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MANAGEMENT THEORY
AND THE ECONOMIC SIZE OF ORGANIZATIONS

by

Edward A. Nelson

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SYSTEM
DEVELOPMENT
CORPORATION
2500 COLORADO AVE.
SANTA MONICA
CALIFORNIA
90406

20040910014

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ABSTRACT

This paper attempts to demonstrate that the management of large organizations need not be inherently less efficient than that of smaller organizations. The impact of the management factors tending to increase total unit costs is explored, and a list of eight generally applicable offsetting factors defined.

THE PROBLEM

The economist's interest in management is primarily focused on the question of the size of the firm. If the process of management does indeed have finite limits,[1] management would provide the fixed factor causing the firm's long-range cost curve to slope upwards beyond a certain output. This U-shaped long-run cost curve is necessary for equilibrium under the concept of perfect competition and helps to explain the predominance of small- and medium-sized firms.

The rationale for the proposition that management is a limiting factor can be based on the following arguments:[2]

1. Total expenditures in time and energy are limited for each individual. There are also finite limits on the number of things to which an individual can direct his attention at any given time.

2. In an organization, the limits imposed by time, energy, and attention spans are reflected in limits on the number of subordinates that a manager can effectively supervise. This limitation is called the Span of Management.[3]

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[1] The focus of this report is on the effects of size of organization on the efficiency of management as reflected in the total unit costs of production. It is commonly claimed that one of the results of increased size that indicates lower managerial efficiency is a more-than-proportionate growth in the administrative component. For a general discussion of this and other points relating to organizational size, and a review of the literature, see Theodore Caplan, "Organizational Size," Administrative Science Quarterly, March 1957, Vol. I, pages 484-505.

[2] It has also been argued that: (a) since coordination must be the act of a single center, division of labor cannot apply to this task; (b) thus, supply of coordinating ability cannot be expanded with increase in the supply of other factors; (c) since the supreme coordinating authority must have knowledge of details of problems, expansion requires greater knowledge by the coordinator. For a discussion of these fallacies, see: N. S. Ross, "Management and the Size of the Firm," Review of Economic Studies, 1952-53, Vol. 19(3), pages 148-154.

[3] H. Koontz and C. O'Donnell, Principles of Management, New York: McGraw-Hill Book Co., Third Edition, 1964, pages 216ff. Many of the concepts in this section were derived from this reference and applied specifically to the question of organization size.

3. As output and personnel resources required increase, the limits imposed by the span of management result in increasing the number of levels in the organization. This scalar chain of superiors, ranging from the ultimate authority to the lowest ranks, cannot be indefinitely extended because of the additional and more complex communications that become necessary.

4. The extent to which both the width of the span and the length of the scalar chain are limited imposes restrictions on the total size of the organization.

We shall attempt to show that, although each of the above may occur, there are devices available to the manager to offset these effects. With the existence of these offsets, diseconomies of size (i.e., eventual increases in the unit cost or production) are not inevitable, from the standpoint of management theory, for those scales of production that are found in reality.

THE SPAN OF MANAGEMENT

The existence of finite capacity spans provides the foundation for the span-of-management concept. It has been shown that the average person can retain and repeat back only about seven unrelated digits; there appears to be a finite span of immediate memory that approximates about seven items in length for various test items; also, there is an average span of absolute judgment that can distinguish about seven categories, and a span of attention that will encompass about six objects at a glance.[4]

It is not suggested that, because the "human engineering" limitations on the number of items a manager can observe at one moment appears to be about six, the number of subordinates he can supervise is therefore also limited to six. The supervision of subordinates and the recognition of objects are obviously different kinds of tasks. Yet, there are direct analogies, and common causal determinants, for the span of management and for psychological phenomena such as spans of attention.

Since a manager, as a functioning human organism, is limited in the number of things that he can do at any one time, he must organize his work day so that the amount of things that require his attention can be done in some reasonable sequence. But, since the time available and the manager's energy are also limited, so must be the total number of tasks that a manager can do. How does this specifically relate to the number of subordinates that a manager can

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[4] George A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information," The Psychological Review, March 1956, Vol. 63(2).

effectively supervise? Graicunas[5] suggested that the tasks of a manager involved dealing with (i.e., coordinating) the various subordinate-superior relationships that arise in an organization. Considering single relationships between the supervisor and any combination of two subordinates, and cross-relationships between any two subordinates, Graicunas arrived at the following formula to represent the difficulty of a manager's job as a function of the number of subordinates:

$$R = s(s^s/2 + s-1)$$

where: R = number of relationships a manager must coordinate and s = number of direct subordinates.

The significance of this formula lies in the geometric progression that it represents. Thus, if a manager has four subordinates, he deals with 44 relationships; 8 subordinates produce 1080 possible relationships; and 16 subordinates 524,534 relationships!

The Graicunas formula understates the problem in that cross-relationships can also occur with combinations of more than two subordinates at a time; that is, with four subordinates reporting to one supervisor, there are also four ways in which groups of three subordinates could interact, etc. On the other hand, the severity of the problem is overstated to the extent that the nature of the business or the organizational environment may make many of the mathematically possible interrelationships unnecessary in actual practice. Thus, the actuary of a life insurance company may have much more daily contact with the controller than with the agency director, even though all three report to the same executive. This effect, recognized by Graicunas, is expressed as the "Principle of Interlocks" by Urwick:

> No superior can supervise directly the work of more than five or, at the most, six subordinates <u>whose work interlocks</u>.[6]

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[5] V. A. Graicunas, "Relationship in Organization," <u>Bulletin of the International Management Institute</u>, Geneva: International Labor Office, 1933. Also published in <u>Papers on the Science of Administration</u> (ed. L. Gulick and L. Urwick), New York: Columbia University, 1947.

[6] L. Urwick, "The Manager's Span of Control," <u>Harvard Business Review</u>, May 1956, Vol. 34(3), page 41. A number of writers, including Urwick, speak of "Span of Control" rather than "Span of Management." The latter term is used here because the limitations imposed by the principle apply not only to the managerial function of control but also to other management functions.

Yet it is not only the existence of work interlocks, but also the frequency and severity (i.e., the amount of attention each requires) of the relationships that result,[7] that determine the difficulty of the manager's task of coordination. We may quibble about details of the Graicunas formula, but the principle that the potential for inefficiency increases geometrically--by some similar relationship--as the number of subordinates is increased, is difficult to escape. This is to a large extent an information processing problem;[8] but it is more than this for the span of management, since the mere existence of work interlocks can create situations that require coordination.

