

Organisation of decision-making : a systems-theoretical approach

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ORGANISATION OF DECISION-MAKING
a systems-theoretical approach

W. J. M. KICKERT

ORGANISATION OF DECISION-MAKING

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PROEFSCHRIFT

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*O si tacuisses,
philosophus mansisses.*

Boëtius (473-525): de consolatione
philosophiae, 2.17

FOREWORD

Organisation science and the science of organisational decision-making is certainly not terra incognita. In my opinion and fortunately not in mine alone, they have not yet ripened to full scientific maturity. That is why my intention is primarily to concentrate on the first stage of the scientific development, that is, the development of a conceptual framework. It was the urgent need for a set of consistently interrelated concepts to serve as a basis for the development of an empirical theory, that induced me to write this book. Consequently the work should be considered as a preliminary contribution to the development of the science of organisational decision-making. It is to be hoped that the book will be a fruitful stimulant to further development.

I am particularly grateful to Ton de Leeuw and Ab Hanken for their critical and helpful assistance throughout the research, notwithstanding the author's frequent obstinacy. There were many others who gave important support by their critical comments and discussions. I also owe many thanks to those who consented to be interviewed or were otherwise helpful in my case studies. Last, but definitely not least, I would like to express my indebtedness to Marlies Becker for the good humour with which she carried out the unenviable task of preparing the manuscript.

I am grateful to all who helped, which of course does not mean that they share any blame for the contents of this book, particularly anything that might be taken amiss.

Walter J.M. Kickert

Eindhoven, September 1979

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PART ONE

BACKGROUND

CHAPTER ONE

INTRODUCTION

Aim of the research

The research outlined in this book aims at developing a conceptual framework of organisational decision-making, particularly the organisation of the said decision-making. This will be done by adopting a systems-theoretical frame of reference. Let me indicate here the reasons that led me to this choice.

Conceptual framework

First of all the choice of forming a framework of consistently interrelated concepts, i.e. conceptual theory formation, was explicit. There are several reasons for this choice. Let me start with a methodological one.

In my view organisations science has nearly all characteristics of what Kuhn (1962) calls a science in a preparadigmatic stage¹. In organisation science one can distinguish a number of competing schools. There is no common interscholar fundament or paradigm. In a satirical survey of the current state of organisation theory Starbuck (1974) typifies the situation as follows:

"the supply of paradigms is so large that an organisation theorist should never be left without intellectual resources. If in doubt, he can always refer to the 1,247-page Handbook of Organisations. In fact, a casual census discloses 6.7 paradigms per organisation theorist, the average paradigm being only 1.009 times different from the adjacent ones. Unfortunately, many organisation theorists must not know what paradigms exist: 13 per cent say they believe only two paradigms; 56 per cent only one and 27 per cent believe none at all. Apparently they have some difficulty in understanding one another's work, a conjecture that is supported by the findings of William Dill (1964) and James March (1965) that there is negligible overlap between the bibliographic citations of different authors".

¹ That is the stage before the rules for studying a science are commonly accepted, in other words, the stage of discussion about the fundaments of the particular science.

Of course this insight is not new. Although not formulated in the latest methodological terms, something analogous was ment by Koontz (1961) with his term 'the management theory jungle'. In fact almost all authors that have given a survey of the state of the art in organisation science (see e.g. Scott, 1961; Dill, 1964; March, 1965; Mouzelis, 1967; Grochla, 1969; Silvermann, 1970; Starbuck, 1974; Kieser und Kubicek, 1978) have inevitably come to the conclusion that - to put it mildly - there is some confusion.

According to Kuhn (1962) this preparadigmatic stage of scientists without science will eventually proceed to the paradigmatic stage of 'normal science', i.e. a stage where one paradigm is accepted and the endless fundamental, philosophical discussions are replaced by normal scientific discussions, or less positively depicted, to a normal science where the subjects are much more restricted and where the scientific community believes in only one paradigm. So there is some hope left, although this transition can neither be explained nor predicted with the traditional means of logic and facts². Logical argumentation between schools mostly makes little sense because they adopt totally different conceptual frameworks. The transition of preparadigmatic science to normal science presupposes the cutting of philosophical knots, a certain amount of non-criticism and a greater puzzle-solving capacity of the resulting school. It is not a rational activity but something which happens and is determined by economical, social and psychological factors (Koningsveld, 1976).

It is surprising to note that except for the West-German organisation science school (see e.g. Wild, 1966, 1967; Schweitzer, 1967; Grochla, 1969; Lehmann, 1969; Kirsch and Meffert, 1970; Hoffmann, 1973; Raffée, 1974; Kubicek, 1975; Kieser, 1971; Kieser und Kubicek, 1978; Steinmann, 1978) few scientists seem to be interested in these methodological questions at all. It looks as if everyone were implicitly denying the fact that organisation science is no normal science. Once it is assumed that organisation science is still in the period of competing paradigms, one should also draw the conclusion: as this period is characterised by the competition between paradigms, start to work on the paradigmatic conceptual level first, try to establish some unanimity on the conceptual level and only then proceed with the construction of normal science theories. What is the sense of searching for normal science theories if the underlying conceptions are not even accepted? The alternative course of action would thus be useful only to those scientists who believe their school will win or has already won so that they can go on directly with the establishment of normal science theories. The modest approach is chosen here, i.e. conceptual theory

² This transition should not be confused with the transitions inherent in 'normal' scientific progress, which are indeed mostly explained in terms of 'logic and facts' (Popper, 1959; Lakatos, 1970).

formation.

There seems, however, one serious objection to the latter line of argument, namely that of Kuhn (1962) that it is to a great extent the puzzle-solving capacity of a school that will determine whether it will win or lose. The capacity of a school to solve scientific puzzles better than another school eventually makes it the winning school (Koningsveld, 1976; Mulkay, 1977). Roughly speaking, one might therefore say that scientists should focus on application-oriented, problem-solving research, for the more useful applications found and the more problems solved, the greater the puzzle-solving capacity and the greater the chance that the school will win. At first sight this seems to deny the need for conceptual theoretical investigations. However, scientific puzzle-solving should not be confused with practical problem-solving, for Kuhn and with him most methodologists, only consider the explanatory and predictive power of scientific theories and not the practical problem-solving power of theories. Kuhn ment theoretical problem-solving³ which is something different than practical problem-solving⁴. Theoretical problem-solving does presuppose the need for theoretical investigations. In fact practical problem-solving does so as well. Practical problem-solving can not do without a backing theory. No practice without theory⁵. Hence the need for conceptual theory formation remains irrefutable.

However, the present approach was explicitly formulated as a conceptual theory formation and not as a paradigm development. The reason for this is not only to avoid a very difficult discussion of what a 'paradigm' really is⁶, but also to avoid possible attacks on the misuse of the term. I intend to develop a conceptual framework of consistently interrelated concepts. In calling this a 'conceptual framework', no pretentions are made that things like 'scientific tradition, general epistemological viewpoint, Gestalt Figure' (interpretations by Kuhn of the term paradigm, cited in Masterman, 1970) are embedded in it. In view of the central role that Kuhn assigns to a paradigm in the revolutionary process of science, I will not call a conceptual framework 'paradigm'. The author pretends to no more than the formation of a framework of consistently interrelated concepts.

³ A theoretical problem is a clash between theory and its empirical basis, or according to modern methodology, a clash between two theories.

⁴ A practical problem is a discrepancy between factual situation and desired situation.

⁵ I will return to this issue in Chapter 2.1.

⁶ An expert in the field of methodology like Masterman (1970) ended up with twenty-one different senses in which Kuhn uses the term paradigma and, recently, Behling (1978) also warned against the many misunderstandings of the term.

Following Koningsveld (1976), the formation of concepts is considered as learning to observe in a certain way. A concept is therefore a method of observation, that is, a way to create order in the chaos of impressions. Observation is conceptually determined and is in fact theory-loaded if one considers a concept as a miniature theory. Observed empirical facts are conceptually or theoretically structured facts. Concept formation is therefore the first stage of the development of a particular science. A concept is a condition for an empirical variable. Only if the concept is operationally defined does it turn into a variable, i.e. a factor which varies and assumes values. A variable is defined only when the instrument that has to determine the value per case has been defined in detail (de Groot, 1961). A conceptual framework is thus the condition for a consistent set of interrelated variables which, once validated, leads to a theory. The process of scientific progress starts with the phase of the formation of concepts and a consistent conceptual framework then proceeds via operationalisation, isolation of relevant concepts, finding of relations to the proper 'theory formation' phase which consists of the theory-hypothesis-test-new theory sequence (Popper, 1959). This process is depicted in Figure 1.1 (see e.g. Kieser, 1971; Kubicek, 1975).

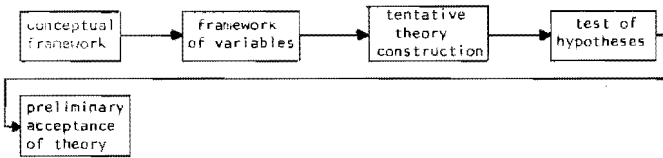


Figure 1.1. Process of scientific progress.

Indeed one can observe a serious conceptual weakness in organisation science. If one considers organisation science one can not only conclude that there is a super abundance of competing schools, but also that according to methodological criteria for scientific theories, there are no, or at least very few, organisation scientific theories. Although each methodological school stipulates different facets of theories, there is some unanimity as to the fact that a theory is a system of statements that should meet the criteria of logical consistency, empirical significance, generality and criticizability. A recent review of existing organisation 'theories' ranging from bureaucracy to contingency theory based on an extensive set of methodological criteria for theories by Kieser und Kubicek (1978) indeed led to quite sad judgements. Large as the number of theoretical imperfections and failures is, that their survey reveals the lack of conceptual theoretical clarity can be considered the main one. If one concludes that the theories are wrong it at least speaks for German 'Gründlichkeit' in that one starts the investigation

at the very beginning, that is, at the basic conceptual level.

One should, however, be careful not to become a type of organisation theorist that Starbuck (1974) describes as follows: "possibly because they are the kind of people who start tidying up whenever they see a mess (this type) is attracted by the idea of doing research on organisations. They are likely to begin with a disdainful attitude towards the quality of organisational knowledge and research, fully aware that existing theories say little or miss the point, and fully confident that things will shortly be set right once they themselves set to work with their newer, stronger research techniques and their fresher insights. So gradually that they are unaware of it, this objective self-confidence fades and is supplanted by a dawning suspicion that the puzzles really are unsolvable, the research tools inadequate, and platitudes more easily formulated than insightful analysis".

Indeed the diagnosis that there are no 'good' theories, still does not imply, however, that the 'good' remedy is to find theories. Starbuck mentions one possible counter argument: the problem might be unsolvable. Let us formulate that less fatalistically. The basic argument is namely that organisation science is not interested in theories per se, but in the solution of practical problems, and one might wonder whether (conceptual) theories serve that purpose. Again we return to the criticism that organisation science is not (primarily) interested in (conceptual) theory formation but in practical problem-solving. I completely agree that organisation science is primarily interested in practical problem-solving, just as any other science should be. And I also fully agree that 'scientific' theories indeed are always oriented to theoretical problem-solving³. The well-known text books on methodology (see Hempel, 1965; Nagel, 1968; Stegmüller, 1969) deal with descriptive, explanatory and, at most, prognostic theories and not with prescriptive⁷ theories, so that one is inevitably obliged to believe that 'science' does not deal with practical problem-solving. Methodologists who are interested in prescription are rare (Lenk, 1972) and only in German organisation science literature is the problem extensively discussed (Grochla, 1969; Kieser, 1971; Kieser und Kubicek, 1978; Kirsch und Meffert, 1970; Kubicek, 1975; Raffée, 1974; Steinmann, 1978; Wild, 1966). I strongly oppose, however, the conclusion that one can therefore do without science. In organisation science one has realised that the kind of practical problem-solving principles from 'scientific management' and 'scientific administration' schools were not so scientific at all, resulting

⁷ As to a discussion on prescription, the reader is asked to be patient until Chapter 2.1

in a 'contingency' school which is a step forward towards a more scientific approach to practical problem-solving. Turning history back would be a pity. Actually the issue of practical problem-solving science is considered to be so important that a separate chapter will be devoted to it (Chapter 2.1). So let us not anticipate and here restrict ourselves to saying that this kind of prescriptive science no more can do without theory than theoretical problem-solving science.

Summarizing, the following are the arguments in favour of emphasis on the formation of a conceptual framework. Organisation science happens to be in a pre-paradigmatic stage, which inclines one to start first at the paradigmatic conceptual level, notwithstanding the objection that paradigms eventually stand or fall by their puzzle-solving capacity. The need for conceptual theory formation can also be shown in simple terms: the process of scientific progress starts with the concept-formation stage. Only after operationalisation, isolation, etc. does the 'real' theory formation stage, consisting of the well-known trial-and-error sequence, take place. If, moreover, it is ascertained that organisation science theories are rather 'weak', particularly in a conceptual sense, the conclusion is obvious that the investigation should be started at the beginning. The objection that organisation science is not interested in (conceptual) theories but in practical problem-solving, something that 'science' seems not in the least interested in, making one wonder whether (conceptual) theories in fact serve that end, is erroneous. Practical problem-solving can no more do without theory than theoretical problem-solving science can.

Organisation of decision-making

Second, the object of research, i.e. the organisation of organisational decision-making is a choice to be justified. Before doing so, the terms have first to be explained. Decision-making within organisations can take place at different levels, that is, at the individual, the group and the organisational level of consideration. Therefore not only 'individual decision-making', but 'group decision-making' and 'organisational decision-making' are incorporated in the term 'decision-making within organisations'. As stated before I chose to consider 'organisational decision-making'. It will be seen later on that the abstract system-theoretical conceptual framework usually permits a multitude of levels of consideration, thus including the individual and group levels. The justification of the choice of the organisation of decision-making⁸ is twofold.

⁸ What exactly is meant by 'organisation' and by 'decision-making', particularly their differences, will be discussed in the introduction to Chapter 3.

On the one hand, there is growing interest in the subject. Particularly in public policy-making it is being realised more and more that the organisation of decision-making processes really is a problem (Faludi, 1973; Dror, 1968, 1971; Kooiman, 1970, 1974; in 't Veld, 1975). Probably one reason is that public-policy advisers rather more than advisers on business decision-making are in the position that they are officially neither permitted nor able to influence the decision on the subject level; public authorities take the decisions. So only the decision about the organisation is left to them. It comes as no surprise that they make that the object of their research.

On the other hand, a survey of the available literature on the subject shows that there is a serious lack of scientific theories about it. Summarising the selective survey presented in Chapter 3.1, one can state that the theories concerned deal mostly with the process of decision-making, that is, they are restricted to only one dimension, namely time. This is the class of theories known as the 'phase models' of decision-making. The other dimensions that can be recognised in the organisation of decision-making are scarcely dealt with. In view of the above-mentioned practical relevance of the subject this seems a sound reason to try and develop some theory about it.

Systems theory

Finally the choice of a systems-theoretical frame of reference. Actually the original inducement to carry out this research was to show that systems theory might be useful in organisation science. I consider such a problem formulation less useful. As mentioned on a similar occasion where the usefulness of fuzzy set theory was discussed (Kickert, 1978c), such a formulation lends itself to a charge of artificiality. Problems particularly suited to underline the usefulness of systems theory are sought out instead of real problems in the field of application and the illustration of how systems theory could be used to solve these real problems. The first-named often do not coincide with the latter. An other course of action has been taken here. The field of organisational decision-making was chosen, the existing problems sought out and it was found useful to solve them by means of systems theory. The primary aim is to develop the science of organisational decision-making one step forward, and not to advocate systems theory per se. (Actually this seems to be the best form of advocacy.) The neutral rationale for the choice of a system-theoretical approach is therefore that it just happened to be useful.

Of course the rationale can be formulated more positively. As already mentioned, the main problem in the science of organisational decision-making, and generally in organisation science, is to be found on the conceptual level. There are numerous inconsistent and even conflicting conceptions and theories and as long as

there is not even some unanimity at the conceptual level, useful developments in the direction of 'normal' science are blocked. Hence it seems evident to look at systems theory which pretends to be a unifying barrier-crossing theory. Systems theory has been used here as a conceptual frame of reference from which I will try to deduce a consistent set of conceptions about the object of research⁹.

In fact systems theory is being used as a metaconceptual framework. Although at this stage an outburst of controversy on the pros and cons of systems theory might be expected, particularly about its vast pretensions, the present study will remain in calm waters. As already indicated, no attempt is being made to 'prove' any usefulness in this way. For a treatment of these discussions see de Leeuw (1974) and Kramer (1978). It is hoped that this conceptual frame of reference will prove to show enough 'meta' to enable it to stand above the competition so that it does not just add a new competing paradigm whereas the aim is to resolve the competition and arrive at some unanimity. The proof of the pudding is in the eating.

Synopsis

Chapter 2 deals first with a number of methodological problems connected with the research task. The first problem to be discussed is that of practical problem-solving and science. As indicated, this question is basic to organisation science and hence also to the present research. Second, we discuss the empirical research method to be adopted. The problem is what significance should be given to empirical research at the stage of conceptual theory formation. Apart from these general problems the thread running through the book is as follows. Chapter 3 contains a brief survey of the existing research on organisational decision-making. From this survey the shortcomings and errors will be established and the problem formulation deduced, that is, the problem of rationality of decision-making and of the organisation of decision-making. Two separate parts are devoted to these problems. In Part Two, Chapter 4, the rationality problem will be dealt with and that will ultimately lead us back to the problem of the organisation of decision-making. Part Three will deal with this latter problem. Chapter 5 will provide an outline of a broader framework in which such a theory of organisation of decision-making should be embedded, in other words, a metadecision-making framework will be discussed. Chapter 6 develops a conceptual theory about the organisation of decision-making, divided in two parts, namely decomposition and coordination. Chapter 7

⁹ It is assumed that the reader has some basic knowledge about systems theory. For introductory text-books see, inter alia, Hanken and Reuver (1976), Kramer and de Smit (1974). For a more thorough treatment of the particular kind of systems theory used here see de Leeuw (1974, 1976a), Hanken and Reuver (1977).

will deal with the problem of the dynamic process of organising decision-making. Both Parts Two and Three will be illustrated by means of practical case studies; one in Chapter 4.3 to illustrate the rationality concepts and one in Chapter 8 to illustrate the conceptual framework proposed in Chapters 5 to 7 inclusive. Chapter 9 of this book contains a final evaluation and discussion of the results of this research, with particular reference to the aim here formulated.

CHAPTER TWO

GENERAL CONSIDERATIONS

2.1. PRESCRIPTION

Science and practical problem-solving

Organisation science is interested primarily in solving practical problems, that is, in changing some existing situation in a desired direction ¹. For the subfield of organisation science under consideration - organisational decision-making - this also holds good. The object of inquiry of decision-making science is the taking of decisions, that is, the influencing of some situation in a desired direction - practical problem-solving. The science of decision-making is however not only interested in describing, explaining and predicting factual decision-making behaviour alone, but primarily in improving it. The main objective is to indicate what decision-making 'ought to be' instead of only what and why it 'is'. Decision-making science is primarily prescriptive ² - 'ought to be' - and not descriptive - 'is'. Indeed one can see that many theories on organisational decision-making are explicitly or implicitly prescriptive. All mathematical decision theories (Luce and Raiffa, 1957; Hanken and Reuver, 1977) are explicitly prescriptive. The assumptions which underly the axiomatic utility function theory and the rationality assumption (optimality) are the explicitly normative foundations of those theories. Although the development of organisation-science theories on decision-making is often characterised as a reaction to these prescriptive theories in the direction of more descriptive theories, most of them are yet implicitly prescriptive. Simon's criticism on the home economicus decision theory was a first step towards a theory that better fitted to reality (Simon, 1945). The organisational 'decision-making' school has proceeded further along this same path (March and Si-

¹ For a systems theoretical treatment on practical problem-solving see Kramer (1978).

² Albert (1970) distinguishes between six kinds of prescriptive statements: resolutive, optative, valuative, performative, imperative and normative statements. I adopt his last definition of prescription: a normative statement which qualifies a certain course of action as justified.

mon, 1958; Cyert and March, 1963). Nevertheless one can say that the descriptive reality value of most theories is still low. A well-known criticism on the comprehensive rationality assumption is that of Lindblom (1959). A less-known criticism on the reality value of the constituent phases of those theories - most organisational decision-making theories are essentially phase models - is that of Witte (1972). As a matter of fact one can describe most of them as prescriptive.

On the other hand, reference to some text-books on the philosophy of science and methodology (e.g. Hempel, 1965; Nagel, 1969; Stegmüller, 1969) soon shows that in their view the aim of science is explanation. Science serves to formulate explanatory theories on empirical reality. A somewhat broader view is that science deals with explanation and prediction³ (Popper, 1969; Brody, 1970; Lenk, 1972) but one will hardly find a methodological treatment of prescription (Albert, 1970; Lenk, 1972; Rapp, 1978).

Obviously one has to distinguish between two kinds of scientific viewpoints, that is, a classical one which considers science's primary aim as the explanation of reality and another which considers that the primary aim of science is to improve reality.

In this chapter the objective is to show how the latter pragmatic aim to improve reality can be pursued in a way which is scientifically adequate. For the problem is that the methodology of 'classical' science has been elaborated to a great extent, whereas, in the author's view, the methodology of practical-problem-solving science has not. As far as is known, there are very few non-classical theories yet on how to practice problem-solving scientifically.

Let us first have a second look at what the differences between the two viewpoints are precisely.

The aim of 'classical' science is to formulate explanatory theories. It yields explanation and prediction. Let us call it 'theoretical' science. The aim of the second science is to solve practical problems, that is, to recommend courses of action to improve a certain situation. It yields normative action statements, in other words, it yields prescriptions. Let us call it a 'prescriptive' science.

In theoretical science the object of research is not allowed to be influenced in any way. If it were, the conclusions would be invalid. In prescriptive science, influencing the object of re-

³ In view of the methodological discussion around explanation and prediction, Lenk (1972) regards the search for scientific laws as the aim of science. Because many social scientists don't believe that it is possible to find such laws - at least they do not yet exist - I consider this a less appropriate formulation.

search is a primary objective. Second, the product of both sciences differ. Theoretical science yields conclusions, prescriptive science yields courses of action. This induced Zwart (1972) to call them conclusion- and decision-oriented research. Van Strien (1975) distinguishes between a method of theoretical science and one of prescriptive science. He states that the former method coincides with the 'empirica cycle' (de Groot, 1961): observation, induction, deduction, test and evaluation. According to him the 'regulative' cycle of problem-solving research is: problem definition, diagnosis, plan, action, evaluation. Note that this coincides with the usual problem-solving phase scheme which will be discussed at length in Chapter 3.2. Brasz (1976) and Breunese (1979) also replace the 'empirical cycle' by an alternative praxeological method, which they have classified into a two-dimensional 'praxeological table' based on the distinction between 'principle', 'process' and 'effect'. Kubicek (1975) illustrates the difference by means of the following Table 4 .

Table 2.1. Theoretical and prescriptive science.

	theoretical science		prescriptive science
	explanation	prediction	prescription
situation	sought	given	given
action	sought	given	sought
consequence	given	sought	given (desired)

In organisation-science literature science is sometimes divided into two parts, one part which has a 'theoretical' objective which includes description, explanation and prediction, and a second part which has a 'pragmatical' objective, that is, prescription. A system of statements with a pragmatical scientific objective is called a praxeological system (see e.g. Kosiol, 1962; Wild, 1966; Grochla, 1969).

There is a trivial line of argument to prove that all science is prescriptive. People do not investigate things just as 'l'art pour l'art'. Scientists investigate things because they want to change and improve those things. Gaining insight serves that goal. People do things because they want something. Hence all science is prescriptive (or at least should be). A less trivial methodological argument is the non existence of 'objective reality'. Observed empirical facts are conceptually or theoretically structured facts (Koningsveld, 1976). Different observers will form different images of reality, depending on their

⁴ Although at first sight this table may be illustrative, it represents only a very rough indication of the structural similarities. They will be discussed in greater detail further on in terms of the logical deductive model of science (see e.g. Lenk, 1972).

pattern of norms and values and their 'world view'. Roughly speaking, this is the argument with which Lakatos (1970) criticises the 'naive' falsificationism and replaces it with a refined falsificationism; there is always an observation theory intermediate between empirical reality and the theory that should be falsified, in other words, one does not test a theory against reality, one tests two theories against each other. Every description of reality will depend on the observer. If one assumes, moreover, that each individual is 'purposeful', then each model which is made of reality is dependent on one's will (Ackoff and Emery, 1972). Hence even explanation and prediction would be normative activities in this view. The conclusion that all science is normative does however not justify the conclusion that all science is prescriptive in the sense of practical problem-solving. Explanation and prediction are not.

Obviously the distinction is closely related to the issue of value-freedom of science. The intention, however, is not to dwell upon the discussion about value-freedom of science. Our interest will, in particular, be focussed on the relation between prescription and description. Let me explain that focus. Theoretical science's fundamental objective is to strive after maximum confirmation. The empirical trial-and-error cycle of hypotheses and tests serves to ensure that theories are as confirmed as possible, in other words that theories are, as far as possible, 'true'. An empirical theoretical law is a maximally 'true' representation of reality. Prescriptive science's aim is to improve things, hence its fundamental objective is not truth but usefulness. Does the prescription result in a useful desired change? The classical scientific approach to prescription is, however, initially description. First find out how things work then change them. In other words, first do theoretical science, then develop your prescriptions. Description is needed for scientifically adequate prescription. In my view this statement is false and I will now proceed to show that. Let us first have a look at the classical scientific considerations on prescription.

Explanation, prediction and prescription

Explanation, prediction and prescription can be considered as identical in their logical structure. Assume the deductive pattern of explanation which can be schematically represented as follows

$\forall x (F(x) \rightarrow G(x))$	theoretical law	} explanans
$F(a)$	antecedens	
$\overline{G(a)}$	consequens	explanandum

The logical pattern of a prediction is then exactly the same. The difference is that $G(a)$ will occur in the future, instead of

already being observed, as is the case with explanation⁵. With explanation $F(a)$ is given and, dependent on some universal law $\forall x(F(x) \rightarrow G(x))$, $G(a)$ is searched for. The same logical deductive pattern⁶ can also be used as an interpretative pattern of prescription: $G(a)$ is given (desired) and, dependent on some law $\forall x(F(x) \rightarrow G(x))$, a measure $F(a)$ that will result in the desired outcome $G(a)$ is searched. The similarity between explanation, prediction and prescription is illustrated in Table 2.2 (compare to Table 2.1).

Table 2.2. Similarities between explanation, prediction and prescription.

	explanation	prediction	prescription
$F(a)$	sought	given	sought.
$\forall x (F(x) \rightarrow G(x))$	given	given	given
$G(a)$	given	sought	given (desired)

According to this view the basis of all three types is the existence of a 'true' or 'highly confirmed' scientific law. Consequently, the same methodological requirements hold good to all three types and to scientific explanations (Sarlemijn, 1977), namely that there should be at least an empirical scientific law, that is, a universal conditional statement which is empirically testable, is not formally (un)true (e.g. a tautology) but nevertheless enjoys a high degree of confirmation. Moreover $F(a)$ should be consistent and contain all conditions, so that $G(a)$ can be deduced. In short, the classical requirements of information content, testability, consistence, etc. do hold good for all three types.

Things grow more difficult if one perceives that the logically deductive pattern of explanation is far from the only accepted one. Patterns of explanation that were originally proposed as radically different from the deductive patterns are the rational, teleological, functional and genetic patterns of explanation (see Nagel, 1961; Stegmüller, 1969; Schwemmer, 1976). Let us briefly indicate what is meant by those types of explanation. Nagel (1961, Ch. 2.II) describes the functional or teleological pattern as an explanation in terms of a unit which performs a

⁵ See Lenk (1972) for an exact definition of the differences between explanation and prediction in terms of the times of occurrence of facts and statements. The definitional difficulty stems from the concept of retrodiction.

⁶ In fact the logic needed for prescription is not the same logical calculus, for prescription should, namely, incorporate operators like 'desired', 'ought to', 'perform action', etc., which do not occur in ordinary logic. For a treatment of action logic (von Wright, 1974a) and logic of norms or deontic logic (von Wright, 1974b) see Lenk (1974).

function or has a role instrumental in achieving some goal. Functional explanations can be recognised by the terms 'in order that', 'for the sake of', etc. Nagel considers functionalism and teleology as synonyms. Stegmüller (1969, p. 526) regards functionalism as a subset of teleology, which is clear from his classification of types of teleology:

- (I) Formal Teleology: reduction of the problem to a time relation between antecedens and explanandum (explanation from future data);
- (II) Material Teleology:
 - (1) real material teleology: goal-intrinsic behaviour;
 - (2) apparent material teleology: goal-directed behaviour, which is not goal-intrinsic (no intrinsically 'real' goals):
 - (a) the logic of functional analysis;
 - (b) the structure of teleological automatisms.

Rational explanation is considered by Stegmüller (1969, VI.7) as a special case of the concept 'Verstehen'. If the behaviour is seen to be 'wise' in view of the person's convictions, beliefs, goals and his available information, it is called rational. If 'unwise' it is irrational. The motivating factors do not have to be right or wrong, they are given ⁷. Besides conscious rationality, rational behaviour can also be unconscious.

Genetic explanations are described by Nagel (1961, Ch.2.II) as a pattern which explains by describing how an entity has evolved out of an earlier one; a sequence of events leads to transformation of a system. The explicans consists of a large number of statements about past events.

Although these patterns of explanation have originally been proposed as alternatives to the typically natural-science deductive pattern of explanation by biologists, social scientists and historians, it can be argued methodologically that they are not different from the former logical-deductive model of explanation. The line of argument is the following.

The classical methodological objection to rational explanation is that this pattern prescribes what a person should do, but does not describe what he does. Only if one assumes that acting persons are rational and that rational actors behave in the above-mentioned way, can the pattern be used as an explanation of behaviour ⁸. However, these last assumptions constitute a hypothesis on the existence of an empirical scientific law, and hence the deductive model is no different.

An analogous argument applies to teleology: the pattern holds as long as it can be proved empirically that there is a goal ⁸. Na-

⁷ In decision-making literature this is generally called formal rationality (see Kirsch, 1977, p. 63). The subject of rationality in decision-making will be treated in more detail in Chapter 4.

⁸ As we shall see later, this presupposed assumption is based on a misunderstanding. I restrict myself here to presentation of the classical arguments only.

gel (1961, 12.I) shows that the functional pattern has the same form as the deductive pattern; 'Y is the effect of X', is identical to 'X is the cause of Y'. In this view every teleological explanation can be transformed into a deductive one. Also according to Nagel (1961, Ch. 2.II), genetic explanations are just explanations where the explicans is necessary but not sufficient and therefore they are identical to probabilistic explanations (the deductive pattern with statistical 'laws').

An argument against the genetic pattern of explanation is the one which also plays a central role in prediction: a large number of statements about past events and the course of events and the extrapolation of such a sequence of events into the future is not a prediction but a description of a trend, a so-called 'quasi-predictive description' (Sarlemijn, 1977). An extrapolation describes present possibilities and not a future situation. A 'real' prediction should be based on an empirical scientific law and a description of a trend is no such law (see also Lenk, 1972 for an extensive discussion of this problem). Genetic explanations based on such trends are hence invalid.

Moreover, one can state that rational and functional, as well as teleological explanations are all identical. The difference between motivation (rationality) and a goal (teleology) may be great for psychologists, but it just means that a system wants to attain a state. The difference between 'for the sake of some function', 'in order to perform a function', and the goal concept also reduces to zero. Hence, all three patterns of explanation are identical and can be represented as follows (Sarlemijn, 1977):

$$(1) \quad \forall x(F(x) \rightarrow G(x))$$

$$\frac{F(a)}{G(a)}$$

(2) the actor wishes that G(a) is true

(3) the actor reasons on the line of argument (1).

In other words, there is a logical deductive pattern, the actor has a goal and the actor behaves rationally. Clearly the difference from the deductive pattern is that there are several psychological assumptions about beliefs, wishes, etc. Therefore this model is called an intentional model of explanation. It is however based on the classical logical-deductive model of explanation.

Let us now leave the classical path and take a critical look at the foregoing arguments. Let us first consider intentionality. In social sciences there is a serious methodological problem in testing intentional assumptions about reality such as the rationality assumption. The problem has to do with the modern methodological view that objective reality does not exist. Only mappings of reality via the filter of an observation theory, that is, only models of reality exist. The perception of reality by

some observer is influenced by his pattern of norms and values, it is influenced by his accumulated previous knowledge of reality, that is, by an a priori theory, and it is restricted by the choice of the observer to consider only that part of reality which is relevant to this problem. It is clear that in this view the intentional assumptions are hardly testable. One can not test norms and values but require only that they are made explicit, that they are motivated and that they contain some criticism potentiality (see the next discussion of normative statements). This implies that the goal concept used in the rational pattern of explanation is no intrinsic property of some person, but merely forms a theoretical construct used to facilitate explanation. A person does not 'have' a goal. A goal is a theoretical concept attributed to that person. We will return to this issue when discussing the rationality of decision-making in Chapter 4.1.

Finally note that the difficulties arising from the fact that a model which tells what an actor should do is used as an explanatory model of what the actor does, vanish if this model is used prescriptively. There is no need then to establish an empirical scientific law that actors behave rationally. The fact that an essentially prescriptive element is introduced in explanation, enables the same model to be used directly for prescription. The conceptual framework that will be developed in Chapters 5 to 7 about the organisation of decision-making is actually based on such a model. The control paradigm of de Leeuw (1974) will be used as a basis for the framework. This paradigm states that every phenomenon can be regarded as a control system consisting of a controller, a controlled system and an environment. Furthermore, control is broadly defined as 'any form of directed influence'. A direction, however, presupposes a goal. Hence the paradigm is an intentional rational model. We will return to this in Chapter 5.2.

Prescription

We see that the prescription requirements arising out of the structural identity between prescription and explanation, are that, in order to be able to prescribe that $F(a)$ should be carried out to attain goal $G(a)$, there should be a universal conditional statement $\forall x(F(x) \rightarrow G(x))$ which is empirically testable, non-tautological and thoroughly confirmed, and $F(a)$ should be a consistent and sufficient condition to deduce $G(a)$. The transformation of the explanatory deductive pattern into the prescriptive pattern, however, poses some problems (Kieser and Kubicek, 1978). First there is the problem that the implication $p \rightarrow q$ only means that p is a sufficient condition for q , but not that p is a necessary condition for q . Therefore we can not conclude from $p \rightarrow q$ that p must always be realised in order to achieve q ; alternatives for p might also result in q . From $p \rightarrow q$

one can only conclude that p is a possible measure to achieve q ⁹.

A second additional requirement is that one should be able to manipulate p .

Up to now we have dealt only with the methodology of prescription given certain goals. Clearly the methodology of prescription on a higher level deals with the goals themselves, too. With this distinction one can distinguish two types of prescription namely (Kieser and Kubicek, 1978):

- (1) prescription where a goal is given. In this type interest is only in the means to achieve some given goal. They call this type of prescriptive statement an 'instrumental' statement;
- (2) prescription about the goals. In this type one has to prescribe the goal to be followed, due to the fact that there are several different or even conflicting goals. They call this type of prescription a 'normative' statement.

As we have seen, the former type of 'instrumental' prescriptions can be derived from empirical scientific laws and have the same deductive logical structure as explanation (apart from the additional requirements). 'Normative' statements are clearly different. A discussion of this kind of 'normative' statement soon leads us to the problem of value-freedom of science. I will try to remain very brief on this subject and refer the reader to Topitsch (1970), Raffée (1974), Ulrich (1976) or Kieser and Kubicek (1978) for a more extensive treatment of the problem. I will restrict myself to a brief summary of the requirements to prescription such as presented in Kieser and Kubicek (1978). Scientists have the right to decide freely on basic value judgements. This freedom to choose one's own values should however not be confused with value-freedom or neutrality. In order to avoid the danger of obscuring values and value conflicts and therefore manipulation, an important requirement is that the value-premises of scientific statements be shown explicitly. It should, moreover, be added that the choice for particular goals be motivated. A third demand that can be made, follows from the fact that a prescriptive statement as to how something should be changed, must be based on criticism of the existing state. Kieser and Kubicek (1978) distinguish between three levels of criticism: criticism of the means to achieve some given goal (endogenous-means criticism), criticism of the fact that means achieve some goal but also have undesired side effects (exogenous-means criticism) and criticism on the goals themselves (norm criticism).

⁹ Note that the additional requirement that p should also be a necessary condition is much too strong for the explanatory deductive model.

Prescription and description

What implications does the foregoing have as to our original question, i.e. the methodology of prescription? Prescription should be based on an empirical scientific law. Such a law is attained in the usual way by the induction of hypotheses from observations and experiments and the deductive test of those hypotheses by observation and experiment. If we consider observations and experiments as a form of description there clearly is a strong causal relationship between prescription and description in this methodologically 'neat' sense. However, there is no rich abundance of scientific laws in social science, nor in organisation science. Usually insight into reality consists of empirical regularities, measurements of sequences of data which are extrapolated into the future, so-called pseudopredictive descriptions (Sarlemijn, 1977). Speaking strictly methodologically, however, this is an inadequate basis for prescription, but (as it is for explanation and prediction) it is generally the only tool available. In this light one should consider the usual statements that 'in order to change and improve reality one needs a model of reality' as a derivative of the strict requirement of a scientific law.

Let us now have a closer look at the translation of this statement in control-theory terms, namely in terms of control (prescription) and model (description). Consider a control system as defined by de Leeuw (1974). He defines control broadly as any form of directed influence¹⁰ and a control system as consisting of controller CR, a controlled system CS and an environment E (see Figure 2.1). Note that this conception is broader

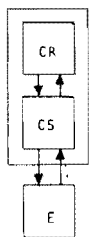


Fig. 2.1. Control system.

than the usual control-theory one, due to the broad definition of control. In cybernetics and its technical branch, control theory, it is usually assumed that in order to design a controller a model of the controlled system is needed. There have even been tests to prove this statement. In an article by two cyberneticians (Conant and Ashby, 1970) the hypothesis has been proved that 'every optimal simple regulator of a system must be a model of that system'. As can be seen from the formulation of the statement, it is false to interpret it as a proof that a regulator needs a model. In Kickert et al. (1978) it has been stipulated that the statement reads that if the regulator is optimal, the regulator

¹⁰ Note that this definition of control is rather similar to that of prescription as a normative statement, indicating a certain desired course of action (Albert, 1976). The control-system framework will be elaborated in Chapter 5.2.

is a model, which does not mean that if a regulator is a model, it is optimal. The condition is not necessary and sufficient. Moreover, model and regulator are identical in the statement, which looks rather odd and stems from the special control system's configuration that Conant and Ashby (1970) use. Finally, it can be doubted whether the optimality criterion that is used in the statement and in the whole cybernetic approach of Ashby (1956), namely minimal entropy, is useful (Kickert et al., 1978).

In my view the statement that a model is needed for prescription is indeed, strictly speaking, untrue. The definition of a model, in fact, differs from that of a theory. A model is generally defined as a 'representation of a system' (Bertels and Nauta, 1969; Nauta, 1974). The criterion for the quality of a model is whether the model is a 'true' representation of the system. This is usually measured in terms of homomorphy or isomorphy. A system $P = \langle A, S \rangle$ consisting of a set of objects A and a set of relations S between all objects A , is called isomorphic with a system $Q = \langle B, R \rangle$, if both the sets A and B , and the sets S and R are one-to-one mappings of each other, that is, if the systems can be mapped one-to-one into each other while retaining their structural relationships. Mark that this general definition of a model embraces the dynamic model. In that case the sets A and B do not simply consist of elements but of time sequences of variables. The model is then a representation of some time sequence(s) by some other time sequence(s).

A prescription is a statement which indicates what ought to be done in order to attain some goal¹¹. Hence the criteria for the quality of a prescriptive statement are effectiveness and efficiency, in other words, does one arrive at the desired state by means of the statement, and how much does it 'cost' to arrive at that state? There is no guarantee that an isomorphic representation of reality, that is, a good model, benefits the effectiveness or efficiency of the prescription. For what is methodologically needed is an empirical law $\forall x(F(x) \rightarrow G(x))$ which predicts that if $F(a)$ is prescribed the desired $G(a)$ will result. As actually mentioned, this is generally realised by pseudo-predictive description, that is, the measurement of a sequence of events and the extrapolation of that sequence into the future. The usual way to do this is by means of a predictive model, that is, an isomorphic representation of a sequence of events which is extrapolated. It will be clear now that quite a few additional assumptions have to be fulfilled before the 'isomorphic representation' of a model can be compared to the 'high empirical confirmation grade' of a scientific law. Summarising, one might say that although predictive modelling is mostly the best pos-

¹¹ This does not mean that in a prescriptive statement there should always be a goal in terms of some desired end states; the statement can have the instrumental 'if...then' form as well (for the relationship between instrumental and normative forms see Hanken and Reuver, 1977).

sible surrogate, it is far from a sufficient guarantee for good prescription.

Of course this does not imply that one should forget about modelling, just prescribe and see what happens, which is a conclusion some people seem to draw from the fact that the only thing which matters in prescription is whether it works. Proceeding in this way seems rather 'unscientific'. It is right that proponents of prescription object to the 'common sense' principle that first one needs good insight into reality before one is able to improve reality, thus representing the simple isomorphy requirement. Just an isomorphic model is not enough, one needs at least a predictive model which forecasts what actions will result and to what effect. Indeed, from a prescriptive point of view it does not matter whether the model is an isomorphic mapping as long as its predictions are right. In measurement-theory terms this means that one is only interested in the predictive validity of the model and not in the concept or construct validity (Supper and Zinnes, 1963; Cronbach, 1969, Ch. 5). In this sense the 'as long as it works' principle is right. The opposite conclusion to do without any model at all can, however, not be drawn from the foregoing line of argument.

Model of decision-making

Before proceeding with the general considerations on a methodology of prescription, let me specify the foregoing line of argument as to our object of research, organisational decision-making.

As decision-making is obviously a form of prescriptive action - a decision constitutes a choice of a particular course of action to change and improve a certain situation - the foregoing conclusions imply that for decision-making one needs at least a predictive model. One should, however, realise what has to be modelled. For it is not the decision-making itself that is to be modelled. It is the situation on which the decisions are taken, and where the decisions are implemented that should be modelled. Decision-making is the control of some situation in a certain environment ¹² (Figure 2.2). The conclusion that prescription needs a predictive model should therefore be interpreted to mean that the situation must be modelled. Indeed most mathematical theories of decision-making incorporate some model of the system on which the decisions are made. In the maximum-expected-utility decision theory (homo economicus) it is assumed that one knows what action will lead to

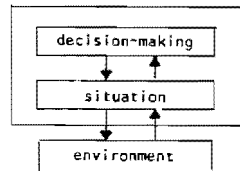
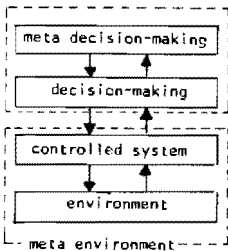


Fig. 2.2. Decision-making system

¹² This control-system analogy will be discussed more extensively in Chapter 5.2.

which next state (effect, result), which comes to a model of the system. In most organisation-science decision theories, however, a model of the controlled system is lacking. The call for a model of decision-making in organisation science indeed does not mean that a model of the controlled system is derived, but that one is interested in knowing how factual decision-making takes place. This is quite a different thing and means that one is interested in a model of decision-making itself, that is, a model of the controller and not of the controlled system. However, a model of the controller can only be useful for a metacontroller, that is, for prescription about the decision-making itself, which is a form of metadecision-making¹³ (see Figure 2.3). Although



it seems to be a serious restriction to conclude that a model of the decision-making can only serve metadecision-making and not the decision-making itself, we will see in Chapter 5 that the object of our research, i.e. the organisation of decision-making, is a form of metadecision-making.

Fig. 2.3. Metadecision-making.

Alternative methodologies of prescription

The aim in this chapter is to indicate some aspects of a methodology of prescription. It has been shown that even in the classical methodological sense the statement that description is needed for prescription is, strictly speaking, false. In a strict methodological sense description per se is insufficient. An empirical theoretical law is needed. In a weak sense this requirement is fulfilled by a predictive model. Up to now I have in fact remained within the boundaries of classical methodology, that is, inside the boundaries of the deductive pattern of explanation. Actually, a much more intriguing question is whether there is not a radically different methodology of prescription. Is it indeed always necessary first to find a highly confirmed theoretical law or at least a highly confirmed predictive model? Does one always have to pursue first the troublesome long path of classical empirical research? Apparently there are tendencies which deny these requirements.

One of them is the research method called 'action research', which becomes increasingly popular in organisation science, par-

¹³ As metadecision-making will be discussed extensively in Chapter 5, it will not be dwelt upon here.

ticularly in organisation sociology (Silverman, 1970). The term 'action research' was introduced in 1946 by K. Lewin to denote a social research method strongly related to 'group dynamics' combining generation of theory with practical problem-solving. Action research aims both at generating critical knowledge about the social system and changing that system (Rapoport, 1970). Action research is a cyclical process that involves planning, factfinding, evaluation, execution and reformulation of the plan (Cunningham, 1976). In a recent article by Susman and Evered (1978) an extensive treatment on the scientific merits of action research is given. Action research is presented as a method for correcting the deficiencies of positivist science for generating knowledge for use in solving problems that members of organisations face. Although action research is found not to meet the criteria of positivist science, it is argued that different criteria and methods of science had better be adopted for judging the usefulness of research methods in solving practical organisational problems. Tested against these criteria, action research is found to satisfy. Apparently action research can be considered as a prescriptive research method denying the requirements of classical (positivist) science.

Another instance of an approach explicitly aiming at design is the study of inquiring systems by Churchman (1971). Churchman addresses himself to the philosophical questions underlying design. He interprets this question as a problem of inquiring system, that is, the system the researcher should adopt to produce his 'knowledge'. Churchman distinguishes between five kinds of inquiring systems: Leibnizian, Lockean, Kantian, Hegelian and Singerian inquiring systems. Although Churchman starts by emphasising that design is the crucial activity of man, his proposed inquiring systems do only weakly relate to design in the sense that they focus on the method to gain knowledge about reality. Mitroff and Turoff (1973) indeed consider the inquiring system as 'the philosophical stances taken towards the problem of predicting the future'. Churchman's approach constitutes a philosophical attempt to clarify the methods of factfinding and prediction - the common classical methodological requirement to prescription - and hence is in fact no alternative direct methodology of prescription.

As mentioned before, there is also a tendency to forget about modelling, just prescribe and see what happens, for the only thing which matters in prescription is whether it works. Also as mentioned before, this seems rather 'unscientific'. But why call it unscientific? In fact only because this course of action does not meet the usual scientific criterion of repeatability, i.e. reliability. Science is supposed to search for things which hold in general and not for unique things. Scientists are trained to search for the universal and not for the unique.

An example of a methodology of prescription where this basic assumption is completely reversed is that of de Zeeuw (1977b, de Zeeuw et al., 1977; de Zeeuw and de Hoog, 1979; Groen, 1977). De Zeeuw's methodology for social sciences, particularly for 'andragogics', starts from the assumption that in this field a scientist should not search for generality but for uniqueness. Every human situation is unique and the process of active change of that situation enlarges the chance that human experience and human action will differ one from the other, that is, leads to an increase of uniqueness. Schematically this can be represented as $dB = O + B$. B represents the accumulation up till now of all experience about action. O represents an additional ordering of that experience, that is, O is an instruction (advice, counsel, suggestion). That instruction will contribute to an improvement of action dB, that is, to a further increase in uniqueness. De Zeeuw opposes his procedure to the classical one, in which action and knowledge are separated from the goal for which they are needed. He schematically characterises this latter procedure as $B = I + D$. B again represents an individual's ability to act at a certain moment. This is the result of I, the relevant insight or knowledge and D, the goal to be attained. Increase in knowledge will be independent of the goal and will contribute directly to a better functioning: $dB = dI + D$. De Zeeuw's BOB model is an explicit methodology of action. In fact it could also be called a methodology of prescription, in view of his key element O, the instruction. Note that, contrary to classical methodology, it is not a methodology of increase of knowledge. De Zeeuw's BOB model constitutes a radical alternative to the classical model of prescription discussed in the earlier part of this chapter. According to him, increase of insight is not the only contributor to better action. Measures like 'truth', 'validity', 'reliance' are not the characteristic qualities in the BOB model. One is not interested in better description of reality. One is directly searching for improvement of action. Not truth but usefulness in improving human action is the criterion. The great advantage of this BOB model is that it avoids the troublesome path of first gaining a better insight dI, i.e. the whole empirical cycle to arrive at scientific laws or, in a weaker form, the identification of predictive models. This model opens new horizons for direct prescriptive research. However, this still does not show us how to arrive meaningfully at a useful prescription O. The BOB model rejects the descriptive by-path to insight but, in my view, does not offer an alternative procedure to obtain O.

Conclusions

In fact the strongest conclusion one can draw is that the methodology of prescription is still open to question. On the one hand one can take refuge in the safe classical methodology in

which things are clearly laid down. First find a scientific law, or at least a predictive model, then you are allowed to carry out your normative activities. On the other hand one can explore new paths in search of a methodology of prescription which makes no such troublesome stipulation but permits direct prescriptive research. This new methodology is however still somewhat unsafe in the sense that many things are not yet clearly established. Obviously the dilemma is between soundness but troublesomeness on the one hand and unsoundness but ease and convenience on the other.

That there must be an alternative to the classical approach to prescription the present writer is intuitively convinced. The problem however is that the sound alternative has yet to be found.

2.2. EMPIRICAL RESEARCH METHOD

In this section we are primarily concerned with the question of the empirical research method to be followed. Although some fears might have been entertained that the research aim in this case - conceptual theory formation about decision-making - would imply pure desk research, the writer does not intend to cut his ties with empirical reality. Conceptual theories, too, have to have an empirical information content. In this section we will address the question of how to achieve that end.

Process of scientific research

In the usual view of scientific research ¹⁴ there are two kinds of ties between theory and empirical reality, which together constitute the path of scientific research processes (see Figure 2.4):

1. the inductive path which leads from empirical observation and experiment to the establishment of hypotheses and theories;
2. the deductive path which leads from the hypotheses and theories to their empirical testing by means of observation and experiment (and once the theories have been confirmed to their application in explanation and prediction) (the so-called 'empirical cycle' (de Groot, 1961)).

¹⁴ The presented scheme of the empirical scientific process is rather classical. In the view of Lakatos (1970) theories are not tested against empirical reality, but against other theories. Moreover, the scheme applies to 'normal science' (Kuhn, 1962) and not to the revolutionary process ultimately leading to that stage.

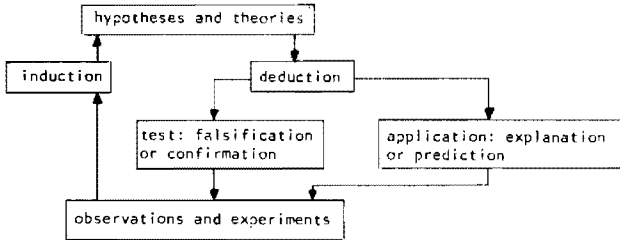


Fig. 2.4. The inductive and deductive process of science.

