1979-04-23

Automation or autonomy in organizational design.

Makridakis, Spyros

Gordon and Breach Science Publishers

Int. J. General Systems, 1979, Vol. 5, pp. 213–220
0308-1079/79/0504-0213 $04.50/0

AUTOMATION OR AUTONOMY IN ORGANIZATIONAL DESIGN

CLAUDE FAUCHEUX

Foundation for Business Administration, Delf, Holland

and

SPYROS MAKRIDAKIS

INSEAD, 77305 Fontainebleau, France.

(Received October 17, 1978; in final form April 23, 1979)

"... For the first time in History, man is obliged to choosefreely his future and thefuture of mankind and he is obliged to do so by the very fact that he has, for the first time, thefreedom hence the responsibility of doing so".

Denis de ROUGEMONT

Today there is growing criticism of the Input/Output (I/O) model as a conceptual tool for explaining and understanding how systems are functioning. These models have been particularly useful-mainly in engineering, where simple, static and open systems are involved-but they are, however, unable to explain the functioning of living and social systems. This paper will present evidence, from various fields, illustrating the relevance of autopoiesis. Furthermore, it will relate the concepts of autonomy and identity to the way in which various social systems function within the environment.

INDEX TERMS: Input/output systems, autonomy, identity, autopoiesis, morphogenesis.

INTRODUCTION

Many physical phenomena can be explained by precise relationships, often called physical laws, which express cause-and-effect relations between, or among, a number of factors. Boyle's law, for. instance, states the relationship between volume, v, and temperature, p. The exact mathematical law is:

$$p=\theta\frac{N}{v} \qquad (1)$$

where N is the number of modecules and θ is a proportionality constant.

The causality postulated by (1) is obvious: if the volume, v, changes—all other things being held constant—pressure also changes, but inversely. Furthermore, it is not difficult to measure the extent of this influence precisely, by using (1) above in a way that could be useful for a variety of applications.

Engineers have carried the idea of causal models a step further by introducing the notion of control as a guiding principle of the system's behaviour. They can, therefore, build systems which could achieve, or maintain, a specific task, i.e. output, by manipulating the input(s) appropriately. This input/output (I/O) control system, made explicit by cybernetics,[1] has gained widespread popularity and has greatly contributed to the automation of a large variety of tasks.

The I/O control model of designing and building systems has also influenced the thinking of many outside the field of engineering. Econometricians, for example, have attempted to discover a causal relationship between the level of economic activity and the numerous factors that determine it;[2,3] organizational theorists have tried to explain various concepts through formal cause-and-effect models;[4,5] management scientists have built a great number of mathematical models relating inputs to outputs.[6,7] However, the most extreme form of the I/O idea is found in

behaviouristic psychology[8,9] which advocates a simple stimulus-response ("S-R", i.e. I/O) model to explain human behaviour. Although most formal developments in I/O systems theory deal with ways of better representation of the internal states of the systems," this aspect has not been disseminated outside of the systems engineering field. From the point of view at least popular amongst social scientists, I/O systems attach little importance to, and requires virtually no insight into, the system or process it is applied to; the system is basically viewed as a "black box". The question that must be asked, however, is whether or not such a simplistic model can adequately explain high level systems[11]—such as social or living ones—by itself. It is believed that it is not appropriate for anything more complex than mechanistic, engineering-type operations, with a few variables and constant or preductable inputs. (See Exhibit 1). The main point of this paper is not to convince the reader of the importance of what have been called autopoietic organizations, as to this end many eloquent literature sources exist.[12,13,14,15] Rather, the paper attempts to enlarge the applications of the concept of autopoiesis to areas other than biology. This will be done by discussing several illustrations and providing many examples of applications of the concept in a variety of fields of social sciences—and in particular, that of management. Secondly, it shows that a number of theorists can be cited,[18-21,26,27] who have been convincingly providing autopoietic arguments, even though they were not actually calling them by such a name.