If we are to offset such difficulties we must find means for reducing this frequency and severity of the relationships between the superior and his subordinates.

THE LENGTHENING SCALAR CHAIN

Some writers have maintained that the principle of minimizing organizational levels contradicts the requirements of the span of management and, hence, illustrates the inadequacy of both principles in application.[9] The issue does pose a dilemma. If a small span is desirable, the number of executives and probably the number of levels between the chief executive and the operating employee will have to be increased. One purpose of specifying more precisely the factors and offsets that influence the relative impact of these two countervailing principles is that individual situations may then be analyzed to determine the best compromise.

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[7] Koontz and O'Donnell, op. cit., page 222.

[8] "In an exhaustive theory of organization, communication would occupy a central place, because the structure, extensiveness, and scope of organization are almost entirely determined by communication techniques." See: Chester I. Barnard, The Functions of the Executive, Cambridge: Harvard University Press, 1958, page 91. Also, "...communication...is...the limiting factor in the size of simple organizations and, therefore, a dominant factor in the structure of complex organizations," ibid., page 106.

[9] Herbert A. Simon, Administrative Behavior, New York: The Macmillan Co., 1959, pages 26-28.

An organization of a given size can be constructed using various spans or numbers of levels (see Figure 4).[10] But extending the number of levels indefinitely may result in inefficiencies arising from three sources:

1. Socio-Political Factors

There is a currently popular emphasis on the social aspects of organization by some writers.[11] The length of the scalar chain, the span of management, or the absolute size of an organization may indeed have an effect on the morale of its members which could in turn influence efficiency; therefore, this possibility should be mentioned. But, these factors are not yet clearly understood. It has yet to be shown that a long scalar chain or a broad (or narrow) span of management necessarily create an adverse psychological environment. However, the issues and countervailing forces in individual or group psychology are quite beyond the scope of this paper; aside from this brief recognition of their existence, further elaboration on this point will not be attempted.

2. Communications

Extending the length of the scalar chain may cause problems in communication because "...contact between organization members (may) be carried upward until a common superior is found...and then downward again in the form of orders and instructions--a cumbersome and time-consuming process."[12] If, on the other hand, a decision can be made without traveling very far up the scalar chain, higher levels of management may be unaware of what is happening within their area of responsibility.

Span of management and length of scalar chain limitations both deal with communication, but from a different point of view. Where span of management is concerned with the saturation of the manager's capacities because of the frequency and severity of communications, scalar chain limitations arise because of impediments to the flow of information. These impediments may result in inaccurate or distorted information

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[10] There are, of course, other considerations than span of management or number of levels used in arriving at a desirable organization structure. See for example the principles of departmentation and assignment of activity, Koontz and O'Donnell, op. cit., pages 231-261.

[11] E.g., Rensis Likert, New Patterns in Management, McGraw-Hill Book Co., Inc., 1961. See also, William H. Newman, Administrative Action, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965, pages 262-263.

[12] Simon, op. cit., page 28.

(intentional or unintentional), lack of important information at the higher echelons of decision, excessive time lags in obtaining information resulting in inflexibility or missed opportunities, and problems and delays in explaining and selling the decisions that have been made.

3. Costs of Additional Management Personnel

When the span of management is reduced, the number of supervisors required for a given work force is increased, as illustrated in Figure 1. The added expenses created by these additional supervisors, and the office space and secretarial and other support personnel required would have to be justified by at least a proportional increase in the productivity of the employees supervised. If this increase in productivity is not forthcoming, lengthening the scalar chain will obviously increase the total unit costs of production.

The interesting thing about the costs of additional management personnel, from the standpoint of the contribution of this factor to possible diseconomies of large size, is that the factor has its greatest impact on the smaller firms!

If we measure this impact by the changes in the ratio of the number of supervisors to the total number of workers, and if we assume that the same span applies to supervisors at every level and that the organization contains the maximum total number of employees mathematically possible for a given span and number of levels, we arrive at the following relationship:[13]

$$R = \frac{\text{Total Number of Supervisors}}{\text{Total Number of Workers}}$$

$$= \frac{\sum_{i=1}^{n-1} S^{(n_i-1)}}{S^n}$$

where: S = span of management (maximum number of employees reporting to each supervisor) and n = number of levels of supervisors (see Figure 1).

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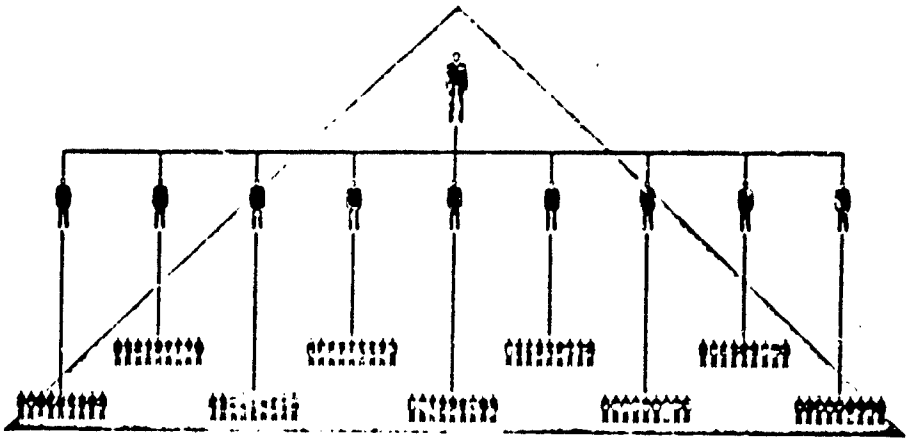
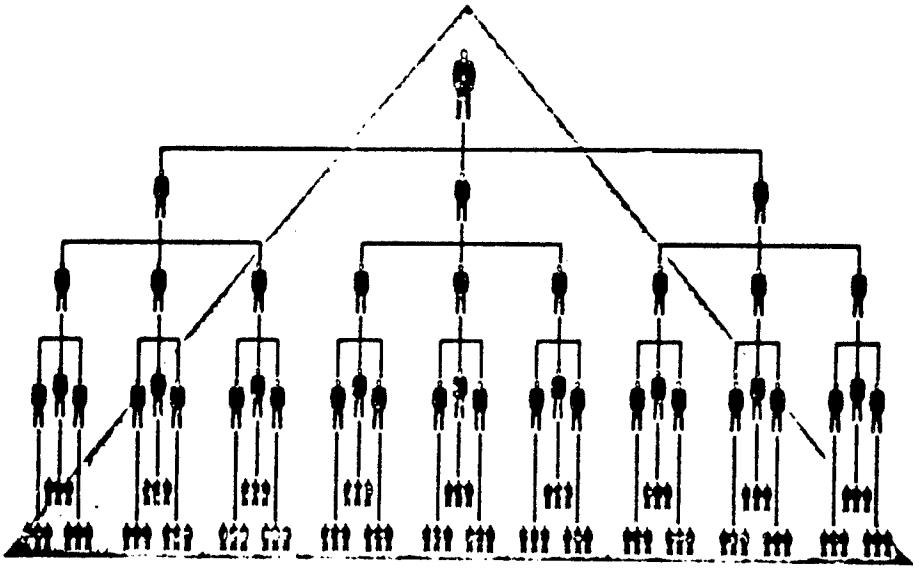
[13] For a different treatment that arrives at substantially the same conclusions, i.e., that the marginal cost per worker remains below a definite bound no matter how large the organization, see: Martin J. Beckman, "Some Aspects of Returns to Scale in Business Administration," Quarterly Journal of Economics, Vol. 74, 1960, pages 464-471.