Of course there are variations on this basic scheme (see Koningsveld, 1976). Essentially, empirical reality has two functions, a discovery function and a test function. Methodology and particularly, 'critical rationalism' (Popper, 1959) deals primarily with the second function, that is, there are quite some criteria and procedures that should be used for testing hypotheses. How to discover theories is a subject largely left to psychologists and sociologists and is scarcely dealt with by methodologists (Albert, 1964). The scheme in Figure 2.4 can be further elaborated when it is realised that the stage of 'real' theory formation is preceded by a stage of conceptual theory formation (see Chapter 1). A concept is a method of observation, a way to create order in the chaos of impressions (Koningsveld, 1976). Concept formation is the first stage of the development of some scientific theory. A concept is a condition for an empirical variable. Operationally defined it turns into a variable, i.e. a factor with variations which assume values (de Groot, 1961). The scientific research process can thus be further specified by introducing the preceding phases of the creation of concepts, the operationalisation of those concepts, the isolation of the relevant dimensions, resulting in a taxonomy of measurable and relevant variables. Secondly one should realise that a theory essentially consists of variables and relationships between these variables. A taxonomy of nominal classes of variables does not suffice. The relationships should also be established (Segers, 1975, p. 32). The same applies to the conceptual stage. Not a nominal set of concepts but a consistently interrelated framework of concepts is needed. Together with the above-mentioned phases of theory formation, testing, confirmation, this leads to a more detailed scheme of the scientific research process like the one depicted in Figure 1.1 of Chapter 1, repeated here for the sake of convenience.

Although the first two phases do not consist purely of inductive theory formation, they can be considered as a helpful specification of this relatively unknown first inductive step. At least it introduces one very important prephase, namely the creation

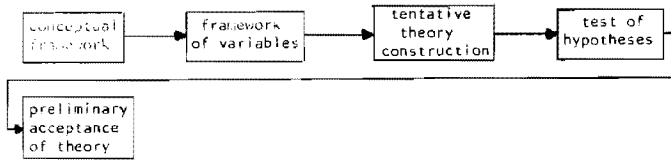


Fig. 1.1. Process of scientific progress.

of a conceptual frame of reference. The arguments in favour of the importance of a conceptual framework set out in the introduction (Chapter 1) will not be repeated here. Kubicek (1975) also argues that in view of the state of the art in organisation science, it seems more useful to create conceptual frames of reference and to develop them into empirically significant frameworks by means of empirical research. In view of the chaotic 'jungle' it is more useful to have some conceptual guidance for ill-structured problems than to develop the next unrelated detail 'theory'. It is however clear that in this view empirical reality does not play a predominant test role any longer. The second function of empirical reality - its discovery role - becomes even more important here than it already was (or had to be) in the 'real theory' formation process. According to Kubicek (1975, p. 46): "the research process can then be regarded as a continuous development of conceptual frames of reference and their continuous specification and modification based on explorative studies". In fact the activities of the first two phases of Figure 1.1 - the definition of rough concepts and relationships, the operationalisation, the isolation of relevant concepts and relationships by introducing new ones, omitting old ones and changing existing ones - previously called a specification of the inductive 'discovery' function of empirical reality, constitute an interaction of both the roles of inductive discovery and deductive verification from the viewpoint of the establishment of a conceptual framework. Note that the empirical studies carried out to establish a conceptual frame of reference do not possess the same rigorous verification and falsification capacity as they (should) do in 'real theory'. It is impossible to derive from such an abstract conceptual level that level of exactness of hypotheses which is needed for confirmation and falsification. Abstractness can not be seized upon so easily. I think that, strictly speaking, the deductive function of empirical reality in this conceptual sense can therefore not be considered as anything more than an illustration, that is, making clear by examples. Note that an illustration with empirical examples is a weak form of empirical verification. The inductive discovery function, however, is much stronger than it usually is. Although the case studies that will be presented throughout this book indeed seem primarily to serve as 'illustrations' of the concepts

that have already been presented, the factual course of events was that these case studies surely served as concept generators, as well. This book is however not intended as a historical description of the author's own learning process.

Research method

The methods of organisation research in gathering, processing and analysing data are essentially identical to the well-known techniques of empirical social research which are extensively treated in literature and need not be discussed here (see König, 1967; Gadourek, 1972; Seegers, 1975). I will only discuss the reasons for the specific choice of my research method: the case study, and the choice of my data acquisition methods: content analysis combined with unstructured interviews.

As to the first choice, there are four global research methods that one can choose in organisation research: the case study, the laboratory experiment, the comparative study and the field study or action research method (Kubicek, 1975; Udy, 1965; Silverman, 1970). Although a case study has the disadvantage that it restricts itself to one case so that it can only result in singular statements about empirical reality and not in universal ones, its great advantage lies in its explorative potentiality. Mouzelis (1967) speaks of the case study-survey dilemma, namely the dilemma that the one-case study leads to insight and fruitful hypotheses without the possibility of testing and that the survey study leads to generalised and methodologically more valid findings, but of a superficial or trival character. There seems to be "an evitable choice between theoretical substance and methodological sophistication" (Mouzelis, 1967, p.66). A one-case study does not have to be a purely descriptive, impressionistic study without any kind of supporting evidence. Moreover, one great advantage of the case study is that it enables a longitudinal study of a dynamic process to be made. It would be best to combine a number of cases in order to enjoy the advantages of both a comparative study and a case study. Roughly speaking, one can say that the one-case study method is particularly suited in the first phase of research, because it results in an abundance of conceptual insights, and that is precisely what we want. Besides, this method is relatively easy and needs little time and energy so that it falls within the possibilities of individual research. Like Kubicek (1975, p. 72) I think that it would require quite a large research group to carry out an all-embracing empirical research program.

As to the second choice for the particular data gathering techniques I will also be brief. The choice here is out of the non-stimulus techniques: document analysis, observation, parti-

cipative observation, and the stimulus techniques: interview and questionnaire (Gadourek, 1972; Segers, 1975; König, 1967). All methods suffer from serious measurement-theory problems such as validity, reliability and accuracy. In view of the aim of the research-conceptual theory formation - for which conceptual insight capacity seems most important, the dilemma with the techniques is between the amount of effort involved and the capacity for insight. On one hand document analysis seems to be the easiest method. On the other, official notes will mostly reveal no deep insight into the factual decision-making process. Although one might state that in order to get a deep insight into the decision-making process, one should at least observe in a participative way, this method has serious disadvantages. First, it is rather dubious whether decision-makers will admit a researcher to be present at their real strategic decisions, let alone to let him participate in them. Second, there is the problem of the untraceable 'corridor' decisions. A third problem, especially with decision-making, is that it is a continuous process whose end time is often hardly predictable. I therefore decided to study finished but recent cases and combined a thorough document analysis with insight-gaining unstructured interviews.

Case study

Investigating decision-making in organisations by means of the one-case study is a method which can be specified in various ways. Let me briefly here say why a longitudinal study of a single decision-making process was chosen. The basic rationale lies in the definitional conception of an organisation and of a decision-making process. It is clear from the choice of the object of research that I consider decision-making as one of the essences of an organisation. Actually, I assume a standpoint less stringent than Simon (1945) who defines an organisation as identical to a decision-making system. In my view one of the important processes that take place within an organisation are decision-making processes. I do not consider organisation and decision-making as identical¹⁵. That is why, in my view, the three forms of case studies of organisational decision-making which are given in Figure 2.5a, b and c are indeed conceptually different, for they implicitly start from different principles.

In the first kind of case study (Figure 2.5a) various decision-making processes inside an organisation are investigated during a certain time interval. The time interval is aggregated to one moment - say a year - so that only static conclusions are derived. The most important characteristic of this kind of case stu-

¹⁵ In the introduction to Chapter 3 the precise meanings attached to 'decision-making' and 'organisation' will be discussed at length.

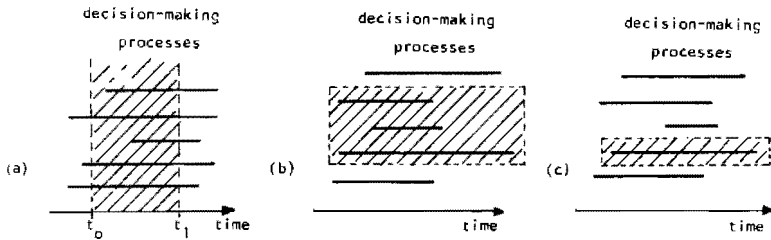


Fig. 2.5. Three kinds of case studies of organisational decision-making.

dy is that it starts from the principle that organisation and decision-making are identical. It leads to statements about the whole organisation as one decision-making system¹⁶.

In the second kind of case study (Figure 2.5b) the dynamic time aspect is introduced. Because complete processes are investigated longitudinally, it is possible to derive statements about the dynamics as well. The statements, however, still deal with the whole organisation as one decision-making system. Here also the conceptual identity between organisation and decision-making is assumed¹⁶.

The third type of case study (Figure 2.5c) represents a longitudinal investigation of a single decision-making process. Statements derived from this investigation deal with decision-making in organisations without assuming that organisation and decision-making are identical concepts. The study leads to statements about decision-making and not about organisation, as in my view they are different concepts. I therefore decided to choose this kind of case study. The danger of choosing such a relatively small system of study is that the system's environmental influences will be much larger. This enhances the need to definitely use an open systems approach. The other disadvantage of such a relatively small system of study seems that it yields little empirical evidence. This is, however, true of every case study. Moreover a single decision-making process can contain many sub-processes and be very complex as we will see in our case studies, so that the empirical evidence is not meager at all.

¹⁶ Note that this assumption does not necessarily hold good if the investigation is not considered as a one-case study but as a comparative set of case studies in separate decision-making processes.

CHAPTER THREE

SURVEY AND PROBLEM FORMULATION

In this chapter the aim is to explain what led to the choice of 'rationality of decision-making' and 'organisation of decision-making' as the two main subjects of my research. I will namely derive these themes from a survey of the state of the art in organisational decision-making, a survey not exhaustive but representative enough to point out the shortcomings in the field, and representative enough to enable the problem formulation, that is, the importance of rationality and organisation of decision-making to be derived therefrom.

What is decision-making?

The essence of a decision is generally considered to be the choice between alternatives. In his famous book (Simon, 1945) which laid the basis for the science of organisational decision-making, Simon stipulates the importance of this 'choice' aspect: "the choice which prefaces all action", "the determining of what is to be done rather than the actual doing", "the process of choice which leads to action" (Simon, 1945, p. 1). Clearly one of the key elements of the concept of decision-making is this choice. No wonder that in mathematical decision-theory where stringent and clean definitions are used, decision-making is indeed defined as the choice between a number of alternatives (Luce and Raiffa, 1957). Mathematical decision theory deals with optimisation of that choice. There are, however, more elements in the concept of decision. For instance, Simon considers "human choice as a process of drawing conclusions from premises. It is therefore the premise rather than the whole decision that serves as the smallest unit of analysis" (Simon, 1945, p. xii). In his view the decision premise plays the key role in decision theory. Furthermore, this last citation points at another element of the concept of decision, namely the process aspect. In the excellent and very extensive text-book on decision-making by Kirsch (1977) this aspect is given a central role. Kirsch distinguishes between two types of models of decision-making behaviour, a closed and an open model.

"In closed models the decision premises are assumed as given, in open models, however, the investigation of the genetics of the decision premises is incorporated" (Kirsch, 1977, p. 26). It is this very search process which forms one of the constituent parts of Simon's well-known 'bounded rationality', and which triggered the development of the so-called phase models of decision-making (Simon, 1945; March and Simon, 1958; Simon, 1960) where decision-making is regarded as a cognitive problem-solving process.

Finally I would like to return to the first remarks about the essence of the choice aspect. In the quotations from Simon about choice and action, Simon clearly reacts to an overemphasis on action in administration (Simon, 1945, p. 1). It should be emphasized however, that decision-making is the determination of what is to be done, and that the ultimate aim of decision-making is to perform some action. This importance of action can be incorporated in the definition of decision-making, as for instance in Taylor's (1965): "the choice among alternative courses of action". It is more clearly reflected in such definitions as "the process of selecting a particular alternative for implementation" (Nutt, 1976) or "a decision is a specific commitment to action" (Mintzberg et al., 1976). It is clear that decision-making should not stop once the choice is made; it should be an integral part of decision-making to ensure that the decision can and will be implemented.

Summarising, one can state that the concept of decision-making should at least consist of the following elements:

- a choice between alternatives;
- the conscious drawing of conclusions from premises;
- a learning process of search, development, evaluation, etc;
- an action commitment for implementation.

Decision-making and organisation

In view of the fact that the present research will deal with the 'organisation of decision-making' it seems significant to indicate not only what meaning should be given to the concept of decision-making but also to the concept of organisation. In particular it should be made clear what exactly the difference is between both concepts in order to be able to distinguish between 'organisation of decision-making' and 'organisation' as such. Let us briefly consider the concept of 'organisation'.

Organisation can be interpreted in a 'functionalistic' sense (a company 'has' an organisation) - a system of rules to perform its tasks - and in an 'institutionalistic' sense (a company 'is' an organisation) - a goal-oriented system with a formal structure. These interpretations can be encountered in more or less detailed variations such as the institutionalistic definition that Kieser and Kubicek (1977, p. 4) adopt: "an organisation is

a social system which permanently pursues a goal and which has a formal structure, by means of which the activities of the organisation members can be directed towards the goal". In addition I make the distinction between the descriptive use of the term organisation, denoting the above-mentioned 'functionalistic' or 'institutionalistic' system, and the prescriptive use of the term, denoting the design of an organisation, i.e. the organising of either a 'functionalistic' or an 'institutionalistic' system. I use the term purposely in this dual sense in order to reflect that the conceptual framework to be developed in Chapters 5 to 7 can indeed be used in a descriptive and prescriptive sense.

None of the various interpretations of the term organisation can be identified with the above interpretation of the concept of decision-making. Nevertheless there is a relationship between them both. Inside an organisation decision-making is very important. In the system called organisation, numerous decision-making processes take place in which numerous members of the organisation are involved in numerous aspects. What is the relationship?

From the institutionalistic viewpoint of an organisation, the concept of decision-making is a subset of the concept of an organisation, that is, (rational) decision-making processes are also goal-oriented systems with a structure, but they only form a part of the organisation in the sense that many decision-making processes and also discrete processes take place in the same organisation. Both are goal-oriented systems with a structure but there are many decision-making systems inside one organisational system. Hence the qualification 'subset of'.

From the functionalistic viewpoint of an organisation there is also a 'subset of' relationship between both concepts. Decision-making also needs a system of rules in order to perform its tasks, but the organisational rules are used for more tasks than one decision-making process alone.

Now let us have a second look at the relationship between both concepts.

In view of the research object of this book it will be clear that decision-making is considered as playing a central role in organisations. However, there is a difference between 'the only important' role and 'an important' role. If one assumes that decision-making is the only important activity inside an organisation, the relationship between decision-making and organisation becomes a true 'subset of' relation. An organisation consists of numerous decision-making processes but all the decision-making processes together constitute the whole organisation, for decision-making is the only important activity. Decision-making is then a subset of organisation (Figure 3.1), for all subsets of a set constitute the set. Note that in the illustrative Figure 3.1 the elements of the set are not necessarily the parti-

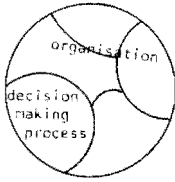


Fig. 3.1. Decision-making is a subset of organisation.

icipating members of the organisation but primarily denote issues, aspects, etc. If the set did consist of individuals only a configuration like Figure 3.2 would namely be impossible. Let us, on the other hand, not assume that decision-making is the only important activity inside an organisation, but merely as one of the important activities. In this view the concept of organisation incorporates characteristics that fall outside the concept of decision-making - one might state that operational activities at shop-floor level are distinct from decision-making; decision-making only takes place in the administrative pyramid of the organisation - and the concept of decision-making incorporates characteristics that fall outside the concept of organisation - besides the institutionalistic 'goal-oriented system with a structure' and the functionalistic 'rules to perform tasks' characteristics, decision-making possesses many other characteristics as already outlined. In this view an organisation consists of more than the sum of all decision-making processes and decision-making processes consist of more than organisation

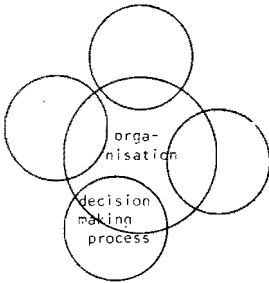


Fig. 3.2. Decision-making intersects organisation.

(Figure 3.2). Decision-making and organisation have an overlap (intersection) but also have separate elements. Actually I consider this last viewpoint more realistic than the one depicted in Figure 3.1.

What light do the foregoing considerations throw on the relationship between 'organisation of decision-making' and 'organisation' as such?

On the 'subset of' assumption (Figure 3.1) any theory about decision-making automatically becomes a theory about

organisation. A theory about a particular kind of decision-making, i.e. one but not all of the subsets, leads to a theory about a restricted part (e.g. aspect system) of organisation. A theory about a particular aspect of decision-making - e.g. the organisation of decision-making - which is not restricted to a certain kind of decision-making, i.e. to one subset, but applies to that same aspect of all kinds of decision-making processes, i.e. all such subsets, leads to a theory about a particular aspect of organisation - i.e. the organisation of an organisation. Under the 'intersection' assumption (Figure 3.2) a theory about decision-making does not automatically lead to one on organisation. In order to prove that, one has to prove that the particular theory applies to the intersection of both.

We will see later on after the presentation of the conceptual

framework on the organisation of decision-making what the relationship actually is.

Let me finally recall that decision-making in organisation can be considered as from different levels, i.e. the individual, the group and the organisational level. As mentioned in Chapter 1 our considerations are restricted to the last level. It was also mentioned there that this restriction will turn out to be not so strict because the abstract systems-theoretical conceptual framework that will be used, generally permits a multitude of levels of consideration, including the individual and group levels.

Outline of the survey

The following is not intended as an exhaustive review of all available literature on organisational decision-making, the intention being rather to make a contribution towards the development of decision-making science. In this survey the focus is on the presentation of some red lines leading to the research objects and only refer to a selection of the most important literature in the field. In order to help the reader to trace them the red lines have been illustrated in Figure 3.3. The survey starts with a presentation of the classical decision-making mo-

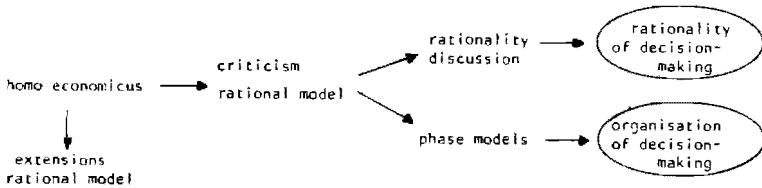


Fig. 3.3. Red lines of the survey.

del, then discusses its shortcomings without fundamentally questioning its assumption leading to certain extensions of the model (Chapter 3.1). We next discuss some fundamental criticisms of the model along two lines. First the rationality discussion about bounded rationality, incrementalism, etc. (Chapter 3.2) and then the second important result of the fundamental criticisms: the focus on the cognitive learning process which leads to the so-called phase models of decision-making (Chapter 3.3). Both lines of argument will finally result in our two problem formulations.

3.1. THE HOMO ECONOMICUS MODEL

The theory of decision-making has its roots in the classical model of the so-called homo economicus, the representation of the purely rational decision behaviour of economic man (McGuire, 1964). Until the breakthrough of Simon's (1945) ideas on organisational decision-making this model actually was the only important one on decision-making. The development of the modern theory on decision-making in organisations originated from this model, and I will therefore present my survey as a critique on this model.

The rational homo economicus has complete information about the decision-situation. He knows the decision alternatives that he can choose from; he knows the situation he is in; he has complete information about the profit that each alternative will offer him in each situation and he strives at maximalisation of that profit. In order to show most clearly what the essential elements of the model are I will give its formal representation first.

Given:

- a set of alternative actions A ;
- a set of states S ;
- a model M of the decision system indicating which action will lead in a certain state to what next state (consequence)
 $M : A \times S \rightarrow S$;
- a preference ordering over the states, represented by a value function $V(s)$.

Then in situation s_j the economic man will choose that action alternative a_i which gives him a maximum value $\max V(s_k)$ with $s_k = M(a_i, s_j)$.

This model can be characterised by the three clusters of assumption that underly it, namely the assumptions about the information, about the preference ordering and about the decision rule (Kirsch, 1977, p. 27).

The information assumption

In the model the set of alternative actions, the set of alternative states and the model of the decision system are assumed to be known. This knowledge is, however, not necessarily deterministic. In classical decision theory three cases are distinguished, namely decision-making under certainty, under risk, and under uncertainty. One speaks of decision-making under certainty when the decision-maker knows exactly what state will occur, that is, the deterministic case. Decision-making under risk introduces the element of probability into the information. The decision-maker no longer knows exactly what state will occur but only knows a probability distribution over the possible occur-

ring states. When, moreover, even this knowledge of probabilities of occurrence of states is not available to the decision-maker one speaks of decision-making under uncertainty. Although this tripartition seems to imply that the decision theory also deals with decision situations with little information, this lack of information is not so great. Even the type of decision-making under uncertainty still presupposes strong information assumptions. All three types namely assume that the set of possible actions, as well as the set of possible states, and the preference ordering are still known. The 'risk' and 'uncertainty' applies only to the model of the decision system. Decision-making under certainty assumes a deterministic model M which can be represented by a mapping $M : A_t \times S_t \rightarrow S_{t+1}$. Decision-making under risk replaces the mapping by a conditional probability function $M(s_{t+1} | a_t, s_t)$ while decision-making under uncertainty completely lacks such a function. Even an 'uncertain' decision-maker still knows, however, what possible states can occur. The decision-maker might have uncertainty as to the occurrence of the states, but none as to the states themselves. These are precisely defined. Classical decision theory does not deal with this latter underlying information assumption¹.

The preference ordering

The second essential assumption of the purely rational model is the preference ordering. The decision-maker is supposed to be able to order all possible states according to his preference. Formally this means that he has at least a weak ordering over the set of states, that is, for each two states the decision-maker either prefers s_1 to s_2 , or prefers s_2 to s_1 , or prefers s_1 to s_2 and s_2 to s_1 , that is, he is indifferent between s_1 and s_2 ; the preference relation is transitive, reflexive and complete (see Gordon, 1967 or Suppes, 1960). Under certain conditions this preference ordering can be represented by a value function: $V(s_1) \geq V(s_2)$ iff s_1 is preferred or indifferent to s_2 . In order to be able to also use this preference ordering or value function in situations of decision-making under risk and uncertainty, there are however some additional requirements. This has led to an axiomatic treatment resulting in the utility function theory (von Neumann and Morgenstern, 1947; Fishburn, 1964, 1970). Starting from a basic set of assumptions (axioms) concerning the preference ordering a particular kind of function is derived. Roughly speaking the axioms are the following (Luce and Raiffa,

¹ Recently a new kind of mathematics called 'fuzzy set theory' has emerged, which does deal with this information assumption. For a survey of the contributions of this theory to decision theory see Kickert (1978c).

1957):

1. all alternatives have to be comparable with each other (indifference or preference);
2. indifference and preference are transitive relations;
3. if a lottery has a lottery as an alternative, it can be decomposed into basic alternatives by means of a probability calculus;
4. if two lotteries are indifferent, they can be exchanged in a composed lottery;
5. if two lotteries have the same two alternatives, the lottery in which the preferred alternative has the highest chance will be preferred;
6. if s_i is preferred to s_j and s_j to s_k , there is a lottery with s_i and s_k which is indifferent to s_j .

(A lottery is defined as a chance mechanism with probabilities $p_1(s_1) \dots p_n(s_n)$ that the alternatives $s_1 \dots s_n$ will occur.)

This axiomatic systems leads to the existence of a real-valued function ϕ on S so that:

- s_i is preferred to s_j if and only if (iff) $\phi(s_i) > \phi(s_j)$;
- the value of the combination of s_i with probability α , and s_j with probability $1-\alpha$ is $\phi(\alpha, s_i; 1-\alpha, s_j) = \alpha\phi(s_i) + (1-\alpha)\phi(s_j)$;
- if two functions ϕ and ψ satisfy these conditions, then $\psi(s_i) = b\phi(s_i) + c$ with $b, c \in \text{Re}$ and $b > 0$.

This function is called the utility function. Note that the last conclusion means that the utility function has at least interval-scale properties.

This utility-function theory has encountered many criticisms which will be briefly mentioned here. First, psychological experiments into the behaviour of individual decision-makers have revealed that the preference ordering of an individual is often not even transitive, let alone cardinal. The explanation of this intransitivity is usually sought in the composed character of the measurement scale, that is, the preference function of one object is in fact related to various different characteristics of the same object. A one-dimensional representation of such a composed measurement might indeed lead to intransitivity. In economy the criticism has mainly concentrated on the interval-scale properties of the function. This criticism has led to the development of alternatives, such as the indifference curves: instead of assuming that the utility values possess interval-scale properties so that the utility of two goods is equal to the sum of the separate utilities, the utility of the combination of the two goods is determined directly. This results in

the so-called indifference curve that only presupposes ordinal characteristics (Edwards, 1954).

A third criticism on the utility-function theory is concerned with its tautological character in explanations. Although at first sight it seems rather easy to ask a person for his preferences, this sometimes is impossible. The only way to obtain a utility function then, is to ask the person how he would decide in certain situations, and reconstruct the function from these data. It is however a tautology to use this function then to explain or predict². For a humorous, indeed witty presentation of similar criticisms see Wagenaar (1977).

The decision rule

The third essential assumption of the homo economicus model is its decision rule to choose optimal alternatives. In the case of decision-making under certainty the decision-maker chooses that action which will maximise his utility (choose a_i such that $\max V(s_k)$ with $s_k = M(a_i, s_j)$). In the case of decision-making under risk the decision rule is to choose that action which will maximise his expected utility (choose a_i such that $\max \sum_k V(s_k) \cdot p(s_k)$ with $p(s_k) = \sum_j \sum_k M(s_k | a_i, s_j) \cdot p(a_i) p(s_j)$). In the case of decision-making under uncertainty there are a number of decision rules. One of them is the minimax decision rule which reads that the decision-maker should choose that action which will give him the highest utility in the worst possible situation. This essentially 'pessimistic' decision rule can be replaced by the 'optimistic' maximax rule to choose that action which will give highest utility in the best possible situation. A compromise decision rule is that of Hurwicz which is a weighted combination of both optimistic and pessimistic rules according to a certain parameter which indicates how optimistic the decision-maker is (for an extensive treatment of these rules see Luce and Raiffa, 1957).

Apparently there are various alternative decision rules. The problem, however, is that it is impossible to decide when what rule should be used. Each rule is derived from some appeal to common sense and it can in fact be argued that they all in some way represent the meaning of 'rational' decision-making. It is however not difficult to construct hypothetical situations in which the different rules lead to different outcomes. This induced Stegmüller (1969, Ch. VI.7) to conclude that there is no unique rationality criterion for decision rules.

² We will return to this question when discussing the goal concept in Chapter 4.1. It will be shown there that explanations by means of a goal are always tautologies fundamentally.

Summarising, one can say that the descriptive value of the homo economicus model is fairly dubious. It is an intentional model for the explanation (and prediction) of decision-making behaviour whose intentional assumptions are questionable from a descriptive viewpoint. As explained in the treatment of this subject in Chapter 2.1, this does not imply that the same objections hold good when this model is considered from the prescriptive viewpoint, for the intentional assumptions then become the normative fundaments. Moreover it is not necessarily true that a low descriptive (construct) validity of the model also implies low predictive validity (Cronbach, 1969). Also note that most criticisms apply to the use of the model at an individual level, which does not yet imply that the criticisms hold true at other levels of aggregation, such as the group or organisational level.

Extensions of the classical model

Apart from the criticism on the descriptive value of the homo economicus model, there is another serious criticism. It is a rather restricted model because it only deals with one decision-maker, who has one goal (preference ordering) and who decides in one step. Hence the model is surely too restricted to function as a model of organisational decision-making, where there are several decision-makers, several goals and several phases. A theory which deals with these extensions without questioning the assumptions of the underlying rational model is the mathematical-decision theory. Note that because mathematical-decision theory assumes the homo economicus model as a starting point, its descriptive validity is also highly dubious.

If we take the above-mentioned dimensions - actors, goals, phases - we can construct a three-dimensional matrix of possible decision-making models (Figure 3.4). Not all entries of that matrix are covered by some existing model from mathematical-decision theory. There are extensions on single dimensions, such as game theory (more actors), multicriteria-decision theory (more goals) and dynamic system theory (more phases). The combinations

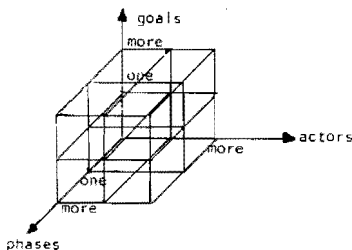


Fig. 3.4. Typology of 8 possible decision models.

are however not all elaborated. It is therefore difficult to find a classification scheme for mathematical-decision theories which starts from practical dimensions. Mathematical criteria are mostly used as classification dimensions. An example of a schematic classification of existing theories according to the person and goal dimension is given in Table 3.1. The kind of classificatory dimensions one finds in these mathema-

tical theories are, for instance, the distinction between certainty, risk, uncertainty in statistical decision theory and the distinction in the amount of interactions between persons in game theory (communication, coalitions). I will not treat these decision models here and refer the reader to the literature on mathematical decision theory (see footnotes to Table 3.1).

Table 3.1. Classification of existing decision models.

single person	single goal	statistical decision theory ³ linear programming (OR) ⁴
	more goals	multicriteria decision theory ⁵
more persons	single group	group decision theory ⁶ team theory ⁷ game theory ⁸
	no single group goal	game theory ⁸

The reason why I restrict myself to such a superficial review is that I do not think that a further elaboration of mathematical-decision theory can now be a contribution to the development of the science of organisational decision-making. As I have stated in the introduction, the primary shortcoming of decision-making science lies at the conceptual-theory level. Hence it is not useful to go into the details of the highly elaborated specialisations of mathematical-decision theory with all its stringent assumptions and rigid definitions, for these very assumptions and definitions are highly questionable. A discussion of those assumptions and definitions is indeed useful. A treatment of the mathematical techniques which start out from the assumptions and definitions is not. That is why I consider these mathematical theories useful only as thought patterns. The important advantage of using mathematics in that way is that it forces the discussion into clarity. Vague discussions at cross-purposes about rationality, for example, can now be replaced by clear discussions about well defined concepts (minimax, etc.). Vague discussions about consensus, cooperation, etc. can now be replaced by well-defined game-theory concepts. Alas mathematical-decision theorists hardly discuss these items either. It is therefore not surprising that some social scientists doubt the sense of game theory at all (de Sitter, 1971).

³ See Lehman (1959), Ferguson (1967), Wald (1950).

⁴ See Wagner (1969), Ackoff and Sasieni (1968).

⁵ See Zeleny and Starr (1977).

⁶ See Arrow (1954).

⁷ See Marschak and Radner (1972)

⁸ See von Neumann and Morgenstern (1947), Luce and Raiffa (1957).

In my view one should clearly distinguish between the use of mathematics to introduce conceptual clarity and the use of mathematics as a starting point for computation. Although from an engineering viewpoint the latter might be ideal - at last the computerised computation of optima can begin - this approach seems 'science fiction' to me in the field of 'real' non-routine decision-making. One should not force 'real' decision-making into the shackles of mathematics but use the clarity of mathematics where possible to clarify 'real' decision-making.

3.2. RATIONALITY DISCUSSION ⁹

The first well-known criticism on the limits of rationality, that is, on the fundamental assumptions behind the homo economicus model, was given by Simon (see Simon, 1945; March and Simon, 1958). His objections stem from the point of view of a limited information processing capacity on the part of the decision-maker and can be grouped according to the main ingredients of the model:

- not all alternative actions are known a priori;
- not all possible effects are known a priori;
- which action will have what effect is not completely known a priori;
- not optimal but satisficing decisions are taken.

These objections together lead to the two main theses of Simon's concept of 'bounded rationality':

- in general, alternative actions and effects are not given but have to be discovered and developed after a search process;
- in general no optimal decisions will be taken, but the decision-maker will be content with satisficing solutions.

In this section of the survey I will concentrate primarily on the second thesis and show how decision-making science has evolved from this starting point.

Satisficing

The 'satisficing' principle is commonly regarded as a serious criticism of the concept of rationality in decision-making. Basic to the concept of rationality is a complete preference ordering from which the best solution is taken, that is, rationality equals optimality. Bounded rationality no longer meets the optimality principle.

Simon's proposal of the satisficing concept is closely related to the psychological theory of aspiration level. The aspiration level is namely defined as the performance level which an individual intends to attain. Therefore I will briefly treat this theory here.

⁹ Rationality will be discussed at length in Chapter 4. Here I more or less restrict myself to a 'unprejudiced' presentation.

In the classical article on the level of aspiration by Lewin et al.(1944), the theory is presented as one on the goals of individuals and the effect on the behaviour of individuals of non-attainment of those goals. In fact it is a theory on goal adaptation. I will however restrict myself to the definitional considerations about the level of aspiration. The behaviour of an individual pursuing a goal can be represented as an adaptation of his goals to the attained results (Figure 3.5).

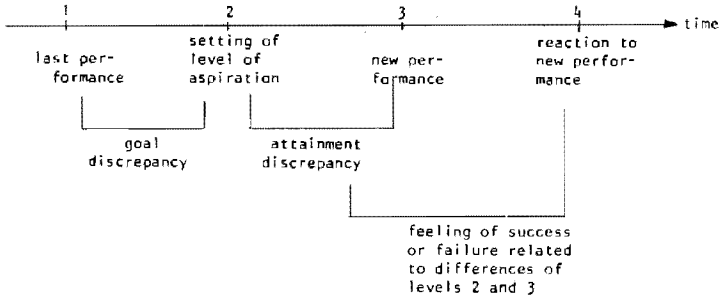


Fig. 3.5. Typical time sequence (Lewin et al, 1944).

The definition that Lewin et al.(1944) attach to the level of aspiration is:

"the level of future performance in a familiar task which an individual, knowing his level of last performance in that task, explicitly undertakes to reach".

This level is therefore different from the goal which the individual would like to reach (ideal goal). The level of aspiration is usually considered as an approximation of an 'action goal'. The concept that is introduced to explain the change of this level is the 'goal discrepancy', that is, the difference between last performance and new level of aspiration. A typical conclusion from psychological experiments is that most people will tend to keep this 'goal discrepancy' positive. Moreover, it shows that the level of aspiration will generally be raised when the performance reaches the level and will be lowered when the performance falls below it. As already stated, I am more interested in the formal theory of the level of aspiration. We will see namely, that the theory strongly resembles the utility-function theory. The theory about aspiration levels is called a 'resultant value theory'. An individual will namely be 'coerced' in fixing his level of aspiration by the values which the different difficulty grades (L) have for him. The performance of an individual is divided into success and failure so that two value functions can be distinguished: the negative value of failure $V_{\text{failure}}(L)$ and the positive value of success $V_{\text{success}}(L)$. To-

gether with the subjective values of expectation of success $Po_{\text{success}}(L)$ and of failure $Po_{\text{failure}}(L)$ these values determine the driving forces behind the individual, namely coercion towards success $f_{\text{success}}(L)$ and towards failure $f_{\text{failure}}(L)$. The resulting force $f^*(L)$ is then defined by:

$$\begin{aligned} f^*(L) &= f_{\text{success}}(L) + f_{\text{failure}}(L) = \\ &= (Po_{\text{success}}(L) \cdot Va_{\text{success}}(L)) - (Po_{\text{failure}}(L) \cdot Va_{\text{failure}}(L)). \end{aligned}$$

The part of L where the resulting force $f^*(L)$ is greatest will then be chosen as the 'action goal'. Hence

aspiration level $\hat{A} \triangleq L^*$ where $f^*(L)$ is maximal.

The aspiration level depends on three factors: the attractiveness of success, the unattractiveness of failure and the subjective estimations of the chances of both outcomes (Lewin et al., 1944).

The resemblance between this way of putting things and the theory of optimisation of expected utility is clear. The driving force is similarly defined as the product of value times chance and the outcome of the procedure is likewise an optimum. Moreover, the conceptual difference between 'the value of the success of a performance to an individual' and 'the value of a performance to an individual' seems a rather vague difference of interpretation.

Observe that the fact that it has empirically been proved that the 'goal discrepancy' will mostly be kept positive, seems to imply that the level of aspiration is indeed aspired to but never attained¹⁰. In this sense Simon's satisficing level would be different from the level of aspiration. This former level is namely one which the alternative has to exceed before it is chosen; each decision action presupposes that the level is reached. Moreover, we have to remember that the theory of levels of aspiration is a theory about how people fix and adapt their goals. Nevertheless, there are enough resemblances to conclude that 'satisficing' and 'level of aspiration' are strongly related concepts.

Summarising, one can say that it is a strange paradox that on

¹⁰ This is not altogether clear because 'goal discrepancy' is defined as the difference between last performance and new level of aspiration, but it seems inevitable in a stable end state.

one hand the concept of 'satisficing' essentially differs from the concept of 'optimality' while on the other the underlying theory of the level of aspiration is defined in almost the same terms, namely the 'expected utility' terms.

Incrementalism

One of the most far-reaching criticisms on the classical rational model is that of Lindblom (see Lindblom, 1959; Lindblom, 1965; Baybrooke and Lindblom, 1963), leading to his concept of 'incrementalism' (successive limited comparisons). Lindblom's argument is essentially the same as that of Simon, namely the limited information-processing capacity of the decision-maker. In his model, which is often regarded as typical for 'political' decision-making, Lindblom states that political decision-makers will tend to take decisions which do not differ much from the status quo, that is, from the previous decisions. They would need much more information to survey the effects of really 'new' decisions and this information is either not available or can not be analysed. Also, according to Lindblom there is no question of a choice out of all possible alternatives, but only of a choice out of a restricted set of alternatives near the previous decisions (the present situation). Moreover, Lindblom states that it is typical of political decision-making that the various participants will never agree on the goals of the policy in question, but only directly on the policy measures themselves (the means). The only test of goodness of a decision is the agreement between participants. Clearly Lindblom's proposals are almost completely contrary to the rational model, and that is the way he meant it, as will be clear from the scheme of characteristics of the rational and the incremental model in Table 3.2.

Table 3.2. Characteristics of the rational and the incrementalism model (Lindblom, 1959).

rational-comprehensive	successive limited comparisons
1a. Clarification of values or objectives distinct from and usually prerequisite to empirical analysis of alternative policies.	1b. Selection of value goals and empirical analysis of the needed action are not distinct from one another but are closely intertwined.
2a. Policy formulation is therefore approached through means-end analysis: First the ends are isolated, then the means to achieve them are sought.	2b. Since means and ends are not distinct, means-end analysis is often inappropriate or limited.
3a. The test of a 'good' policy is that it can be shown to be the most appropriate means to desired ends.	3b. The test of a 'good' policy is typically that various analysts find themselves directly agreeing on a policy (without their agreeing that it is the most appropriate means to an agreed objective).

- | | |
|--|---|
| <p>4a. Analysis is comprehensive: Every important relevant factor is taken into account.</p> | <p>4b. Analysis is drastically limited:
 (i) important possible outcomes are neglected;
 (ii) important alternative potential policies are neglected;
 (iii) important affected values neglected.</p> |
| <p>5a. Theory is often heavily relied upon.</p> | <p>5b. A succession of comparisons greatly reduces or eliminates reliance on theory.</p> |

In my view the essence of Lindblom's model of 'muddling through' is that it pretends to be a descriptive model of factual policy-making. Troubles arise when such a descriptive model is simply identified with and transformed into a prescriptive one. This amounts to stating reality as the norm. A criticism from this viewpoint was given by Dror (1964). Dror first states that the validity of the 'muddling through' model is low because incrementalism presupposes certain conditions (present policy must be satisfactory, continuity in the nature of the problems, continuity in the available means). His second criticism is that the main impact of the model is an "ideological reinforcement of the pro-inertia and anti-innovation forces" (Dror, 1964), which induces Dror to propose his own model (Dror, 1968), which is normative but based on reality. Essentially Dror's argument is a methodological one: prescriptive (normative) models should indeed be based on a description (model) of reality but the descriptive model can not simply be equalised to a normative one. Neither Dror (1964) nor Lindblom in his reply to Dror (Lindblom, 1964), seem to have understood this point. Lindblom replies that incrementalism should indeed be considered as a 'good' norm. Dror presents his alternative third model as a mix of rationalism and incrementalism.

Mixed scanning

Besides these antitheses on rationality there are also some syntheses. Etzioni (1967) has proposed a model which explicitly combines both the rationalistic model and the incrementalist model into a 'third' approach to decision-making which he calls 'mixed scanning'. According to Etzioni, incrementalism seriously underestimates the importance of 'fundamental' decisions to which rationalism but not incrementalism applies. Etzioni (1967) states that "(a) most incremental decisions specify or anticipate fundamental decisions, and (b) the cumulative value of the incremental decisions is greatly affected by the related fundamental decisions". Etzioni proposes a mixed scanning approach to decision-making consisting of a two-level strategy: first scan the entire area at an all-embracing level but not in great de-

tail, and next scan those areas revealed by the first scan to require an examination in greater depth at a highly detailed level. The first scan applies to the fundamental decisions made by exploring the main alternatives without too much detail, so that a review is feasible and the second scan applies to the incremental decisions made within the context of the fundamental ones. This type of two-levels-of-detail strategy is of course quite trivial. First get an overall view and then go into details. Although Etzioni has explicitly proposed his mixed-scanning approach as a synthesis of the rationalistic and incremental approaches, the identification of the first overall-view scan with rationalism and the second detailed scan with incrementalism seems dubious. A high level of detail seems contrary to the basic rationale for incrementalism, that is, the limited information-processing capacity of the decision-maker. In my view, level of detail and amount of rationality are independent dimensions.

Extrarationality

Although all models discussed till now deviate in some way from the purely rational model, they are clearly derived from it and indeed generally provide a realistic surrogate for that unattainable ideal, pure rationality. A completely opposite model would be the extrarational model. Practitioners in the field of decision-making often take their decisions, based on things such as 'intuition', 'judgement', 'feelings', etc. It is by no means proved that these extrarational processes do not play a central role in decision-making. Many so-called experienced decision-makers would agree and even emphasise that extrarationality should be a normative element in decision-making theory. Although some authors (see Dror, 1968; Cowan, 1975) do stipulate the importance of these aspects more or less convincingly, any serious theory on extrarational decision-making does not yet appear to exist.

'Political' decision-making

The type of decision-making which is generally considered to be far from rational, is political decision-making. To a large extent this is a misunderstanding. It is not at all certain that public policy-makers use more intuition and feeling to arrive at their decisions. This surely does not show from the literature on public policy-making theories. The reason why it seems nevertheless to be common usage to accuse politicians of non-rational decision-making has in my view more to do with a lack of insight into the concept of rationality combined with the western cultural morale in which rationality plays such a central role. The fact that politicians do not always explicitly state their goals, surely does not mean that they have none and that their

behaviour can not be explained by means of goals. The argument that policy making is a struggle for power and therefore irrational can simply be rejected by looking at the theories about power (see Dahl, 1957; French and Raven, 1959; March, 1965; March, 1966; Cartwright, 1965). Most theories about power are namely explicitly formulated in terms of goal-oriented, that is, rational behaviour. Power is a means to achieve some goal by influencing someone to do something he would otherwise not do. Only sporadically does one find theories about power where power is not a means but an end, a goal per se (Mulder, 1977). Roughly the same applies to bargaining theories¹¹.

Alternative models

The purely rational model of decision-making has encountered many severe criticisms of which some important ones were discussed. Of course numerous other criticisms on the concept of rationality exist. Most criticisms propose some alternative model. These alternative models may deviate in some way from the purely rational model, they are often still rather similar to it. In Chapter 4.1 it will be shown that the alternatives of Simon's 'bounded rationality' and Lindblom's 'incrementalism' are actually equivalent to pure rationality. There exist however criticisms on the rational model which do result in radically different alternatives.

A well-known example of some radical alternatives to the rational model is the set of conceptual models which Allison (1969, 1971) proposes. He proposes two alternatives to the 'rational policy' model, namely the 'organizational process' model - governmental decision-making behaviour is understood less as deliberate choices of leaders but more as outputs of standard operating procedures of large organisations - and the 'bureaucratic politics' model - government behaviour is understood as the output of competitive bargaining games among players positioned hierarchically within the government. Allison shows in a very convincing way how the same decision-making process - the Cuban missile crisis - observed through the three different 'conceptual lenses' does not only yield different explanations but even completely different descriptions of reality.

Another alternative to the rational model, originating from the same institute at Harvard University, is that of Steinbruner (1974). His alternative to the 'analytic paradigm' is the 'cybernetic paradigm' of decision-making based on the cybernetic 'homeostat' of Ashby (1952) and the principle of 'nearly-decomposability' of Simon (1962). Steinbruner adds to his 'cybernetic paradigm' a theory on cognitive processes, which in his view yield

¹¹ For an extensive decision-making-oriented treatment of social influence in organisations, see Kirsch (1977, III.3).

a decomposition of a complex problem in the absence of a stable environmental decomposition, that is, a structure within which the cybernetic paradigm can function.

An example of a completely different approach to decision-making can be found in the french book by Sfez (1973). The typically french habit to raise fundamental philosophical issues is clearly reflected here. Sfez presents the classical model of decision-making as a model of Cartesian decision based on the three concepts of 'linearity', 'rationality' and 'liberty', where 'linearity' does not coincide with the familiar (mathematical) notion of linearity, and 'rationality' does not seem to have the familiar meaning but rather to coincide with the philosophical concept of 'rationalism' (see Chapter 4.1), whereas 'liberty' is a quite uncommon concept in the Anglo-Saxon decision-making literature. Although much material discussed under these labels is more closely linked to the literature familiar to Anglo-Saxon scholars, there is a multitude of totally unfamiliar ideas in Sfez's book. His alternative to classical 'Cartesian' decision-making - a political theory of "surcode" - of trying to decipher the "style" of decision-making via a sequential treatment of the process, a finding of the changes and a study of the laws of change by means of psychoanalytic models, is however not clear. His proposed concepts are rather vague and they do not clearly relate to his previous criticisms. It is however not unprobable that this is due to the unfamiliarity of the present author with the intriguing and fascinating french world of ideas on decision-making. It is a pity that there are so little translations of these ideas available (for a recent survey see Ashford, 1977).

Problem formulation

The survey in this section has been limited to what I consider the most important contributions of literature to the subject. Of course there are other and better surveys of organisational decision-making, such as the classical reviews of Edwards (1954) and Feldman and Kanter (1965) and the more recent ones by Dror (1968, Chapter 12) and Nutt (1976). In my opinion the characteristic milestones in the development of decision-making theory are the classical rational model, the criticism of Simon, the further-reaching criticism of Lindblom and the synthesis of Etzioni. Others may stipulate other milestones. The striking similarity of all reviews, however, is that they highlight the importance and centrality of the concept of rationality in organisational decision-making theory, albeit just to criticise it. That is why I consider rationality important enough to be part of the problem formulation here. Although this subject has been studied by many eminent scholars and it is perhaps not very encouraging to add the hundredth contribution, I think there are some significant observations that can be made about rationality by adopting a system-theoretical viewpoint. That will be done in

Part Two.

3.3. PHASE MODELS

As has already been shown, the criticisms of Simon on the classical rational model of economic man, lead him to his concept of 'bounded rationality' the two main theses of which are:

- in general, alternative actions and effects are not given but have to be discovered and developed in a preceding search process;
- in general, no optimal decision will be taken, but the decision-maker will be content with satisficing solutions (Simon, 1945; March and Simon, 1958).

In the previous section of this survey we have concentrated on the developments following the second thesis and shown how organisational decision-making theory has evolved therefrom. In this section we will start from the first thesis and indicate the development of more process-oriented considerations on organisational decision-making.

Cognitive problem-solving processes

The main argument of Simon in introducing both theses was his viewpoint that an individual has only a limited capacity for processing information and solving complex problems. He is therefore not able to know everything in advance and is therefore not able to take optimal decisions. It is not surprising from this point of view that decision-making is sometimes just a routine response to a stimulus that has been developed and learned at some previous time (Simon, 1945; March and Simon, 1958). According to Simon the contrary of "routine" or "programmed" decision-making is "real", "problem-solving" decision-making. This problem-solving type of decision-making involves a great deal of search aimed at discovering alternative actions and their consequences. The consequence of the recognition that non-programmed 'real' decision-making is essentially a problem-solving activity, and that cognitive learning processes play such a large role in problem-solving, is clear. It implies that decision-making science should concentrate on the investigation of cognitive problem-solving processes. No wonder that after the first introduction of this theme (Simon, 1945; March and Simon, 1958) decision-making theory has in fact gradually evolved from an analytical rational theory towards a theory of cognitive learning processes (Kirsch, 1977, I-2.1).

Note that Simon's conceptual identity of decision-making and problem-solving presupposes a broader definition of decision-making than merely a 'choice between alternatives'. As Kirsch (1977, p. 70) points out this narrow definition is mostly used in cognitive psychology so that decision-making, problem-solving,

creativity, etc. are different concepts (Taylor, 1965). As will be clear from the previous discussion of the definition of decision-making (introduction of Chapter 3) I definitely do not adopt such a narrow definition but consider both concepts as largely equivalent (McCrimmon and Taylor, 1976). Simon has clearly drawn his conclusions and has since then concentrated his efforts on the investigation of human problem-solving which, after many publications, have recently culminated in a voluminous text-book on the subject (Newell and Simon, 1972). These developments will not be discussed here because they are explicitly limited to individual problem-solving and the reader is referred to excellent surveys such as that of Kirsch (1977, II).

Phase models of decision-making

The most obvious result of the concentration of decision-making theory on problem-solving processes is the taking over of the phase schemes characteristic of problem-solving. Decision-making is divided into a certain sequence of phases, such as the three phases of the model of Simon (1960): the intelligence activity, the design activity and the choice activity, which are strongly related to the three problem-solving stages: what is the problem, what alternatives are possible, what alternative is best? This is an extension of the original two-phase model of Simon's 'bounded rational man': the choice and the preceding search, with a first 'problem identification' phase. Further extensions have led to the six-phase model of decision-making that is usually adopted:

- (1) problem identification, (2) information gathering, (3) development of possible solutions, (4) evaluation of these solutions, (5) selection of a strategy for performance, (6) actual performance of an action (Brim et al., 1962, p. 9).

Note that the main extension of this scheme, compared to the previous one, is the incorporation of an implementation phase (Brim et al. also add learning and control to this phase). In this scheme the decision process is no longer concentrated on the preceding search phase alone, but a learning phase after the decision is also explicitly added. Learning is not confined to the pre-decision phase alone, but also relevant in the post-decision phase.

A recent example of a highly detailed phase model can be found in Mintzberg et al. (1976). Based on a field study of 25 strategic decision processes, Mintzberg et al. suggest that there is a basic structure underlying these processes, consisting of 3 central phases, 3 sets of supporting routines and 6 sets of dynamic factors. The three phases are (1) identification, (2) development and (3) selection, which are all further specified. In the identification phase two kinds of activities are distinguished, namely the recognition of a problem and its diagnosis.

The development phase is distinguished into the development of custom-made solutions (design) or the modification of ready-made ones (search). The selection is further specified into a screen phase, an evaluation/choice phase and an authorisation phase. The evaluation itself is divided into three modes of evaluation: judgement, bargaining and analysis (Figure 3.6). The three supporting routines are (1) decision-control routine, (2) decision-communication routine and (3) political routines. The dynamic

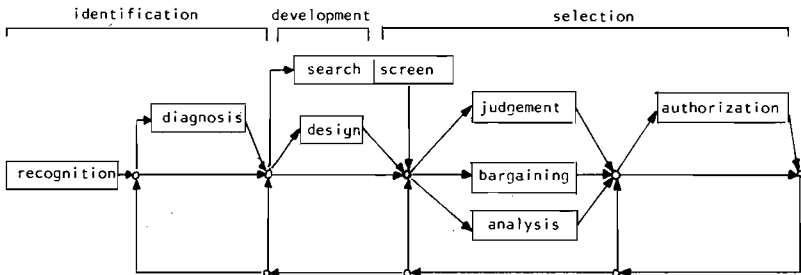


Fig. 3.6. Model of strategic decision process (Mintzberg et al, 1976).

factors are divided into six groups: (1) interrupts, (2) scheduling delays, (3) timing delays and speedups, (4) feedback delays, (5) comprehension cycles and (6) failure recycles. In my view the most important contribution of this model is that it explicitly makes clear that the phases are not gone through sequentially, but that interrupts, delays, cycles, feedbacks, etc. can occur so that several phases may be passed through once several times, or even omitted and that the resulting sequence is certainly not straightforward. The six dynamic factors account for these kinds of deviations. The supporting decision-control routine accounts for the metacontrol of this process, in other words, the decision-control routine constitutes the metadecision-making. The essential contribution of Mintzberg et al. is that they explicitly state that the different phases in the process will not form a straightforward linear sequence but will follow each other in an arbitrary way depending on endogenous or environmental situations determined by political factors, conflicts, available information, etc.

