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Research on the Effect of Different Marketing Strategies on the Workload of Knitting Machines, and Unit Costs

Abstract
Marketing strategies have a direct effect on the target mass, production programs, production types, and consequently on the dispersion percentages of workflow types of machines. Establisment of workflow types is aimed at determining machine productivity and idle times. In this study, workflow types of circular knitting machines were first determined. Afterwards, any change in the proportions of these workflow types were examined in two companies applying different marketing strategies. The "Work Sampling" method was used for this study. At the end of the study, the effect of changes in t machine use rates stemming from different marketing objectives on the company's overhead expenses, and consequently unit costs were evaluated.

Key words: *knitting company, marketing strategy, work sampling, workflow types, cost evaluation.*

Introduction and literature review

In today's competitive world, in order to be successful, companies must consider their marketing strategies, production efficiency and unit costs together. Time is an important factor for productivity. Which activities are essential to the company objectives and in what proportions these activities are realised must be determined during the period of working time. The "Work Sampling" method used for this purpose is described in the literature as 'a method which determines the percentage of occurrence of works or activities via statistical sampling and random observations' [1].

Work sampling, as the name implies, utilises the well established principle of drawing inferences from a random sample of a whole [2]. In this case the "Whole" is the total activity of the area, persons, or machines observed during the entire period of time over which observations are made. Work sampling is a practical compromise between the extremes of a purely subjective opinion and the "certainty" of continuous observation.

The work sampling technique has been around since 1935. It is generally conceded that L.H.C. Tippett, a British statistician, is the father of work sampling. At that time it was used as a method of determining machine down time and its causes. Later this method was broadened to measure the inactive time of men and machines to determine the causes and improve them [3].

Work measurement techniques such as time study and work sampling are used in measuring or forecasting the rate of output of an existing or newly designed operation, as well as in determining how much time is consumed for the various productive and non-productive activities of a process or operation. Also involved is the determination of standard times, which represent the allowable time for the performance of work [4, 5].

It is seen that work sampling applications are widely used in determining productive and non-productive activities [6], evaluating relationships with customers in restaurants [7], measuring activities in clinical applications [8] and also assessing the performances of young people with confidence and accuracy [9]. This method, commonly used in industry, has also been applied in library settings for planning and implementation [10]. Intel used this method for Office Space Plan depending on employee work habits [11]. Some advantages of work sampling studies can be made over a period of days or weeks, thus decreasing change in day-to-day or week-to-week variations [12].

Purpose

The objective of the present study is to determine the types, rates and percentages within the basic time of work flows, regardless of the existence of customer orders, during the use of knitting machines of circular knitting companies. Thus, idle times, which may cause a decrease in productivity, can be determined, and weak points resulting from marketing strategies will act as a guide in the search for improvement in the future.

Material and method

The study was conducted on circular knitting machines in two companies where different marketing strategies, and thus different production programs, are applied. Each of the two companies runs a three-shift operation.

- Company A is an establishment that focuses on customer orders, manufactures new and different types of fabrics, frequently makes adjustments to its machines, deals with small batches

(min.300 kg., max. 2000 kg.) and closes down its machines when there are no orders to fill. The company has 15 single-bed and 13 double-bed circular knitting machines.

- Company B is an establishment that produces to increase stocks rather than filling orders, in other words producing classic fabrics, and does not implement machine adjustments frequently. The company has 24 single-bed and 14 double-bed circular knitting machines.

In this study, the "Work Sampling " method was used. Lorents and Andrew identify the steps for conducting a work sampling study as follows [13]:

1. Identifying the specific activities, which constitute the main purpose of the study, and design the recording forms,
2. Making preliminary observations to determine an appropriate value for "p",
3. Estimating the confidence level and the degree of errors,
4. Determining the number of observations "N",
5. Determining the procedure for making observations (tour plans, tour times),
6. Explaining the work sampling procedure to all concerned.