(A) Span of 81 per executive: 1 supervisory level, 1 executive.



(B) Span of 9 per executive: 2 supervisory levels, 10 executives.



(C) Span of 3 per executive: 4 supervisory levels, 40 executives.

Figure 1. Diagram of Different Spans of Management

The results of this relationship are shown in Figures 2 and 3 for several values of span and numbers of levels. Except for the comparatively trivial case of only two people reporting to one supervisor (see Figure 2), the change in the ratio of supervisors to workers is small when we go from two to three levels of supervision, and totally insignificant for levels of supervision beyond three, regardless of which span we are using! Likewise, Figure 3 illustrates that this ratio is primarily a function of span, not levels, with the number of levels being most important in the lower ranges, i.e., for the smaller firms. Furthermore, the relationship of management cost to span is a negative one; the larger the span, the less the total average unit costs for supervision.

Since the restrictions created by the number of levels or coordination by socio-political factors are at best tenuous, and the impact of the costs of additional management personnel becomes less important as an organization gets larger, we are left with the second factor. The primary tangible reason for an adverse effect on efficiency, resulting from increasing the length of the scalar chain, must stem from problems in the flow of information.

OFFSETS TO SPAN AND SCALAR CHAIN LIMITATIONS

We have seen that the mechanisms that would generate limitations on the span of management and the length of the scalar chain operate primarily by:

1. Affecting the frequency and severity of the interaction required between a manager and his subordinates.

2. Affecting the flow of information up or down the scalar chain.

But there exists a number of factors that could have an important influence on both of the above, and hence, on the span or depth of organization that could be tolerated in a given situation without loss of efficiency. These factors are listed below, and discussed in terms of their value as offsets to span and scalar chain limitations.

Both the frequency and severity of interaction, as well as the flow of information required in an organization, can be profoundly affected by the dynamics of the "business" in which the organization is engaged. The Roman Catholic Church, for example, has demonstrated a remarkable stability and durability over the centuries with a very wide span of management, partly because changes in policies, procedures and objectives have occurred slowly. Likewise, the amount of personal contact required by managers, both inside and outside of the

