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THEORIES OF BUSINESS ORGANIZATION FOR PLANNING AND CONTROL

by
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ABSTRACT

This paper is a draft for discussion. It categorizes and inter-relates various theories of business organization within the context of a unified meta-theory. Theories of business organization are discussed according to their appropriateness as theories of computational machines, cybernetic systems, organisms, and organizations. The emphasis is on structuring the theories in such a way as to facilitate matching managerial problems with relevant bodies of knowledge. To the extent this structuring is successful, the paper represents itself a theoretical framework which tries to encompass major existing theories and to constructively rephrase theoretical issues.

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I. Introduction

In this paper, we are particularly interested in theories of business organizations which will give useful indications to managers and designers of managerial planning and control systems as to where they should direct their efforts and as to how they should measure their success. Our goal is to elucidate the appropriate features of such theory, and to consider the degree to which certain approaches have been characterized by these features. We discuss in an assumed meta-theory, the business organization as a computational machine, as a cybernetic system, as an organism, and as an organization.

Assumed Meta-Theory

Theories of business organization will be characterized, for the purposes of further discussion, by their relation to the meta-theory described in this section.

We assume that theories of business organizations, in common with the social sciences generally, will usefully be compatible with knowledge in other fields, specifically the physical and information sciences. These sciences are themselves inter-related. In particular, it has been persuasively argued that information measures, such as that of Shannon, can be usefully viewed as corresponding to the negative of the entropy measure of thermodynamics.[1]

> Entropy is usually described as measuring the amount of disorder in a physical system. A more precise statement is that entropy measures the lack of information about the actual structure of the system. This lack of information introduces the possibility of a great variety of microscopically distinct structures, which we are, in practice, unable to distinguish from one another.

The concepts of entropy and information also appear useful in the social sciences. Let us review the foundation of this usefulness.

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[1] See Brillouin [8, p.160].

Certain problems of physics, for example the Maxwell Demon Paradox, are immediately clarified when one generalizes the law of non-decreasing entropy to include a negative information term. Thus, in a closed system including both observer and environment, the difference between the usually measured entropy S and the observer's information about that environment I can never decrease. Gains in I are accompanied by countervailing gains in S. The minimum negative entropy expenditure required, according to this theory, to gain one "bit" of information is on the order of 10^{-16} ergs/C°, an extremely small but nonetheless not infinitesimal quality. One implication of this phenomena is that an observer's knowledge of the environment can never attain perfection because at the limit of gaining more and more accuracy his act of observation adds entropy to the environment. Another corollary is that his knowledge of the environment will continually tend to lose its validity unless supplemented by new observations; that is, without further observation, his initial errors will through time propagate until they are dispersed over the whole range of possibilities.[2]

It seems to this writer that many of the phenomena of interest in business organizations are concerned with the gaining and utilizing of information in a real environment. Thus, it seems relevant to distinguish between theories of business organization which can or cannot explain these phenomena. Let me give an example. There is nothing in the classical micro-economic theory of the firm which can explain, nor does it seek to explain, the necessity for the firm to maintain an internal information system. If we want to understand this phenomenon either descriptively or normatively we must move to some other theory.

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[2]See Brillouin [8] for a very lucid and simple example. Unfortunately, the principle of non-decreasing entropy has often been misunderstood; see Litinetos and Wilcox [39] for further discussion.

For reasons too lengthy to fully explain here, the writer has found it useful to classify theories of business organization in the following four classes, which arise from a consideration of the foregoing:

1. theories appropriate to computational machines;
2. theories appropriate to cybernetic systems;
3. theories appropriate to organisms;
4. theories appropriate to organizations.[3]

These terms are to be defined in the following way.

We will call devices which transform, after a time delay, sequences of changes in the states of input channels to sequences of changes of states of output channels computational machines.[4] When a computational machine is able in a self correcting manner to gain and maintain for an appreciable time states which are not consistent with maximum entropy in a real, but possibly artificially benign environment, we will call it a cybernetic system. When a cybernetic system can maintain itself for an indefinite period in a non-artificial environment, we will call it an organism. These notions seem useful even though what we mean by "indefinite" and "non-artificial" is somewhat imprecise. Finally, when organisms couple together to form a conglomerate cybernetic system but retain an ability to decouple themselves and resume their independence we will call the conglomerates organizations.

Let us consider theories of business organization according to their appropriateness as theories of computation machines, of cybernetic systems, of organisms, or of organizations.[5]

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[3] See Zannetos and Wilcox [39] for a similar treatment.

[4] See Minsky, [22].

[5] This is, of course, an approach roughly similar to that taken by K. Boulding [5].