A BASIC ANTINOMY: HIERARCHICALLY CONTROLLED VERSUS AUTONOMOUS SYSTEMS

Disenchantment with I/O thinking is not completely new or limited to single disciplines. Several theorists in the field of social sciences can be cited,[18,19] who have convincingly argued against the I/O approach and who have proposed alternative approaches with far-reaching explanatory powers.[20,21] As Zeleny[22] has pointed out, autopoiesis has been emerging as a new paradigm of thought for more than a century. However, most of the impetus has come from Maturana and Varela.[23,24] Their thinking and research has developed mainly from biology; their striking example of why an I/O model is inadequate to explain reality is taken from the effects of immunization.[25]

Certain living systems somehow have the ability to recognize a foreign substance. This has been shown by some biologists by the capacity of the organism to generate, when necessary, a specific antibody to counteract each specific invader. This presupposes both the capacity to identify each foreign substance and a large reserve of antibodies to select from. This is indeed a typical I/O mode of operation, whereby the organism, through experience and learning, gradually builds up a reserve of responses to deal with incoming stimuli adequately. However, this kind of model becomes extremely complicated, if not unable, to explain how new synthetic substances, which did not exist before, and therefore could not have been encountered and experi-

EXHIBIT 1

Range and/or type of Inputs	Number of Inputs: A FEW	LARGE	INFINITE
CONSTANT	I/O system is adequate	I/O system is possible	I/O system impossible
CHANGING BUT PREDICTABLE	I/O system can work with external modifications	I/O system extremely difficult or impossible	I/O system impossible
CHANGING BUT UNPREDICTABLE	I/O system cannot work without constant outside supervision	I/O system impossible	I/O system impossible

enced in the past, are nonetheless recognized and neutralized. Varela proposes an elegant solution by shifting the emphasis from . the process of reaction to every foreign substance (input) by neutralization (output), to the process of recognition that a certain material is indeed a foreign substance and not part of oneself. Equally important is the existence of a process, ability or function, which can generate an infinite number of antibodies and which is flexible enough to deal with any and all possibilities. This is very different from an I/O model, or a trial-and-error mode of operation.

Another similar example can be found in Festinger's work[26] on consciousness. Using several elegant experiments, he argued for an alternative theory to the prevailing I/O model of vision. A brief description of an experiment he carried out will further illustrate the inadequacy of the I/O approach. A subject is given two prismatic contact lenses to wear on his eyes, and the experimenter gives him a straight line to look at. His vision at first tells him that this is a curved line. This is indeed a true impression, consistent with the curvature on his retinal image. However, as he keeps looking at the line, moving his eyes from one end to the other, he sees less and less curvature and after some minutes he in fact sees a straight line. Festinger explains that while the subject is attempting to direct his eyes so as to continuously focus on the line, the muscles of his eyes move in accordance with the fact that the line is straight in spite of his subjective experience of curvature, determined by the prismatic lens. Thus, as the eye muscles are instructed to move for a straight line, the conscious perception shapes up according to this fact and after a while the line is seen straight. Therefore, the conscious perception of the line is not the organization of informational inputs from the eyes, but the organization of efferent signals to those eyes; what the subjects see is what they actually do with their eyes.

Another convincing case of the inadequacy of I/O theories can be found in the explanation of linguistic performance. In a well-known article, Noam Chomsky wrote a definite rebuttal to the claim advanced by behaviourists to account for "verbal behaviour" by "S-R" (Stimulus-Response) type models :

> It appears that we recognize a new item as a sentence not because it matches some familiar item in any simple way but because it is generated by the grammar that each individual has somehow and in some form internalized, and we understand a new sentence, in part, because we are somehow capable of determining the process by which this sentence is derived in this grammar."

A paradigmatic shift in linguistics has resulted from Chomsky's theory, precisely by moving away from an externally caused model of behaviour towards a theory of the internal competence of the speaker. In other words, a speaker possesses a certain creative capacity which enables him to reproduce or understand new sentences which he had never uttered or heard before. This is something which cannot be accounted for by a mechanistic, behaviouristic I/O type model.