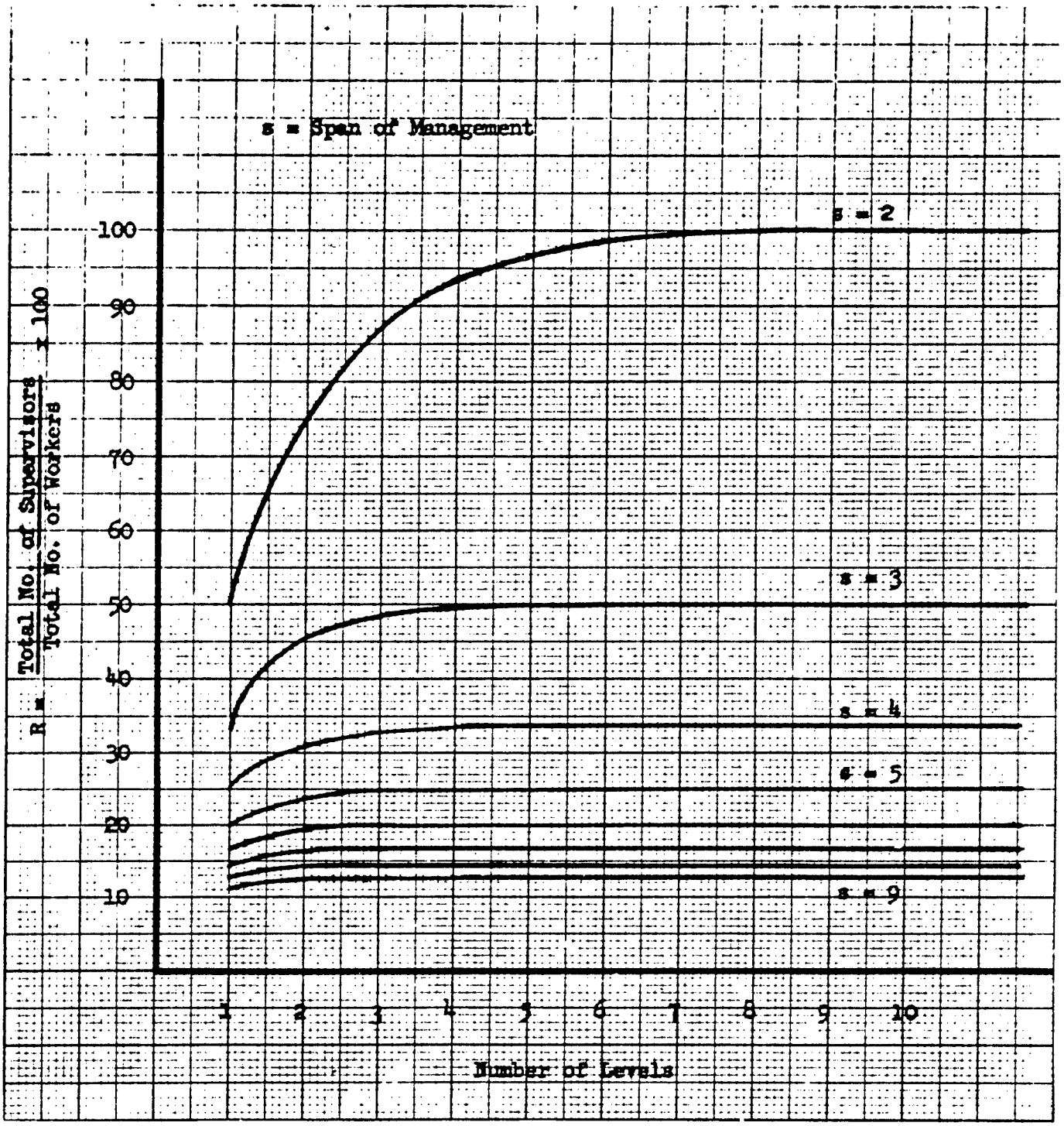


Figure 2. Relationship of Percent Supervisory Personnel to Workers versus Number of Levels of Organization

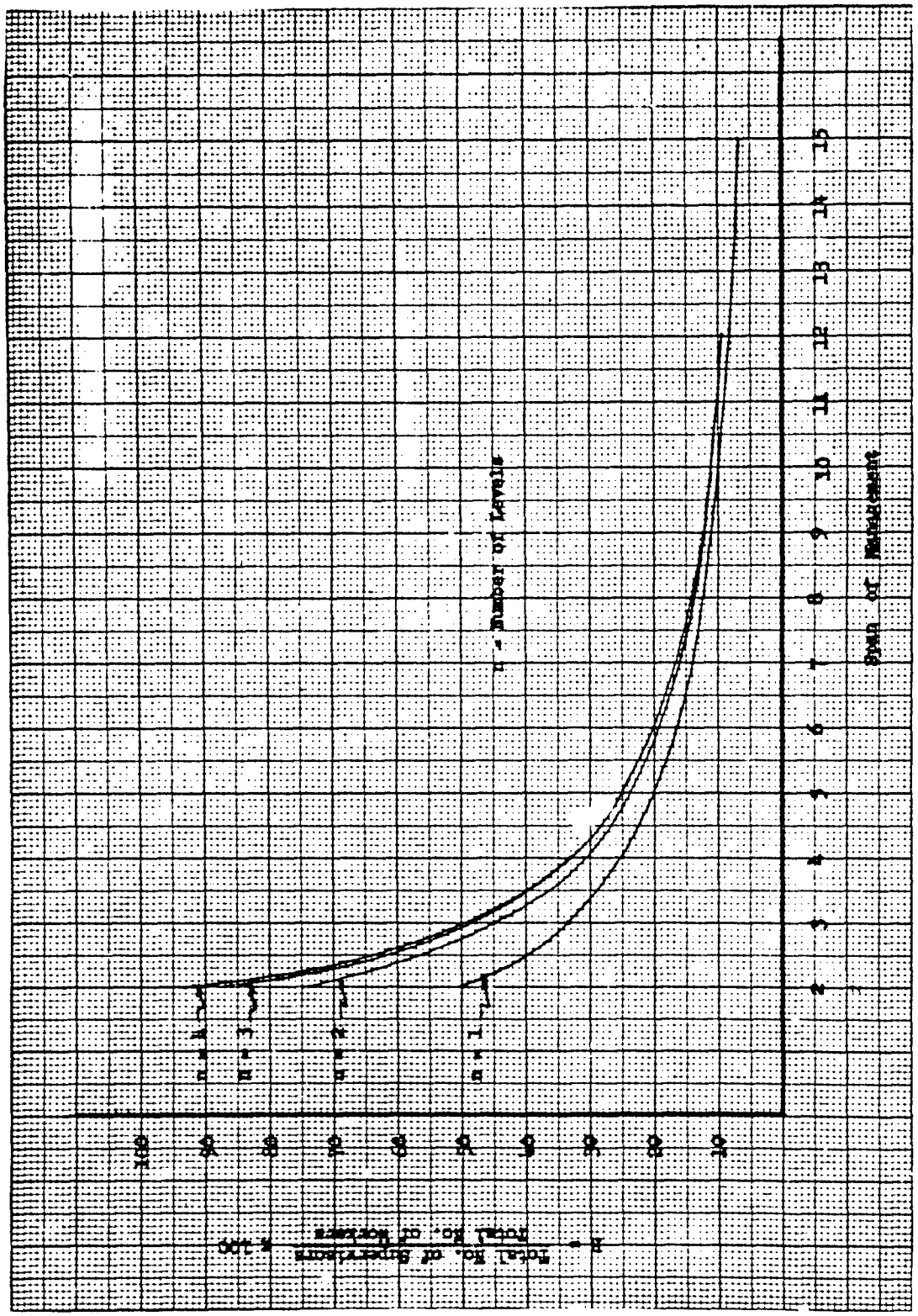


Figure 3. Relationship of Percent Supervisory Personnel to Workers versus Span of Management

organization, and other duties such as community projects or professional meetings and conferences, will vary by the type and purpose of the organization and the complexity of the business, and will have an important bearing on communications and the time and attention available for the managerial functions.

Although the dynamics of the business, the intricacies of a particular product line, and the amount of personal contact that is inherent in the nature of some specific operations, may indeed exert a strong influence on the acceptable span of management and length of scalar chain for a specific organization, these factors are not a part of our list of offsets. This exclusion permits a listing of offsets that are more directly subject to the discretion of management, and hence more germane to a general treatment of the hypothesis that diseconomies of scale need not necessarily exist.

In any organization, management may employ various combinations of the following factors to decrease the frequency and/or severity of interactions between the manager and his subordinates, or promote the flow of information between the levels of the organization:

1. Subordinate Training

   It should be self-evident that the better the subordinate knows his job, the less guidance he will require from his superior, and the less coordination between the subordinate and his associates will be necessary. But the importance of training extends beyond instruction in the technical or procedural aspects of a job. Training can also be a valuable aid in securing a prompt response from a subordinate when he is told what to do. The hours spent by new recruits in military drill exercises are not only intended to make the regiment look good at the victory parade; the purpose is that the recruit experience coordination with his comrades in a direct physical sense and acquire a conditioned response to the issuance of an order.