II. The Business Organization as a Computational Machine

The classic theory of micro-economics (as elucidated in the nineteen forties, say) has been described fairly by Cyert and March.[6] The basic model describes the firm as a calculating machine operating in a world of perfect knowledge. It optimizes the profit obtainable from economic transactions; in these transactions the price is regarded as fixed because perfect competition has insured the firm's inability to alter market prices. Thus, the calculation's inputs are:

1. a perfectly known set of factor and output product prices;
2. a set of perfectly known, deterministic and analytically tractable production functions which describe the output quantities obtainable from any combination of input quantities and vice versa.

The calculation's output is a specification of that set of inputs and outputs which yields the maximum profits. This model is basically static and deterministic but can be extended to some inclusion of effects of time through the use of time discounting (though at the cost of greatly enlarging the problem) and can be extended to certain problems of risk where restrictive assumptions make reasonable the use of the expectation as a certainty equivalent. Though it has merit as a theory of the equilibrium of the firm, it is not very useful as a guide to managers.

When the problem is extended to include those "imperfect" markets where prices are partly under the control of the firm, the dimensions of the problem enlarge at an awkward pace. One must assume the firm's perfect knowledge of the quantities which will be demanded and supplied within the markets for inputs and outputs at each price, and in the dynamic case, over various time horizons. In the case of oligopolistic situations this requires a knowledge of the strategies of competing firms. Unless restrictive assump-

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[6] See Cyert and March [10].

tions as to the nature of these strategies are made, very quickly considerations of gamesmanship intrude, and the basic assumption of perfect knowledge faces a subtle contradiction.

What are the strengths and weaknesses of this model? Its main strengths are:

1. simplicity and comprehensibility;
2. focus on the state of development of the market mechanism, that is, the degree to which the market is competitive, as a key variable in determining profit, efficiency and output;[7]
3. the high state of formal theoretical development associated with it.

Its main weaknesses for the purposes of managers and management information and control system designers, who are not so much concerned with a description of perfection as with a prescription for getting there, are the following:

1. its lack of mechanisms for dynamic solution of problems in an uncertain and changing environment about which the manager has imperfect knowledge; there is no provision for collecting or creating information necessary to ascertain and predict prices and potential production functions. Thus, the whole issue of management information systems for planning and control is evaded;
2. its lack of consideration of the problems of selecting, building, and maintaining the productive resources underlying the actual exercise of the production function; thus it does not give a theory of the growth of the firm, etc.
3. its lack of consideration of the business organization's goals other than profit (this lack may be desirable in an economically oriented normative theory but hinders the descriptive theory's

[7]See T. Marschak [21].

predictive ability);

4. its lack of consideration of the reality-imposed problems, a) of limited cognitive capacity for performing the implied calculations, and b) of business firms having also to cope with the fact that their cognitive capacity is distributed among even more limited subunits with very imperfect inter-communication;
5. and finally, its lack of recognition of the business organization as composed of subunits with objectives distinct from that asserted for the organization as a whole.

These lacks have been discussed piecemeal and at length by various critics, although integrated appraisals are rare. The list of deficiencies follows fairly directly from the meta-theory sketched earlier.

For example, the lack of mechanisms for solving dynamic problems follows from the neglect of the characteristic problems of cybernetic systems, i.e., the necessity of error and thus imperfect information. We know from fundamental considerations that error in the business organization's knowledge of the environment is inherent. The resultant phenomena of error reduction, control and uncertainty shifting cannot be treated by a model assuming perfect knowledge, and thus, using the definitions of the preceding section, by a theory of those computational machines which are not cybernetic systems such as those modeled by the classical microeconomic theory of the firm. The absence of treatment of developing productive resources, of a broader range of goals, and of limited cognitive capacity, fall into the category of failures to deal with the problems or organisms as previously defined. The absence of consideration of problems in communication and in goal conflicts between the organization and its participants is a failure to deal with the peculiar problems of organizations. These will be discussed further in later sections.

In recent years the classical micro-economic theory of the firm has be widely critiqued from within the field of economics, and attempts have

been made to revise it along various lines. Three broad lines of attack have been focused on:

1. the perfect knowledge assumption,
2. the profit-maximizing assumption,
3. the firm as a single entity.

