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Causes, Frequency and Duration of Stoppages in Weaving Fabrics

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ABSTRACT

The causes, frequency and duration of each type of stoppage during weaving was studied for each loom in a typical medium-scale Textile manufacturing outfit. All operations performed and their duration during repair before the loom was restarted was noted. For 20 weaving machines, a total of 3199 stoppages were recorded in 24hrs which took a whopping 24,244 minutes to rectify. This is the equivalent of 404.07 hrs or 16.84 days. The loss in productivity is similar to stopping one machine for 16.84 days or 17 machines for approximately one day. These stoppages arose mainly from poor quality of raw materials, maintenance habits as well as employees' attitude to work. A mathematical model for monitoring and control of weaving activities was formulated.

Keywords: machine, stoppage, frequency, duration, maintenance, raw materials, employees.

INTRODUCTION

Stoppages in any manufacturing outfit refer to a situation where a machine stops by itself or is stopped. A machine may stop automatically when an operation it coordinates is either completed or fails to be concluded successfully. In the latter case, allowing the machine to continue running may cause damage to either the material in process, the machine itself or both. Alternatively, the machine can be stopped manually in order to prevent, limit or stop any form of damage (Ormerod, 1979; Enrick, 1990) for the same reasons.

Generally, stoppages are usually associated with faults (either in the material being processed, the machine or both) or the completion of an operation or process (Ormerod, 1979; 2002). In the former case, the fault has to be identified and rectified before restarting the machine; the time taken to carry out these remedial activities is very important to any time–dependent manufacturing establishment.

This is significantly more highlighted when we consider several other types of fault that can cause stoppages during the same processing operation (Iliya, 2007). The typical case studied here is the weaving section of a medium-scale textile mill operating 3, 8–hour shifts per day, specialized in producing Baby shawls.

EXPERIMENTAL

Materials

Two types of yarns were used – 24 tex 100% acrylic and 10/11 c.c. (singles) and 22/24 c.c. (doubled) 100% cotton.
The operator–to–machines ratio is 1:2.

Methods

An inventory was taken of the machines used in this section. The details are as shown in Table 1.

TABLE 1: Details of Weaving Machines in this Section.

EQUIPMENT	TYPE	MODEL (Year)	WIDTH (cm)	SPEED (picks/min)	TOTAL No. in use
Saurer Loom	Rigid Rapier	1978	260.0	180.0	6
Vamatex 201	Flexible Rapier	1979	260.0	180.0	4
Vamatex C401	Flexible Rapier	1979	320.0	220.0	4
Vamatex S401	Flexible Rapier	1979	350.0	340.0	6

For each stoppage, the time taken to rectify the fault and start the machine again was measured. The following procedures were observed where applicable:

- Average delay time;
- time required to identify the type of fault;
- average warp repair time;
- average weft repair time;
- number of yarns involved;
- average repair time for mechanical faults;
- average repair time for electrical faults;
- number of machines involved.

Faults that Cause Stoppages

The following frequently occurring faults were observed:

1. **Weft Break:** When the weft yarn breaks anywhere from the package on one side of the machine through the shed to the other side.
2. **Warp Break:** When the warp yarn breaks during weaving. Sometimes several threads break at the same time (multiple warp break).
3. **Mechanical Fault:** A faulty part or component on the machine can cause faulty operation or even prevent it from functioning e.g. a situation where the taker head of the rapier fails to grip the weft yarn or when the shedding mechanism exerts too much tension and causes warp breakage.
4. **Electrical Fault:** This usually arises from faulty or bad electrical/electronic component(s) in the machine and can affect the efficiency of its operation or even render it inoperative.
5. **Beam Change:** This occurs when the weaver's beam is exhausted and is being replaced.
6. **Quality Change/Knotting:** This occurs when a weave design is changed. It usually requires replacing the punch card with the appropriate one. The new design may require changing the warp yarn linear density and this implies replacing the whole weaver's beam, drawing-in, denting and beam-knotting or tying-in.
7. **Power Failure:** This includes both power outage and low voltage from the municipal supply, power fluctuations (which can also cause machine stoppage) as well as changing from one power source to another.
8. **No Weaver:** This is when there is no operative to man the loom.
9. **Skill and Commitment of Operative:** Skilled operative reduce the duration of stoppage by effecting repairs quickly and efficiently. A committed operative ensures that the machines are always running.