   The success of the Catholic Church as an organization, in spite of its wide span of management, has already been partly ascribed to the slow rate of change to which the organization must respond. But this ability to manage with a wide span must also be credited to the elaborate guidelines for decision and action that have been established (the factor to be discussed next), and the years of extensive training required of the ecclesiastic. The importance of training to span of management is also attested to by the fact that many authorities[14] attribute the existence of larger spans at the lower levels of organizations partially to the greater difficulty of discovering what to teach at the higher levels of management, and how to teach it.

[14] See, for example Koontz and O'Donnell, op. cit., page 222.

Besides its impact on the span of management, training can help to extend the scalar chain in several ways. In the first place, a thorough understanding of policy and objectives "...prepares the organization member to reach satisfactory decisions himself, without the need for the constant exercise of authority or advice";[15] this reduces the need for information flow between levels. Secondly, this understanding can help to assure that information that would be useful at higher levels is recognized and properly forwarded. Likewise, training in the art and use of the means of communication available, whether these media are memoranda, oral presentations, or sophisticated data processing systems, or training in the arts of communication per se, can contribute substantially to the efficient and effective flow of information between levels.

2. Planning

The thoroughness of planning, and the clarity of goals and policy, when combined with the authority to act, reduces the need for communications. Thus, the shop foreman in a production operation where procedures and production requirements are precisely known, can generally supervise more workers than can his counterpart in a jobshop.

On the other hand, when plans are not precise and require periodic new decisions or elaborations, or when plans are changed frequently, there is necessarily more interaction between a superior and his subordinates. To the extent that these interactions affect other levels, the information flow along scalar chain can also be increased.

One of the direct benefits received from the growing use of ADP has been more thorough planning, since the automation of a procedure requires an attention to detail and to objectives.

3. Delegation of Authority

"The most serious symptom of poor organization affecting the span of management is inadequate or unclear authority delegation."[16] Actions not specifically covered by plans must be coordinated with the supervisor when the subordinate does not have the authority to act on his own initiative. This produces a frequency of interaction that is a direct function of the number of problems that arise, which are, in

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[15] Simon, op. cit., page 15.

[16] Koontz and O'Donnell, op. cit., page 223.

turn, directly related to the size of the organization's output. Thus, the limits of managerial attention could be exceeded very quickly as output expanded, and if a manager were given additional subordinates to handle increased output, the result would be the classical situation for the Graicunas effect.

But the frequency of interaction is only half of the story. Reporting on progress, or receiving inspiration or information from a superior, are comparatively benign interactions; but the necessity of a decision following a meeting imposes a severe kind of coordination problem. The effects of this are not confined to span of management, but are also influenced by the number of levels in the organization; for, as Fayol pointed out,[17] as orders are passed through a series of intermediaries, the opportunities for distortions, omissions, or misinterpretations are increased.

Thus, adequate authority delegation[18] provides a major offset to the frequency and severity of interaction between the superior and his direct subordinates and, hence, a major offset to the limitations on the size of the span of management.

When the authority for decisions is moved downward in the organizational hierarchy, the process is frequently termed decentralization. Decentralization can have the effect of reducing the necessity for, and hence the volume of, communications up and down the scalar chain.[19] This in turn reduces the impact of the length of the total scalar chain on the flow of information. Authority delegation thus provides an offset to information flow problems caused by the number of levels in an organization; it puts the decision where the action is.

4. The "Gangplank" Principle

Fayol[20] refers to direct communications by subordinates, operating within their spheres of authority, as the use of a "gangplank." That is, a direct bridge may exist between two members of different departments, and communications may cross this bridge, or gangplank, even though authority follows the scalar chain. It is a sound principle of

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[17] Fayol, Henri, General and Industrial Management, Pitman & Sons, London, 1963.

[18] For a list of principles that serve as guides to effective authority delegation, see Koontz, op. cit., pages 63-66.

[19] For a discussion of some of the advantages and disadvantages of decentralization, see K. K. White, Understanding the Company Organization Chart, AMA Research Study 56, American Management Association, New York, 1963, pages 44-49.

[20] Fayol, op. cit., pages 34-36.

good management that there must be a clear line, or scalar chain, from the ultimate authority to every subordinate position in the organization. The existence of this chain of authority constitutes the formal organization, and provides a route over which information may, and does, pass. But it is not the only route possible or desirable for the flow of information. If an actuary would like to know how many claims have been filed this year on the "Programmers' Special" life policy, and he could determine this by directly contacting a records clerk in the claims department, there is no general reason why he should not do so; to fill out a special information request form, and to pass this up the line until a common supervisor (perhaps the executive vice president in this case) is reached, to wait for it to filter down through the scalar chain until it reaches the records clerk, and back through the same route with the clerk's answer, would be an unnecessary waste of everyone's time.

Fayol suggests that the supreme executive insist that subordinates take advantage of the gangplank principle as long as the course of action is approved by the employee's immediate superior, and that the personnel involved remain in agreement. The use of the gangplank avoids many of the communications problems created by the number of levels. It also reduces the frequency of interaction of superiors and subordinates at all levels, but not necessarily the severity of interaction, since decisions for which no authority has been delegated must still be processed along the scalar chain. However, it is often possible for several subordinates to process enough authority between them to resolve problems without recourse to higher management.[21] This combination of "splintered" authority, a logical extension of the gangplank principle, can be a very useful device in overcoming the limitations of span and depth of organization; but its recurring use on similar matters may indicate that authority delegations have not been properly made, and that some reorganization is in order.

5. Objective Standards at Strategic Points

Subordinate training, good planning, proper authority delegation, and advantageous use of the gangplank principle may reduce the need of the subordinate to communicate with his supervisor. However, it is still

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[21] Suojanen refers to the formation of "primary groups," through which the supreme coordinating authority "becomes indefinitely extensible...with...no limit to the size of any one formal organization...," not only invalidating span of management limitations, but unity of command as well. (W. Waino Suojanen, "The Span of Control--Fact or Fable?", Advanced Management, Vol. 20(11), November 1955, page 11.) This is an extreme position.

the responsibility of the supervisor to insure that proper control, or the conformance of events to plans, is being exercised. This managerial function of control promotes superior-subordinate interaction at the instigation of the manager.