All these examples suggest that living organisms are able to develop an "internal milieu", and can therefore maintain relative stability inside the system boundaries, in spite of external turbulence. This distinctive feature of the living systems, as Canguilhem has shown, is a capacity for generating internal norms :

> ... life being not only submission to the environment but institution of its own milieu, sets thereby values not in the environment, but in the organism itself.[28]

Another illustration of the importance of autonomy is given indirectly by Wilden in a stimulating book, where he discusses the contributions of authors such as Bateson, Chomsky, Spencer- Brown, Lacan, but not Varela, in their attempt to go beyond the limitations of I/O models towards a systems approach :

> ... it is almost universally accepted that the behaviour of any system, open or closed, informational or energetic, organic or inorganic, is a function of the way the observer-participator punctuates it.[29]

But Wilden still stresses the hierarchical nature of organizations (in the form of the Russel-Whitehead Theory of Types) and their quality as open systems, while Maturana and Varela point out the necessity of looking at living and social systems as organizationally closed systems,[30] thus stressing the need for self-referential description.

> ... wholes, or whole systems, are arranged like Chinese boxes. One whole contains another whole and every whole is contained in another whole. There is a recursion principle there. But that does not mean that you cannot stop at some point and consider a system. And I have come to the conviction that the key to understanding the wholism of such system, the wholeness of systems, is to understand that they are organized, their parts are organized, in a circular form. That is, every part interacts with every other part. That gives us a total self-referential system.[31]

Maturana and Varela's essential point is not only that autonomy is an important concept but also that self-reference is a necessary process for understanding the essential emerging properties of living systems, and consequently it is necessary to look at such living systems as closed systems. Autopoiesis is a characteristic and consequence of autonomy and self-reference. It is a process of creating oneself. Varela's views are valid for all living systems but take particular significance for social systems where the symbolic processes are so central and where communication is not only the transmission of information but also the elaboration of meaningful social codes through dialoguing autonomous entities.

In the rest of the section, several other examples will be taken from four levels of organizational complexity which illustrate further the concept of autonomy and the antinomy between autopoietic and I/O type systems.

Workers: Robots or Agents?

"Scientific management", a school of thought founded by the engineer F. Taylor,[32] advocated the introduction of an engineering oriented approach to the management of operations at shop-floor level. Through time-and-motion studies, and the separation of conception from execution of work, various tasks were designed in such a way as to maximize efficiency and productivity. A worker was not expected to think, but simply to execute movements as instructed. The result was the mechanization of different tasks, and the downgrading of the human worker to the level of an automaton. This dehumanization of work led to some unrest in the work force, as boredom became increasingly unbearable. Various remedies, such as "job enrichment" and "job enlargement" of the tasks performed were introduced with mixed results, but without basically changing the logics of the approach. As an alternative to Taylorism, the socio-technical school of thought advocated autonomous work groups as the basis of work organization.

Originally, the socio-technical school was initiated in England through the joint efforts of a coal miners' union and the Tavistock Institute of Human Relations, and this trend, known as "industrial democracy', spread largely to the Scandinavian countries.[33,34] The basic philosophy of this new approach is to use the distinctive resources of human agents as fully as possible: namely their willingness for initiative and their capacity for membership and self-regulation. Groups of workers are given the responsibility of organizing themselves as they like, in order to accomplish a certain task. Not only do they organize themselves, but as a result, they also tend to request more and more responsibility; for instance, direct contact with customers to follow up their defective products, re-organization of working procedures and methods, processing of technical or commercial information, setting of goals and objectives, etc. By so doing, these autonomous groups tend to gradually take over some of the responsibilities formerly restricted to various functional staff services.

Control: Check or Self-Regulation?

As an organization grows, various organizational changes become necessary; for instance, moving from a functional to a divisional type of structure. This entails decentralization and delegation of responsibilities, with the corresponding authority, to lower levels of executives who can manage their units with a larger degree of autonomy. Correspondingly, it was felt necessary to introduce what has been known as "management control systems"[35] which could provide proper information as to the actual achievements of various departments as compared with their objectives, the purpose of which is to be able to detect deviations early enough so as to take corrective actions rapidly when necessary.

