] or \[ \frac{\text{MPI}}{\text{MTS}} \times 100 \]

So, to improve productivity, either MPI is to be increased (>100) and LER or MTS is to be reduced (<100).

In a study covering a number of jute mills around Kolkata by interfarm comparison of IJIRA, 6, 7 the representative averages of MPI, LER and PI are found around 85, 103 and 82. Thus, the industries performance fall short (average including both spinning and weaving) 15% achievable standards. Assuming that such level of deficiency prevails in major stage of manufacturing (spinning and weaving), it can be estimated that cost economy to the extent of Rs. 400 – 500 per metric ton can be obtained by improving productivity to the expected standard level by implementation of proper strategy and care needed for identified causes of production loss in loom shed, as discussed below.
3.0 Causes of Loss of Production in Loom Shed

The followings are the major factors for the loss of productivity in loom shed:

1. Improper warp and weft yarn quality
2. Poor supply/shortages in warp and weft yarns
3. Improper sizing of warp yarns
4. Improper loom setting and tuning
5. Undesirable loom stoppages including knock-off
6. Undesirable speed loss in the loom
7. Improper quality control measures for fabric production
8. Ineffective and inadequate process control measures
9. Higher wastage in loom shed
10. Improper or inadequate maintenance of loom
11. Improper or less efficient organizational policy
12. Improper skill and work method of weavers, weaving sardars and loom fitters
13. Inadequate mind setup, training and HRD activity

Before explaining the above mentioned factors, a typical snap study has been presented below both for hessian and sacking looms indicating the major and minor causes of loss in weaving efficiency.

Typical snap study indicating loss in weaving efficiency

A typical snap study report gives details about loss in production of looms due to various reasons in Table-2. This snap study was taken in some jute mills for 8 hours covering the entire running hessian and sacking looms in the weaving shed. Under mentioned average data have been collected from those mills for a considerable period, to obtain a better representative figures.

<table>
<thead>
<tr>
<th>Reasons of loom stoppages</th>
<th>Percentage loss of production</th>
<th>Hessian</th>
<th>Sacking</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Warp breakage (Single &amp; Multiple)</td>
<td>11-13</td>
<td>5-7</td>
<td></td>
</tr>
<tr>
<td>b) Weft Breakage</td>
<td>0.75</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>c) Shuttle Change</td>
<td>3.5</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>d) Beam Joining</td>
<td>1.5</td>
<td>3.53</td>
<td></td>
</tr>
<tr>
<td>e) Line Sardars' Job</td>
<td>1.0</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>f) Mechanical Troubles</td>
<td>1.0</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>g) Beam Shortage</td>
<td>0.25</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>h) Cop Shortage</td>
<td>0.25</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>i) Weaver Away / out</td>
<td>1.5</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>j) Picker, Picking strap / Tugger Change</td>
<td>1.0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>k) Smash</td>
<td>1.0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>l) Interference (one loom idle without reason)</td>
<td>5.0</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>m) Miscellaneous undesirable loom stoppages</td>
<td>1.0</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>Total Loss</td>
<td>29.25 - 31.25</td>
<td>i.e. Average 30%</td>
<td>19.00-21.00</td>
</tr>
</tbody>
</table>

Therefore, (100-30)% = 70% should be available utilisation time for production in hessian loom and (100-20)% = 80% should be available utilisation time for production in sacking loom; if there is no other factors responsible for the loss of efficiency in looms.

However, by careful action to control or to minimize/optimize the said 13 factors (given in item-3) affecting the production in loom shed; the production loss may be reduced to some extent. Hence, the role of these 13 factors for loss of weaving production along with required suggestions
It is observed from the above snap study (Table-2), that warp breakage rate is the biggest single factor responsible for the loss of weaving efficiency. In case of more number of warp yarns break at a time during weaving, the weaver is unable to repair all the broken warp yarns at a time and fails to perform his other normal duties properly, leading to lower efficiency in the weaving. Simultaneously, more number of warp breakage in the looms also affects the quality of the produced fabrics.

During the process of weaving, the warp yarn is subjected to cyclic stress and strains of irregular nature, which is a complex action consisting of mainly extension, abrasion and bending. Locations of these actions of warp yarns in the weaving zone with different loom parts and accessories is shown in the Table – 3.

Thus, warp yarns remain under high stress and strain cycle of irregular nature experiencing above said complex actions during weaving causing warp breakage as the biggest single factor (Table – 2) for loss of efficiency in both hessian and sacking looms. Hence, another snap study analysis about the main causes of warp breakage is presented in item – 3.1.1 below.

### 3.1 Improper warp and weft yarn quality

It is observed from the above snap study (Table–2), that warp breakage rate is the biggest single factor responsible for the loss of weaving efficiency. In case of more number of warp yarns break at a time during weaving, the weaver is unable to repair all the broken warp yarns at a time and fails to perform his other normal duties properly, leading to lower efficiency in the weaving. Simultaneously, more number of warp breakage in the looms also affects the quality of the produced fabrics.

During the process of weaving, the warp yarn is subjected to cyclic stress and strains of irregular nature, which is a complex action consisting of mainly extension, abrasion and bending. Locations of these actions of warp yarns in the weaving zone with different loom parts and accessories is shown in the Table – 3.

#### Table – 3: Action on Warp Yarns During Weaving

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Action on warp yarns</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flex abrasion and Frictional Abrasion</td>
<td>Back roller, mail-eyes in the healds, reed wire and fell of cloth.</td>
</tr>
<tr>
<td>2.</td>
<td>Scraping action &amp; Rubbing action</td>
<td>Any part where yarn is in contact with loom parts, particularly during forward and backward movement of the sley and other moving parts.</td>
</tr>
<tr>
<td>3.</td>
<td>Yarn to yarn abrasion, Cyclic stretching, bending and entanglement of yarns.</td>
<td>Upward and downward movement of the healds and reed motion.</td>
</tr>
<tr>
<td>4.</td>
<td>Shuttle and yarn collision</td>
<td>Shed opening.</td>
</tr>
<tr>
<td>5.</td>
<td>Strain in the entire warpsheet during weaving.</td>
<td>Vibrations caused in any moving parts of loom.</td>
</tr>
</tbody>
</table>

Thus, warp yarns remain under high stress and strain cycle of irregular nature experiencing above said complex actions during weaving causing warp breakage as the biggest single factor (Table – 2) for loss of efficiency in both hessian and sacking looms. Hence, another snap study analysis about the main causes of warp breakage is presented in item – 3.1.1 below.

#### 3.1.1 Analysis of causes of warp breaks

The process of correctly analysing the reasons of warp breakages is a tedious and tough task. However, an other snap study for 8 hours in few mills covering hessian and sacking looms of those mills and analyzed the reasons of warp breakage. Undermentioned average data have been collected from selected mills for considerable period and is given in Table-4, with analysis/mention of major reasons of warp breakage.

7
Table – 4: Analysis of Reasons of Warp Breakages in Hessian and Sacking Loom

<table>
<thead>
<tr>
<th>Reasons /Causes</th>
<th>Percentage weightage of reasons for warp breakage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hessian</td>
</tr>
<tr>
<td>1. Slub</td>
<td>20.6</td>
</tr>
<tr>
<td>2. Roots</td>
<td>17.6</td>
</tr>
<tr>
<td>3. Weak yarns.</td>
<td>8.8</td>
</tr>
<tr>
<td>4. Big Knot</td>
<td>14.8</td>
</tr>
<tr>
<td>5. Bad Beam</td>
<td>8.8</td>
</tr>
<tr>
<td>6. Missing Ends</td>
<td>17.6</td>
</tr>
<tr>
<td>7. Broken Selvedge</td>
<td>5.9</td>
</tr>
<tr>
<td>8. No Knot</td>
<td>—</td>
</tr>
<tr>
<td>9. Loose Knot</td>
<td>—</td>
</tr>
<tr>
<td>10. Throw Ends</td>
<td>—</td>
</tr>
<tr>
<td>11. Others(reasons clearly not understood)</td>
<td>5.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

The typical data obtained in the above snap study indicate that no knot, loose knot and slubs are the major reasons for warp breakage in loom for production of sacking fabrics and big knot, missing ends and slubs are the major reasons of warp breakage in loom for production of hessian fabrics. There are numerous other factors which can affect the performance of the warp and weft yarns in weaving. However, (a) Requirement of warp and weft yarn quality and (b) Cares in warp and weft yarn preparation for weaving play a major role, which are also discussed below.

(a) Requirement of warp and weft yarn quality

Poor quality of the warp and weft yarns is primary cause influencing warp breaks. A weak, fuzzy and non-uniform yarn will break very often. Thus strong (i.e. preferably sized) and more uniform warp yarns having lower coefficient of friction and with moderate elongation at break are able in better way to withstand the cyclic stress and strain during weaving, consequently improving the weavability of warp yarns. Therefore supply of warp yarns with required quality characteristics must be ensured. This can be done by correct selection of jute fibres and proper batch mixing, proper control of moisture, required level of sliver and yarns regularity and cleanliness of slivers & yarn, regular cleaning and maintenance programme of machines upto winding stage, maintaining appropriate yarn parameter including twists during spinning, effective process control and responsible supervision upto winding etc.

The followings are the required quality characteristics (Table – 5) in respect of quality ratio, strength CV, mass CV, weight CV and hairiness index etc. of warp and weft yarns for production of hessian and sacking fabrics in conventional jute looms as standard yarn parameters, as reported by IJIRA.8
Table – 5 : Requirement* of Quality Ratio, Strength CV%, Weight CV%, Mass CV%, Hairiness index of Warp and Weft Yarns for Production of Hessian and Sacking Fabrics in Conventional Jute Looms.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Count range (lb)</th>
<th>Weight CV%</th>
<th>Strength CV%</th>
<th>Quality Ratio %</th>
<th>Mass CV % (1 cm)</th>
<th>Hairiness Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>Normal</td>
<td>Good</td>
<td>Normal</td>
<td>Good</td>
</tr>
<tr>
<td>Hessian</td>
<td>7.5 to 8.5</td>
<td>Below 4</td>
<td>4 to 6</td>
<td>Below 20</td>
<td>20 to 22</td>
<td>Above 65</td>
</tr>
<tr>
<td></td>
<td>8.5 to 10.5</td>
<td>Below 5</td>
<td>5 to 6</td>
<td>Below 18</td>
<td>18 to 20</td>
<td>Above 90</td>
</tr>
<tr>
<td>Hessian</td>
<td>7.5 to 8.5</td>
<td>Below 5</td>
<td>5 to 7</td>
<td>Below 20</td>
<td>20 to 22</td>
<td>Above 80</td>
</tr>
<tr>
<td></td>
<td>8.5 to 10.5</td>
<td>Below 5</td>
<td>5 to 7</td>
<td>Below 18</td>
<td>19 to 21</td>
<td>Above 85</td>
</tr>
<tr>
<td></td>
<td>Above 10.5</td>
<td>Below 6.5</td>
<td>6.5 to 8.5</td>
<td>Below 18</td>
<td>18 to 20</td>
<td>Above 90</td>
</tr>
<tr>
<td>Sacking</td>
<td>9.5 to 12</td>
<td>Below 6</td>
<td>6 to 8</td>
<td>Below 19</td>
<td>19 to 21</td>
<td>Above 85</td>
</tr>
<tr>
<td></td>
<td>Above 12</td>
<td>Below 7</td>
<td>7 to 9</td>
<td>Below 19</td>
<td>19 to 21</td>
<td>Above 85</td>
</tr>
<tr>
<td>Sacking</td>
<td>28 to 32</td>
<td>Below 6</td>
<td>8 to 10</td>
<td>Below 18</td>
<td>18 to 20</td>
<td>Above 75</td>
</tr>
<tr>
<td>Weft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Source – IJIRA quality norms.

However, state of yarn cleanliness also play a major role in increase or decrease of warp breakage in looms. Presence of more roots, undesirable bark and slubs and big defective knots in warp yarns leads to higher ends breakages during weaving and these parameters are not included in IJIRA described yarn parameters. Therefore, more cleanliness of sliver & yarns, proper knots and less slubs must be ensured during preparation of yarn in spinning and yarn preparatory department. The strength retention in piecing zone and knots should be proper in terms of its tail ends for avoiding excess warp breaks during weaving.

Also, uster hairiness index values (as given in IJIRA’s standards yarn parameters, Table – 5) are not true indicator of actual condition of hairs of the yarns, as it measures total hair length instead of number of hairs. Thus, a yarn with large numbers of short hairs and another yarn having less number of long hairs may show same value of uster hairiness index, while these two yarns will perform differently in weaving. So, it is better to use photoelectric yarn hairiness tester of JTRL (presently NIRAF), which is a better representative data relating to weaving performance. The required/standard limit of hairiness index for different quality of yarns (for different quality of yarns required for different fabrics) measured in photoelectric yarn hairiness tester is to be standardized for this purpose.

Moreover, the quality ratio (based on mean single thread strength in lb per unit grist) does not reflect truly the possibility of warp break, as among two jute yarns having same or nearest quality ratio, one yarn may has more weak points than other. The chances of break either in unwinding or weaving can be better represented by a K-value (as defined by Stout) which is obtained by the following relationship :
\[ K = \left( \frac{S - T}{\sigma} \right), \text{ where } S = \text{mean breaking load}, \ \sigma = \text{standard deviation of breaking load values}, \ T = \text{Particular tension value (applicable in unwinding or weaving)}. \]

If a fixed maximum tension (T) has been applied to each specimen in turn, only a proportion P of specimen would have broken, where P is the proportion of specimen having breaking load less than T.

Frequency distribution of breaking load for jute yarn approaches very closely to the normal distribution. K values of jute yarn lie between 1.5 and 4.0 and relates to a particular P value. Higher the K value of yarn, lesser is the proportion of yarn break. It provide an useful means of comparing strength properties of nominally similar yams with more practical relevance for rate of yarn breaks during unwinding or weaving etc. For more clarification, reference 10 can be consulted. So, use and standardization of K value of yarn may be introduced in practice for better control of warp yarns performance in weaving.

(b) Cares in warp and weft yarn preparation

The following cares are essential for preparation of warp and weft yarns aimed at better performance in weaving:

(i) For warp yarn preparation
The quality of the spools/cones with respect to shape and size should be uniform. During the course of winding, compactness of the warp package should be uniform and limited to the desired level. Common faults if warp winding such as, cobwebbing, missing ends and improper knots etc. must be avoided in respect to smooth processing of warp yarns in the pre-beaming, dressing and sizing machines etc.

(ii) For weft yarn preparation
During preparation of weft yarn package, the shape and size should conform the required specification i.e. the weft package should be uniform with respect to its length and diameter.

The yarns traverse bar should be adjusted accordingly where nose length of a cop should be at least \( \frac{1}{8} \) inch bigger than the diameter of the cop. Otherwise, more number of loops at the selvedge side and snarls in the fabrics will result. Similarly the weft package should be free from missing end and defective knots. So many problems are coming in the produced fabrics if the quality of the cops during its' preparation is not proper. The moisture regain percentage of cops should be reasonably uniform to control the variation in width of the resultant fabric. The cops should not be stored in the cop godown for a long period of time. Not more than four bundles of cops should be stacked by keeping one above the other in the cop go-down.

(iii) For preparation of Pre-beam and Final Warp beam
Conventionally, final hessian quality warp beam is produced in Beaming and Dressing machine in one step, and Pre-beaming operation is carried out in case of carpet backing fabrics. Sometimes this operation is also adopted for hessian quality warp beam. This operation is necessary to obtain better quality warp beams with even yarn tension. Missing and cross ends should not be present in the pre-beams and final warp beams.

Sizing or dressing operation is essentially to be carried out for both carpet backings and hessian quality warp beams. In preparation of size paste, the three very important control factors are correct recipe, proper mixing of the ingredients and proper size-cooking. Different parameters of
sizing process such as viscosity of size paste, temperature of sow box and drying cylinder, percentage of size take-up in yarn should be reasonably uniform and the level of the size paste at the sow box should also be constant. The followings are the details of standard process parameters for dressing and beaming operation, as given in Table – 6.

| Table – 6 : Processing Parameters for Sizing/Dressing of Warp Yarns |
|-----------------------------|-------------|-----------------|
| Sl. No. | Sizing Parameters | Hessian |
| 1. | Temperature of size paste at sow box | 65°-70°C |
| 2. | Viscosity of size paste in sow box | 300 – 350 R.W. Sec |
| 3. | Moisture regain % of yarns in beams | 22 - 26 |
| 4. | % size take-up by warp beams | 1.8 - 2.2 |
| 5. | % increase in strength of dressed yarns | 14 - 18 |

Uneven size take-up and moisture regain of sized warp yarns and its over-drying or under-drying leads to lower efficiency in the loom.

3.2 Poor supply/shortages in warp and weft yarns

It may also be noted from the snap study in Table-2 that poor supply of warp and weft yarns (i.e. beam shortage and cop shortage) leads also a part of loss in weaving efficiency in the loom shed. Proper balancing of production of yarn preparatory section to the production of weaving section is highly essential to avoid idle time of loom for shortages of warp and weft yarns. This may happen due to short supply of full spinning bobbin to the subsequent cop-winding, spool winding and also in beaming and sizing department or due to higher number of breakdown in weft winding, warp winding, pre-beaming or dressing and beaming machines. Apart from this, frequent changes of the yarn quality increases the idle-time of the beaming and dressing machinery leading to shortage of full warp beams in weaving.

3.3 Improper sizing of the warp yarns

A properly sized warp yarn should have adequate abrasion resistance indirectly indicated by the increase of its tensile strength. The other important criteria of sized warp yarn are minimum loss of extensibility and require amount of moisture present. Therefore, during sizing, the following aspects are very much important:

(a) Selection of appropriate size recipe and size application level.
(b) Correct preparation of size paste and its viscosity level.
(c) Control of size pick up, drying and moisture content, as well as improvement in strength, abrasion resistance and laying of hairs in warp yarns.
(d) Maintenance of Proper speed and efficiency of sizing machine.
(e) Proper dressing of the warp beam to avoid cross ends on the loom.
(f) To ensure correct number of warp yarns and uniform yarn tension in warp beam etc.