This last addition is essential in view of the serious objections that have been made against the descriptive validity of the phase models. In an extensive field research on complex decision-making processes Witte (1972) has criticised the phase scheme severely. In his research into 233 cases of decision-making Witte has investigated the thesis that distinct phases could be distinguished. Witte reduced the six-phase model of Brim et al. (1962) to a three-phase model consisting of (1) gathering

of information, (2) development of alternatives and (3) evaluation of alternatives. It is quite probable that if these three can not be verified the six-phase model can also be rejected. It indeed turns out that the hypothesis must be rejected that the maximum number of activities of the different phases fall within the different intervals. Even when the decision-making processes are subdivided into subprocesses and considered each apart, the hypothesis must be rejected. The activities of the different phases are rather distributed over the total duration of the process. Consequently, the descriptive validity of the phase model is low. The obvious reply that the model should be considered as a normative model, has also been studied by Witte. The hypothesis that if a complex decision-making consists of the sequence of the three phases, then the final decision will have a higher efficiency than otherwise, was found to be false. The phase model is therefore neither a valid descriptive nor a valid normative model. It is indeed astonishing that a model which is widely accepted, and has even become a central theme, and from which many theoretical and practical consequences have been derived, can not even be empirically validated either descriptively or prescriptively (Witte, 1972).

It will now be clear why such importance is attached here to the explicit addition of Mintzberg et al. (1976) that the phase model is no rigid straightforward sequence but that a decision-making process is characterised by a continuous switching between the distinctly separate phases. The phase model is only a very approximate scheme of decision-making processes and only expresses a general tendency (Kirsch, 1977, I, p. 75). It should be noted that Witte (1972) has found that the phases do not follow a rigid sequence, but that he has not falsified that the phases exist. Nor did he falsify a switching circuit of arbitrarily coupled phases. I am, however, afraid that it would not be so easy to verify this last thesis, so that one had better be careful in using the phase model.

Alternative models

In view of this criticism on the problem-solving phase model of decision-making it seems useful to stipulate that there are alternative models of decision-making which also illustrate a decision-making process as a sequence of phases but not derived from the cognitive problem-solving process. A well-known example of such a model is the one that Cyert and March (1963) propose. Organisational decision-making is divided by them into four types of operations, namely (1) quasi-resolution of conflict, (2) uncertainty avoidance, (3) problem-oriented search and (4) organisational learning. Their model is shown in Figure 3.7. This model also consists of a series of sequential phases. The phases are however not derived from problem-solving processes but seem to be related to the cybernetic model of a hierarchical

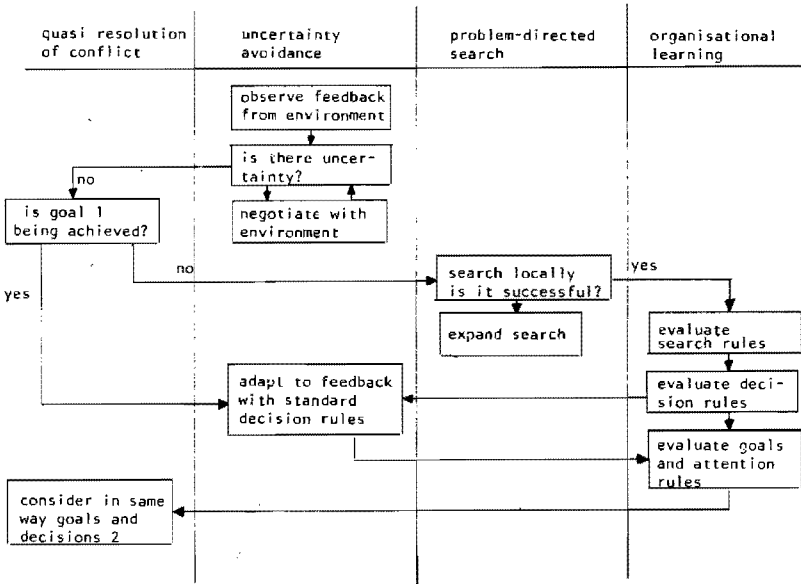


Fig. 3.7. Organisational decision process in abstract form (Cyert and March, 1963).

regulator: the 'lowest' operation is the exchange of information with the environment, the next-higher operation is the factual control, which is governed by an adaptive controller which in turn is governed by the 'highest' operation, goal adaptation.

A recent alternative model of organisational decision-making which explicitly considers itself as an antithesis to the usual phase model of generation of alternatives, examination of their consequences, and final decision, is the 'garbage can' model of Cohen, March and Olsen (1972). They consider a type of organisation which they call 'organised anarchies'; such an organised anarchy is characterised by: (1) problematic preferences, (2) unclear technology and (3) fluid participation. A theory dealing with organised anarchies should consist of a theory about decision-making under goal ambiguity, a theory about the attention patterns and a revised theory of management. They propose a behavioral theory of organised anarchy which contains four main elements: (1) problems, (2) solutions, (3) participants and (4) opportunities for choice. In their view

"an organisation is a collection of choices looking for problems, issues and feelings looking for decision situations in which they may be aired, solutions looking for issues to which

they might be the answer, and decision-makers looking for work".

"To understand processes within organisations, one can view a choice opportunity as a garbage-can into which various kinds of problems and solutions are dumped by participants as they are generated".

"A decision is an outcome or interpretation of several relatively independent streams within an organisation" (Cohen et al., 1972, p. 2).

Obviously their model is almost the opposite of regarding decision-making as a rational problem-solving process. It is a purely descriptive behavioral model for very 'bad' decision situations. According to Cohen et al. these situations occur quite often however and it is therefore important to understand these processes so that they can eventually be managed, something they have tried to achieve by means of computer simulations.

As a matter of fact the 'garbage can' model seems to have a similar function with respect to the phase model as the 'incrementalism' model had to the rational model of reality. Hence the same remarks also apply here: although a descriptive model of reality is in fact a prerequisite for improvement, the descriptive model can not simply be raised to the status of a norm.

Problem formulation

In the second part of the survey another line of thought underlying the development of organisation decision-making science has been pointed out, with emphasis on the process aspect of decision-making. This part has been coupled to one of the two main theses of Simon's 'bounded rationality' concept: the search process, just as the first part was coupled to Simon's other main thesis: the satisficing concept. It has been shown how the identification of decision-making with problem-solving has resulted in typical cognitive learning-process models of decision-making. Obviously organisational-decision theorists are convinced of the importance of the dynamics of decision processes. The next step, however, is to realise that organisational decision-making processes consist of more than phases alone. Time is only one of the dimensions which span the space of decision processes. It is in fact rather surprising that most of the research effort in organisational decision-making has been put into this aspect alone, whereas it is obvious that numerous other structural aspects also play a role. Examples of structural models of decision-making which deal with more than phases alone, are rare (Gore, 1964). This is one of the great contributions of the 'garbage can' model of Cohen et al. (1972). Consequently the main objective of the present research will be to make a contribution towards the development of a more general theory on the structure of decision-making processes, or to use a term which has both a descriptive and a prescriptive meaning, a theory on the organi-

sation of decision-making. This will be the subject of Part Three of this book.

PART TWO

RATIONALITY OF DECISION-MAKING

CHAPTER FOUR

RATIONALITY OF DECISION-MAKING

Rationality in general, and rational decision-making in particular, is a subject on which a very extensive literature already exists. Although the prospect of adding yet another contribution to the subject is rather daunting, I shall nevertheless put forward some ideas which I think may shed some additional light on the subject. I think that an analysis of the essences of the concept of a goal, which is the basic concept behind rationality, reveals some new ideas about rationality.

There are three issues to be discussed in this chapter. First, some ideas on rationality used as a descriptive concept for explanation. The intention is to indicate how the concept can be generalised and what the consequences of such a generalisation are (Chapter 4.1). Second, it will be shown that by adopting a different view of the concept of a goal the criticisms on rationality such as 'bounded rationality' and 'incrementalism' can still be considered as forms of rationality (Chapter 4.1). Finally, two forms of rationality which accentuate the process of decision-making, namely the concepts of 'procedural' and 'structural' rationality will be introduced. These concepts will be related to structural decision-making, that is, the organisation of the decision-making process (Chapter 4.2). These latter concepts will be illustrated by means of a case study on the construction of a new hospital (Chapter 4.3). I will show that the concept of rationality also leads us to the subject of the organisation of decision-making. In this sense the last two sections of this chapter form a transition to Part Three where this latter subject is extensively discussed.

4.1. SOME CONSIDERATIONS ON RATIONALITY

In the discussion on rationality the philosophical meanings of the concept, such as the philosophical concept of 'rationalism' that considers reason as the chief instrument and test of knowledge (Blanshard, 1965; Williams, 1967) will not be dwelt upon. Rationalism is often characterized by the ideas of the

eighteenth-century thinkers of the enlightenment, particularly in France, who emphasised the power of scientific reasoning. Reason was praised in contrast with faith, traditional authority, fanaticism and superstition. It chiefly presented, therefore, an opposition to traditional Christianity. Rationalism in philosophy is however mostly contrasted with empiricism, against which rationalists have sought to show that our most certain and significant knowledge comes not from sense experience but from reason. As opposed to empiricism, which holds that all knowledge comes from perception, rationalism maintains that our knowledge primarily comes from intellectual insight. This appears most clearly in logic and mathematics, so that it is no wonder that distinguished mathematicians like Descartes, Spinoza and Leibniz are the clearest exponents and founders of this type of rationalism. Although the debate of rationalism versus empiricism is very interesting and relevant to the understanding of the development of the school of Logical Positivism, for instance, the author will stick to his last thus preventing philosophical misunderstandings by laymen. Neither will he dwell upon the ideas of Weber (1964) about 'Zweck Rationalität' and 'Wertrationalität' nor on the ideas of Mannheim (1940) about 'functional' and 'substantive' rationality (Aron, 1967), but restrict himself to the concept of rationality as it is commonly used in decision-making. The intention is not to restart a general discussion about rationality but only to sketch out some ideas about it arising from simple system-theoretical considerations.

Rationality in decision-making behaviour is a concept that deals with behaviour¹. As behaviour is generally considered to be a choice made between alternatives, rationality is therefore a concept which deals with the way one chooses between alternatives. The concept of rationality is used and defined in many different ways. Misunderstandings usually arise when the concept is applied without a precise definition. The definition of rationality that is commonly adopted in decision science literature, as well as in the present instance, is that rational behaviour is goal-oriented behaviour. For an extensive treatment of the many considerations that led to this definition the reader is referred to the 'classics' on rationality in organisational decision-making of Simon (1945) and March and Simon (1958), to a recent extensive treatment in Dutch literature by Koch (1976) or to the excellent treatment by Kirsch (1977). In view of the central role which the goal concept plays in rationality it would be as well to consider that concept first.

¹ Rationality is explicitly related to observable behaviour and considerations about rationality in terms of intrinsic human intentions, attitudes, instincts, drives, etc., which are not behavioural concepts are thus excluded. Actually this amounts to a 'behaviouristic' stance.

Goal concept

A goal is defined as a preference ordering over alternatives. This general definition can be specified in two ways, first by specifying the kind of ordering and second by specifying the set of alternatives. Let me present the exact system-theoretical definitions ² (de Leeuw, 1974, Ch. 5.3; Hanken and Reuver, 1977, Ch. 3).

Given the set of all the alternatives that a decision-maker has, the goal set $Z = \{z_1 \dots z_n\}$. Given the weak preference relation R , where $z_i R z_j$ denotes that z_i is preferred to z_j or that one is indifferent to both z_i and z_j . Then a goal is defined as a weak ordering ³ over the goal set, that is, (1) for each $z_i, z_j \in Z$ either $z_i R z_j$ or $z_j R z_i$ or both $z_i R z_j$ and $z_j R z_i$ (completeness), (2) $z_i R z_i$ (reflexivity) and (3) if $z_i R z_j$ and $z_j R z_k$ then $z_i R z_k$ (transitivity). Under certain conditions the preference ordering relation can be presented by value function $V(z_i)$ so that $V(z_i) \geq V(z_j)$ if and only if $z_i R z_j$. Obviously the numerical scale of that function possesses ordinal characteristics only. As to the set of alternatives - the goal set - it must be emphasised that this should consist of all relevant alternatives, that is, the goal set should not be constrained to desired outputs or end-states only, but should incorporate inputs, actions, states and outputs at all relevant time instances. The value function V applies to the cartesian product of input space X , action space U , state space S and output space Y during the whole time period $V : X(t) \times U(t) \times S(t) \times Y(t) \rightarrow \text{Re}$ ⁴.

In (de Leeuw, 1977; Hanken and Reuver, 1977) several deviating forms of the goal concept are discussed. Although the mathematical definition might give the impression

² For typically organisation-science treatments on the concept of organisational goal the reader is referred to Simon (1964), Cyert and March (1963) and Kirsch (1977).

³ There are many kinds of mathematical orderings (Gordon, 1967). In general, any transitive, reflexive binary relation is called a (quasi) ordering. Examples of a quasi-ordering are implication and partition, i.e. the 'if, then' and the 'subset of' relations. A complete quasi-ordering is called a weak ordering. An example of this is the relation 'as high as'. If a quasi-ordering possesses an equivalence relation it is called a partial ordering, e.g. the relation 'smaller or equal to'. A complete partial ordering is called a simple ordering. Finally an asymmetric transitive complete quasi-ordering is called a strong (or linear) ordering. An example of a strong ordering is the relation 'smaller than'.

⁴ If 'means' is interpreted as the system input to obtain some system output, whereas 'ends' is defined as an ordering over the system output, this general definition of a goal implies that 'means' and 'ends' become conceptually identical concepts, i.e. orderings over sets of alternatives which determine the process.

that a goal should always be specified quantitatively and exactly, this is not the case. In Chapter 3.1 the axiomatic treatment of the preference ordering resulting in the utility function theory (von Neumann and Morgenstern, 1947; Fishburn, 1964, 1970) has been discussed. It has been observed that the existence of a real-valued function with interval-scale properties was certainly not always guaranteed. Several criticisms on this formal function were mentioned which I will not repeat here.

Sometimes the goal can be incomplete, that is, there is an ordering but the relative preference from several pairs of alternatives is not known. The ordering is still reflexive and transitive but not complete. It is then called a quasi-ordering (Gordon, 1967). Figure 4.1 illustrates this situation: 1 is preferred to 2, 2 to 4, 1 to 3 and 3 to 4.

Transitivity yields that 1 is also preferred to 4. The preference ordering of 2 and 3 is, however, unknown⁵.

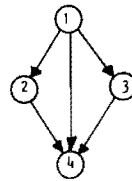


Fig. 4.1. Incomplete ordering.

Third, the goal could assume the form of a partitioning of the set of alternatives into a set of derived alternatives and a set of undesired alternatives. The goal is then defined as a subset. Note that this form still meets the definition of an ordering, though there are only two classes of preference: preferred and not-preferred. In spite of the yes/no character indicating nominal scale properties, the 'subset of' relation is a weak ordering. An example of such a goal is the 'satisficing' principle of Simon. Constraints indicating boundaries for the solution are also examples of this type of goal.

Besides weaker forms of ordering stronger requirements are sometimes applied to the ordering. The set of requirements to the preference ordering that are made in statistical decision theory leads to the real-valued interval-scale utility function discussed in Chapter 3.1. Obviously the ordering of alternatives is supplemented there by the additional requirement that differences between alternatives are also ordered.

Goals can have a composed character, that is, goals can apply to a composed set of characteristics of the considered alternatives and the goal itself can have a multidimensional vector form (a composed set of orderings). In mathematical terms this means that the goal represented by a real-valued function $V : Z \rightarrow \text{Re}$ can either apply to a number of characteristics ($V : Z_1 \times Z_2 \times \dots \times Z_n \rightarrow \text{Re}$) or can be multidimensional ($V : Z \rightarrow \text{Re}^n$). An example of the latter is the so-called lexicographical ordering in

⁵ One should not confuse this incomparability with equivalence. 2 and 3 are equivalent if 2 is ordered above 3 and 3 above 2, that is, if one is indifferent between them.

which case there is a dominance between the orderings: first the alternatives are ranked according to the most important aspect, then according to the next-important aspect, and so on. An example of the former is, e.g. the preference ordering of cars. This preference is composed of a set of characteristics, such as speed, comfort, fuel consumption rate, price, etc., all summing up to a single composed ordering of cars. The goal can apply to a sequence of alternatives in time. The goal is then a goal trajectory. In fact this is an example of a composed goal; the preference is not composed of a set of characteristics but of a set of elements in time. Moreover, the goal can itself be changing in time.

All the previous deviations of the goal concept sometimes make it very difficult to state goals explicitly. In fact one of the major criticisms against typically goal-centered policy-making procedures like PPBS (see van Gigch, 1974; Eyzenga et al., 1977) or its Dutch version COBA, is that the goals needed in the procedure can be made explicit. This serious difficulty can be overcome by reducing the requirement of a goal - an explicit ordering over alternatives - to the much weaker requirement of an evaluation. The theory of control shows that for effective control it is not necessary to have a complete ordering over all relevant alternatives but that an evaluation mechanism which can evaluate the system variables relevant at the time is already sufficient. It is not necessary to have complete ordering over all output alternatives (Figure 4.2) but an evaluation of the output at the time compared to the previous one (Figure 4.3) is sufficient. In the

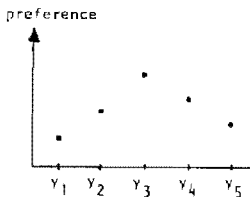


Fig. 4.2. Complete ordering.

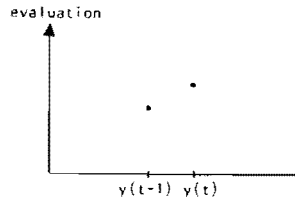


Fig. 4.3. Evaluation.

former case the overall optimum is known. In the latter case one only knows whether the output at the time is better or worse than the last one. In fact an evaluation is an example of a very incomplete preference ordering, that is, an ordering of two alternatives only. A practical consequence is that any kind of evaluation mechanism, such as a group of experts reaching some consensus about the judgement of expected effects or actions, will do. The goal concept where actions are to be tested as to the desired ends, is replaced by the 'test' in which experts have to reach agreement as to the goodness of the actions. Instead of

having never-ending discussions about goals one can now directly proceed in some assembly or other to the discussion and evaluation of concrete cases.

Finally some observations on the concept of a goal as a tool for explanation. As has been shown in Chapter 2.1 it can methodologically be argued that a goal is no intrinsic property of any person. No system whatsoever, hence no person either, 'has' a goal. A goal is a theoretical concept which is attributed to a particular system in order to explain its behaviour (de Leeuw, 1977). A goal is no system property but a model property. Hence the question whether it can empirically be proven that a certain person 'has' some goal is irrelevant. The only criterion is whether the person's behaviour is adequately explained or not. The so-called a posteriori rational reconstruction of some behaviour by attributing some goal to the person afterwards, which is often considered an abuse of rationality as an explanatory tool, is no abuse at all. Explanation by means of a goal is always rational reconstruction.

Rationality

Rational behaviour being defined as goal-oriented behaviour, the presented formal definition of the goal concept implies that a rational decision-maker chooses that alternative action which corresponds with a maximal preference or the resulting outcome. This latter strict definition of rationality is very clearly reflected in the classical decision-making model, namely the model of homo economicus (see Chapter 3.1). This model where 'economic man' chooses the most preferred, i.e. the optimal alternative as his decision, is in fact the pure exponent of rational decision-making.

Note that in this definition rationality only applies to how the decision-maker chooses. As long as the revealed behaviour is consistent with the given goal, the behaviour is rational. This form of rationality which only applies to the proper choice of means to attain a certain end is called 'formal rationality' by Kirsch (1977, p. 63) and corresponds to the concept of 'Zweckrational' of Weber and 'functional rationality' of Mannheim. It can be contrasted to a form of rationality which also applies to the ends themselves ('Wertrational' with Weber and 'substantial' rationality with Mannheim). These goals should also be motivated by a rational choice. The commonly adopted definition of rationality however does not apply to the ends but only to the means. Note moreover that the formal definition precludes the often heard remark that only individuals can be rational because only individuals can have norms, values or goals. The formal definition of a goal as a preference ordering applies to any decision-making entity. The fact that this concept is extensively applied in a purely technical science like optimal control theory (Elgerd,

(1967) also supports this conclusion. A computerised automatic control system is a purely rational decision-making system.

Explanatory rationality

If one considers descriptive decision theory one could even state that the concept of a goal has been completely misunderstood when it is stated that only individuals can have a goal. The concept of a goal is used in descriptive decision theory as a theoretical construct to explain the decision-making behaviour. From this theoretical concept of a goal, a theoretical behaviour is predicted and the factual behaviour is called rational if it meets the predicted behaviour. Hence goals are no intrinsic quantities of the observed systems; goals are attributed to a system in order to explain its behaviour. So there is no question of individuals having goals. A goal is a theoretical and attributed concept (de Leeuw, 1977).

Clearly this view radically differs from the classical view about rational explanation. As stated in Chapter 2.1 the pattern of rational explanation can be represented in the following scheme (Sarlemijn, 1977):

- (1) the implication $p \rightarrow q$, plus the implicans p , implies q ;
- (2) the actor wishes that q is true (goal);
- (3) the actor reasons on the line of argument (1).

As mentioned in Chapter 2.1 the classical methodological criticism on rational explanation is that this pattern is essentially prescriptive; it prescribes what a person should do, not what he does. Only if one assumes that acting persons have a goal and that actors behave in the rational way (assumptions 2 and 3), can the pattern be used as a scientific explanation of factual behaviour. These last two assumptions (2 and 3) however constitute a hypothesis about the existence of an empirical scientific law (Stegmüller, 1969, VI-7.d). In order to make this pattern of explanation a scientific one, assumptions 2 and 3 should be empirically validated, i.e. it should be proved empirically that actors are rational and behave rationally. This line of argument forms the methodological basis for statements that rationality only applies to individuals because only individuals 'have' a goal. From this point of view the statement that 'a goal is a theoretical and attributed concept' (de Leeuw, 1977) is false. We have however shown in Chapter 2.1, that the empirical confirmation of such intentional presumptions about reality, such as the rationality assumption, can seriously be doubted. In the modern methodological view that objective reality does not exist (Lakatos, 1970) intentional presumptions are hardly testable, for one can not test norms and values. In this latter view the rationality assumption no longer has to be empirically confirmed, and consequently the statement that a goal is a theoretical and attribu-

ted concept indeed holds good. So we see that though this interpretation of rationalism could be false from a classical methodological point of view, it holds good from a modern methodological point of view.

If one proceeds along the line of argument that a goal is just a theoretical attributed concept serving as an explanatory technique, one can draw some interesting conclusions about rationality. The concept of a goal serves as an explanatory technique. Any other concept to explain behaviour would accomplish the same purpose. Indeed we often see an equivalence between explanatory theories with and without a goal. In my opinion this leads to the conclusion that the definition of rationality as goal-orientedness is not sufficiently general, whereas the theoretical usefulness of a concept is mostly supposed to be proportional to its generality (Koningsveld, 1976). I might therefore suggest the adoption of a more general definition:

rational behaviour is explainable behaviour.

This more general definition implies that not only the goal but also the whole theory of decision-making is a basis for that explanation. In fact this definition or rationality as the whole from which the decision-making behaviour can be explained, means that rationality is related to the concept of a model. For in dynamical systems explaining is equivalent to prediction, which is actually the main task of a dynamic model.

So rational behaviour is a behaviour that can be modelled. This definition of rationality differs from the former one in more than one sense. The definition in terms of a goal applies to the real system of decision-making (or to a theory about it), but the latter definition applies to the reconstruction of a model from reality. The latter concept looks more like the methodological concept of rational reconstruction. Note furthermore that in this latter definition, scientific theories of decision-making behaviour per definition deal with rational behaviour. As soon as a theory of that behaviour exists, that is, as soon as a theory explains that behaviour, the behaviour must be rational. With this definition of rationality the rationality assumptions of organisation theories like the 'under norms of rationality' theses of Thompson (1967) would automatically be satisfied.

It is indeed clear that this definition of rationality is much more general than the definition in terms of a goal, maybe too general if one sees its implications (schizophrenic behaviour that can be modelled, is rational). It rather seems that by destroying the common meaning that rationality has as a concept in social science theory, this proposed definition renders the concept deductively useless, so that it will not be used furtheron.

Criticisms of rationality

The criticisms of rationality presented in the survey Chapter 3.2 will now come in for discussion again. It can be shown that,

by adopting a different view about the concept of a goal - the central key element of rationality - the criticisms on rationality can still be considered as specific instances of rationality. As stated above, the classical model of decision-making - homo economicus - is the most explicit exponent of rationality. The two main criticisms on this rationality concept have been put forward by Simon and by Lindblom.

Simon's (1945) objections to the rational model of decision-making stem from the point of view that a decision-maker has only a limited information-processing capacity. The objections led Simon to his concept of 'bounded rationality' which consists of two main theses:

- in general, actions and effects are not given, but have to be discovered and developed in a preceding search process;
- in general, no optimal decision will be taken, but the decision-maker will be content with satisficing solutions.

This 'satisficing' principle is usually considered a serious criticism of the concept of rationality in terms of a goal. Basic to the concept of a goal is a preference ordering from which the best solution is taken, that is, rationality equals optimality. Clearly bounded rationality no longer satisfies the optimality principle. Satisficing behaviour is therefore not goal-oriented behaviour and bounded rationality is thus not a form of rationality. From the foregoing presentation of the goal concept we can however see that this conclusion is not true. The satisficing decision-maker still has a goal and that goal still meets the definition of a complete ordering over all alternatives. The ordering is only a very simple one; it partitions the set of alternatives into a set of desired (satisficing) alternatives and a set of undesired (dissatisficing) alternatives. The goal is defined as a subset. The subset relation is however still a weak ordering. Satisficing decision-making is therefore still rational decision-making.

Another well-known criticism of rationality is that of Lindblom (1959) leading to his concept of 'incrementalism' (successive limited comparisons). Lindblom's argument is essentially the same as that of Simon, namely the limited information-processing capacity. In his model, which is often regarded as typical of 'political' decision-making, Lindblom states that the political decision-makers will tend to take decisions which do not differ much from previous decisions. They would need much more information to survey the effects of discrete decisions and this information is either not available or can not be analysed. Also, according to Lindblom, there is no question of a choice out of all possible alternatives, but only from a restricted set of alternatives near the previous decisions (present situation). Moreover, Lindblom states that it is typical of political decision-making that the various participants will seldom agree on the

goals of the policy in question, but only directly on the policy measures themselves (the means). The only test of goodness of a decision is the agreement between participants. Testing whether policies satisfy goals is generally impossible. Rationality as goal-orientedness seems to be outside the scope of this theory. Again our previous considerations about the goal concept show that this conclusion is not true. Lindblom's incrementalism is an example of the before-mentioned deviation of the goal concept into a very incomplete preference ordering, i.e. an evaluation. When explicit goals can not be obtained, evaluation mechanisms are the only possibility left. Such evaluations might be considered as a variation on the usual concept of a goal. The definition of a goal as a preference ordering over all possible alternatives presupposes complete information on all alternatives in order to construct a complete preference ordering so that the optimal choice can be made. Evaluation only presupposes information on the alternatives which are close to the present state, 'local information', the ordering is not complete. However, an evaluation, as well as a goal, presupposes the possibility of ordering, that is, the possibility of deciding whether one alternative is better than the other. So if one focusses on the ordering concept behind a goal and permits the ordering to be incomplete, that is, only a limited set of all alternatives is ordered, an evaluation mechanism is still an example of a goal and hence 'incrementalist' decision-making is still rational decision-making. From the point of view of our definitions of the goal concept 'bounded rationality' and 'incrementalism' are still instances of rationality.

4.2. PROCEDURAL AND STRUCTURAL RATIONALITY

Procedural rationality

A different objection to rationality is that it does not sufficiently explain the process of decision-making. If one defines rationality as goal-orientedness and a goal in terms of desired outcomes, the dynamics of the process fall outside the scope of rationality.

Recently some leading figures in the field of organisational decision-making have realised this dynamic insufficiency of rationality. In an empirical study of decision-making in the German federal bureaucracy Mayntz (1975) states that "rationality is usually defined in terms of the outcome of the decision, but it might be more meaningful to look for the rationality in the procedure followed to arrive at the decision". Another recent proposal for procedural rationality was made by Simon (1976). He states that, apart from the economic concept of rationality, which he calls "substantive rationality", the concept of "procedural rationality" should be studied. He argues that the limited

information-processing capacity of the decision-maker prevents him from taking optimal decisions - the classical argument. This implies that one has to be content with satisficing solutions and that now the problem is how to set up a procedure to find this solution in the most efficient way. In other words, the problem is the procedural rationality.

This objection is the more important as we have shown in Chapter 3.3 that one of the main developments of organisational decision-making theory has been the trend from static theories to dynamic multiphase theories. The original thesis of Simon (1945) that the final choice of one alternative - the decision - had to be preceded by a search phase, (the first dynamic two-phase model) has triggered the development of a number of studies into phase models (see Chapter 3.3). Obviously organisational-decision theorists are convinced of the importance of the dynamics of decision processes. It is, however, very simple to show that a rationality concept, formulated in terms of desired outcomes, can not possibly explain the dynamic aspects of the process leading to that particular outcome. For a goal should not be restricted to an ordering over outcome alternatives only. Although the insufficiency is in fact trivial I will briefly show the line of argument.

Assume a description of a decision process in terms of a normative dynamic system consisting of a set of actions, a set of states, a present state-action-next state relationship (the model), and a goal in terms of a desired end state. Take the next simple example: Given the action set $A = \{a_1, a_2\}$, the state set $S = \{s_1, s_2, s_3\}$ and the present state-action-next state model

which can be represented in the form of the diagram of Figure 4.4.

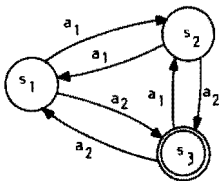


Fig. 4.4. An example of a model.

Assume that s_3 is the desired outcome. It

is then possible to transform this normative system into a procedural system which describes the procedures in arriving at the desired end state, depending on what state you are in. The procedural model of the example is presented in Table 4.1.

Table 4.1. The procedural equivalent of the normative system.

if present state is	then perform action
s_1	a_1
s_2	a_2

As we see, the transformation in the case of the example is unique and trivial. The transformation of a normative model into a procedural one is, however, not always as simple as that. An extensive treatment of this kind of decision table where the uniqueness problem is discussed in depth, can be found in Ashby (1956). We see that the model of this normative decision-maker is formally equivalent to the model of the procedural decision-maker which describes the procedure of what to do when. The previous example, however, only illustrates a one-stage decision-making process, i.e. the final state is attained in a single step. So let us give an example of dynamic decision-making where the final state is attained in a number of steps. Let the action set be $A = \{a_1, a_2\}$, the state set $S = \{s_1 \dots s_6\}$, the desired outcome s_6 and let the dynamic model be represented by Figure 4.5.

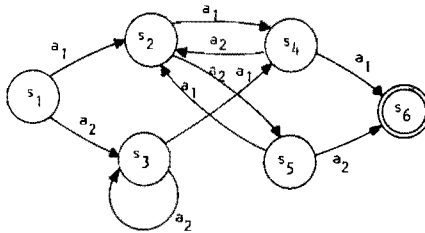


Fig. 4.5. An example of a dynamic model.

In this situation there is no unique procedural model possible. One can see that it is only in the starting states s_3 , s_4 and s_5 that a unique procedure exists. From s_1 there are three ways to s_6 and from s_2 there are two ways to s_6 as represented in Figure 4.6.

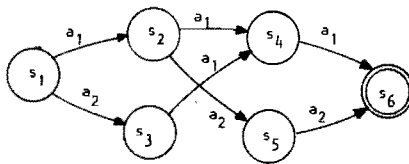


Fig. 4.6. The procedural model of decision-making.

A choice out of the alternative procedures will only be possible if these alternative procedures themselves can also be ordered according to some preference. In this case, a specification of the preference of action a_1 to action a_2 would suffice. The best

way from s_1 would then be procedure $a_1-a_1-a_1$ and from s_2 the procedure a_1-a_1 . In general, several procedures made up of sequences of actions and states lead to one and the same end state. In other words, the transformation of the normative decision-making model into a procedural one is not unique.

Let us define procedural rationality as the determination of the best procedure of decision-making. The dynamic insufficiency of the 'ordinary' rationality concept stems from the restricted interpretation of a goal, that is, an ordering over end states only. A goal should, however, be defined as an ordering over all relevant alternatives including inputs, actions and intermediate states at all relevant time instants. With this broad definition of the goal concept there is no insufficiency and the concept of procedural rationality is still equivalent to 'ordinary' rationality. A goal interpreted as an ordering over all relevant alternatives already results in an ordering of the procedures leading up to the final decision.

Note that the usual phase models of decision-making are instances of procedural rationality. Although such schemes are sometimes considered to be examples of descriptive decision models, I have shown in Chapter 3.3 that the descriptive power of these models is rather dubious. This means that one should have to classify these models under the label of 'intentional' presumptions of explanation, as is the case with rationality. This is why I consider such phase models as instances of procedural rationality. From this point of view the phase models of decision-making which form a clear criticism and antithesis to rational decision-making (see Chapter 3.3) would then still be instances of rationality, albeit rationality defined in terms of a preference ordering over alternative process phases.

Structural rationality

In the previous paragraphs it has been argued that in order to deal with dynamic decision-making processes the concept of rationality should be extended to include the dynamics. I called that procedural rationality. Now the obvious next step is to realise that organisational decision-making processes consist of more than phases alone. Time is only one of the dimensions which span the space of decision processes. It is in fact rather surprising that most of the research into organisational decision-making processes has concentrated on this aspect, whereas it is obvious that numerous other structural aspects play a role (see the conclusions from the survey in Chapter 3.3).

Let us deduce some structural aspects of decision processes from systems theory, namely the three dimensions: object-, aspect-

and phase systems.

A system is defined as a set of objects W , a set of relations R_W between all these objects and an environment $E(W)$ with relations $R_{E(W)W}$ between E and W (de Leeuw, 1974). Now a subsystem is defined as a subset of these objects W with all the original relations R_W , an aspect system as all the objects W with only a subset of the relations R_W and a phase system as a system identical to the original system only during a certain time interval. If we consider an organisational decision-making process as a system and define the participating individuals as the set of objects W , then the partitioning of the system into sub-, aspect- and phase systems can roughly be interpreted as: 'who' is doing 'what' and 'when'⁶. In order to illustrate a decision process one will have to analyse the following:

- subsystems - which groups, departments, etc. are concerned?
- aspect systems - which issues can be discerned in the process?
- phase systems - which phases can be distinguished?

The structure is then defined as the relation between sub-, aspect- and phase systems:

- relations subsystems - interactions, communication, etc.
- relations aspect systems - independent and related issues
- relations phase systems - how do phases relate, what is the sequence?
- relations aspect-subsystems - who does what?
- relations phase-subsystems - who acts when?
- relations phase-aspect systems- what is dealt with when?

Given this classification into sub-, aspect- and phase systems, one can depict a decision-making process by means of a trajectory (or a set of sometimes parallel trajectories) in this three-dimensional space. This can be represented by several projections into two-dimensional diagrams, such as an aspect-time, a subsystem-time and a subsystem-aspect diagram (Figure 4.7). This configuration is of course quite idealistic. In a concrete case it might well be more sensible to deviate from this neat picture, for instance, by merging two dimensions into a combined one.

⁶ The correct interpretation is as follows: if one considers the individual participants to be the objects of the system, then subsystems are clusters of individuals (groups, departments, organisations, etc.), aspect systems are clusters of relations between the individuals (issues, subjects, aspects) and phase systems are clusters in time (periods, phases).

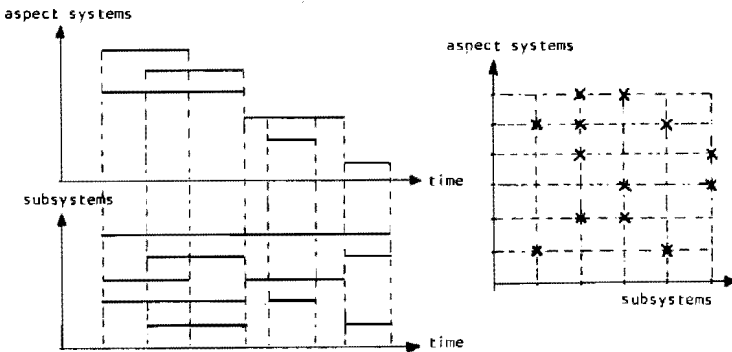


Fig. 4.7. Diagrams of decision-making.

Note that in this framework an important part of the problem lies in the decomposition of the several dimensions into their constituent parts. The many existing phase models show that there is no unique partition of phases. A method which can be used in this decomposition problem is the decomposition criterion of Simon (1962) which states that a complex system should be subdivided so that the relationships inside the parts are greater than those between the parts, in other words, the intrarelations should be greater than the interrelations. Observe that this decomposition criterion is based on the relations so that it will result in a clustering dependent on the type of relation considered. One will find different clusters per aspect. Another method of decomposition which is generally used in organisation science is the similarity criterion. One forms clusters of objects which are similar. A discussion of different decomposition methods will be presented in Chapter 6.2.

Let us call rationality used to determine the structure of the organisational decision-making process, structural rationality.

By analogy with the explanation given to procedural rationality one can imagine it quite possible to arrive at the same final decision with different sequences of sub-, aspect- and phase systems. The determination of the best path in the three-dimensional space of the sub-, aspect- and phase systems, is the concern of structural rationality. With this concept of structural rationality one is interested in the different transfers from one part of the system to the other in order to explain the process of events. Besides the transfers, one is also interested in the construction of those parts. In other words, structural rationality is concerned with the organisation of the decision-making

process.

Note that the proposed model of the structure of decision-making is by no means the only possibility. There are other models which deal with the structure of organisational decision-making, such as the 'garbage can' model of Cohen et al. (1972) which use other types of structural rationality.

Metadecision-making

Although the impression could have arisen that the derivation from 'ordinary' rationality via procedural rationality of the concept of structural rationality was a straightforward extension, in fact one large step was taken in between: while 'ordinary' rationality is usually dealing with decision-making on the object level, structural rationality deals with decision-making on a metalevel. Let me briefly explain this difference.

In the case of 'ordinary' rationality the concern is with the outcomes of the decision process, the decisions themselves, whereas in the case of structural rationality the concern is with the structure of the process leading to the decisions - call it 'structural' decision-making. At first sight one would say that the difference between the two is a matter of difference between levels of aggregation: if one starts with the structure of the decision process and continuously partitions the system one eventually ends up at the level of the factual decisions. In general this will however not be true. Partitioning a structure does not automatically lead to a model in terms of outcomes of decisions.

Nevertheless there is a difference in level between the two. I will try to clarify the difference by adopting a cybernetic point of view. Take the concept of control in its broad sense as any form of directed influence (de Leeuw, 1974). Decision-making is clearly a form of control. One should namely not forget that decision-making leads to decisions which influence, change and, it is to be hoped, improve the system on which the decisions are to be made. A comparison of decision-making with the usual model of a control system consisting of a controller and a controlled system, shows the parallels: the decision-maker is the controller, his control actions are the alternative decisions which are fed into the system to be controlled, that is, the system on which decisions are made. Note that in this model we are interested in the control actions for the system to be controlled, that is, the outcomes of the controller or the outcomes of the decision-making: the decisions. Now take the case that we are no longer interested in the control actions but in the organisation, the structure of the decision-making, that is, the structure of the controller. However, changing the structure of the controller itself can only be a structural mode of control by a controller on a higher level, that is, a structural mode of control of a meta-controller. Hence in the case of structural decision-making the

concern is about the structure of the decision-making process which is itself the outcome of a decision-making process on a higher level. So we see that structural decision-making is a form of metadecision-making (Kickert and van Gigch, 1979). This subject will be dealt with extensively in Chapter 5.

4.3. STRUCTURAL RATIONALITY IN PRACTICE

Decision-making on the new construction of a hospital - a case study

The aim in this section is to illustrate, by means of a case study (Kickert, 1977), the various concepts about rationality presented in the previous sections. There is probably no need to repeat that no rigid empirical test or validation will be presented, but only some illustrations of abstract conceptual ideas by means of examples taken from practice. As indicated in Chapter 2.2 the case-study method seems particularly suitable at the stage of conceptual guidance for vague problems, because it usually results in an abundance of conceptual insights. Let me also briefly remind the reader of the considerations on the explanatory use of the rationality concept: the illustrations may seem rather interpretative abuses of rationality, that is, arbitrary *ex post* rational reconstructions. It has been explained that this is no abuse at all, for any rational explanation is a rational reconstruction. The possible objection that the illustrations are 'weak' in the sense that they are interpretative reconstructions rather than 'real' explanations, is therefore fundamentally erroneous.

The illustrations will moreover be 'practical' in another sense as well. In some instances the illustrations will not be purely explanatory but to some extent prescriptive, that is, they will also be used to illustrate the prescriptive role of the concepts in a possible design of the decision-making process.

In addition to the document analysis technique the insight was completed by means of a number of interviews with the persons concerned in Hospitals, Sickness fund, Regional and Provincial Administration ⁷.

The decision-making process was studied until July 1977 ⁸. We begin with a brief sketch of the course of events in the decision-making process (Chapter 4.3.1) and proceed subsequently

⁷ The following persons have been interviewed: Dr. J.J. Hirdes (St. Joseph's Hospital); drs. J. Schuurman (Diaconessen Hospital); drs. M. Leers (Sickness fund); drs. A. Meyer and drs. P. Stevens (Agglomeration Council); drs. H. Einmahl (Provincial Council).

⁸ In the meantime the Minister of Health has granted permission for new construction and the St. Joseph's Hospital is busy erecting a new building on a site in Veldhoven, south-west of Eindhoven.

with the analysis of the process (Chapter 4.3.2).

4.3.1. CHRONOLOGY OF THE DECISION-MAKING PROCESS

Origin of the plans for new construction

In 1932 the St. Joseph's Hospital was built in its present-day location in the southern part of Eindhoven with a capacity of 200 beds. After World War II the hospital was expanded. The tightness of the building market at the time and the resulting government policy on hospital construction meant that small extensions were permitted only now and then. The narrowness of the site, however, was such that already in 1965 the building was no longer adequate. A complex building had grown on a site too small to satisfy the requirements of a modern hospital any longer, either as to logistics or as to architecture. This induced the board of St. Joseph's Hospital to investigate the possibility of a total renovation, i.e. new construction on the same spot. The first plan for this consisted of a building of eleven storeys, which was rejected because the municipal plan for that part of Eindhoven did not permit high-rise constructions. A change in the municipal plan would take too long. The next plan consisted of a phase scheme of demolition and new construction on the same site.

About that time - 1968/69 - the plans for new construction of another hospital in Eindhoven were made public. This publicity was quite negative. The rumours that the new Catharina hospital would be too large and too expensive, induced the St. Joseph's hospital, which at that time had a common board with the Catharina hospital, to ask a group of external consultants for an advisory report on the future of the St. Joseph's hospital. The conclusions of this advisory committee in autumn 1970⁹ were that the existing hospital was too old, too small and pinched, on too narrow a site, so that adaptation of the existing building was out of the question. Of the two alternatives, new construction on the same site or new construction on a different site the committee chose the latter. The arguments were financial, technical and social. The opinion of the committee was that the capacity at that time of 600 beds could be maintained.

Afterwards the hospital board once more deliberated on a possible compromise solution of half new construction and half renovation. A project development company which was asked to study this question thought it feasible but nevertheless dissuaded the board from it.

⁹ H.O. Goldschmidt, L.N.J. Groot and J.J. Hirdes: rapport St. Joseph ziekenhuis, Eindhoven, November 1970.

Hospital Committee, first advisory report

In April 1972 the St. Joseph's hospital asked the Public Health Department for 'permission in principle' to erect a new hospital on a different site with the same number of beds. This request was passed by the Minister to the 'Hospital Committee' for advice¹⁰. The Hospital Committee took into account the gentleman's agreement of 1965 between the hospitals in the region about the development of the regional hospitals which had been approved at the time by the committee (see Table 4.2).

Table 4.2. The agreement of 1965.

	1964	65-70	70-75	75-80	total
Catharina	620	180	-	-	800
Diaconessen	213 ¹¹	-	387	-	600
St. Joseph's	570	30	-	-	600
St. Anna's	262	100	-	138	500
Valkenswaard	-	-	200	-	200

The Hospital Committee advised the Minister in June 1972 to grant a permission in principle but not to decide on the final bed capacity.

¹⁰ The official procedure for new construction of hospitals in the Netherlands is as follows.

Because of the shortage of building capacity after World War II each hospital construction plan required the permission of the Ministry of Housing and the Ministry of Health. The consultant body for the Minister of Health was the 'Hospital Committee', set up in 1947 and legally constituted in a decree in 1965. For the new construction of a hospital two kinds of departmental permissions are necessary, on which the 'Hospital Committee' gives advice: (1) a permission in principle and (2) approval of the construction plan. The former was judged according to the local needs, the latter had to meet the criteria of effectiveness and soberness. In 1971 the 'Hospital Provisions' Act came into force. According to this law the procedure was now to be that construction plans had to be judged by the 'Hospital Provisions Board' on the basis of a National Hospitals Plan. The national plan would be a result of an integration of various provincial plans. The provincial councils however did not succeed in making the legally prescribed hospital plans so that a National Plan could not be realised either. As long as this situation continues the old 'Hospital Committee' still is the consultant body of the Minister. Instead of the provincial and national plans which were found to be infeasible, the so-called Regional Plan was more or less officially instituted in 1973. A Regional Plan is more extensive and general than the investigations on which the 'Hospital Committee' hitherto based its advisory reports. Moreover, the Minister introduced in 1973 his 4% norm against which each plan had to be tested. Although officially there are only two steps in the procedure before the final construction plan is agreed upon, there are two informal steps in between. After the 'permission in principle' a 'program of demands' is first submitted to the Minister, then a 'draft of the plan' and only finally the 'construction plan' itself. These latter specifications of the procedure are mentioned in the recent Bill of Amendment of the Hospitals Provisions Act.

For more information on the official procedure see the special issue of the Tijdschrift voor Sociale Geneeskunde 53(1975) p. 750 f.f. on advisory bodies in public health, particularly P.J. van Leeuwen: het college van ziekenhuisvoorzieningen, T. soc. Geneesk. 53(1975), 768-773.

¹¹ In 1964 a licence was already granted for 334 beds, which was the starting point for the 1965 agreement.

Regional plan and 4% norm

In February 1973 the Minister (Secretary of State) of Health ordered all plans, including the approved ones, to be tested again on the basis of a regional investigation. Moreover, in November 1973 he introduced the norm of only 4 beds per 1000 inhabitants (4% norm). The Hospital Committee would have completed such an investigation for the Eindhoven region only by 1976. After some pressure it was decided not to carry out such a regional investigation for the St. Joseph's application but to do with a time-saving 'old style' investigation.

Hospital Committee, second advisory report

In November 1975 this investigation was completed¹². The conclusion was that on the basis of a prediction for 1985 a St. Joseph's Hospital with a capacity of 400 to 450 beds would be a good solution, on the condition, however, that the other hospitals in the area would together be reduced in capacity by some 100 beds. In the event that this reduction of beds would not be realised, St. Joseph's should only be permitted to have 360 beds. Moreover, it was advised that the Provincional Council of North Brabant should see to the 100 bed reduction. This advice was given to the Minister in December 1975 who, in turn passed it to the Provincional Council of North Brabant with the request to start the regional deliberations.

Reaction of St. Joseph's

When it became clear that the Hospital Committee would advise reduction in regional bed capacity, the St. Joseph's Hospital and the Diaconessen Hospital considered the idea of fusion. As the St. Joseph's would probably have to shrink and the Diaconessen would not be allowed to expand, fusion might well be the answer to ensure the size necessary to keep up functionality and quality. A research committee was set up and an external consultant was contracted. The fusion plans were, however, turned down. After the advice of the Hospital Committee but before the regional deliberations the St. Joseph's carried out an alternative study into the necessary bed capacity for the region¹³. By including not only the 'small' region Eindhoven, but the whole of south-east Brabant in the study, the predictions of the necessary bed capacity was much higher. According to this study the 250 beds by which the St. Joseph's capacity was to be reduced according to departmental advice, would be needed again in 1995, only

¹² Report of the Hospital Committee concerning St. Joseph's Hospital, Utrecht, November 1975.

¹³ Nota beddenbehoefte regio Z.O. Brabant, St. Joseph hospital, December 1975.

ten years after the original date of prediction 1985.

Regional deliberation

In September 1976 the Council of Deputies of North Brabant set up a committee of three external advisers: dr. H. Festen, consultant to the Secretary of State for Public Health, dr. A.C.J. Rottier, director of DSM and dr.ir. Th.P. Tromp, director of Philips. This so-called Festen Committee again carried out a study in the region and completed its report in February 1977¹⁴ after two consulting rounds with the hospitals concerned. The report is presented in Table 4.3.

Table 4.3. Advisory report of Festen Committee.

	actual	proposed
Catharina	732	625
Diaconessen	363	350
St. Anna's	456	410
St. Joseph's	605	500
St. Lambertus'	380	370
St. Willibrordus'	164	150

The capacity of 500 beds proposed for the St. Joseph's was accompanied by emphasis on a flexible construction so that the polyclinic activities could be extended in the future. The report was sent to the hospitals and to the three regional councils. Their common reaction was sent in July 1977 to the Council of Deputies of North Brabant which passed the report almost unchanged to the Minister¹⁵.

The six hospitals

Before proceeding with the analysis of the decision-making process I will first briefly add some background information on the hospitals, particularly as to their relative positions in the process.

Of the three hospitals in Eindhoven the Diaconessen hospital is the smallest. This hospital is the only Protestant one in the predominantly Catholic region and lies in the north-east of Eindhoven. Of the three hospitals, this was the first to be re-

¹⁴ Rapport van de adviescommissie ziekenhuissituatie Zuid-Oost Brabant ten behoeve van het College van Gedeputeerde Staten van Noord-Brabant, 's Hertogenbosch, February 1977.

¹⁵ The case study was finished then. As stated before, in the meantime the Minister of Health has decided in accordance with the advisory report and the St. Joseph's Hospital is putting up a new construction on a site in Veldhoven south-west of Eindhoven.

placed by a new construction in 1968. The plan at that time to extend the bed capacity to the ultimate number of 600 beds, has never been realised because in the meantime the new Catharina Hospital has been built a short distance away. The Diaconessen Hospital has by far the shortest nursing period in the region. The Catharina Hospital which was previously situated in the centre of the town, was replaced in 1973 by a new hospital in the north-west of Eindhoven. The bed capacity then planned (800) would be regarded as high by present-day standards. Some thought so even then. This hospital is the biggest in the region and has regional and even supraregional functions (heart surgery, radiotherapy).