The perfect knowledge and single entity assumptions will be broadened in the following sections. However, the profit-maximizing assumption can be divided into, first, an assumption about feasibility of optimization, which reduces to the assumption of perfect knowledge, and second, about what is optimized, i.e., monetary profit. The latter may be briefly noted now. A number of revisionist theories have challenged the tenets of profit motivation without really dealing with problems in imperfection in knowledge. Typical are efforts by Williamson and by Baumol.[8]

Williamson substitutes for profit maximization a preference function of managerial perquisites. Baumol substitutes sales maximization with a profit constraint. These theories, though they are interesting and by no means irrelevant for some purposes, do not change in any fundamental way the characterization of the business organization as a computational machine which is not a cybernetic system. Thus, they offer no real dynamic theory telling the manager how far on the average the system is away from equilibrium given some specified parameters of disturbances in prices or production functions, and no guidance as to an appropriate information and control system for reporting and correcting these disturbances and the errors they create.

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[8]See Williamson [36], and also Baumol [1].

III. The Business Organization as a Cybernetic System

Once the postulate of perfect knowledge is given up, one must move toward theories of adaptive control processes for insights into the nature of the business organization. Three different approaches which have been proposed are dynamic programming and sequential decision theory, industrial dynamics, and "cybernetic" homeostasis models.

Dynamic Programming and Sequential Decision Theory

Much of the field of "operations research" is concerned with mathematical programming; that is, with linear, non-linear, integer, and dynamic programming. These mostly belong in the previous section on computational machines. In fact, the classic micro-economic model of the firm has already been reformulated as a linear programming model.[9]

However, certain extensions of dynamic programming into the area of "adaptive control processes" are characterizations of the class of computational machines which fit our definition of cybernetic systems.[10] These treat situations where the manager or controller not only does not know ahead of time the precise result which will follow his control actions, he does not even know perfectly the probability distribution of his results. In this case, the crutch of being able to use an expectation as a certainty equivalent will often not be open, and even the decomposability of the two problems of observing the states of nature which govern his results and of controlling based on that knowledge will be in question. This last follows from the fact that the controller gains knowledge about the states of nature partly as a result of his efforts in controlling.

Dynamic programming, along with its more restrictive cousin the cal-

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[9] See Boulding and Spivey [7].

[10] See Richard Bellman [3], and also Stuart E. Dreyfus [12], especially the final chapter of the latter.

culus of variations, offers an avenue of approach into the relatively uncharted field of adaptive control processes characteristic of realistic sequential decision-making. However, at its present state of development it cannot handle systems of more than a few independent variables without requiring excessive computer computation time. Though there have been few applications yet to the theory of business organizations, the continuing advances in this field make eventual widespread application very likely.

Industrial Dynamics

During the nineteen-fifties, following the development of system control theory for the design of servo-mechanisms, a number of engineers and economists attempted to apply it to economic problems. For example, H. Simon followed this course by demonstrating at least some applicability of servo-mechanism theory for the theory of the firm in terms of the production-inventory control loop.[11] Unfortunately, the analytical techniques used at that time were transfer function analysis and the use of Laplace transforms; these were mainly useful for simple linear systems, whereas most of the systemsof interest to the manager and the managerial planning and control system designer are complex and non-linear. These difficulties are partly overcome in the approach known as "industrial dynamics" which has been developed by J. Forrester.[12]

A pioneer in servo-mechanism and computer design, Forrester was impressed by the widespread occurences in management problems of the feedback phenomena explicitly recognized in servo-mechanism control theory. However, industrial dynamics differs from the engineering-based theory in two important respects.

First, the traditional transfer function analysis is largely put aside in favor of techniques more suitable for analysis of complex non-linear sys-

[11] See Herbert Simon [30].

[12] See J. Forrester [15].

tems; these techniques are at present much more qualitative and informal. Second, computer simulation has largely replaced mathematical manipulation as a means of exploring system structure.

Several studies based on the industrial dynamics framework are applicable to the theory of business organizations. Generally, they do not address themselves to the question of the need for a management information system, for example, but rather assume its existence as part of the feedback system in which repetitive management decisions appear to be embedded. Given this assumption, they investigate the effect of various decision policies, and thus typically of various sources and uses of information, on the characteristic dynamic behavior of the system. Good examples are studies by Roberts, Packer, Nord, and Swanson.[13] The study by Swanson is particularly interesting. It demonstrates the interaction of production control and observation of the market in determining production resource inputs appropriate to a changing and uncertain market.

Though embedded in a deterministic philosophical framework, industrial dynamics simulation models can in practice, however, incorporate stochastic variables and potentially could be used to study simple adaptive or learning situations where correct policies must be "learned" through the operation of the system.

The basic weakness of the industrial dynamics approach is that of computer simulations of large models in general. There are a great many different changes one could try in the model to observe what happens. Thus, one needs guiding meta-theories to determine the program of trials on the way to building up an optimum control policy. Such guides are presently very informal and intuitive, and industrial dynamics is largely at present an unitegrated series of special case studies.