However, the sacking warp yarns are normally passed through only water without sizing during beaming. Hardly a very few jute mills are doing sizing of sacking warp beams. It has been found that the rate of warp breaks is significantly lowered in case of sized sacking warps. Therefore, for increasing weaving efficiency mild sizing for sacking warp can be recommended.

Apart from this, the beam flanges of the warp beam used in dressing and beaming machine must be straight & properly aligned to accommodate the pressing roller in such a way that the gap between the beam flange and the pressing roller edge should not more than $\frac{3}{8}$" on both their sides for preparation of good quality warp beam. If this arrangement is not properly made, then
the chances of yarn breakage at both the selvedges increase and subsequently lead to lower efficiency of the loom. Another important motion is the keel marking motion in beaming & dressing machine, for marking laid/cut length of fabric. Non functioning or absence of keel-marking motion leads to higher wastage in the weaving department and causes lower output. Thus, proper sizing of warp yarns along with correct warp beam preparation is playing a vital role for improving higher efficiency in the loom shed.

However, in the present context, it is known to many practicing people that sizing of jute warp yarns using 1.5 – 2% TKP and 0.02 – 0.04% antiseptic agent with or without 0.15 – 0.5% adhesive gums in the recipe is perhaps not sufficient, comparing the improvement in weaving efficiency obtained after sizing and the total cost of sizing. Moreover, there are reports\textsuperscript{11} that there is poor film forming property of TKP-based size paste. Though sizing of jute warp yarns improves the breaking load and quality ratio of the yarn, but the weaving performance of sized yarns is found inadequate considering the scrapping action of sizing material from surface of jute warp yarns during weaving cycle as well as further enhancement/regeneration of hairs of warp yarns causing much less improvement in weaving efficiency then expected and thus conventional sizing of jute warp yarns does not remain much techno-economically viable processing. Hence, many jute mills are avoiding sizing even with sacrifice of 2-3% improvement in weaving efficiency and saving the cost of sizing. But if one gives an in-depth look into the subject, he will agree with us that this not a positive step aiming at higher productivity. Higher productivity can only be achieved by solving technically the said deficiencies weaving performance of sized warp yarns. This demands the need of a comprehensive study for identifying and optimizing a better size recipe to give much better weaving efficiency. It has been observed in a study\textsuperscript{12} carried out at IJT that use of about 0.5% amino silicone softener cum antifriction/lubricating agent on jute, the reduction in coefficient of friction of jute goes down to 0.21 – 0.22 from 0.32 - 0.34. So, along with TKP or starch or with their blends with any better film forming size material, why 0.1 – 0.5% amino silicone softener cum lubricating agent will not be used to reduce the coefficient of friction of jute warp yarn, to get expectedly better abrasion resistance of sized warp yarns. So, IJSG or any jute related institution can take up a research project for identifying and optimizing a better recipe and method of sizing jute yarn aimed at higher performance of jute warp yarns in weaving.

It has been found by many researchers and practitioners that during sizing instead of present practice for using single sow box in sizing, if two sow boxes are used, it results better penetration of the size paste alongwith better size film formation on warp yarns with higher increase in the strength and abrasion resistance to a certain extent, if the concentration of the size paste in the first sow box is 50% of that of the 2\textsuperscript{nd} sow box, which contains size paste of normal concentration\textsuperscript{11,13}. It leads to higher penetration of size paste and lays the hairs or loose fibres on the surface of the yarns in a better way and strengthens the yarns more by reducing the slippage of the fibres which subsequently leads to improve weaving efficiency.

3.4 Improper loom tuning and setting

Inspite of playing adequate attention to the above mentioned points (item 3.1 to 3.3), it is not at all possible to obtain standard productivity and quality of the fabrics, if looms are not properly tuned i.e. different motions of looms have to be synchronized with crank cycle rotation. A slight deviation from the above may lead to excessive warp breakage as well as frequent stoppages of looms along with occurrence of many other loom operational problems. As a result, neither productivity nor quality can be maintained, wastage in loom shed increases, consumption of spare-parts becomes excessive and work load of weavers, mistries and weaving sardars also increases. So, loom tuning is a matter of cardinal importance (Weaving Line Sardars are totally responsible for this job) in weaving department, for which mainly weaving line sardars and loom fitters and mistries are to be skilled and watchful.
Tuning of the loom and its checking

Efficiency of a loom is primarily dependent on good tuning of a loom. Incorrect shed depth, faulty picking, faulty shuttle-box setting and improper shuttle checking system in a loom dominate loss of production or efficiency. A faulty picking and shuttle-checking device may even be very fatal if not noticed at the early stage.

The most common reflection of the faulty tuning of loom is the frequent knock-off of the loom i.e. loom is stopped by the buffer and buffer tongue. Correct timing of the picking, correct force of picking and force of beating, correct shuttle checking, smooth passage of the shuttle, correct shed depth and shed-dwell timing are also essential to avoid loom 'knock-off' i.e. to obtain smooth running of a loom.

Attention should also be paid to picking force and shuttle checking mechanism to stop or deaccelerate the shuttle at the end of its passage from one side to the other side. If the drag chain is too tight or take-up motion is faulty, there will be excessive tension on warp yarn leading to excessive warp breakage. Sometimes Pin roller does not pull cloth sufficiently and slack warp threads may break.

Breakage of camb or camb cord, picking strap or check strap, picker, worn out or damaged shuttle may cause frequent loom knock-off or may produce faulty fabrics.

Shedding motion with correct shed timing are also equally important. Improper drawing-in arrangement and higher tension of the warp yarns also cause severe warp breaks. The other important factors, which have important bearing on warp breaks in looms are the proper setting of 'let-off' and 'take-up' motion controlling tension of the warp and fabric respectively. Improper tension in 'let-off' and 'take-up' leads to high warp breakage rate. All these factors again lead to the high workload and fatigue to the weavers. Besides, the above mentioned problems another most common problem in mill is the frequent breaking of some loom parts and accessories like picking band, martingale strap, camb, cords, bottom shaft, crank shaft, loom gable etc. Elimination of such causes after proper checking by weaving line-sardars are essential at the start of the shift. Thus, careful checking, repairing and proper tuning of looms can easily eliminate the above problems and thus can improve the production and quality of fabrics.

The details of the tuning of jute hessian and sacking looms mentioning the measurement details of each setting of loom parts/different motions of the looms, are well described with illustrations in the Training manual for weaving line sardars of jute mills, published by IJT.

However, weaving line-sardars have to check the following points after completing the tuning or setting of the various motions of a jute loom

1. Whether loom is properly tuned as per crank cycle rotation.
2. Whether warp threads are correctly drawn through lease rods, mail-eyes of cambs and reeds in proper sequence.
3. To check proper arrangement of warp yams after eliminating cross ends, big knots, missing ends and tight ends.
4. To check and adjustment of warp tension and weft tension.
5. To check proper adjustment of let-off motion and take-up motion.
6. To check whether the shed depth is adequate and satisfactory tension of selvedge yams are maintained.
7. To check proper functioning of warp-protector motion. By starting of the loom without any shuttle, if the warp protector motion works properly, then the loom should knock-off immediately.

13
Oil and grease points of the looms are to be checked for whether oils or greases are applied appropriately at all points and on picking spindle.

Cop of specified mark should be put in the shuttle to place it in the shuttle box and the crank is placed at back centre before start of the loom.

Position and correct working of pushing pawl and retaining pawl are to be checked.

In case of sacking looms with auto-loader attachments, all settings of auto cop loading mechanism have to be checked.

There should be immediate replacement or repair of any damaged/broken loom parts or loom accessories like martingale strap, picking band etc. after checking of the looms by weaving line-sardars.

Position of picking stud from the gable should not be more than $1\frac{1}{2}$ inch with proper matching of picking wyper point and picking cone. The length of the picking stud with cone should be around 7 inch from the picking shaft.

Proper adjustment of shuttle checking box, particularly adjustment of box-front rail should be checked and adjusted as required.

Smooth running of the loom and its start and stop are to be checked by the use of starting handle. After checking of few minutes smooth run of the loom only, sardar should handover the loom to the weavers.

A weaver shall also check the following points before starting of a loom and should make the required adjustment for its smooth running:

(a) Tension of the warp yarn should be properly adjusted (if not adjusted properly) by loosening or tightening the chains of warp beam.

(b) To ensure proper beating-up, the position of the reed should come upto the fell of the cloth during beating up; i.e. to keep/maintain equal space between picks even at the starts to avoid starting mark or missing weft, the weaver has to adjust it by slight turning the ratchet wheel, as necessary.

(c) Though loom can start keeping the sley in various position with respect to fell of the cloth, it is preferred to keep the sley to the furthest back position from the weaver, so that there is sufficient picking force maintained before picking. At the starting position of loom, the shuttle should be inside one of the shuttle box, in that side from which picking is to start.

(d) No loom parts should be in worn out condition or in loose condition or become slack. There should be no play of crank shaft and connecting arm.

(e) The missing warp on the reed, lease rod and warp beam (if found) should be replaced immediately with additional warp from left-over small/half spool.

(f) The weaver should apply lube-oil to the picking spindle from time to time. This should be done by oil soaked piece of soft cotton or jute fabric, so that there shall be no oil dripping, staining on the fabric.

(g) To check the shuttle for any outside damage. Any obstruction during picking or checking of the shuttle can be identified easily from the nature of surface damage of the shuttle. Tight protector spring, too tight reed cap, bent connecting arm or defective sword pin or misadjustment in beating-up assembly may cause the outside surface damage in shuttle. The inside bristles of the shuttles in the eco-loader loom should not be in damaged condition.
(h) To check the proper weft count in cops to be used. Also the dimension of cop must be proper.

(i) To put each weaver’s own mark on the woven cloth at the start of the shift.

(j) Running the loom at proper speed is very essential for required productivity. So there should be a check by the weaver for reasons of speed loss of loom (discussed later). Lower speed of loom meant loss of production. Its immediate rectification is essential.

(k) Shuttle checking being the limiting factor for higher speed of loom, unnecessary higher speed of the loom may be suicidal or fatal, resulting more breakdown.

(l) There is environmental and seasonal effect on the loom speed, which should be taken into care and to be adjusted by the weavers.

(m) The weaver should know about the quality of fabric running, the quality of warp and weft yarns are being used. Weaver has to be ensured timely supply of sufficient number of cop bundles and beam.

(n) Proper alignment of the sley race, reed, box back etc. are to be checked and to be adjusted if required, to avoid shuttle flying out.

(o) Proper alignment of the swell-wood, lifter, tongue and buffer should be checked and rectified as necessary. Buffer must be at both side of the loom, with proper length of tongue and buffer kicker.

(p) Proper alignment of picker movement with respect to picking spindle, is to be checked i.e. picking spindle should be properly aligned. Picking spindle must not be loose, leather washers can be provided between picker and box-end plate to reduce load on martingale strap.

(q) Single-side-single chain let-off system is to be avoided. It should be double-side-double chain system only.

(r) In group drive system, the belt fork should be completely on the fast pulley during loom running. Anything should not be attached/fitted with the belt fork to place the belt in between loose pulley and fast pulley to reduce the loom speed. Diameter of loose pulley and fast pulley should be equal. Also, minimum two (2) no. of v-belts are essential for individual motor driven loom. Use of single belt is to be avoided.

(s) Finally, the weaver should check the tuning of the loom by rotating the crank to compare different settings with crank cycle rotation for different motions of loom.

3.5 Undesirable loom stoppage including knock-off

There is 1 – 1.7% loss in weaving production for undesirable loom stoppages (Table – 2) for miscellaneous reasons including loom knock-off. This loss may further go up if additional production loss due to interference, weavers away and mechanical trouble are also considered, for which undesirable loom stoppages also increases. The reasons for loom knock-off (as listed below) should be known to the weavers and weaving line sardars, to take preventive measures to avoid these.

Reasons for Loom Knock-Off

A weaver and weaving line sardars must see that a loom is not knocked-off for avoidable reasons, for which a weaver and weaving line sardar should take care or report to mechanical mistries for rectifications.
The common reasons for which a loom is knocked-off are given below:

1. Dirty or bent picking spindles
2. Bad pickers / worn out pickers
3. Slack/tight or broken picking-strap
4. Improper fitting of picking-arm
5. Too little or too much travel of the picking-arm
6. Slack cone or picking stud
7. Slack picking point, worn out point and point plate
8. Slack Truck Boss and Plate of picking wyper/tappet
9. Faulty setting of top-roller mounting device
10. Loose connecting-arm
11. Slack driving-pinion or spur wheel & driving pulleys
12. Bent/broken crank shaft or bottom shaft
13. Shuttle entrapped inside the shed, for improper shed depth or other reasons
14. Improper tuning of loom causing faulty picking, misalignment and improper setting of different parts of looms
15. Too tight or loose or broken tie-ropes/string tied (cambs straps) to cambs
16. Misalignment of buffer and buffer tongue, reed and sley etc
17. Too tight / loose protector spring
18. Improper setting of finger
19. Broken or damaged swell
20. Worn out shuttle or too light shuttle or rounded shuttle
21. Slack driving belt or tearing of driving belt
22. Broken swell pins and worn out or improper fitting of swell wood
23. Slack, tight or broken check strap / martingle strap
24. Slack or too tight box-front
25. Slack reed
26. Loose box plate
27. Picking too early or too late and hard pick / soft pick
28. Worn out rocking shaft and bushes allowing sley to tilt
29. Worn out spindle or slip ring allowing shuttles to rise in the shuttle-boxes
30. Bad setting of Ecco-loader assembly in sacking loom (incorrect setting of latch, catch, weft fork, actuating lever and cam, push rod and hammer etc)

Additionally, the undesirable stoppages of looms are found to the tune of 3 – 5% for interference, 0.26 – 1.5% for weavers away, 1.17 – 8.5% for minor mechanical trouble and 1 – 1.2% for awaiting line sardar’s job of loom resetting & tuning etc. (Table – 2). Some of the faults can be rectified by weavers or weaving sardars immediately to re-start the loom, to reduce these avoidable/undesirable stoppage of loom causing the production loss and low output from looms.
3.6 Undesirable speed loss in the loom

The speed of looms is important in relation to weaving productivity. The loom speed is a pre-determined factor depending mainly on the design of the loom and the fabric construction to be woven.

The specified loom speed is not achieved in many cases due to belt slippage and power fluctuation. In case of group drive of looms by means of an overhead line shaft, which is the common practice for narrow looms in India, wrong size of loom pulley is also a variable factor in this respect. Speed loss through belt slippage is much lower in case of looms with individual drive. In case of group drive, sometimes the weavers reduce the speed of the looms by adjusting the position of the leather belt on the pulleys. The leather belt driving the loom, should be adjusted with correct tension. If the belt is too tight, the frequency of belt-breakage is increased leading to higher idle-time and consequent lower efficiency of the loom. If the belt is too slack, the efficiency of the loom drops through greater belt slippage. The leather belts should be maintained properly and belt-breakages should be repaired promptly and skillfully.

As per the snap study report (Table – 2) given here, the loom efficiency for hessian and sacking jute loom should be around 70% and 80% respectively. But, many mills, the actual efficiency remains below 70% for hessian loom and below 80% for sacking looms. If, one try to analyse the reasons, it will be found that this low efficiency is mostly due to speed loss in loom. In existing practice, the speed constant of hessian jute loom is considered as 200 and that of a sacking loom is considered as 210, because these figures nearly matches the existing production efficiency of both type of looms.

The standard theoretical speed for 46 1/2" reed space hessian loom is (200-46.5) = 154 picks per minute(ppm), while the actual loom speed obtained for hessian loom in mill is around 140 ppm. Hence, there may be a speed loss of about 9%, \(\frac{154 - 140}{154} \times 100 = 9\%\). So, there is a production loss of about 6.3% (9% of 70%) for speed loss of about 9%. So, actual efficiency of 46.5" RS hessian loom considering 9% speed loss is 63.7%, \([70 \times \frac{(100-9)}{100}] = 63.7\%\).

Similarly, for sacking loom of 37 1/2" reed space, the ppm of loom is usually 210 - 37 1/2 = 173 ppm. While, actual loom speed obtained for sacking loom in mills is around 160 ppm. Hence, there is a speed loss of 7.5%, \(\frac{(173 - 160)}{173} \times 100 = 7.5\%\). So, actual efficiency obtained in this case is 74%, \([80 \times \frac{(100 - 7.5)}{100}] = 74\%\).

These results more or less conforms the present level of efficiency obtained in hessian and sacking looms of many Jute Mills. Hence, the weavers and weaving sardars, have a definite responsibility to minimise the speed loss to improve output and productivity. The more is the speed loss, lower is efficiency of loom.

The major reasons of speed loss of a loom are discussed below:

**Reasons of speed loss in jute looms**

A loom draws maximum amount of power at the instant of picking and as a result loom speed drops to minimum momentarily. It is to be noted that speed variation of a jute loom is as high as 9 - 10%. Besides this normal fluctuations of loom speed there is speed loss in jute looms for following reasons:

1. If loom pulley or line shaft drum pulley gets polished and thereby increases belt slippage (i.e. speed loss of loom). Loom pulley may be crowned to avoid it.
(2) If nuts and bolts in any parts of loom remain slack or sley curvature is improper.
(3) If loom tuning is not perfectly done or if for any reason, loom is deliberately run in low-speed. This is to be checked and rectified from time to time.
(4) If loom is run with hard pick, slow speed become inevitable. This is harmful for loom. Late pick is also responsible for speed loss. In this case, early pick may be the alternative solution.
(5) If any key is slack. Keys are to be checked and tightened properly to avoid this.
(6) If loom belt is of improper length or remain weak. After running for specific period, loom belt is extended and becomes slack. Hence, there is a speed loss. It is to be checked and to be rectified.
(7) Improper positioning of driving handle and loom driving flat belt associated with belt fork causes speed loss Loom driving belt should be completely or maximum on fast pulley. Hence, these are to be checked properly. Position of belt fork stud and starting handle bracket may be rectified, if they are not properly positioned. Belt fork must not be too widen to avoid this.
(8) Bad setting of shuttle box and bent picking spindle often affects picking force and weavers then run the loom at slow speed, which should not be allowed.
(9) If looms run at slow speed, sometimes housing of shuttle in opposite side box is not properly done and loom stops. Proper speed of loom must be attained.
(10) Sometimes weavers deliberately reduces the loom speed by various ways, when there is high warp breakage or excessive loom knock-off occur. This practice should not be allowed at all.

