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Letters to the Editor

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LETTERS TO THE EDITOR

Dear Sir: I would like to make the following points with respect to my article "A Problem in Optimal Machine Loading" which appeared in the April, 1956, issue of MANAGEMENT SCIENCE. I appreciate the interest shown by several persons in writing me in these regards.

1. *Page 236*: beginning with part 15— the decimal point should be moved one place to the right for numbers in the column, headed "Operation Time."

2. *Page 241*: the non-zero numbers in Table VII were taken directly from Table VI. Their reciprocals should have been used, as is obvious from the definition of a_{ij}. I neglected to make this transformation on inserting fictitious numbers for publication.

3. *Page 247*, first full paragraph: I did not intend to underestimate the difficulty of determining certain costs nor the importance of accountants in cost determination. My intent was only to avoid a digression at that juncture into a broad class of separate problems.

4. *Page 248*: equation 3 and following should have the "2" in the numerator.

5. *Page 254*: equation 10, should read

$$\Phi = \sum_k p_k e_k \left(\frac{\theta - S(x_j)^0}{\theta}\right) T - \left(C\theta - \frac{T \cdot d}{\theta}\right).$$

The term T, and the first closing parenthesis were omitted inadvertently in transcribing from working papers.

T is the number of units of time in the production planning period. If this is taken as unity and all other time measurements as percentages, it can be dropped.

C is a constant for relating cycle length to cost. It is determined as

$$C = \sum_k c_k m_k$$

where c_k is the cost of storing one unit of the kth part and m_k is the average number of units of the kth part stored per unit length of the cycle time. If one wished to be uneconomically exact in computing C, he would include a constant cost term for each part representing the storage cost of the average amount which would be carried during the invariant set-up times. In this instance, this was a second order effect and was dropped for simplicity.

6. It is possible to determine the items in (5) above analytically. The costs would be determined by usual cost methods. The average inventory can be determined by suitable equations which should be obvious on inspecting the structure of the graphs in Figure II, Page 251.

7. In referring only to business schools on Page 259, I did not intend to raise a jurisdictional dispute as to which college—engineering or business administration—should incorporate material of this general character in its curriculum. It certainly is appropriate also in industrial and management engineering curricula. The Management Sciences represent a set of intellectual activities which

properly are subsets also of other intellectual activities, including engineering as well as psychology, philosophy, ethics, economics and others.

Sincerely,
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Sir: We read Mr. James R. Jackson's article "A Computing Procedure for a Line Balancing Problem" in the April issue of Management Science with a great deal of interest.

We would like to suggest a decision rule for crossing off sequences in Step n-C of his computing method.

There are two criteria for a "good" balance: (a) the total unbalance, or the total idle time, should be a minimum, and (b) the variation in total work assignment from station to station should be a minimum. The former criterion is an economic criterion and should take precedence over the latter which is a psychological criterion. By minimizing the total idle time we obtain a balance with the lowest cost. By minimizing the variation in unbalance, we obtain a balance that can be put into effect more easily, since this is minimizing the difference in work pace between individuals on the same line.

Thus, in the example of this article, using the minimum variation criterion in Step 2-C

abc, *ih* will be crossed off rather than *abh*, *ci*

abc, *gh* will be crossed off rather than *abh*, *cg*

because in each case, although the two sequences have the same total idle time, the latter sequence has less variation from station to station than the former.

(10, 7 against 9, 8; 10, 8 against 9, 9.)

In this article, Mr. Jackson indicates that both Step *n-C* of the computing method and Step III of the subroutine are somewhat arbitrary, and that strengthenings of these have not often turned out to be economical. We think by thus introducing the second criterion of minimum variation in Step *n-C* and maintaining Step III (Step III is less arbitrary in that it appeals to intuition by the minimum idle time criterion.), the arbitrariness can be greatly reduced without much effort. The additional effort should not be uneconomical because the computing procedure needs not be a complicated one such as minimizing the variance (or the sum of the squares of the deviations from the mean work assignment in the sequence). Minimizing the sum of the absolute value of the deviations, or even minimizing the difference between the maximum and the minimum work assignments in the sequence may be quite sufficient. The additional effort is certainly justifiable when it is realized that a "good" balance is good only when it can be actually put into effect.

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