On the other hand, in any practical problem one can usually discover

[13]See Nord [34], Packer [25], Swanson [34], and Roberts [28].

improvements over existing policies through industrial dynamics. One can also obtain many insights into basic components of the management of the firm which are unapproachable through the perfect knowledge computational machine models.

"Cybernetic" Homeostasis Models

Two approaches to a theory of business organization based on insights from cybernetics but rather different than those preceding are the models of K. Boulding and of Stafford Beer.

Kenneth Boulding has sketched a partial model of the firm. In this model, certain "normal" relationships between various classes of assets and liabilities appearing on the balance sheet of businesses were associated with rules for business decisions which would tend to correct departures of actual relationships from these norms.[14] This balance sheet homeostasis would tend to preserve the firm as a surviving entity and could thus be tied to the normative viewpoint of long-run survival. Of course, the problem here is to say what the norms and nature of these relationships ought to be, and this he was unable to suggest.

Stafford Beer's cybernetic conception of the firm is similar. Here, however, the firm is pictured as a hierarchy of homeostats whose mechanisms are altered through random trial and error until they perform in accordance with a criterion.[15] Among other problems, his model is subject to the difficulty that pure random trial and error is fundamentally too slow for the manager's purposes in any real-world environment for any but the simplest processes, because the search space is too large, particularly in terms of its dimensionality.

[14] See Boulding [6, pp.26-38].

[15] See Beer [2].

IV. The Business Organization as an Organism

There at present exists no very satisfactory model of biological organisms which can be translated into a theory of business organization useful for managers. Attempts at such translation from the fields of "cybernetics" and "general systems theory" have generally appeared premature. Yet, there are a number of theories about business organizations which deal with what this writer would call characteristic problems of organisms.

In the previous section, we noted models which furnish potent guides to the manager and the planning and control system designer. However, these models do not seem, at least as thus far developed, to deal effectively with three reality-imposed problems of organisms:

1. selecting, constructing, and maintaining the resources underlying the production function and decision-making capability of the firm;
2. providing that the basic survival constraints on the objectives of the business organization are not exceeded;
3. explicitly coping with limited cognitive capacity for performing decision-making.

Selecting, Constructing, and Maintaining Resources

The classic micro-economic theory assumes the production function as a given. It does not really treat the phenomena of growth of the firm in the sense of evolution of the production function, either creatively or imitatively. Though part of the problem is labeled, i.e., "economies and diseconomies of scale", it is not resolved nor usefully structured. Similarly, though in industrial dynamics we have models of control loops, we have no model of their construction and operation.

Within the broad field of economics, however, three writers have provided verbal, partly intuitive models which do shed some light on this char-

acteristic problem of organisms; they are E. Penrose, J. Schumpeter, and G. Richardson.

E. Penrose contributed some very useful insights in her attempt to construct a theory of the growth of the firm.[16] If one assumes an environment in which growth is a result of development of the production function, a very interesting assumption, certain logical consequences follow. First, internal development is an important, perhaps dominant, determinant of expected growth. Second, one can form a theory of growth by categorizing the relationships between various limits on the rate of internal development, such as entrepreneurial vision and motivation, and the various resources necessary for consequent development. Among the latter are finances, managerial time for various tasks of ongoing production, planning, and integrating new resources, resources devoted to research, and so on.

It is the rate at which managers can integrate new personnel into full effectiveness which Penrose saw as the typical governing constraint on the growth rate of very rapidly growing organizations, although in principal any of the constraints could dominate. Since managerial time is scarce, since the managerial team requires experience and time to learn to work together efficiently, and since this working experience itself requires managerial time for planning and operation, "It follows...that if a firm...expands its organization more rapidly than the individuals in the expanding organization can obtain experience...the efficiency of the firm will suffer, even if optimum adjustments are made in the administrative structure." Note how the thinking here is based on reality-imposed notions of an uncertain environment and the notion of a required period of learning adaptation to that environment.

Another key tenet of Penrose is the incentive unused managerial and other productive services provide for development and thus growth of the firm, and

[16] See Penrose [26].

also the direction of that growth. Less well developed is her notion of the nature of risk constraints on growth,

but enough is said to indicate a theoretical basis for such characteristic strategisms as diversification, integration, provision for shortrun flexibility, and legal subsidiaries. Also raised is the point that just as there are economies of scale, there are also economies of development and growth. That is, organizations can gain experience in development and thus gain managerial knowledge about development problems which makes further development easier. Taken collectively, these are a rather remarkable collection of notions, and would represent, if they were to be reduced to a formal theory, a quantum jump over the classic theory of the firm.