3.7 Improper quality control measures for fabric production

The terms productivity and quality are very much interrelated. If there is excessive warp breakage or loom knock-off, fabric quality is affected and productivity suffers. If looms run smoothly, there is an improvement of quality and productivity and consequently work load of weavers and weaving line-sardars reduces. Weaving supervisors, weaving line-sardars and weavers have to be very watchful to the following points for improvement in productivity of looms in terms of improved quality of fabrics –

(1) Weaving supervisors, line-sardars and weavers should be fully aware of the quality standards, specifications and possible faults of woven fabrics and should know required quality standards of warp yams and weft yams for jute fabrics of different specifications. They should check fabric faults in different looms and should be watchful for confirming to the specification and quality of fabric.
(2) Constant watch has to be put by weaving line sardars to keep ready the next warp beam of good quality, where, missing ends, cross ends and big knots are to be eliminated. Drag chain should be tighten or slackened timely as necessary in a running loom as and when required, for controlling let-off motion.
(3) Warp yams should properly pass through lease rods, mail-eyes and reed dents in correct sequence.
(4) Broken warp ends should be mended by weaver's knot and proper sequence of warp threads are to be maintained.
(5) Incorrect tension of warp yams at the selvedges causes inadequate shed depth and hinders movement of shuttle. There are to be properly checked. Moreover, weavers should be so trained that regarding any abnormal wear and tear of loom parts causing problems to operate the looms, they should inform the same to loom fitters or weaving line-sardars to take necessary action immediately.
(6) Incorporation of some sort of signalling arrangement by weavers is necessary, for easily indicating the loom with mechanical problem, which can help weaving line-sardars or loom fitters to attend the loom immediately.
(7) Weaving line-sardars should occasionally check if correct weft (as per fabric specifications) is used.

(8) Fabric width and pick density and fabric defects, if any, should be checked from time to time by weaving supervisors and line-sardars.

(9) Reason for malfunctioning of auto cop-loader are to be identified properly and to rectified with the help of eco-loader mistry.

(10) Loom speed should be checked time to time and to be readjusted as necessary. Lower loom speed causes loss of production and auto-loader looms do not run properly at low speed. While higher speed of loom also can cause vibrations and early wear and tear of loom parts.

(11) Weaving line-sardars have to train the weavers to check the settings of loom parts and to follow correct method of working. Sardars must keep constant watch on performance of weavers and to help them to upgrade their skill for maintaining fabric quality.

(12) Proper lubrication of loom parts is very important. Weavers must watch the activity of oilers and get their looms properly lubricated. If, during beam change, oiler is not available (for whatever reason), weaving line-sardar or weaver himself must lubricate the necessary loom parts by themselves.

(13) Weavers are to be made aware to keep their looms and surroundings clean. Good house-keeping must be maintained.

(14) Weavers and weaving line-sardars are to be fully aware for readjustment and repair of all type of faults of looms particularly for avoiding fabric defects.

(15) Weavers must not unnecessarily leave their looms and should always try to operate both of the looms. In sacking looms, whenever possible, warp breakage should be attended on running looms without stopping.

3.8 Ineffective and inadequate process control measures

Ineffective and inadequate process control measures may lead to loss of production by either low efficiency or production of defective fabrics. Hence strict supervision on process control in yarn preparatory and weaving is essential. The following are the important check points for process-control measures during weaving.

Product related process control
(a) Quality of warp and weft yarns
(b) Numbers of ends in beam and no. of missing ends/cross ends/broken ends
(c) Moisture in the warp yarns in beam, cop and fabrics on loom
(d) Tension of warp and weft yarns in loom
(e) Ends per dm, picks per dm and width of the fabric on loom
(f) Weight of the fabric (gsm)
(g) Weaving faults in the fabrics

Machine parameter related process control
(a) Adjustment of the fell of the cloth along with the beatup-motion and correct beat up force
(b) Setting of sley and reed alignment
(c) Reed porter and camb porter
(d) Shed depth (position of shedding wyper and cambs)
(e) Picking force and setting of entire picking assembly
(f) Setting of shuttle box and shuttle checking device
(g) Setting of let-off and take-up motion
(h) Proper loom tuning and setting of the different loom accessories and loom parts
(i) Speed of the loom  
(j) Correct sequence of drawing-in  
(k) Correct setting of warp protector motion  
(l) Proper maintenance of beam flange, eco-loader, shuttle condition and yarn unwinding tension  

**Others**  
(a) Environmental conditions (temp, humidity etc.)  
(b) Luminarie design  
(c) Sound pollution level  
(d) Efficiency and skill of weavers  
(e) Efficiency of supervision  

The weaving supervisors should be knowledgeable to know how to control, what to control and when to control the above said product/process parameters and machine parameters for effective process control measures aiming at higher productivity in weaving.  

### 3.9 Higher wastage in loom shed  

Certain percentage of thread waste is unavoidable in manufacturing of jute products. But the quantity of thread waste should be within a reasonable limit. The impact of higher thread waste resulting higher cost of production of jute goods is significantly important. About 80 - 85% of the total thread waste is produced from yarn preparatory to weaving stage. About 60 – 65% of the weaving thread waste is obtained mainly for weft yarns. The data on total wastage (%) in loom shed (as observed in a survey for thread waste and gunny cuttings, Table - 1) indicate about 2.5 – 3.25% loss of processed material in loom shed. Any percentage of reduction in wastage of loom shed will be related to increase in output of a jute mill, i.e. an increase in productivity. It should be limited to 2 - 2.5% in hessian fabric production and 1.5 – 2% in sacking fabric production as shown in the following Table - 7 with stagewise breakup of target limit of thread waste from winding to weaving stage:  

<table>
<thead>
<tr>
<th>Table - 7 : Target Percentage of Thread Waste Limit at Different Stages of Yarn Preparation and Weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stages of production</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>A. Winding : (% on winding production)</td>
</tr>
<tr>
<td>i) Warp winding</td>
</tr>
<tr>
<td>ii) Weft winding</td>
</tr>
<tr>
<td>B. Beaming &amp; dressing : (% on beaming and dressing production)</td>
</tr>
<tr>
<td>C. Weaving : (% on Weaving production)</td>
</tr>
<tr>
<td>i) Warp</td>
</tr>
<tr>
<td>ii) Weft</td>
</tr>
<tr>
<td>iii) Overall</td>
</tr>
<tr>
<td>Average total waste % (upto weaving)</td>
</tr>
</tbody>
</table>

Followings are some essential control points for reducing the wastage in loom shed.
Control of wastage in weaving shed

It is extremely necessary to control wastage of warp and weft yarns in yarn preparatory and weaving stage. Weavers must be made fully aware of the following aspects and their performance are to be watched closely by weaving supervisors and line-sardars for reduction of wastage in the following way:

1. Reasons for wastage of warp and weft yarns are to be explained to weavers by corresponding line-sardars. Weavers and winding/beaming operators are to be motivated to reduce all types of thread waste.

2. For repairing missing ends and broken warps, yarns from small cops must not be used and minimum yarn should be used from small spools, without wasting yarns unnecessarily.

3. Warp beams are to be fully consumed, i.e. beams should not be doffed without its full exhaustion. Full beams may doffed on cushion place on floor and rails should be used for storing and carrying the beams.

4. Cops should be fully consumed. Yarn must not be pulled from cops after they are loaded in magazines, for auto-loader looms.

5. While joining fresh warp beam, yarn must not be pulled or wasted unnecessarily. This practice of wasting beam yarns is not at all acceptable. The system of using gummed tape and proper leasing at the beam stage will reduce wastage of warp yarns.

6. Proper quality mark should be given on cops, spools and beams and they are to be stored with proper care. Empty beams/full beams must be handled with care and beam yarn or beam-flanges must not be damaged during beam carrying.

7. Defective cops should be sorted out separately and are to be consumed during beam change, as far as practicable.

8. Weavers must give up the habit of pick-back practice.

9. Correct warp and weft count must be used.

10. Cop should be packed or tied by cop bands and not by loose yarns. Cop bands should not be thrown away or scattered here and there on the floor.

11. Weavers must not store excessive number of cops near the looms, as cops get distorted and become soft due to this reason.

12. Wastage should always be kept in particular waste bag.

3.10 Improper or inadequate maintenance of looms

Inadequate maintenance of looms including faulty tuning and setting of looms is the main reason for occasional loom knock-off as well as it may cause higher warp breakage even if the yarn quality is good. It may also cause production of defective fabrics. Thus, there may be a notable amount of loss in productivity in loom shed due to improper maintenance of looms. Presently in jute mills, looms are maintained by the following four level of maintenance activities.

(i) Breakdown maintenance: As and when a loom fails in smooth running, the concern mechanical faults are identified and repaired or even the defective parts need to be replaced. Usually loom fitter does this job in co-ordination with carpenter (if required) and weaving sardar. But mills are suffering for shortages of experienced loom fitters and weaving sardars.
(ii) **Preventive maintenance**: At the interval of $2 - 2\frac{1}{2}$ yrs., each loom is inspected thoroughly for overall replacement and repair of all faulty/worn out parts and accordingly a through maintenance work is undertaken by which the loom is reset, tuned and lubricated properly for its smooth running. A few mills, who has adequate maintenance staff do this job more frequently. Scientific studies show that this should be done at 40 – 90 days interval or maximum at 6 month's interval, which most of the jute mills can not follow due to inadequate number of maintenance staff.

(iii) **Overhauling**: Overhauling of loom is a pre-schedule long-term maintenance job for complete dismantling and resetting of looms with check of all drives, bearings, gears/wheels and all other moving parts with replacement of necessary parts, to rejuvenate smooth running of the looms. In most of the jute mills, overhauling of looms is usually done at the frequency of 5 – 6 yrs. for sacking looms and at the frequency of 6 – 8 yrs. for hessian looms. IIT-Kharagpur in its study report suggested to do this at the interval of $2 - 2\frac{1}{2}$ yrs.

(iv) **Routine cleaning and opportunistic maintenance**: At the interval of 1 – 2 weeks, each loom is to be cleaned in a routine schedule, which most of the mills do not follow. But opportunistic maintenance like cleaning of dirt/dust and jute flups/loom caddies from the shedding wyper, picking wyper, bottom shaft and treadle lever zone as well as cleaning of cambs and reeds etc. for 10 – 15 minutes during beam change time by the operator itself has to be regularly done. This practice is in vogue in most of the mills except a few.

However, the major faults in present maintenance activities of looms in jute mills as observed and suggestions for required improvement in those activities are given below:

(i) There are fast wearing out of loom parts causing huge spare parts consumption and even frequent break of crank shaft and center shaft of looms mainly due to improper metallurgy, specifications and quality of spares. No vendor rating is followed in most of the jute mills. No life expectancy record of spare parts is maintained in most of the mills. Vendor rating, maintenance of history card and check of quality of spares etc. are must.

(ii) Most of the conventional looms are very much older and accordingly there is a need of rescheduling of frequency of maintenance activity, which is not done in real cases.

(iii) Instead of preventive maintenance schedule followed for these old looms, predictive maintenance is to be practiced gradually, replacing normal preventive maintenance practices.

(iv) There is no loom audit system from maintenance point of view. A regular audit of loom's condition and record keeping through history- card/log-book for assessing the real condition of each particular loom may help to decide early rectification of major mechanical faults to prevent from major damages and thus, there is an essential need of Condition Based Maintenance (CBM) practice by experienced maintenance squad. However, this need sufficient knowledge (through proper training) of mistres with required requirement for machinery fault diagnosis ; the details of which is available in the report of IIT-Kharagpur.

(v) Most of the mills depend on separate oiler for routine lubrication and weaving operators are reluctant to do this lubrication job, any minor maintenance job, routine cleaning and setting of loom parts. A concept of Total Productive Maintenance (TPM) is to be implemented i.e. all minor maintenance including routine cleaning (weekly as well as at the warp beam finish
The newer/younger/learner mistries must be trained properly, which most of the mills do not follow. The regular training for newer mistries for a longer period (approx-3 months) is must.

For maintenance of modern shuttleless automatic looms, there are three major problems observed i.e. (a) Inadequacy of trained mistries in jute mills for maintenance of these modern looms, (b) Costliness and non-availability of good quality spares for these looms, and (c) Maintenance department of most of the jute mills are not well equipped for maintaining these looms. These can be well tackled if a separate trained maintenance squad can be created for this and have a contract with manufacturer/supplier for regular supply of original good quality spares for these looms.

There is inadequate supervision for maintenance of looms from maintenance supervisors and weaving sardars. If this is done correctly many problems can be sorted out on the spot. Hence, a special discussion is made below for the responsibilities of weaving sardars for their responsibility of proper supervision and check of maintenance activities of looms.

Responsibility of weaving line sardars for assuring proper maintenance of looms

Weaving line sardars has to take all responsibilities for proper supervisions of loom maintenance alongwith proper tuning and setting of looms. They have to develop awareness among weavers regarding maintenance of various loom parts so as to improve productivity, quality and reduction of cost for spare parts, finally assuring proper maintenance of looms for its smooth running.

The followings are necessary cares to be taken by weaving sardars for assuring proper maintenance performance of looms:

1. Weaving line-sardars must train the weavers for minor maintenance jobs of looms. Weavers are to be instructed to report for any abnormality found while operating their looms. In such cases, weaving line-sardars should seriously try to find out the reasons of the faults and should try to rectify it immediately with the help of loom fitters/maintenance mistries.

2. Cambs, reeds, loom driving belt, loom spindle, picker, martingle strap and other accessories of looms should be cleaned frequently by weavers. They should not always wait for maintenance mistry to do these. At the time of beam change, the shedding and picking tappet assembly zone must be cleaned throughly.

3. Proper lubrication of looms as per routine schedule is extremely necessary. Weaving line-sardars should take the whole responsibility for this matter (they may get it done by oilers in existing system, but gradually weavers should do it themselves through proper training).

4. Broken or worn out loom parts should be periodically checked and identified by weaving line-sardars and are to be immediately replaced through maintenance mistries, otherwise serious accidents or major breakdown may occur. This predictive maintenance attitude in weaving sardars is must.

5. Weaving line-sardars have to check tuning and setting of loom from time to time, and have to rectify immediately as necessary with or without the help of maintenance mistries.
The newer/younger/learner mistries must be trained properly, which most of the mills do not follow. The regular training for newer mistries for a longer period (approx-3 months) is must.

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2. Cambs, reeds, loom driving belt, loom spindle, picker, martingle strap and other accessories of looms should be cleaned frequently by weavers. They should not always wait for maintenance mistry to do these. At the time of beam change, the shedding and picking tappet assembly zone must be cleaned thoroughly.

3. Proper lubrication of looms as per routine schedule is extremely necessary. Weaving line-sardars should take the whole responsibility for this matter (they may get it done by oilers in existing system, but gradually weavers should do it themselves through proper training).

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5. Weaving line-sardars have to check tuning and setting of loom from time to time, and have to rectify immediately as necessary with or without the help of maintenance mistries.
(vi) The newer/younger/learner mistries must be trained properly, which most of the mills do not follow. The regular training for newer mistries for a longer period (approx-3 months) is must.

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2. Cambs, reeds, loom driving belt, loom spindle, picker, martingle strap and other accessories of looms should be cleaned frequently by weavers. They should not always wait for maintenance mistry to do these. At the time of beam change, the shedding and picking tappet assembly zone must be cleaned througly.

3. Proper lubrication of looms as per routine schedule is extremely necessary. Weaving line-sardars should take the whole responsibility for this matter (they may get it done by oilers in existing system, but gradually weavers should do it themselves through proper training).

4. Broken or worn out loom parts should be periodically checked and identified by weaving line-sardars and are to be immediately replaced through maintenance mistries, otherwise serious accidents or major breakdown may occur. This predictive maintenance attitude in weaving sardars is must.

5. Weaving line-sardars have to check tuning and setting of loom from time to time, and have to rectify immediately as necessary with or without the help of maintenance mistries.
(6) Weaving line-sardars have to develop a well co-ordinated harmony among all concerned in the weaving department and maintenance departement for getting the maintenance jobs done timely.

(7) Weaving line-sardars must check all the loom parts in case of frequent loom knock-off and high warp breakages. After identifying the cause, it should be rectified as early as possible.

(8) The condition of each loom should be checked by weaving sardar at a fixed schedule and should be recorded in log-book or history card with a comment if pre-schedule Condition Based Maintenance (CBM) work is necessary for any particular loom. Weaving sardars should not depend only on weavers to report for breakdown maintenance.

For the said improvement in loom shed, by adopting proper maintenance activities, the maintenance staff and loom fitters are to be trained properly to improve their skill particularly with reference to implementation of condition based maintenance, machine audit and for doing other maintenance activities efficiently.

IJT offers two levels of training programmes for maintenance staff of jute mills (2 – 3 days duration for existing experienced mistries and 3 months durations for learner/fresh mistries). IJT has published necessary training manuals for these courses.

3.11 Improper organizational policy

Productivity in terms of overall output/input ratio is also affected by improper organizational policy while correct and a positive organization policy decisions helps to improve overall output/input ratio. All or any of the following improper organizational policy and their consequent effect may follow a loss in total productivity:

(1) Inadequate capacity utilization/machine balancing (affects the Machine Productivity Index).
(2) Improper plant layout/plant design (unnecessarily requires more hands for material handling and affects Mandays per ton index).
(3) Poor supervision and managerial skill (affects the production output and quality of production).
(4) Inadequate innovation of technology (use of low productivity machines leads to less production output).
(5) Improper product mix/product design (affects utilization of production capacity and product improvement).
(6) Poor work environment (affects overall production output).
(7) Use of low quality machine-spares and raw materials (affects the machine hour available and the quality of products).
(8) Use of overaged machinery (affects machine hour availability for production).
(9) Fluctuations in market demand and product price (affects the sales turnover and overall financial output/input ratio in term of capital realization/capital invested).
(10) Improper capital investment (affects ratio of financial output/input ratio for higher or improper capital investment decisions).
(11) Ineffective or inadequate growth policy (affects the output/input ratio gradually with change of market situation, if future progress for growth and diversification is not planned).
(12) Inadequate motivation & staff welfare measures (Improvement of overall output/input ratio much depends on motivation and welfare measures for staff).
(13) Inadequate HRD activity for staff development (Training & HRD – activity for development of skill, knowledge and proper work method facilitates improvement in productivity in the long run).
3.12 Improper skill and work method of weavers, weaving line-sardars and loom fitters

Among the reasons of loss of production in loom, the skill of weavers, weaving line-sardars and loom fitters play a major role. Properly trained weavers, weaving line-sardars and loom fitters may definitely give higher production. Timely attending of the loom operational problems by skilled weavers, weaving line sardars and loom fitters is essential. Unskilled workers multiplicate the troubles rather than its solving.