The frequency and severity of interaction with subordinates can be markedly reduced for a manager if he is able to establish simple, objective criteria, at strategic points in the operation, against which actual results can be measured. Objective standards at strategic points form the cornerstone of the exception principle,[22] which states that a manager should direct his attention only to significant deviations. The use of this principle not only reduces the necessity of direct superior-subordinate contact, but also, by helping to define more precisely the information that is most required at various levels of the organization, makes the flow of information between levels more efficient; this is accomplished in both a positive and negative sense--by focusing on and acquiring what is needed, and by eliminating that which is superfluous.

6. The Staff Device

The staff assistant or group may be a particularly useful device for keeping an executive informed on matters that require summarized, specialized knowledge, or special studies that cannot be effectively delegated to operating personnel. The staff can collect and distill information on particular topics or subject areas, inside or outside of the organizations, on an ad hoc or continuing basis. To the extent that the staff deals exclusively with information and advice, it is independent of the length of the scalar chain, and requires only the right of access. This independence of the scalar chain establishes the staff device as an effective offset to inefficiencies created by a large number of levels of organization.

The staff device can also serve to broaden the permissible span of management. This is accomplished partly by providing the decision maker with research on the problem area, to decrease the severity of the superior-subordinate interactions. But the staff may also decrease the frequency of interaction between manager and subordinates when it exercises a functional authority over specific kinds of

[22] First formally stated by Taylor (see Frederick W. Taylor, Shop Management, New York: Harper and Brothers, 1919, pages 126-217), and frequently mentioned in the management literature.

activities. Urwick[23] recalls an example of this in the organization of a British infantry division. The division commander in this instance had 18 persons reporting directly to him, clearly a very wide span of management; yet he spent only a couple of hours a day in his office and was able to maintain a very close contact with all of his subordinates. But every subordinate was expected to take up all routine business in the first instance with the appropriate staff officer; only after the subordinate had failed to secure a satisfactory settlement with the staff officer would the commander accept a direct discussion. The commander thus had only six immediate subordinates who usually approached him directly, plus two staff officers. The latter relieved the commander of all of the routine work of coordinating line and specialist activities and did virtually all of the paper work, drafting of orders, correspondence, etc. Yet, the staff officers had no personal authority; the responsibility for everything they did, and every word that they wrote, was the commander's.

7. Right Versus Use of Direct Access

A powerful device for preserving an executive's time, yet permitting a wide span of management and preventing a loss of morale by creating additional levels of organization, is for the executive to make a clear distinction between a subordinate's right of direct access to him and the frequent use of that right. In Urwick's example of the British infantry division commander, the subordinates' nominal right of direct access preserved a unity of command, and safeguarded their independent responsibility for their functions as well as their organizational status. Also, a right of direct access to a high-level executive for the purpose of transmitting important information can substantially relieve the problem of communication through numerous levels. This principle is important if delegation of authority and the use of the staff device are to work well.

Some companies make a noteworthy use of the principle of right of direct access by a well-published policy that every employee in the organization may deal directly with the chief executive if the employee feels that there is a matter that merits this attention. One such firm is International Business Machines.[24] Although at IBM the "Open Door" policy is discussed primarily in terms of its value in promoting good

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[23] Urwick, op. cit., page 46.

[24] Thomas J. Watson, Jr., A Business and Its Beliefs, McGraw-Hill Book Company, Inc., New York: 1963, pages 19-21.

human relations, the possibilities for communication on important matters that might otherwise escape the attention of management are clearly recognized.

8. Technological Developments

Technological developments can affect the operations of a business in many ways. Simulation techniques and operations research methods can help the manager evaluate the many factors in a large and complex business. The discovery and implementation of principles of management provides guides to effective administration that help offset the problems inherent in large-scale operations. Developments in computer technology that permit a growing number of tasks to be automated will directly affect the way that these tasks are departmentalized, as well as the technical aspects of the manager's job.

There are two ways in which technology will produce an effect on scale of operations. First, there may be an augmentation of the impact of the previously mentioned seven offsets. Programmed learning techniques, for example, may make subordinate training more effective; or PERT methodology may upgrade the planning process for certain types of projects. Second, advances in information technology may directly relieve communications problems that now restrict growth. For example, current efforts in the development of management information systems are directed, in part, toward providing management with the ability to obtain detail information, on demand, for many aspects of the business; such systems have, at least conceptually, the potential of eliminating most of the information flow problems arising from a large number of levels of organization.

It would be a digression to elaborate on such matters as the state-of-the-art in management information systems, the effect of ADP on centralization or decentralization of authority, or the prospects of middle management in the automated enterprises of the future.[25] But there is an important concluding remark pertinent to technological

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[25] See, for example: Harold Koontz, "Top Management Takes a Second Look at EDP," Harvard Business Review, November-December 1961, pages 74-84; J. F. Burlingame, "Information Technology and Decentralization," Harvard Business Review, November-December 1961, pages 121-126; Charles Stein, "Some Organizational Effects of Integrated Management Information Systems," Changing Dimensions in Office Management, AMA Report No. 41, 1959, pages 82-89; Norman J. Ream, "Organizational Relationships of Operations Research, Systems Planning, and Data Processing," AMA Report No. 41, 1959, pages 90-102.

developments as an offset to the frequency and severity of superior-subordinate interactions, and problems of information flow through the levels of organization. The contribution of technology will, in the long run, be positive; that is, it will have the effect of permitting larger spans or greater numbers of levels, or the innovation would be discarded. This means that if empirical studies based on current data validate the hypothesis that large-scale operations can be managed as efficiently as their smaller counterparts, then these conclusions should hold with increasing force for the management of the future.

HOW BIG IS BIG?

The obvious argument for the existence of eventual diseconomies of large size is that, conceptually at least, all of the offsets previously listed are themselves subject to the law of diminishing returns. That is, the proportional advantages gained from a given offset cannot be expected to continue indefinitely, and each factor will eventually play itself out. This may be true. But the important question from the standpoint of management theory is not that raised by the special case of the infinitely large organization; rather, it is whether a firm can expand without incurring increased costs of coordination up to the limits fixed by the scarcity of other economic resources, or by the extent of its markets. That is, it is sufficient to demonstrate that management is not the limiting factor.