J.S. Schumpeter, similarly, dealt with the notion of the development of the production function; this development he referred to as innovation.[17] Most of his thinking is directed toward the results, not the causes, of innovation; for the firm, the result is profit beyond the normal risk premium; for the economy, the result is stimulation of economic growth and the consequent effects on the business cycle.

We can draw from his thesis of innovation-induced profit a major potential function of the business organization's planning and control system: the association of specific sources of innovation with profits. Schumpeter gives us little, however, in the way of a theory of the determinants of innovation itself beyond stating that once an innovation in an area has been perceived related innovations in the same area become at once easier, and that the applications of new inventions in innovations very often require the rise of new firms and new men to undertake them. Another weakness in his work is the lack of easily quantified measures for many of the key concepts.

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[17] See Schumpeter [29].

G. Richardson dealt with a topic which appears to be on the borderline between theories of organisms and theories of organization.[18] Given a situation in which cognitive resources are distributed and divided among sub-units within the organism or organization, how is control of total resources to be subdivided among the capabilities of the sub-units, and how is that subdivision to be changed in an adaptive way? In Richardson's terms, the central problems of micro-economics are two: not only the efficient allocation of resources to different production activities, but also the efficient selection of allocaters (managers) on whose subjective estimates the allocations are based. He indicates aspects of economic functioning which, though they represent imperfections from the point of view of optimum resource allocation under certainty, are highly functional in selecting good subjective estimates. If one assumes a degree of non-communicability of knowledge, this selection reduces to the problem of selecting good managers. Aspects of this problem seem to fall into the theory of organisms because no assumption of independent basic objectives of the sub-units (managers) need be made, but it is a problem which is also highly characteristic of organizations.

Richardson helps us see how organized markets can serve not only as efficient communicators but also as efficient selectors. In a sense, this is Adam Smith's invisible hand revisited. In Richardson's analysis, organized capital markets and reputational variables are demonstrated as useful in channeling control of productive resources to effective decision-makers. Premiums for risk and low-reputation in market yield rates are shown to be highly desirable for selection under partial uncertainty. Finally, the role of the "free-enterprise" competitive market system in efficient selection is shown to depend on appropriately increasing managerial responsibility based on past per-

[18] See Richardson [27].

formance, where the sensitivity of responsibility assignment as a function of immediately prior performance results is adjusted to reflect the stochastic nature of the environment. That is, just as in hypothesis testing, the organization learns about a parameter (the manager's effectiveness) at a rate which is inversely proportional to the sampling error. Consequently, managers operating in areas of high risk should not be judged too strongly on the basis of few observations. Conversely, managers can be effectively selected for promotion more easily when effects of chance are reduced.

A weakness of Richardson's discussion, of course, is a relative lack of consideration of the adaptive nature of the managers themselves. Particular strengths are his interesting insights into risk-adjusting mechanisms, such as reputation, insurance, market intermediaries, relatively stable expectational relationships between managers within the firm, etc.

Resolving the Basic Survival Constraints

A theory of business organizations, if it aims at effective description, needs to take account of the characteristic motivation of the firm in its organism-like aspects toward its own survival. Even if we regard the business organization as initially, on the one hand an artifice of its owner, or, on the other hand, as a mere coalition of multiple participants, it is obvious at least to this writer that many organizations gain with time some attributes charateristic of organisms. That is, they become no longer wholly dependent on their owner(s) or their individual participants for their survival. This is a key empirical observation.

Suppose a firm has many owners, none of whom influence policy strongly, is only loosely controlled by government, and has many participants. Suppose the participants are transient with respect to the firm, and must be socialized into the culture and information networks of the firm as they enter and rise

to power through it. Then the firm will partly determine them and in turn the way they determine it. The knowledge, valid or invalid, which governs the firm is partly residual in the firm's structure and socializing culture. The firm is thus partly self-governing. If this governance promotes survival, the firm will tend to be long-lived and readily observable.

Whether or not business organizations ever as a practical matter incorporate, as organisms, enough intelligence into their policies to provide for wholly effective self-direction toward survival is an open empirical question.

Given some descriptive usefulness of the firm modeled as an organism, one ought to be able to utilize one's notions of organismic functions to enlighten his understanding of certain planning and control problems. This problem is certainly approached by the work of Baumol and others who attempt to derive a micro-economic theory of the firm based on other than a profit objective. However, it has so far been impossible to reduce long-run survival, the most logical substitute, to a measurable, operational objective. Even fairly long lists of measurable surrogate constraints, only one or none of which is maxmimized, have not been satisfying. What is desirable here is a theory which would suggest more appropriate surrogates.[19]

A consideration of necessary organismic functions may lead toward such a theory.[20] Given the real environment's non-decreasing entropy, it is clear that organisms must take in and utilize sources of negative entropy for promotion of their survival. A broad, rough classification of functions is given as follows:

1. current self-maintenance;

2. gathering, processing, and assimilation of nutrients;

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[19] See Simon [33], and also Zannetos [37].