Timely attending of the loom operational problems by skilled personnel

In case of excessive warp breakage, frequent loom knock-off, speed loos in loom or for production of defective fabrics for any reasons, the skilled weaving line-sardars have to take leading role in identifying the cause of the problem by attending the loom immediately and has to rectify these as early as possible, with or without the help of loom fitters. For a weaver or weaving line-sardar, to identify the causes of frequent loom knock-off and frequent warp breakages in loom, they have to be skilled and knowledgeable in this regards. To rectify the mechanical problems, the loom fitters are also to be very much skilled. Improper skill may lead multiplication of loom operational problems and increase in loss of production and or production of faulty fabrics. So, all personnel working in weaving department, are to be properly trained for their skill and knowledge development.

For example, weavers and weaving line-sardars must know the following points for identifying the causes of excessive warp breakages and/or frequent loom knock-off.

(1) Weavers or weaving line-sardars should first throughtly check the tuning of the loom and if anything is wrong, it is to be rectified immediately. For this, they should be skilled in loom tuning. Skilled weavers or weaving line-sardars should check whether all the primary and secondary motions of loom i.e. shedding, picking, beating, let-off and take-up motions are working correctly as per the crank cycle rotation. Weaving line-sardars must be sufficiently skilled to do this checking and rectification.

(2) For identifying exact reason of warp breakage, they should know that warp breakages usually happen at the following three zones, in the loom:

(a) Warp yarn may break from beam itself : In this case, length of broken thread is approximately equal to the distance from fell of the cloth to beam. Reasons may be - (a) inadequate sizing, (b) weak warp yam, (c) excessive tension on warp yarn. Appropriate corrective actions are to be taken by weavers or weaving line-sardars after finding out the exact reason.

(b) Warp breakages may take place at mail-eyes : In this case, length of broken thread is relatively smaller. In such case, either of the cambs are to be adjusted properly. If mail-eyes are worn out, mail-eyes in the respective cambs (i.e. containing mail-eyes) should be replaced immediately.

(c) Warp breakage may occur by defective movement of shuttle or faulty picking : In this case, the length of broken yam is much less. One has to find out whether picking is accomplished from left or right, when this warp break happens. Then, one has to check the shed-depth, picking force and timing of picking as well as setting of box-front and warp-protector motion. Broken picking strap and martingle strap, broken camb, cords, defective pickers also cause high warp breakage. If anything is found wrong, it is to be rectified as early as possible to reduce the avoidable stoppages of loom due to warp breakage.

So, proper organizational policy must be taken considering the above factors in mind for decrease or increase of overall productivity aiming at higher productivity. Induction of effective qualified and professional management group is essential for this purpose.
Weavers and weaving line-sardars must get trained to be aware about the above and have to be able to check the exact reason of breakage or any other loom operational problems. Skilled weavers or weaving line-sardars or loom fitters have to identify the exact reasons of loom stoppage or warp breakage and have to arrange to rectify those immediately. Hence, weaving productivity is very much dependent on skill of the weavers, weaving line-sardars and loom fitters.

3.13 Inadequate Mind Setup, Training and HRD Activity

Weavers and weaving line-sardars play a key role to keep up the quality and productivity of weaving shed as they directly look after the smooth running of looms. So, the main purpose of the training of weavers and weaving line-sardars, is to improve the performance of weaving department by improving the skill, knowledge and work performance of them. So, alongwith technical skill and knowledge, the weavers and weaving line-sardars must have the following behavioural/human quality characteristics in them to deliver the goods expected from them, to get the work done in least possible time. To improve output/input ratio in the loom shed, the following important training inputs are essential to improve the following human quality parameters of weavers, weaving line-sardars and loom fitters.

(1) **Skill and Knowledge** : Adequate knowledge of different loom parts and sufficient skill to set and tune the loom for smooth running of the looms.

(2) **Self confidence and Pride in Work** : Must know the job responsibility thoroughly and should be able to do all required setting of loom in own hand, so that, weavers and weaving line-sardars can feel pride of their work, with full self-confidence.

(3) **Ability to command respect** : Good job skill will enable a good weaver and weaving line-sardar to command respect from other weavers and loom fitters. This makes the task easier.

(4) **Ability to Motivate, Co-ordinate and Communicate** : A weaving line-sardar particularly should be able to motivate weavers and loom fitters to get the work done by his ability to motivate, co-ordinate and communicate others.

(5) **Sense of Duty and Belongingness** : A weaver and weaving line-sardar must be extremely dutyfull and responsible to their jobs and should establish an example to others by their good sense of duty. They must maintain their culmness even in a crisis period. They must have sense of belongingness to the organization.

(6) **Good Behaviour** : By vertue of good and friendly behaviour, a weaving line-sardar should be able to get the various jobs done by fellow mistries, weavers and helpers. So is important for others also.

(7) **Good Intentions and Desireness** : A weaver and weaving line-sardars must have good intentions and strong desireness to upgrade the skill to improve the working in loom shed.

(8) **Discipline and Punctuality** : A weaver and weaving line-sardar must be very disciplined and punctual.

(9) **Adoptibility, patience, alertness and watchfulness for any situation** : A weaver or weaving line sardar must improve his adoptability, patience, alertness and watchful nature for any crisis situation to come.

(10) **Consciousness for quality control and waste reduction/cost reduction** : Consciousness of quality of the products and waste reduction is must to improve output/input ratio in a loom shed.

Compared to other departments, a much larger number of workmen (Weavers, Helpers and Weaving Line-Sardars) are needed in weaving department. To improve the performance in weaving, weavers, loom fitters and weaving line-sardars are the key personnel of weaving.
department. Hence, the formal training of weaving and weaving line-sardars and loom fitters is extremely necessary to maintain a consistent level of productivity and quality in weaving shed.

Every workman in the mill has to develop a positive mind set-up for doing good work assigned to him with all responsibility and has to create a good work environment for a peaceful working place. A mill or company can stand well only by good work of grass root level workers. Every workman in the mill should feel that the machine he operates, in his own and he is there to achieve the target of the mill authority for the betterment of both. Furthermore, every workman should be aware that he plays a key role in the quality and quantity of the production of the mill and he is also responsible for developing good work-culture in the production of the mill. So, he must well aware of his duties and shall attain the optimum skill of doing his jobs and at the same time he has to maintain a good relation with his co-workers and superiors. So, he has to report for the duties well in advance of the shift and has to take the responsibility of target production in the allotted machine with supplied feed material and other available resources.

All sardars, weavers and other personnel of weaving department must always keep in mind that in order to produce adequate quantity of fault-free fabrics, good skill, right method of working, hard labour are essential. All employees of weaving department should be proud of the fact that they are the actual and final producers of jute fabrics. All weaving line-sardars are required to set an example to weavers and workers of other departments by their punctuality, discipline, method of working, constant effort to maintain quality of product and to reduce wastage, along with proper utilisation of productive capacity and maintenance of looms and to attend all loom operational problems immediately to reduce idle machine hours, as well as to time to time checking of loom tuning and setting of loom parts for smooth running of looms. All these are essential for improving output/input ratio in loom production and this mind setup can be inducted by proper HRD/Training activity only.

IJT has been conducting two levels of training programme (2 – 3 days duration for existing experienced weavers and weaving sardars and 3 months durations for learner/fresh weavers and weaving sardars). IJT has published require training manuals in 3 different languages for these courses.

4. Actions Required for Improvement of Productivity in Shuttleless Looms

The performance of shuttleless looms has been evaluated by the different jute related organizations including IJIRA under a jute mill production condition, for weaving fine hessian quality plain weave jute fabric. The main factors identified for low productivity in shuttleless looms used in jute mills and their remedial measures are as follows:

(1) Quality of both the conventional jute warp and weft yarns is not up to the mark for high speed automatic shuttleless looms, resulting high rate of yarn breakages during weaving. It may be suggested that, warp yam having nearby 100 quality ratio will be required, by using better quality jute i.e. superior batch mix.

(2) Existing yarn winding process is not efficient enough to produce yarns free from roots, slubs, snarls, poor quality knots, piecing defects and thin places etc. In warp yarns suitable for shuttleless looms, slubs should be eliminated as far as practicable and the knots for joining of missing ends should be the weaver's knot (not dog knot) for this purpose, during winding.

(3) Conventional weft yam preparatory system is unable to produce the weft packages with proper size and shape suitable for shuttleless looms. Weft yarns in shuttleless loom is supposed to unwind without any interruption in subsequent processes. Hence, the weft packages are to be prepare in such a way that over end easy withdrawal/unwinding become possible. Also coil angle should not exceed 80°, the cone angle should be less than 6° and pitch difference between two subsequent coils should be relatively larger. Tag ending system should be incorporated for continuous and uninterrupted supply of weft yarns to the shuttleless looms.
Existing warping process is unable to remove different faults, such as missing ends, cross ends, slack ends, high variation of tension between warp ends, damaged beam flange etc. which leads to higher end breaks during weaving in the shuttleless looms. Moreover in the existing warping system, tension-controlling device is not enough to control uniform tensions, for which proper stretch control in warping is not possible. This results nonuniform tension and higher stretches on warp yarn in the subsequent processes. As a remedy, to control proper warp tension and to avoid missing ends and cross ends etc., properly set tensioners and auto-stop motion should be introduced in the warping machine.

Common package faults in both warp yarns in beam and weft packages results higher loss of weaving efficiency in these looms. It is needless to say that both the beam yarns and the weft packages should be free from all common defects.

Existing sizing recipe and method of application for jute warp yarns to be used for high speed automatic shuttleless looms, is not sufficiently effective, as understood from following points:

In the conventional sized beam yarns, following defects are common:

(a) Perfect size beam can not be produced with the conventional sizing machine which creates so many faults during preparation of beam, i.e. ends are not wound straight & parallel to each other and has crossed, stuck or missing ends.
(b) Uniform warp tension from end to end cannot be maintained.
(c) Uniform warp density through out the sized beam cannot be always maintained.
(d) Due to variation in tension, selvedge ends near the beam flange are sometimes overlapped, instead of being flat and parallel with warp yarns in beam.
(e) High or low moisture content of sized yarn, low percent of size add-on, lappers and migration of ends are more frequent.
(f) More amount of invisible loss of sizing ingredients during weaving, resulting more hairs generation and droppings at loom etc. thus, existing sizing system generates excessive weaving faults resulting less efficiency of shuttleless looms. Hence, to avoid all these, a better sizing system, with suitable auto control devices is necessary for improvement of productivity in shuttleless looms.

Inadequacy of trained mistries in jute mills for maintenance of these modern looms.

Costliness and non-availability of good quality spares for these looms.

Maintenance department of most of the jute mills are not well equipped for maintaining these looms.

Some of the shuttleless looms being used in jute mills, are not designed considering weaving of coarser jute yarns.

Most of the mills are using only a few number of shettleless looms for a particular quality of fabric and hence, attention given to those looms are also inadequate.

Points 7,8 & 9 can be well tackled if a separate trained maintenance squad can be created for this and have a contract with manufacturer/supplier for regular supply of original good quality spares for these looms.

In order to ensure high productivity in shuttleless looms for weaving jute fabrics, the feed materials i.e. the warp beam and weft package should be prepared very carefully with minimum faults. These yarns should posses superior quality characteristics.

In a study made by IJIRA, they have shown if the jute yarns are specially produced using best possible production machines and processes (for production of fine hessian fabric in shuttleless loom), the property parameters (as shown in Table - 8) of unsized (as weft) and sized (as warp) yarns may be better than the referred norms of IJIRA, (Table - 5), for conventional jute warp and weft yarns for production of comparable hessian fabrics.
Table – 8 : Physical Properties and Yarn Parameters of Unsized/Sized Jute Yarns Made Specially**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Warp/Weft (unsized)</th>
<th>Warp(sized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count, tex (lb)</td>
<td>292 (8.5)</td>
<td>292 (8.5)</td>
</tr>
<tr>
<td>Normal</td>
<td>270 (7.83)</td>
<td>284 (8.25)</td>
</tr>
<tr>
<td>Actual</td>
<td>270 (7.83)</td>
<td>284 (8.25)</td>
</tr>
<tr>
<td>Count CV%</td>
<td>4.6</td>
<td>--</td>
</tr>
<tr>
<td>Breaking Strength, kg f</td>
<td>3.45</td>
<td>4.37</td>
</tr>
<tr>
<td>Average</td>
<td>1.94</td>
<td>2.27</td>
</tr>
<tr>
<td>Minimum</td>
<td>4.89</td>
<td>6.58</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.65</td>
<td>1.24</td>
</tr>
<tr>
<td>Breaking Elongation, %</td>
<td>1.12</td>
<td>0.88</td>
</tr>
<tr>
<td>Average</td>
<td>2.09</td>
<td>1.5</td>
</tr>
<tr>
<td>Minimum</td>
<td>96(80-85*)</td>
<td>116</td>
</tr>
<tr>
<td>Maximum</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Quality Ratio, %</td>
<td>136</td>
<td>174</td>
</tr>
<tr>
<td>Average</td>
<td>12.79</td>
<td>15.39</td>
</tr>
<tr>
<td>Minimum</td>
<td>7.18</td>
<td>7.99</td>
</tr>
<tr>
<td>Maximum</td>
<td>18.11</td>
<td>23.17</td>
</tr>
<tr>
<td>RKM (kgf x N m)</td>
<td>19.64(20-22*)</td>
<td>19.34</td>
</tr>
<tr>
<td>Average</td>
<td>4.33(12.64)</td>
<td>--</td>
</tr>
<tr>
<td>Minimum</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* Range of value as per IJIRA Norms
** Source : IJIRA study.

From the above data they have shown that such special jute yarn produced particularly for shuttleless looms, show the weavability limit as 0.65 (i.e. RKM value/strength CV %), which is just above the minimum weavability limit being 0.6. Strength and quality ratio of these yams are found to be higher than standard IJIRA norms for conventional good yarns of comparable count. The yarn imperfection data of these yarns are tabulated in Table – 9 given below:

Table 9 : Uster Evenness Test Results of Unsized Jute Yarn Made Specially **

<table>
<thead>
<tr>
<th>Yarn mass CV% :</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut length 1 cm</td>
<td>31.26 (28-32*)</td>
</tr>
<tr>
<td>Cut length 10 metres</td>
<td>6.74</td>
</tr>
<tr>
<td>Yarn imperfections</td>
<td></td>
</tr>
<tr>
<td>a) Thin (No/Km)</td>
<td></td>
</tr>
<tr>
<td>-50%</td>
<td>1384</td>
</tr>
<tr>
<td>b) Thick (No/Km)</td>
<td></td>
</tr>
<tr>
<td>+50%</td>
<td>1361</td>
</tr>
<tr>
<td>+100%</td>
<td>160</td>
</tr>
<tr>
<td>c) Slub (No/Km)</td>
<td></td>
</tr>
<tr>
<td>+200%</td>
<td>236</td>
</tr>
<tr>
<td>d) weight CV %</td>
<td></td>
</tr>
<tr>
<td>+200%</td>
<td>4.6(4-6*)</td>
</tr>
<tr>
<td>e) Hairiness index</td>
<td></td>
</tr>
<tr>
<td>+200%</td>
<td>12.27 (10.5-12.0*)</td>
</tr>
</tbody>
</table>

*Range of values as per IJIRA Norms
** Source : IJIRA study.
The yarn imperfection results of unsized yarn show that the most of the imperfection parameters of this yarn are either satisfying or more than satisfying IJIRA norms (Table – 5), for conventional yarns of comparable counts, indicating a better weaving performance in shuttleless looms. Though the standard norms of jute yarn parameters required for shuttleless weaving is still undone, the above parameters may be taken as guidelines.

5. Services Offered by Institute of Jute Technology for Improvement in Productivity in Jute Mills

Institute of Jute Technology, being the premier HRD Institute in Jute Technology, it offers following services for overall improvement in working performance and productivity for all the jute mills, taking a reasonable charge from the interested mills:

(A) Workers Training Activity

IJT offers two levels of workers’ training for all sections of workers in jute mills including weavers and weaving line-sardars taking a reasonable charge from the mill. For weavers, weaving line-sardars and loom fitters/mistries IJT has been conducting following two levels of training courses to be arranged on request from mills, taking a reasonable charge for the same.

Level-I
Module W-I : (i) Training of existing experienced weavers : 2-3 days
Module WS-I : (ii) Training of existing experienced weaving line-sardars : 2-3 days
Module – M1 : Training of existing maintenance mistries for factory side : 2-3 days

Level-II
Module W-II : (i) Training of learner/fresh weavers : 3 months
Module WS-II : (ii) Training of learner/fresh weaving line-sardars : 3 months.
Module – M2 : Training of learner/fresh maintenance mistries for factory side : 3 months

These courses are usually carried out in the mill campus, but can be conducted at IJT campus also. The course modules of the above training programmes are available from IJT. IJT has already published some training manuals and publishing more training manuals for such training modules to spread such HRD training activities in all the jute mills for overall improvement of productivity in jute mills including the improvement of productivity in loom shed. These training manuals in Bengali/Hindi and English are available for procurement by any mills at a concessional price from IJT.

(B) Short refresher courses for existing supervisors:

For all sections of jute mills, IJT offers separate refresher courses on chargeable basis, for Mill side supervisors and Factory side supervisors (total 5 modules each of 2 days for mill side and also same duration for factory side separately) along with a common 2 days’ training on Motivation and Behavioural aspects for all supervisors. These training courses are also carried out in mill campus or at IJT campus as per preference of the interested mills.

Also for fresh non-technical junior supervisors inducted in mills for 1 – 2 years, a special training course is available at IJT, known as Junior Level Supervisory (JLS) Course of 3 months for spinning side and 3 months for weaving side separately, as a regular course of activity of IJT. These courses are carried out Oct/Nov – Jan/Feb in each financial year in the Institute campus only.