Because the St. Joseph's Hospital situated in the south of Eindhoven, has already been extensively dealt with, suffice it to say that the St. Joseph's is the second-biggest and also claims regional and supraregional functions (centre for kidney dialysis).

The St. Anna's Hospital in Geldrop - a town east of Eindhoven - was newly constructed in 1972 and with more beds than permitted. Somehow St. Anna's managed to get permission afterwards for these 'black' beds.

The St. Lambertus' Hospital in Helmond has never been extended since it was opened in 1957 with a capacity of 396 beds. The St. Willibrordus' Hospital in Deurne which was replaced by new construction in 1969 has not been extended since then either. Its capacity is 170 beds. Both these two small hospitals have the great advantage that, according to the 4% norm they do not have such a large overcapacity as the four others. Moreover, the predictions about population growth of the region around Helmond is higher than for the Eindhoven region. The St. Willibrordus' Hospital, however, has a very low loading rate.

4.3.2. ANALYSIS OF THE DECISION-MAKING PROCESS

The structure of the process

If one adopts the system-theoretical dimensions, the decision-making process can be partitioned according to subsystems, aspect systems and phase systems, which roughly means 'who' does 'what' and 'when'? (see Chapter 4.2). This scheme will be adopted to sketch the structure of the above-mentioned decision-making process. The decision-making process can be divided into two parts: a first subprocess which took place inside the St. Joseph's Hospital and resulted in the construction plans and a second subprocess which took place outside St. Joseph's, that is, the external settlement of the St. Joseph's request. This clearly is a decomposition into subsystems. If we take the second subprocess and consider its structure at a lower level of aggregation, we get a scheme as represented in Figure 4.8.

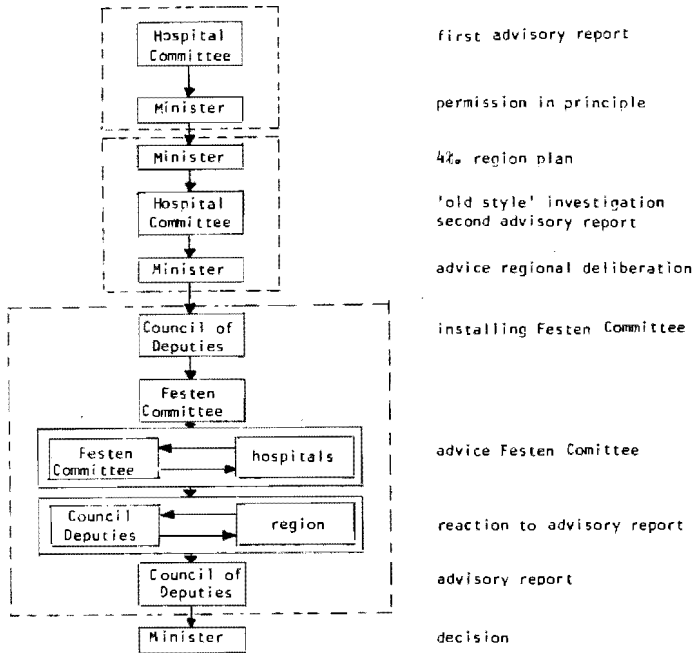


Fig. 4.8. Scheme of decision-making subprocess.

In this figure the emphasis is laid on the configuration of subsystems, however the phases are also clearly reflected in the sequential setting of the figure. If only the subsystems were emphasized the scheme would look like Figure 4.9 where the phases can also be discerned but with much greater difficulty. This latter scheme, moreover, clearly illustrates that the decision-

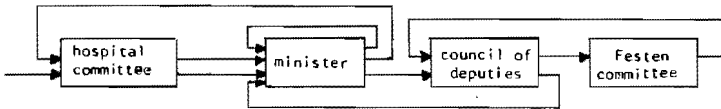


Fig. 4.9. Decomposition of the process into subsystems.

making is no straight-forward sequential process but rather a complex system, as was emphasized in Chapter 3.3. In Figure 4.8 a particular level of aggregation was chosen for the subsystems. It is also possible to decompose the process into parts on a higher level of aggregation as has been indicated

by means of the dotted lines. This latter decomposition corresponds to a division of the system into aspect systems. At first the Hospital Committee dealt only with the question whether the St. Joseph's should be renovated or built anew. In the second report the aspect of the regional bed capacity is dealt with. In the third part the decision-making concentrated on the aspect of the bed capacity per hospital. The classification of the process into these aspect systems is illustrated in Figure 4.10, which also shows the interrelations between the aspects.

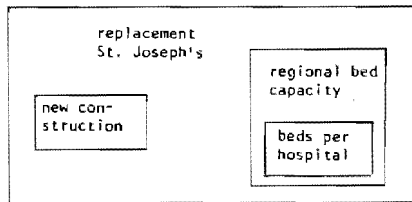


Fig. 4.10. Decomposition of the process into aspect systems.

Rationality of the decision-making

As to the rationality of the subsequent subdecisions in the decision-making process the following remarks can be made. The first important decision was not to renew the hospital on the same site but to construct a new hospital on a different site. This decision was taken on the basis of social factors (the disadvantage of renovation lasting twelve years), financial factors (the costs for renovation and new construction were the same) and technical factors (the site was too small so that expansion was impossible). In principle this decision might be regarded as a multicriterion decision between two alternatives and hence as a rational decision. It is, however, strange that the very basis of the whole line of argument - further expansion - can seriously be questioned in view of the subsequent decision to reduce the capacity to 500 beds. Nevertheless, the first decision to construct a new building somewhere else was never discussed again. The first decision (report) of the Hospital Committee in 1972 to grant permission in principle seems to be a confirmation of the need for new construction on the same grounds as the St. Joseph's had previously concluded. The second decision (report) of the Hospital Committee rather seems a computational affair. The prediction of the regional bed requirements minus the existing beds yielded a surplus which had to be yielded up either by the St. Joseph's alone or by St. Joseph's together with 100 beds from the others. The advisory re-

port therefore seems a classical example of a computationally rational decision. The computations have however been criticised several times and replaced by alternative calculations. In particular, the choice of the regional boundaries and the validity of the population predictions came in for criticism¹⁶. Criticism of the assumptions and data underlying a decision does not imply however that the decision is irrational if one used the 'formal' rationality definition (Chapter 4.1).

The decision (advisory report) on the specific bed capacities per hospital which resulted from the regional deliberation, did not have a computationally rational character. The computations per hospital are namely very inaccurate and invalid.

Let us consider the specific advices (see Table 4.3).

The reduction in capacity of the St. Joseph's to 500 beds was decided on the argument that the existing nursing training could be maintained on that basis. The reduction of the Catharina to 675 beds without heart surgery and 700 beds with heart surgery, was a compromise between a reduction pro rata of size and a reduction pro rata of loading. Because the minimum threshold of municipal hospitals was supposed to be 350, the Diaconessen was not reduced further.

The St. Anna's got as many beds as it would have had without the inclusion of additionally unsanctioned beds. The St. Lambertus and St. Willibrordus Hospitals were scarcely reduced because of the slight overcapacity and the high population growth predictions in that area.

From the viewpoint of rationality the arguments for the specific hospital capacities can be criticised in several ways:

- the validity of several arguments and data can be argued;
- most arguments only apply to a single hospital so that they are incomparable and unrelated;
- it is sometimes unclear how the specific bed capacities follow from the various arguments.

No wonder that the advice of the Festen Committee is considered to be 'pragmatic' by most participants.

¹⁶ The several quantitative predictions made during the process are all basically the same; they are namely all based on the so-called adherent population of a hospital, i.e. the number of people from a region who are committed to a particular hospital. This is calculated by means of the formula: (adherent population) = (number of inhabitants of a town) . (number of patients in the hospital from that town)/(total of hospital patients from that town). This number, together with the 4% norm, directly results in the required bed capacity. In most calculations the ration is fixed so that population predictions suffice to compute the adherence. The change in predictions was due to several causes. First, the region concerned was changed to include Helmond and Deurne which do not have such overcapacity. Second, different population predictions were used, namely more recent predictions. The calculations of bed capacity can also be further specified by inclusion of the ratio of hospital admission, the mean nursing period and the loading rate of the hospitals. These methods of capacity computation can be criticised as to their accuracy and validity. That is why they can at most be used to calculate regional capacities but not to calculate specific capacities per hospital (for more details see Kickert, 1977).

Structural rationality

In the previous paragraph the focus was on the rationality of the decisions themselves. We now focus on the 'procedural' and 'structural' rationality of the process and structure of the decision-making.

The subsystem 'Hospital Committee' was drawn into the process by statutory prescription (see footnote 10 on the official procedure). One might consider this as an extreme form of structural decision-making, particularly concerning the subsystem structure. The most important outcome of this subsystem - the constraint on the regional number of beds seems rather a routine decision - to indicate the Provincial Council as the subsystem advising on the final capacity assignment, points to an element of structural decision-making: the previous subsystem indicates what the next subsystem should be. There was no statutory prescription to involve the Provincial Council as this council had already been consulted by the Minister at an earlier stage. Again this can be considered an example of decision-making as to the subsystem structure of the process.

The decisions of the Council of Deputies of North Brabant to install an external committee headed by Festen is likewise an illustration of structural decision-making. The structural rationality of this decision is obvious. A committee of consultants consisting of three such powerful and expert persons, gives some guarantee that the advice will be accepted by all parties concerned, including the Minister. Another subsystem, such as a committee consisting of expert civil servants, might never have come up with a solution. In this case it is clear that the various participants were quite conscious of this form of structural decision-making. Here too, the structural decision-making mainly applies to the subsystem structure of the process. As will be clear from the scheme of the decision-making process in Figure 4.8 there are however analogies between subsystems and phase systems, so that one might argue that the before-mentioned three examples of structural decision-making do not only apply to the subsystem structure but also to the phase system structure. Probably less conscious but nevertheless important examples of structural regulation of the process were the two following ones. As already observed, it is remarkable that the decision on renovation or new construction after the first advice in 1972 was never argued again, though the ultimate decision to reduce the bed capacity might well have given occasion for reconsideration. The fact that in a later phase there was no return to the original aspect system is in itself a form of structural decision-making. Here the structural decision-making seems to apply to the aspect structure mainly. Note, however, that the aspect-systems also more or less coincide with phase systems of the process (see Figure 4.10 and 4.8), so that the structural decision-making in fact applies to a combined aspect and phase sys-

tem structure.

Another example of structural decision-making is the decision of the Hospital Committee in 1973 not to carry out an extensive regional investigation but to stick to the 'old style' form of investigation so as not to delay the decision. An extensive study, however, would probably have resulted in a specific report as to the bed capacities of the separate hospitals. A regional deliberation would then have been unnecessary. As regards the structural rationality it can be said that the decision did not save so much time in the end as the Hospital Committee had given 1976 as the date by which an extensive regional study should be completed. Here too, the structural decision-making applies to a combined aspect and phase system structure.

Conclusions and discussion

The aim of the case study has been to illustrate the concepts proposed in this chapter, particularly the concepts of 'structural' decision-making and the related concept of 'structural' rationality. It has been shown that the structure of the decision-making process could be represented in terms of sub-, aspect- and phase systems. Although this is not the only possible mode of representation - there is no pretence that it is the best one - it does yield a clear insight into the structure of the process, something particularly desirable if it is desired consciously to decide upon this structure, i.e. to carry out structural decision-making. For it has become clear that besides the decision-making at the 'substantive' level - the (sub)decisions according to 'substantive' arguments about replacement, new construction, regional bed capacity and bed capacities per hospital - the decisions as to the structure of the process played at least as important a role, if not the most important one. The decisions to let the Provincial Council decide about the bed capacities per hospital and the decision to install the Festen Committee to advise on that were both very important structural control measures. The less conscious structural measures not to rediscuss the original subdecision on new construction and not to carry out an extensive regional investigation were certainly important also. Especially from a prescriptive-design viewpoint the emphasis on the structural decision-making must be regarded as very important. As we have seen, particularly as regards the not-so-conscious structural decisions, a systematic control of the structure of the process might very well lead to its improvement. It will be clear that many strategic decision processes are expensive and that it would certainly make sense not to look only at the rationality of the outcome but also at the rationality of the human-effort, time, energy and money-consuming process leading to it. In my view concern about the structure of a decision process leading to a particular decision is of great importance. Although

most decision-makers are busy with the rationality of the 'substantive' decisions to be taken, there are many situations where the structural aspect is predominant. The case study in fact provided some examples in which administrators were not able or permitted to control the substantive process. This is reflected in the fact that many legal measures to control decision-processes in the field of public policy-making consist of measures concerning structural decision-making.

A tentative hypothesis might be that structural decision-making comes into the picture particularly when the decision-making at the 'substantive' level threatens to 'get stuck'. When it is improbable that further deliberation at the 'substantive' level will lead to consensus, it seems indeed a good alternative to pass to the structural level and take some decision there e.g. about setting up an advisory committee. Whether structural decision-making is a stage following 'substantive' decision-making or not, it is nevertheless clearly a control at a higher level, that is, the level of the structure of organisational decision-making, and clearly one that is an important kind of decision-making. Notice, however, that although some general concepts on 'structure' and 'structural decision-making' have been presented in this Chapter, there is still a long way to go before one obtains an empirically confirmed and useful theory on this subject. In this Chapter and particularly in the case study, the importance of the concepts has been stipulated. An empirical theory on how exactly to perform structural decision-making as to sub-, aspect- and phase system structure, however, still misses. So let us now fully concentrate on the subject of the organisation of decision-making.

PART THREE

ORGANISATION OF DECISION-MAKING

Chapter 3 brought out two important themes in the survey of decision-making, namely rationality and organisation, the first-named having already been dealt with. As we have however seen, the rationality theme eventually leads us to the organisation theme. Consideration of the rationality theme led us to the conclusion that the usual rationality concept, defined in terms of a 'desired-end-state' goal, was insufficient to cope with the process of decision-making. This induced us to introduce the concept of procedural rationality in which the dynamic-process aspect was incorporated. In order to cope not only with the dynamic aspects but also with the other structural aspects of the decision-making process, the concept of structural rationality was introduced. This last concept hence applies to the organisation of the decision-making.

As has been shown in the survey (Chapter 3.3) much energy has been devoted to research into the dynamics of the decision-making process. Since the identification of 'real' decision-making with problem-solving by Simon (1945) much effort has been devoted to the study of the cognitive learning process typical to problem solving. Besides the cognitive psychological study of purely individual problem-solving (Newell and Simon, 1973) with its implications in individual decision-making, the main consequence as regards organisational decision-making has been the taking over of the phase schemes characteristic of problem-solving, such as the usual six-phase scheme (Brim et al., 1962): (1) problem identification, (2) information gathering, (3) development of possible solutions, (4) evaluation of these solutions, (5) selection of a strategy for performance and (6) actual performance of an action. Although this kind of scheme is commonly supposed to be deduced from descriptive studies of the actual cognitive learning behaviour of problem solvers, and usually considered to be a good description of how things work, it has been shown in Chapter 3.3 that there is serious doubt as to the descriptive validity of this kind of scheme (Witte, 1972). More recent phase schemes, like that of Mintzberg et al.

(1976), avoid the objections by taking a much less rigid viewpoint; the phase scheme is considered as a flexible non-sequential global scheme which only expresses a general tendency (Kirsch, 1977). In addition to these typical problem-solving-oriented studies of the dynamics of decision-making other schemes have also been presented in Chapter 3.3, which, however, all had more or less descriptive pretensions. Of course, the matter can also be approached from the opposite, prescriptive side. The fact that the phase schemes do not possess sufficient descriptive reality value does not imply that they are also useless in a prescriptive sense. It should, however, be emphasised that Witte (1972) also seriously questioned the prescriptive validity of the phase schemes. An example of a straightforward prescriptive approach is, for instance, the 'systematic approach to problem-solving and decision-making' by Kepner and Tregoe (1965) who discern three kinds of operations that should be performed sequentially: (1) problem analysis (recognize problems, specify deviation, develop possible causes, test for causes), (2) decision-making (establish objectives, classify them, operate alternatives, compare and choose) and (3) potential problem analysis (anticipate potential problems, separate and set priority, anticipate possible causes, set contingency actions). Their prescriptive norm is clearly the rationality norm, although they waste few words on the essential basis of their proposal. Another recent example of an explicitly prescriptive problem-solving scheme is that of Kramer (1978). Kramer formulates problem-solving within the framework of control-theory concepts, particularly in terms of the 'control paradigm' of de Leeuw (1974). His scheme of problem-solving is derived from a normative set of conditions for effective control (Kramer, 1978, Ch. 5) to the effect that the problem-solver should have (1) a goal, (2) a model of system and environment, (3) information about system and environment and (4) enough 'requisite control variety' (Ashby, 1956). Kramer elaborates this to a normative phase scheme for the problem-solving process and its organisation.

The evident conclusion from this brief summary is that one should be careful about making statements such as that there are no theories about the organisation of decision-making in organisations. First, there are obviously quite a lot of theories about the procedure and phases of decision-making. Second, most of these theories do not restrict themselves to the time dimension only. The phases in the schemes denote different aspect systems in the process, so that it might be argued that these schemes are not only phase schemes but aspect schemes as well. This coincidence between phase systems and aspect systems (functions) has also been noted by Botter (1977). Third, theories do exist which explicitly deal with such structures, for instance as the 'garbage can' model (Cohen et al., 1974). Fourth, one might argue that the numerous contributions by organisation

science on organisation structure and structuring can be considered as contributions to the subject. In view of the explicit distinction made by the present writer between 'organisation' and 'decision-making' (see Chapter 3), this is not per se true, although we shall see later on that the statement is indeed partly true. Summarising it can be concluded that there are models and theories that partly deal with the problem, models that can be reinterpreted to deal with it and incidental models that deal with it explicitly. Nevertheless it can be concluded that a systematic theory which explicitly deals with the structure and structuring, that is, the organisation of decision-making, does not exist.

In this third part of the book the aim is to try to take some steps towards such a systemic theory, indeed to try to systematize these steps as well. I shall start, not by elaborating the theory itself, i.e. establishing the variables and their interrelationships inside the theory, but by investigating the relationships of the theory within its wider framework. This will be presented in Chapter 5. The theory itself will be treated in Chapter 6, approaching the problem by first reducing the concept of organisation to its essential components, decomposition and coordination. These two subjects will subsequently be elaborated and discussed. The conceptual theory thus developed will then be extended in a dynamic sense. The organisation of a decision-making process is not a static activity but itself is a process as well. This dynamic approach to the process of organising decision-making will be presented in Chapter 7. Finally the conceptual propositions given in Chapters 5, 6 and 7 will be illustrated by means of a case study in Chapter 8.

CHAPTER FIVE

META DECISION-MAKING

Chapter 4 stressed the importance of structural aspects of organisational decision-making in explaining these decision processes. It was shown that the usual concept of rationality is inadequate and that dynamic and other structural aspects should be incorporated in the concept of rationality in order to explain the structure and process of decision-making. These ideas were elaborated by introducing a new type of decision-making, namely 'structural' decision-making. Interest here is in the structure and structuring of decision-making, that is, the process leading to the decisions about the organisation of the decision-making process. In Chapter 4.2 a descriptive framework was proposed for the organisation of decision-making using a systems-theoretic approach. This structural framework describes an organisational decision-making process as a path through the three-dimensional space spanned by sub-, aspect- and phase systems. The structure of this process consists of the relations between all parts of the system, that is, the transfers from one part of the system to another. In this chapter a conceptual framework for decision-making is presented from a control-systems viewpoint, in which the concept of structural decision-making is embedded in a meta-systemic model.

5.1. THE CONCEPT OF METASYSTEM

'Meta' stems from Greek where its meaning is 'after'. Metaphysics start where physics end, that is, it comes after physics. 'Meta' is nowadays, however, mostly used in the meaning of 'above'. Methodology is the science of scientific method. Methodology stands above science and is therefore considered as a metascience. In order to describe the metascientific properties of methodology one usually distinguishes between object language and meta language. A sentence like $'1+1 = 2'$ is an object-language sentence. The words in this sentence (the figures) refer to objects. A sentence like $'"1+1 = 2"$ is an arithmetical equation'

is, however, a meta-language sentence. The sentence no longer deals with the objects but with a higher-level property. It stands above the first sentence and it is in this sense that the concept of a metasystem is used. A system is defined as a set of elements and relationships between the elements. As long as one deals with these elements and relationships - the objects of the system - the considerations on the system are at object level. When this level is exceeded, the considerations are at a meta-systemic level.

In section 5.2 and particularly in section 5.3 this metasystemic approach will be elaborated in a particular way. The system will be considered as a control system in accordance with the control paradigm of de Leeuw (1974) and on this basis the meta-control system will be specified. Let us, however, first consider some examples of the (often different) use of the concept of a metasystem in literature.

The literature of organisation science and systems theory refers in several places to the concept of a metasystem, a system placed at a level above the system under consideration. To this metasystem are attributed many properties and functions. To take an organisational example: the need for coordination derives naturally from the hierarchical form of the bureaucratic organisation where lower administrative units are embedded in, and supervised by, units of higher rank and order. Thus, the divisional organisation is the metasystem for several lower-level departments pertaining to a division. In turn, the headquarters organisation represents the metasystem encompassing several divisions, and so on.

Beer (1966, 1972) explicitly refers to the metasystem when comparing the neurophysiology of the brain to the organisation of the firm. He emphasises the need for a metalanguage, a language of a higher logic level in which the issues of lower-level systems can be expressed, argued and settled. In (Beer, 1975) the idea of a metasystem receives further elaboration, not only as a formal requirement for system hardware, but also as a framework in the context of which the issues of soft systems control are discussed. Platform for Change (Beer, 1975) can be considered a cybernetic metasystem model: it is cybernetic because it features feedback, it is metasystemic because it represents a system standing on a level above the other systems.

The concept of a metasystem has implicitly or explicitly been incorporated in the design of computer hardware and software. The central control unit of a computer exercises higher-level control over the order in which programs are processed. Furthermore, in structural design, program logic is built on the principle of multilevel control so as to facilitate programming, debugging and modification of routines.

Churchman's (1971) incursion into the design of inquiring systems is premised on the need for designing the metasystem for human inquiry. From time immemorial, philosophers have studied how to proceed to increase human knowledge and understanding. Churchman attempted to find in the work of several philosophers the features which are most appropriate to a modern inquiring system. When referring to the 'X of X', Churchman (1968) explicitly states the need, not only for management science, but also for a science of management, a decision-making science from which we can learn to decide or to make decisions on how to decide, that is, to make metadecisions.

Ulrich (1977) follows in Churchman's footsteps by integrating all problem-solving methodologies in a hierarchy of problem-solving systems. This hierarchy is meant as a General Systems Theory model of design. Klir (1976) conceptualised a hierarchy of epistemological levels of systems which are differentiated by the level of knowledge regarding the set of variables and of potential states contained at each level. Thus, "a higher-level system entails all knowledge of the corresponding systems at any lower level and contains some additional knowledge which is not available at the lower levels"¹. Levels of systems are defined: the source-, the data-, the generative-, the structure- and the meta-system.

Mathematics is considered the metalanguage of science, that is, the language in which higher-order generalisations can be expressed. As Rapoport (1977) has noted, mathematics serve to bring out the isomorphisms existing across particular sciences and thus acts as the metalanguage of General Systems Theory. Within mathematics one can refer to more specific metalanguages which only encompass a more limited need. Thus probability theory has been called the metalanguage of uncertainty and fuzzy set theory the metalanguage of ambiguity (van Gigch, 1976, 1978; Kickert, 1978c).

Recently van Gigch (1978) discussed the need for a metasystem in the context of a comparison of methodologies for systems design and problem-solving. A study of these methodologies reveals that their results are open to question because they do not include any step by which the truths which they propound can be validated. In Operations Research the problem to be solved is modelled and usually formulated in mathematical form. A solution is obtained which optimises the objective function. It is obvious that this solution is 'self-serving', for it is considered a 'good' solution to the extent that it optimises the objective function which was postulated by the researcher. There is no gua-

¹ Note that this definition differs from the above-mentioned 'meta' definition. There the metalevel deals with properties different from the properties at the object level, so the metalevel does not "entail all knowledge of the object level".

rantee that the solution meets any external criteria of truth. Systems research and systems engineering methodologies suffer from the same shortcomings as OR methodologies or even worse, because they usually embody not one, but several interrelated OR models.

The concept of metasystem also appears in policy-making and planning science. Dror (1968) explicitly distinguishes between meta-policy making, policy making and post-policy making. In a later work Dror (1971) adds one more level, namely the level of megapolicy making, which involves the determination of the postures, assumptions and main guidelines to be followed by specific policies. Metapolicy making is described as the way to improve the policy-making system, that is, policy on how to make policy. Faludi (1973, 1975) distinguishes between three levels in planning theory, namely metaplanning, procedural and substantive theories on planning. The first deals with the design of the planning system, the second with the way plans operate and the last with the area of concern. Faludi explicitly defines metaplanning as the design of planning agencies and their procedures. Some initial hypotheses about a theory of metaplanning are developed by Emshoff (1978). Mitroff and Betz (1972) explicitly refer to meta decision-making.

As will be clear from this brief and surely incomplete review of the concept of meta-system in some of the literature, the concept is used in many more or less different ways. The interpretation of the concept adopted here sticks to the first-mentioned methodological one, which stems from the difference between object-level language and meta-level language. Let us now proceed to discuss how it can be viewed in relation to organisational decision-making and control.

5.2. A CONTROL-SYSTEMIC APPROACH TO DECISION-MAKING

In this chapter I will show how the adoption of a control systems point of view can lead to better insight in decision-making, particularly in the conceptual differences between the various sorts of decision-making encountered in literature, such as, for instance, structural, procedural, operational and substantive decision-making. One may find more or less vague, confusing and tautological definitions of these terms. Structural decision-making is concerned with the structure, that is, the organisation of the decision-making process. Operational decision-making deals with how decision-makers operate, procedural decision-making with the procedures used in decision-making - which is almost synonymous with the second term - and substantive decision-making deals with the area of concern. Although these concepts might well be very useful in certain cases like

the field of planning (see, e.g., Faludi, 1973), a clearly defined conceptual framework into which all these various concepts fit in a consistent way, is usually lacking. I think that a control-systems viewpoint may serve to construct such a framework. Moreover, I will show that this viewpoint leads to a model in which the decisions are emphasized and attention is paid to the important issue of the implementation of decisions, i.e. the changes that the decision brings about. I will introduce and clarify the control-systems approach by beginning with the well-known classical model of homo economicus (see Chapter 3.1). There are several basic aspects of this model that can be noted. First, the decision is the choice out of a set of actions. Second, the interest of the decision maker is with the possible effects of the alternative decisions (actions). The decision maker wants to improve some situation, that is, he strives for a desired situation, given that he has a preference ordering (goal) over the possible situation values (the states). From this goal he will derive the best action which can be taken, knowing what action will have which effect, namely he has a model of the situation he tries to change. This scheme is illustrated in Figure 5.1.

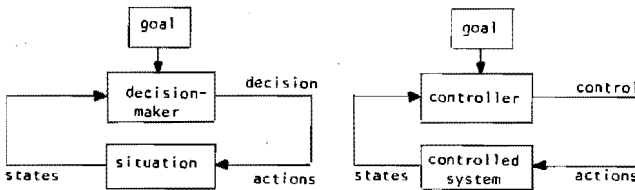


Fig. 5.1. Analogy between decision-making and control.

A comparison of this model of decision-making with the usual model of a control system (Figure 5.1) clearly shows the parallels: The decision maker is the controller (CR), his control actions are the alternative decisions which are fed into the system to be controlled, the controlled system (CS). The latter system is modelled by a relation between actions A and states S. The preference ordering (goal) results in a preferred state from set S which the decision maker (controller) tries to attain by choosing an optimal action from set A. The main objective of decision-making is to change and improve some situation of a system by means of control. It is clear that in this view implementation can never be overlooked.

Control paradigm

According to the 'control paradigm' of de Leeuw (1974) any interesting phenomenon can be modelled by means of a control-system configuration. A control system is defined in a very gene-

ral way. A control system consists of a controller (CR), a controlled system (CS) and an environment (E). Control is defined as any form of directed influence of the controller on the controlled system. The union of controller CR and controlled system CS is called the control system C (see Figure 5.2). Because

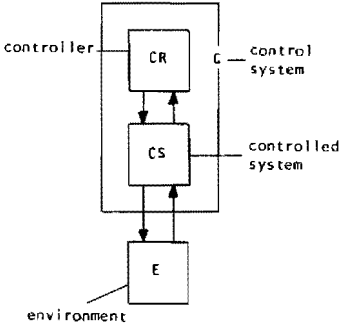


Fig. 5.2. General model of control system.

(Kuhn, 1962). More specifically, it is considered a fruitful point of view for considerations about empirical reality leading to a directed change in the existing situation. It is therefore a praxeological paradigm, that is, it is supposed to constitute a basis for a problem-solving, prescriptive methodology. In this paradigm phenomena are considered from the point of view of directed change. The behaviour of the controlled system CS is influenced by the environment E and by the control actions of the controller CR. Control by the controller CR of the controlled system CS is intended to bring about a behaviour of CS which is desired by CR. CR exercises a directed influence on CS. In order to apply this conceptual framework in a certain situation, one first has to determine the components (CR, CS and E) and the relationships between these components. (Remark that these components do not necessarily have to be subsystems but can also be aspect systems.) Subsequently one can determine for that particular CR what control actions will accomplish the desired effects. Kramer (1978) has shown how merely playing around with this model of a control situation can already provide much insight into the factual situation. The situation can namely be considered from several viewpoints. For instance, a certain department can be considered as the controller of a part of society, but also as the controlled system of the minister, or even as the controller of the minister (Kramer, 1978, p. 74). The different viewpoints may cause different or even conflicting conclusions, for example as to the organisation of that department.

² It is therefore an intentional model in the methodological sense discussed in Ch. 2.1.

this paradigm has extensively been described and discussed in the original publication of de Leeuw (1974) and subsequent publications (de Leeuw, 1976a; Kramer, 1978) its main contents will only be briefly presented here.

The control paradigm states that any interesting phenomenon can be modelled as a control system configuration². It is considered as a point of view supposedly fruitful to consider empirical reality. That is why it is called a 'paradigm'

For a traditional scientist oriented towards uniqueness of solutions, this multitude could seem a horror. From a theory-pluralism point of view (Feyerabend, 1975) this inherent pluralism of the paradigm on the contrary constitutes one of its main advantages. I also think that the explicit compulsion to consider a situation from different viewpoints, is very fruitful.

The concept of a goal

Ultimately the choice will be made on the basis of the desired effects, that is, the goal. The definition of control as 'any form of directed influence' encompasses the goal concept. Without a goal there is no directed influence. Chapter 4.1 considers the goal concept quite extensively and only the key issues need be referred to at this point.

A goal is defined as an ordering over alternatives. This general definition can be specified by means of exact mathematical specifications of the set of alternatives and particularly of the kind of ordering. The ordering should be a weak-ordering. The set of alternatives - the goal set - should consist of all relevant alternatives, that is, the goal should not be constrained to desired end-states only, but should apply to inputs, actions, states and outputs at all relevant time instances. Remember that in section 4.2 I have shown the inadequacy of a goal in terms of end-states only, in explaining the process leading to an end-state. A goal should be defined on inputs, states and outputs during the whole time period.

Although the mathematical definitions might give the impression that a goal should always be specified quantitatively and exactly, this is surely not the case. Moreover, goals can change in time, be incomplete, have a composed character, etc., which are all deviations discussed in Chapter 4.2. An important deviation that I would like to emphasize here is the impossibility of explicitly stating goals on many occasions. This serious difficulty can be overcome by reducing the requirement of a goal to that of an evaluation mechanism. It can be shown that an evaluation of the effects of the control actions on the controlled system is adequate to that control system. In Chapter 4.1 it has been shown that the theoretical consequence of this is that incrementalism (Lindblom, 1959) is still a goal-oriented model. A practical consequence is that any kind of evaluation mechanism, for example such as a group of experts reaching some consensus on the judgement of expected effect or actions, will do. The goal concept, by which actions should be tested as to the desired ends, is replaced by the 'test' in which experts should reach an agreement as to the goodness of the actions ³.

³ Note the coincidence with Lindblom's (1959) test of goodness in his incrementalism model of decision-making.

Finally I would like to remind the reader of the remarks about the concept of a goal as a tool for explanation. It has been shown in Chapter 4.1 that the concept of a goal as an explanatory tool is no intrinsic property of any person, organisation or system. No system whatsoever, hence no person either, 'has' a goal. A goal is a theoretical concept which is attributed to the particular system in order to explain its behaviour. A goal is not a system property but a model property. I will not repeat the rationale of that conclusion here, but only the consequences, namely that a researcher who explains a certain behaviour by means of some goal, does not have to prove empirically that the system has that goal. The only criterion is whether the behaviour is adequately explained or not. Discussions as to whether a certain person has a certain goal are simply irrelevant. An explanation by means of a goal is a rational reconstruction. The so-called a posteriori rational reconstruction, which is often considered as an abuse of rationality as an explanatory tool, is therefore no abuse at all.

Control modes

Besides the multitude of viewpoints that can be obtained by different interpretations of a certain situation in terms of controller, controlled system and environment, de Leeuw (1974) has also elaborated a general classification of possible modes of control by the controller.

The controlled system CS is influenced by the environment E. Hence E indirectly influences the controller CR as well. In order to obtain a desired behaviour of CS the controller CR can therefore in principle also exercise influence on the environment E. In addition to the direct control of CS by the controller CR, another mode of control is to influence E in order to obtain a desired behaviour of CS indirectly. This indirect mode of control is called "external" control of E by the controller CR. The direct mode of control is called "internal" control of CS by CR.

Consider the controlled system CS as a black box, consisting of an environmental input x , a control action u , and a transfer function f which determines the output y (Figure 5.3). The controlled system CS can then be described by the equation $y = f(x, u)$. Assume that the goal of the system can be considered as a subset G of the set of all possible outputs Y . Based on this goal and the knowledge about the controlled system CS, the controller CR has to choose appropriate control actions. From this representation of CS it is clear that the control-

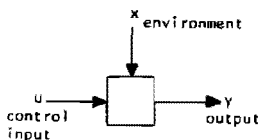


Fig. 5.3. Black box.

ler can bring about a desired behaviour of CS, that is, the attainment of the goal G, in the following ways:

- 1- choose an appropriate control action u. This is the normal type of control. Nothing else is changed;
- 2- change the structure f. It is clear from the black-box model that this will affect y and thus indirectly affect the goal attainment;
- 3- change the goal G. Obviously a change in goal directly influences the goal attainment;
- 4- change the input x. This is the external mode of control. Influencing E will indirectly influence y and hence the goal attainment.

De Leeuw (1974) calls the first three modes of control (1) 'routine' control, (2) 'adaptive' control and (3) 'strategic' control, respectively. Considering the fact that these three modes of control can also be applied to the environment if one perceives it as a black-box too, this results in a control characteristic consisting of six modes of control

<IR, IA, IG, ER, EA, EG>

where I- means internal, E- external, -R routine, -A adaptive, and -G goal control. This characteristic is a typology of possible control modes.

Finally I want to introduce the concept of metacontrol in terms of this paradigm. Metacontrol is the control of the control, that is, the directed change of the controller itself in order to improve its control. The controller is controlled by a metacontroller, that is, at a next higher level the controller has become the controlled system of the metacontroller. So there are two levels of control, the control at the object level of the controlled system CS by CR, and the control at the metalevel of the controller CR by the metacontroller meta CR (Figure 5.4)⁴. Metacontrol can be dealt with by applying the control paradigm on a next higher level. The controller CR becomes a new controlled system CS' above which the metacontroller meta CR = CR' is placed. This means that the environment E' of the metacontrol system CS' + CR' is generally not identical to the original environment E of the control system CS + CR. Apart from the control characteristic of control modes at the object level, the same characteristic can be applied to the metacontrol level, yielding six modes of meta control

⁴ Observe that if one adopts the distinction between a normative and an instrumental decision maker as Hanken and Reuver (1977, pg. 75) do, the metacontrol concept only applies to the normative one. An instrumental decision maker is defined as a mere input-output relation (an automatic routinized decision procedure) and hence there is no difference in level between this CR and the CS similarly represented as a black box. Both CR and CS are symmetrical concepts without any difference in level, that is, it is arbitrary to label one as the controller and the other as the controlled system. The concept of metalevel control is obviously irrelevant here.

<IMR, IMA, IMG, EMR, EMA, EMG>

where the additional -M- refers to the metalevel.

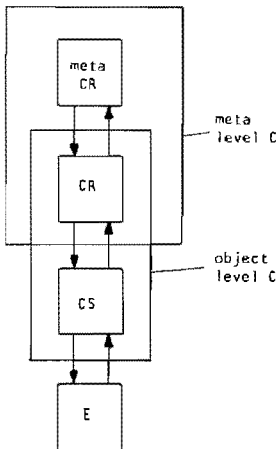


Fig. 5.4. Control and meta control.

Structural decision-making

I will now try to explain the concept of 'structural' decision-making, which was introduced in Chapter 4.2, in terms of this control-systems framework.

I have shown the analogy between decision-making and control. The decision maker or the decision-making process could be identified with the concept of controller. Therefore interest in the structure of the decision-making process means interest in the structure of the controller. Note that this is different from concern with the structure of the controlled system. Structuring the controlled system would be a particular kind of control by the controller, namely an 'internal adaptive' control mode. The decision-making aim might well be to change the structure of a particular situation. However, if the intention is to change the structure of the controller itself this change can only be a structural mode of control performed by a controller on a higher level, that is, an 'internal-adaptive' control performed by a metacontroller. In the case of structural decision making we are concerned with the structure of the decision-making process which is itself the outcome of a decision-making process on a higher level. By analogy with the above-mentioned terminology I call decision making which is concerned with the objects of decision making, namely the decisions themselves, decision-making at the object level, whereas decision-making as to the structure of the decision-making process is called decision-making at the metalevel.

5.3. A METASYSTEMIC APPROACH TO ORGANISATIONAL DECISION-MAKING

Consider decision-making in the control-systems framework. The situation on which the decisions are made and where they must be implemented is viewed as the controlled system CS. The decision-maker or the decision-making process is viewed as the controller CR. As stated above, the union of controller and controlled system constitutes the control system C. Furthermore, influences from the environment E on the situation must be considered. This control-systems viewpoint is made relative to the level of consideration, that is, this same framework can be used at different levels. I will use the index i for the object level and the index $i+1$ for the metalevel.

Possible metacontrol configurations

Now let us consider the three alternative forms of metacontrol which can directly be deduced from the E, CS, CR, meta CR configuration. The metacontroller meta CR does not have to restrict its metacontrol to CR. Via external metacontrol the metacontroller can influence CS, as well as the combination of CS and CR. Let us consider these three possibilities somewhat more closely.

In the first case the metacontroller CR_{i+1} has as its metacontrolled system CS_{i+1} the object-level controller CR_i , that is, CR_i is equivalent to CS_{i+1} ($CR_i \leftrightarrow CS_{i+1}$) as depicted in Figure 5.5. Note that this is identical to the configuration of Figure 5.4 which illustrated the structuring of the decision-making process.

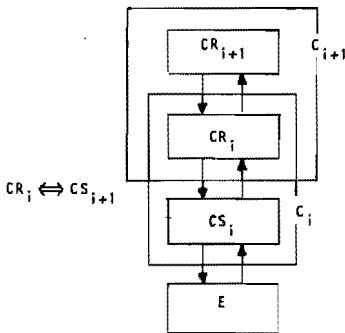


Fig. 5.5. One possible metacontrol configuration.

The second alternative configuration is the case where the metacontroller CR_{i+1} exercises external control of the original controlled system CS_i , that is,

where CS_i is equivalent to CS_{i+1} ($CS_i \leftrightarrow CS_{i+1}$) as depicted in Figure 5.6. Imagine, for example, the case where a superior goes over his subordinate's head to directly influence the latter's subordinate. In this case the metacontroller CR_{i+1} and the controller CR_i together control

the controlled system CS_i . Observe, however, that some doubt can

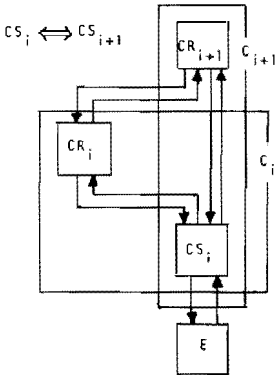


Fig. 5.6. Another possible meta control configuration.

arise as to the question whether this is still metacontrol. CR_{i+1} and CR_i are simultaneously controlling CS_i and there does not seem to be any difference in level left. Both controllers now perform their tasks in a parallel way on the same level. So it completely depends on the question whether the CR_{i+1} control actions can be defined positively as actions of a higher meta-level in comparison with the CR_i object-level actions, whether CR_{i+1} can be regarded as a metacontroller in this case.

The third alternative metacontrol configuration is where the metacontroller CR_{i+1} exerts influence on the combination of object controller CR_i and controlled system CS_i , that is, CR_{i+1} controls the control system C_i as a whole. In this case CS_{i+1} is equivalent to $C_i (C_i \leftrightarrow CS_{i+1})$ as depicted in Figure 5.7. The most obvious specification of this metacontrol of the combination of CR_i and CS_i , in addition to the separate metacontrol of CR_i and CS_i , is the metacontrol of the relationships between CR_i and CS_i .

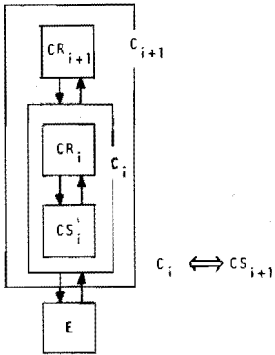


Fig. 5.7. A third possible meta control configuration.

In brief, the three possible metacontrol configurations can be characterized as follows. The metacontroller CR_{i+1} controls the metacontrolled system CS_{i+1} . Now CS_{i+1} can be either equivalent to CR_i , or to CS_i or to the union $CR_i \cup CS_i$ ⁵. There is probably no need to give an example of the first configuration ($CR_i \leftrightarrow CS_{i+1}$) for it is

in fact the concept of 'structural' decision-making which started the whole metacontrol treatment off. Influencing the structure of

⁵ This enumeration is complete, apart from the possible environmental configurations.

the decision-making process is an example of metacontrol of the object-level controller. An example of the second metacontrol configuration ($CS_i \leftrightarrow CS_{i+1}$) is the case before mentioned, in which a subordinate is not only controlled by his direct superior but also by his superior's superior. This metacontrol can be either supplementary to control by his direct chief or a replacement of that control⁶. An example of the last-named metacontrol configuration ($C_i \leftrightarrow CS_{i+1}$) is the case where it is not the structure of the decision-making process which is of primary concern, but the process of implementing the decisions, particularly the relationships between the decision-making and the implementation. As decision-making has been identified as the controller and implementation occurs in the controlled system, the relationship between decision-making and implementation is an example of the relationship between CR_i and CS_i .

Meta decision-making

The introduction of the metacontroller concept permits decision-making to be studied at three systemic levels:

1. the lower level, that of the controlled system;
2. the middle level, that of the controller;
3. the higher level, that of the metacontroller.

Note that it is this middle level that has been called decision-making at the object level in section 5.2. Studying decision-making at the 'lowest' level means studying the controlled system, to try to find out how the system behaves, in other words, to find a model of the system. In broader terms, it amounts to finding a description of reality. It is this concept that comes nearest to the already mentioned concept of 'substantive' decision-making which aimed at serving "to understand the area of concern" (Faludi, 1973).

There are indeed some parallels between the distinctions made by Dror (1968) and Faludi (1973) and this tripartition of levels. Faludi (1973) distinguishes between metapanning (defined as the design of planning agencies and their procedures), procedural theories (serving to understand the way planners operate) and substantive theories (serving to understand the area of concern). As stated above, the last type seems to coincide with the present concept of lowest level decision-making. Dror (1968) distinguishes between metapolicy-making, policy-making and post-policy-making. The differences between these two partitions and mine mainly lie in the generality and coherence of our concepts, e.g. 'meta' with Faludi is restricted to structural design and post-policy-making with Dror is restricted to implementation and

⁶ Note that in this last case particularly the 'meta' character of the control becomes rather dubious.

execution. Moreover, the basis from which they arrive at their concepts and thus how these last are interrelated is not clear. In my conceptual framework meta-decision-making is namely more general than structural decision-making alone. Structural decision-making is merely one mode of metadecision-making, besides other possible modes of metadecision-making. Following the above mentioned general classification of control into the control of goals, control of structure and 'routine' control, it will be clear that the same tripartition into control modes applies to the metalevel.

An example of a form of metalevel decision-making with the main emphasis on the goal control mode is the Dutch version of PPBS, the COBA system. In this system a hierarchically ordered system of goals is constructed in order to improve policy-making. The well-known means-end hierarchy is also an example of metalevel goal decision-making.

So far I have adopted the three-way partition in control modes to derive a typology of modes of metadecision-making. Obviously, depending on the kind of descriptive framework one adopts, different types of metadecision-making will arise. An example of another type of metadecision-making is the rationality of the decision-making process. To choose in favour of a rational-comprehensive or a disjointed-incrementalist mode of decision-making (Lindblom, 1959) or some intermediate mode such as mixed-scanning (Etzioni, 1967) is clearly a metadecision. Other modes of metadecisions follow from other typologies such as, for instance, the three-dimensional classification of Faludi (1973) into (1) the blueprint versus process mode of planning, (2) the rational-comprehensive versus disjointed incrementalist mode of planning and (3) the normative versus functional mode of planning, or the six decision-making models of Nutt (1976). The last-named stipulates that the choice among these models can be made on the basis of an assessment of the contextual variables which affect the problem. However, as in the case of the OR methodologies there are no criteria external to the models presented by which an impartial judgement can be made. A decision made at the level of the universe of discourse of the six models themselves without recourse to metasystem criteria will of necessity be considered arbitrary and without rational basis. The criteria for choice and the methodology by which the choice is made can only be ironed out at another level where the differential weighting of the criteria can be the subject of a methodology expressly designed for that purpose. Therefore, what is needed is to design a decision-making procedure by which the methodology of choosing between competing models can be resolved. This was also suggested by Heiskanen (1976) who explicitly spelled out the need for a metasystemic methodology to evaluate different approaches and scientific strategies of theory formation in the social sciences.

Structural metadecision-making

As stated in the introduction to Chapter 5 the main reason for developing the 'meta' framework was the concern for structural decision-making. So let us now have a closer look at this mode of metadecision-making.

As was explained earlier, according to de Leeuw (1974) the three-way partition into different modes of control follows from the black box concept. In a black box the structure is defined as the input-output function. Here a slightly different definition of the concept of structure, namely as the set of relationships S between the objects X of a system $\langle X, S \rangle$ will be adopted, in order to visualise structural decision-making. Consider the complex multilevel decision-making process in Figure 5.8.

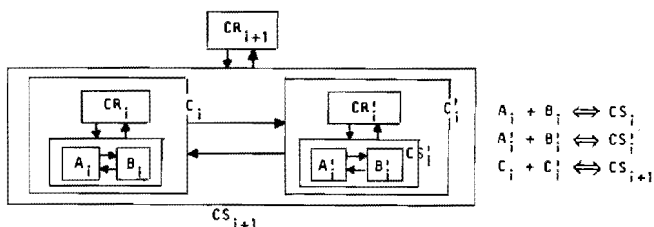


Fig. 5.8. Complex multilevel decision-making.

If the decision-making at the i -th level CR_i controls the relationships between the elements A_i and B_i of the controlled system CS_i , this is called a structural mode of decision-making (control). Notice that this is still control at the object level. If the metadecision-making CR_{i+1} controls the relationships between the decision-making systems C_i and C'_i , both objects of the meta-controlled system CS_{i+1} , this is a structural mode of metadecision-making from the point of view of CS_i and CS'_i . From the point of view of C_i and C'_i this structural control reduces to object-level control. It should therefore be emphasized that meta- or object-level control completely depends on the level of consideration one adopts. What is metacontrol on one level reduces to object-level control on another and vice versa. As mentioned before, I consider this inherent pluralism, which is due to the fact that the conceptual framework is object-independent, not as a negative ambiguity but as a fruitful property. Approaching the same problem from various points of view increases the possibility of fruitful problem-solving, an opinion which in me-

thodology is strongly promoted by Feyerabend (1975). I will return to the multilevel question later on in the discussion.

One might also introduce a further subclassification of modes of structural decision-making according to the proposals of Chapter 4.2. There I proposed to divide the structure of a decision-making process into three dimensions: sub-, aspect- and phase systems:

- subsystems - groups, dept., etc.
- aspect systems - the issues, topics
- phase systems - the phases

The structure of such a system is then defined as the relations between sub-, aspect- and phase systems:

- relations sub/sub - interactions, power, communication
- relations aspect/aspect - functional coordination issues, etc.
- relations phase/phase - what sequence?
- relations aspect/sub - who does what?
- relations phase/sub - who acts when?
- relations phase/aspect - what is dealt with when?

In other words, the structure, that is, the relations between sub-, aspect- and phase systems should be interpreted as to 'who is doing what and when'. With this descriptive framework an organisational decision-making process is modelled as a path in the three-dimensional space spanned by sub-, aspect- and phase systems. The structure of this process consists of the relations between all possible blocks of the system.

Observe that I did not distinguish between prescriptive and descriptive theories of decision-making. This implies that the organisation of decision-making can mean two things: either the design of the structure or the description and explanation of the structure of a decision-making process. As I have mentioned before, it is this very duality in the meaning of the term organisation which induced me to use it. The distinction between prescription and description has been discussed extensively in Chapter 2.1 and I will therefore not dwell upon this theme here. Suffice it to repeat that a configuration in terms of control and metacontrol system does not automatically imply that one is talking in a prescriptive sense only; the same framework can be used in a descriptive sense.

5.4. DISCUSSION

In this section some problems arising out of the concept of metadecision-making will be discussed, some of which are not problems, some can be solved and some can not (yet) be solved. Let me start with a problem which turns out to be no problem.

The goal of a metacontroller

The metacontroller exercising directed influence has per definition a goal ⁷. Now consider the example of structural meta-control as visualized in Figure 5.8. Assume that the object-level controllers CR_i and CR'_i , which per definition also have goals, have conflicting ones, that is, assume that it is impossible to deduce an overall goal for CR_{i+1} from the conflicting goals of CR_i and CR'_i . Then CR_{i+1} has no goal and hence the metacontroller CR_{i+1} does not exist. Or where does CR_{i+1} get his goal from?

The answer to this problem is that the goal of the metacontroller CR_{i+1} is no derivative of the goals of the object-level controllers CR_i and CR'_i . The definition of metalevel namely is that this level qualitatively differs from the object level. Metacontrol deals with different and higher-level objects than object-level control. Hence the goal of the metacontroller applies to different objects than the goals of the object-level controllers do. Of course, there will be a relationship between both for the simple reason that the aim of the metacontroller still is to contribute to a desired behaviour of the controlled system at the object level ⁸. The metagoal can, however, not be regarded as an aggregation of the object-level goals ⁹. The question as to where the metacontroller gets its goal from, is therefore the same as the general question where a controller gets its goal from, a question to which there is no general answer ¹⁰.

⁷ As long as we do not consider it an instrumental controller (Hanken and Reuver, 1977, p 75).

⁸ Think e.g. of the so-called 'means-end' hierarchy which mostly means that the output of a system is the input (instrument) of the next higher system. In this sense goals at different levels can be related.

⁹ Only in the case where the metacontroller's aim is to coordinate explicitly the goals of the object-level controllers, does the problem of aggregation of a common goal from (possibly conflicting) goals occur. This matter will be treated in Chapter 6.3.2 on goal coordination.

¹⁰ Remember that a goal used as an explanatory tool, is a theoretical and attributed concept. So if the control system framework is used in an explanatory sense, the controller's goal simply comes from the researcher whose task it is to explain.