The philosophy of "management control systems" was developed with the necessity of entrusting lower echelons within the organization with larger degrees of autonomy. This developed rather well within Anglo-Saxon countries, but proved to be somewhat more difficult to implement within Latin countries, as many multinational companies have experienced. Students[36, 37, 38] of control systems in Latin countries suspect the main reason to be the reluctance among Latin managers to trust their subordinates enough to really delegate responsibilities and authority to them. The result of this attitude is that the "management control system", applied in Anglo-Saxon cultures where it is tacitly understood, accepted and encouraged that everyone strives for more autonomy, finds itself in jeopardy in Latin countries.[39] In the latter, not only does this tacit assumption not hold, but worse, the reverse seems to be the case, namely

that there is enough mistrust among managers and subordinates.

The same type of antinomy that exists on the shop-floor is found here too. Among Latin cultures, control is understood as a checking device that a superior maintains over his subordinates, which is the engineering sense of the idea of control. On the other hand, among Anglo-Saxons, control is understood as a regulating mechanism enabling both superiors and subordinates to increase their responsibility and be given more autonomy.

Corporate Strategy: Conglomerate or Synergetic?

Conglomerates are made up of a number of business firms, which are not necessarily related, under a single top management. They flourished in the 1960s when the idea was to grow through the acquisition of any business opportunity likely to generate positive cash flow if properly managed. Synergetic corporations, on the other hand, can be as large and complex as conglomerates, except that growth is not attempted unless what is to be added will contribute to the distinctive competence of the existing organization. In this respect, growth is the result of either vertical or horizontal integration in carefully selected directions. These two kinds of organization (conglomerate and synergetic) have opposite senses of corporate identity. Conglomerates are only interested in growth for the sake of size and because it is believed that enough positive cash flows can be generated to make the entire organization more profitable. Their sense of corporate identity is low, if it were to exist at all, and it would be of a rather kaleidoscopic nature. Their only objective, which is imposed from above, is high short-term profitability. Synergetic organizations, on the other hand, possess a strong corporate identity and profitability, even though important, is not an end in itself, but a means to implement the corporate strategy. A careful study of these two extreme corporate philosophies reveals a great deal about the concepts of autonomy and identity, to be examined' more fully in the next section. It should be noted, however, that very few conglomerate corporations have been consistently successful even though they were extremely popular in the 1960s thereby demonstrating a lower capacity to adapt to changing environmental consitions.

Centralized Nation-State versus Autonomous Regions.

In the same way that corporate strategy has to include the participation of members of the organization as far down as possible, in order to be correctly formulated and successfully implemented, so the establishment of national policy has to be the combined effort of regional contributions. Denis de Rougemont argues very convincingly that a challenge for modern industrialized nation-states is their capacity for allowing regional participation in public management. Rougemont pleads for the development of an important kind of power:

> the power one takes over himself because it means freedom but also responsibility.[40]

and stresses the necessity "of the accession to power over self not power over others". One cannot think of more convincing plea for autonomy than in the political domain, which should go beyond national affairs to the international sphere.

Hierarchical Coordination and Identity

The illustrations considered in the last section show the existence of a wide range of organizational structures and processes, and a variety of concepts of how the universe can be explained and dealt with. Each organization has strengths and weaknesses. It must be viewed in relation to the task it has to achieve and the environment within which it exists. In autonomous subsystems the various units/members are more motivated. They are "masters" of their own fate by being allowed to communicate with their environment. Goal determination is done by consensus rather than being imposed from above. Various constraints are explicitly acknowledged when setting goals and during action. Coordination among the autonomous subsystems can be more difficult, and effective communication takes much longer, since there are many more links in decentralized structures. But at the same time, each unit is part of the overall decision-making process of the system. Changes in the environment can, therefore, be known much more easily with autonomous groups; furthermore, they can be dealt with faster than when changes are imposed from above. Learning, self-organization and adaptation can be achieved more easily because they are mainly left to the operating level to initiate and

implement rather than being decided on at the highest level and then being pushed downwards. In final analysis, social systems are better managed by consensus rather than coercion and this is precisely where the benefits from autonomous systems are derived.