(C) Technical consultancy

IJT offers special technical consultancy services on chargeable basis in any of the production section of jute mills, including weaving. IJT undertakes the consultancy work for assessment/diagnosis of technical faults in production activity of mills to identify the reasons for poor quality or lower level of
production, defective products, frequent maintenance failure etc. and suggests to the mills for the necessary remedial measures to improve the situation for overall improvement in productivity of jute mills.

IJT also offers consultancy services for product development, testing & inspection of raw material/product characteristics, loom tuning and other setting and does small R&D studies on process performance, technical viability/feasibility studies, as well as does technical valuation and analysis of machinery condition etc. as and when required and requested by mills; suggesting possibilities of improvement therein, to improve productivity (i.e. output/input ratio) of the mills.

(D) HRD-consultancy:
IJT also offers services for setting up training centre for jute mills and provides master trainers and relevant training manuals for organizing regular basis training of all category of jute mill personnel on continual basis, taking a reasonable charge from the mills.

6. Concluding suggestions:

In nutshell, following are the important action plan required for improvement of productivity in jute mills and particularly in loom shed of jute mills:

(a) Induction of effective, qualified and professional management for effective management policy.
(b) Induction of trained workers, sardars and mistries through training of learner/freshly inducted workers.
(c) Innovative R & D on process optimization and product developments with re-engineering of the design of jute fabrics/bags.
(d) Effective process control measures and strict quality supervision in all sections including yarn preparatory and weaving sections.
(e) Implementation of Total Production Maintenance (TPM) concept along with phase wise start of Condition Based Maintenance (CBM) and Predictive Preventive Maintenance (PPM).
(f) Effective waste reduction and cost reduction approaches.
(g) Assurance of quality of raw materials and quality of spare parts of machines.
(h) Adoption of high-tech production methods creating sufficient improvement in backup processes, for ensuing better quality raw materials and maintenance of those high-tech equipment (e.g. shuttleless looms).
(i) Improvement in raw jute quality and yarn quality (development of high yielding variety finer jute with better retting and farm management) required particularly for improving production in shuttleless looms.
(j) Finding new uses of jute products.
(k) Attaining TQM and TQC system.
(l) Standardization of labour productivity norms.
(m) Effective HRD activity for proper skill knowledge and attitude (mind set up) development for all category staff of jute mills.
(n) A totality approach instead of piece meal approach.
(o) Productivity improvement plan and its effective implementation.
References:

4. IJIT report to IJO (Presently – IJSG) on Sustainable human resource development programme for management of jute industry of Bangladesh, India and other countries, Institute of Jute Technology, Kolkata, Feb-2002.
## EXTRACT OF DATA REGARDING PERFORMANCE LEVEL OF DIFFERENT JUTE MILLS VISITED BY I.J.T. SURVEY TEAM

**Table-1: Data for Product-mix, Production Performance of Weaving Section And Man-days per ton etc. of Different Jute Mills of India and Bangladesh.**

<table>
<thead>
<tr>
<th>Product Mix (%)</th>
<th>MILL : A</th>
<th>MILL : B</th>
<th>MILL : C</th>
<th>MILL : D</th>
<th>MILL : E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hess : Skg : Other Products</td>
<td>40 : 30 : 30</td>
<td>46.5 : 42.3 : 11.2</td>
<td>44 : 52 : 4</td>
<td>50.7 : 32.2 : 17.1</td>
<td>39.5 : 57.2 : 3.3</td>
</tr>
</tbody>
</table>

### Spinning Data Related to Weaving

<table>
<thead>
<tr>
<th>Production: Avg. No. of spindles / loom / shift</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>82%</td>
<td>60%</td>
<td>75%</td>
<td>69.0%</td>
<td>75%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse</td>
<td>74%</td>
<td>49.8%</td>
<td>70%</td>
<td>60.3%</td>
<td>72%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Production Performance in Weaving:

<table>
<thead>
<tr>
<th>Avg. No. of looms worked/shift</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Hessian</th>
<th>Sacking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Stopped looms:</td>
<td>15.0</td>
<td>7.11</td>
<td>12.31</td>
<td>16.7</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Loom efficiency:</td>
<td>65%</td>
<td>48.8%</td>
<td>52.1%</td>
<td>54.1%</td>
<td>58%</td>
<td></td>
</tr>
<tr>
<td>Sacking:</td>
<td>72%</td>
<td>66.3%</td>
<td>70.9%</td>
<td>68.9%</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wastage (%) in Loom shed:</th>
<th>Thread waste</th>
<th>2.5% (app.)</th>
<th>3% (app.)</th>
<th>3%</th>
<th>2.2%</th>
<th>2.3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunny cutting:</td>
<td>0.3% (app.)</td>
<td>0.25% (app.)</td>
<td>0.20%</td>
<td>0.25%</td>
<td>0.20%</td>
<td></td>
</tr>
</tbody>
</table>

| Productivity Index (MPI/LER x 100) | 92.2 | 78.3 | 82.4 | 85.2 | 88.1 |

| Material (Jute) Input–Output ratio (overall) | 1.035 | Data not available | 1.03 | 1.05 | 1.04 |

<table>
<thead>
<tr>
<th>Man-days/ton of production</th>
<th>Hessian</th>
<th>Sacking</th>
<th>Others:</th>
<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hessian</td>
<td>51</td>
<td>76.6</td>
<td>45 (Twine)</td>
<td>70.7</td>
</tr>
<tr>
<td>Sacking</td>
<td>36</td>
<td>64.4</td>
<td>45</td>
<td>59.3</td>
</tr>
</tbody>
</table>

| Total weaving production in tonnes (contract wt. Annual) of different mills | 24600 | 7404 (?) | 23610 | 15089 | 24600 |
POSSIBLE PRODUCTIVITY IMPROVEMENT THROUGH IN HOUSE MANAGEMENT OF WORKING ENVIRONMENT IN JUTE MILLS

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General Manager (Research)
Bangladesh Jute Mills Corporation
Dhaka
POSSIBLE PRODUCTIVITY IMPROVEMENT THROUGH INHOUSE MANAGEMENT OF WORKING ENVIRONMENT IN JUTE MILLS

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Bangladesh inherited 77 units of jute goods manufacturing industry from the then East Pakistan having some 3,50,000 spindles and 26,000 looms capable of producing over 6.5 lac MT of Sacking, Hessian, CBC, Carpet, Tape, Felt etc. by achieving productivity of around 70%. All the jute mills were nationalised in 1972 without the concept of nationalism being imbied among the citizenry of the country especially among the workers. During pre-liberation period most of the managerial and supervisory posts of the jute industry were occupied by the non-Bengalis. Their exodus led to a vacuum in mill administrators, managers, supervisors, technical personnel and skilled workers in the floor levels. Trained and skilled manpower is the backbone of any industry on which success depends. In addition, there were chaos, confusion and lawlessness in the country and jute mills were no exception to it. This resulted in the production of 3.2 lac MT of jute goods in 1971-72 as against 6.5 lac MT. At that time the industry witnessed manifold increase in various cost components, such as:

- Raw jute price increased by - 380%
- Repair & maintenance increased by - 1270%
- Fuel and power increased by - 450%
- Wages and salary increased by - 500%
- The rate of depreciation increased by - 240%

At that time government realized that production efficiency of the jute mills cannot be increased to the desired level unless its manpower do not have required skill and technical know-how. It is expected that about 25% of its officers of various categories should have knowledge of the machinery, its economic use, repair and maintenance. As such the government initiated and trained its personnel on the following areas:

- On the floor level job training.
- Institutional and theoretical training coupled with evaluation of performance within industry.
- Overseas training of the junior mid-level executives toward sufficient potential for future development.

The above measures led jute industry to achieve 5.7 lac MT of jute goods in 1982-83. Production would have been much higher had there been no loss of production due to power failure and lay off/strike.

The government denationalized 40% production capacity of the Bangladeshi promoter-owner retaining 60% in the public sector in 1982. The production in the private sector jute mills has fallen to 25% from 40% as against public sector's increase of 75% from 60% - that excludes production of jute yarns in the private sector.
At present there are 128 jute mills as follows:

- BJMC - 34
- BJMA - 44
- BJSA - 50

Their installed/operable and operated looms/spindle along with their production is given in Table - 1

Table-1

<table>
<thead>
<tr>
<th>Organization</th>
<th>Looms installed/operable</th>
<th>Looms operated</th>
<th>Production in MT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hessian</td>
<td>Sacking</td>
<td>CBC</td>
</tr>
<tr>
<td>BJMC</td>
<td>6652</td>
<td>3405</td>
<td>1187</td>
</tr>
<tr>
<td>BJMA</td>
<td>5817</td>
<td>3621</td>
<td>741</td>
</tr>
<tr>
<td>BJSA</td>
<td>96297 spindles</td>
<td>77038 spindles</td>
<td>220000 MT</td>
</tr>
</tbody>
</table>

The volume, value, use, production and cost of production of jute and jute goods from the years 1996-2000 to 2003 are shown in Table-1.A excluding the figures of the Spinners Association whose raw jute-purchasing price is higher than that of BJMC and BJMA, their corresponding production cost being lower and efficiency higher.

Table – 1.A

The volume, value, use, production and cost of production of jute and jute goods.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sector</th>
<th>Jute Purchase (lac bale)</th>
<th>Average price/mt of jute (Tk.)</th>
<th>Use of jute (lac bales)</th>
<th>Production (lac MT)</th>
<th>Cost of production (000 Taka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-97</td>
<td>Public</td>
<td>17.06</td>
<td>444/-</td>
<td>15.43</td>
<td>2.72</td>
<td>40.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>8.30</td>
<td>517/-</td>
<td>7.40</td>
<td>1.38</td>
<td>33.00</td>
</tr>
<tr>
<td>1997-98</td>
<td>Public</td>
<td>19.64</td>
<td>245/-</td>
<td>14.46</td>
<td>2.55</td>
<td>37.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>9.60</td>
<td>316/-</td>
<td>8.60</td>
<td>1.54</td>
<td>30.00</td>
</tr>
<tr>
<td>1998-99</td>
<td>Public</td>
<td>10.55</td>
<td>302/-</td>
<td>15.60</td>
<td>2.36</td>
<td>39.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>6.59</td>
<td>370/-</td>
<td>7.68</td>
<td>1.32</td>
<td>30.00</td>
</tr>
<tr>
<td>1999-2000</td>
<td>Public</td>
<td>12.18</td>
<td>381/-</td>
<td>13.58</td>
<td>2.36</td>
<td>41.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>5.79</td>
<td>434/-</td>
<td>6.16</td>
<td>1.04</td>
<td>32.00</td>
</tr>
<tr>
<td>2000-2001</td>
<td>Public</td>
<td>12.43</td>
<td>412/-</td>
<td>13.99</td>
<td>2.46</td>
<td>42.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>5.22</td>
<td>436/-</td>
<td>5.43</td>
<td>0.82</td>
<td>33.00</td>
</tr>
<tr>
<td>2001-02</td>
<td>Public</td>
<td>15.60</td>
<td>512/-</td>
<td>14.20</td>
<td>2.49</td>
<td>49.00</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>4.99</td>
<td>536/-</td>
<td>4.59</td>
<td>0.72</td>
<td>35.00</td>
</tr>
<tr>
<td>2002-2003</td>
<td>Public</td>
<td>11.43</td>
<td>314.86</td>
<td>11.86</td>
<td>2.08</td>
<td>41.614</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>6.13</td>
<td>413.00</td>
<td>5.71</td>
<td>0.84</td>
<td>35.16</td>
</tr>
</tbody>
</table>
The breakdown of cost of production in public sector jute mills is shown in Table-2.

<table>
<thead>
<tr>
<th>Year</th>
<th>Raw jute and direct materials</th>
<th>Wages</th>
<th>Salary</th>
<th>Repair &amp; maintenance</th>
<th>Power and Fuel</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983-84</td>
<td>43</td>
<td>27</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>2001-02</td>
<td>30</td>
<td>33</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>2002-03</td>
<td>27</td>
<td>37</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

The above table indicates:

i) Cost of raw jute has decreased.

ii) Cost of wages has increased.

From the above table it further reveals that raw materials, wages and salaries together amount to an average of about 75% of the total cost leaving only a very small margin to cover other costs. These are average figures and vary greatly from mill to mill and product to product. The ideal standard would be around 60% on account of raw materials, wages and salaries for labour intensive industries to be cost effective. There is hardly any scope to reduce cost components on repair and maintenance, power and fuel, bank interest, insurance etc. as those are beyond the control of the mill management. However, it is possible to reduce cost components on account of raw material, wages and salaries to bring down by an average of 10 to 15 percent to a standard level of 60 percent by taking measures as discussed.

Raw Jute Production: The production, consumption and price of jute fibres are shown in Table-3.

<table>
<thead>
<tr>
<th>Year</th>
<th>Jute produced (lac bales)</th>
<th>Jute purchased (lac bales)</th>
<th>Jute consumed (lac bales)</th>
<th>Price of jute at mill ghat per maund (Tk)</th>
<th>Price of jute at Farmer's level per maund (Tk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-97</td>
<td>59.01</td>
<td>33.45</td>
<td>29.94</td>
<td>503/-</td>
<td>352/-</td>
</tr>
<tr>
<td>1997-98</td>
<td>69.04</td>
<td>38.40</td>
<td>31.14</td>
<td>312/-</td>
<td>180/-</td>
</tr>
<tr>
<td>1998-99</td>
<td>47.33</td>
<td>25.83</td>
<td>28.91</td>
<td>372/-</td>
<td>245/-</td>
</tr>
<tr>
<td>1999-00</td>
<td>40.84</td>
<td>26.76</td>
<td>28.47</td>
<td>434/-</td>
<td>280/-</td>
</tr>
<tr>
<td>2000-01</td>
<td>42.93</td>
<td>28.90</td>
<td>29.75</td>
<td>446/-</td>
<td>286/-</td>
</tr>
<tr>
<td>2001-02</td>
<td>51.37</td>
<td>33.25</td>
<td>29.95</td>
<td>536/-</td>
<td>370/-</td>
</tr>
</tbody>
</table>

POSSIBLE PRODUCTIVITY IMPROVEMENT.

Dr. M. M. Mustafizur Rahman
Jute is not cheap fibre though it is the cheapest mass-produced natural fibre. Jute is expensive when the cost is compared with the low priced traditional hessian, sacking and CBC and products thereof. The complicated raw jute marketing system adds about 35-40% in cost on the price of farmer which the middlemen exploit by performing purchases from the farmers and subsequent collection, grading and transporting to the jute purchasing agencies. Price reduction at the farmer’s level is not justifiable as they get low price. But the unethical exploitation earning of the middlemen must be reduced to a reasonable level of 20% on farmer’s price. This can be done by mobilising the jute farmers to form cooperatives in the appropriate jute growing areas and these societies will sell the fibre to the mill’s jute purchasing agencies after properly grading and bundling/baling. Cooperatives will be given soft loan by the banks. Mills will ensure purchasing jute from the cooperatives from their existing jute purchasing centres by making running payments as per existing system but not deferred payments. Memorandum and Articles of Association of the cooperatives will be as per law of the land. In this way the farmer’s fair price for jute and mills cost components can be reduced to an acceptable standard and their predicament can be improved.

Wages and Productivity:

To improve the productivity of a jute mill will include two stages - firstly to rationalize the existing mills’ working environment, and secondly on the longer term, to introduce a new generation processing machinery. The country’s jute mills were established during the span of 20 years from 1950’s to 1970’s. The jute mills infrastructural plan, design and lay-out were more or less the same prototype ones that are capable of handling and transporting jute through several processes of jute to finished products. The factory buildings and layout plans did not have the facilities of dust collection, dust extraction, de-dusting, noise absorbing or conditioning systems as these are the basic requirements of any modern textile mills, for that matter of jute mills.

There are at least 25 to 30 steps of handling and transportation of raw jute and process jute within mill/factory premises to produce finished jute products. These are done manually. That means to produce 1 metric tonne of finished jute products the process needs to handle, lift, store and transport 25 to 30 metric tonnes of processed materials through different processing zones/stages by ordinary carts/trolley/basket on trolley, driven manually.

It is a fact that in existing jute mills about 20% of the total workforce cost is shared by material handling alone and their number is roughly 30-35% of the total labour force who are mostly unskilled. By introducing specially designed crane and/or fork lift in the Raw Jute godown for storing and stacking of jute bales and palletisation in the Batch House for transportation of materials in selection, softening, piling, root cutting and card feeding about 50% labour force can be reduced thereby saving on wages.

By introducing specially designed cart fitted with spikes in the spinning area for transportation of spinning bobbins to winding department in place of basket-on-trolley will be able to reduce labour-force by about 30%. Similar saving in labour
force can be achieved in all the material handling areas in jute mills by improving the
following which do not require major capital investment:

- Old trolleys to be replaced by appropriately designed ones having
tyred/rubber-based wheel.
- Introducing tyre/rubber-based wheel in carts fitted with spikes.
- Palletisation wherever possible.
- Floors to be renovated/reconstructed for smooth movement of forklifts,
carts, trolleys and other related activities.
- Establish Threshold Limit Value (TLV) of Air pollutant, Noise and
Vibration of machinery of Jute Mills.
- Implement ILO Convention No. 148 and its Recommendation No. 156
concerning the Protection of Workers against Occupational Hazards in the
Working Environment Due to Air Pollution, Noise and Vibration in Jute
Mills.
- Introduce Dust Collection, Dust Extraction, De-dusting, Vibration and
Noise absorbing System in the mills.

Conclusion:

All the European Jute Industries, except one in Germany, have already been
closed/relocated as it is not viable to invest in high-tech machinery as the available
machinery is not much better than those already installed. It needs some modification
and renovation and management’s ability to arrange steady flow of materials and
stores so that all machines are in proper working order and manned by trained
operators. By introducing Manuals of Industrial Engineering, Time Study and Process
Costing in Jute Mills coupled with improving working environment as discussed will
certainly improve productivity, accountability and profitability of the existing jute
mills. These measures will certainly narrow the present trading losses being incurred
by the jute industry to a significant level – may be, the industry will be profitable.