The number of observations (N) were calculated using the following equation (1) [14]:

$$N = Z^2 \times [p \times (100 - p)] / f^2 \quad (1)$$

where:

N — the number of observations (sample size)

Z — appropriate confidence level for the study. For example, if Z equals 1.96, this implies a 95 percent confidence level. Z values can be found in Standard Statistical References

p — proportion of time spent on activity during preliminary observations

$f = (s \times p)$ — degree of error from the true mean

s — desired relative accuracy

To determine the number of observations, the confidence level selected is important. The most general level which is used for work sampling is 95 percent [14].

The "s" value must not surpass the 10 percent limit for "p" proportions and not exceed 25 percent at a 95 percent confidence level [15]. In this study, the "s" value was accepted as "0.05".

The study

Determination and definition of workflow types

Workflow types and activities of circular knitting machines were classified as follows, taking into account the REFA Machine Activity Chart [16]:

1. Out of usage: machine condition has been inactive for a long time.
2. In usage: machine condition is active.
   - 2.1. Main usage: the knitting process.
   - 2.2. Auxiliary usage: putting yarn on the feeder system, machine setting.
3. Cessation of usage: Machine condition has been inactive for a short time.
   - 3.1. Cessation of usage due to failure: breakage of or damage to the sinker or needle, breakdown of the motor, faulty yarn or elastane change, cessation of the fly, and interference from the fabric fault.
   - 3.2. Cessation of usage due to workflow: quality control, fabric tension adjustment(accuracy), removing the fabric roll from the machine.
4. Indefinite: Unclear conditions.

The tool for recording and coding each activity must be precise so that each function is easily identifiable and mutually exclusive, with observations being classifiable in one, and only one function [17]. In the present study, "Cessation of usage" was considered for the "p" value, which serves as a guide in the determination of the total number of observations.

Determination of the total number of observations

To determine an appropriate value for "p", preliminary observations (n) were made at Company "A" and Company "B". Later, the total number of observations (N) was calculated for each of the two companies using the Equation (1) mentioned above (***Table 1***).

Making tour plans and determination of tour times

At this stage the tour quantity was determined (***Table 2***). For the detemination of tour quantity, equation (2) was used.

$$RT = N / (T \times NR) \quad (2)$$

where:

RT — number of tours per day

N — total number of observations

T — number of application days

NR — number of machines observed.

After that, tour plans which show observation points were prepared, tour times were determined for each company. Details of which are not given in this article.

The results

The total number of observations made was 6400 for company A and 3900 observations for company B. "p" values were

Table 1. *Total number of observations for Companies A and B.*

Company	N	p	p, %	s	f, %	N
A	500	100	20.0	0.05	1.00	6144
B	500	149	29.8	0.05	1.49	3618

Table 2. *Number of tours for companies A and B.*

Company	N	T	Number of machines in the companies	NR	RT
A	6144	20	28	20	16
B	3618	15	28	20	13

Table 3. *Distribution of the workflows in Companies A and B.*

No.	Workflow Types	Company A		Company B	
		N	p, %	N	p, %
1	Out of Usage	2342	36.6	234	6.0
2	In Usage				
2.1	Main Usage	2585	40.4	2777	71.2
2.2	Auxiliary Usage	282	4.4	23	0.6
3	Cessation of Usage				
3.1	Cessation of Usage due to Failure	717	11.2	472	12.1
3.2	Cessation of Usage due to Workflow	467	7.3	390	10
4	Indefinite	7	0.1	4	0.1
Total		6400	100	3900	100

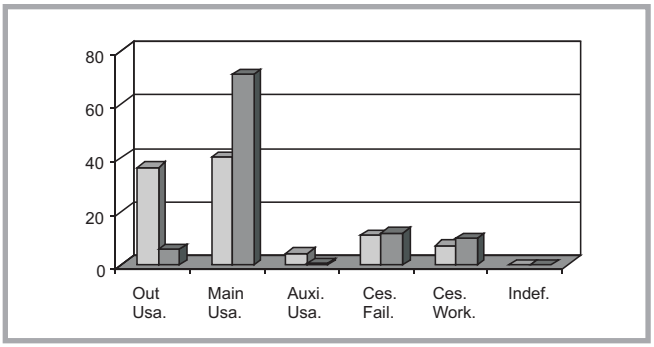

Figure 1. *Actual chart (variation) of workflow types for Companies A and B (The particular values are also presented in Table 3).*

calculated for all workflow types in both companies at the end of the observations. An evaluation of the application in companies A and B is shown in ***Table 3***.