Structural metadecision-making

One of the problems in identifying structural metadecision-making is, for example, the question whether changing rules inside a subsystem is also a kind of structural metadecision-making or whether this term is reserved for changes in relations between subsystems. There are two possible answers to this question.

First, one can adopt the black box point of view and thus realise that changing the rules, that is changing the black box transfer function, is indeed a structural change.

Second, one can subdivide the subsystems into parts so that the subsystem itself becomes a system of subsystems and relations. A change within a subsystem can therefore be represented as a change in structure between sub-subsystems on a lower level of aggregation. Such problems in identifying structural decision-making will be illustrated in the case study dealt with in Chapter 8.

In general this problem of rules or structure, i.e. of the definition of structural metacontrol, amounts to the problem of the exact definitions of 'structural control' on one hand and of 'metacontrol' on the other. Structural control was defined by de Leeuw (1974) as one of three possible control modes apart from goal control and 'routine' control. The tripartition followed from the black box representation of the controlled system (see Chapter 5.2). As I have already remarked, instrumental conceptualisation of a controller (Hanken and Reuver, 1977, pg. 75) lacks the goal concept. Hence in this conceptualisation goal control does not exist. The same kind of definitional problem occurs when comparing the three modes of control with the 'decision-cell' paradigm of Hanken and Reuver (1977, pg. 62) for example. From the point of view of this paradigm the identification of goal, structural and routine control may often seem arbitrary and artificial. The conclusion herefrom that these three modes of control are ambiguous and should be better defined is of course false, for it is quite evident that the identification of some key issues of one paradigm by means of the key issues of another paradigm will be difficult, if not impossible. Most paradigms are incomparable. In brief, one can state that not only does it depend on the model or point of view adopted in dealing with a situation, whether something is or is not structural control, it also depends on the more general point of view, for example, the paradigm adopted, whether something like structural control exists at all. On the other hand this problem of rules or structure amounts to the problem of the exact definition of metadecision-making. I have introduced the concept of metadecision-making in a three-level control system, with the controlled system at the lowest level, the controller at the next, and the metacontroller at the highest level. Of course, it is possible to invent a multitude

of different verbal descriptions of these levels such as substantive decision-making, post-policy-making, implementation, execution, etc. for the lowest level; procedural decision-making, functional decision-making, operational decision-making, etc. for the middle level; structural decision-making, goal decision-making, etc. for the metalevel. In our view misunderstandings can be avoided by the use of the control-systems point of view: define the system, the controller, the control action, the inputs and outputs, etc. and there is no ambiguity left. One should, however, realise that these are not the only possible approaches and that there is no guarantee that they will be the most fruitful for developing a theory of metadecision-making. From the point of view of theoretical progress it would be better to take a theoretic-pluralism point of view (Feyerabend, 1975), that is, approach a problem with more than one theoretical tool at a time. As I have stipulated several times, the control-systems framework is inherently very pluralistic. The definitions are object-independent and difficult points of view or levels of consideration yield different results. The framework possesses a large degree of freedom which actually amounts to some kind of pluralism.

Multilevel problems

The control-system description does not stop at the metasystem level. On the contrary. It seems rather that one can apply an infinite iteration of metalevels arriving at an object level, a metalevel, a meta-metalevel and so on. One can obtain this multitude of levels by continuously lowering the level of aggregation; subdividing the system into parts and relations at each level of aggregation and applying the principle of structural metadecision-making. The same can be done by looking at the goals resulting in a multilevel hierarchy of goals, subgoals, etc. (this is closely related to the well-known means-end hierarchy). This point of view implies that the levels only differ in their amount of detail but that the aspects considered are the same.

However, one can also imagine a system, metasystem and meta-metasystem configuration where the levels differ qualitatively. Take, for instance, the example of an imaginary PPBS control system (van Gigch, 1978). At the object level the PPBS is implemented, carried out, at the next higher level (the metalevel) one has to decide which kind of budgeting system should be adopted, and on the meta-metalevel there might be a body concerned with the general question as to what kind of control should be applied to public administration at all. At a still higher level one might imagine that our Western cultural system plays a role. In this example there are clearly qualitative differences between the matters of concern at each different level; it is not simply a question of the amount of detail. Another example

of such qualitatively different levels might be a decision-making configuration where the metalevel considers the structure of the process and the meta-metalevel considers what mode of decision-making should be adopted (rational, incremental, mixed-scanning, etc.). Still another example might be an imaginary meta-metadecision-maker who decides about the general question as to what type of decision-making is wanted, e.g. democratic or plutocratic or autocratic. The metadecision-maker, knowing that the system is democratic, decides on the specific democratic procedure, for instance, majority, district system, etc., and at the object level the specific decision-making system, say the simple-majority system, is carried out and decisions are taken which are implemented in the object-level controlled system.

Maybe some light can be shed on the confusion between these two apparently different kinds of multilevel system configuration by drawing a parallel with the concept of hierarchy as defined by Simon (1962): a hierarchical system is a system which can be partitioned into subsystems, which in turn can be partitioned into sub-subsystems, and so on, to some level of elementary subsystems. This definition pictures a multilevel system constructed by iteratively subdividing the system. At first sight it would appear that the levels only differ in their amount of detail. However, this is not necessarily true, because nothing has been specified in the definition as to the dimension along which the subsequent partitions take place: the aspects according to which systems are partitioned into subsystems can indeed differ from level to level. Hence a hierarchical system in which all different levels have qualitatively different matters of concern is a specific but still hierarchical system as well as a hierarchical system in which the aspects per level do not differ.

Remember, however, that the concept of a metalevel was explicitly defined as a level of qualitative difference compared to the object level. A multilevel hierarchical system, where the aspect of concern is the same at all levels, may be defined as multilevel, but does not meet the metalevel definition. The aspects per level differ in that definition.

Closely related to the problem of the difference or identity between matters of concern at the various levels is the question whether a theory at the system level is different or isomorphic to a theory at the metasystem level. On the one hand one might state that because we envisaged a control-systems approach in which the same concepts apply to a higher (meta)level, it seems probable that the theories needed to explain the phenomena at the different levels will be isomorphic too. On the other hand it is not difficult to give a counter example in which it is clear that totally different kinds of theories are needed. This issue is clearly related to the question of the relationship of

theories at different levels of aggregation, such as considered, for example, by Heiskanen (1976). Again the point is that the general concepts and ideas used in the theories may remain the same at different levels, but their specific empirical contents in the particular case under consideration will, however, surely differ due to the definition of the metaconcept. Hence theories at different levels might be similar in a general sense but will surely be dissimilar in a specific empirical sense.

Another problem related to the multilevelness is the finiteness or infiniteness of the iteration of levels. One can go on talking about structural metadecision-making as long as one can subdivide a system into parts and relations. Top down one might consider some level of detail - e.g. the individual level - as the end of the regression just as in the earlier-mentioned definition of hierarchy. But what about a bottom up iteration? Does one stop at the level of cultural system of values or does one proceed into the universe? An answer to this question would probably lead us to philosophy, something I prefer to avoid. There is, however, one thing that should be emphasised about the finiteness or infiniteness of levels, namely that in essence only two levels are considered, that is, the level of the controlled system and the next-higher level of the controller, no matter how high the level of consideration may be. Even the level of the metacontroller, which I have called the third level, is nothing other than the application of the two-level controller-controlled system configuration one level higher, namely the level of the metacontroller-metacontrolled system. No matter at what level one works, one always has to do with only two related levels at a time.

Conclusion

The intent of this chapter is to draw a general conceptual framework of metadecision-making in which the subject of the organisation of decision-making is embedded. As we have seen, problems remain. What is clearly needed is a further extension of this conceptual framework in the direction of a 'real' empirical theory of metadecision-making which can meet the scientific requirements of theories such as consistency, testability, etc. A conceptual framework can hardly be tested because of its abstract conceptual level. It can only be illustrated, which will be done in the case study dealt with in Chapter 8.

After having developed a general framework in this chapter, in which a theory about the organisation of decision-making is embedded, the next chapter will be devoted to the development of a theory on the organisation of decision-making itself.

The advantage of explicitly incorporating the metasystem into the model of decision-making is that it openly sets out the roles of the system and of the metasystem so that it becomes clear that the former carries out procedures and implements standards whose design is formulated in the latter. This separation is taken for granted by most decision-makers but receives more emphasis if the decision-making model indicates different systems with separate functions.

CHAPTER SIX

ORGANISATION OF DECISION-MAKING

After having introduced the theme of the organisation of decision-making via the path of rationality in Chapter 4, and after having elaborated in Chapter 5 the framework in which it is embedded, we now concentrate on developing a theory on the organisation of decision-making - both in the descriptive sense as 'structure' as well as in the prescriptive sense as 'structuring'. As indicated in the survey given in Chapter 3.3 and repeated in the introduction to Part Three, a systematic theory explicitly dealing with the organisation of decision-making does not exist. Let me remind the reader that this statement should be carefully interpreted. What does exist is a vast literature on one dimension of the organisation of decision-making, that is, the time dimension (Simon, 1945; March and Simon, 1958; Simon, 1960; Brim et al., 1963; Cyert and March, 1963; Kirsch, 1977; Witte, 1973; Mintzberg et al., 1976). Secondly, these phase models often coincide with functional aspect-system models. Third, there are incidental examples of models which in fact deal with the structure of decision-making (Cohen et al., 1974; March and Olsen, 1976; Gore, 1964). Fourth, organisation science can be considered to deal at least partly with the subject. The habit, for instance, of many German organisation scientists to put the terms 'Entscheidung' and 'Organisation' together in one title (Kosiol, 1959; Hax, 1965; Mag, 1969; Fieten, 1977) should however not mislead us; apart from some treatment of team theory, game theory and linear programming, subjects which for reasons not yet clear have still not disappeared from the organisation-scientific scene in Germany, and might indeed be considered mathematical models of the organisation of decision-making, it is all normal organisation science, that is, it deals with the structure and structuring of an organisation and not with that of a decision-making process. As I have explained in the introduction to Chapter 3, I consider the concepts 'organisation' and 'decision-making' as different in general. This general difference does not exclude the possibility that some partial theory on organisations might be applicable as a partial theory of the organisation of decision-making. There might well be some (considerable) overlap (see Figure 3.2).

I will, however not follow the approach to deriving parts from organisation science - such as the theory of project organisation, for example (Botter, 1977, Ch. 8) - and adapt them to a theory of the organisation of decision-making. The main reason - apart from a personal dislike of exegetical reinterpretations - being that in my view the concepts and, in particular the consistency of the conceptual network used in organisation science is rather weak, to put it mildly. I therefore prefer to go down to the roots of the concept of organisation first. In the next section I will sketch my ideas on the theme. Starting from a general and systematic definition of the concept of organisation (of decision-making) I will systematically elaborate the concept. As to the systematics I will for the most part be systematic. As regards the systemics, reliance will primarily be on systems theory.

6.1. THE ORGANISATION OF DECISION-MAKING

Decision-making and organisation

Let me start by briefly recalling my interpretation of the concepts of decision-making and organisation, particularly what the difference between 'organisation of decision-making' and 'organisation' exactly is.

In the introduction to Chapter 3 I have indicated that, in my view, a decision-making process and an organisation are distinct concepts. The concept of organisation can be interpreted in a 'functionalistic' sense as a system of rules for performing its tasks, or in an 'institutionalistic' sense as a goal-oriented system with a structure (Kieser and Kubicek, 1977). Moreover, I also make the distinction between the descriptive use of the term organisation, denoting the above-mentioned 'functionalistic' or 'institutionalistic' system, and the prescriptive use of the term organisation, denoting the design of an organisation, i.e. the organising a system which is either 'functionalistic' or 'institutionalistic'. None of these various interpretations of the term organisation can be identified with the concept of decision-making, the latter being characterised as a learning process of search, development and evaluation leading to a choice of alternatives and a subsequent action commitment for implementation (see introduction to Chapter 3). Inside the organisation 'system', numerous decision-making processes are launched by many members of the organisation on numerous aspects. From the institutionalistic viewpoint of organisation the decision-making concept is a subset of the organisation concept, that is, (rational) decision-making processes are also goal-oriented systems with a structure, but they only form a part of the organisation in the sense that many other decision-making processes and still other processes also take place in that same organisation. All are goal-oriented systems with a structure, but there are more decision-making systems inside one organisa-

tional system. Hence the qualification 'subset of'.

From the functionalistic viewpoint of an organisation, there also is a 'subset of' relationship between both concepts. Decision-making also needs a system of rules for the performance of its tasks, but the organisational rules serve more tasks than that of just one decision-making process.

Let us try to specify the relationship between both concepts further.

In view of the subject of this book, decision-making is felt to play a central role in organisations. There is, however, a difference between 'the only important' role and 'an important' role. If one states that decision-making is the only important activity inside an organisation, the relationship between decision-making and organisation is that an organisation consists of numerous decision-making processes, but that all the decision-making processes together constitute the whole organisation, for decision-making is the only important activity. Hence the relationship is that decision-making is a subset of organisation (Figure 3.1), for all subsets of a set constitute the set¹.

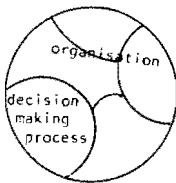


Fig. 3.1. Decision-making is a subset of organisation.

If, on the other hand, one does not believe decision-making to be the only important activity inside an organisation - operational activities on the execution level on the shop floor might, for instance be distinguished from decision-making processes; decision-making only takes place in the administration of the organisation - and if, moreover, one states that besides the institutionalistic 'goal-oriented system with a structure' and the functionalistic 'rules to perform tasks' characteristics, decision-making possesses

many other characteristics - e.g. learning process, choice, implementation - then decision-making is no longer a subset of the organisation concept, for it possesses characteristics that the organisation does not have and the organisation possesses characteristics that decision-making processes do not have. From this viewpoint an organisation consists of more than the sum of all decision-making processes (Figure 3.2). Decision-making and organisation have an overlap (intersection) but also have separate elements.

¹ Note that the elements of the sets in this configuration are not necessarily the participants, individuals, etc., but primarily denote issues, aspects, subjects, etc. Note that if the set did consist purely of individuals, a configuration such as in figure 3.2 would be impossible.

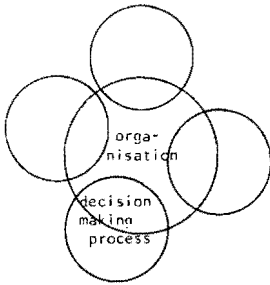


Fig. 3.2. Decision-making intersects organisation.

So what can one conclude from these relationships between decision-making and organisation as to the relationship between a (conceptual) theory on the organisation of decision-making and one on the organisation of organisations?

If one adopts the 'subset of' relationship (Figure 3.1) it follows automatically that any theory on decision-making becomes a theory on organisation. Note that a theory on a particular kind of decision-making, i.e. one, but not all of the subsets, does lead to a theory on a restricted part of organisation. A theory on a particular aspect

of decision-making - e.g. the organisation of decision-making - which is not restricted to one kind of decision-making process, i.e. to one subset, but applies to that particular aspect of all kinds of decision-making processes, i.e. all subsets, does lead to a theory on a particular aspect of organisation - that is the structure and structuring of an organisation. If one adopts the 'intersection' relationships (Figure 3.2) a theory on decision-making does not automatically lead to one on organisation. In order to prove that one has first to prove that the theory applies to the intersection of both. In fact, this is a tautology for in order to prove that a statement applies to the intersection one has to prove that it applies to decision-making and to organisation.

When I have presented my conceptual framework on the organisation of decision-making, I will return to this question and evaluate its relationship with a theory on organisation along this line of argument. I shall now proceed with the development of this framework.

The concept of structure

In Chapter 5 the organisation of decision-making has been identified as a form of metadecision-making about the structure of the decision-making process. Obviously the basis for a theory on the organisation of decision-making is the concept of structure. Let us first consider this concept for a moment as it is used in organisation science and then proceed with a system-theoretical approach to the concept.

The concept of structure is widely used in almost all sciences, including organisation science. In classical organisation science the structuring problem was considered paramount. The structuring problem was generally approached as a division-of-tasks and coordination problem, particularly in the 'Scientific

Administration' school (Gulick and Urwick, 1937): in every organisation the diversity of tasks will lead to a division into classes of similar tasks. The necessary coordination of those classes of tasks will need relationships, will, in short, need a 'structure'. From the point of view of the 'Human Relations' school structure means relationships and communication between people, that is, the 'Human Relations' school was primarily interested in group structures and not so much in organisational structure, or, to put it in the words of Bennis (1959): the 'Human Relations' school was concerned with 'people without organisations', contrary to the classical organisation science which was concerned with 'organisations without people'. In view of the fact that 'Human Relations' treatments on organisational structure do exist (e.g. Likert, 1961) the statement is somewhat overdone. Nor did the 'decision-making' school pay much attention to the structuring problem either, which might be explained from their assumption that 'organisation' and 'decision-making' were identical. Only in the recent 'contingency' school does the structuring problem return as one of the key issues, which is not surprising if one observes that the issue has been reintroduced by some authors by referring to the bureaucracy theory of Weber (Pugh et al., 1964). The great difference between the classical and the contingency approach, however, is that the former approach is a closed-system one while the latter is an open-system one. In classical theory one starts with the tasks inside an organisation, partitions these tasks, coordinates, and thus obtains a structure. In contingency theory, structure is considered to be determined by situational factors (environment, technology, size, etc.) whereas intraorganisational factors like group behaviour, leadership, etc. are sometimes also included in contingency research on organisations (Staehle, 1973; Pugh et al., 1964). Although my contention is that the conceptual framework is intended to develop in this connection, actually is situational or can easily be extended in that sense - this will be discussed at length in Chapter 7 - my approach in this chapter will be rather more like the classical one.

The system-theoretical definition of structure will be assumed as a starting point mainly because it embraces most others by its generality. Consider a decision-making process as a system. A system is defined as a set of objects plus a set of relationships between these objects. This latter set of relationships is called the structure of the system. Note that the objects can be both persons or things, such as tasks, and that the same set of objects can have different kinds of relationships and each different kind will result in a different structure. In formal terms this means that we are looking at the different structures of different-aspect systems of the same original system. This leads us to the more extended definition of the structure of a system, which was introduced in Chapter 4.2. Take the

formal system-theoretical definitions (de Leeuw, 1974)²:

- a system $S = \langle A, R \rangle$ consists of a set A of objects and a set R of relationships between these objects (the structure);
- a subsystem $SS_1 = \langle A_1, R \rangle$ consists of a subset $A_1 \subset A$ of objects and the (original) set R of relationships between these objects;
- an aspect system $AS_1 = \langle A, R_1 \rangle$ consists of the (original) set A of objects and a subset $R_1 \subset R$ of relationships between these objects;
- a phase system $PS_1 = \langle A, R \rangle$ is identical to the original system S , only during a certain time interval T_1 smaller than the duration T of S : $T_1 \subset T$.
- S_1 is called a part system of S if S_1 is a subsystem and/or an aspect system and/or a phase system of S .

A system S can generally be split up into a set of various subsystems $SS = \{SS_1, SS_2 \dots SS_n\}$ a set of various aspect systems $AS = \{AS_1 \dots AS_m\}$ and a set of various phase systems $PS = \{PS_1 \dots PS_k\}$. In these terms the structure of a system is defined as the set of relationships between the sub-, aspect- and phase systems of the system. Note that this definition is an extended version of the mere 'set of relationships between objects' definition in the sense that the objects are specified into sub- aspect- and phase systems; the relationships are not further specified.

A simple illustration of this definition of structure is the following.

Consider an organisational decision-making process as a system and define the participating individuals as the set of objects A . Then the subsystems are clusters of individuals (groups, departments, etc.), the aspect systems are classes of relationships between the individuals (information flows, personal relations, power relations, etc.) and the phase systems are classes in time (periods, phases). Roughly speaking, the partitioning of the system into sub-, aspect- and phase systems can be interpreted as: 'who' is doing 'what' and 'when'. Given this classification, a decision-making process can be depicted as a trajectory in the three-dimensional space (see Figure 4.7 in Chapter 4.2). A less artificial illustration of this definition of structure can be found in the case study in Chapter 4.3.

As mentioned above, this definition of structure is an extension in the sense that the objects are specified. The relationships are not specified. Observe that the objects of a system

² These definitions are incomplete in the sense that the environment is not included. In de Leeuw (1974) the complete definitions are given.

can also be further specified in the sense that each object of the system is itself a system of objects and relationships. In other words, a part system of a system also has objects and relationships. Clearly structure is a multilevel concept (this multilevel characteristic will be discussed at length in Chapter 6.3.3). Whatever the specification of the objects of a system may actually be, the essence of the definition of structure is that it deals with the relationships between these objects.

Organisation of decision-making: decomposition and coordination

Following the system-theoretical definition of structure, it is evident that the organisation of a decision-making system must consist of two measures:

- a. to form the relevant part systems of the original system;
- b. to form the relevant relationships between these part systems.

The two measures correspond to the concepts of 'decomposition' and 'coordination' respectively.

Let us consider both in somewhat more detail.

Decomposition

In its simplest form the first measure would read 'find the objects of the system'. The given formulation is an extension of that simplest form in the sense that account is taken of the fact that the organisation of a decision-making system probably does not always take place at the lowest level of aggregation, namely the level of the elementary objects. In practical situations it is often possible to consider objects as (part)systems themselves. The choice of a lowest level of aggregation, i.e. the choice of a set of elementary objects, is a matter of the aim of the research. Once a description of a decision-making process is given as a system consisting of a set of elementary objects, say the individual participants, then the structuring has to start with the formation of relevant part systems. Observe that it is not always true that the part systems relevant to the problem under consideration consist of direct clusters of elementary objects. It may very well be that the first clustering level is not yet relevant and that the clustering will follow an iteration of levels of aggregation before ending at a level which is relevant to the problem under consideration. Hence the formation of relevant part systems may very well be an iterative formation process.

Second, note that part systems can be formed in two opposite ways: one can start from the elementary objects of the system and group those objects together into part systems, on the other hand one can start from the system as a whole and partition that whole into part systems. The first is a bottom-up method while the latter is a top-down method, and it is clear that the organi-

sation design philosophies behind both methods are surely different. Although one had better call the first method 'composition' and the latter 'decomposition', I will refer to both ways of forming part systems by the term decomposition. We will see in the next section on decomposition that formally discerning between the two opposite methods is often just a matter of nuance. Third, note that we have been speaking about the formation of part systems, whereas decomposition has been specified as the clustering of elementary objects, which, however, would appear to be the definition of the formation of subsystems. It is indeed important to define clearly what decomposition means in order to prevent confusion. So what exactly is meant by the formation of part systems?

Part system is the general term for subsystem and/or aspect system and/or phase system. A subsystem of a system consists of a subset of the original objects, a part system consists of a subset of the original relationships, and a phase system consists of a subset of the original time interval. All three kinds of part systems are per definition formed via the 'subset of' method, all three are subsets of the original system, only the elements of the sets differ. In the first case the elements of the set are the objects, in the second case the elements of the set are the relationships, in the third case the elements of the set are the time instances. Thus formulated, it becomes clear that in all three cases the formation of a part system can be represented as the formation of a subset of elements from a set. The relationships and time instances can namely be represented as 'elements' of a set as well. Although the formation of part systems defined as the formation of subsets of 'elements' might indeed seem to be the definition of the formation of subsystems, it will now be clear that these 'elements' are not necessarily restricted to the objects of the system, but also include the relationships and time instances of the system. So far the specification of the term part system in the concept of decomposition. Let us now turn our attention to the term formation.

The formation of part systems defined as the formation of subsets of objects, relationships or time instances of the system seems to be a typical top-down interpretation of the concept. One starts from the whole set and forms subsets. The typical bottom-up version would be to start from the elements of the set and group them into subsets. The term subset formation however does not exclude one of the two versions. Its meaning is neutral in that sense.

Finally I would like to emphasise the 'subset of' interpretation of decomposition. For it clearly illustrates that decomposition of a system means that inside this system subboundaries are drawn around subsets, that is, that the primary meaning of decomposition is its demarcation meaning. Just as a set is defined by

its boundary - which elements fall inside, which outside - a system is defined by its boundary, too. Everything outside the system boundary is its environment. Decomposition is the drawing of boundaries inside a system. Decomposition results in a demarcation of what falls inside which subboundary. The reason why I emphasise this meaning of decomposition is that I want to make clear that decomposition has no broader meaning. Formation of part systems might well be understood as the complete construction of part systems, that is, the creation of elements, the drawing of the boundary, the creation of relationships between the elements, the creation of external relations, etc. That is not my interpretation. The obvious reason for keeping the meaning of decomposition restricted is that it would otherwise interfere with the second measure to be taken in the organisation of decision-making: the formation of relationships.

Coordination

Once the part systems of a system have been formed, one can proceed with the formation of the relevant relationships between these part systems. This measure seems to correspond to the well known concept of coordination. First form the parts, then coordinate them. According to the definition of a system, the formation of part systems, which I have called decomposition, and the formation of relationships between these part systems completely account for the construction of a system. Nevertheless I will attach a broader meaning to the organisation of decision-making. Apart from decomposition I will not restrict my treatment to the formation of relationships only, but extend that second part to include the treatment of the coordination of part systems. In my view the coordination of part systems has a broader meaning than only the formation of relationships. The organisation of a decision-making system does not only consist of the off-line a priori construction of the structure of the system but also of the further process control of that system. And that is how I will interpret the concept of coordination.

Although it may cause irritation among readers to stop at these rather vague indications of the additional meaning of coordination besides the 'formation of relationships' meaning, I would rather not anticipate things. After the treatment of decomposition in Chapter 6.2, the concept of coordination will be treated at greater length in Chapter 6.3. The reader is asked to be patient till then.

This postponement of the treatment of coordination implies that we can not yet extensively discuss the exact relationship between both concepts of decomposition and coordination at this point. The issue will be discussed in Chapter 6.4.

6.2. DECOMPOSITION

In this section I will enlarge on the first step of the problem of organising decision-making, namely that of decomposition. Although coordination is usually considered as the most important problem in organisation design, or even as the only important one as some representatives of the 'Scientific Administration' school seem to imply when they consider organisation and coordination as equivalents (Gulick and Urwick, 1937), the problem of decomposition is as important as coordination. As I have shown in the previous section, the one can not do without the other; both concepts are closely related because together they result in the organisation of a system. I will start with an introductory consideration of the concept of decomposition from the organisation-science viewpoint in which some forms will be presented but in which some alternative methods of decomposition will be dealt with in particular. Subsequently these alternative methods will be treated in a formal way. Before actually doing so I think I had better explain why I take the formal approach.

Formal approach

The aim of this chapter and in fact of the whole book, is to develop a clear system of concepts where clarity applies to both the concepts and the consistency of the network of interrelated concepts. In this chapter I will try to achieve a maximum of clarity by formalising the methods of decomposition into strictly unambiguous mathematical terms. The aim is conceptual clarity and hence the use of the mathematical formal approach lies on the conceptual level. Let me, however, emphasise that the aim is not to use the set of mathematically defined variables and procedures as a starting point for computation. Although this might be an ideal from a mathematical viewpoint - at last the computerised calculation of 'optima' can begin - from the organisation-science viewpoint this seems to make little sense. For in my view mathematical approaches in the field of 'real' non-routine decision-making should not serve the end of computation of optima - here that would be science fiction - but at most serve the aim of conceptual clarification of the vagueness and confusion which is alas often present in decision-making science. That aim is not served by a large set of formal variables which require exact specifications. That aim is best served by a relatively small number of variables which, by their abstractness, provide the flexibility needed to approach the problem from various points of view. That is the difference between a conceptual eye opener and a conceptual eye flap. I do not want to confine 'real' decision-making with the shackles of mathematics but use the clarity of mathematics, where possible, to enlighten 'real' decision-making. This general statement is to the effect that one should be very careful when interpreting the formal models. The necessary

step of translating the mathematical concepts into organisational terms should not be misunderstood as a straightforward operationalisation and measurement of the proposed concepts. I do not pretend that the proposed models can be used as operational calculation models. I propose the formal models as frameworks on which an empirically solid theory should be developed in due course. Hence the objection that my design approach assumes a deductive rational strategy and is therefore certainly 'old hat' and ignores all kinds of different approaches to organisation design, such as the 'political strategy', can be countered in advance. The proposed conceptual framework is kept abstract and hence broad enough to fill in the various concrete approaches at the right time. The concrete examples presented throughout the text are merely illustrations of the approach and of the fact that the problems addressed are indeed relevant, basic and elementary. It will also be shown that the clarity of the framework leads to some fruitful insights into the ambiguity of some 'real' organisation design methods. Let me, last of all, repeat the argument of Chapter 2.1 that in my view a good theory does not come from empirical reality but as the result of a process which includes a first conceptual step.

6.2.1. FORMS OF DECOMPOSITION

"Perhaps the most important principle on which the economy of a manufacture depends, is the division of labour amongst the persons who perform the work" (Babbage, 1969). As soon as the work to be done becomes too much for one person, work has to be divided amongst several persons. "Work division is the foundation of organization; indeed, the reason for organization" (Gulick, 1937). This consideration formed the starting point of the development of 'Scientific Management' (Taylor, 1911) and 'Scientific Administration' (Gulick and Urwick, 1937). The economic rationality of division of labour (specialisation) is based on several principles (Babbage, 1969; Gulick and Urwick, 1937; Kieser and Kubicek, 1977):

- specialised tasks require little time for learning, little waste of material in learning, and little loss of time when changing from one task to another;
 - frequent repetition of the same task results in a higher skill and rapidity;
 - tasks which require only simple skills can be performed by cheaper workers;
 - when fewer operations have to be performed, the work will be less tiring and strenuous and hence productivity will increase.
- The validity of these principles is however restricted in view of the fact that extreme specialisation often leads to greater personnel fluctuations, higher absenteeism, illness, decrease in concentration, etc. (Friedman, 1956) and that more specialisation

leads to a higher need for coordination. A good illustration of the psychological consequences can be seen in Chaplin's film 'Modern Times'. The 'Human Relations' school did not arise without reason.

Besides the division of labour into individual tasks, decomposition also applies to the formation of larger organisational parts containing several persons or tasks, such as groups, departments or even larger entities. Decomposition at this level of aggregation is generally called 'departmentalisation'. The formation of departments or groups inside an enterprise can be performed along different dimensions, that is the subdivision of the activities can be divided on several possible bases such as (Dale, 1952):

1. function; the subdivision is by principal activities such as finance, production, sales, etc.;
2. product; the subdivision is by (types of) products;
3. location; the departmentalisation is geographical, and several other dimensions such as customers, process, equipments, etc.

On the next higher level of aggregation, the 'external structure' of an enterprise, that is, the set of relationships between different enterprises, the same principles can be applied. Decomposition by function at this level leads to 'differentiation', when an enterprise applies itself at one of the stages in the transformation process of raw materials into consumer goods; decomposition by product to 'specialisation' when an enterprise applies itself to the fabrication and sale of one single product (Botter, 1977).

Another dimension to which decomposition can be applied is the dimension of authority. The formation of relatively autonomous subdivisions of an enterprise is called 'decentralisation'. The difference between the above-mentioned concept of departmentalisation and the latter concept is that in decentralisation the emphasis lies on the delegation of authority. This difference, for instance, is shown in the two following concepts that are used in Dutch public administration (Rosenthal et al., 1977), namely 'decentralisation' which is the delegation of public juridical authority to lower public authorities, which can be either functional or territorial and 'deconcentration' which is defined as the establishment of regional or local units of central public institutions. In the last form of decomposition there is not necessarily a delegation of authority. In terms of decomposition, 'decentralisation' means the decomposition of the central authority of a system into authorities of subsystems. In control-system terms 'decentralisation' clearly differs from the above-mentioned forms of decomposition in the sense that 'division of labour' and 'departmentalisation' deal with the decompo-

position of the controlled system, whereas 'decentralisation' deals with the decomposition of the controller. An organisation can be split up into a primary production system and an administrative pyramid on that production system. The production system coincides with the concept of controlled system and the administrative system with the concept of controller. Hence in this interpretation decomposition either applies to the controlled system - division of labour, departmentalisation - or to the controller - decentralisation. Note that both forms of decomposition can therefore surely not be independent. The decomposition of controllers is dependent on the decomposition of the controlled system.

It is clear that these different terms all denote specific forms of the concept of decomposition. Division of labour, departmentalisation and external structure apply to three different levels of aggregation: individuals, groups or departments, and whole enterprises. Apart from this typology according to aggregation levels, one can also discern a typology of decomposition according to the different relational aspects between the parts such as the decomposition by function, by product or by location or decomposition by authority. In system-theoretical terms this means that one is decomposing different aspect systems. Finally one can discern a typology of decomposition according to whether the primary system or the administrative control system is being decomposed.

After this introductory treatment of the various forms of decomposition from the viewpoint of organisation science, the most important problem to solve is how to form part systems. It is this question which forms the main subject of the rest of this section. For it is particularly the vagueness about the various possible methods for decomposition that induced me to formalise this problem.

6.2.2. METHODS OF DECOMPOSITION

In classical organisation science organisation structure is coupled to the division of labour; the multitude of tasks in an organisation requires a division of these tasks into homogeneous groups of tasks. The decomposition problem is mostly dealt with by various 'principles', such as the principle to seek to achieve a decomposition into clusters of tasks which from the operational point of view are as similar as possible with regard to execution, required education, skill and experience, or a decomposition into tasks which are as far as possible at the same level, that is, are paid at the same rate. Note that the second clusters tasks of the same value, whereas the first clusters tasks of the same sort. Of course, a number of other general rules could be added to the list. For example, other rules state that

the tasks should be as similar as possible as to the required technique or similar as to the place where they are performed. In all these structuring principles the predominating decomposition criterion is that of similarity: operations and tasks are differentiated or integrated into clusters of tasks which have some kind of similarity with regard to their value, their type, their technology, their place, etc. This decomposition method is obviously directed to the creation of homogeneous part systems with high internal similarity and, consequently with low similarity across part systems.

Although this decomposition by dissimilarity might appear to be self-evident, a few counter-examples might falsify it. It is clear, for instance, that people propagating 'job enlargement' definitely do not use this decomposition criterion. It is also clear that if one wants to build up autonomous, self-contained groups of individuals in an organisation, the criterion might well be that they should all perform different tasks, namely those different tasks which together sum up to self-contained autonomy. There is probably no need to give other examples to show that the similarity criterion of decomposition is not the only one. Indeed, the counter-example of autonomous part systems leads us to a completely different method of decomposition.

It should be recognised that decomposition into part systems, which are as similar as possible internally but are mutually as dissimilar as possible, will inevitably result in very stringent coordination requirements. Division of labour is directly coupled to coordination in the sense that the more different tasks are created the more coordination is needed. "It is self-evident that the more the work is subdivided, the greater is the danger of confusion, and the greater is the need for overall supervision and co-ordination" (Gulick, 1937). Thus decomposition by dissimilarity implies more coordination. It will be clear that from the point of view of the management control of an organisation this fact is very disadvantageous. Management would like a decomposition into part systems that require a minimum of coordination, that is, a decomposition into autonomous part systems. (An extreme example of this desire is the very classical 'divide et impera' principle.)

This leads us to a different method of decomposition in which not the similarity criterion but the relationship criterion plays a central role. In the introduction a structure was defined as a set of relationships between the objects of a system. Therefore it would seem quite natural to approach the structuring problem and the decomposition problem from the point of view of these relationships. Although I have split up the problem of the organisation of decision-making in Chapter 6.1 into two measures, i.e. the formation of part systems - decomposition - and the formation of relationships between those part systems - extended to coordination - this does not imply that the formation of part

systems should be carried out independently of the relationships between them. It would, on the contrary, be very useful if one could perform the decomposition in such a way that account is taken of the relationships, or better still, in such a way that the formation of relationships, or more generally the coordination, is facilitated. This approach to the decomposition problem from the point of view of the relationships between the part systems can be found in the decomposition rule of Simon (1962). In this rule this viewpoint is operationalised by stating that a complex system should be decomposed into such part systems that the relationships inside these part systems are maximised and the relationships between these part systems are minimized. In other words, the interrelationships should be smaller than the intrarelationshps. This rule is usually called the 'nearly-decomposability' rule because it results in nearly-autonomous part systems. As already stated, the main argument for this decomposition method is that it decreases the required coordination capacity. The system is decomposed into nearly-autonomous part systems which need a minimum of coordination. The capacity that would otherwise be used for coordination can now be used for directly operational tasks.

Clearly the difference between dissimilarity and interrelationships as decomposition criteria lies in the field of application. Division of labour is typically a shop-floor principle, that is, the work should be partitioned into homogeneous tasks at the level of execution. However, at the administration level the concern is for coordination and control. One might therefore state that decomposition into homogeneous, similar tasks is typically an organisation criterion at the execution level, whereas decomposition by interrelationships into autonomous part systems is typically a criterion at the level of management and administration. From the viewpoint of control one would aim at autonomy, from the viewpoint of the work to be done one would aim at homogeneity. Or in other words, decomposition by dissimilarity is a method of forming part systems not only without taking account of the important next measure, the coordination of the part systems, but even resulting in an increase of the necessary coordination. Decomposition by interrelationship does not only take into account the relationships but even facilitates the coordination of the part systems.

A third method that will be discussed is a specific form of Simon's decomposition rule. This method focusses on a particular kind of relationship, namely on communication and information flows. In this approach the emphasis is laid on the organisation as an information-processing system. The system is decomposed in such a way that the information transmission flows inside the part systems are larger than the flows between the part systems. The analogy with Simon's decomposition rule is clear. The resul-

ting system structure will lead to a maximum information throughput under the constraint that parts of the system suffer from information overload. For it is well known in organisation science that the capacity of individuals or groups to handle information is restricted.

Three methods of decomposition have been introduced. The three criteria are similarity, interrelationship and information flow, respectively. At first sight one might think that the differences between the three are already clear enough. I think, however, that an abstract conceptual approach to organisation design like mine should have a maximum of conceptual clarity. What are the basic essences of the three methods? Exactly in what sense and to what extent do they differ? In this section we will try to obtain that maximum of clarity and precision by formalising the three methods in strictly unambiguous mathematical terms.

6.2.3. FORMAL MODELS OF DECOMPOSITION

First a brief recall of the definition of decomposition and the ins and outs of that concept as discussed in Chapter 6.1. Decomposition is defined as the formation of part systems of a system. This formation can be performed in two opposite ways: one can start from the elementary objects of the system and group these together into part systems, or one can start from the system as a whole and partition that whole into part systems. It will be shown in this section that, formally speaking, the difference between the bottom-up and top-down approaches mostly reduces to a matter of nuance. One should surely not misunderstand the formal approach as a mere top-down one. Both are involved. Consequently we do not consider the decomposition approach typically normative and the composition approach typically descriptive, such as Sweeney et al. (1978). Second, it should be recalled that the formation of part systems can be defined as the formation of subsets of 'elements' whose 'elements' are not necessarily restricted to the objects of the system, but also include the relationships and time instances of the system. Decomposition can therefore be defined formally as a 'subset of' action. Note, however, that formally the 'subset of' action has nothing to do with the factual content of the elements of the set from which subsets are formed. Hence formally there is no difference between the formation of sub-, aspect- or phase systems. Although the 'subset of' definition seems to indicate the formation of subsystems, the definition should not be misunderstood in that restricted sense. Finally, one should recall to mind the fact that the 'subset of' definition of decomposition is restricted and does not include whatever broader meaning one might attach to the term 'formation of part systems'; in particular it does not include any formation of relationships.

6.2.3.1. DECOMPOSITION AND DISSIMILARITY

Cluster analysis

Decomposing a system into part systems so that the elements inside the part systems are as similar as possible and those of different part systems as dissimilar as possible, can mathematically be modelled as a problem of cluster analysis. A clustering problem can be formulated as follows (Duran and Odell, 1974):

Given a set of n individuals $I = \{I_1, I_2, \dots, I_n\}$ from a population π_0 , a set of characteristics $C = \{C_1, C_2, \dots, C_p\}$, a valuation x_{ij} of the i -th characteristic of individual I_j , and a vector $X_j = [x_{ij}]$ of measurements per individual, then the cluster problem is to determine m clusters (subsets) of individuals $\pi_1, \pi_2, \dots, \pi_m$ so that each I_i belongs to one and only one subset and those individuals assigned to the same cluster are similar, whereas those assigned to different clusters are different. The measure used for dissimilarity is mostly a distance function, defined as a non-negative, antireflexive, symmetric and transitive function. One can measure the distances between the individuals (or elements) and state that the mutual distances inside a cluster should be minimal or not exceed a certain threshold. One can take the average distance of one element to all elements from a cluster and add the element if the similarity is maximal or above a certain threshold. One can take the average distance of all elements of one group to all elements of another group and maximise that. Essentially the differences between these three methods are that they use one-to-one, one-to-group and group-to-group distances, respectively. Another typology of clustering algorithms is given by Hartigan (1975):

- sorting: partition the elements according to some key variable; form further partitioning inside these clusters according to some next-important variables (not suitable for many variables);
- switching: an initial partition is given and new partitions are obtained by switching an element from one cluster to another (uncertainty whether the initial partition was a good start);
- joining: begin with single elements; find the closest pair of elements and join them in a cluster; repeat this procedure until all elements are in one cluster (only suitable for a limited number of elements);

³ Without any loss of generality 'individual' can be replaced by the general concept 'element' thus embracing objects, relationships, time instances, etc.

- splitting (the inverse of joining): begin by partitioning the elements into several clusters; then partition each cluster into further clusters, and so on. Note that sorting is a kind of splitting;
- adding: a clustering structure is given; each element is added to it in turn; for instance an element typical of each cluster is selected and each element is added to the cluster to whose typical element it is closest;
- searching: if many clusters are ruled out by some criterion, search the remaining clusterings for the optimal one.

The method called joining is often referred to as 'hierarchical clustering': consider $I = \{I_1 \dots I_n\}$ as a set of clusters

$\{I_1\}, \{I_2\} \dots \{I_n\}$. Select two clusters I_i and I_j which are nearest and fuse them into one cluster. The new set of $n-1$ clusters is $\{I_1\}, \{I_2\} \dots \{I_{i,j}\} \dots \{I_n\}$. Repeat the procedure. With this 'hierarchical' clustering one can depict the cluster structure as a so-called dendrogram, for example as in Figure 6.1.

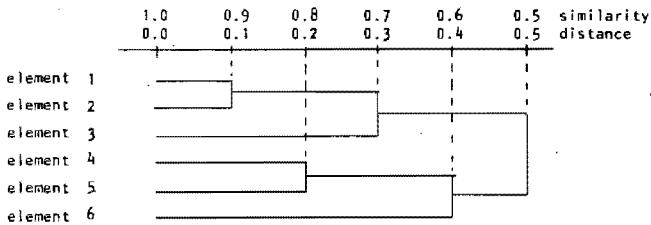


Fig. 6.1. An example of 'hierarchical' clustering.

Note that some optimisation or threshold criterion is needed to decide upon aspects such as:

- the number of clusters,
- the number of elements per cluster.

The algorithm in fact needs a stopping criterion. In the application of clustering techniques in engineering science the extraction of relevant features to be measured is often an important problem. Which characteristic features are relevant to determine the clustering?

Conclusions

Let us now summarise the basic ideas behind decomposition by dissimilarity. First of all 'dissimilarity' is a broad concept which can be specified in many ways. Second, it has been shown that clustering can be done hierarchically. (In Chapter 6.3.3.1 we shall dwell upon this question of hierarchical systems.) Perhaps the most important basic idea is that for clustering one

needs more than a similarity measure alone; without some kind of objective function it is impossible to arrive at one final set of clusters, as a stopping criterion, i.e. a goal, is needed. This emphasises first of all the importance of a goal concept in decomposition. Contrary to coordination, which in most cases is explicitly defined as a kind of control in view of a common goal, in decomposition the goal concept is mostly lacking. Decomposition without a goal is however impossible. Although this conclusion might seem trivial, the fact that it is usually forgotten stresses the need to mention it. Second, there are certain analogies between the specific types of goal - the stopping criteria - and certain organisational concepts. If we imagine a hierarchical type of clustering, the quantity 'numbers of elements per cluster' in some sense resembles the well known concept 'span of control' (Urwick, 1937) and the number of hierarchical cluster levels resembles the concept 'vertical span' (Pugh et al., 1968), while in a non-hierarchical clustering 'the number of clusters' indicates some measure of the specialisation in the enterprise (Kieser and Kubicek, 1977). On second thoughts it is evident that in order to decompose an organisation one has to know how many specialisations (departments) are wanted - the number of clusters - , how big the departments should be - the number of elements per cluster - and how many hierarchical levels there should be, all of which is related to the second criterion (the higher the span of control, the flatter the organisation). Note, however, that it seems to be impossible in organisation science to indicate a certain optimal span of control. Although 'early' organisation scientists searched for optimal spans of control (Gulick and Urwick, 1937), it soon turned out that there is not one optimal figure. Investigations showed up that the span of control varied in practice between 1 and 90 (Woodward, 1965). The span of control changes considerably per hierarchical level, that is, at the top it is much smaller than at the bottom of an organisation. Moreover, it is fallacious to believe in fixed spans of control, for the idea that one has to stick to a certain span of control and increase the number of hierarchies if it threatens to be surpassed, is based on the assumption that only direct personal coordination exists. If, for instance, other technological coordination instruments are put in, the span of control can surely increase (Kieser and Kubicek, 1977). It is therefore clear that one can not decompose a system by means of the classical criteria about span of control, vertical span, etc. alone. That would simply be a return to classical fallacies. Hence one should be careful not to interpret the formal clustering technique straightforwardly, which certainly leads to the 'old hat' classical interpretations.

A recent example of the use of a clustering technique for organisation design based on a similarity measure is the MAPS design technique of Kilman (1977).

6.2.3.2. DECOMPOSITION AND INTERRELATION

A mathematical theory which seems particularly suited to structural analysis and was in fact invented for the purpose, is the theory of graphs. A graph is directly coupled to the concept of a relation. Actually a graph is an abstract configuration of a set of elements and relations. It is therefore easy to understand that the above-mentioned concept of decomposition by interrelationships will be formalised with this theory of graphs. Let me first give a short summary of the essential concepts of graph theory (Harary, 1969; Harary et al., 1965) before passing on to the decomposition problem.

Graph theory

A graph is defined as a tuple $G = \langle V, A \rangle$ where set V forms the set of points of the graph and set A forms the set of lines of the graph which joins pairs of points. If the joined pairs of points are ordered, that is the lines joining the points are directed (arcs) the graph is called a directed graph or digraph. By definition a digraph has no loops or multiple arcs. Clearly the concepts of digraph and relation are closely related. If there is a binary relation R then each related pair $(x, y) \in R$ can be represented by two points and an arc. The adjacency matrix $A(D) = [a_{ij}]$ of a digraph D has an entry $a_{ij} = 1$ if arc $v_i v_j$ is in D and entry $a_{ij} = 0$ if arc $v_i v_j$ is not in D . A point v_n is joined to v_1 if and only if there is an undirected path (semipath joining v_1 and v_n). A semipath is a collection of points $v_1, v_2 \dots v_n$ together with $n-1$ lines (undirected arcs), one for each pair of points $v_1 v_2, v_2 v_3 \dots v_{n-1} v_n$. A point v_n is reachable from v_1 if there exists a path from v_1 to v_n . A path is a directed semipath (directed arcs instead of lines). The length of the path, that is, the number of lines in the path, is called the distance from v_1 to v_n . A digraph is strongly connected or unilateral if for any two points at least one is reachable and weakly connected or weak if every two points are joined. A maximal strong subgraph of a digraph is called a strong component. A maximal weak subgraph is called a weak component. A subgraph is called maximal if it contains no other such subgraph.

Decomposition of graphs

Graph-theoretical concepts can be used to decompose a digraph into subgraphs. This can be done by analysing the adjacency matrix $A(D)$ of a digraph D . If the matrix $A(D)$ can be partitioned

into

$$A = \begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}$$

so that A_{12} and A_{21} are filled with zeros, then A is said to be decomposed. This decomposition is often called a block diagonal form or complete discomposition⁴. More generally the square matrix A is called (hierarchically) decomposed if by a rearrangement of rows and columns A has the block triangular form

$$A = \begin{pmatrix} A_{11} & 0 & 0 & \dots & 0 \\ A_{21} & A_{22} & 0 & & 0 \\ \vdots & & & & \vdots \\ A_{m1} & A_{m2} & \dots & \dots & A_{mn} \end{pmatrix}$$

where all A_{ii} are square and all blocks above the diagonal are zero. A is maximally decomposed if m is maximal. If all off-diagonal blocks A_{ij} with $i \neq j$ are zero, A is called completely decomposed. In the latter case the structure can be decomposed in completely autonomous substructures, in the former case interconnections between the blocks remain. The reason why this is sometimes called hierarchical decomposition is that these remaining interconnections form an ordering of the subgraphs represented by the diagonal blocks.

It follows from the definition of a weak component that a digraph can only be partitioned into weak components if it is completely decomposable. Note that the condition is necessary but not sufficient: weak components imply complete decomposition but complete decomposition does not imply weak components.

If it is required to partition the digraph into strong components one first has to construct the reachability matrix $R(D) = r_{ij}$ of the digraph D which has an entry $r_{ij} = 1$ if v_i is reachable from v_j , otherwise $r_{ij} = 0$. This matrix can be derived from the adjacency matrix $A(D)$ by computing its sequence of Boolean powers, for $R(D) = (I + A(D))^{p-1}$ in a digraph with p points (I is the identity matrix). From this matrix the strong components can be derived. Both the partitioning of a digraph into weak components and into strong components is unique.

⁴ Formally the system is then no longer a system (objects plus relations).

The decomposition rule

Let us now try to formalise the decomposition rule formulated in Chapter 6.2.2, namely the rule that a system should be decomposed into subsystems so that the relationships inside these subsystems are maximized and the relationships between these subsystems are minimized. At first sight this rule appears unambiguous. But let us look at an example (Figure 6.2):

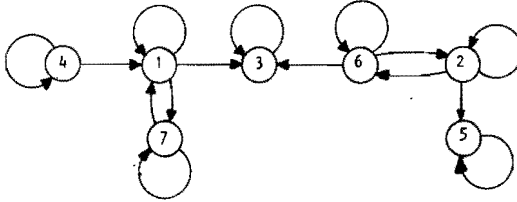


Fig. 6.2. Example of a system.

This digraph can be represented by its adjacency matrix

$$A = \begin{matrix} & \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{matrix} & \begin{pmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \end{matrix}$$

The above-mentioned rule reads that we have to transform A via row-and-column rearrangements into a form A'

$$A' = \begin{pmatrix} A_{11} & A_{12} & \dots & A_{1n} \\ A_{21} & A_{22} & & A_{2n} \\ \vdots & & & \vdots \\ A_{n1} & A_{n2} & \dots & A_{nn} \end{pmatrix}$$

where there should be as many as possible 'ones' (1) inside the diagonal blocks A_{ii} and as few as possible 'ones' (1) in the off-diagonal blocks A_{ij} with $i \neq j$.

Now apply a row-and-column permutation which takes the matrix A

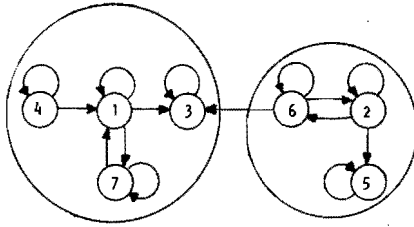


Fig. 6.4. Another decomposition of a system.

or even to zero interrelations by not partitioning the digraph into subgraphs at all. Clearly the counterpart of few interrelations is that the clusters themselves will contain lots of zeros, that is, that there will not be many intrarelations neither. This latter property might be reduced by additionally requiring connectedness in the subgraphs. If strong connectedness is required, that is, every two points should be mutually reachable, the only possible partition is into the strong components [6,2], [1,7], [3], [4] and [5] resulting in 4 interrelations and 11 intrarelations. If weak connectedness of the subgraphs is required, every partition will do, because the digraph itself is a weak component, that is, all points are joined. So obviously one has to add requirements to the rule that intrarelations should be maximized and interrelations minimized, otherwise this rule would lead to nonpartitioning.