I/O type systems have limited links with the environment, which must be regulated centrally, otherwise the system can become unstable. This presupposes, however, two things: first that the environment can be simplified enough so that all its interactions with the system can be modeled into a limited number of variables (usually few); second, that the environment will remain constant in such a way that the variables identified as the most critical will still remain the same; moreover, their range must not go beyond limits which can be regulated.[41] In the case of important permanent changes in the environment, the only alternative is to have these changes identified from above and at the same time possess an efficient procedure for re-organizing those functions of the system that need to be modified. In other words, an I/O system cannot learn, self-organize itself or adapt to environmental changes. Its major characteristic is simplicity, ease of communication, efficiency in operating and effective reaction to a specified number of outside responses, as long as they remain constant and within a certain range. Thus, the very strengths of an I/O system exclude learning, flexibility, complexity, larger number of possible responses and the ability to scan the environment generally. Furthermore, it cannot self-organize itself or adapt. These are tasks that can only be achieved by systems which possess, as "mind" does, the above-mentioned characteristics.

Autonomy and Identity

If there are advantages in autonomous subsystems, then why shouldn't the idea be carried to its extreme---complete independence of each subsystem from the rest? Autonomy, however, does not mean separation, and paradoxically there is less change of separation taking place in decentralized than in centralized type systems. Centralized operations are tightly controlled. People working 'in such organizations are given little initiative and they must carry out orders from above as closely as possible. In the extreme case of centralized structures, as in Taylorism, humans are viewed as machine processors in a chain of input/output operations. They stay together as a system because of strong supervision, coupled with adequate rewards and punishments. The sense of organizational identity is low and limited to a few top levels in the organizational pyramid. Thus, if the chance of separation arises, it will be taken up happily. Lack of organizational identity can also be seen in Latin countries where employees and workers are tightly supervised. In such countries, identity comes from loyalty to subsystems, for instance a union, usually in constant conflict with management and among themselves because of the lack of common objectives.

In autonomous groups, even though there is little or no control, there is a higher sense of organizational identity, a result of the very nature of autonomy. Each worker or employee is part of deciding on the overall organizational goal and the specific objectives that must be achieved. This means that he or she understands the need and advantages of being part of a larger organization and is aware of the goals and objectives. Conflicts are solved by dialogue, rather than bargaining, between subsystems which share some supra-ordinate goals.

Strong national identity can 'similarly be the result of greater regional autonomy. This is even more true when heterogeneous populations make up a nation. History is full of instances where tight controls or oppression have not worked as a measure to achieve national unity. On the contrary, it has provided the driving force for regional struggle, or revolution, and eventual independence. On the other hand, growing regional autonomy can strengthen national unity and result in countries of people with a high sense of national identity. The same way that oppression does not result in national unity, separation of a region from a nation creates as many difficulties and problems for the newly independent region as it solves. History is again full of examples of this kind, in which separated regions were worse off on their own than when they belonged to a bigger nation.

Conclusions

Input/output type systems have only a very restricted range of applicability where organizational social systems are concerned. Even when standard tasks are considered and when the environment is constant I/O modes of operation

are inappropriate as long as people are involved. Theoretically speaking, an I/O mode of operation should be more efficient and productive, but to be effective, it requires tight controls which were difficult to apply historically, and which are even more difficult in our times of high social awareness. The results of humans being obliged to behave like machines is that they get bored, the quality of what they do diminishes, and they change jobs often. Furthermore, they create strong unions which obtain enough benefits as to diminish the advantages of the I/O approach such as those originally perceived and implemented by Taylor. It is not an accident that today there is no advocate of "scientific management" nor that the psychological and social problems of managing people are in the foreground. Participative management[42] and what has been known as industrial democracy[43] are clear illustrations of the direction that management and work organization is evolving in.