Comments on results

If we compare the distribution of the workflows in both companies, we get ***Figure 1***.

This distribution of workflow types may be interpretted with company costs as follows:

Evaluation of out of usage

Machines in company A sit idle for nearly one-third of the total worktime. This company has to work below its capacity because of the marketing strategies it follows.

Progressive variable costs are low because machines are not in continuous operation in company A. Progressive variable costs occur because of overwork (e.g. attrition of machines; increase in faulty products, the maintenance cost of machines, overtime allowance, as well as the supplementary rate of electricity owing to an increase in consumption [18].

Company B maintains a high rate of using its capacity by producing to increase its stocks, consequently reducing the amount of idle time. However, producing for stock will naturally increase warehouse costs, such as warehouse rent, staff payment and other expenses for maintenance of the premises and fabrics.

Company B is in a disadvantageous position in terms of opportunity costs. Because it invests in stocks whose time of purchase is not definite, the company loses the chance of making this invesment in a more profitable area.

Evaluation of main usage and auxiliary usage times

The rate of total capacity usage of company A is much lower than that of company B. Companies can earn money only while their machines are in the main usage workflow phase. When viewed from this perspective, nearly 100% main usage is desired for machines, but it is impossible to avoid auxiliary usage workflows, which prepare the machines for the main usage workflow.

The rate of auxiliary usage is higher in company A than it is in company B, in that putting yarn on the feeder system and machine setting are frequently done as fabric types are often changed.

Evaluations of auxiliary usage within the main usage provide us with much more accurate results. Therefore the rate of auxiliary usage was found to be (4.4% **:** 40.4% = 0.10) for company A and (0.6% **:** 71.2% = 0,008) for company B.

The amount of fixed costs per unit is low in company B due to optimum capacity usage, but higher in company A, which consequently reduces the unit cost. Some examples of these fixed costs could be the depreciation costs in general, the rent of the building, or the salary paid to managers [18].

Table 4. *Evaluation of the effects of cost categories on unit cost for Companies A and B.*

Cost Categories	Company A	Company B
Fixed Costs	High	Low
Variable Costs	It is directly releated to the amount and type of production; a comparison in this sense is not possible.	
Degressive Costs	Low	High
Progressive Variable Costs	High	Low
Opportunity Cost	Low	High

Direct raw material and other material costs, often referred to as variable costs, increase or decrease depending on the amount of products obtained.

Company B is at an advantage regarding degressive costs because the total raw material costs do not necessarily change at the same rate as the size of the production volume due to the discount given when big purchases are made [18].

Evaluation of times of cessation of usage

Total cessation of usage is higher in company A than it is in company B. The number of operational machines is fewer in company A; for that reason fewer numbers and and varieties of failures could be seen. According to the theory of probability, as the size of the sample pool grows, the probability of observing a specific state also increases.

However, evaluation of cessation of usage within the main usage is much more accurate. Under these circumstances the rate of total cessation of usageis found to be (18.5% **:** 40.4% = 0.45) for company A, (22.1% **:** 71.2% = 0.31) for company B. According to these results, cessation of usage within the main usage is low in company B because its product line includes classic, the same or similar fabrics.

The rate of indefinite workflow in both companies is insignificant (10%).

The evaluation of the effects of cost categories on unit cost for comanies A and B is summarised in ***Table 4***. In light of these evaluations, companies should determine the unit cost with their actual costs by considering the fact that the workload percentage of the machines can change depending on their marketing strategies, which will affect the categories of cost types.

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