Each loom was observed for 24 hours and the data obtained are shown on Table 2 and 3.

Model for Calculating Duration of Stoppage

A model for calculating the duration of each stoppage for each machine and even the whole mill can be proposed.

Let

D = duration of stoppage,
l = average delay time,
m_1 = average warp repair time including restarting,
m_2 = average weft repair time including restarting,
n = number of yarns involved,
m_c= average repair time for mechanical faults,
m_e = average repair time for electrical faults,
k = number of machines,
s = time required to identify the type of fault.

In an ideal case, the following relations are valid.

	Cause of stoppage	Duration of stoppage (mins)
i.	Warp Break	$(l + s + nm_1)k$
ii.	Weft Break	$(l + s + nm_2)k$
iii.	Mechanical Fault	$(l + s + m_c)k$
iv.	Electrical Fault	$(l + s + m_e)k$
v.	Beam Change	$(l + t_0 + t_r + t_i)$ if weave is the same,
	and	$(l + t_0 + t_r + t_d + t_c + d_e)$, if the weave is changed..

where:

t_0	=	Beam doffing time
t_r	=	Beam Replacement time
t_1	=	Tying-in time
t_d	=	Drawing-in time
d_e	=	Denting time
t_c	=	Punch card changing time (where applicable).

TABLE 2: Frequency of Stoppages (3 Shifts)

Type of Machine	Loom No.	Warp Break	Multiple Warp Break	Weft Break	Mechanical Fault	Electrical Fault	Beam change/ Knotting	Quality Change	No Weaver	Power Failure	Total Stoppage
	1	48	3	96		3			6		156
	4	45		48					15		108
	5	18		6	15				3		42
Saurer	6	123	9	141					9		282
	7	24	3	84					24		135
	8	45		30					21		96
Total		**303**	**15**	**405**	**15**	**3**			**78**		**819**
	13	50	7	144	6				4	1	212
Vamatex	14	41	4	171		1			5		223
201	15	51	8	142							201
	16	55	8	127						1	191
Total		**197**	**27**	**584**	**6**	**1**			**9**	**2**	**827**
	17	50	10	19	3				3		85
Vamatex	18	51	12	93		12	2		1		171
C 401	19	123	10	81	2			1	3		219
	20	13	7	21		15			2		58
Total		**237**	**39**	**214**	**5**	**27**	**2**	**1**	**9**		**533**
	21	65	3	138		10	1				217
Vamatex S	22	116	4	160							280
401	23	66	10	69		1	1	1	4		152
	24	134	13	104					4		255
	25	14		14	14		1				46
	26	41		24			1				70
Total		**436**	**30**	**509**	**14**	**11**	**4**	**1**	**8**		**1020**
Grand Total		**1173**	**111**	**1712**	**40**	**42**	**6**	**2**	**104**	**2**	**3199**

TABLE 3: Duration of Stoppages forthe various faults in 3 shifts (min.)

