MAN 65 - 2

Theoretical Analysis of Impact on Operational Effectiveness by Control of High Grades, Average Salary and Manpower Spaces

1 OCTOBER 1965

Management Analysis Note ...

Office for Laboratory Management

Office of the Director of Defense
Research and Engineering
Washington, D.C.

THEORETICAL ANALYSIS OF IMPACT ON OPERATIONAL EFFECTIVENESS BY CONTROL OF HIGH GRADES, AVERAGE SALARY AND MANPOWER SPACES

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1 October 1965

Management Analysis Note 65-2

of the

Office for Laboratory Management
Office of the Director of Defense Research and Engineering
Washington, D.C. 20301

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CONTENTS

1. Methodology and Outline

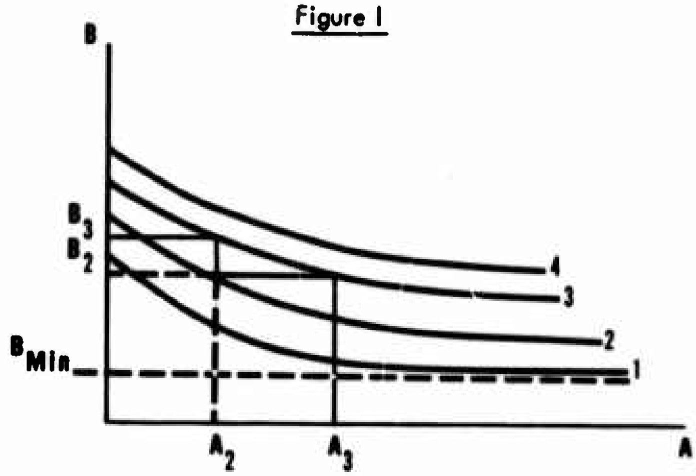
The indifference curves and maximizing principles of economic analysis are used ~~here~~ to demonstrate how management controls over high grades, average salary and manpower spaces prevent the line manager who is limited to a certain dollar budget from optimizing his organization's effectiveness. For the sake of simplicity and clarity, the analysis is restricted to a two-dimensional framework, although it can easily be extended to as many dimensions as desired, depending on the number of inputs.

First, the general method of optimizing the allocation of resources is discussed, and then the impact of each control is separately analyzed.

2. General Method

Suppose that the professional personnel of an organization (e.g., a laboratory) can be divided into two subsets, the GS-13s and below (GS-13−) and the GS-14s and above (GS-14+). Let A represent the number of GS-13s− and B, the number of GS-14s+. Further, let us assume that the productivity of a typical employee within each grade range can be measured and that overall productivity varies according to the mix of A and B. On this basis, the following diagram (Figure 1) may be constructed:

Figure I



The curves labeled 1, 2, 3 and 4 correspond to isoproductivity curves. Thus, line 1 represents the combinations of A and B that yield an equal level of productivity; line 2 represents a higher level of productivity than line 1, and so on. With an input mix of A_2, B_2, for instance, productivity is $E(A_2, B_2)$. If A_2 is held constant and the number of GS-14s+ is raised to B_3, then productivity increases; that is, $E(A_2, B_3) > E(A_2, B_2)$. Similarly, $E(A_3, B_2) > E(A_2, B_2)$.

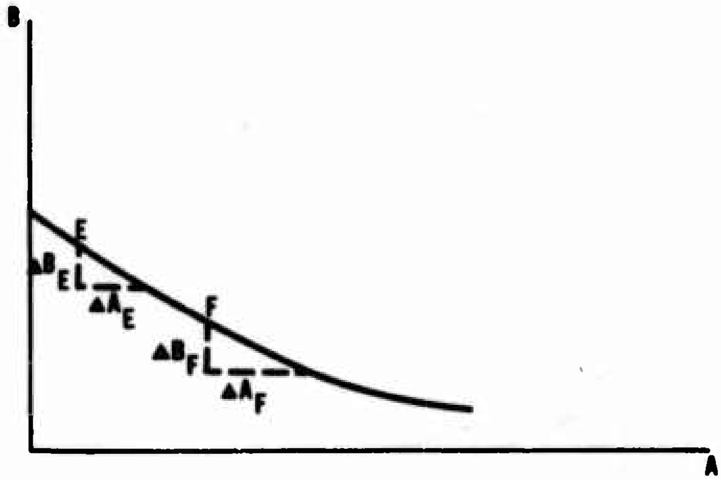
Several other important points about the diagram should be noted: The lowest level of productivity, represented by curve 1, is asymptotic to B_{min}, which represents the minimum of GS-14s+ that must be hired to reach any positive level of productivity. Moreover, all the curves have a flat, negative slope throughout. The negative slope indicates that both A and B have positive productivity, i.e., there is no negative productivity. The curve's flatness indicates that, in any possible input mix, the GS-14s+ are always more productive than the GS-13s-; that is, assuming that we seek to maintain the same level of productivity, if B is decreased by 1, we must increase A by more than 1.