[20] One would expect to find some future development from the proponents of "general systems theory" on this. See Bertalanffy [4].

3. gaining external security with respect to other organisms;

4. adaptation and self-improvement.

The first two of these follow immediately from the postulated reality environment. The third follows from the existence of competitive and predator organisms, and the fourth from the reality environment and the existence of competitors and predators. Purely cooperative functions between organisms and are beyond the scope of analysis here; generally they appear to arise between organisms which are themselves components of a more global system.

Mapping in detail these or similar categories into the functional areas of the firm is a large but potentially productive effort which might yield useful insights, particularly into extensions of current accounting practice. For example, accounting now is almost entirely focused on "objectively" measurable monetary profit and thus on obtaining a kind of payment for nutrients. Other functions of the organismic firm are slighted. Their consideration might point up the need for improved measures for assessing:

1. maintaining of current resource usefulness potential;[21]

2. translation of money payment into assimilated resources, for example the recruitment and training of managerial services;

3. external security efforts, for example efforts to outperform competitors;

4. finally, efforts to innovate.

Coping with Limited Cognitive Capacity

As H. Simon has often remarked, real-world problem solvers have to make do with limited cognitive capacity and typically, therefore, cannot afford to optimize, but must satisfice.[22] This also implies that real-world

[21] See, however, Brummet, Flamholtz, and Pyle [9].

[22] See Simon [32].

decision-makers must typically use heuristics which are "usually" helpful rather than exhaustive algorithms which are guaranteed to work. Many interesting phenomena follow from the necessity for small brains to tackle large problems in an uncertain environment. Progress in artificial intelligence programming has given us important understanding in this area. A key notion is that of a tree-like hierarchical sub-division of problems.[23] If a problem is too big, divide it hierarchically and attack the smaller ones separately. Other important notions are the retention of guides to solution for a class of problems and subproblems so that they do not have to be solved de novo each time, together with methods of "recognizing" problem classes. The derived notions of hierarchy, sub-stability, standard procedure, and recognition procedures appears to be of great potential advantage in analyzing the business organization's divisional structure, policies, and planning and control facilities.

Direct applications from the fields of artificial intelligence and its close relative, cognitive psychology, to improved design of management information for planning and control systems are not yet a reality. However, one may predict a growing influence from this quarter on planning and control in business organizations.

For example, a theory of organizational divisionalization, indirectly inspired by progress in this area, has grown out of consideration of the effect of cognitive limitations. Following Simon's Adminsitrative Behavior, Zannetos and others have succeeded in laying bare some principal determinants of the degree of organizational centralization versus decentralization and have begun to propose operational measures for important variables.[24]

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[23] See Newell and Simon [23], Feigenbaum and Feldman [14].

[24] See Simon [31], Zannetos [38], Emery [13], Lawrence and Lorsch [17], and Galbraith [16].

The strength of this approach is that it explicitly takes into account the role of uncertainty and limited cognitive capacity in determining divisionalization, degree of standardization, types and rates of information flow, and so on.

Now, of course in real business organizations, we have to solve large complex problems in an uncertain environment where not only is our knowledge limited, but it is distributed extremely broadly over the organization. Whereas in general we may be able sequentially to concentrate most of our cognitive resources on individual sub-problems, in business organizations we are forced to use people in a more distributed way. We cannot concentrate large fractions of our total cognitive power on small sub-problems. Therefore the quantitative importance of communication and coordination problems dealt with in business organizations is greater than in most artificial intelligence computer programs. However, the differences are in some sense quantitative, not qualitative.

V. The Business Organization as an Organization

We have remaining those theories which attempt to explicitly take into account the fact that organizational components are organisms in their own right. Typically, these individual organisms (individuals) have their own separate histories, outside life, and future plans. Theories which deal with this area include what may loosely be called the behavioral sciences, including "organization theory", anthropology, social psychology, sociology, political science, and parts of economics.

When we try to predict actual organizational behavior in detail in some concrete situation we are almost invariable driven to this level of theory. Often, in fact, we must aggregate such details extensively before "organizational noise" is reduced sufficiently so that the variables treated in earlier sections stand out for inspection.