It can readily be shown that very large organizations can be created using small spans of management and numbers of organizational levels. Figure 4 was constructed from a relationship that assumed that a given span of management was carried throughout the organization, and that the total work force consisted of the maximum number of employees that was mathematically possible with a given span and number of levels. This diagram shows that the personnel of the world's largest life insurance company could be contained in an organization with a span of only 6 and a depth of 7, or a span of 4 and depth of 8, etc.[26] It has been estimated that there were 1,142,000 persons employed in the insurance business, including clerical workers and salesmen in life and nonlife fields, in the whole of the United States in 1962;[27] this number could be absorbed by an organization with a span of 6 and a depth of 8. On the basis of 15 workers to a foreman, and only 4 superiors to every supervisor, perhaps

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[26] The actual maximum executive span of this company was 8, and depth about 6, as of June 1963.

[27] Virginia T. Holran, "Employment in the Insurance Business, 1962," Journal of the American Society of Chartered Life Underwriters, Vol. XVII(2), page 158.

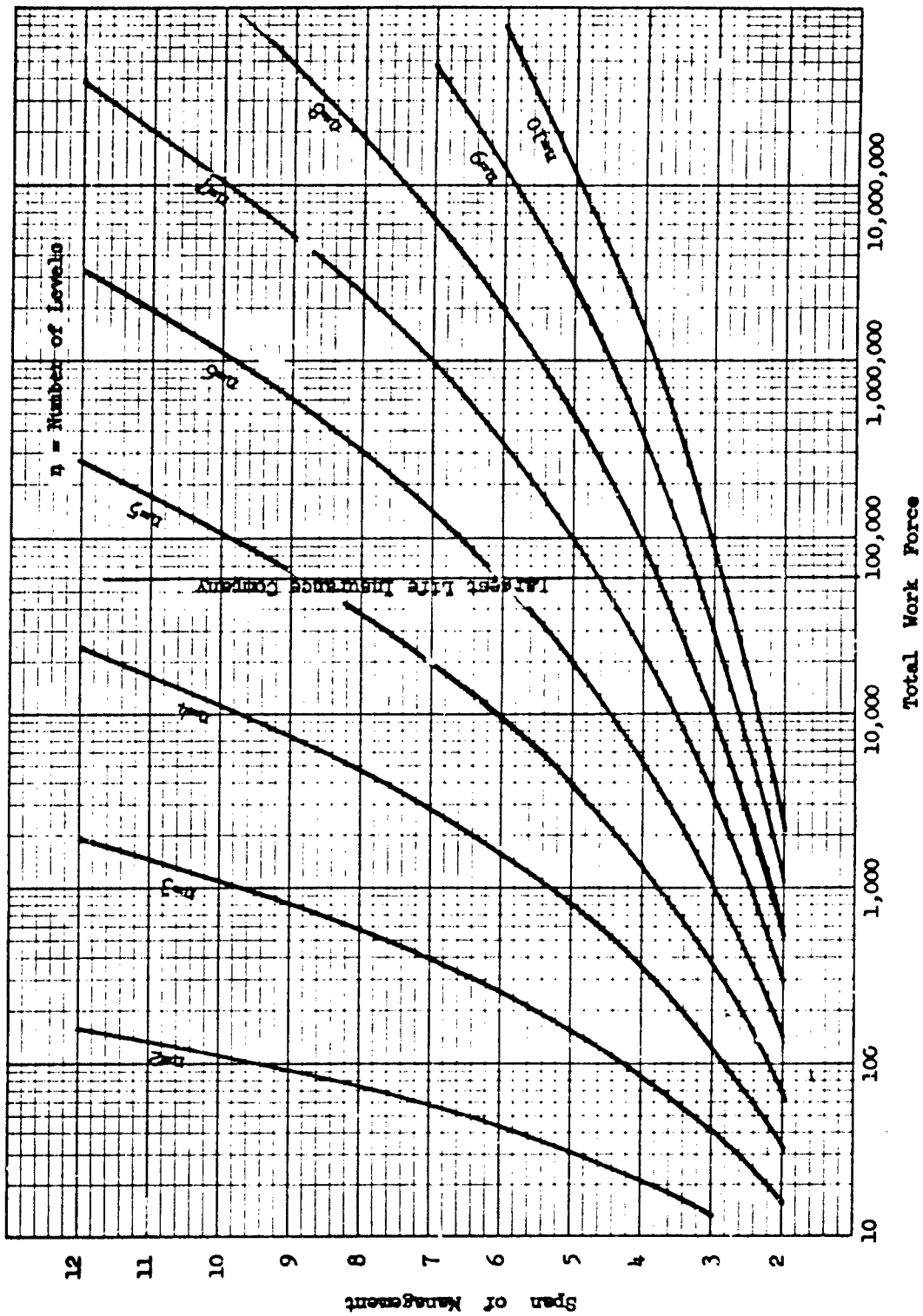

Figure 4. Total Work Force for Various Spans and Levels

a more typical arrangement than constant span at all levels, Fayol illustrated that 251,658,240 workers could be employed by a firm with a depth of only 12 levels--more than the entire population of the United States'

> I quote these figures...to show that the normal form of development of the organization lends itself well to the grouping of any number of employees and that the number of levels of authority in the largest business concerns is quite small.[28]

The importance of the above argument is that, for the sizes of organizations to be encountered in practice, the problem of coordination is not as intractable as has frequently been suggested. If the offsets available to the manager do eventually play themselves out, these diminishing returns must occur very quickly indeed if they are to restrict any actual operating managers. It appears that any increasing costs of coordination could be more appropriately attributed to poor management--that is, the inability or unwillingness to make use of the offsets and principles of management that are available--than to organization size.

There is some empirical evidence to support this conclusion. Suojanen,[29] in an attempt to show that the span of management is no longer a valid principle,[30] cites the data presented in Table I. Representing firms "known to have good management practices," these data were assumed by Suojanen to raise doubts about the validity of the Graicunas hypothesis, since "...the theoretical limits of the executive span of control are in practice more often violated than they are observed."[31] But Table I could just as convincingly show that the offsets to frequency and severity of interaction are indeed operative over the ranges of span discussed.

Preliminary results from this author's research into the effects of organization size on the operating efficiency of life insurance companies also tend to contradict the hypothesis that large size imposes losses in efficiency. Figure 5 portrays the relationship between total administrative cost, measured as nonsales (i.e., clerical and managerial) personnel plus office equipment costs, and size

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[28] Henri Fayol, op. cit., page 55.

[29] Suojanen, op. cit., page 6.

[30] For a point-by-point rebuttal to Suojanen's contention, see: L. Urwick, "The Span of Control--Some Facts About the Fables," Advanced Management, Vol. 21, November 1956, pages 5-15.