When intricate interactions within a complex social environment are involved, the I/O approach is useless. The mistake which is often made, however, is that this is not so[44] and that complex interactions of a system with its environment can be modeled, and causal relationships-involving only important variables-can be found. This belief grew strongly in the sixties among westerners, when large computers first appeared and when mathematical models were thought to be able to solve all problems facing mankind.[45] The seventies have tuned down these hopes. Ecological considerations, quality of life concerns, social awareness and the understanding of the severe limitations in both sciences and human rationality have made man much more aware of his limitations, and increased the need for the concept of autonomous systems. The lesson is that the environment is too complex to be formally modeled. Instead, a constant dialogue is needed between man and man, and between man and the environment, This might mean that boundaries will need redefining, changes in the interaction pattern might be necessary, or structural changes should take place.[46] The implications for management and organizational theory is that the capacity of social systems for self-reference has to be stressed, namely the capacity for reflection, the capacity for defining one's own boundaries and sense of belonging.

BIBLIOGRAPHY

1. N. Wiener, Cybernetics or Control and Communication in the Animal and the Machine. John Wiley, New York, 1948.
2. R. S. Pindyck and D. L. Rubinfeld, Econometric Models and Economic Forecasts. McGraw-Hill, New York, 1976.
3. J. Johnston, Econometric Methods (Second Edition). McGraw-Hill, New York, 1960.
4. J. G. March and H. A. Simon, Organizations. John Wiley, New York, 1965.
5. K. J. Cohen and R. M. Cyert, Theory of the Firm: Resource Allocation in a Market Economy. Prentice-Hall, Englewood Cliffs, New Jersey, 1965.
6. H. M. Wagner, Principles of Management Science. Prentice-Hall, Englewood Cliffs, New Jersey, 1970.
7. G. Hadley and T. M. Whitin, Analysis of Inventory Systems. Prentice-Hall, Englewood Cliffs, New Jersey, 1963.
8. B. F. Skinner, Verbal Behaviour. NY-Appleton Century Crofts, 1957.
9. J. Thibaut and H. M. Kelley, The Social Psychology of Groups. John Wiley, 1959.
10. K. Ogata, Modern Control Engineering. Prentice-Hall, New Jersey, 1970.
11. G. Pask, Conversation Theory, Elsevier, New York, 1977.
12. F. Varela, H. Maturana and R. Uribe, "Autopoiesis, the organization of living systems, its characterization and a model." Biosystems 5, pp. 187-196, 1974.
13. H. R. Maturana, "The organization of the living: A theory of the living organization." Internation Journal of Man-Machine Studies, 7, No. 3, pp. 313-333, 1975.
14. M. Zeleny and N. A. Pierre, "Simulation models of autopoietic systems." Proceedings 1975 Summer Computer Conference, San Francisco, pp. 831-842, 1975.
15. H. R. Maturana, "Strategies cognitives", in L'unité de l'homme, Morin, E. (Ed.), Vol. 2, pp. 156181.
16. P. Herbst, Alternatives to Hierarchies. Martinus Nijhoff, Leiden, 1976.
17. H. von Foerster, "On constructing reality." In: W. F. Streiser (ed.), Environmental Design Res., Vol. 2, Dowden, Hutchison & Rose, Strousburg, 1973.
18. K. Lewin, Field Theory in Social Sciences. Harper, New York, 1947.
19. P. Zimbardo, The Cognitive Control of Motivation. Scotts Foresman, Glenview, Illinois, 1969.
20. N. Chomsky, Cartesian Linguistics. Harper and Row, New York, 1966.
21. G. Bateson, Steps to an Ecology of Mind. Ballantine, New York, 1972.
22. Ibid 14.
23. Ibid 12.
24. F. Varela, "A calculus for self-reference." International Journal of General Systems, 2, pp. 5-24, 1975.
25. F. Varela, "On being autonomous: The lessons of natural history for system theory." In: G. J. Klir (ed.), Applied General Systems Research: Recent Development and Trends, Plenum Press, New York, 1978.
26. L. Festinger et al., "Efference and the conscious experience of perception." Journal of Experimental Psychology, 1967-74, No. 4, Part 2; pp. 1-36.
27. N. Chomsky, "A review of B. F. Skinner's Verbal Behaviour." Language, 35, No. 1, 1959, pp. 2657 (p. 57).
28. .G. Canguilhem, Le Normal et le Pathologique. PUF, 1966 (p. 156).