As an introduction to organizations, let use review some key problems which would face the manager if he were to attempt to utilize other individuals in an organization with only the knowledge of the mechanisms of the previous sections. Since he might know a good deal about higher mathematics, feedback system characteristics, problems of divisionalization and coordination in problem solving under uncertainty, and so on, he might at first be confident. However, he would find that he couldn't communicate effectively what he wanted to achieve. If this basic limitation were solved, the other individuals would not necessarily accept the value of his objective. Even if by chance they did accept it, they might not accept his ideas as to the appropriate means to reach the objective, so that he could not coordinate. Even if he learned how to partly overcome all these problems. further obstacles would arise. In particular, the other individuals would form sub-organizations among themselves with ideas and values differing from his and they would withhold information, or worse, distort it.

Thus, real world managers, and real world information systems, must

take into account a wider range of organizational problem phenomena than dealt with in the preceding sections if they are to accomplish significant results working through people.

A theory of business organization which attempts to take at least some of these variables into explicit account is that by Cyert and March. In addition, there is a very large literature in social psychology and organizational theory, selections of which we will briefly mention. Finally, certain observations from political science, sociology, and economics will be noted.

Cyert and March

In A Behavioral Theory of the Firm, Cyert and March postulated a workable organization which can operate with partial effectiveness toward the unitary objectives characteristic of an organism.[25]

The underlying conflict between organizational participants is handled by a series of assumptions.

First, organizational participants may be represented as a coalition to which each makes contributions and from which each receives inducements.[26] It is assumed that participation is complementary so that for each participant the inducements exceed the contributions. Further, from the point of view of the coalition as a whole, total returns from contributions exceed costs from inducements; this is organizational slack. This slack represents a space in which to search for solutions to organizational problems. If all solutions which exceed the participant's minimum aspiration levels of inducement greater than contribution are acceptable, and if solution search stops with the first acceptable solution, then the potential conflict of interest

[25] See Cyert and March [10].

[26] See Von Neumann and Morgenstern [35].

between the participants need not arise. If only those constraints which are temporarily violated or "near" to being violated are used to generate alternative solutions (selective focus) and if aspiration levels are not allowed to rise so far above minimum aspiration levels as to unduly restrict the search space, the organization will be viable and conflict resolution practical.

Now, suppose that the participant's constraints are to be mapped into a set of organizational goals (constraints) through bargaining, coalition formation and rational logic based on some knowledge of the organization's resources and enviornment. An important result is that typically the weakest constraints will always be in the set of derived goals. That is, organizational objectives will frequently be ambiguously or non-operationally stated, because they will be components of the most likely coalitions. This has very interesting consequences for the manager or planning and control systems designer. Questioning organizational means-ends relationships, which was always functional in the previous section, may sometimes be dysfunctional here because it may undermine the solidarity of the coalition by directing the attention of the participants toward areas of conflict. Another interesting result is that the firm will tend to respond to its problems sequentially, because if all problems were considered at the same time too much inter-participant conflict would arise.

The "behavioral theory of the firm", so called, thus provides a richer descriptive theory of business organizations than those previously offered.

Many bits and pieces from other fields could be included here in a purely descriptive sense regarding the determinants of the five fundamental "organizational" problems noted at the beginning of this section:

1. communication difficulty,

2. disunity of objectives,

3. disunity of means,

4. rivalry of sub-organizations with the parent organization,

5. secrecy and distortion.

Why, however, do we consider these to be problems? It is, of course, because we are implicitly taking a normative stance. We need to make the norms explicit, because there are basically two partly conflicting normative stances we could take.

The first, and the one we have been taking implictly, is to regard the organization within a single set of reconcilable objectives, either that of the organization as itself an organism, or that of an organism, perhaps an owner or ruler, for whom the organization is a tool to achieve its objectives. An alternative normative stance is to regard the organization from the point of view of its multiple participants, rather than on any unified set of objectives. Considerable difficulties arise from the confusion of these two different normative stances, so that it is well worthwhile to try to keep them distinct.

The most interesting normative case for our purposes is to take the point of view of a manager who attempts to make an organization behave as much like an organism with him as controller as practicable. Typically, he must operate in a real social world in which certain actions aimed at gaining this organizational unity will be more or less forbidden, either through choice or necessity. These forbidden activities are typically those which impinge too strongly against the second normative stance based on the separate and multiple welfares of the organizational participants. Participant welfare, however that may be defined, will thus be taken as a constraint.

Making the Organization Behave as an Efficient Organism

No unified theory useful in making organizations act like organisms

presently exists. However, there are many helpful findings and sub-theories regarding strategies for improving inter-personal communication, establishing leadership authority, and especially "legitimate" authority, effecting compensation, aiding work motivation and morale, harnessing groups, and establishing "openness" and safeguards on communication. These are too extensive to review here but are easily available in compendiums of work in social psychology and organization theory.[27]

Some, but not enough, practical advice regarding consequent modifications of budgeting and responsibility accounting procedures is contained in management accounting texts.