Also, the isoproductivity curves are convex to the origin:

$$\left(\frac{dB}{dA} < 0, \ \frac{d^2B}{dA^2} > 0 \ \text{ for } A > 0, \ B > 0\right).$$

This property depends upon the assumption of diminishing marginal productivity. For example, refer to Figure 2: At point E on curve 1, a decrease ΔB_E in the number of GS-14s+ requires an increase ΔA_E in the number of GS-13s- in order that total productivity remain constant.

Figure 2

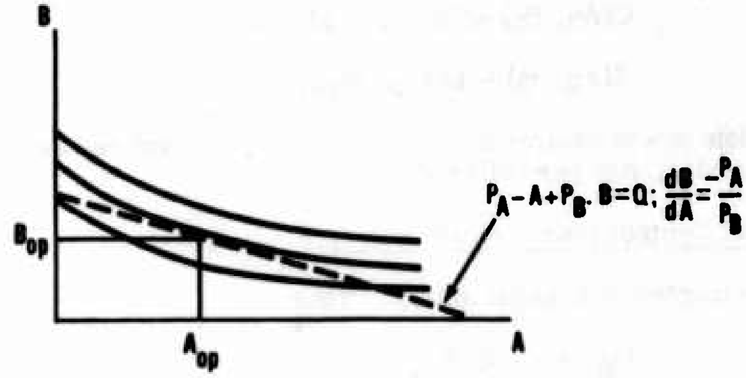


However, at point F, where the relative number of GS-14s+ is smaller, the same decrease in the number of GS-14s+ ($\Delta B_F = \Delta B_E$) requires a larger increase in the number of GS-13s- ($\Delta A_F > \Delta A_E$) to keep the total productivity constant. This condition does not appear unreasonable, for the GS-14s+ may perform some tasks more efficiently than the GS-13s-. If the curves were concave to the origin, this would be equivalent to making an assumption of increasing marginal productivity; i.e., as the GS-14s+ become relatively fewer, it will take fewer and fewer GS-13s- to replace the same number of GS-14s+.

3. Maximizing Productivity, Given a Budget Constraint

Suppose the isoproductivity curves are represented as in Figures 1 and 2. Let P_A = salary (cost) paid a GS-13-; let P_B = salary (cost) paid a GS-14+; and let Q = the total budget available for salaries. Then, $P_A \cdot A + P_B \cdot B \leq Q$. Now, superimpose this linear budget constraint on the productivity contour surface, as in Figure 3.

Figure 3



Given Q, we now maximize our productivity by hiring $A = A_{op}$, $B = B_{op}$, since at this point the budget line reaches—and is tangent to—the highest isoproductivity curve. This method vitally depends on the convex nature of the isoproductivity curves.

3.1 Effect of Limitation on Number of GS-14s+ (B)

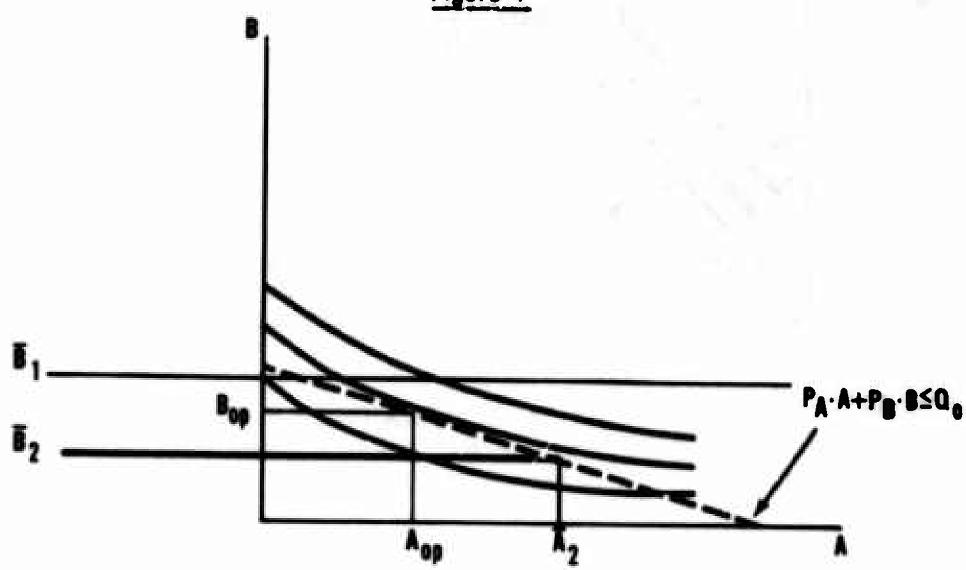
Let us state the constraint imposed by a limitation on the number of GS-14s+ in the following manner:

$\overline{B}$ = maximum allowable number of GS-14s+;

thus,

$B \leq \overline{B}$.

Figure 4



When $\overline{B} = \overline{B}_1 > B_{op}$, the constraint is irrelevant, because, given $Q = Q_0$, the optimum mix is A_{op}, B_{op}, with effectiveness (productivity) equal to $E(A_{op}, B_{op})$.

When $\overline{B} = \overline{B}_2 < B_{op}$, and given $Q = Q_o$, the highest productivity is at point (A_2, B_2). Yet the costs of the two mixes are the same—both fall on the line $P_A . A + P_B . B = Q_o$.

$$C(A_2, B_2) = C(A_{op}, B_{op}) = Q.$$

but

$$E(A_2, B_2) < E(A_{op}, B_{op}).$$

Thus, when this grade control is not irrelevant, it always reduces cost-effectiveness in terms of productivity per dollar of cost.

3.2 <u>Effect of Control over Average Salary</u>

Let S = maximum average salary. Thus

$$\frac{P_A . A + P_B . B}{(A + B)} \leq S.$$

For the interesting case, assume that $P_A < S < P_B$. Then $(S-P_A) > 0$, and $(S - P_B) < 0$. Also

$$P_A . A + P_B . B \leq (A + B)S$$

$$B(P_B - S) \leq A(S - P_A)$$

$$B \leq \frac{(S - P_A)}{(P_B - S)} A$$

<u>Figure 5</u>

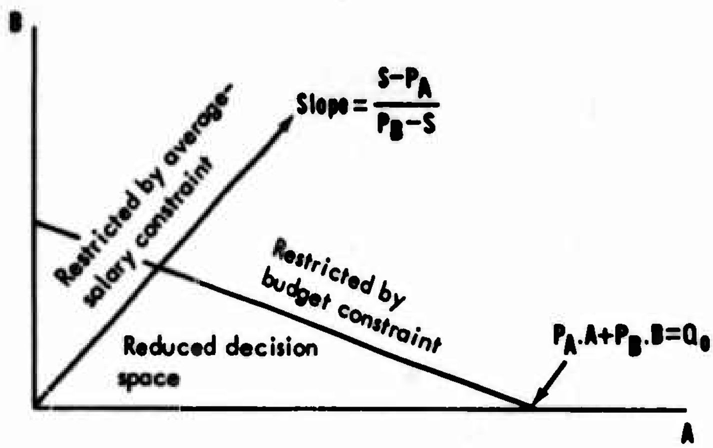
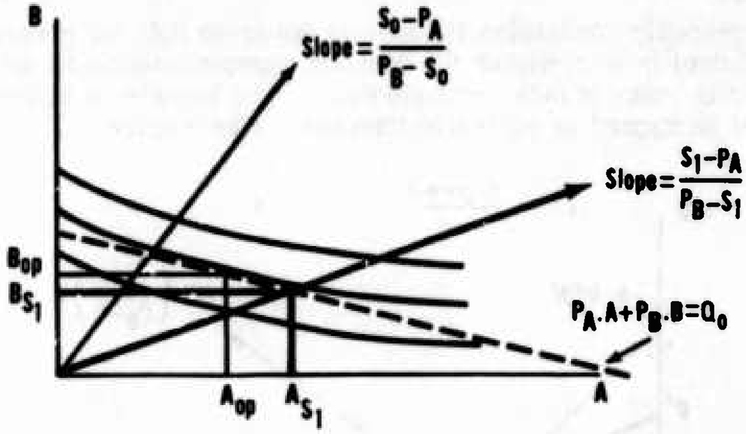


Figure 5 illustrates how control of average salary reduces the decision "space" available to the local line manager. Figure 6 shows the influence of this constraint on the effectiveness of his decisions.