One might think of a series of possible alternative requirements:

- specify the number of subgraphs and/or the number of elements per subgraph;
- specify the number of steps in which points of a subgraph should be reachable or joined.

This last point requires some explanation. Joining and reachability are defined independent of the number of lines or arcs needed to join two points or reach one point from another. It might, however, be useful to indicate a maximum number of steps in which two points should be joined or reachable. Note that in the partition of Figure 6.4 all points are two-step joined, but that in the partition of Figure 6.3, points in D_1 are two-step joined, whereas points in D_4 are one-step joined.

Another possible requirement might be:

- vulnerability, that is, will the removal of points or lines disconnect the subgraphs? (Harary et al., 1965).

Restrictions

The analysis of decomposition by means of graph theory is, however, restricted due to the fact that graph theory only deals with binary Boolean relations⁵. The considered relations deal only with relations between two elements at a time, i.e. they are binary, and one can only discern whether the relation exists or not, i.e. they are Boolean. The restriction to binary relations implies that relations between three or more variables of a time are impossible. The dependence of a certain variable y on two other variables x_1 and x_2 can not be represented in a graph by a multivariate function $y = f(x_1, x_2)$ but only by some sort of composition, for instance an addition of two separate functions $y = f_1(x_1)$ and $y = f_2(x_2)$. Moreover, the restriction to Boolean relations implies that a very important property of a relation, namely its strength, can not be analysed by means of Boolean graph theory. The difference between a functional relation $y = 2.x$ and $y = 10.x$ is not dealt with for instance. Graph theory does not offer the possibility of decomposing a system into sub-systems in which not only the number but also the strength of relationships is maximized. By transforming real-valued relationships into some measure of dissimilarity one can, however, fall back on the techniques of cluster analysis. For it should not be forgotten that dissimilarity, the basic constituent in cluster analysis, is a particular relation. The great conceptual difference between decomposition by dissimilarity and decomposition by interrelations, formally reduces to nothing: both are binary relations and hence in an abstract formal way identical. Mathematically the only difference lies in the use of Boolean algebra with graph theory or linear algebra with cluster analysis.

Conclusions

It will be clear from this brief review of graph-theoretical methods of decomposition that decomposition by maximising intra-relations and minimising interrelations involves much more than would appear at first sight from this rule. The rule per se leads to ambiguity and additional criteria have to be stated. We have sketched some kinds of possible additional criteria. The same remarks that were made about the organisational relevance of clustering, can be made here as well. Here, too, the need for goals was found to be very important. Moreover, the extra criterion to specify 'the number of subgraphs' or 'the number of elements per subgraph' comes to exactly the same as the

⁵ Note that we are not dealing with causal or functionalistic relationships here, but with the mathematical concept of relation, of which the mathematical concept of function is a special case.

'number of clusters' or 'the number of elements per cluster', so that the same analogies with organisational concepts like 'span of control', 'vertical span', etc. also hold good here. A criterion like 'the number of steps needed to reach points' is clearly related to a concept like 'length of communication lines', a concept which plays a central role in the discussion about advantages or disadvantages of line organisations, line-staff organisation, functional organisations and matrix organisations (Hill et al., 1976). The organisational relevance of the criterion of 'vulnerability' can be seen in the typical line organisation; there all communications have to pass via the head, so that this function makes the structure vulnerable. A result of this is management overload in line organisations, for instance. An example of the decomposition of related activities by means of a matrix of relationships, can be found in Child (1977).

6.2.3.3. DECOMPOSITION AND INFORMATION

A particular form of the already mentioned method of decomposition by interrelations is to centre on a special kind of relation, namely communication by information flows. In this approach the complex system is considered as a communication system in which the relationships are represented by information flows. Although these two methods are basically equivalent they are nevertheless treated separately because there is some mathematical difference between the two. In the graph-theoretical approach the assumption is that there are deterministic (Boolean) relationships between the variables. In the information-theoretical approach no such deterministic relationships are assumed. The relationships are statistical. In this approach the variables are at most statistically dependent. Note that cluster analysis is in the same sense only a specific form of decomposition by interrelations because a similarity relation is just a specific form of a binary relation. So at an abstract level all three methods are basically equivalent and only use different kinds of relations: graph theory uses Boolean relations, cluster analysis real-valued relations and information theory statistical relations.

Information-theoretical approach

Instead of the usual measure for a statistical relationship between variables - the correlation coefficient - which presupposes linearity, the concept of information transmission is used in this information-theoretical approach. This measure is based on the concept of 'entropy', the measure for the average quantity of selective information $H(x)$ of a variable x (Shannon and Weaver, 1949).

Given a variable x that can assume the values $x_1 \dots x_m$, where

n_i is the observed number of times that x assumes the value x_i and where $\sum_{i=1}^m n_i = N$ is the total number of samples, then the entropy $H(x)$ is defined by:

$$H(x) = - \frac{1}{N} \sum_{i=1}^m n_i \log_2 n_i$$

This is a measure for the variety of x . If x assumes only one value, then $H(x) = 0$, and if x assumes all its possible values just as often, then $H(x)$ is maximal, namely $H(x) = \log_2 m$. With two variables x and y the transmission $T(x,y)$ between x and y is defined by:

$$T(x:y) = H(x) + H(y) - H(x,y)$$

This is a measure for the strength of the relationship between x and y . The transmission is zero if x and y are independent and it is maximal if one variable is strictly dependent on the other, that is, if there is mapping from x to y or from y to x . In general the transmission between variables $x_1 \dots x_k$ is:

$$T(x_1 : x_2 : \dots : x_k) = \sum_{j=1}^k H(x_j) - H(x_1, x_2, \dots, x_k)$$

With this measure we can decompose a system S into those subsystems $S_i = \{x_{i_1}, x_{i_2}, \dots, x_{i_{n_i}}\} \subset \{x_1 \dots x_k\}$ for which the internal

transmission $T(x_{i_1} : \dots : x_{i_{n_i}})$ is larger than the external

transmission: $T(\langle x_{1_1} \dots x_{1_{n_1}} \rangle : \langle x_{2_1} \dots x_{2_{n_2}} \rangle : \dots) = T(S_1 : S_2 : \dots)$.

With these concepts the complexity $C(S)$ of a system $S = \{x_1 \dots x_k\}$ can be defined as (van Emden, 1971):

$$C(S) = H(x_1) + \dots + H(x_k) + H(S).$$

If the total system S is decomposed into the subsystems S_1, S_2, \dots where each subsystem S_i contains a subset of all elements $\{x_1 \dots x_k\}$ (see Figure 6.5), the complexity can be formulated as:

$$\begin{aligned}
 C(S) &= \sum_{j=1}^k H(x_j) + H(S) = [\sum_{x_i} S_1 H(x_i) + H(S_1)] + \\
 &= [\sum_{x_i} S_2 H(x_i) + H(S_2)] - H(S_1) - H(S_2) \dots + H(S) = \\
 &= C(S_1) + C(S_2) + \dots - T(S_1 : S_2 : \dots)
 \end{aligned}$$

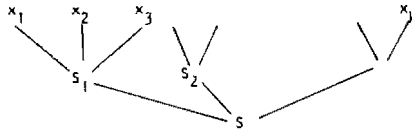


Fig. 6.5. A complex system.

Thus defined we see that the concept of complexity measures 'the amount to which the whole differs from the sum of its parts'.

An interesting result of this information-theoretical approach is that Conant (1976) has proved that the total flow of information through a system is the sum of (1) a part needed to block irrelevant information, (2) a part needed to coordinate the parts and (3) a part consisting of information which comes out of the system.

Assume a system S consisting of a set of elements (variables) $S = \{x_1 \dots x_k\}$. This system gets its input E from the environment. This input can also be a multidimensional variable. Now split the variables up into a part that can be observed from the environment, that is, a part which gives the output: S_0 and a remaining part S_{int} of internal variables. Thus S is partitioned into $S = \{S_0, S_{int}\}$ (see Figure 6.6).

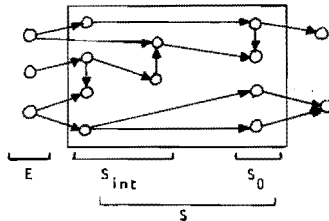


Fig. 6.6. An information processing system.

For this system Conant (1976) has shown that the following law applies:

$$F = F_t + F_b + F_c + F_n$$

where F is the total information rate, F_t is the throughput information rate, F_b is the blockage information rate, F_c is the coordination information rate and F_n is a noise factor⁶. The total information rate is the sum of all the individual capacities to handle information. The throughput rate measures the input-output information flow of S . The blockage rate is the rate at which information on the input E is blocked within S , given the kind of information that is relevant for the output. The coordination rate is a measure of the coordination of all the elements of S . The noise rate speaks for itself.

Let us illustrate this law by means of a simple example.

Imagine some deliberation council, like a university council, as the system S . Assume that the members x_i of the council can be classified into a part S_0 which produces output to the environment, for instance, memoranda and reports, and a remaining part S_{int} of other members. The total information rate F is determined by the capacities of all individual members to process information. The capacity of the members of S_0 to transmit information, that is, the fluency with which those persons can write reports, determine the output rate F_t . The information-blocking rate can be represented plastically as the effort that has to be made not to write as many memoranda and reports as the incoming 'package' of written pages; only part of all incoming information is processed and a great deal thrown away. This is the blocking of the incoming information flow from the environment in view of its relevancy to the output of the council. Finally, everyone who has ever handled the chairman's hammer at a council meeting, will know how much effort will be put into the coordination of the individual members in order to deliver some significant work. This is the coordination rate F_c . It will be clear that the total information rate is usually fixed - the sum of the individual capacities - so that the fruitful production of the information-processing system F_t can only be increased by a corresponding decrease of F_c , that is, by splitting up the council into nearly-autonomous parts which require less coordi-

⁶ On the determinism assumption, that is, complete knowledge of the system inputs, this last factor vanishes.

nation. So the interesting conclusion which can be drawn from this law is that it gives an information-theoretical argument for near-decomposability (Simon, 1962). Because the total information rate is mostly fixed, namely the sum of the individual capacities, an increase in the useful production of the system, its throughput, can only be achieved by a corresponding decrease in coordination needs, that is, by splitting the system into units that are as autonomous as possible.

The previous outline gives only a first impression of the information-theoretical approach to control systems, in other words 'cybernetics' (Wiener, 1948). Particularly the late W.R. Ashby (1956) and his ex-student R.C. Conant have elaborated this information-theoretical approach to systems. The great advantage of this kind of cybernetics is that it enables us to derive some general laws, like the 'law of requisite variety' (Ashby, 1956), and the above-mentioned one which are applicable to the field of organisation science. The importance to organisation science of the argument that the limited information-processing capacity implies that coordination efforts should be minimised by autonomy, will probably not be denied. Some other interesting general properties that have been investigated by this cybernetics school are the relationship between error-control and cause-control (Conant, 1969), the function of models in regulation (Conant and Ashby, 1970) and complex and hierarchical systems (Conant, 1972, 1974, 1976). Besides these specific studies a number of more general papers on this cybernetics approach has been published (Ashby, 1956, 1958, 1965, 1970). For a recent critical appraisal of this approach see Kickert et al. (1978) among others.

6.2.4. DISCUSSION

From a practical organisation-design viewpoint the discussed methods are quite distinct. To decompose an organisation into parts that are as homogeneous as possible is certainly not the same as to decompose an organisation into parts that have few interrelations. The distinction between these two approaches is very obvious from the point of view of coordination. In the first approach coordination is surely not minimised, whereas the second approach is particularly directed towards a minimisation of coordination. By using a formal approach I have tried to make clear exactly what the differences are between the three methods. It was found that the first method could be modelled as a cluster-analysis problem, the second as a graph-theoretical problem and the third as an information-theoretical one. However, from a still more abstract mathematical viewpoint all three methods are equivalent; they all three deal with decomposition according to some kind of mathematical binary relation, only the kinds of relations differ. In the first method the relation concerned is a

dissimilarity relation, that is, an anti-reflexive, symmetric and transitive relation. In the second method the kind of relation system concerned was described as a digraph. This concept does not specify the kind of relation to be used but specifies some structural requirements as to the system of relations. The essential restrictions of this second approach are that only the yes or no existence of a relation and its direction are considered. Real-valued relations expressing a strength of a relation are ignored in this method ⁷. In the third method the relation concerned was based on statistical relationships, namely the information-theoretical concept of transmission. All three formal methods suffer from the restriction that only binary relations are considered.

What about the significance of this mathematical formalisation for organisation science? My intention was to use this formal modelling as a way to construct a clear framework of basic ideas. The use of this mathematically formal approach lies, in my view, on the conceptual level ⁸. A clear conceptual framework is a condition for a good theory and in that sense the formal models can, per definition, be used for guidance in organisational design. But let us specify the conceptual fruitfulness in somewhat more detail.

One example of fruitfulness of a clear framework was the insight that the decomposition rule as formulated by Simon (1962) was not unambiguous. There have to be additional requirements to the rule that intrarelations inside part systems should be maximised and interrelations between part systems minimised as the rule would otherwise lead to non-partitioning.

Goal of decomposition

In fact this requirement of additional criteria might be considered one of the most important conclusions on decomposition in general. It boils down to the requirement that decomposition in general can not do without a goal, for it should be noted that criteria are specific examples of the more general goal concept. One can not form part systems of a system just by looking

⁷ Decomposition of systems of interrelated elements which have real-valued relations expressing a strength is not solely treated by framing the problem as one of cluster-analysis. There are methods of decomposing dynamic systems represented by the equation $x(t+1) = A \cdot x(t)$, for instance where the matrix A representing the dynamic structure consists of real-valued entries. An extensive treatment of the decomposition of this matrix and the implications of such a decomposition for the stability of the system can be found in Ando et al. (1963), especially in the two articles of Simon and Ando (1963) and Ando and Fisher (1963).

⁸ In Gagsch (1978) the two mathematical techniques of decomposition by dissimilarity and by interrelationships are elaborated in an attempt to really apply the formalisms as a basis for computer-aided job-design techniques. In Kilman (1977) the cluster-analysis technique is indeed used as a computer-aided-design technique.

at similarities, relationship, information flows, etc. One needs a preference ordering as to the desired degree of similarity of elements, how many interrelations are permitted, how many clusters are wanted, how many elements per cluster, etc. to mention just a few things. One can not form part systems without goals. As to where the goal(s) come from the reader is referred to the discussion on the goal of metadecision-making in Chapter 5.4. The organisation of decision-making, i.e. metadecision-making, has been subdivided into two parts: decomposition and coordination. Hence the goal of the metadecision-making is also split into two corresponding parts. As was shown in Chapter 5.4 the metacontroller goal is not a derivative of the goals of the object controllers though it is related to them, so that one can not aggregate the metalevel goal from the object-level goals. In the same sense one can state that the goal of decomposition can not be derived from the goals of the system elements. Both kinds of goals are from different levels and are concerned with different things. It is clear that a goal to maximise intracluster similarity plus additional criteria as to size and number of clusters etc., has not necessarily much to do with the goals of the elements that are clustered. In the event that these system elements are the objects, say individuals, their aims will probably have to do with their work and also with personal and social issues. In principle both types of goals are different in level.

One should, however, not forget that goals of different levels mostly fit into some 'means-end hierarchy'. Decomposition of a system also serves the aim of influencing the system in some desired direction and therefore the clustering of elements into part systems constitutes a means of obtaining the ultimately desired change of (the system of) part systems. The decomposition goal is a means to achieve the goal of the overall system control. If one interprets the aim of decomposition by dissimilarity as the increase of the part systems' productivity by homogeneity, one might indeed state that this is obviously a means to increase the overall system productivity. In the same sense, decomposition by interrelationships serves the aim of forming autonomous part systems, in other words, a means to facilitate the coordination of the overall system, and this can also be a goal of the system.

If one pursues this line of argument some interesting relationships between decomposition and coordination are revealed. Up till now the relationship between decomposition and coordination has been regarded as the following: decomposition by dissimilarity increases the necessary coordination, and decomposition by interrelations decreases the necessary coordination. But let us now have a second look at decomposition.

Decomposition and coordination

Two basically different approaches to decomposition have been explored. In the first a system is decomposed into parts that are as homogeneous as possible. In the second a system is decomposed into parts that have few interrelations, i.e. into nearly autonomous parts. In practice this will often imply decomposition into heterogeneous parts consisting of all kinds of different elements which together guarantee self-supporting autonomy. As has been stressed, the distinction between both approaches is obvious from the point of view of coordination. The first method seems typically an approach from the point of view of the work to be done, the second seems typically an approach from the point of view of coordinative control. At first sight one would therefore be inclined to conclude that the first decomposition method is from the viewpoint of the 'controlled system', that is the system where the work is done, and that the second one is a method from the viewpoint of the 'controller'. The distinction is, however, not as simple as that. If one interprets the aim of decomposition into homogeneous parts as that of increasing productivity, then it is also a control action. More production is surely a desired change in the controlled system, and hence per definition a form of control (de Leeuw, 1974). Thus the first method is an approach from the controller's viewpoint as well. Only the types of control action of the two methods differ. In the first the system is influenced so as to increase productivity, in the second method the system is influenced so as to facilitate the mutual adjustment of the parts. Now, if it is assumed that productivity increase is in fact a goal of the system, then the first method permits easier goal attainment of the system and the second method permits easier mutual adjustment of the parts. The reason why I rephrased both methods of decomposition in these terms becomes clear when one considers the usual definition of coordination. However vague and capable of discussion this concept may be, most authors define coordination by means of two main ingredients: (1) the mutual adjustment of the parts, and (2) attainment of some common (organisation) goal (see Chapter 6.3.1). Hence the apparent conclusion is that both methods of decomposition are closely related to both main ingredients of coordination. Decomposition of a system into homogeneous parts aims at facilitating the attainment of the coordinative goal and decomposition into autonomous parts aims at facilitating the coordinative mutual adjustments between the parts. Particularly the first of these close relationships is, however, based on a number of assumptions. First, it is assumed that decomposition into homogeneous parts is aimed at productivity increase of the part systems (let alone that it actually results in productivity increase). Second, it is assumed that productivity increase of the part systems results in a productivity increase of the system. Third, it is assumed that productivity increase is the com-

mon organisational goal of the system. The doubtfulness of these assumptions diminishes if one does not narrowly interpret productivity increase in its usual industrial sense but interprets it generally as increase in system output. Of course, the concept of system output is not restricted to industrial products but can include other things. The third assumption then becomes somewhat more reasonable. The second assumption depends mainly on the second coordinative measure, i.e. the mutual adjustment of the parts, and is not actually altogether unreasonable. Hence the first assumption remains the most dubious link in the argument: do part systems yield more output the more homogeneous they are? I have in Chapter 6.2.1 mentioned the economic rationality of division of labour: little learning time, little waste of material in learning, short switching time, higher skill and rapidity, cheaper work, higher productivity. Most of these factors influence the system output positively. However, I also mentioned in Chapter 6.2.1 that the validity of these statements can be doubted since high specialisation often leads to higher personnel fluctuation, higher absenteeism, lack of concentration, etc. The assumption that homogeneity implies more output is therefore dubious if more output is narrowly interpreted as an increase in industrial productivity. Whether it yields more output in general remains open to doubt.

In short one might cautiously state that on some assumptions there seems to be a close relationship between the methods of decomposition on one hand and coordination in its dual sense of goal-oriented adjustment of parts, on the other.

Decomposition and relationships

The restricted definition of decomposition should be emphasised once again. In this concept the formation of part systems is restricted to the demarcation issue, that is, to the drawing of boundaries around subsets of elements of the system. Given a system as a set of elements - e.g. objects, relationships and time instances - decomposition results in a clustering into part systems. After this decomposition, coordination will take place and result finally in a certain organisation of the decision-making system. This resulting organisation will contain part systems and relationships between them and these last will generally differ from the original set of relationships before the organisation has taken place. Decomposition, however, does not change the relationships⁹. The change in relationships is a task performed by the coordination. Note, of course, that decomposition has an effect on the final structure; a decomposition into homogeneous part systems will result in a different coordinative structure than a decomposition will into autonomous part

⁹ The specific problem of dynamic relationships, or in general, the dynamics of the organisation of decision-making, will extensively be treated in Chapter 7.

systems. The proper construction of the relationship structure is, however, not a matter of decomposition, but of coordination. It is now obviously high time to deal with the concept of coordination.

6.3. COORDINATION

6.3.1. THE CONCEPT OF COORDINATION

If one divides the organisation problem up into decomposition and coordination and defines decomposition as the formation of relevant part systems of the system to be organised, then the logical implication is that coordination deals with the interrelations between the part systems. If a system consists of objects plus relationships, the organisation of that system consists of the formation of subsystems and the formation of the relationships between them. Or, to use the broader concept of structure: the organisation of a system consists of the formation of part systems - this being either sub- and/or aspect- and/or phase systems - and the formation of relationships between them. Having called the former decomposition, it seems obvious to define coordination by means of the latter. Indeed the subject of interrelationships is very important, if not the most important, subject within coordination. Kirsch (1971) treats coordination entirely in that context. Although the systems-theoretical approach would also imply such an interpretation I shall not follow this lead. I shall present a more general definition of coordination. For it will be shown that with coordination it is not only the interdependences that matter, in other words, it is not only structural coordination that matters. There is, namely one additional important aspect to coordination: the concept of a goal.

Coordination and goal

In most organisation-science literature coordination is considered a central problem in organisation design. Some representatives of the 'Administrative Management' school actually consider organisation and coordination as equivalents (Gulick and Urwick, 1937). As to the more recent literature, I will concentrate mainly on German literature. As usual, the search for systematic treatments among our 'gründliche' eastern neighbours is more promising than in the pragmatic Anglo-Saxon literature. Although in German literature one mostly concludes that there is an almost complete vagueness and confusion about the precise meaning of coordination (Kirsch, 1971, 1977; Wollnik und Kubicek, 1976; Kieser and Kubicek, 1977; Hill et al., 1976) all definitions, however vague they may be, seem to have some properties in common; they all indicate two main ingredients of the concept of coordination: (1) the mutual adjustment of the parts, (2) in

order to attain some common (organisation) objective (Meyer, 1969). An important difference from decomposition is that the concept of a goal is explicit in the definition of coordination¹⁰. This apparent emphasis on the goal concept in coordination implies that one should attach more importance to it than its natural common-sense meaning¹¹. Nevertheless it seems that generally in the literature the goal concept in coordination apparently has this weak meaning. There is no further talk of it at all, except perhaps in a negative sense, such as, e.g. in Kirsch (1977). Kirsch remarks that a definition of coordination in terms of some common organisation goal becomes useless if one considers these goals no longer as fixed given entities but as outcomes of goal decision processes. For these goal decisions can be one of the various instruments to attain a coordination. Kirsch concludes that one should therefore define coordination independent of whatever organisation goals. In my view, one should, however, draw the opposite conclusion from the same arguments. The fact that a common organisational goal is indeed not given a priori, the fact that the attainment of such goals is not a matter that can simply be settled a priori - the goal attainment is itself a troublesome decision process - together with the fact that this very goal-attainment process forms an important instrument of coordination, in my view clearly leads to the conclusion that one should explicitly incorporate this form of coordination in the definition.

The importance of the incorporation of the goal concept in coordination becomes even clear if one also realises the strength of the goal concept in an explanatory sense. In Chapter 2.1 it has been shown that any behaviour can be explained by means of the goal concept as goal-oriented behaviour (see Chapter 2.1 on teleological, functional and rational explanation). Thus different or conflicting behaviours can be explained by means of goal differences or conflicts and the interdependences between parts of a system caused by different and conflicting behaviour of the parts can be explained in goal terms. Hence the two main reasons presented in Fietsen (1977) as the causes for coordination: goal differences and interdependences, are in fact tautological. Interdependences¹² can be deduced from goal differences.

¹⁰ Note that although the goal concept does not appear explicitly in the definition of decomposition - the formation of part systems - one of the main conclusions of Chapter 6.2 was that decomposition can not do without a goal.

¹¹ It can be argued that each activity can be considered normative, so that in each activity, such as e.g. coordination, there is a goal. As I have shown in Chapter 2.1 the methodological argument for this is the non-existence of objective reality, or else the common-sense argument: people do things because they want something, i.e. actions are goal-oriented.

¹² Note that here 'interdependence' is not defined by the concept of 'relationship' but is interpreted in terms of conflicting behaviours.

Control systemic definition of coordination

In order to define coordination without vague and more or less tautological terms like 'mutual adjustment' and in order to incorporate the above-mentioned form of goal coordination, a general system-theoretical viewpoint has been adopted. The problem is considered as a control-system problem and coordination is defined as the control¹³ of a system of part systems¹⁴ (Figure 6.7).

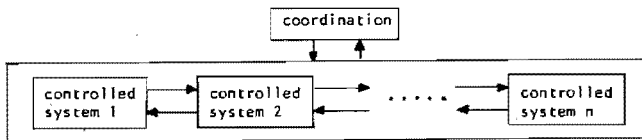


Fig. 6.7. Coordination.

Note that this definition implies that the part systems are interrelated, otherwise they do not together constitute a system. Second, that this definition is not a specific but the general definition of control. The control of a system implies via the definition of a system that the control applies to a system of interrelated entities. The explicit mention of the fact that the control applies to some interrelated part systems is, however, usually lacking, and in the usual black-box considerations about control this aspect might implicitly be present but certainly not apparent. Though the definition of coordination is the general definition of control, in fact it mostly amounts to a specification of the control definition, namely to considering the controlled system on a lower level of aggregation, i.e. the level of the part systems.

Let us now consider various important distinctions that follow from this definition.

Coordination and metacontrol

The controlled part systems themselves can, of course, be split up into parts as well. One particular subdivision is to consider them in turn as control systems, that is, as controllers plus controlled systems. This seemingly mere play with words does have a practical meaning. In most treatments coordi-

¹³ Control is understood in its broad meaning as 'any form of directed influence' (de Leeuw, 1974). For a presentation of the control-systemic framework the reader is referred to Chapter 5.2.

¹⁴ A part system is the common term for a subsystem, and/or an aspect system and/or a phase system.

nation of organisations it is implicitly or explicitly assumed that coordination applies to the administrative system, i.e. to the management. Management, however, in control terms is that part of the organisation which controls the primary production system. Management is the controller of the controlled system on the shop floor. Coordination of the administrative system is therefore control of the controllers, that is, metacontrol (Figure 6.8). The coordination of the operations on the shop floor would imply a direct coordination of the lowest level, i.e. a direct control of the controlled systems. This distinction could be recognised in the two main methods of decomposition that were discussed in Chapter 6.2: decomposition by dissimilarity corresponds to the control from the shop-floor viewpoint and decomposition by interrelationships corresponds to the control from the management viewpoint ¹⁵.

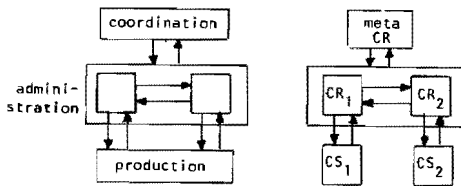


Fig. 6.8. Coordination of administration.

Coordination of the administrative system, considered as metacontrol, can therefore be subdivided into the three forms of metacontrol discussed in Chapter 5.3, i.e. metacontrol of the controller, of the controlled system and of the whole control system (see Figures 5.5, 5.6 and 5.7 in Chapter 5.3).

It should, however, be recalled that from another point of view coordination itself is already metacontrol. Coordination is the control of the part systems of the decision-making system and, as has been shown in Chapter 5, decision-making can be considered as the controller of some controlled system. Hence coordination is metacontrol of the part systems of the controller if we consider it from this point of view. The previous consideration implies that in addition the part systems of the decision-making system are themselves thought of as consisting of controllers plus controlled systems (see Figure 6.9).

¹⁵ Note that one can not just assume that decomposition by dissimilarity applies to the controlled system and decomposition by interrelation to the controller. The controlled system can also be split up into autonomous parts, and moreover management, too, can be considered as a controlled system (cf. Chapter 6.2.4).

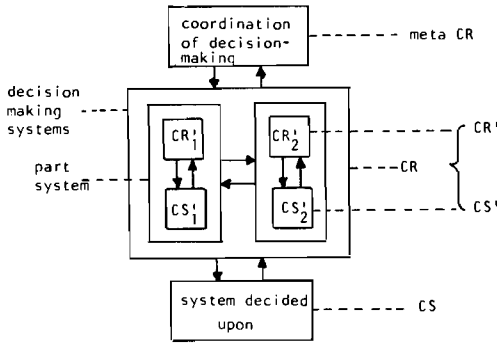
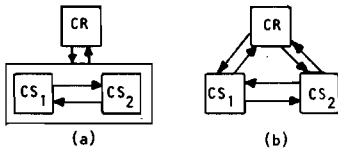


Fig. 6.9. Coordination of decision-making system.

Precisely what is identified as 'the' controlled system does matter. From the controller's viewpoint of decision-making, coordination is metacontrol, but at the decision-making level an extra level has been added. In fact the resulting four levels imply that coordination then becomes meta-metacontrol. If one omits the lowest level of the controlled system, and identifies the part systems of the decision-making system as the controlled system, coordination is object-level control. The addition of the extra level then transforms coordination to metacontrol. In the remaining part of this chapter we will restrict ourselves to the two-level configuration where the coordinator is the object-level controller.

Modes of coordination

A second important distinction which can be deduced from the general definition of coordination is that the coordinative unit can control either the system as a whole, or the separate part-systems. So one can consider coordination either as the controller of the whole system of controlled part systems (Figure 6.10a)



or as the direct controller of the separate controlled part systems (Figure 6.10b).

If one superimposed the tripartition of control modes (see Chapter 5.2) on this distinction, six different coordination modes are obtained:

Fig. 6.10. Coordination of the whole and coordination of the parts.

1. goal control of the whole system, i.e. control of the common overall-goal of the system;
2. structure control of the whole system, i.e. control of the relationships between the part systems;
3. 'routine' control of the whole system, i.e. ordinary control of the whole system;
4. goal control of the part systems, i.e. control of the various goals of the separate part systems;
5. structure control of the part systems, i.e. control of the relationships inside the part systems;
6. 'routine' control of the part systems, i.e. ordinary control of the part systems.

Observe that in organisation science, coordination is usually restricted to the second mode only, that is, the coordination of the relationships between the parts. This structural mode of coordination can of course be further subdivided according to various dimensions, such as the distinction in German literature between 'Aufbau' and 'Ablauf' organisation (Kosiol, 1962, pg.32), where 'Aufbau' applies to the formal system of positions in the organisation and 'Ablauf' applies to the dynamic aspects of organisational procedures, or for example the distinction into four modes of coordination that van Aken (1978) adopts according to the two dimensional distinction between stratified (official power) versus nonstratified (only influence) coordination and direct (direct intervention) versus indirect (condition self-control) coordination.

Note that 'routine' coordination in control terms means that goal and structure are fixed so that only variations in the usual control variable are left. Although this mode might seem to have some analogies with the 'Ablauf' concept, the latter concept is however meant explicitly for structural coordination. Routine coordination is a mode of control for a fixed system, that is, a kind of executive coordination within prescribed structural and goal constraints¹⁶. An example of this kind of coordination is the form of coordination that Mesarovic et al. (1970) propose, which will be discussed lateron.

Another important distinction is that between 'extrinsic' and 'intrinsic' coordination. With extrinsic coordination a distinct instance functions as the coordinator; with intrinsic coordination, the participating part systems coordinate themselves, or, to put it in system-theoretical terms: with extrinsic coordination the coordinator is a subsystem distinct from the coordinated part systems; with intrinsic coordination this is not the case (Figure 6.11).

¹⁶ Mark, however, that 'routine' control on one level of aggregation, might well be a form of 'structural' control at a next-lower level of aggregation (cf. the considerations on level confusion in the discussion of a number of problems in Chapter 5.4).

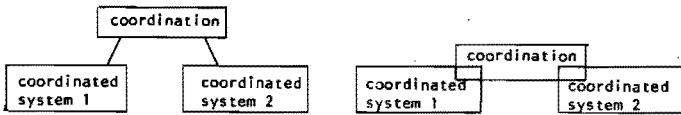


Fig. 6.11. Extrinsic and intrinsic coordination.

In addition one can distinguish between 'internal' coordination and 'external' coordination according to the distinction between 'internal' control and 'external' control, the latter being a control of the environment in order to influence the control system in that indirect way (de Leeuw, 1974; see Chapter 5.2).

This general control-systemic definition of coordination includes most organisation-science interpretations of the concept. As I have mentioned earlier most authors assign at least two main elements to the concept, namely the 'mutual adjustment' and the 'common organisational goal' (Frese, 1972, 1975; Galbraith, 1974; Hill et al, 1976; Kieser and Kubicek, 1977; Kirsch, 1971, 1977; Meyer, 1969; Wollnik and Kubicek, 1976). These two ingredients are entailed in my definition. In fact we will see later on that several distinctions made in literature about coordination coincide with the distinctions developed from the general control-systemic definition of coordination.

Other attempts to define coordination in a mathematically exact, systemic way are those of Mesarovic (1960, 1970; Mesarovic et al., 1970) and of Conant (1972, 1974, 1976). The latter approach has been discussed in Chapter 6.2.3.3 and will not be repeated here. Mesarovic puts the problem in typical 'control theory' terms: the system can be divided into a process and a goal part and coordination therefore falls into proces-coordination and goal-coordination parts. Two types of the process coordination are distinguished, namely the prediction of subprocess interactions and the decoupling of the subprocesses¹⁷. Coordination is defined by Mesarovic et al. (1970) as "the control by a higher-level controller on lower-level controllers in order to get a global optimum of local control-systems optima". Causes for coordination are "the subprocess interactions" and "the decision unit's ignorance of the actions of the other units". This implies that the coordinator handles the interactions. Although Mesarovic indeed distinguishes between goal and structural coordination, he only elaborates the latter type and uses a very res-

¹⁷ Actually Mesarovic et al. (1970) discern four types, but only these two types are elaborated.

stricted definition of hierarchy (see e.g. de Leeuw, 1976b; de Leeuw and Kickert, 1977 and the discussion on hierarchy in Chapter 6.3.3.1). Mesarovic's approach is quite restricted; his mathematical problem formulation implies that in fact everything is known a priori (inputs, goals, structures, etc.) so that his coordination boils down to 'routine' coordination.

As will be clear by now, goal coordination is considered here at least as important as the commonly considered form of structural coordination. This importance is reflected in the fact that the next section is devoted to it. Subsequently the other important form of structural coordination will be dealt with. In order to link up with the organisation-science considerations on coordination, I will restrict myself to these two modes of coordination.

6.3.2. GOAL COORDINATION

In this section a systematic treatment of the mode of goal coordination is presented. Obviously the central concept here is the goal concept. Not only do we deal with 'control' in a broad sense which already embodies the goal concept, but we deal moreover with the specific control of goals themselves. In Chapter 4.2 the goal concept has been considered quite extensively. I will not repeat that here but only very briefly recall its key issues.

Goals and goal control

A goal is defined as an ordering over alternatives. The kind of ordering and the set of alternatives can be specified further. The latter should not be restricted to desired end-states only but should include inputs, actions, states and outputs at all relevant time instances. A goal should not necessarily be specified quantitatively and precisely. Goals may change in time, be incomplete, have composite characters, etc. Moreover, the requirement of a goal can be reduced to that of an evaluation mechanism. An evaluation of the effects of the control actions on the controlled system is adequate to a control system. Any kind of evaluation mechanism, such as group consensus, will do. Finally, a goal used in an explanatory sense is a theoretical and attributed concept. It is not an intrinsic system property. This implies that one does not have to empirically prove the existence of a goal. An explanation by means of a goal is a rational reconstruction.

Let me also briefly recall the key elements of the goal mode of control (de Leeuw, 1974). Consider the controlled system CS as a black-box consisting of an environmental input x , a control input u and a transfer function f which determine the output y :

$y = f(x,u)$ (see Figure 5.3 in Chapter 5). Assume that the goal of the black-box can be considered as a desired subset G of the set of all possible outputs Y : $G \subset Y$. From this configuration it is clear that the controller can bring about a desired behaviour of CS, i.e. the attainment of the goal G , in four ways: (1) by an appropriate control action u ('routine' control), (2) changing the structure f of the black-box (structural control), (3) changing the goal G (goal control) and (4) changing the environmental input x (external control). The difference between goal control and the other modes of control can be simply represented as follows: the other modes try, directly or indirectly, to influence y in order to change it in the direction of the desired subset G (Figure 6.12a) whereas goal control changes the subset area in order to let it include y (goal displacement: Figure 6.12b). If Mohammed does not come to the mountain the mountain comes to Mohammed. Of course, in reality goal control is not so simple as that. If one does not represent G as a one-dimensio-

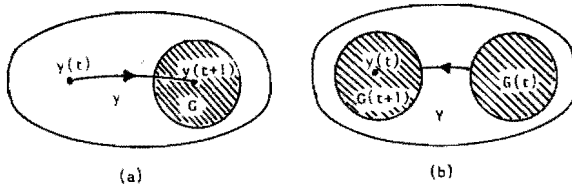


Fig. 6.12. Goal-control and other modes of control.

nal subset of Y but as an ordering over inputs, actions and outputs during the whole duration of the system, matters obviously grow more complicated. One of the most obvious complications is that coordination per definition deals with a system of interrelated part systems, so that goal coordination deals with a system of interrelated goals.

6.3.2.1. SYSTEMS OF GOALS

A system of interdependent decision-making processes can have several forms of interdependences. The system can be coupled via its inputs and outputs, so that the output of one decision process can be the input of the next process. Imagine a sequence of decisions where each decision forms a constraint on the next one. Another representation of the interdependences is the one used in mathematical decision theory. Mutual interdependences of decisions are represented there by the interrelations between the utility functions of the various decision-makers. The interdependences between decisions are represented as interdependences between the goals of the decision-makers. Because it is precisely the goal aspect of interrelated decision processes which I want to deal with in this section and because mathematical deci-

cision theory at least possesses a great deal of conceptual clarity¹⁸, I will use this framework here.

Decision theoretical classification

As I have indicated in Chapter 3.1, mathematical decision theory can be classified according to the dimensions along which it has extended the classical homo economicus model of a single-objective, single-stage, individual decision-making. An example of a schematic classification of existing theories according to the person and goal dimension was given in Table 3.1, which is repeated here¹⁹.

Table 3.1. Classification of existing decision models.

single person	single goal	statistical decision theory linear programming (OR)
	several goals	multicriteria decision theory
several persons	single group goal	group decision theory team theory game theory
	no single-group goal	game theory

The single-person, single-objective theories are of no interest here. Strictly speaking, the single-person, multiple-objective theories should not be of interest either, although coordination is also needed for the mutual adjustment of different decisions by one individual (Kirsch, 1977). Broadly speaking, one can however drop the condition that the single decision maker is one individual: the decision maker can be any entity. Imagine a group with different objectives trying to obtain a single decision. Although this configuration is usually dealt with in group decision theory, this interpretation is surely not impossible here. Though the mathematical techniques of both theories may be different, essentially the methods are the same: aggregate different objectives into a common objective. This comes clearly to the fore when we compare both models. In group decision theory the situation is represented as follows:

- a set of n individuals, denoted $1, 2 \dots n$;
- a set of alternatives $A = \{a_1 \dots a_m\}$;

¹⁸ The reader is referred to the introduction to Chapter 6.2 where the sense is indicated in which the author considers a formal approach useful - conceptual clarity - and in what sense not - computation of 'optima'.

¹⁹ Mark that in this classification decision-makers are considered individuals. This restriction can be dropped; the decision-maker can be any entity, for example a part system.

- n individual preference orderings $O_1 \dots O_n$ in which O_k stands for the ordering of the alternatives according to the preference of individual k;
- a 'social choice' function F which aggregates all individual preference orderings into the preference ordering of the group itself.

On the other hand the multicriteria decision problem is usually described as:

- a set of n criteria, denoted 1, 2 ... n;
- a set of alternatives $A = \{a_1 \dots a_m\}$;
- n preference ordering sets $O_1 \dots O_n$ in which O_k stands for the ordering of the alternatives according to the k-th criterion;
- a set of weights $W = \{w_1 \dots w_n\}$ where w_k denotes the importance of criterion k in the evaluation of the alternatives.
- an aggregation of all separate orderings via the weighting factors into an overall preference ordering of the alternatives.

Apart from the set of weights, this latter representation shows a strong similarity with the group-decision model.

A further subdivision of multiperson theories into four classes is presented in Table 6.1.

Table 6.1. Typology of multiperson decision-making.

several persons	hierarchy	collectivity	coalition	autonomy
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Systems of different individuals all having one or more different goals, can be classified according to the extent to which there is a common overall system goal in the decision-making (Hanken and Reuver, 1977).

The extreme case is that of a so-called hierarchy of goals. Each individual in the decision-making system has adopted the common (organisation) objective. This is the 'ideal' case of a strict mechanistic hierarchy in which each individual identifies himself with the organisation and does precisely what he ought to. In most cases the common organisational goal is assumed to be decomposed into a consistent system of constituent subgoals (the hierarchy of goals). Although strictly speaking this is a multiple-objective situation, all the goals can be considered as one consistent whole so that this is classified as a single-goal situation.

In the second class (collectivity) all individuals initially have their own different objectives but come to a consensus as to the

common group objective. The concern is here with a method of aggregating individual objectives into an acceptable common group goal. Although the result is one goal as in the previous case, the method is essentially opposite; here the method is bottom-upwards, a collective goal formed out of the individual ones, but with hierarchy it is top-downwards, a common goal decomposed into subgoals and attributed to individuals.

The third class (coalitions) is a special case of the second in the sense that the same applies, but only to subgroups. All individuals originally have their own objectives and subgroups of individuals agree on common subgroup objectives; they form so-called coalitions. The difference is that not the total group but only subgroups come to a consensus about common goals. There remain groups with different group objectives.

The last class (autonomy) is the other extreme. All individuals have, and keep, their own different objectives. There is no common decision in the sense that each individual himself decides according to his own goal. In the relevant mathematical decision theory - game theory - a further distinction is made into pure-conflict situations, where an advantageous alternative for one individual is disadvantageous for the other, and non-pure-conflict situations. In the former case total 'profit' is a constant, i.e. what one wins, the other loses - the so-called 'null sum' situation - in the latter case there is no 'null-sum'.

The four classes can be displayed according to Hanken and Reuver (1977) as systems of decision makers D_i controlling a primary system PS. The hierarchy case can be represented by means of a factual superordinated decision maker D (Figure 6.13a). The case of collectivity can be represented by means of an imaginary superordinated decision maker ID (Figure 6.13b), coalitions by a set of such imaginary decision-makers (Figure 6.13c) whereas the autonomy case should be represented without any superordinated decision-maker at all (Figure 6.13d).

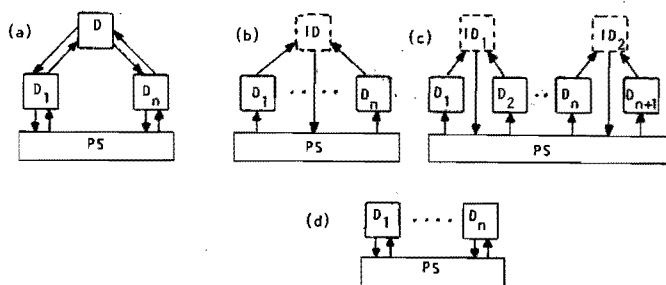


Fig. 6.13. Types of multi-person decision-making.

Another important decision-theoretical distinction that can be made is that between situations with or without direct communication between the decision-makers. Where there is no communication it is in fact impossible for decision-makers to change their objectives or adapt them to each other. In the collectivity case this implies that the only way to arrive at a consensus is to vote, in the autonomy case it blocks the possibility of bargaining. Goal adaption can take place where there is communication and by means of goal adaption a group can come to a consensus. The distinction does not play a role in the case of hierarchy.

This decision-theoretical classification of systems of goals (Hanken and Reuver, 1977) will be used as a starting point to derive a typology of methods to change these situations, i.e. to a typology of goal coordination methods.

Before proceeding with treatment of these methods it must be emphasised that the seemingly trivial assumption behind these considerations is certainly essential. Objectives are assumed to exist. In other words decision-making is assumed to be rational.

6.3.2.2. GOAL COORDINATION

Following the lines of the above-mentioned typology of systems of goals, one can now make a classification of the methods by which these systems can be coordinated.

Decision-theoretical classification

With hierarchical goal systems the corresponding form of coordination is goal decomposition. According to de Leeuw (1974) goal decomposition can be distinguished as 'fitting' or 'non-fitting'. The organisational goal is decomposable if it can be split up into two or more constituent subgoals. These subgoals are called 'fitting' if each subgoal refers to exactly one part system. It may well be that this is not the case. If not, there will be a need for further forms of coordination besides goal decomposition.

In the collectivity or coalition case the methods of coordination are essentially methods of attaining consensus, that is, methods to aggregate individual objectives into a common group objective (collectivity) or into a number of common subgroup objectives (coalitions). As already mentioned, the non-existence of communication implies that the only aggregation method left is voting. Some of the possible procedures for aggregating the votes (individual objectives) into a common outcome are the following:

- weigh the various objectives (votes) and take the weighted average as the outcome (this is essentially the procedure follo-

- wed in multicriteria decision-making);
- take the unweighted average, that is, the democratic voting procedures: one man one vote, majority rule;
- other voting procedures such as Copeland's rule, sum rule, product rule, etc. (see Hanken and Reuver, 1977, Chapter 6 for a discussion of the various rules invented to meet the problems of the Arrow dilemma);
- procedures like the English district system and the possible allotment of the remaining seats;
- the order of voting on different amendments (Luce and Raiffa, 1957 show that the order might have a great influence on the final outcome);
- veto right, majority, 2/3 majority, unanimity, etc.

In autonomy without communication it can be shown by means of simple examples that different procedures will, in the same situation, lead to different outcomes. Hanken and Reuver (1977) mention three such procedures:

- dominance principle: the autonomous individual chooses non-dominated alternatives, in simpler terms: he changes his choice only if that is advantageous to him;
- the maximin principle: the individuals choose so as to get maximum 'profit' in the worst possible case;
- equilibrium principle: the individual does not change his choice if that is disadvantageous.

Although the three procedures have been presented very simply it will nevertheless be clear that they all three seem quite reasonable interpretations of rational group decision-making. Yet they all three can yield different results ²⁰.

The case in which there is communication strongly differs in the sense that now all kinds of mutual influencing, interaction, etc. are possible and this opens many coordination horizons. This issue has been elaborated in mathematical decision theory by means of simple (mostly linear) dynamic models, e.g. of attitude change and bargaining (Hanken and Reuver, 1977, Chapter 7.2 and 10.3). Instead of further dwelling upon this decision-theoretical approach which does not offer much additional utility as to conceptual clarity let us end this section with a brief indication of an alternative approach to goal coordination.

Social interaction

If one defines communication according to Shannon and Weaver (1949) as the transfer of information from a transmitter to a receiver, then it is clear that the term is improperly used in mathematical decision theory as to the classification of decision systems with, and without communication. In game theory, commu-

²⁰ This induced Stegmüller (1969, XI-7) to conclude that there is no unique rationality concept.

nication is apparently used with a different meaning, namely that of 'mutual direct influencing' which I prefer to call social interaction or in control system terminology: social control. For 'control' means 'directed influence' and 'social' means that there is more than one controller. Note that social interaction presupposes communication. Communication (information) is a condition for influencing (control).

Social interaction presupposes at least two entities which are mutually influenced (Figure 6.14). These entities can either be individuals or groups or departments or organisations or any

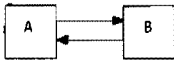


Fig. 6.14. Interaction.

other cluster of individuals. From the configuration of Figure 6.14 it is clear that interaction can be discussed in two ways: first, consider interaction from the viewpoint of the entities, second, consider it from the viewpoint of the interrelations between the entities. In other words, first consider the processes that take place inside the individuals: the intra-individual processes. Second, consider the inter-individual processes which play a role in the interrelationships between the individuals.

A particular mode of social interaction is the mutual, direct influencing of the goals, goal coordination in other words. Hence goal coordination can be approached from the intra-individual and inter-individual points of view. Indeed one can recognise this distinction in the social-science theories on group behaviour. Theories that concentrate on the intra-individual processes leading to goal adaptation are for instance theories on the level of aspiration (Lewin et al., 1944) and other behavioural-change theories, the theories on group balance (Heider, 1946, 1958) and its variations (congruity theory: Osgood and Tannenbaum, 1955; attitudinal change: Abelson and Rosenberg, 1958; Rosenberg and Abelson, 1960; cognitive dissonance: Festinger, 1957; for a survey see Taylor, 1970). Theories that concentrate on the inter-individual processes are, for instance those on power (Cartwright, 1965; Dahl, 1957; French and Raven, 1959; Hickson et al., 1971; March, 1957, 1966; for Dutch surveys see Helmers, 1975; van Schendelen, 1977; for a treatment of power from the viewpoint of decision-making for instance, see Kirsch, 1977; for treatments on the politics of organisational decision-making for instance, see Crozier, 1964; Pettigrew, 1973, 1975; and for explicit treatments on political decision-making see Dahl, 1961; Dahl and Lindblom, 1953; Lindblom, 1959; Gore, 1964; Ringeling 1976).

The treatment of goal-coordination methods has been very restricted. I therefore have not dwelt upon the possible abundance of details of all specific methods. I have to emphasize therefore that only broad lines have been indicated and that no claim is made to completeness.

6.3.3. STRUCTURAL COORDINATION

As mentioned in Chapter 6.3.1, structural coordination can be either the control of the structure of the whole system, i.e. the relationships between the part systems, or the control of the structure of the part systems themselves (Figure 6.15). As one can see from Figure 6.15 the difference is clearly a difference in level of aggregation; in both cases the control applies to the relational structure on different levels.

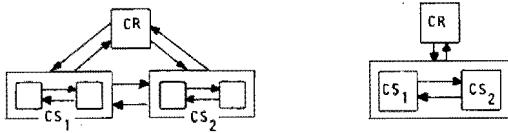


Fig. 6.15. Structural coordination of the parts and the whole.

Let us therefore first consider some types of relational structures. First of all, it is important to realise that a given system can consist of many different aspect systems, i.e. can have many different structures per aspect. Imagine, for instance the command structure, the communication structure, the responsibility structure, the personal-relations structure, the informal structure, etc. of one and the same system. Apparently the first important choice is that of the aspect under consideration. As we saw in Chapter 6.2 on decomposition two different kinds of relationships - similarity or dependence - resulted in two different decompositions.

Besides the content of the relationships, one can also discern other types of relational structures, such as the distinction made by Thompson (1967) into 'pooled', 'sequential' and 'reciprocal interdependence' which was interpreted by de Leeuw (1974) as a parallel circuit, a series circuit and a feedback circuit (Figure 6.16).

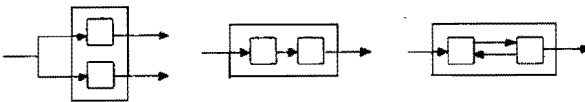


Fig. 6.16. Parallel, series and feedback circuits.

Note that in this representation of types of structures, the part systems are coupled via their inputs and outputs. Although this may seem very general, we have seen in the preceding chap-

ter that goal interdependences are possible as well.