Considerable knowledge regarding effective participant socialization and socializing ideology has been garnered by political scientists. A broad introductory summary of political science issues and findings is presented by Dahl.[28] A classic and perceptive analysis of the sources and uses of ideology is that by Mannheim.[29]

The Constraint of Participant Welfare

There are several criteria to consider.

One, the "efficiency" aspect, takes the achievement of a Pareto optimum among the participants as its criterion. This latter is any situation a movement away from which can make no participant better off without making another worse off. Results from economics, particularly those which show perfect competition among participants leads to a set of Pareto optima, are relevant here. These seem to imply that the existence of competitive markets of various sorts within the organization can promote participant welfare. Of course this

[27] See March [20] and Lindzey [18].
[28] See Dahl [11].
[29] See Mannheim [19].

does not mean that competitive markets are the only route to Pareto optima, but they possess many advantages in terms of the low sub-unit cognitive capacity and knowledge required for the system to iteratively work out a solution.[30]

The field of political science deals with two further criteria; it has a good deal to offer regarding mechanisms, first, for reaching relatively "equable" distributions and, second, for reaching relatively stable distributions of participant welfare smoothly. These are those where distributions of welfare among participants are not "too" unequal, and where the system structure maintains a high tolerance for shifts in environmental conditions and relative power of participants. A classic contribution here is Madison's eighteenth century work in The Federalist Papers, which has recently begun to be formalized and made more rigorous.[31] This work shows the desirability under certain conditions of democratic participation in major organizational decisions, and of safeguards to protect minorities and system integrity.

Finally, in addition to Pareto efficiency, equity, and stability, there are vague criteria of "humanity" which operate also with respect to the absolute level of particular participants' welfare. Thus, in many societies certain organizational activities which are physically or mentally coercive are strictly forbidden, or are restricted to the social entity of ultimate sovereignty.

One of the chief mechanisms at work in our society which forces these constraints on business organizations is the employee's freedom of choice in leaving the organization to go elsewhere. A second is the possibility of revolt or outside intervention. Thus, even the manager who identifies solely with the welfare of his firm is constrained by aspects of social morality from necessity, if not by choice. In addition, managers may also be partly governed

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[30] See T. Marschak [21].

[31] See Dahl [11].

by purely personal constraints, but as indicated before, such "cooperative" functions, though relevant, are beyond the scope of this paper.[32]

[32] Again, see Zannetos [37].

VI. Summary and Conclusion

At the start, an informal meta-theory was described in which four categories of theory applicable to business organizations appeared. These were:

1. computational machines,
2. cybernetic systems,
3. organisms,
4. organizations.

A variety of conceptual frameworks useful to the manager and to the planning and control systems designer were reviewed within these categories; they ranged from classical micro-economics to managerial ethics.

The foregoing structuring of the material can help support managerial problem recognition. For example, consider the following diagnostic questions. First, is the problem one of better processing a given, fixed set of data to obtain an answer? Second, is it one of appropriately adapting to a varying, uncertain environment? Third, is it, rather, a problem of properly dividing a large problem among decision-makers of limited capacity in this uncertain environment? Finally, is it a problem in getting effective cooperation among people of differing backgrounds and objectives, subject to certain ethical constraints? The answers suggest appropriate bodies of knowledge for helping solve the problem.

Typically, the manager must solve all these types of problems, but he may not have to solve them all at once. Similarly, for example, the designer of a management information for planning and control system will sometimes be able to take existing solutions to "organizational" problems as a given constraint within which he can construct improvements in the capabilities of the organization as a cybernetic system or as an organism. Obviously, this constraint of not over-disturbing the balance of organizational inducements and contributions or the organizational ideology is usually imposed on him by

top management.

What makes feasible in business organizations the partial decomposition of organism or cybernetic system problems from "organizational" problems? This is a fundamental theoretical question as yet undetermined. However, one might conjecture that organizational situations in which participants behave together in an organism-like way would be helpful. From our previous discussion, we may argue that the organismic approximation is particularly useful in two kinds of related cases:

1. cultural and ideological similarities among organizational participants (consensus as to global values);
2. a mechanism for translating individual values into a common denominator (money, free market, and intra-coalition payoffs).

Both of these are influences toward the willingness of the individual to act in accord with a common set of preferences; both of these may be effective in successful business organizations. Where they break down, we may expect the designer of the planning and control system to meet difficulties unless he is able to first solve "organizational" problems.

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