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POSSIBLE PRODUCTIVITY IMPROVEMENT. . . .
Dr. M. M. Mustafizur Rahman
TECHNICAL SESSION - 4
IMPROVEMENT IN PRODUCTIVITY THROUGH INDUCTION OF NEW TECHNOLOGY

S Palit
S R Dasgupta
Lagan Jute Machinery Co. Ltd.
Kolkata
1.0 Introduction

The productivity improvement exercise is an effective activity of any enterprise to optimize cost, reduce price and make product competitive. It is a powerful management tool which many organizations fail to appreciate.

In the Indian jute industry, the first attempt was made by the Government of India to assess the overall productivity level of the jute industry in the year 1982 when the Prime Minister announced the year as productivity year for the country. The Jute Commissioner on behalf of MOT initiated the exercise and the study conducted by IJIRA was an excellent attempt to quantify the productivity level in terms of indices for the jute industry as a whole and also for each unit. It was observed that the overall productivity index (PI) for the industry was 80. With a scatter between maximum and minimum PI for best and poor mills ranging between max PI 90 and mini PI 63.
The index PI is an indicative scale and shows the degree of improvement can be achieved. It was observed that the Jute Industry can do much better to improve overall PI. This study was an eye opener for the jute industry. Jute mills had found fruitfulness of such exercise. To follow up the exercise IJIRA created a separate division for productivity improvement under direct control of the Office of the Jute Commissioner. The exercise continued for a decade and turning out monthly statement.

As matter of interest, though Lagan is not directly part of the industry but it is felt that such exercise needs to be continued under the able guidance of the Jute Commissioner once again. It was a model exercise which is worth adopting by other jute producing countries for betterment of productivity.

An important element of production is the machine specification. The productivity index works out for the jute industry is based on the level of technology at present in vogue. This paper would discuss the relevance of induction of new and advanced technology in improving the machine productivity significantly at the spinning stage. Thus reducing cost of production and improve product competitiveness and in turn entrepreneurs will be able to pay fair wages to the workmen.
2.0 What is PI*

PI is an expression of functions in ratio. There are a number ratios can be developed. However, a simplest form devised for the jute industry is explained here.

The production system have two critical components, machine[Mc] and man[M].

\[ \text{Mc PI}= \frac{\text{Actual machine hours}}{\text{Std. machine hours}} \times 100 \quad \ldots \quad [1] \]
\[ \text{M PI}= \frac{\text{Actual Man hour}}{\text{Std. Man hour}} \times 100 \quad \ldots \quad [2] \]
\[ \text{Overall PI} = \frac{\text{McPI}}{\text{MPI}} \times 100 \quad \ldots \quad [3] \]

Now, one can see the role and importance of Machine in the production system and its influence in improving overall productivity of an enterprise.

As a machine manufacturer Lagan wants to focus on the development of new generation of technology for the industry which was so far not given due attention it deserved. Hopefully this workshop would lead IJSG to undertake machine developmental projects.
2.1 Parameters of the Technology

<table>
<thead>
<tr>
<th>Machines</th>
<th>Delivery Speed</th>
<th>No. of deliveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaker Card</td>
<td>220</td>
<td>1</td>
</tr>
<tr>
<td>Finisher Card</td>
<td>220</td>
<td>1</td>
</tr>
<tr>
<td>1st Drawing</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>2nd Drawing</td>
<td>110</td>
<td>10</td>
</tr>
<tr>
<td>3rd Drawing</td>
<td>160</td>
<td>20</td>
</tr>
<tr>
<td><strong>SPINNING FRAME</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 1/4&quot; P. Slip Draft</td>
<td>4500 maximum</td>
<td></td>
</tr>
<tr>
<td>4 1/4&quot; a.d.</td>
<td>4750 MAXIMUM</td>
<td></td>
</tr>
<tr>
<td><strong>LOOM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46 1/2; R.S.</td>
<td>154 PPM</td>
<td></td>
</tr>
</tbody>
</table>

The present level of technology is briefly outlined in Table I. The technology outlined up to Spinning has been upgraded in mid 60s while technology of weaving is as old as the jute industry i.e. 150 years.
In both areas suitable advancement in technology particularly in the Drawing and Spinning area and also in weaving has been achieved and can be adapted for processing of jute fibre efficiently. These technologies are efficiently in operation for long staple fibre, flax and synthetic, in the Drawing and Spinning areas. While in the weaving the shuttle loom has gradually taken over by Shuttleless Looms. The brief outline of the specification of the proposed new technology is shown in table II.

<table>
<thead>
<tr>
<th>Machines</th>
<th>Delivery Speed</th>
<th>No. of Deliveries</th>
<th>Type of Drafting Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Drawing</td>
<td>450 ft/min</td>
<td>4</td>
<td>intersecting</td>
</tr>
<tr>
<td>2nd Drawing</td>
<td>450 ft/min</td>
<td>4</td>
<td>intersecting</td>
</tr>
<tr>
<td>3rd Drawing</td>
<td>500 ft/min</td>
<td>8</td>
<td>intersecting</td>
</tr>
<tr>
<td>Spinning - Type I</td>
<td>Speed / RPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyer</td>
<td>6000</td>
<td></td>
<td>Slip Draft/Single Apron</td>
</tr>
<tr>
<td>Spinning - Type II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring</td>
<td>8000</td>
<td></td>
<td>Single Apron/Double Apron</td>
</tr>
</tbody>
</table>
The comparison between Table I and Table II reveals that there is basic change in the design of the machines which would improve machine productivity and is briefly summarized in Table III.

<table>
<thead>
<tr>
<th>TABLE - III</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTIVITY INDEX OF NEW TECHNOLOGY</td>
</tr>
<tr>
<td>EFFECTIVE SPEED</td>
</tr>
<tr>
<td>Existing ft/min</td>
</tr>
<tr>
<td>(1) Drawing I</td>
</tr>
<tr>
<td>Drawing II</td>
</tr>
<tr>
<td>Drawing III</td>
</tr>
<tr>
<td>(2) Spinning R.P.M.</td>
</tr>
<tr>
<td>1)Flyer 4 1/4&quot; 4.500</td>
</tr>
<tr>
<td>2)Ring</td>
</tr>
<tr>
<td>Spinning PI</td>
</tr>
<tr>
<td>(3) Loom 46.5 in RS</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Spinning &amp;Weaving Tech PI</td>
</tr>
</tbody>
</table>
It will be observed from Table III that the technology itself can bring significant change in the improvement of productivity. Through machine productivity. For mass scale adaptation of new technology there should be attempt by the jute sector to invest adequately for the development and adaptation of new technology through capable jute / textile machine manufacturers. IJSG is, perhaps, the appropriate forum to take lead in this direction and source funding from international funding institutions like World Bank, Asian Development Bank etc. Meanwhile, and interesting scenario has emerged in India while attempting to diversify products. Through the effort of UNDP and GOI a new product range has emerged which calls for to spin light and weave light. Spin light means capability to spin below 6 lbs and weave light means that these yarns has to be woven on suitable looms having balanced fabric geometry. This criteria can only be met by a Ring Spinning and Shuttleless Looms. In India there is a trend to import and adapt second hand Ring Spinning from the flax / long staple industry to spin light and for weaving light shuttleless loom from textile industry. Sizable number of machines are in the process of introduction in India. If this is a pace setter then all the more it is important that IJSG should pay renewed attention seriously to adopt a project on the development of new machinery for the sake of not only improving machine productivity but also to usher in the way of new products.
FOR NOTES
DEVELOPMENT OF UP-GRADATION KITS FOR EXISTING MACHINERY: IN NEED OF THE JUTE INDUSTRY

Shimna Engineering Pvt. Ltd,
Howrah, India.
DEVELOPMENT OF UP-GRADATION KITS FOR EXISTING MACHINERY:
IN NEED OF THE JUTE INDUSTRY

We all are aware of the present trend of the market, manufacturing cost of jute goods and the need of the jute industry which have been reassessed and spelt out repeatedly by various authors / speakers at numerous seminars and forum since late eighties. We also acknowledge the fact that new modern high productive cost saving machinery is an essential component to meet the challenging requirement of the industry in its effort to hold the existing market share of packaging and then spread beyond the confines of traditional jute products to the household textiles. Unfortunately, at the same time we realize that the industry is in no position to afford replacement of existing machinery with new ones on the reqd. scale. It is also a fact that there has hardly been any development in Jute preparing and spinning machinery which could merit / win spontaneous choice of one and all in the same way as the introduction of slip draft sliver spinning and screwgill drawing frames did in fifties.

Although there was no new development for jute as such, there were certain labour saving machines which could immensely benefit the industry, available from European machinery manufacturers, like Mackies but due to high import duty and exchange rate the cost was prohibitive. Being incharge of Mackies (James Mackie & Sons, Belfast) entire business operation of India & Nepal, I found it extremely difficult to introduce these new machines in Indian mills, the landed cost was the biggest deterrent. So on one side there were the machines with the European manufacturer and on the other side were the mills who needed these machines badly but the two could not meet due to cost barrier.

In this sort of helpless situation it occurred to me that up-gradation of existing machines with suitable kits could provide the necessary solution to the problem. These up-gradation kits would introduce high performance, cost saving, quality improvement features on to the existing machines at a fractional cost of new imported machines. For example, cost per spindle of a new imported Ring Spinning frame suitable for jute could be well over US$ 1200/- whereas cost of conversion of an existing Slip Draft Spinning per spindle could be around US$ 100/-. The converted / upgraded spinning frame will have better feature suited to jute. Similarly, the conversion kits cost will compare very favourably with indigenous machines; for example the cost of up-gradation kit for 2nd drawing which produces almost double of the existing machine is approximately INR 400,000/- as against the price of a new indigenous 2nd drawing of around INR 1200,000/-. 

My concept of up-gradation of different machines was discussed with various experts, firms and organizations both at home and abroad and was acclaimed by all. In fact, the world leader of jute machinery manufacturing firm of UK was indeed very keen on this plan but for their unfavourable mfg, cost and other compulsions this was not pursued outside India. They, therefore, initiated an Indian set-up “Shimna Engg Pvt Ltd” named after the ‘Shimna’ river of Northern Ireland. Interaction with overseas firms and my experience of working for Mackies in other natural fibre & synthetic machinery installation in various parts of the world further consolidated my resolve for the development of up-gradation system.

I had been advocating development of up-gradation kit of preparing and spinning machine since 1987 and in fact, submitted proposals to IJMA in 1992. The existing machine can be upgraded to yield very high degree of improvement in productivity as well as quality and even wider range of products by dint of these kits which would be available at a very attractive price, price being the most vital criteria. The programme would involve development of such components, assemblies, sub-assemblies, system etc. which could be easily adopted / incorporated in to the
existing machines with minimum changes to the basic machines and not just replacement of complete section / zone of the machine with complete section / zone of another existing model.

Moreover, this will enable the mills to undertake full scale modernization / upgradation, may be without having to wait for any external financial assistance. This kind of upgradation appears to be the only means of ensuring general up-liftment of the industry since almost all mills will be able to afford required investment and without entailing the hassles of introducing new machines and risk of worker apathy etc. etc.

After the incorporation of Shimna Engg Pvt Ltd in 1988 we concentrated on mfg. & supply of spares to Mackies and other European and African buyers in order to support our machinery development activities and we were able to take up development programme of upgradation systems only after 1993.

With our own limited resources, we have been working on following upgradation kits and attachments out of which some have been already completed and are ready for commercial sale. Others are at various stages of development and expected to be ready for mill trial soon. Present status of each development has been indicated later in this paper.

1. **DM TZ Intersecting Finisher Card Attachment.**
   (New machine of our own concept & design)
   Object :
   a. To shorten the system (by eliminating First Drawing) of standard hess. 3 drawing line.
   b. To improve doublings of export yarn system.
   c. To improve quality of export yarn, by two zones intersecting drafting
   d. To improve card out put (finisher card processing export yarn) by 12 to 15%.
   e. To feed loose crimped sliver in large cans to the first passage drawing.
   (Features & advantages listed to be noted)

2. **DM TZ Intersecting First Passage Single Delivery Drawing With Provision For Autoleveller**
   (New machine of our own concept & design)
   Object :
   a. High quality yarn processing
   b. High production, 5 MT (from single delivery machine)
   c. Increased doubling up to 1 : 6.
   d. Controlled sliver wt. by electro-mechanical draft control.

3. **Modification Kit For Existing Screwgill Second Drawing**
   Object :
   a. To increase no. of deliveries from 10 to 14 (in the existing length of machine)
   b. To increase speed by 50%.
   c. To increase package (can size) from 16” dia to 18” dia.
   d. To reduce splicing & stoppage of finisher drawing.
   e. To improve skg. Weft replacing P.B. drawing with surplus 2nd drawings.
   f. To increase output by almost 100%.
   g. To incorporate in built dust extraction.
   (comparative features to be noted)
4. Kit For Converting Existing 4¼" or 4¾" or 5½” P Slip Draft Flyer Spinning To Ring Spinning Frame
Object:
   a. To increase operating speed from existing max. of 4000 to 6000 rpm.
   b. To increase package (bobbin size) by 100%.
   c. To widen count range 6 to 18 lbs. for 4¼” P (range will be different for 4¾” & 5½” P Spg.)
   d. To eliminate doffing loss.
   e. To have sliver stopmotion (Ring Spg. do not have this)
   f. To improve existing drafting system
   g. To incorporate two drafting zone.
      (comparative features to be noted)

5. Kit For Upgrading Existing 5½” Pitch “V” Roller Skg. Weft Spinning
Object:
   a. To increase operating speed up to 4500 rpm
   b. To spin both light & heavy count in the same machine (8 to 30 lbs.)
   c. To increase package (bobbin size) by 75%
   d. To improve drafting system, existing zone.
   e. To spin export quality heavy yarn at higher speed, 4000 rpm.
   f. To add another drafting zone.
      (comparative features given later to be noted)

6. Shuttleless Flexible Rapier Automatic Twin Loom For Skg. (New machine)
Object:
   a. To weave 2 cloths independent of each other.
   b. To weave plain & twill simultaneously
   c. To weave jute + P.P., 100% P.P. or jute + cotton
   d. To suit existing input.
   e. One weaver to operate 4 looms producing 8 cloths
   f. To have flawless cloth.

7. Attachments / Add-Ons For Existing Jute Spreader.
Object:
   a. To automatically control feeding by electronic & electro-mechanical means.
   b. To automatically mark each roll wt. on rolls of pre-set length.
   c. To improve life of components.
   d. To improve quality.
   e. To reduce maintenance.

8. Linear Carding Opener
Object:
   a. To eliminate ills of spreader.
   b. To reduce carding requirement.
   c. To improve quality.
   d. To reduce mfg. cost.

9. Conversion Of Existing Finisher Drawing To Intersecting System
Object:
   a. To improve doublings to 4
   b. To improve output from 3.8 MT (avg.) to 10 MT.
c. Present sliver straight from Intersecting Drawing to spinning.
d. To reduce mfg. cost.

We are glad to confirm that the above up-gradation systems have been designed in an unique way involving minimum changes and by and large retaining basic machine and component same.

Since our kits will call for minimum changes these result in following additional advantages on top of increasing production, package, quality etc.:

a. Lower cost of kits – because new parts are less and existing parts are used.
b. Large scale mfg. and implementation at shortest time – because no. of new parts to be made is less.
c. Less stores and inventory of new items – because new items are little.
d. Less resistance from workers / operators – because the machine apparently remain same and at same place, also no change in operation system.
e. Assembly / fitting of the kits at the mills, i.e. conversion on the machine in mill floor – because up-gradation will be carried out at site.

We would like to point out another important factor namely, Integrated Nature of Our Development Programme, containing preparing and spinning designed to shortening the present system to achieve overall improvement of cost, quality and production very substantially at a reasonably cheap price / investment. Schematic lay-out of systems have also been given to indicate the integrated approach of our development programme.
PRESENT STATUS OF VARIOUS DEVELOPMENT ITEMS

1. DM TZ Intersecting Finisher Card Attachment.
   Status: Ready for commercial sale.
   Regular 3 shifts operation in mill showed very satisfactory spinning performance and yarn quality even eliminating first drawing from Hess. 3 drawing system.

2. DM TZ Intersecting First Passage Single Delivery Drawing With Provision For Autoleveller
   Status: Ready for field trial.

3. Modification Kit For Existing Screwgill Second Drawing
   Status: Ready for commercial sale.
   Performance of regular 3 shift running in the mill proved satisfactory.

4. Kit For Converting Existing 4½” P Slip Draft Flyer Spinning To Ring Spinning Frame
   Status: Ready for mill trial.
   Test spinning was done from ordinary (old) sliver: 18 lbs & 6 lbs at 4800 rpm. The quality & performance were satisfactory.

5. Kit For Upgrading Existing 5½” Pitch “V” Roller Skg. Weft Spinning
   Status: Preliminary test run of Poney frame done and will be ready for mill trial soon.

   Status: Ready for mill trial.
   Test ran plain fabric with improvised beam.

7. Attachments / Add-Ons For Improving Existing Jute Spreader.
   Status: Development progressing.

8. Linear Carding Opener
   Status: Preparation for miniature model (prototype) is underway. Preparing papers for patent.

9. Kit for conversion of existing finisher drawing intersecting system
   Status: Work just taken up.

Our progress has been quite satisfactory considering the fact that we are pursuing so many developments of totally new concept, all at a time and with constraints of scanty resources.
Although some of the machines and kits have already been developed and ready, we are holding up general sale till we can organize large scale / bulk manufacturing to ensure adequate supply to meet the requirement promptly. We are sure that our machines, specially the kits will be copied as soon as some mills install these. So it is extremely important for us to build up necessary facility to ensure at least a reasonable return before piracy takes over.

While we are expanding our own machining and assembly capacity we are also considering tie-up with domestic or overseas firms of S.E. Asian region.

It is our intention to organize a demonstration of all our developments some time end of next year to the international jute community if we are able to complete the construction of the new unit for which land has been acquired. We will install these machines and operate as demonstration cum yarn unit.

In conclusion, we hope that the above information and the workshop will help generate due awareness and keen interest of the industry to mobilize the incorporation of the upgradation systems on a large scale because these developments can indeed benefit the industry at this hour of need; as the saying goes “A friend in need is a friend indeed”.