An important method of coordination is to avoid, or reduce the need for coordination. In the first place one should try to enlarge the autonomy of the part systems, for the greater the autonomy, the fewer the interdependences and hence the less coordination is needed. This method is however not a form of coordination but a form of decomposition, because structural coordination has been defined explicitly as the control of the relationships between part systems. Several other measures to reduce the need for coordination do however satisfy the definition of structural coordination, such as (Galbraith, 1973; Kieser and Kubicek, 1977):

- the creation of slack resources;
- the introduction of zones of indifference where no coordination takes place (management by exception);
- the introduction of tolerance on norms;
- the formation of supply buffers;
- the formation of staff buffers;
- the interchangeability of staff;
- the interchangeability of machinery.

Galbraith (1972, 1973) deduces his typology of coordination from an information-processing viewpoint and arrives at the following distinction (Figure 6.17).

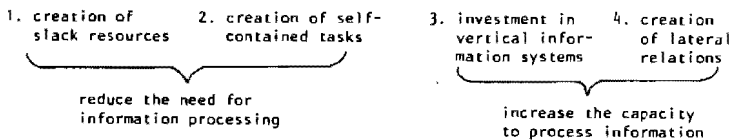


Fig. 6.17. Design strategies (Galbraith, 1974).

Galbraith further subdivides the strategy 'creation of lateral relations' according to the amount of task uncertainty. The greater the task uncertainty the greater the amount of information that has to be processed. Galbraith distinguishes the following types of 'lateral relations' along the increase-of-uncertainty line:

1. direct contact: the managers concerned who share a problem solve it themselves;
2. liaison roles: when the volume of contacts grow a specialised role for handling this communication is set up;
3. task forces: when more managers or departments are involved, a task force from representatives of the departments affected is set up;
4. teams: the groups are made permanent, group consensus is pursued;
5. integrating role: the leadership issue is solved by creating

a new role. Power is exerted in the form of persuasion and informal influences;

6. managerial linking role: the leader must get more power of the formal-authority type but it is still different from line-managerial roles;

7. matrix organisations: create dual authority relationship. The coordination authority and line authority are equalised.

This typology of 'lateral relations' represents a horizontal cut through the existing organisational vertical-line hierarchy.

From the fifth type on it is however no longer intrinsic coordination. In a matrix organisation there exists, along the horizontal dimension, also a hierarchy of functions and persons, i.e. as separate coordinating functions surely exist, there is also extrinsic coordination. We see that coordination crossing through formal hierarchy as, for instance in the project and matrix structure, does not necessarily have to be intrinsic coordination. One had thus better use the term multi-line structure than the term horizontal structure (Kieser and Kubicek, 1977).

Real intrinsic 'horizontal' coordination comes under the label of group cooperation. One can discern several types of group cooperation. First the distinction as used in game theory: the group either functions as an (imaginary) entity, or each member of the group fights for his own sake, i.e. the distinction between collectivity or autonomy (see Chapter 6.3.2.1). Essential is the fact whether there is social interaction between the actors in the group. Group decisions can be modelled according to voting behaviour (Arrow, 1951) or team behaviour (Marschak and Radner, 1968). Autonomous multiperson systems can be modelled by means of games theory (Luce and Raiffa, 1956). The contributions from social sciences to group decision-making (Collins and Guetzkow, 1964), power influence, manipulation and bargaining in groups (Kirsch, 1977) reveal much more about 'real' intrinsic coordination.

6.3.3.1. HIERARCHICAL STRUCTURAL COORDINATION

In this chapter the discussion is about a particular type of structural coordination, namely a hierarchical type. Let us therefore first have a closer look at the concept of hierarchy, especially its relationship with decomposition and coordination (de Leeuw, 1976b; de Leeuw and Kickert, 1977).

The concept of hierarchy

The usual classical concept of hierarchy implies the ordering of superiors and subordinates, as visualised in Figure 6.18:

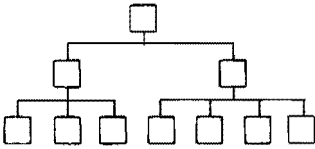


Fig. 6.18. Classical hierarchy.

This figure of a typical organisation chart shows the characteristics of this concept of hierarchy: subordinates have only one superior, and there is only one element at the top, that is, the highest superior. This definition of hierarchy clearly refers to the line-organisation structure which is based on the principle of 'unity of command'. In that sense

the adjective 'classical' is justified.

This concept of hierarchy can be formally defined by the mathematical concept of an ordering. There are many kinds of orderings. In general any transitive, reflexive binary relation is called a (quasi) ordering. Examples of a quasi-ordering are implication and partition, the 'if, then' and the 'is subset of' relations. A strong, connected quasi-ordering is called a weak ordering. An example of this is the relation 'as high as'. If a quasi-ordering possesses an equivalence relation it is called a partial ordering, such as 'smaller or equal to'. A strongly connected partial ordering is called simple ordering. Finally, an asymmetric transitive-connected relation is a strong ordering. An example of a strong ordering is the relation 'smaller than' (Gordon, 1967).

A possible definition of the concept of hierarchy is to consider it as a set on which an ordering relation is defined and which, moreover, is a mapping. The requirement that the relation be a mapping follows from the single-superior requirement: a mapping assigns to each element (subordinate) only one element (superior). The requirement of a classification hierarchy - representable by a quasi-ordering - that each element belongs to only one class, implies that all classes at one level should be disjoint. Note that in this definition of hierarchy situations, where a subordinate has several superiors, are excluded. This type of organisation is surely not unimportant in view of functional, project and matrix organisation structures.

A quite different approach to the concept of hierarchy is the approach where it is not the ordering relation of subordinates and superiors that is emphasised but the aspect of decomposition. Essential to this approach is the viewpoint that a complex-structured system consists of part systems and relationships between them and that an insight into partitions and connections determines the insight into complexity. When one does not stop at the decomposition of a system into constituent part systems but again decomposes the part systems thus obtained into sets of part systems via aggregation or disaggregation, resulting in a new set of part systems on a lower level of aggregation, and repeats this decomposition iteratively down to some lowest elemen-

tary level, one has arrived at the concept of a hierarchical system as defined by Simon (1962) and displayed in Figure 6.19. Simon (1962) defines a hierarchical system as one which can be divided into part systems, which in turn can be divided into part-part systems and so on, down to some elementary level:

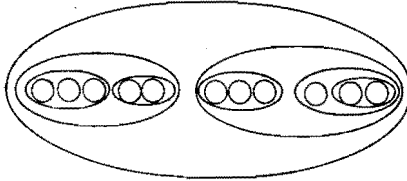


Fig. 6.19. A hierarchical system.

In this latter concept of a hierarchical system the problem of constructing command relations is shifted to the problem of the decomposition into part systems. We see that in classical hierarchy the essence lies in ordering, whereas in this type of hierarchy the essence lies in decomposition. In a hierarchical system one is not primarily interested in command relations. Note however that, mathematically speaking, there is an equivalence between both types of hierarchy in the sense that decomposition comes to the 'subset of' relation (Chapter 6.2) which is a quasi-ordering so that the latter concept of hierarchy also satisfies the ordering definition of classical hierarchy. The great difference between the two concepts becomes clear if one follows the line of argument of Simon (1962) further on. Simon in fact adds the concept of 'nearly-decomposability' to his concept of hierarchy, that is, the part systems from which a complex system is composed have many internal relations and few external mutual relations (see Chapter 6.2.3.2). Hence in hierarchical systems the focus of interest lies on the intra- and interrelationships on one level and not on the relationships between different levels as in classical hierarchy. The former might be called a horizontal concept and the latter a vertical one. Remember that if one adds the 'nearly-decomposability' rule to the concept of hierarchy a system is obtained which minimises the required coordination.

Coordination of a hierarchical system

In Simon's conception coordination apparently means the control of the remaining relations between the nearly-autonomous part systems. Let us now consider what the extrinsic control of these relationships, i.e. extrinsic structural coordination, would look like. In Figure 6.20 it has been shown how an extrinsic structural control of the hierarchical system indeed leads to a pyramidal hierarchical control.

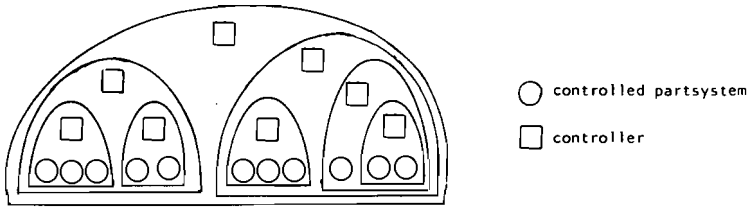


Fig. 6.20. Control of a hierarchical system.

From the viewpoint of control one will make use of the property that the various part systems are nearly autonomous. The total complex control task can then be partitioned into a set of easier control tasks. However, as the controlled systems are not independent, the control tasks are not independent either. These latter control tasks have to be coordinated in their turn, and so on. This line of argument is worked out in a mathematical sense by Conant (1976). As we have shown in Chapter 6.2.3.3 Conant (1976) has proved that from an information-processing point of view the law applies that the total information rate in a system is equal to the sum of throughput information plus blockage information plus coordination information rate. In the 'null-sum' case this implies that the information capacity needed for coordination will have to be extracted from the usual information capacity needed for the output production of the system. In order to increase 'throughput', coordination has to be diminished, that is, one should strive at part systems which are as autonomous as possible. From this same information-processing viewpoint it also follows that the next-higher controller will not control the whole underlying system but only the next-lower controllers (see Figure 6.21). The configuration of Fig. 6.21 clearly shows the analogy with Likert's (1961) 'linking pin' organisation structure, illustrating that this hierarchical form of coordination can also be realised by group coordination.

Note that Likert (1961) actually proposed a separate coordinative task to be fulfilled by a specific individual, i.e. an extrinsic coordinator.

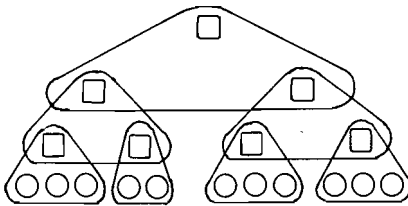


Fig. 6.21. Hierarchical control of a hierarchical system.

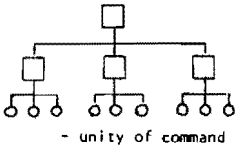
Note that the distinction between intrinsic and extrinsic coordination is indeed related to the distinction between single-level or multilevel (hierarchical) coordination. The coordination by a separate coordinator, i.e. extrinsic coordination, is generally considered as the very basis of the classical superior-subordinate hierarchy. It is therefore not surprising that one often meets with the distinction between intrinsic and extrinsic coordination in organisational literature. The distinction between intrinsic and extrinsic coordination coincides with the distinction between 'decentral' and 'central' coordination (Kirsch, 1971), with the distinction by Meyer (1969) into 'active' and 'passive' forms of coordination and up to a great extent with the distinction that van Aken (1978) makes between 'self-control' and 'coordination'. Kirsch (1971) splits 'decentral' (intrinsic) coordination up into one-sided or reciprocal adaptation and into direct or indirect adaptation. Indirect adaptation means the external control of the environment in order to achieve the desired changes via that detour.

Besides the system-theoretical considerations on the necessity of a hierarchical coordination structure, there are other considerations as well. An example of a typical organisation-science consideration is to tackle the problem as one of vertical division of tasks; by analogy to the horizontal specialisation of tasks at the shop-floor level one can distinguish between execution and management (coordination) as two specialised forms of labour. Coordinative functions have to be fulfilled by separate individuals. And inside these coordinative functions there is again specialisation. Imagine, for example, the functional structure of Taylor (1911) with his eight different functional coordinators. There is a division of tasks both in the execution and coordination as well as between execution and coordination.

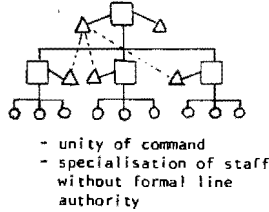
Typology of coordination structures

The well-known typology of coordination structures is the set of line, line-staff, functional and project/matrix organisations. These four types of structure constitute points on a continuum whose two extremes are 'unity of command' and 'manifold command'. This is represented in the following Figure 6.22 (Hill et al., 1976):

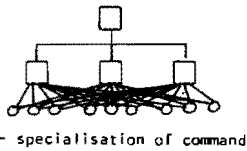
1. line organisation



2. line-staff organisation



3. functional organisation



4. matrix organisation

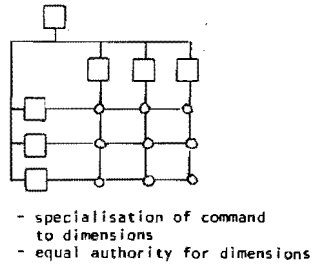


Fig. 6.22. Organisation structures.

As we see, the functional organisation might be placed further on the continuum than the matrix organisation because it has many more command entities. The reason for the chosen ordering is that the command instances with matrix organisation bear upon many more qualitatively different dimensions.

Besides this typology of coordination structures the 'contingency' school particularly has developed alternative classifications for organisation structures. The classifications there do not consist of a summing up of all possible types but are a classification along various dimensions. This dimensional classification has the advantage that a structural insight is gained with much fewer variables. The dimensions that have been used by Pugh et al. (1964, 1968, 1969a, 1969b) were (1) specialisation, (2) standardisation, (3) formalisation, (4) centralisation, (5) configuration and (6) flexibility. These six basic dimensions can be found in more or less adapted forms in many 'situational' authors (Child, 1972, 1973; Wollnik and Kubicek, 1976; Hill et al., 1976; Kieser and Kubicek, 1977). As Chapter 7 will to a great extent be devoted to the situational approach, it will not be dwelt upon here.

6.3.4. DISCUSSION

I hope the essence of my conceptual theory on coordination has become clear. Coordination follows decomposition. Decomposition yields a set of part systems. Coordination is the control of these part systems. This is a very general definition of coordination which in fact coincides with the definition of control apart from its explicit emphasis that the control applies to a system of part systems. Hence the same distinctions that apply to control also apply to coordination. In order to link up with the organisation-science considerations on coordination, I have restricted myself to two modes of coordination, goal coordination and structural coordination. Organisation science generally omits the first and concentrates on the second. It has been shown how 'hierarchical' structural coordination corresponds to the systems-theoretical considerations on hierarchical systems. I have tried to obtain a systematic classification of different modes of coordination because in my opinion particularly the systematics are lacking in many organisation-science treatments of the subject. A consistent and comprehensive treatment of all possible forms of coordination at least prevents the failure to restrict oneself a priori to one very specific form of coordination or to leave the right path altogether.

There is probably no need to repeat that this discussion of coordination is only a first conceptual step on the path leading to a consistent, empirically validated and useful theory on the organisation of decision-making. Let me indicate one specific example of this quite general statement. The conceptual framework on the organisation of decision-making was presented as a theory on the formation and control of part systems in general, i.e. subsystems and/or aspect systems and/or phase systems. Although the elaborations in this chapter might have given the impression that it was restricted to subsystem structures only, this is not true. There is, however, still a long way to go before one obtains an empirically validated and useful theory on the organisation of e.g. phase systems. The general conceptual framework has still to be elaborated into a practically useful 'real' theory. Nevertheless we will also give some examples of the application of the framework to phase system structures in the case study of Chapter 8.

Coordination and decomposition

Let us once more consider the relationship between coordination and decomposition, now that the definition of the former concept has been presented as well. Decomposition was defined as the formation of part systems and the concept was elaborated in Chapter 6.2 as an approach to partition a system of given objects and given relationships into part systems. Decomposition was restricted to the demarcation issue: find the boundaries of the

part systems. Clearly this interpretation of decomposition is rather narrow, and surely narrower than 'formation of part systems' might imply. A broad interpretation of this latter term could come very close to our already mentioned 'structural coordination of the parts' mode. For if one interprets 'formation of part systems' in a broad sense so as to include the determination of the internal structure of the part systems, then the decomposition is identical to the structural coordination of the parts. If, moreover, one adopts the following sociological line of argument the confusion even increases: phenotypical properties of social systems always are a function of interaction²¹. This implies that elements are determined by their relationships with other elements. Forming the relationships therefore automatically implies the formation of the elements. Translated into our terms this means that decomposition is a logical consequence of structural control. Although the basis of the argument is rather weak - compare it to the well-known statement that individuals are influenced by their social environment, which of course is true. Influence, however, does not imply complete determination - it emphasises the danger of confusion, in spite of clear system-theoretical definitions. A system is defined as a set of elements (part systems) and a set of relationships between them. This latter set is called the structure. Structural control of a system therefore only applies to the relationships only and not to the elements. Decomposition results in clusters of elements. Structural control (coordination) affects either the relationships inside the clusters or the relationships between the clusters but not the elements. So even in the case of the structural coordination of the separate part systems, both concepts are still distinct.

The goal of coordination

In Chapter 5.4 we have discussed the relationship between the metacontrol goal and the object-level control goals. It was stated there that, apart from things like 'means-end hierarchies', the goals at both levels were in principle independent. At first sight one might however argue that in the case of goal coordination where the metacontroller's aim is explicitly to coordinate the goals of the object-level controllers, the coordinator's goal is to aggregate the lower-level goals into a common goal. If the object-level controllers then have different and conflicting goals, the aggregation is impossible. (This is the case of autonomy discussed in Chapter 6.3.2.1.) It is then impossible to find a common goal. Hence there is no goal coordination possible. This line of argument is however false. For let us clearly recall the various definitions. Goal coordination is the goal con-

²¹ Prof.dr. L.U. de Sitter drew the author's attention to this possible line of argument.

trol of interrelated part systems. The definition of control is 'directed influence'. Hence goal coordination means the directed influencing of the goals of the part systems and/or the common overall goal. Goal coordination is hence by no means restricted to 'aggregation of part system's goals into a common goal', and it is surely nonsense to state that the latter common goal is the goal of goal coordination. The goal coordination of conflicting part system goals will just consist of another term of influencing the existing goals so as to obtain some adequate goal coordination, such as the change of the part-system goals themselves via some intra- or interindividual process. Goal coordination is broader than 'aggregation of goals' and the goal of goal coordination is not the 'aggregated goal'. The goals on the object-level - part systems - and metalevel - coordination - are still in principle independent, in the case of goal coordination as well.

Existence of coordinator

Coordination was defined as the control of a system of part systems. One of the implications of this definition is that coordination is performed by only one coordinating controller. Of course there might e.g. be various aspect systems of the same system that need to be coordinated, resulting in various coordinating controllers per aspect. But unless complete autonomy of the aspect systems is desired, these aspect coordinations have also to be coordinated, so that there will be one coordinator on the next-higher level. On the highest level there will always be one and only one coordinator. In other terms, the organisation of a decision-making system is described or prescribed in terms of one highest-level controller. Broadly interpreted this conclusion seems to imply a rather questionable approach towards decision-making systems. For it is clear that there exist many complex decision-making systems where there is no such single highest-level controller and that it can not be stated that in all these cases there should be one. Let me explain why this reproach is wrong. First, it is not true that all decision-making behaviour is interpreted in terms of one highest-level controller. Only the organisation of decision-making is interpreted in these terms. Second, it should be emphasised that the highest-level controller does not necessarily have to be a person, group, in short, a subsystem. It can be a purely theoretical construct, that is, it does not have to really 'be' there. Third, it is of course not true that in general the organisation of decision-making can only be explained in terms of one highest-level entity. This is only true in our interpretative conceptual framework, and of course many other interpretative frameworks

may be found. In the interpretation of 'instrumental' decision-making (Hanken and Reuver, 1977, p. 75) the conclusion would e.g. not hold true. In summary, my conceptual framework is not refuted in case there 'is' no single highest-level controller.

Extrinsic and intrinsic coordination

If the coordinator, i.e. the controller, is a subsystem distinct from the part systems which are coordinated (the controlled systems), then the coordination is called extrinsic. If not, the coordination is called intrinsic. These definitions seem clear enough and it is indeed not difficult to find illustrative examples of both forms of control. Let me, however, give some examples which are not so clear and illustrative.

Take the 'linking pin' structure of Likert (1961) which was illustrated in Figure 6.21. Likert proposed his structure along the lines of the 'Human Relations' school as an alternative to the formal coordinative superior structure. The coordinator should no longer be a distinct superior of some group but a participating member of the group. Hence, an intrinsic coordinator, one would say. Likert however proposed a separate coordinative task which should be fulfilled by a specific individual in a 'linking pin' position. Therefore an extrinsic coordinator after all.

Take as a second example a council consisting of representatives of some population which is 'controlled' by that council. The representatives are no superiors of their population. Yet they are distinct from it and therefore extrinsic coordinators.

It will be clear that very few of these examples will meet the definition of intrinsic coordination. Democratic representative control systems don't. Only a kind of true Soviet republic where all persons together take the decisions would meet it. Obviously factual examples of intrinsic control will mostly be met in small group decision-making where the number of decision-makers still allows complete participation by everyone.

From a different level of consideration, however, a representative council can still be an example of intrinsic coordination, namely from the viewpoint of the coordination (control) of the council itself. The council, viewed as a controller of the population (controlled system), is extrinsic. The coordination (control) of the council (now itself viewed as the controlled system) might well be intrinsic²². A council which is coordinated by means of some majority vote procedure meets the definition of intrinsic coordination: all votes have the same influence on the decision; no one can be pinpointed as 'the' controller. Clearly all depends on what is identified as the controller and what as the controlled system, that is, it all depends on what exactly is identified as control

²² From the viewpoint of 'the population' the latter coordination is a form of meta-control.

6.4. CONCLUSIONS AND DISCUSSION

In this chapter a conceptual framework was proposed as a basis for a theory on the organisation of decision-making. Starting from the definition of a system and the systems-theoretical definition of structure, it has been shown that the organisation of a decision-making system consists of two measures: decomposition and coordination.

Decomposition was defined as the formation of part systems of the decision-making system. The term part system is the general term for subsystem and/or aspect system and/or phase system. The formation of part systems essentially amounts to the 'subset of' action. All three kinds of part systems are subsets of the original system, only the elements of the sets to which the 'subset of' applies, differ. With subsystems the elements are the objects, with aspect systems the elements are the relationships and with phase systems the elements of the set are time instances. The primary meaning of decomposition is its demarcation meaning. Decomposition of a system means that boundaries are drawn around subsets inside this system. 'Formation of part systems' should not be interpreted in a broader sense. It was found that basically there are two different methods of decomposition: form part systems that are as homogeneous as possible or form part systems that are as autonomous as possible. Both methods have been formalised in order to reveal their conceptual essences most clearly. It was found that the goal concept plays a central role in decomposition. Without goal there is no decomposition possible. It has been shown that although the decomposition methods were quite distinct from an organisation-design viewpoint, the differences vanished from an abstract mathematical viewpoint. Finally, it has been shown that on some assumptions there is a relationship between both methods of decomposition and the usual two main ingredients of coordination: goal attainment and mutual adjustment.

Coordination was defined as the control of a system of inter-related part systems. Although our starting point - the definition of a system - together with the definition of decomposition, would point towards a definition of coordination as 'the formation of relationships between part systems', coordination has been given a broader meaning. For the organisation of a decision-making system consists not only of the off-line a priori static construction of the structure of the system. The definition is very broad and actually coincides with the general definition of control. Hence the control-systemic approach also applies to coordination. In order to link up with the organisation-science considerations on coordination, I have restricted myself to the goal coordination and structural coordination modes. Organisation science generally omits the former. Two approaches to goal

coordination have been sketched: one based on a decision-theoretical classification of systems of goals and another based on the concept of social interaction. The treatment of structural coordination has revealed that 'hierarchical' structural coordination corresponds to the system-theoretical consideration on hierarchical systems.

As with any proposal and particularly with first-stage conceptual proposals, problems can be raised, such as:

(1) what is the relationship between decomposition and coordination, (2) what is the relationship between metagoals, object-level goals, goals of decomposition and goals of coordination, (3) what is the relationship between the organisation of decision-making and organisation design in general.

Decomposition and coordination

One of the questions that can be asked is what exactly the difference is between decomposition and coordination. This question has already been discussed several times in this chapter, so that the arguments will only be briefly repeated.

Coordination was defined as the control of a system of part systems. One of the modes of coordination is the direct structural coordination of the parts, particularly the structural coordination of the part systems. This latter concept does not seem to differ very much from a broad interpretation of 'the formation of part systems', such as an interpretation like 'the formation of part systems including the formation of their internal structure'. This interpretation is however false as has already been shown. Decomposition is a demarcation problem: given a set of elementary interrelated entities one determines the boundaries of the part systems, that is, one determines which entity comes within which part system.

A second line of argument which was presented was the sociological statement that phenotypical properties of social systems are always a function of interaction, which implies that elements are determined by their relations to other elements. Forming the relationships then implies the formation of the elements, so decomposition is then a logical consequence of structural coordination. The counter-arguments are that the statement in its rigid form is false and that the unambiguous definition of structural control applies to the relationships only whereas decomposition applies to the elements only, so that both concepts are distinct.

In Chapter 6.2.4 it has been shown that on some assumptions there seems to be a strong relationship between decomposition by dissimilarity and by interrelations on one hand and coordination in its dual sense as goal-oriented adjustment of parts, on the other hand. For if one assumes that decomposition into homogeneous part systems is aimed at the increase of the part system's

output, that this part system's increase in output results in an increase of the overall system's output and that the overall system's output increase is (one of) the common organisational goal(s) of the system, then this method of decomposition serves the goal coordination of the system. The decomposition into nearly-autonomous part systems facilitates the structural coordination of the system.

Although decomposition and coordination are distinct concepts, they are none the less both interrelated. Both measures of organisation design can not be taken independently. They interact. One can therefore e.g. not rigidly state that the organisation of decision-making should start with decomposition and only then proceed with coordination. Two interactive measures can not be ordered so strictly.

The goal problem

A problem which has repeatedly been discussed is that of the relationships between metagoals, object-level goals, goals of decomposition and goals of coordination. The inducement in stating this problem was the following (see Chapter 5.4): imagine a metacontrol of two object-level controllers with conflicting goals, so that it is impossible to aggregate them into a common overall goal for the metacontroller. Then the metacontroller has no goal and consequently does not exist. As I have shown, the line of argument is erroneous as the goal of the metacontroller is in principle independent of those of the object-level controllers. The same applies to decomposition and coordination. The goal of decomposition, i.e. maximising similarity or intrarelations plus additional criteria as to cluster size, number of clusters, etc., has not necessarily much to do with the goals of the elements and part systems that are clustered. At first sight one might argue that in the case of goal coordination the metacontroller's aim is to coordinate the goals of the object-level controllers, i.e. the coordinator's goal is to aggregate the object-level goals, so that conflicting object-level goals indeed block the aggregation, which implies that goal coordination is impossible. Even in this case, however, the argument is false. Goal coordination is not restricted to 'aggregation of the goals of the part systems into a common goal' and it is definitely erroneous to state that the goal of goal coordination is this 'aggregated common goal'. The goals on both levels are still independent.

There is however some relationship between both levels, for they mostly fit into some 'means-end hierarchy'. Ultimately metacontrol of a control system still serves the aim of bringing about a desired behaviour on the part of the object-level controlled system. The metacontrol of the object-level controller serves indirectly to bring about the desired change of the object-level controlled system. The metacontrol actions serving the goal

the metacontroller form one of the inputs of the next-lower controller. Interpreting inputs as means therefore leads to the so-called 'means-end hierarchy'. Note, however, that I turned the hierarchy the other way around, for I look at the multilevel control system from the point of view of the system actually to be controlled, and not from the top. In this sense goals of both levels are related. We have, in discussing the goal of decomposition into homogeneous part systems, indeed noted such a 'means-end' relationship. The goal of this decomposition method was assumed to constitute a means of increasing the overall system's output.

Organisation and decision-making

In Chapter 6.1 my interpretations of the concepts of decision-making and organisation were briefly repeated with the aim of clearly indicating what exactly the difference is between 'organisation of decision-making' and 'organisation' in general. I have shown that if one adopts the viewpoint that decision-making is the only important activity in an organisation, the relationship between both is a 'subset of' relation: decision-making processes are subsets of an organisation. Together they completely constitute an organisation (Figure 3.1). If one adopts the - in my view more realistic - viewpoint that decision-making is one of the important activities inside an organisation but not the only one, both concepts have an intersection but also contain separate elements (Figure 3.2). In this latter viewpoint a theory on decision-making does not automatically lead to one on organisation, nor vice versa. In order to prove an equivalence one first has to prove that the theory applies to the intersection of both.

How is my conceptual framework for the organisation of decision-making related to organisation design in general? As I have shown in Chapter 6.1 my theory on the organisation of decision-making follows from a theory on the organisation of a system in general, which in turn consists of two theories: one on decomposition and another on coordination. As an organisation might also be considered as a particular form of system - both the institutionalistic and the functionalistic concepts are forms of systems - a theory on organisation design also follows from a theory on the organisation of a system. Hence both derivations of the general system design theory, can indeed be equivalent, for they grow from the same root. Note that sprouts of the same root do not necessarily have to be the same in their specific appearance.

I hope this brief line of argument may provide an adequate answer to the question as to what the difference is between my conceptual theory of the organisation of decision-making and a conceptual theory of organisation design in general. They are closely related.

The organisation of decision-making

In Chapter 5 the organisation of decision-making was defined as metadecision-making. Decision-making was considered as the controller of some controlled system so that the structuring of decision-making could only be the activity of some next-higher metacontroller. The organisation of decision-making was identified as a structural mode of metacontrol (Chapter 5.3). In comparison to the definitions given in Chapter 6 the former definition of the organisation of decision-making is thought to be too restricted. For in Chapter 6 the term was much more broadly defined: the organisation of a decision-making system consists of decomposition and coordination. Decomposition is the formation of part systems, coordination the control of those part systems. It should be recalled that those part systems are parts of the decision-making system, or in the terms of Chapter 5, the part systems are parts of the object-level controller. Coordination as the control of those part systems is therefore per definition identical to metacontrol. So, in fact, coordination does amount to the general definition of metacontrol. Thus the concept of coordination alone is already broader than the definition of 'organisation of decision-making' as structural metacontrol given in Chapter 5. Actually the whole book shows a steady increase in generality. First we started with 'normal' decision-making and its rationality (Chapter 4.1). Then we introduced procedural rationality concerned with the process of decision-making only. This concept was extended to structural rationality concerned with the whole structure of decision-making. This structural decision-making was called the organisation of decision-making (Chapter 4.2) and subsequently identified as one of the modes of metadecision-making, particularly its structural metacontrol mode (Chapter 5.3). Finally, in Chapter 6 the concept of organisation of decision-making was extended further to include decomposition and coordination. In Chapter 7 the framework of this chapter will moreover be extended in a dynamic sense to deal with the process of organising decision-making.

Usefulness of the conceptual framework

Let me end this chapter with a few remarks on the usefulness of the proposed framework. In principle one could say that the framework possesses a high praxeological value because it can easily be used prescriptively. It is based on the 'control paradigm' of de Leeuw (1974) which states that phenomena can be perceived in terms of control systems. Hence it is an intentional model (see Chapter 2.1). Second, the control-systemic interpretation implies that it is goal-oriented. These two considerations imply that the framework is an intentional rational (teleological) model and that it can therefore easily be used in a prescriptive sense.

Of course this conclusion as to the prescriptive value is still quite general. What about the concrete usefulness of the conceptual framework? Although it will be shown in the case study of Chapter 8 that the conceptual framework can generate prescriptive proposals for the organisation of the numerus fixus decision-making process, it is not surprising that the proposals derived from abstract concepts are themselves abstract as well. However, this conceptual framework does not pretend to have a direct practical usefulness, that is, that it can be used directly to solve practical problems. The usefulness of a conceptual framework lies in being a basis for the development of a theory rather than in direct applicability to practice. In fact this is evident if one remembers the scheme of the scientific process which was presented in Chapter 2.2. The concept formation is a prephase of the construction of 'real' theories. After the tentative construction of theories, the validation phase follows and it is only then that one possesses an empirically usefull tool for practical purposes, namely a validated theory which describes relationships in reality on which a scientifically sound prescription can be based (see Chapter 2.1). As already stipulated in the stage of conceptual theory formation empirical reality primarily has an inductive discovery function and only a very weak test role: illustrations surely do not possess the same test capacities as empirical research plays in the verification of theories. The empirical research method which I used in conceptual theory formation, i.e. the case-study method, is certainly no proof of the prescriptive usefulness of the concepts, at most it forms an indication of some future usefulness. I have explicitly chosen this theoretical approach to the problem of the organisation of decision-making: first to develop a framework of concepts, then develop a theory based on it, then validate that theory and finally use this theory as a tool for prescription. Of course this is a long way and in fact only the first step on that long road has been taken as yet. Apparently many organisation scientists prefer a shorter one, namely directly generating useful prescriptive recommendations from 'practical experience'. As we will see in the next Chapter, even contingency theory which somehow forms a reaction to this dubious approach follows the shorter 'practical' way. Of course, it would not be so difficult for an experienced organisation scientist to generate an extensive set of variables characterising the organisation of a decision-making process. By means of factor analysis or some similar technique one could derive a set of significant clusters of characteristic variables. Similarly, one could generate an extensive list of methods for organising a decision-making process and apply the same techniques to this list. This list of methods for improving the decision-making process might consist of very practical recommendations such as programming the decision-making, techniques to improve the process of meetings (brainstorming, discussion techniques, group climate im-

provement), feedback control, information-processing control, motivation improvement, and indirect methods such as improvement of the organisational context of the decision-making process (communication structure, information systems and organisation structure). One can test these elements as to significance and from that deduce the most relevant methods.

I consider this approach not very satisfactory from a scientific point of view. There is no guarantee at all that the variables and methods so derived possess qualities like consistency and completeness, notwithstanding the fact that the approach might work, that is, could prove to result in effective and efficient prescriptive recommendations.

CHAPTER SEVEN

THE PROCESS OF ORGANISING DECISION-MAKING

In the previous chapter I have developed a conceptual framework for the organisation of decision-making. Of course, this framework is far from being definitive, apart from the fact that a framework is in principle not definitive because it is the first step towards a theory.

In this chapter I will concentrate on a particular type of extension of the framework, namely in a dynamic sense. One might perhaps get the impression that the framework of Chapter 6 is a static typology, that is, a set of concepts dealing with the organisation of decision-making without any reference to dynamic aspects. The decomposition and coordination framework seems not to take into account the fact that the organisation of decision-making changes with time. An organisation is not static but also incorporates dynamic aspects, a distinction which one might relate to the distinction between the concepts of "Aufbau" und "Ab-lauf" organisation (Kosiol, 1962). The organisation of decision-making itself is a process. In short, the framework seems to overlook the dynamic aspects of decision-making.

The reader will have noted that I have formulated the shortcomings of the framework several times in slightly different terms. The reason for this is that, although one might think that the slightly different formulations all denote the same sore spot, they do not. The formulations dealt with 'the process of organisational change', 'the process of organising decision-making' and 'the process of decision-making'. In my view these three issues certainly differ. So, in order to be able to address the right problem in this chapter, it has first to be clearly defined. Let me therefore start by indicating what the essential differences between the issues are in order to isolate and solve the essential problem in this chapter.

The process of decision-making, the process of organising decision-making and the process of organisational change

The objection that my framework does not take into account the dynamic aspects of decision-making, is false. I have expli-

citly defined the structure of a decision-making process as a trajectory in the three-dimensional space spanned by subsystems, aspect systems and phase systems. This last dimension hence refers explicitly to the dynamic process facets. The treatment of the organisation of decision-making in terms of decomposition and coordination hence refers to all three dimensions, including the dynamic phase. The framework therefore explicitly takes into account the dynamic aspects of decision-making. I consider the organisational structure of decision-making as a dynamic process.

So what dynamic aspects of the organisation of the decision-making are overlooked?

In order to give an answer to this question I refer to the meta-systemic approach which was discussed in Chapter 5. In that chapter I explicitly distinguished between decision-making at the object level, and decision-making at the metalevel. Explaining or designing the structure of (object level) decision-making is a metalevel decision-making matter.

In the conceptual framework the structure of decision-making clearly encompasses dynamic aspects, in other words, object level decision-making is regarded as having a dynamic structure. And it is with this structure that Chapter 6 deals. The decomposition and coordination framework applies to the structure of object level decision-making, and as such it is a meta decision-making framework. The metadecision-making about the organisation of the object level decision-making, however, has a dynamic structure as well.

Organising the (object level) decision-making is itself a process too, to put it in more comprehensible terms. This level difference has been explained in Figure 7.1.

It is clear from

this figure that the decision-making is a process and the organising of that decision-making process is a process too, and that both processes are at different levels, namely at the object level and the metalevel. The output of the process of organising the decision-making, that is, the output of the metadecision-making process, is the organisation structure of the object level decision-making process.

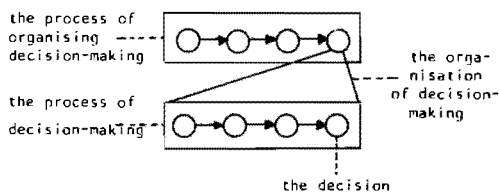


Fig. 7.1. The organisation and process of organising decision-making.

Up till now we have distinguished between two types of processes, the process of decision-making and that of organising

decision-making. Let me now try to 'make confusion worse confounded' by introducing another interpretation of the fact that an organisation is a dynamic process, that is, the process of organisational change, in the hope that the solution of this artificial confusion will eventually contribute to clarification of the concepts. By the process of organisational change I mean a process as illustrated in Figure 7.2. The process consists of the sequence of organisational structures of decision-making at

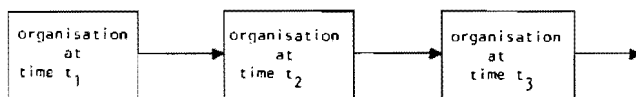


Fig. 7.2. The process of organisational change.

different subsequent moments of time. Let us now compare this process with that of organising decision-making. The last-named might, for instance, be described as a process of recognition, development, evaluation and choice of an alternative decision on the organisation of decision-making (see Figure 7.3).

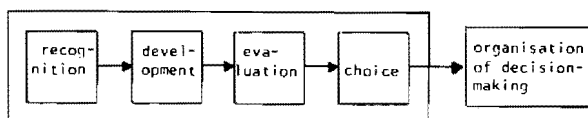


Fig. 7.3. The process of organising.

In this process only the output is some kind of organisational structure, differing from the process of organisational change shown in Figure 7.2. The relationship between both processes is clearly a matter of aggregation level. The output of the process of organising, that is, a certain organisation, constitutes a single step in the process of organisational change; the process of organising accounts for one transition from a certain organisational structure to a new, desired organisational structure. Note, however, that in order to explain the process of organisational change, that is, why a certain structure changes into a new one, the process-of-organising type of explanation can be used.

So we have now, at long last, arrived at a clear specification of the problem which will be addressed in this chapter. The framework of Chapter 6 does account for 'the process of decision making'. Furthermore, 'the process of organisational change' can be explained by understanding 'the process of organising deci-

sion-making'. Consequently I chose to identify 'the process of organising decision-making' as the central problem of this chapter. The key problem of the conceptual framework of Chapter 6 is that it deals with the organisation of the decision-making process and not with the fact that this organisation itself is a process too. It deals with metadecision-making without any reference to the dynamic process aspects of metadecision-making, or, to put it in less understandable terms, it lacks a meta-meta-decision-making consideration. For the process structure of metadecision-making is, in its turn, the concern of meta-metadecision-making.

In this chapter I will deal with the process of organising the decision-making, as the title indicates, in the above-mentioned sense. First I will elaborate the meta-metaconsiderations. Next I will focus on a particular approach to the process of organising decision-making, namely a situational approach.

7.1. META-METADECISION-MAKING

The process of organising decision-making

Let me first explain the relationship between 'the process of organising decision-making' and 'meta-metadecision-making'. As was discussed in Chapter 5.2 decision-making can be regarded as a control system. The decision-maker is then identified as the controller CR and the situation about which decisions are taken, that is, the situation which it is intended to change in a desired direction by means of the implementation of the decisions, is identified as the controlled system CS. In a broader sense the decision-maker no longer has to be restricted to a certain person, but can be any decision-making entity, that is, the decision-making process leading to a decision is identified as the controller. Or to put it in systems-theoretical terms, the decision-maker is not a single person, not even a single subsystem, but it can be a decision-making system consisting of a system of part systems. This latter system is identified as the controller. In Chapter 5.3 I have shown that concern with the structure of the decision-making process can never be the concern of decision-making itself. In control-system terms, the controller can exercise structural control on the controlled system, that is, can influence the structure of the controlled system. Influence on the structure of the controller itself can, however, not be exercised by that same controller. Control of the controller's structure must be a form of metacontrol. Structural control of the decision-making process, that is the organisation of decision-making, is a matter of metadecision-making. The output of this metadecision-making is a decision on the structure of the (object level) decision-

making process. The process of arriving at this metadecision, that is, the process of organising the decision-making, is the metadecision-making process. In the same sense as decision-making is not the single-stage choice of a decision, but a multi-stage dynamic process leading to a decision, metadecision-making is not a single-stage decision choice either. Metadecision-making is a process, too. Moreover, metadecision-making is not only a process, but has a multidimensional structure, consisting of subsystems and aspect systems in addition to the dynamic process aspects covered by the phase systems. It will be clear by now that the metasystemic approach of Chapter 5.3 also applies to the metadecision-making structure: the decision as to the structure of metadecision-making is a matter for meta-metadecision-making. Designing the process of organising decision-making is a meta-metalevel activity from a control-systems viewpoint, namely an activity of a meta-metacontroller¹.

We have now ended up with a four-level control-system configuration (see Figure 7.4). The object level controller CR represents

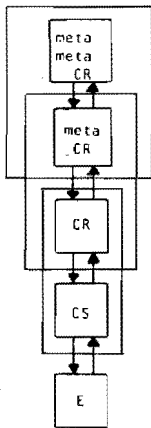


Fig. 7.4. Meta meta control system.

the decision-making process which results in decision outputs that are fed into the controlled system CS. The metalevel controller meta CR represents the metadecision-making whose output is a decision on the structure of the decision-making CR. The structure of the process of organising the CR structure, that is, the structure of the process ultimately leading to a decision on the CR structure, is in turn the output of a meta-metalevel controller. Notice that although Figure 7.4 represents everything in the form of single blocks, both the object level decision-making and the metalevel decision-making (and, of course, the meta-metalevel decision-making) are processes as has been illustrated in Figure 7.1.

Let me try to illustrate the foregoing considerations by means of a simple example. Consider the following hypothetical situation drawn from some hypothetical public administration. A certain public organisation takes decisions on, say, rural development. These decisions are implemented in some province, and

¹ Note that the control-systems viewpoint can also be used in a descriptive sense, namely in explaining the process of organising decision-making. The meta-meta control system framework can therefore be used not only to design the process of organising decision-making but also to explain that process.

lead to lots of implementation troubles which are evaluated and result in a revision of rural planning, and so on. In other words, the output of the decision-making, the decision, is the input to the controlled system, but CS also influences CR. Let us now look at the controller. As the organisation is situated in a certain democratic country, the decision-making procedure ultimately passes a certain council which democratically decides according to some majority vote rule. Let us, for the sake of simplicity, consider majority rule as the typical structure of the democratic decision process and now pass one level higher, namely to the metadecision-maker which once upon a time decided that the decision-making structure should be the majority vote rule. How did this hypothetical metadecision-maker - view a legislative body, such as a parliament - come to this particular decision? From what alternative democratic procedures did it choose (see e.g. Hanken and Reuver, 1977, Ch. 6)? Now let us consider the constraining structure of this metadecision-making to be the constraint that the decision-making should be democratic. This choice, however, is the decision of a hierarchically still superior meta-metadecision-maker. This still more hypothetical instance - consider the constitutional assembly during the French Revolution - chose between alternatives like democratic, plutocratic, oligarchic or autocratic decision-making. More realistic illustrations of the foregoing considerations will be presented in the case study dealt with in Chapter 8.

Why a meta meta approach?

The reader must now be wondering about the sense of this play with meta and meta-meta levels. So let us now consider the consequences of this conceptualisation.

First, the metasystemic approach has served the aim of clarifying the problem to be addressed. As we have seen in the introduction to this chapter, what was meant by the objection that the organisation of decision-making was not static but dynamic, was not clear. The conceptualisation has led to a clear distinction between 'the process of decision-making', 'the process of organising decision-making' and 'the process of organisational change of decision-making'. It has been shown that the conceptual framework of the previous chapter does account for 'the process of decision-making' and that 'the process of organisational change' can be explained by understanding 'the process of organising'. Consequently I have chosen 'the process of organising decision-making' as the central problem to address in this chapter.

Independence of level

Second, the metasystemic approach offers the great advantage

of independence of level, that is, the power to use the same conceptual considerations on different levels. One should not forget that such consideration, i.e. metacontrol of the object level controller, is purely the application of the two-level controller-controlled system configuration one level higher, that is the level of the metacontroller-meta controlled system. As has been remarked in Chapter 5.4, no matter at what level one works, one has to do with only two related levels at a time. Hence even a meta-metacontrol system consideration, essentially remains a CR-CS consideration, but at two levels higher. The whole control paradigm (de Leeuw, 1974) briefly presented in Chapter 5.2, remains applicable at whatever high level. As a result, the conceptual coordination framework presented in Chapter 6.3, also remains applicable because it was based on the two-level CR-CS considerations of the control paradigm. Remember that 'coordination' has been defined as 'the control of an interrelated system of part systems' which amounts to the general definition of 'control of a system' (Chapter 6.3.1).

This independence of level stems from the fact that the control system considerations are object-independent. As stipulated several times in Chapter 5, this object independence does not cause ambiguity, but results in a fruitful pluralism, that is, the ability to use the same framework from different points of view, or more specifically, from different levels of consideration.

Note furthermore that the definition of decomposition as the formation of part systems, is object-independent as well. In consequence the whole framework of decomposition and coordination, used in Chapter 6 as a framework for the organisation of object-level decision-making, is level-independent and can therefore also be used as a framework for the organisation of metalevel decision-making, that is, as a framework for the process of organising decision-making².

As in the case of the decision-making process, the process of organising decision-making can be represented as a sequence of part systems, that is, a sequence of sub-, aspect and phase systems. If we consider the participating individuals as the objects of that metadecision-making system, then the three-dimensional partitioning into sub-, aspect and phase systems can be reduced to the usual interpretation: 'who' is doing 'what' and 'when'? The process of organising in fact also consists of participating individuals, groups, departments, etc. - the sub-systems - , various issues will play a role in this organising process - the aspect systems - and finally the process will consist of several stages - the phase systems. So the same

² Note that consequently the conceptual framework for the organisation of decision-making from Chapter 6, takes into account the fact that organising is a process, so that the objection mentioned in the introduction to this chapter is overcome.

structure description can be used at this higher level, too. Quite naturally the organisation of this organising process will therefore also follow the two steps of 'formation of part systems' and 'coordination of those part systems', that is, it will find out who will participate, in what groups, what issues will be considered, and whether some issues can be combined, what steps must be taken, and which of these steps can be done simultaneously. In short, the process of organising decision-making is itself a decision-making process, and therefore the same theories apply to it. Object and metalevel of the conceptual framework are simply shifted one level higher: the metasystem now becomes object level and the meta-metasystem becomes metalevel. For the framework is object-independent. This will not be illustrated here but the reader is referred to the case study in Chapter 8.

Situational approach

Third, the two-level controller-controlled system consideration explicitly underlines that CR not only influences CS but that the controlled system CS also influences the controller CR, which is usually represented in system terms by the fact that the control action depends on the state of the controlled system. The previous remarks about the level-independence of the CR-CS conceptualisation should not be misunderstood. Both the concept of the controller and the concept of the controlled system are defined as object-independent, so that the CR-CS conceptualisation - the control paradigm - is independent of the level of consideration. The controller level is, however, definitely not independent of the controlled-system level. Consequently there will never be a theory of control which is independent of the system to be controlled. Only CS-dependent CR theories exist. The control system should always be considered as a whole, that is, as consisting of a CR and a CS.

Although these remarks might seem quite trivial, their consequence is surely not so. The statement that the controller depends on the controlled system, can be translated into the statement that decision-making is dependent on the situation. Or, to put it in terms recognisable to organisation scientists, a decision-making theory should be situational.

Hence a theory on the process of organising decision-making should also be situational. As we see, the situational approach is clearly implied in systems theory³.

Considerations, however, other than systems-theoretical also lead directly to the need for a situational approach. Remember that our emphasis on meta-metadecision-making resulted from the consideration that the organising of decision-making itself was also a process. One of the most evident reasons for saying that organi-

³ This implication obviously depends on the interpretation of the concept of situation. A systems-theoretic elaboration of this issue will be given in Chapter 7.2.

sing decision-making is a process and not a single-stage activity, is that one has to take account of the existing situation. The final organisational structure does not suddenly 'fall from heaven' but is the result of a troublesome process of adaptation and change of some existing situation. In short, the process of organising is situational. We therefore proceed with the elaboration of a specific kind of meta-metadecision-making, namely a situational theory on the structural mode of meta-metadecision-making, that is, a situational theory on the process of organising decision-making.

7.2. SITUATIONAL APPROACH TO ORGANISING DECISION-MAKING

Let me briefly recall the line of argument which has ended up with the situational approach. The objection to the conceptual framework for the organisation of decision-making developed in Chapter 6 was that it did not take into account that the organising of decision-making itself is a process, too. Organising is not a static single-stage activity but definitely incorporates dynamic aspects. Although at first sight one might wonder how the emphasis on the dynamic aspects of organising leads one to this situational approach, the line of argument becomes quite clear from a systems-theoretical point of view: the control of a system is a directed change of a system from some present situation towards a subsequent situation by means of a control action. So control is essentially situation-dependent. A less systems-theoretic line of argument is the following. The structure of a decision-making process does not fall from heaven, but is the result of a process of organising. Besides the demands for a desired structure, the existing one plays at least as important a role in this process of organising, that is, the process is situation-dependent. Another factor that influences the process is the influence of the environment on the process, that is, the external side effects, the organisational setting of the process, etc. We are obviously moving towards a systems-theoretical description of the process of organising in terms of the usual constituents: environment, control action, state, output, etc. My considerations relate to the situational approach, well known as 'contingency' theory. 'Contingency' theory explicitly purports to be an organisation theory which is situation-dependent. Contrary to classical organisation theory which formulated its organising principles with general validity, 'contingency' theory does not lead to generally 'best' organisational structures but to situationally dependent 'best' organisational structures. So at first sight one might think that the situational approach to organising decision-making already exists in the form of 'contingency' theory. In my view this is not the case. Let me therefore first pay some attention to the clarification of 'contingency' theory and to my comments upon it before proceeding with

the development of my own conceptual framework in a situational direction.

7.2.1. SOME COMMENTS ON CONTINGENCY THEORY

What is contingency theory?

The term 'contingency' introduced by Lawrence and Lorsch (1967) is a loose term open to a number of interpretations. The dictionary's meanings of the word - uncertainty of occurrence, thing dependent on an uncertain event, etc. (Concise Oxford Dictionary, 1964) - do not seem to adequately cover the contents of 'contingency' theory. Most authors implicitly or explicitly define 'contingency' theory as a theory on organisation where organisation is considered dependent on situational factors, whatever their definition of the term situation might be. It is therefore not surprising that the term 'situational' theory of organisations is coming more and more into vogue, especially in the non-Anglo-Saxon world (Staehle, 1973; Hill et al., 1976; Kieser and Kubicek, 1977).