29. A. Wilden, System and Structure. Tavistock Publications, 1972 (p. 111).
30. An organizationally closed system is not "closed" in the traditional sense of the word. The system, after all, exists within an environment with which it exchanges inputs and outputs; however, the boundaries between the system and the environment are artificial, and arbitrarily perceived by the observer. Maturana calls this the "structural coupling" which implies no clear inside/outside and inputs/outputs.
31. F. Varela and D. Johnson, "On observing natural systems." Co Evolution Quarterly, Summer 1976, pp. 26 31 (p. 26).
32. F. Taylor, Scientific Management. Harper, New York, 1911.
33. F. Emery and E. Thorsrud, Democracy at Work. Martinus Nijhoff, Leiden, 1976.
34. P. Herbst, Alternatives to Hierarchies. Martinus Nijhoff, Leiden, 1976.
35. The term "management control system" denotes a whole area of management whose main purpose is to provide information for more efficient management and more effective planning.
36. The authors would like to thank Jean-Loup ARDOIN of CESA for his valuable comments at this point.
37. C. Faucheux, "Strategy formulation as a cultural process." Int. St. Mngt. & Org., Summer 1977, VII, No. 2, pp. 127-138.
38. C. Faucheux and J. Rojot, "Social psychology and industrial relations: A cross cultural perspective" in G. M. Stephenson and J. Brotherton (Eds.) Industrial Relations: A social psychological approach, John Wiley, New York, 1973, pp. 3349.
39. Ibid 37.
40. D. de Rougemont, L'Avenir est Notre Affaire. Paris-Stock, 1977 (p. 349).
41. W. Ross Ashby, Design for a Bruin. Science Paperbacks, London 1960.
42. R. Likert, New Patterns of Management. McGraw-Hill, New York, 1961.
43. F. Emery and E. Thorsrud, Democracy at Work. Martinus Nijhoff, Leiden, 1976.
44. C. Faucheux, A. Laurent and S. Makridakis, "Can we model the wild world or should we first tame it?" Management Science (Special Issue on World Modelling, Editor: Churchman, C. W. and R. 0. Mason), 2, 1976, pp. 107-115.
45. H. Leavitt, "Beyond the analytic manager." California Management Review, Spring 1975, pp. 5-12.
46. E. Jantsch, Design for Evolution, George Braziller, New York, 1975.

CLAUDE FAUCHEUX is Vice President of the Institute of Human Relations (Zurich). He studied Social Psychology at the Sorbonne (Paris), belonged to the Centre National de la Recherche Scientifique (1953-64), has been a visiting professor at the Carnegie Institute of Technology (GSIA) and the University of Stanford (GSB), Research Director at INSEAD (1970-76). His research interests have been in the area of group dynamics, social influence and comparative study of cultural behavior. He is presently a Professor at the Foundation for Business Administration in Delft, Holland.

SPYROS MAKRIDAKIS is a professor of Management Science at the European Institute of Business Administration (INSEAD). He received his MBA and Ph.D degrees from New York University's Graduate School of Business Administration. He has been a consultant to many organizations, including AT & T, Corn Products, Motorola, UNESCO, Aussedat-Rey and CISI and has held teaching or research positions with several European and American institutions, including being a research fellow at IIM in Berlin, an ICAME fellow at Stanford University and a Visiting Scholar at MIT and Harvard.

Dr. Makridakis'main research activities have been in the area of General and Organizational Systems, and Forecasting where he has been attempting to apply General Systems Theory concepts and ideas. In the area of General Systems he has been working on a simulation project which aims at studying organization and its evolution over time in a dynamic and richly joined environment. He has published several books and numerous articles in General Systems, Management, Statistical and O.R. Journals.