D. K. MALLICK
Managing Director
SHIMNA ENGINEERING PVT. LTD.

P/S:
For the better understanding of the above developments we are giving Features, Advantageous, Comparative Features of each. DUTY DETAIL SHEET giving all technical and processing parameters / figures calculation will be provided in due course of finalizing any installation.
DM TZ Intersecting Finisher Card Attachment

**Features**

2 Drafting Zones
- Primary Drafting: Intersecting gill roller
- Secondary Drafting: Intersecting L.G. chain

Draft Range: Up to 4

Can Size: 24” dia x 40” (28” x 40” if requested)

Packing: High density can packing, turning & reversing motion

Auto Functions:
- Automatic sliver switching to reserve can on preset sliver length
- Automatic severing of sliver after full can & sliver switching
- Automatic delinking from finisher card on card jamming / sliver breaking

Stop Motion: Comprehensive electrical stop motions

Function Indicator: Colour lamp tower for signaling mode of operation at any point.

Short Fibre Extraction: In built

Top Head Lifting: Pneumatic

Operation Of Card: From front panel switches located on attachment.

Can Be Attached To: Any type of Finisher Card
**Features**

Free Standing Drawing

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of Heads</td>
<td>1</td>
</tr>
<tr>
<td>No. Of Deliveries</td>
<td>1</td>
</tr>
<tr>
<td>Drafting Zones (Both Intersecting)</td>
<td>2</td>
</tr>
<tr>
<td>Draft Range</td>
<td>Up to 5.5</td>
</tr>
<tr>
<td>No. Of Doublings</td>
<td>Up to 6 : 1</td>
</tr>
<tr>
<td>Delivery Speed</td>
<td>Up to 140 yds. / min</td>
</tr>
<tr>
<td>Production</td>
<td>5 MT / day (or more)</td>
</tr>
<tr>
<td>Auto leveler unit</td>
<td>Optional</td>
</tr>
<tr>
<td>Driving motor H.P.</td>
<td>5</td>
</tr>
<tr>
<td>Can Size</td>
<td>24” dia x 40” (28” x 40” if requested)</td>
</tr>
<tr>
<td>Packing</td>
<td>High density can packing, turning &amp; reversing motion</td>
</tr>
</tbody>
</table>
| Auto Functions                 | • Automatic sliver switching to reserve can on preset sliver length  
                                | • Automatic severing of sliver after full can & sliver switching |
| Stop Motion                    | Comprehensive electrical stop motions |
| Function Indicator             | Colour lamp tower for signaling mode of operation at any point. |
| Short Fibre Extraction         | In built |
| Top Head Lifting               | Pneumatic |
Features

- **Type**: Flexible rapier, Twin width
- **Reed width**: 51”
- **Fabrics / Loom**: 2
- **Target operating speed**: 240 rpm
- **Selvedge**: Crochet / Tuck-in / Leno
- **Beat-up**: Positive reed beat-up
- **Drive location**: Center
- **Weave**: Plain & Twill
- **Beam**: 36” dia. x 2 Nos.
- **Let-off**: Positive
- **Shedding mechanism**: Tappet box
- **Weft**: 5 – 8 Kg. Tag-end spools
- **Weft feed**: Pre feed accumulator
- **Colour selector**: Optional
- **Cloth Roll Up**: Free standing up to 5’ dia.

Advantages

1. High quality flawless fabrics
2. Complete versatility
3. Savings in wages (reduction in mandays) stores & spares etc. etc.
4. Noise pollution & environment
5. Continuous weft supply
6. Electronic & electric weft & warp stop motion
7. Weaving from creel alternative
## MODIFICATION OF SCREWGILL SECOND DRAWING

### COMPARATIVE FEATURES

<table>
<thead>
<tr>
<th></th>
<th>EXISTING</th>
<th>MODIFIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Length</td>
<td>16 ft. approx.</td>
<td>16 ft. approx.</td>
</tr>
<tr>
<td>No. Of Heads</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>No. Of Deliveries</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Can Size</td>
<td>16&quot; dia. x 40&quot;</td>
<td>18&quot; dia. x 40&quot;</td>
</tr>
<tr>
<td>Doublings</td>
<td>3 : 1 (usual)</td>
<td>4 : 1 (or 3 : 1 if reqd.)</td>
</tr>
<tr>
<td>Rollers &amp; Shafts Fitted On</td>
<td>Bush Bearings</td>
<td>Ball &amp; Roller Bearing</td>
</tr>
<tr>
<td>Coiler Drive</td>
<td>Single</td>
<td>Duel</td>
</tr>
<tr>
<td>Reversing Motion</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stop Motion</td>
<td>Mechanical</td>
<td>Electronic</td>
</tr>
<tr>
<td>Draft Range</td>
<td>5.5 to 6.5</td>
<td>5.5 to 6.5</td>
</tr>
<tr>
<td>Sliver Wt.</td>
<td>3.8 to 5 (or more)</td>
<td>3.8 to 5 (or more)</td>
</tr>
<tr>
<td>Delivery Speed</td>
<td>25 yds (JMS rated normal)</td>
<td>50 yds</td>
</tr>
<tr>
<td>Motor H.P.</td>
<td>5 KW</td>
<td>5 KW</td>
</tr>
<tr>
<td>Dust / Short Fibre Extraction</td>
<td>No</td>
<td>Yes (incorporated)</td>
</tr>
</tbody>
</table>
# COMPARATIVE FEATURES OF CONVERSION KIT FOR 4⅝" S. D. SPG. TO RING SPG.

<table>
<thead>
<tr>
<th></th>
<th>EXISTING FLYER SPINNING</th>
<th>CONVERTED RING SPINNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pitch Of Spindles</strong></td>
<td>4⅝&quot;</td>
<td>(or 4¾&quot; or 5½&quot;)</td>
</tr>
<tr>
<td><strong>No. Of Spindles</strong></td>
<td>100 (96 or 80)</td>
<td>100 (96 or 80)</td>
</tr>
<tr>
<td><strong>Type Of Spindles</strong></td>
<td>Dead</td>
<td>Live</td>
</tr>
<tr>
<td><strong>Package Size</strong></td>
<td>5-1/2&quot; x 2-11/16&quot;</td>
<td>(Of 4-1/4&quot; Spg.)</td>
</tr>
<tr>
<td><strong>Spindle Speed RPM</strong></td>
<td>3600 - 4000</td>
<td>4500 - 5500</td>
</tr>
<tr>
<td><strong>Feed Sliver Wt.</strong></td>
<td>120 lbs. / 144 lbs.</td>
<td>120 lbs. - 180 lbs.</td>
</tr>
<tr>
<td><strong>Yarn Range</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-1/4&quot; Pitch Frames</td>
<td>6 - 10 lbs.</td>
<td>3 - 16 lbs.</td>
</tr>
<tr>
<td>4-3/4&quot; &quot; &quot;</td>
<td>7 - 16 lbs.</td>
<td>4.5 - 30 lbs.</td>
</tr>
<tr>
<td>5-1/2&quot; &quot; &quot;</td>
<td>20 - 40 lbs.</td>
<td>8 - 28 lbs.</td>
</tr>
<tr>
<td><strong>Drafting</strong></td>
<td>Single Zone</td>
<td>Single or Two Zone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Optional)</td>
</tr>
<tr>
<td><strong>Drafting Type</strong></td>
<td>Slip Draft Or Apron</td>
<td>New Combination L.G. &amp; A.D.</td>
</tr>
<tr>
<td></td>
<td>Draft</td>
<td></td>
</tr>
<tr>
<td><strong>Draft Range</strong></td>
<td>10 - 15</td>
<td>10 - 45</td>
</tr>
<tr>
<td><strong>O.H.T. Blower / Extractor</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Sliver Stop Motion</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Operating Efficiency</strong></td>
<td>80%</td>
<td>88%</td>
</tr>
<tr>
<td><strong>Spindle Stop</strong></td>
<td>No</td>
<td>Foot Brake</td>
</tr>
<tr>
<td><strong>Doffing Loss</strong></td>
<td>Considerable</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>Production / Day (23.5 hrs.) (of 4-1/4&quot; Spg.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 lbs.</td>
<td>0.739 MT</td>
<td>1.12 MT</td>
</tr>
<tr>
<td>3 lbs.</td>
<td>Not Possible</td>
<td>0.27 MT</td>
</tr>
<tr>
<td>16 lbs.</td>
<td>1.8 MT</td>
<td>2.75 MT</td>
</tr>
<tr>
<td><strong>Yarn Suitable For</strong></td>
<td>Packaging &amp; Industrial Use Only</td>
<td>Packing, Also Speciality Yarn</td>
</tr>
<tr>
<td><strong>Finisher Drawing Reqd.</strong></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Current Price</strong></td>
<td>Rs. 11.0 Lacs</td>
<td>Rs. 5.0 Lacs (Target Price)</td>
</tr>
<tr>
<td>Indian</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spinning Frame Reqd. For 12 Tons</strong></td>
<td>17.44</td>
<td>9.44</td>
</tr>
<tr>
<td>(12 tons assumed for comparison purpose)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### COMPARATIVE FEATURES OF UP-GRADATION KIT FOR 5.1/2" SPG.

<table>
<thead>
<tr>
<th></th>
<th>Normal (MACKIE)</th>
<th>Upgraded (SHIMNA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No. Of Spindles</td>
<td>80</td>
<td>80 or 100</td>
</tr>
<tr>
<td>2. Drafting</td>
<td>“V” Roller</td>
<td>Two Zones ; L. G and Apron &amp; P. Plate</td>
</tr>
<tr>
<td>3. Yarn Range</td>
<td>18 lbs – 40 lbs</td>
<td>8 lbs. – 40 lbs.</td>
</tr>
<tr>
<td>4. Draft Range</td>
<td>5 to 10</td>
<td>5 to 20</td>
</tr>
<tr>
<td>5. Spindle Speed</td>
<td>1900 – 2500 rpm (For STD. SKG WEFT H.Y. Yarn)</td>
<td>Up to 4500 rpm (For STD. Skg. Weft Yarn &amp; Light or Export Yarn)</td>
</tr>
<tr>
<td>6. Spindle Type</td>
<td>Dead</td>
<td>Dead / Live</td>
</tr>
<tr>
<td>7. Bobbin Size</td>
<td>7.1/2&quot; x 3.1/2”</td>
<td>8¾” x 4½”</td>
</tr>
<tr>
<td>8. Yarn Concent</td>
<td>18 oz (approx.)</td>
<td>36 oz (approx.) *</td>
</tr>
<tr>
<td>9. Motor</td>
<td>20 H.P.</td>
<td>20 H.P.</td>
</tr>
<tr>
<td>10. Lifter Jam</td>
<td>Frequent</td>
<td>Rare / Eliminated</td>
</tr>
<tr>
<td>11. Friction Base Assy.</td>
<td>Fixed Point</td>
<td>(M.S.D.) Varying</td>
</tr>
<tr>
<td>12. Wharve</td>
<td>Standard</td>
<td>Heavy Duty</td>
</tr>
<tr>
<td>13. O.H.T. Blower / Extractor</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>14. Sliver Stop Motion</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>15. Auto Speed Control During Spinning</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>16. Machine Per Operator / Spinner</td>
<td>1</td>
<td>2 (expected)</td>
</tr>
<tr>
<td>17. Operating Eff.</td>
<td>Above 75%</td>
<td>Improved (Substantially over existing)</td>
</tr>
<tr>
<td>18. Yarn Quality</td>
<td>Standard</td>
<td>Improved</td>
</tr>
<tr>
<td>19. Doffing Time Loss</td>
<td>4% (approx.)</td>
<td>Reduced 2% (or less)</td>
</tr>
<tr>
<td>20. Production Ratio</td>
<td>1</td>
<td>1.74 (approx.)</td>
</tr>
<tr>
<td>21. Increase In Production</td>
<td>----</td>
<td>74%</td>
</tr>
</tbody>
</table>

- Advantage of this increase of package is tremendous when spinning yarn count of 8 to 14 lbs., the package of light / medium count being 8 oz to 14 oz only.
ADVANTAGES OF 2\textsuperscript{ND} DRAWING MODIFICATION

1. Production increased by almost 100%

2. Package, i.e. Sliver content of each can increased by 26%

3. Less handling, less piecing at finisher drawing feed, less stopping and increased efficiency of finisher drawing

4. For a mill having 16 nos. 2\textsuperscript{nd} Drawing machines at least 7 second drawings will be surplus after modification

5. These surplus machines can be used :
   a) Some, say 4 machines for making 4 passage drawing for quality yarn (export)
   b) Balance, say 3 machines can be installed in Skg. Weft side (in place of push bar drawing) to improve Skg. Weft Spg. very substantially.

6. Thus both export yarn and Skg. Weft system are improved at no extra cost

7. No hassle for floor space, layout etc.

8. Ease of operation unchanged

9. Without compromising maintenance

10. Dust extraction, new concept in multi-head screw gill drawings will help in maintenance and quality

11. Modification costs fractional compared to new machines, requiring low capital outlay

12. Saving in electricity bill.
ADVANTAGES OF DM SD CAN DELIVERY ATTACHMENT

• Increased doubling in the Drawing system (twice that of existing systems) for existing 3-drawing system.

• Increased Card output by 15 – 20% (by adjusting Card sliver wt. to allow proper draft at C. D. Unit, draft range 1.5 to 3.5)

• Slower Card Delivery speed without loss in production giving better fibre length of between 8% and 12 – 5%

• Reduction in line waste of 8% with the elimination of the Roll Former

• Reduction in splicing (by 4 times, i.e. splicing after approx. 72 min against 12 min. at present)

• Better penetration with no floating of sliver in the 1st passage (Open Gill Drawing)

• Improved performance and durability of carriage component of 1st passage Drawing (if 1st Drawing is retained. 1st Drawing not reqd. for standard yarn)

• Better moisture retention

• Elimination of extra short fibers (1/2” to 1.1/2” group to 1.1/2% - 3% of total)

• Sandwiching of top blending (when blending synthetic top)

• No peeling / false drafting associated with Roll Feed

• Longer drafting in 1st passage drawing (depending on sliver weight)

• Low maintenance (absence of faller members)

• Regularity improvement is substantial.

Elimination of 1st Drawing Frame and particularly where Push-bar Drawing Frames are still in use.
# ECONOMICS / VIABILITY OF INTRODUCING
# DM TZ INTERSECTING DRAW UNIT
# (FINISHER CARD ATTACHMENT)

<table>
<thead>
<tr>
<th></th>
<th>Finisher Card With Rollformer</th>
<th>Finisher Card With Draw Unit Attachment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery Speed (Assumed)</td>
<td>60 yds. / min</td>
<td>60 yds. / min</td>
</tr>
<tr>
<td>Feed Sliver Wt. (Breaker Card Sliver Wt.)</td>
<td>180 lbs./1000 yds</td>
<td>190 lbs./1000 yds.</td>
</tr>
<tr>
<td>Draft</td>
<td>14.14</td>
<td>13.00</td>
</tr>
<tr>
<td>Finisher Card Delivery Sliver Wt.</td>
<td>140 lbs./1000 yds</td>
<td>160 lbs./1000 yds.</td>
</tr>
<tr>
<td>Can Delivery Attachment Draft</td>
<td>-----</td>
<td>1</td>
</tr>
<tr>
<td>Final Delivery Speed</td>
<td>60 yds./min</td>
<td>60 x 2 = 120 yds./min</td>
</tr>
<tr>
<td>No. Of Deliveries</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Final Sliver Wt. Ex Finisher Card / Can Delivery</td>
<td>140 lbs./1000 yds.</td>
<td>80 lbs./1000 yds.</td>
</tr>
<tr>
<td>Operating Efficiency</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Production / Day (23.5 hrs.)</td>
<td>4.57 mt</td>
<td>5.23 mt</td>
</tr>
<tr>
<td>Finisher Card Req'd. For 21 mt / Day Production</td>
<td>4.59 say 5 M/Cs</td>
<td>4 M/Cs</td>
</tr>
<tr>
<td>No. Of Drawings In The System For Standard Weaving Yarn</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;, 2&lt;sup&gt;nd&lt;/sup&gt; &amp; 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; &amp; 3&lt;sup&gt;rd&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
EXISTING 3-DRAWING SYSTEM FOR HESSIAN YARN

**EXISTING BREAKER CARD**
- STD. PRODUCTION/DAY = 6 M.T. PER MACHINE

**EXISTING FINISHER CARD**
- STD. PRODUCTION/DAY = 5 M.T. PER MACHINE

**FIRST DRAWING**
- STD. PRODUCTION/DAY = 5.5 M.T. PER MACHINE
  - 10 NOS. 18" DIA CANS

**2ND DRAWING**
- STD. PRODUCTION/DAY = 5.5 M.T. PER MACHINE
  - 10 NOS. 16" DIA CANS

**3RD DRAWING**
- STD. PRODUCTION/DAY = 3.8 M.T. PER MACHINE
  - 20 NOS. 12" DIA CANS

**MAX. SPEED = 4000 R.P.M.**
**YERN RANGE = 6 TO 10 lbs. (3800 R.P.M)**
**PACKAGE = 8 oz**
EXISTING 4-DRAWING SYSTEM FOR FINE YARN

STD. PRODUCTION/DAY = 6 M.T. PER MACHINE

STD. PRODUCTION/DAY = 5 M.T. PER MACHINE

STD. PRODUCTION/DAY = 5.5 M.T. PER MACHINE
10 NOS. 18" DIA CANS

STD. PRODUCTION/DAY = 5.5 M.T. PER MACHINE
10 NOS. 18" DIA CANS

STD. PRODUCTION/DAY = 5.5 M.T. PER MACHINE
10 NOS. 18" DIA CANS

STD. PRODUCTION/DAY = 3.8 M.T. PER MACHINE
20 NOS. 12" DIA CANS

MAX. SPEED = 4000 R.P.M.
YERN RANGE = 6 TO 10 lbs. (3800 R.P.M)
PACKAGE = 8 oz
SHIMNA SYSTEM FOR EXPORT YARN

4:1 DOUBLING.
DELIVERY - 10 NOS.
CARRIAGE - 5 NOS.
FEED CAN SIZE - 24".
NO. OF FEED CAN - 40 NOS.