Type of Machine	**Loom No.**	**Warp Break**	**Multiple Warp Break**	**Weft Break**	**Mechanical Fault**	**Electrical Faults**	**Beam change/ Knottings**	**Quality Changes**	**No Weaver**	**Power Failures**	**Delay Time**	**Total Stoppages**
	1	282	66	246		180			333		270	1377
	4	255		177					852		126	1300
	5	195		69	87				131		132	1314
Saurer	6	420	105	246					249		78	1098
	7	126	24	270					792		147	1359
	8	108		153					924		90	1275
Total		**1386**	**195**	**1161**	**87**	**180**			**3281**		**843**	**7723**
	13	232	148	336	65				213	4	141	1140
Vamatex	14	217	35	431		47			296		257	1283
201	15	228	67	228							136	659
	16	373	157	300						4	221	1055
Total		**1050**	**407**	**1295**	**65**	**47**			**509**	**8**	**755**	**4137**
	17	367	223	62	72				411		154	1290
Vamatex	18	204	183	259		278	103		33		163	1223
C 401	19	564	93	178	72			60	146		178	1291
	20	41	135	46		926			103		27	1278
Total		**1176**	**634**	**545**	**144**	**1204**	**103**	**60**	**693**		**522**	**5082**
	21	274	34	237		555	85				80	1265
Vamatex S	22	488	27	335							268	1118
401	23	539	106	157		27	85	85	112		196	1221
	24	532	31	195					178		196	1098
	25	126		88	14		168		1014		130	1358
	26	198	38	59			1		720		58	1242
Total		**2157**	**236**	**1071**	**14**	**583**	**339**	**85**	**2024**		**928**	**7302**
Grand Total		**5769**	**1472**	**4072**	**310**	**2014**	**442**	**145**	**6507**	**8**	**3048**	**24244**

vi. No weaver

If z = time lost in the absence of an operative, k = operator's efficiency and D = total time lost in repairs, then

For any stoppage, machine down time,

$$M = \frac{z + k}{\text{ti} \quad \text{u} \quad \text{c}}$$

$$= \frac{z + kD \ (\text{mins})}{8 \times 3 \times 60 \ (\text{mins})} \quad (\text{in a day})$$

Hence, percent useful time left,

$$T\% = (l - M) \times 100\%.$$

The value M, for any machine can therefore be calculated by adding all the applicable stoppages and dividing by the time under consideration.

DISCUSSION

The results obtained are not only interesting but shocking. In Table 4, for the six Saurer looms, there were 819 stoppages in just 24 hours which took a whopping 7723.0 minutes to rectify. This is equivalent to 128.72 hours or 5.36 days. It is similar to stopping a machine for 5.36 days or 5 machines for one day (remember, we are considering only six machines here!). When this is translated into production figures and lost income, it is quite alarming (Hanby,1966; Enrick, 1990; Iliya *et al*,2008). A similar trend is followed by the next four Vamatex 201 – 827 stoppages which took 4137.0 minutes to correct, equivalent to 68.95 hours or 2.87 days.

The next four Vamatex C401 had 533 stoppages that required 5082.0 minutes equivalent to 84.70 hours or 3.53 days. The next six had 1020 stoppages that lasted 7302.0 minutes or 121.70 hours (5.1 days). When all these losses are added together, the waste is quite significant. This section of the mill had 3,199 stoppages which took a total of 24,244 minutes to rectify, the equivalent of 404.07 hrs or 16.84 days in just 24 hrs.

From Table 2, it appears most stoppages are caused by weft and warp breakages. The quality of these yarns must therefore be investigated and monitored. The picking mechanism should also be maintained properly and regularly. An interesting activity can be observed in Table 3 in the column 'delay time'. It directly expresses the human contribution to the stoppages and gives an idea of the attitude of workers in this factory.

TABLE 4: How stoppages relate with time

TYPE OF LOOM AND NO. STUDIED	TOTAL NO. OF STOPPAGES	TOTAL DURATION OF STOPPAGES (mins).	EQUIVALENT IN HOURS (DAYS)
Saurer (6)	819	7723.0	128.72 (5.36 days)
Vamatex 201 (4)	827	4137.0	68.95 (2.87 days)
Vamatex C401 (4)	533	5082.0	84.70 (3.53 days)
Vamatex S 401 (6)	1020	7302.0	121.70 (5.1 days)

CONCLUSION

It is obvious that this enterprise is experiencing a lot of stoppages which amount to huge losses. They can be attributed to the machine conditions (maintenance habits and obsolescence), the quality of the raw materials (warp and weft yarns) and the skill and commitment of the workers. These must be addressed quickly but meticulously. The workers must be sensitized, encouraged, trained and motivated to be committed to their work, reduce delay time and increase their speed at work.

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