Figure 6



When $S = S_O$, the constraint is irrelevant.

When $S = S_1$, $S_1 < S_o$ so that $\frac{S_1 - P_A}{P_B - S_1} < \frac{B_{op}}{A_{op}}$

$$C\left(A_{S_1}, B_{S_1}\right) = C(A_{op}, B_{op})$$

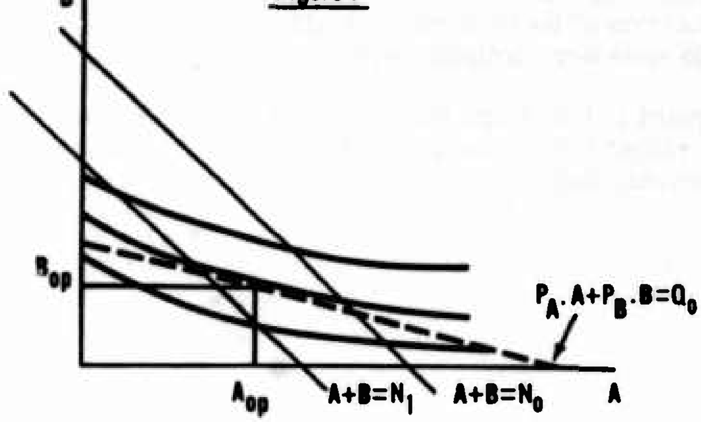
but $$E(A_{op}, B_{op}) > E\left(A_{S_1}, B_{S_1}\right).$$

Thus when the average-salary constraint is not irrelevant, it always reduces effectiveness in terms of productivity per dollar of cost.

3.3 Effect of Control over Total Spaces

The statement of this constraint is $A + B = N$.

Figure 7

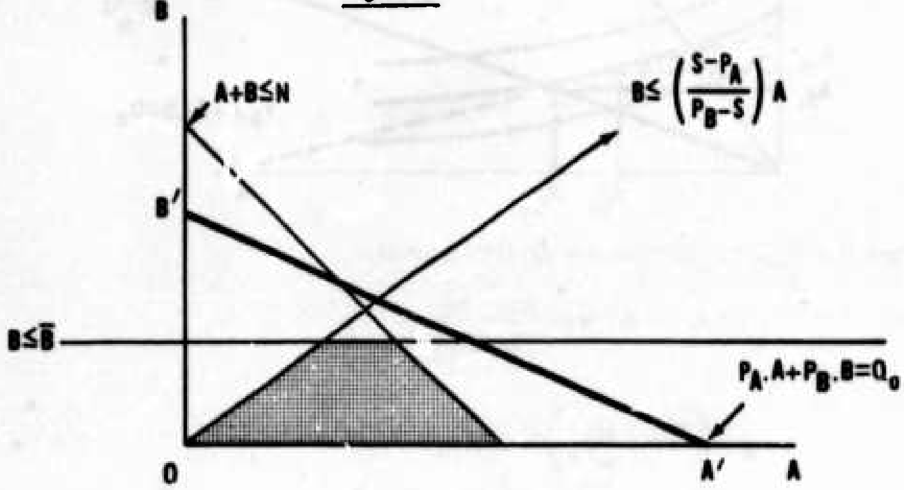


Once again, when $N = N_O$ the constraint is irrelevant, and when $N = N_1$ it reduces effectiveness.

4. General Result

From the preceding examples it becomes apparent that the general effect of these types of control is to diminish the decision space available to the local line manager and thus to make it less probable that he will be able to achieve an optimum level of operation in regard to cost-effectiveness. (See Figure 8.)

Figure 8



OB'A', the original decision space, is defined by the single budget constraint. The shaded area represents the reduced decision space after the three constraints have been drawn. As shown here, the budget constraint has become irrelevant—which may not always be the case.

The addition of one or more constraints may or may not reduce the cost-effectiveness of the operation by a large amount. The important point to remember, however, is that such constraints or controls cannot increase effectiveness but can only reduce it. Moreover, it is most unlikely that, by some mystical process, the simultaneous imposition of these controls would force the local manager to make a decision that would have been optimum without them.

The major point is that these three controls, which represent indirect attempts to control dollars rather than other resources such as manpower, can only reduce operating effectiveness; they can in no way increase it.