[31] Suojanen, op. cit., page 6.

TABLE I. NUMBER OF EXECUTIVES REPORTING TO PRESIDENT IN 100 LARGE COMPANIES (OVER 5,000 EMPLOYEES)

Number of Executives Reporting to President	Number of Companies	Total Theoretical Direct and Cross Relationships
1	6	1
2	-	6
3	1	18
4	3	44
5	7	100
6	9	222
7	11	490
8	8	1,080
	Median	
9	8	2,376
10	6	5,210
11	7	11,374
12	10	24,708
13	8	53,404
14	4	114,872
15	1	245,974
16	5	524,534
17	-	1,114,392
18	1	2,359,612
19	-	4,981,090
20	1	10,486,154
21	1	22,020,532
22	-	46,137,824
23	2	96,469,518
24	1	201,327,166

Sources: Columns (1) and (2) are from Ernest Dale, Planning and Developing the Company Organization Structure, Research Report No. 20, New York: American Management Association, 1952, page 57; Column (3) is from V. A. Graicunas, op. cit. (Relationships beyond 12 subordinates have been computed according to Graicunas' formulas.) All of the companies in the above sample have more than 5,000 employees.

as measured by the total amount of life insurance in force. The total administrative costs are adjusted values, reflecting adjustments to eliminate cost variations attributable to different proportions of term and industrial business written by the companies in the sample. Figure 5 reveals some advantage of medium-sized and larger firms, but no noticeable diseconomies of large scale; and the range of size of the firms in this sample is five orders of magnitude.

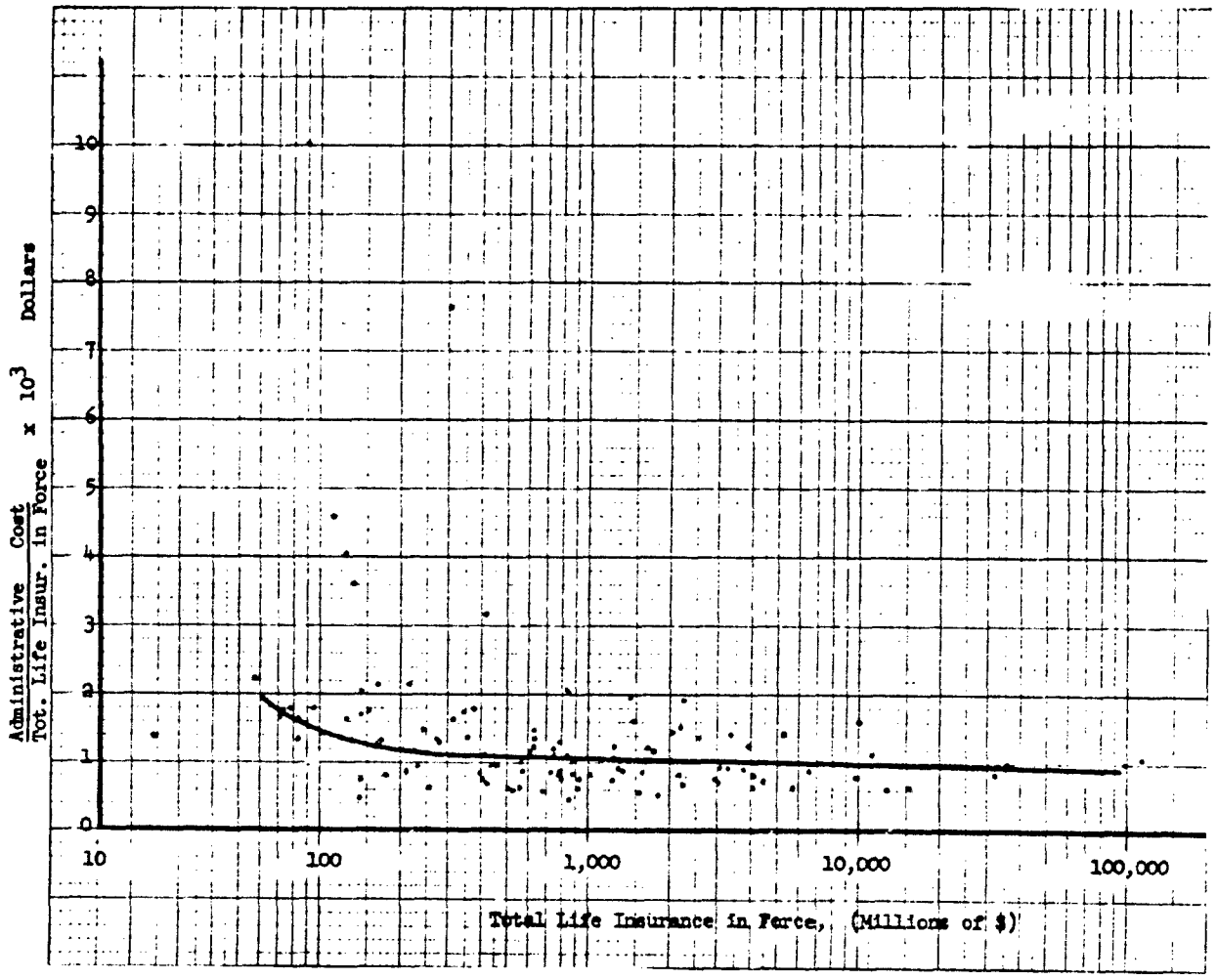

Figure 5. Administrative Cost Rate By Size of Company

CONCLUSIONS

There is conceptual justification for the hypothesis that increasing spans of management and/or number of organizational levels can result in a deterioration of management performance. However, there are factors that a manager can employ that provide offsets to the frequency and severity of interaction required between a manager and his subordinates, and to the restrictions in the flow of information between organizational levels. These offsets, when properly used, will permit a wide variation in the number of subordinates a manager can supervise, and the number of levels an organization can tolerate, without adversely affecting coordination. And since extremely large organizations can be constructed using relatively small spans and number of organizational levels, management theory imposes no *a priori* reasons why diseconomies of large size need *necessarily* occur in the largest organizations to be found in practice.

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This paper attempts to demonstrate that the management of large organizations need not be inherently less efficient than that of smaller organizations. The impact of the management factors tending to increase total unit costs is explored, and a list of eight generally applicable offsetting factors defined.

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