4:1 DOUBLING.
DELIVERY - 14 NOS.
CARRIAGE - 7 NOS.
FEED CAN SIZE - 18".
NO. OF FEED CAN - 56 NOS.

6:1 DOUBLING.
DELIVERY - 10 NOS.
CARRIAGE - 5 NOS.
FEED CAN SIZE - 18".
NO. OF FEED CAN - 60 NOS.

2:1 DOUBLING.
DELIVERY - 20 NOS.
CARRIAGE - 5 NOS.
FEED CAN SIZE - 16".
NO. OF FEED CAN - 40 NOS.
SHIMNA SYSTEM FOR PREMIUM EXPORT YARN

EXISTING FINISHER CARD

ROLL FEED:

SINGLE ZONE GILL ROLLER INTERSECTING DRAW UNIT (DRIVEN BY FINISHER CARD).

D-O-M UNIT POSSIBLE.

TWO ZONE GILL ROLLER INTERSECTING DRAW UNIT (DRIVEN BY MOTOR).

4:1 DOUBLING.
H.P. 2ND DRAWING.

6:1 DOUBLING. (ALTERNATE PASSAGE).
EXISTING 1ST DRG.

2:1 DOUBLING.
FINISHER DRAWING.

4.3/4" CONVERTED RING SPG.

4.1/4" CONVERTED RING SPG.

5.1/2" CONVERTED TWO ZONE RING SPG.
10 TO 28 lbs.
HIGH SPEED QLTY. SPG.
SHIMNA SHORT SYSTEM FOR STD. HESSIAN YARN

EXISTING FINISHER CARD

TWO ZONE GILL ROLLER
INTERSECTING DRAW UNIT
(DRIVEN BY MOTOR).

EXISTING 1ST DRAWING
WITH NORMAL RATED PRODUCTION

EXISTING 2ND DRAWING
WITH NORMAL RATED PRODUCTION

EXISTING 3RD DRAWING
WITH NORMAL RATED PRODUCTION

(ALTERNATELY)
MODIFIED 2ND DRAWING MACHINE
(SHIMNA)

4.3/4" CONVERTED
RING SPG.

4.1/4" CONVERTED
RING SPG.

5.1/2" CONVERTED
TWO ZONE RING SPG.

10 TO 28 lbs.
HIGH SPEED QTY. SPG.
FOR NOTES
INTRODUCTION OF ROTARY FALLER GILL DRAWING SYSTEM

Mr Dinesh Khaitan
Hans Machineries Pvt. Ltd.
Kolkata, India
INTRODUCTION OF ROTARY FALLER GILL DRAWING SYSTEM

The industrial trend for 'More and Better' has dictated continuously the developments in the Faller Gill systems. This ushered in the Screw Gill Faller System for better pinning and then from single to triple threaded screws for Higher Speeds of Feed. It even went up to 4 threaded screws. Hand in hand went the attendant increase in Complications such as Shorter Pitch of Screws, adjustments of the Timing Cam Mechanisms, prevention of shocks, reduction in the weights of the Fallers while increasing their mechanical strength and so on and so forth. As the speeding up brought about increase in wear, the next chain reaction was machine trouble and resultant down-time for repairs / maintenance, Higher Service Expenses and higher Running Cost through the need for Higher Skills to operate.

The logical next step in the above mentioned scenario is our development of the Rotary Faller Gill system for meeting the requirements of the spinning work of the future. This is a very simple and robust system, simple in working, repair and maintenance, without sacrificing the ever increasing needs for speeding up the production and improving quality, and consequent reduction in Running Expenses.
Working Principle: Steel fallers are placed inside two nos. of toothed hardened steel Rotary Wheel Discs on each side of the carriage inner sides. Static hardened Faller Bar Guides (Faller Track) are placed on inner sides of both the Rotary Wheel to guide the faller path. The faller guide at both entry & exit area of the Fallers are made to special shape to facilitate vertical entry & Exit of the Fallers. As the faller moves circularly upward after the Retaining Roller & the Drawing Roller is positioned at a lower level than the Fallers, the pin penetration inside the Fallers are very much ensured. As the Fallers are driven positively by the Rotary Wheels, very high speed of the Fallers can be achieved.
PERFORMANCE OF NEWLY DEVELOPED AND PROPOSED MACHINES BY MILLTEX, INDIA

S Manikandan
Sr. Executive – Corporate Planning
Milltex Engineers (P) Ltd., India
Performance of newly developed and proposed machines by Milltex, India

By S. Manikandan, Sr. Executive - Corporate Planning

Introduction

Productivity and man-machine economics are the most talked about mantra in today's business scene. We have been silent spectators watching Business Houses close "uneconomical" production centres and relocating them especially in the developing countries and third world countries.

The concepts of productivity is not new to the mechanized Jute Industry which was originally established in Dundee but soon shifted to Sub-Continent of India to exploit the closeness to raw material and availability of cheap labour. The first mill was established in India in 1855 at Serampore, West Bengal and subsequent development was so rampant that mills sprang up all along the banks of river Hooghly and by 1900 India overtook Dundee and never looked back.

The Sub-continent's jute industry thrived on the expertise and skills of the engineers, managers and machinery from Dundee. But the slow death of the Dundee jute industry saw the machinery manufacturers closing their doors ending the only source of technological support for the industry.

Since then, the Jute industry that forms a predominant part of the Sub-continent's economy has been supported by vendors from the local unorganised sector with spares to keep the industry ticking. This resulted in a stagnation of the technology deployed in the industry while the other fibres saw periodic introduction of newer technologies that enabled them to turn more competitive than jute. Adding to this was the growth of high-tech plastic fibre polypropylene that emerged as a direct competitor to jute.

Polypropylene fibre predominantly developed and manufactured by companies in the developed countries saw revolutionary changes as a fibre as well as on the processing front, which was totally lacking in the Jute Industry.

Milltex - entry into Jute Industry

We at Milltex have been working with the textile industry for over 25 years and have collaborated with leading research and educational institutions across the India. Our expertise in renovation of over 10,000 semi-high production cards of different makes to high production cards, followed by manufacture of over 350 cards for the cotton textile industry saw us emerging as the front runner to design and manufacture Carding Machinery for the Jute Industry. In 1999, the Indian Jute Industries' Research Association (IJIRA) & Indian Jute Mills Association (IJMA) retained us to design and develop carding machines in the line of JF cards as part of a United Nations Development Programme (UNDP) assisted scheme.

The objective was to develop suitable carding machines for the organized and decentralized sector with modifications based on inputs from the Jute Industry and attached Research Institutions. The machine developed held over 3 decades of the entire industry's aspirations and received excellent feedback at the time of installation of the prototype.
The experiences from re-engineering the existing carding machine, installation of the prototype @ Birla Jute Mills, West Bengal and the practical knowledge of the industry technicians along with our expertise resulted in the commercialisation of the our cards with all required modifications.

**Milltex's Current Product Mix for the Jute Industry**

The following machines are offered and installed at leading Jute and Twine Mills across India:

1) Breaker (MJB Series) Cards  
2) Finisher (MJF Series) Cards  
3) Roll Formers  
4) Customized Spares for existing Carding Machines  
5) Kits for existing JF Cards to convert Chain Driven Rollers to Gear/Pulley & Belt

At Milltex, we have followed a pre-determined path towards design and manufacture of our machines. The criteria defined by our core team prior to designing the machines are:

1) Higher Production  
2) Lower Cost  
3) Better Quality  
4) Easier Maintenance  
5) Reduced Power Consumption  
6) Consistent Product Quality

**High Production Carding Machines**

The Jute Carding Machines (MJB & MJF Series) with over 60 installations across India are offered with two drive options:

1) Worker & Stripper Rollers are Chain Driven (Similar to JF Cards)  
2) Worker Rollers driven by Gears & Stripper Rollers are Pulley/Belt Driven

We give below the developments incorporated in our machines as part of our efforts to offer technically advanced and user-friendly products:

- In the typical JF Cards, the Worker and Stripper Roller drives have been devised with Chain / Sprockets on the same end making it extremely difficult even for periodic maintenance. We offer alternate drive with gears & pulley to easy maintenance and smooth functioning.

- The Drawing and Delivery Rollers were driven by the same chain causing severe strain on the rollers due to the loading at the doffing stage. Independent drives have been devised for the respective rollers resulting in minimal down-time due to break-down maintenance and ensures longer life of the rollers.
- The Stop Motion System has been introduced in our Finisher cards to reduce down time in case of chocking of fibre. The introduction of the Stop Motion paves way for the use of coarse counts on our Finisher cards with use of staves of relevant specifications designed by us and modified gauge settings.

- The introduction of Energy Efficient Motor along with the Centrifugal Clutch Pulley for the Main Drive ensures huge saving in energy bills. The systematically devised Electrical Control Panel gives adequate safety for the Electrical Motor.

Our change process is continuous and our efforts have resulted in a High Productive Card with adequate emphasis to Quality. A study conducted by IJIRA revealed the High Production Capacity of our cards with CV% in par or lower than the industrial average.

The cards priced between 35000-37000 US Dollars complete with Roll Former and Staves has not only been successfully installed in the organised Indian Jute Industry but has found a number of takers in the unorganised (decentralized) sector who have overlooked the option of the second hand cards imported from the African and Asian Markets. The reasons are attributed to the High Production, Low Maintenance, Availability of Spares and strong support from our front line team at every stage.

Our Breaker & Finisher cards offer between 7 – 9 Tons / day @ 22 lbs at 80% efficiency with savings on power due to the introduction of the Energy efficient motors. Our team is ardently working on the possibility of weight reduction of the machine to further bring down power consumption.

The introduction of individual Dust Extraction System in the cards has failed due to the excessive accumulation of fly (waste fibre) however efforts are being made to introduce group Dust Extraction Systems to bring down air pollution in the Jute Mills. This will result in the gradual reduction of occupational hazards arising out of exposure to dust flying in Jute Mills.

Our Roll Formers (Tk type) are built heavy with graded cast iron and aluminium to sustain the high delivery speed of our cards. The machines have been designed for low maintenance and long life.

Apart from the cards, kits to convert existing JF cards from Chain Drive to Gear Drive are available as retrofits and can be installed with ease removing existing chain and sprockets.

As part of our manufacturing scope, we supply precision spares like alloy steel rollers and machine-hobbed gears for our clients.

The specifications of our cards along with the respective catalogues will be made available if required for further information.

The relationships we forged with IJIRA and Jute Mills in India gave us the impetus to work on the following machines as part of our endeavour to support the Jute Industry:

1) Full Circular Finisher Card
2) Metallic Card Clothing for Carding Machines
3) Tandem Centre Section & Tandem Cards
4) Rotary Gill Drawing Machines & Draw Heads
5) Slip Draft & Modified Russian Drafting based Spinning Frames
6) Cutting Machines

Full Circular Finisher Card

The design has been conceived with the objective of achieving the high quality parameters set by Mackie Cards and the high production levels of JF cards. The result was the evolution of a Full Circular Double Doffer Finisher Card offering about 7.5 tons per day @ 22lbs sliver weight at 80% efficiency levels.

This machine has been devised to cater to the emerging market that focuses on high value fine counts yarn for diversified jute products. The detailed specifications of proposed card along with the respective catalogue will be made available if required for further information.

Metallic Card Clothing for Carding Machines

We carry with us over 25 years of Carding Experience and are currently working on the development and manufacture of Metallic Card Clothing for the jute Industry.

Carding Efficiency depends on:

1) Carding Angle
2) Surface Speed of the Roller
3) Population of Carding Points
3) Depth of Cut (Pin Projection in the case of Staves).

It is to be noted that except the Surface Speed of the Roller the other parameters have a direct bearing on the Card Clothing.

Further, Carding Efficiency is directly proportional to
- Carding Angle
- Population of Carding Points,

but inversely proportional to
- Depth of Cut.

With the above facts in mind, we have designed suitable metallic card clothing for jute fibre processing.

The use of Metallic Card Clothing provides a wide range of options for varying population, depth of cut and Carding angle along with the option of using material ranging from medium carbon steel to tungsten vanadium alloy steel wires. The steel used in the manufacture of metallic card clothing is virgin steel without the addition of any scrap in the making, which gives uniform high hardness with tremendous
strength in the blade root with abrasion resistance. But all this was not seen in the card pins tested in a metallurgical lab. The conical shape of the card pins makes it absolutely impossible to have a uniform hardness and the test reveals dropping of hardness as we move down from the tip.

It was interesting to note that the hardness value of the carding pins were only 518 VHN to 550 VHN which is normally prone to abrasion, while a hardness of 950 VHN of the wires to a depth of 1 mm should definitely have 100% more abrasion resistance yielding much longer life of the wire points.

The wire points can be regenerated by a light touch of grinding when they turn blunt and the grinding process will take less than 4 - 6 hours for all the rollers thus reducing the down time compared to repining of the rollers.

The successful implementation of the Metallic Card Clothing can be followed by the introduction of carding plates to remove short fly (micro-dust) and trash and better for parallelisation of the fibres leading to a good sliver. The carding plates will further go a long way in protecting and prolonging the life of the wires.

We propose to introduce Metallic Card Clothing in our Finisher cards and the specifications of wires have been designed along with the equipments required for mounting and grinding of the wires. This project will be a joint venture with IJIRA and supported by other agencies working towards bringing innovations into the Jute Industry.

Further information on the design and the specifications of the card clothing can be provided if required.

Tandem Centre Section & Tandem Cards

The cost of manufacture of jute products has become too high to sustain its competitiveness due to steep hike in wage and energy cost in the absence of technological developments that would result in high productivity. The concept of tandem cards, well accepted in Cotton Textile Industry, can be incorporated in the Jute Industry with slight modifications.

The disadvantage will be the lack of scope in doubling to arrive at product mix at pre-finisher stage and the sliver output required will have to be derived during batching and at the Breaker Feeding stage.

The assumptions of the proposed system are:

1) The operating ratio of the Breaker and Finisher to be converted to 1:1 as against the existing 2:3.
2) The transfer mechanism, designed on the principles of the Camel Back System, will synchronize the delivery of the Breaker Card and the feed of the Finisher Card and this attachment has been primarily designed suitable for JF and Milltex type cards.

The advantages of the system are:

1) Labour Saving due to the removal of Roll Former at delivery @ Breaker Card end and feed at the Finisher Card side.
2) The Roll Former at the Breaker end will be removed from the system. The Roll Former by condensing 70 inch sliver to 5 inch causes overlapping of the fibre and the absence of the Roll Former gives scope for better sliver. The mounting of a Draw Head on the Finisher card eliminates the Roll Former completely from the card room and further removes 1 stage of Drawing resulting in major labour, energy and space savings.

The Centre section so designed has been manufactured and is currently at one of the Jute mills in India, awaiting final clearances to commence installation. The results will be published after successful trials and we have requested for open permission to bring in visitors to enable commercialisation of the system. This system will turn the functioning of the card room highly competitive.

This project is a joint venture with development assistance from the National Centre for Jute Diversification (NCJD), Government of India.

Further information on the design and the specifications of the Centre Section can be provided if required.

**Rotary Gill Drawing Machines & Draw Heads**

We have embarked on the design and manufacture of the Rotary Gill Drawing Machines with the strong support of our clients. The Rotary Gill Systems brought into the Jute Industry finds its origin in the Woollen industry and has to be sufficiently altered to process jute.

All relevant patterns, jigs and fixtures to manufacture the drawing machines have been made. A prototype is currently under trial at our plant and is likely to be commercialised in the next 10/12 weeks.

Emphasis is being laid on the design of the Draw Head that can be mounted on the new Finisher Card and reflect 1:1 production of the Finisher Card.

The specifications of our drawing machines along with the respective catalogues will be made available if required for further information.

**Slip Draft & Modified Russian Drafting based Spinning Frames**

Our tryst with Spinning Frames began in November 2000 when we collaborated with IJIRA in designing and manufacturing the “Spin Tester” – a PLC driven 8 Spindle Spinning Frame incorporating 4 different Drafting Units with 2 spindles in each. The prototype-spinning machine has been built with 2 spindles each of

- a) 4 1/4" Slip Draft
- b) Apron Draft
- c) V Roller Drafting
- d) Modified Russian Drafting Systems.

The device has been conceived as a testing device and built in capacity to vary all parameters for research & trials with different types of fibres.
The manufacture and implementation of the device has given us the required experience to design and manufacture Spinning Frames of any of the above-mentioned drafting unit with varied pitches.

With the design for the 4 3/4" Slip Draft – 104 Spindle Frame ready and patterns being designed to take up manufacture shortly, our Design department embarks on the design of the other modified Russian drafting unit. The Spinning Frame will have a Cone Pulley with Variator for the Main Drive to vary the working speed and is designed to run at 3500-5000 rpm with a count range of 7 – 29 lbs.

We are likely to commence manufacture of the prototype in the next 12/14 weeks and after trials at our plant we hope to offer the machines to the industry in the next 20/22 weeks.

The specifications of our spinning machines along with the respective catalogues will be made available if required for further information.

**Cutting Machines**

Our standard product portfolio consists of high-speed rotary cutter for varied cutting functions. The cutter has a cutting range from 1 mm – 60 mm and is custom built to suit the requirement of the clients.

Recently, we have designed Root Cutting Machine with manual / automatic cutting arrangement for cutting raw jute roots. The final touches are being provided for the cutting machine and is likely to be offered to the industry in the next 20/24 months after successful trials. The cutter will increase productivity prior to batching or spreader feeding.

Finally, We at Milltex are committed to the Natural Fibre industry and carry with us years of varied industrial experiences and deem it a pleasure to share our experiences with our clients to help them attain global standards. Jute – the Golden Fibre has the potential to regain its lost glory to be the fibre of the 21st century. We are sure that the support of the International Jute Study Group, the co-operation of the Jute Mills across the world coupled with the expertise of the Research Institutions we will be able to achieve the common objective.

**Acknowledgement**

The author expresses his sincere thanks to the Secretary General and the entire team at the International Jute Study Group for having given us the opportunity to put forward our plans for the Jute Industry. On behalf of my company, I am also thankful to all the Jute Mills who have evinced faith in us, supported us with their valuable orders and feedback. I take this opportunity to remember late Dr. K Jayachandran, former Director – IJIRA for the excellent support he and his team extended to us during his tenure, which is continuing till date.