Among various authors there seems to be a variety of interpretations of 'contingency' theory. Lawrence and Lorsch (1967) emphasize the dependence of organisation on various economic and market conditions. Pugh et al. (1964, 1968, 1969a, 1969b) talk about the relationship between organisational structure and contextual factors such as history, size, ownership, control, charter, technology, location, etc., and originally Pugh et al. (1964) intended to include group and individual levels of analysis of behaviour in organisations in their general analysis. Kast and Rosenzweig (1973) interpret 'contingency' theory as a study of the relationships within and among the subsystems of an organisation as well as between the organisation and its environment. According to Luthans (1976) contingency management is concerned with the functional relationships between environmental variables and management concepts and techniques. According to Child (1977) the contingency approach stresses that organisational structure design should be adapted to the operation situation. Moreover the conceptual bases - call them 'paradigms' - of various authors also vary: whereas Lawrence and Lorsch (1967) and Kast and Rosenzweig (1973) still more or less adopt the systems-theoretical 'paradigm', one sometimes gets the impression from the changes in book subtitles such as 'a systems approach' to book subtitles like 'a contingency approach', that contingency theory is considered a replacement for the systems 'paradigm', an opinion the present writer does not share, as will be shown in the following pages.

From these no doubt incomplete accounts of some interpretations of 'contingency' theory one might distill the emphasis on environmental dependence as a common interpretation. This seems, however different from my previous emphasis on the 'situatio-

nal' dependency. So why this other term? The reason is that it is clear from the massive amount of contingency research that organisational structure does not depend solely on environmental factors. Child (1972) distinguishes three particularly influential variables relevant to an explanation of variation in organisational structure. The first argument is environment, the second is technology and the third is size. Child (1972) calls them contextual factors. However, the context of a system, such as an organisation, is usually defined as its environment (de Zeeuw, 1977a). I therefore prefer to use a term which is explicitly not restricted to the environment concept, and I consider the term 'situation' broad enough to also embrace all the other influential factors.

The comments on contingency theory that I will make are based on its general definition as a theory of situation-dependent organisation. My comments namely focus on the two main constituents of this definition, that is, the concept of 'situation' and the concept of 'dependence'. I will start by clarifying the meaning of 'situation' and then proceed with the interpretation of 'dependence'. I will present a complete set of interpretations of 'situational dependence' and subsequently show what type of empirical research is needed for each of these interpretations. Finally this will be compared to the factual empirical contingency research. The difference between 'ist' and 'soll' will appear to be great. My comments will not touch upon much more general questions on the methodological status of contingency theory. The impression is sometimes gained that the contingency approach is meant as a new methodology of organisational science, but discussion of that will be avoided here, the more so as the factual contingency research using the traditional statistical correlation techniques, does not seem to involve any new methodology (for more general criticisms on contingency theory, see e.g. Moberg and Koch (1975) or Child (1973)).

The concept of situation

In contrast to classical organisation theory which formulated organisation principles possessing general validity, contingency theory does not offer generally 'best' organisation structures but only conditionally 'best' organisation structures. Contingency theory is a reaction to the 'one best way' approach in the 'it all depends' direction. In classical organisation science a theory had the form of a descriptive 'if, then' explanation (cause → effect) or of a prescriptive 'if, then' recommendation (action → effect). Both 'if, then' forms did have a general validity. The important inducement to set up situational 'contingency' theories was that scientists realised that

explanation and prescription could not be generally valid. Statements about how organisations are or should be structured can not be valid independently of the kind of organisation, the environment, etc. The effects are found to depend on more aspects and this 'more' has been called 'situation'. Prescription and explanation depend on the 'situation' the organisation happens to be in. In 'if, then' form this can be conceptualised in two different ways:

- (1) the prescription or explanation depends on the situation:
situation \rightarrow (action/cause \rightarrow effect);
- (2) the effect depends on the situation and the action/cause:
action/cause + situation \rightarrow effect.

In short, the effect depends on more simultaneous causes⁴. Point of departure is that the output depends on more different inputs, and that the 'more' is called 'situation'. So let us have a closer look at the term 'situation'.

An output depends on more inputs. Now call the manipulatable inputs the actions and the non-manipulatable inputs the 'situation'. In systems-theoretical terms this means that action corresponds with 'control action' and situation corresponds with 'environment' (see the definitions of de Leeuw, 1974, pg. 127). Indeed one often meets this interpretation of the situational approach. The motivation for a situational approach in this interpretation amounts to the well-known argument that the analysis of a problem in terms of a closed system has the great danger that unexplainable but above all undesired side effects will occur, caused by a not incorporated environment. It is therefore that the problem of the demarcation of system boundaries and the incorporation of 'context' (environment) in the analysis is of such great importance. For an extensive treatment of this problem see de Zeeuw, 1977a, 1979).

The concept of 'situation' can, however, no longer be identified with the concept of 'environment' if one notes that investigations into the influence of organisational technology, size, etc. on the organisation structure constitute an important part of the situational approach (Child, 1972). In this interpretation 'situation' apparently has a different meaning. The point of departure that the output depends on different inputs can no longer be interpreted by regarding situation as environment but by interpreting the concept of 'situation' as the system-theoretical concept of 'state'. The 'more' on which the output depends can therefore be regarded as 'environment' (x) and as 'state' (s) (Figure 7.5).

⁴ This formulation implies a causality assumption, as is indeed usual in the definition of a theory as a causal relationship. However, the causality of factual relationships are not usually open to proof, as, for example, in the case of statistical correlations. In order to avoid a discussion on causality (Stegmüller, 1969; Nagel, 1968) and different terms for prescription and description, I shall adopt the systems-theoretical terms output and input in a neutral meaning, that is, the relationship between both is a 'relation' in the mathematical sense and not in the functionalistic sense.

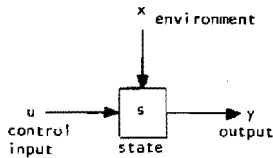


Fig. 7.5. Environment and state dependence of output. Black-box.

The argumentation for the situational approach is then different in view of the systems-theoretical definition of the state concept. De Leeuw (1974, pg. 122) defines the concept of state as the aggregated memory information on the inputs from time $t = -\infty$ to present time. The output depends on the history of the system, i.e. the system contains a memory and the concept of state is a measure of this dependence. Regarding both context and technology as situational factors can now be interpreted in systems-theoretical terms by introducing both the environment and the state concept. 'Situation' is then both 'environment' and 'state'. This leads us to the usual black box concept of a system (Figure 7.5). Thus interpreted, the situational approach implicitly assumes that some output (e.g. productivity) depends on some manipulatable control input (organisation structure), on non-manipulatable environmental inputs (context) and on the non-influenceable previous history (state).

A different system-theoretical interpretation of the situational approach is given by de Leeuw (1974, pg. 202). He identifies 'context' with the non-manipulatable external disturbances, 'technology' with the controlled system and 'organisation structure' with the controller. Contingency theory then corresponds to the trivial statement that there is an influence of the context properties (environment) on the controlled system (technology) and the controller (organisation structure).

Armed with these different possible systems-theoretical interpretations of 'contingency' theory let us now consider 'contingency' theory itself, restricting ourselves to two German, and hence 'gründliche' text-books (Hill et al., 1976; Kieser and Kubicek, 1977) which both present a systematic and comprehensive situational theory based on a thorough review of existing contingency literature. Both embrace most existing 'part' situational theories but are nevertheless essentially different. Kieser and Kubicek (1977) adopt the causal chain: situation \rightarrow organisation structure \rightarrow organisation members as their overall framework. 'Situation' is split up into two parts, namely an 'internal situation' which they define as the influenceable part and an 'external situation' defined as the non-influenceable part. So there is a clear analogy with the system concept of en-

vironment (external situation) but a less clear analogy with the concept of state (internal situation). Internal situation is further subdivided into 'momentary' and 'previous', and external situation into 'task specific' and 'general'. In view of the limitations of existing contingency literature they only treat the internal momentary situation (task program, size, technology, legal form) and external task specific situation (environment, competition, technological dynamics). The next causal link of the chain which they deal with is the influence of organisation structure on the members of the organisation. The intermediate variable in this link is the organisational role concept: organisation structure → role → behaviour of organisation members.

Hill, Fehlbaum and Ulrich (1976) adopt as their overall framework a mutual interaction between the entities goal, instrument and condition. 'Goal' is identified with the concepts of effectiveness and efficiency, 'instrument' is interpreted as the structuring of the organisation and 'condition' as the concept of 'situation'. 'Condition' is defined as non-manipulatable (only instruments are manipulatable) and non-pursuable (only goals are pursuable). The sum of all conditions is called the 'situation'. As we see, there is no clear analogy between their concept of situation and system concepts like environment or state. Note that the concept of 'condition' implies that the input-output (instrument-goal) relation as a whole is conditioned. Thus interpreted they apparently adopt the first of the above-mentioned 'if, then' forms of 'situation', namely: situation → (input → output). They divide the concept of situation into two parts, namely the properties of the tasks and the properties of organisation members. The former is further subdivided into environment and technology, the latter into job characteristics and socio-culture.

Apparently there are various possible interpretation of the concept of situation. The factual interpretations of the situational approach indeed appear to be quite different, if not conflicting and confusing. The writer has restricted himself to two highly systematical and comprehensive text-books on contingency theory. Of course many other interpretations exist as well and serve to increase the impression of vagueness and confusion still further.

Situational dependence

Let us now have a closer look at the second main constituent of contingency theory, the situational dependence. The general form of a theoretical statement is some relationship between two variables, here called input x and output y , and which can be denoted by $y = f(x)$, or $x \rightarrow y$. In classical organisation theory this was a statement about the best method of organising, that

is, the statement reads that some organisational structure x leads to an optimal result y . So the (control) input variable x is organisational structure and the output variable y (e.g. productivity) leads to some measure of effectivity or efficiency. As mentioned earlier, the fact that an input-output relationship depends on the situation can be interpreted in two different ways: either the whole relationship depends on the situation (situation \rightarrow (input \rightarrow output)) or the output depends on the input and the situation (situation + input \rightarrow output). In other words, the original classical form of organisation theory where output y was considered to be a function of some input with universal validity: $y = f(x)$, can be replaced by two kinds of situational theory: either $y = f_i(x)$ if z_i or $y = f(x,z)$, where y denotes the output, x the (control) input and z the situation. This difference in notation however vanishes if the conditional relationships are framed in discrete set-theoretical terms. Both interpretations then reduce to the same two-dimensional table. So what are the essential differences or is it merely a matter of notation? Instead of plunging into a philosophical or methodological discussion on causality, it may be preferable to indicate the essence of the argument on a more practical level, namely the differences in the implied research methods needed for the various situational approaches⁵. So let us have a closer look at the various interpretations of the situational approach.

The situational approach being an extension of a universal binary relationship (function): input \rightarrow output, with an additional influencing factor called 'situation', can essentially have three possible forms:

- a. situation \rightarrow input \rightarrow output;
- b. situation \rightarrow (input \rightarrow output);
- c. situation + input \rightarrow output.

These three together constitute all the possibilities of introducing an additional influencing factor to an already existing binary relationship, as will be clear from Figure 7.6, where y is the output, x the input and z the situation.

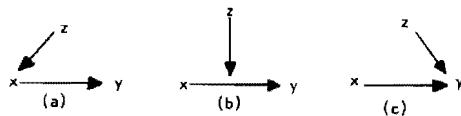


Fig. 7.6. Three forms of situational influence.

⁵ The writer is indebted to ir. J. Praagman for helpful and thorough discussions on this issue.

Figure 7.6 clearly indicates the meaning which should be attached to the above-mentioned three possible forms.

In the first form (Figure 7.6a) the situation influences the input which, in turn affects the output, or in terms of a mathematical function: $y = f(x)$ and $x = g(z)$ so that $y = f \cdot g(z)$. This form however does not seem to be a good interpretation of the situational approach, for here z does not influence y , but only x . The relationship between y and x is still universal and does not depend on input x or situation z in any other way. The output y depends either on the input x ($y = f(x)$) or on the situation z ($y = f \cdot g(z)$), but not on both together. The empirical research method that one should adopt to empirically test this form of situational influencing is to investigate the relationships between z and x and the relationships between x and y separately, by means of statistical correlation or regression techniques, for example.

The second form of situational influence (Figure 7.6b) is rather peculiar. The situation z does not influence any of the variables x or y but influences the relationships between x and y directly: $y = f_z(x)$. It has already been noted that this latter notation does not differ from the $y = f(x, z)$ notation in the discrete set-theoretical sense. Both can then be represented by a two-dimensional table indicating the resulting output values of y for all possible x, z combinations. Each $y = f_z(x)$ then yields one row (or column) of the table, namely the relationship between y and x for a particular z . All rows (or columns) together constitute the whole tabular representation of the discrete function $y = f(x, z)$. The empirical research method needed to test the influence of z on the relationship between y and x , however, differs decidedly from the usual bivariate statistical correlation or regression techniques. One should use the 'moderator variable' technique (Saunders, 1956; Ghiselli, 1963; Zedeck, 1971). Roughly speaking, the technique is to split up z into certain classes and investigate the relationships between x and y for those particular classes, for example by means of the usual correlation techniques. If the correlation coefficients for those classes differ significantly, there is an influence of z on the relationship.

The third form of situational influence (Figure 7.6c) represents the usual case of a variable y which depends on two other variables x and z : $y = f(x, z)$. Note that this dual influence can be divided into two possible forms, namely a noninteractive dual influence (Figure 7.7a) and an interactive dual influence ⁶ (Fi-

⁶ The influence of x and z on y is non interactive if the partial derivatives of y to x and to z are independent of z and x , respectively.

figure 7.7b). In a linear case the interactive relationship might take the form

$$y = a_0 + a_1x + a_2z + a_3xz$$

and the noninteractive relationship might assume the additive form $y = b_0 + b_1x$

+ b_2z . Note that in this

latter interpretation the situation does not affect the relationship between x

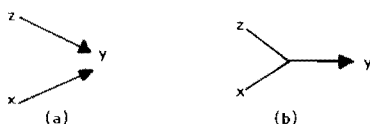


Fig. 7.7. Interactive and non-interactive dual influence.

and y : it is represented by the linear regression coefficient b_1 which is independent of z . In general, it is indeed possible that the relation $x + y$ does not depend on z whereas y does. The empirical research techniques for testing a multivariate relationship $y = f(x, z)$ are well known. In case of linearity, multiple correlation and the usual regression techniques can be used.

Empirical contingency research

It is, however, astonishing to note what the factual empirical 'contingency' research amounts to. The comprehensive survey of existing empirical contingency findings of Kieser and Kubicek (1977) reveals an abundance of studies on the correlation between situational variables, such as production program, organisational size, production technology, information technology, legal form, ownership, environment, etc., and organisational-structural variables, such as specialisation, coordination, configuration, formalisation, delegation, etc. An example of such a systematic study of the correlation between situational variables and structural variables is the series by Pugh et al. (1964, 1968, 1969a, 1969b). However, it is hard to find investigations of a situational influence on some input-output relationship ($z \rightarrow (x + y)$), neither are studies on the multivariable interpretation ($z + x \rightarrow y$) to be found. Almost all empirical research is confined to a study of the relationship between situation and some organisational variable. This kind of relationship takes the $z \rightarrow x$ form however. The organisation structure variables such as specialisation and coordination, constitute the control input variables of the input-output relationship. The output variables are those which indicate the effects of the structural measures, and only these effects can be evaluated according to some measures for effectivity and efficiency for instance. An organisational structure is not a goal, it is a means to obtain some desired effect, such as increased productivity or increase of satisfaction, to name but two. Therefore structural variables constitute the input variable x to the $y = f(x)$ relationship. In short, we can conclude that almost all empiri-

cal contingency studies therefore appear to investigate the $z \rightarrow x$ relationship only. Kieser and Kubicek (1977) do not even consider a possible relationship between structure (x) and effects (y) whereas Hill et al. (1976) at least do consider this $x \rightarrow y$ relationship as well. Hill et al. (1976) however still investigate the $z \rightarrow x$ and $x \rightarrow y$ relationships separately, so that in fact they implicitly work along the $z \rightarrow x \rightarrow y$ interpretation of the situational approach (Figure 7.6a). I have shown that this interpretation is in fact a questionable interpretation of the situational approach.

Let us try to discover under what conditions contingency researchers are indeed permitted only to consider the $z \rightarrow x$ relationship in their approach to the problem.

Empirical situational research should in general consist of a set of data about the three variables situation z , input x (structure) and output y (effect) arranged in a table which indicates what situational value, together with what structural value, resulted in what effect, i.e. a tabular representation of the multivariable relationship $y = f(x,z)$. Data are gathered from a group of companies about their situation, their structure and the resulting effects. This is a description of the situational pattern. The aim of the research is to find out what structure x has to be chosen in what situation z in order to obtain an optimal effect y , that is, the descriptive pattern is used as a tool for prescription. The researcher has to decide what kind of output is desired - he has to establish a goal on the output space - and with this desired value of y he can simply trace in the $y = f(x,z)$ table, which (x,z) combination yields the favourable result; that is, the researcher will end up with a prescriptive list which tells him what structure x he has to choose in what situation z . In short, the table of $y = f(x,z)$, together with a desired y , will result in a list of 'good' (x,z) combinations.

A restricted form of this procedure is to restrict the data on the output variable to a binary good/wrong form. This leads to a division of the $y = f(x,z)$ table into a set of (x,z) combinations which yield favourable effects ($f(x,z) = 1$) and a set of (x,z) combinations which yield bad effects ($f(x,z) = 0$). The first descriptive set of favourable (x,z) combinations can now directly be transformed into a prescriptive list indicating what structure x should be chosen in what situation z .

So a still further reduction of this empirical research procedure is to gather data only from that subset of companies which yielded favourable results, that is, only gather data about situational values and structural values which led to good results (the $f(x,z) = 1$ table).

Hence the conditions on which a mere investigation of the $z \rightarrow x$ is permitted are the following: only on the assumption that the investigated companies had favourable results and on condition

that these companies were rational, that is, aimed at optimal results by means of structural measures, can a mere list of observed situation-structure combinations make any sense at all. As I have noted, this is what actually happens in contingency research.

There is, however, a serious objection to this very restricted form of data gathering and empirical research. The objection stems from the very important problem as to the relationship between description and prescription. As has been said in Chapter 2.1, a description per se is not enough to form the basis for prescription. Officially the description should have the methodological status of an empirical law before one is permitted to deduce prescriptions from it. Of course, this is almost always impossible. The description should however possess as great a validity as possible, in other words, it should be confirmed as far as possible. Confirmation however is methodologically impossible (Popper, 1959). The only form of confirmation is the rejection of a falsification. Therefore confirmation of the fact that a set of situation/structure combinations yields good effects however has to be arrived at via rejection of its falsification. And the falsification of a logical implication, if p, then q can only be given by showing that p implies not q⁷. This means that in order to confirm the goodness of a set of (x,z) combinations one should search for companies that yield bad results with these (x,z) combinations. Only the rejection of that falsification probe suffices to confirm the goodness of the set of (x,z) combinations. A gathering of favourable (x,z) data alone is not sufficient.

Conclusions

Summarising, one could say it is no exaggeration to conclude that 'contingency' theory has quite an amount of conceptual vagueness. A clear definition of what situation means exactly is mostly lacking, let alone a consistent definition. The contingency theory school in stead of replacing the systems theory school, would do better to borrow some conceptual clarity from systems theory.

Second, it has been shown that trying to reconstruct the implied essences of contingency theory from its factual empirical research, only adds to the queries. Although at first sight it might seem quite evident why the correlation between situational variables and structural variables is investigated, a second look reveals that this kind of empirical contingency research is rather dubious.

⁷ This is evident from the truth table of logical implication.

7.2.2. TOWARDS A SITUATIONAL THEORY

As I have repeatedly pointed out, the rationale for developing the conceptual framework on the organisation of decision-making in a situational direction, is that this organisation is itself a process. The organising of decision-making is not a single-stage action but a process of actions: one which starts from some present situation and via some action in a desired direction, results in a next situation. This formulation of the process of organising clearly corresponds to the dynamic representation of a system with memory, where a control input leads via a change in present state (aggregated previous history) to a next state. The state concept has been invented precisely to cope with systems that are not independent of previous history, i.e. not memoryless. Adding the concept of environment to the state concept completes the systems-theoretical framework in which 'situation' is conceptualised by means of the concept of environment and state, thus completing the black box with its control inputs and outputs (see Figure 7.5). Remember that I have defined coordination very generally as the control of a system (Chapter 6.3.1), so that this definition is very suitable to be developed in the above-mentioned 'situational' direction of environmental and state dependence. Note, moreover, that in Chapter 7.1 it was shown that my concepts about the organisation of decision-making, i.e. decomposition and coordination, were level-independent and could therefore be used as well at the level of the process of organising decision-making, that is, the metadecision-making process.

It will be clear from the discussion on contingency theory in Chapter 7.2.1 that the author prefers to develop the conceptual framework in a situational direction rather than link up with the existing contingency theories and derive situational concepts from them. As has already been mentioned, even very systematical versions of contingency approaches, such as the comprehensive ones of Kieser and Kubicek (1977) and Hill et al. (1976) lack an underlying systematical theory from which all concepts can be systematically and consistently derived. In contingency literature, structure is defined by a set of operational variables which are generated purely pragmatically via statistical techniques as being significant, that is, more or less without theory and surely not deduced from a theory (see e.g. Pugh et al., 1964)⁸. Of course, the variables might be related to some conceptual framework like mine, and it indeed seems that most of them (specialisation, standardisation, formalisation, centralisation, confi-

⁸ Unless one calls a set of operational variables plus correlations between these variables a 'theory', which I don't (Koningsveld, 1976).

guration, flexibility) can be related to some of my types of coordination. Nevertheless the set possesses neither theoretical consistency nor completeness, even when translated into some conceptual framework. Therefore the approach in which situational variables are deduced from the existing contingency theories will not be followed.

As mentioned before, my conceptual framework of the organisation of organisational decision-making serves very well as a starting point for a situational extension. The framework is explicitly formulated in terms of control systems, so that situational concepts, such as state and environment or the other situational interpretations which were discussed in Chapter 7.2.1., evidently fit in very well. In fact this is a tautology: of course a systems-theoretical approach fits into a systems-theoretical interpretation of the situational approach. Moreover, in my opinion the situational approach is already implicitly and often even explicitly embedded in the conceptual framework on coordination. My framework is constructed from types of systems of goals and types of structures with the corresponding types of methods to change those situations. I have sketched types of situations - as to goals and as to structures - plus the corresponding methods of changing those situations. In the case of goal coordination I have even explicitly coupled the methods to the situations, in the case of structural coordination this coupling was indeed not explicit. So the bases for a situational approach are already present. Let us then start to develop a situational theory on organising decision-making. Evidently we have to begin by determining 'the situation of decision-making'.

The situation of decision-making

The process of organising decision-making should be considered as a change, dependent on some present situation, into some next situation, in which situation should not only encompass the state concept (memory of aggregated information about previous history), but also that of environment (context). So, first of all we have to analyse the situation the decision-making system is in.

In order to justify the need for a change, the present situation should be unsatisfactory. When is a situation unsatisfactory? To answer this one has to define what a situation of a decision-making system is, in other words, one has to indicate a consistent and complete set of variables which determine the 'situation' of a decision-making system. The usual representation of the situation of a system is by its present state, its action input, its structure and its environmental input (black box of Figure 7.5). We are, however, not looking at systems per se but at a decision-making system, which was represented throughout this

book as a control system, this being a combination of an environment, a controlled system and a controller. Actually we are looking at the organisation of decision-making, which has been identified in Chapter 5 as a property of the controller. A situational approach to the organisation of a controller would therefore need a definition of the situation of the controller and not of the controlled system, such as, for instance, the black-box representation⁹. Hence, strictly speaking, one would have to define 'situation' by the characteristics of the controller only. As I consider a control system as an interrelated composition of controller, controlled system and environment, I will not reduce the definition of 'situation' to the controller characteristics only, but include in that definition the characteristics of all three components. Thus we have to add the representation of the decision-maker, i.e. the controller, and the representation of the environment to our concept of 'situation'. Clearly the key issue now becomes what representation to choose. As to the environment I chose a representation analogous to that of the controlled system. The reason for this is that in control-systems terms the environment not only influences the controlled system, but can itself also be the object of control, the so-called 'external' mode of control (see Chapter 5.2). Because the whole theory about possible modes of control of the controlled system - the control paradigm of de Leeuw (1974) - was based on the black-box representation of that system, it seems appropriate to use the same representation for the control of the environmental system also, so that the same theory also applies to 'external' control.

As to the representation of the decision-making process, i.e. the controller, the typical controller characteristics are chosen. According to 'the conditions for effective control' (Kramer, 1978) a controller should possess a goal¹⁰, a model of the controlled system (in the case of external control a model of the environment), information about the state of the controlled system and the environmental state, and sufficient control variety (Ashby, 1956). Actually these characteristics nearly coincide with the classical representation of a decision-maker (the homo-economicus model discussed in Chapter 3.1): decision action set, system state set, model of the controlled system, decision rule and goal. I chose this latter representation.

The complete representation of the situation of a decision-making system is shown in Figure 7.8.

⁹ Unless one interprets the controller in an 'instrumental' way (Hanken and Reuver, 1977, pg.75) in which case the controller is likewise represented as a black box. I however prefer a 'normative' representation of the controller.

¹⁰ As has been discussed in Chapter 3.2, an evaluation mechanism instead of a goal, will be sufficient.

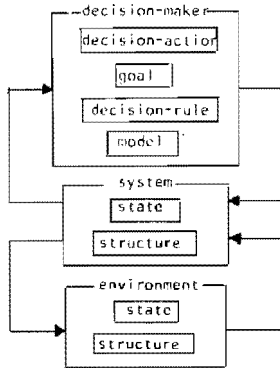


Fig. 7.8. Situation of a decision-making system.

There is one more addition that has to be made. The configuration of Figure 7.8 applies to a single control system whereas, the organisation of decision-making applies to a system of interrelated part systems, so that an extra characteristic has to be added, namely the relationships between the coordinated part-systems. As indicated in Chapter 6.4.1 these coordinated systems might themselves be regarded as control systems compounded out of controllers and controlled systems. In that case the relationships between the coordinated systems should be distinguished as the relationships between the controllers and those between the controlled systems. Stated briefly, the consistent and complete set of variables defining the 'situation' of a decision-making system is:

1. (controller) model, goal, decision rule, action, state;
2. (controlled system) structure, action, state;
3. (environment) structure, state;
4. (structure) relationships between part systems (possibly dual).

Note that the same control action and system state appear twice and that the model incorporated in the controller is a model of the system structure and hence assumedly an isomorphy of it. Note furthermore that the decision rule seems redundant beside the goal concept. The importance of a decision rule however is not only revealed in single decision-maker situations (maximising, satisficing, etc.) but primarily in multidecision-maker situations (minimax, maximin, majority rule, etc.).

Situational changes

The need for an organisational change in this system should follow from the fact that the situation is unsatisfactory. In what sense can the system situations be unsatisfactory from an organisational viewpoint?

First of all there can be a difference in goals leading to different, divergent part system behaviours. Because a goal is defined as a preference ordering over a set of alternatives A represented by a value function $V(a)$, $a \in A$, a difference in goals V_1 and V_2 can mean

- that the value functions V_1 and V_2 apply to different sets of alternatives (which may or may not be partially overlapping);
- that different value functions V_1 and V_2 apply to the same set of alternatives.

The latter type of goal conflict can further be specified to the special case where both value functions are completely opposite (null-sum, pure conflict). A measure for the goal difference in the latter case might also be a tripartition into ¹¹:

- emptiness. There is no consensus on whatever alternative: no possible alternative;
- uniqueness. There is consensus on one alternative only: one possible alternative;
- ambiguity. There is consensus on various alternatives: more possible alternatives.

Secondly there can be a difference in the modelling of the same system. Different controllers can have a different model of the same controlled system, that is, they may have a different perception of the same situation.

The set of possible alternative courses of action can be unsatisfactory or various sets can be conflicting (compare to first type of goal difference).

The state the system is in might be unsatisfactory.

The internal structure of the part systems, i.e. the set of relationships between them might be unsatisfactory.

The environmental state and structure might be unsatisfactory.

From this enumeration of possible classes of unsatisfactory situations, the obvious thing is to propose a classification of possible changes in the unsatisfactory situation:

- change the goals (goal coordination);
- change the models (change of perceptions);
- change the possible courses of action (development of alternatives);
- change the states (routine control);
- change the internal structures (structural coordination);
- change the interdependences between the part systems (structu-

¹¹ This tripartition was suggested by Prof.dr. A.F.G. Hanken.

- ral coordination);
 - change the environment (external control).

I will not perform the exercise to illustrate all these different modes of situational organisation measures by means of 'practical examples'. Such examples can be found in Mulder (1978) or Baumgartner et al. (1975).

Organisational change, however, does not only depend on the situation the organisation happens to be in and the applied organisational measure. If this was true it would be unexplainable why so many unsatisfactory situations are never changed or why so many changes fail. Obviously certain factors concerning the change itself also play an important role, one of the best known factors of course being the 'resistance to change'. The importance of these additional change factors can easily be derived from systems-theoretical considerations. Consider the usual black-box with its control input u , environmental input x , internal state s and output y (see Figure 7.5 in Chapter 7.2.1). Assume that the output is identical to the state. Now if a certain state (output) is unsatisfactory, some control input u will be applied to obtain a desired state. That change will, however, not only depend on the preference ordering over the possible states but also on the costs of the control inputs. The 'goal' of the system should not be restricted to a preference ordering over outputs only. The preference ordering should include all relevant system variables, including the inputs (see the discussion on the goal concept in Chapter 4.1). The costs of the inputs also determine the desirability of some system change. The 'costs of change' are composed of both the utilities (inverse costs) of the states and the costs of the inputs. Therefore organisational change will not only depend on the desirability of certain situations and the availability of certain organisational measures but also on the costs of these measures. Organisational change will depend on the 'costs of change'. Remark that these costs also include the costs of environmental inputs. As we will see in the case study of Chapter 8 it is not only the costs of organisational measures that count but also the costs of the environmental setting; changing a system in a certain environment changes the environmental inputs and costs.

Underlying systematics

It will be clear that I am primarily interested in the underlying systematics of this situational approach. Remember that it was the very absence of underlying systematics in contingency theory that induced me to develop this situational approach. Let me start by emphasising that the framework of a situational theory of organisation of decision-making which was sketched on the previous few pages, is not only a first preliminary attempt in view of its shortness but is also one possible approach out

of many alternative possibilities. As one can observe, this classification of situational organisational change modes differs from the one presented in Chapter 6. Of course this is not surprising as it was developed from different underlying systematics. Let us therefore consider some alternative underlying systematics, their relationships and the reasons for a particular choice.

In order to develop a situational theory of organising decision-making one has to start by defining the 'situation' of a decision-making system. A possible definition of the situation of a decision-making system is the one represented in Figure 7.8 which consists of the key characteristics of controller, controlled system, environment and part-systems structure. Another possible approach is to define the situation of a decision-making system according to the three-dimensional model of sub-, aspect and phase systems. Situational changes would then be classified into subsystem changes, aspect system changes and phase system changes. The disadvantage of this approach, however, is that it lacks a relationship between decision-making, i.e. the controller, and the controlled system. The three-dimensional model applies to a certain system at one level and not to a composition of three systems at three levels, that is, the controller, controlled system and environment composition. From a control-systems viewpoint this approach is therefore inappropriate, which is why I did not choose it here.

A third possible approach which comes near to the first one, is to start directly from the control paradigm of de Leeuw (1974). Essentially, this paradigm consists of two steps: first consider the problem as a control-system configuration (which was also done in the approach in Fig. 7.8). Then distinguish possible control modes, namely goal control, structural control and routine control, corresponding to the different kinds of influence that the controller can have on the controlled system (or the environment). Essentially, this tripartition of control modes is based on the various constituent elements of the controlled system, that is input, structure and goal of the control system. The conceptual framework underlying the situational approach presented in Chapter 7.2.2 however was the consistent and complete set of variables constituting the 'situation' of a control system, that is, the set of variables which represent the controller, the controlled system, the environment and the relationships. Together these variables form a complete model of the whole system. A classification of the possible modes of coordinative control action was derived in accordance with all these constituent elements. The essential difference between this classification of control actions and de Leeuw's classification of control actions is that some alternative control options are derived from the constituent elements of the controller itself and not only from the constituent elements of the controlled sys-

tem and the environment, to which de Leeuw (1974) restricts himself. It therefore in principle offers a more extensive classification. Note, however, that the additional control modes derived from the controller's characteristics are the model control mode, the goal control mode and the decision-rule control mode, the second of which also appears in the control paradigm and the third can be considered as a structural metacontrol mode of the controller. So the only essential addition in the classification of this section is the explicit mention of a possible change in perception (model).

7.3. CONCLUSIONS AND DISCUSSION

In this chapter the process of organising decision-making has been considered from several viewpoints.

It has been considered to begin with from a rather general viewpoint of meta-metadecision-making, that is, the decision-making about the organisation of decision-making. This consideration from the meta-metasytemic viewpoint served several ends. First it served as a clarifying tool in order to designate precisely what was meant by a dynamic view on the organisation of decision-making. Second it revealed that the conceptual framework of the organisation of decision-making developed in Chapter 6 could be used at this higher level as well because of its level-independence. So the decomposition and coordination framework in Chapter 6 can also be applied to structure the process of organising decision-making.

Second, the process of organising decision-making has been considered from a situational viewpoint, that is, the organisational structure of a decision-making process was considered to be the result of a certain change in a beginning situation in a desired direction towards a next situation. In other words, the main rationale for the fact that organising decision-making is a process itself, was sought in its situational dependence. Because of the strong analogy to the contingency approach, this latter approach has been considered first. The conclusion of that critical consideration was that contingency theory was conceptually too vague to be used as a basis for a situational theory on the process of organising decision-making. A conceptual framework for such a situational theory has been developed on the basis of a control-systems point of view. Finally, the ins and outs and, in particular, the pros and cons of that situational framework have been discussed. It turned out that the proposed framework was very similar to alternative control-systems approaches.

In short it can be said that both the meta-metasytemic approach and the control-systemic situational approach to the process of organising decision-making offer a broad, clear and consistent

framework. Of course there is still a long way to go before this framework can be transformed into a practically applicable theory on how exactly to organise a certain decision-making process in a certain situation. Some indications of its fruitfulness will be given in the case study dealt with in Chapter 8.

Although the introduction of this chapter was planned as a criticism on the conceptual framework of the organisation of decision-making dealt with in Chapter 6, it can now be concluded that most of the contributions of Chapter 7 were already implicitly but in most cases explicitly contained in the former framework. The meta-metasytemic approach revealed that the same framework could also be applied to the process of organising decision-making and the control-systemic situational framework discussed in Chapter 7.2.2 turned out to be strongly similar to the 'control-paradigmatic' approach in Chapter 6. Both frameworks are not so much opposing or complementary but a logical continuation of each other. The former framework is a control-systemic approach to the organisation of decision-making, the latter is a similar control-systemic approach to the process of organising decision-making.

Let us end this chapter with some queries.

Is the situational approach dynamic?

In Chapter 7.1 the situational approach has been presented as a logical consequence of the control-systemic approach. The control system consists of three mutually interacting subsystems, the controller, the controlled system and the environment, which means that there is not only influence from the controller but also influence on the controller. Control is state- and environment-dependent. And that is how the situational approach has been defined. Hence the situational approach is a logical consequence of the control-systemic approach of the process of organising decision-making.

On the other hand, the situational approach essentially consists of the viewpoint that some existing situation will be influenced by some directed change into some next situation. The process of organising decision-making is therefore reduced to a single state-action-next state step. In this sense the situational approach is no longer a process approach but a single-stage-change approach. Although a single change is still a change and therefore meets the definition of the concept of process, it seems however a drastic reduction of the concept of process. The process of organising decision-making clearly consists of a number of steps. The obvious answer to this objection is that the multi-stage process consists of many state-action-next state stages, so that the situational viewpoint still applies. Nevertheless it should be noted that from the dynamic system viewpoint adopted

this might very well be true, except that the elaboration of the situational approach in the so-called contingency theory contradicts this multi-stage viewpoint. Contingency theory replaces the classical 'one best way' of organising by a 'conditional best way': in a certain situation a certain organisational structure will be best. Contingency theory does not indicate the process of arriving at this conditionally best organisation. It still considers organising as a static activity, albeit a situational activity.

Although in general the situational approach is dynamic from the systems-theoretical viewpoint, one should be careful not to let the approach degenerate to a single-stage consideration.

Is the situational approach adequate?

The situational approach described in this chapter was pictured as a logical consequence of the control-systemic approach of the process of organising decision-making. Situational dependence of the organisation of decision-making was represented in the usual system terms as a state and environmental dependence. In view of the generality of systems-theoretical concepts it is quite probable that this interpretation of the situational approach is sufficiently general to cope with all kinds of influential factors. Furthermore, the comprehensive definition of situation in Chapter 7.2.2 as the set of all characteristics of a decision-making system ensures its generality. Nevertheless one might doubt whether some situational influence has been dealt with by simply classifying it in one of our characteristics of a decision-making system. Let us take some arbitrary examples of factors which might influence the organisation of decision-making: previous history, costs of change, organisational setting. These factors can be classified as the characteristics of a situation as presented in Chapter 7.2.2. Previous history is almost per definition a factor which coincides with the concept of state. Organisational setting is either an environmental factor or a factor which denotes the influence of the organisational relations of the decision-making system with its surrounding organisational systems. It then denotes the factor 'relationships between part systems'. So actually it seems that the situational approach is indeed capable of coping with all kinds of influential factors.

Two objections can be made to that conclusion.

First it is clear that the situational approach is a specific approach, that is, a specification of the more general description of the process of organising decision-making as a meta-meta-decision-making problem. As has already been gathered, this approach is based on some specific underlying systematics. Other systematics exist as well, so that this approach can surely not be claimed to be the only one. The claim that it is the best one depends on the fruitfulness of the approach, which leads us to

the second point.

Second, it should be emphasised again and again that the fruitfulness of a conceptual approach lies in its fertility as a starting point for the development of a theory. It is not the ability to classify but the ability to deduce a theory from it, which forms its fruitfulness. And it is quite obvious that in order to develop a theory, that is, in order to disaggregate my conceptual framework, consisting of an abstract and empirically void system of concepts, towards an empirically meaningful theory, empirical reality should be added. However, this does not come from the control-systemic conceptual framework, which is why the situational framework in this sense is inadequate. The empirical complement should come from the particular field under consideration. A preliminary step in that direction will be made in the case study considered in the next chapter.

Of course one might now remark that the practical fruitfulness of contingency theory is greater by far than that of the conceptual framework of this chapter. As I have clearly shown, however, contingency theory is conceptually quite vague, to put it mildly. In a situational theory on the organisation of decision-making, concepts like organisation, situation, etc. have first to be clarified. In order to determine a system of relationships between concepts the concepts themselves should first be clear, and the network of concepts should be consistent.

CHAPTER EIGHT

ORGANISATION OF DECISION-MAKING IN PRACTICE

Decision-making on numerus fixus at Dutch universities - a case study

The case study presented here serves as a practical illustration of the conceptual framework introduced in the three preceding chapters of Part Three of this book. Let me first of all specify what exactly is meant by 'practical illustrations'.

Practical illustration

The 'practical illustrations' are actual examples taken from practice. As stated in Chapter 2, I have chosen the case-study method as the adequate empirical research method in the stage of our conceptual theory formation. At this stage of conceptual guidance for ill-structured problems, empirical reality does not play a predominant test role but rather an inductive discovery role. The case-study method is particularly suitable here as it usually results in an abundance of conceptual insights. And this was in fact what happened in the present instance. However, this chapter will not be a description of the troublesome path of the author's progress, but the case study being used purely as an illustration of the conceptual framework in its weak deductive test role, in other words, a weak form of empirical confirmation. Apart from this there is another kind of 'weakness' of the illustrations that should be remarked on. The illustrations are interpretations of 'reality' as seen through the filter of the conceptual framework and, as such, suffer from the additional 'weakness' of being ex post rational reconstructions. An ex post rational reconstruction, usually considered an abuse of rationality as an explanatory tool, is in fact no abuse at all. Let us not forget the observations in Chapter 4.2 on the explanatory use of the goal concept. It was shown there that a goal is no intrinsic property of any person, organisation or system, but a theoretical concept attributed to the particular system in order to explain its behaviour. As a result a researcher who explains some behaviour or other by means of some goal, does not have to prove empirically that the system has that goal. Any rational explanation is a rational reconstruction. The objection that the illustrations seen through the filter of the control-systemic frame-

work, which in fact uses the goal concept, are 'weak' in the sense that they are interpretative reconstructions rather than 'real' explanations, is therefore fundamentally erroneous.

The illustrations will be practical in another sense, too. The conceptual framework will be applied to the case study not only in an explanatory but also in a prescriptive sense. The practical relevance of the framework will also be illustrated by reference to the importance of its role in the design of the decision-making process. For the framework is an example of an intentional, rational pattern of explanation. Its very basis is the intentional assumption of the 'control paradigm' of de Leeuw (1974) that each phenomenon can be regarded as a control system. Moreover, control is defined as 'any form of directed influence'; a direction must be derived from a goal, so that the control viewpoint implies a goal. It has been shown in Chapter 2.1 that an intentional, rational model can easily be used as a prescriptive tool.

The case study

The case study will serve as an illustration of the conceptual framework proposed in the previous three chapters, that is, the conceptual framework of metadecision-making (Chapter 5), of the organisation of decision-making (Chapter 6) and of the process of organising decision-making (Chapter 7). This chapter has been divided up accordingly. We start with a consideration of the factual controlled system, that is, with object-level decision-making (Chapter 8.1). We then proceed to metadecision-making, that is, the organisation of the decision-making (Chapter 8.2). Subsequently meta-metadecision-making is treated, that is, the process of organising decision-making (Chapter 8.3).

Two data-gathering techniques, document analysis and interviews, have been used. After an introductory document analysis for which I have mainly used the files of the Academic Council, I have completed the study with a number of interviews with the persons concerned in Universities, the Academic Council and the Department of Education¹, often supplied with a specific document analysis.

¹ The following persons have been interviewed. Ministry of Education and Science: mr. C.H. van Norden, mr. J. Thoof, drs. A. v.d. Berge. Academic Council: drs. J. Havik, mr. A. Hazewinkel. Planning department of Universities: drs. J.J. Smit (Leiden), drs. W.J. Koning (Utrecht), ir. R. Brons and drs. M. van Hulsel (Nijmegen), drs. A. Grotenhuis (Amsterdam), ir. R. Zijlstra (Free University of Amsterdam), ir. E.M.F. Butter (Eindhoven). Biology: dr. A.C. de Roon (Utrecht). Literature: dr. H. Pinkster (Amsterdam), prof.dr. C.M.J. Sicking (Leiden). Medicine: prof.dr. M.T. Jansen (Utrecht), ir. A. Besteman (Leiden).

As far as I know there have hitherto been very few studies of the numerus fixus decision-making, namely two discussion reports from Leiden University in 1973², which primarily dealt with fundamental problems, the yearly evaluation reports of the Capacity Commission of the Academic Council³, a sociological study into decision-making on numeri fixi in the University Councils of Leiden, Utrecht and Amsterdam⁴, and an unpublished study by the Ministry of Education and Science at the end of 1976.

Let me briefly sketch the course of events leading to the decision-making process that has been studied.

History

Although individual freedom of choice of study has never been legally laid down, in the past it formed the factual basis of the admission policy for Dutch universities. Since 1960 the growth in the number of students has however risen from some 5% to about 10% per year. The related increase in costs was no less explosive (see Table 8.1). In view of the national financial priorities

Table 8.1. Increase 1970 compared to 1965.

students	59%
total staff	47%
scientific staff	54%
total costs	123%
personnel costs	143%
investments	83%

this increase in costs was not considered desirable. Officially the unrestricted freedom of choice in study came to an end in 1972 with the approval of the 'Machtigingswet inschrijving studenten' by Parliament⁵. Admission policy had, however, already changed in that the freedom of choice of the place

of study was restricted. The first admission committee was set up in 1960 for dentistry. Medicine followed in 1964, biology in 1968 and psychology in 1971. The first proposal to regulate not only the place of study but also the maximum number of matriculations was made in medicine and resulted in a Bill for numerus clausus in medicine in 1968⁶. It was not accepted by Parliament because of the fundamental opposition to any restriction of

² R.J. in 't Veld: Principia toelatingsbeleid, nota RU Leiden, February 1973. Witboek toelatingsbeleid, discussienota, RU Leiden, October 1973.

³ Evaluatie machtigingswet inschrijving studenten, report Commissie Capaciteitsproblematiek, Academische Raad, September 1976. Idem, November 1977.

⁴ C. de Rooi: Simulatie Universitair bestuur, Dept. of Sociology, RU Utrecht, August 1976. F.P. Gout: Numerus Fixus in Leiden, idem, October 1977. T. Veerman: Numerus fixus in Amsterdam, idem, October 1977.

⁵ Law of 6th July, 1972. Staatsblad 355.

⁶ Bill nr. 8508, session of Parliament, 1965-1966.

the freedom of choice of study. Notwithstanding the foundation of new medicine faculties, the number of matriculations could not be coped with, so that another Bill was proposed in 1969. As this consisted only of waiting lists for the second year, so that freedom of choice was not affected, it was passed and became law⁷. The further increase in the number of students induced various universities to take their own measures, such as first-year waiting lists. These measures were declared illegal in 1971 by the minister. In 1972 the minister proposed a Bill for the admission of students which was passed after he threatened to resign⁵. The law was regarded as a temporary, emergency measure, emphasised by its restriction to a period of two years. Every proposal in later changes and prolongations of the law affecting its temporary and emergency character by introducing permanent elements was rejected by Parliament. In principle there is still freedom of choice of study. However, the law also still exists.

The decision-making on the admission of students takes place yearly. In this case study the process has been studied up to and including the decision for admission to the academic year 1977-1978⁸.

8.1. OBJECT-LEVEL DECISION-MAKING: ADMISSION OF STUDENTS

The law of 6th July 1972 restricts the admission of students to Dutch universities. Where the number of intending students threatens to be too high for the available capacity, the Minister can take restrictive measures. Depending on the comparison between the available university capacity and the estimate of expected students, he has three alternatives:

1. not to restrict admission;
2. to restrict the freedom of choice of place of study in order to prevent a disproportional load on the various institutions in some field of study. The total number of students is however not restricted. An 'admission committee' is set up for the particular field of study;
3. also to determine a maximum number of students per place and field of study. This last-named measure is known as 'numerus fixus'.

The case study concentrates on the last kind of decision. No attention is paid to decision-making on and in admission committees, nor to the selection procedure after the numerus fixus decision. In the legal procedure now in force, selection is by

⁷ Law of 1st July 1970, Staatsblad 348.

⁸ For a more extensive treatment of this case study see Kickert (1978a).

weighted lottery, that is, high-school examination results lead to a weighting factor which determines the chance of the student to succeed in the lottery.

The procedure of the decision-making will be dealt with in the next section. A university has to send its proposals for numerix by 1st February at the latest to the Academic Council and the other universities. The Academic Council advises the Minister by 1st April. The Minister decides at the latest by 1st June.

Control systems interpretation

In this part we will be concerned with the outcomes of the decision-making, i.e. the decision-making at object level. In view of the previous control-systemic considerations it is clear that we will emphasise an approach from the point of view of control systems. The admission policy can be regarded as a control of the student intake into the scientific educational system. Hence the educational system is identified as the controlled system and the numerus fixus decision-making as the controller. According to Kramer (1978) there exists a set of conditions for effective control of a system: the controller needs a goal, the controller needs a model of the controlled system (see Ch. 2.1 of this book), the controller needs information on the relevant system variables and the controller needs sufficient control variety (the so-called 'law of requisite variety' of Ashby (1956)). We will concentrate on the second and third condition. So let us first consider the second condition for effective control, that is, the requisite insight into the controlled system.

Regard the educational system first as a black-box: students go in, and graduates come out (Figure 8.1).

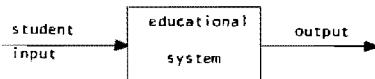


Fig. 8.1. Educational system as a black-box.

In order to grasp what is going on in this system one has to split the black-box up into related components, i.e. into a system of interrelated elements. In our configuration of the system as one which processes a student stream, it is obvious that this element is

strongly related to the 'curriculum'. The curriculum itself is strongly influenced by the element 'means', by which not only financial but particularly personnel costs are meant. The educational system can therefore be presented simply as a system consisting of the three interrelated elements 'student', (teaching) 'tasks' and (personnel) 'means' (Figure 8.2).

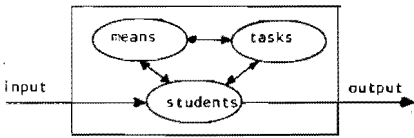


Fig. 8.2. Educational system.

The objective is to control this system. Until the mid-sixties this system was controlled by increasing the means proportional to the increase in amount of students. The student intake was not controlled, neither were the curricula (at

least not in this sense). Developments since then can be considered as one towards a more general control of the interrelated constituent parts of the system. From the model of the controlled system it is clear that besides the control of means there are two other possible forms of control:

- task control. Increase the 'efficiency' by educating more students with less staff by curriculum changes;
- student control. Regulate the number of students by means of student intake control.

The control of interrelated elements should itself be interrelated too, that is, the means control, task control and student control should be interrelated. This complex control system is illustrated in Figure 8.3.

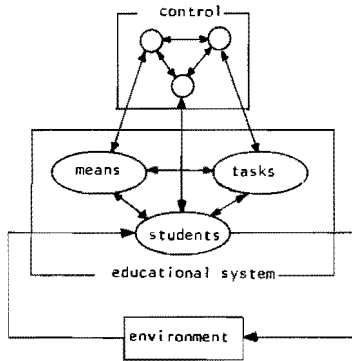


Fig. 8.3. The complex control system.

We are interested primarily in the control of the system variable 'students'. Let me show how the methods that are actually used can be explained from the control-systems point of view.

The two main quantities according to which the decisions are taken, are the estimate of the expected number of students and the available capacity. Let us consider the latter issue first.

Determination of capacity

Because the calculation of available capacity differed strongly per field of study and per university, the Minister asked the Academic Council in November 1972 to set up a working-group to develop uniform starting points and methods for capacity calculations. The Academic Council set up the 'Loevendie' working-group the same month. In view of the great diversity and incomparability of the various methods, the working-group did not succeed in presenting a uniform method before the academic year '73-'74; in September 1973 the working-group presented its calculation method. Although the method was of course not presented in systems-theoretical terms, the method essentially amounts to a model of the above-mentioned system of tasks, means and students. From a control viewpoint this is a quite logical step: the controller needs a model of the controlled system. Making a model of this system essentially consists of two steps, i.e. modelling the elements of the system and the relationships between the elements:

- represent the three controlled system's elements (means, tasks, students) by measurable model variables;
- represent the interrelations between the elements by measurable relations.

The proposed method meets these requirements exactly.

The variable 'tasks' is represented in terms of the manhours needed for the curriculum (scientific staff only). The curriculum is split up into phases (the program grades) and furthermore contains a part which is dependent on the number of students and a part which is independent of that number. In terms of manhours per phase i this leads to the variables:

- Y_i the student-independent part of the teaching task;
- W_i the student-dependent part of the teaching task.

The variable 'means' is represented in terms of the (scientific staff) manhours available for teaching. This is a matter of norms. The official norm for scientific staff is 900 hours per year and for doctoral assistants 640 hours per year in teaching⁹. The number of manhours available is therefore:

$$PO = (\text{staff} \cdot 900) + (\text{assistants} \cdot 640).$$

The variable 'students' is represented as a stream which decreases in each phase of the curriculum. After each phase there are 'fails' who, in part, repeat the phase. The fall-out per phase is represented by a generation-coefficient G_i which indicates the percentage of the original first-year intake of students A reaching a certain phase i . The total number of students is therefore $A \cdot \sum_i G_i$ and in each phase i there are $A \cdot G_i$ students.

⁹ The other staff tasks are 'research' and 'administration'. Originally the staff norm decreed by the Minister was 1000 hours. This norm was later reduced to 900.

The interrelations between means, tasks and students are represented as follows. The product of student-dependent teaching task times the generation coefficient yields the student-dependent task per student per phase. A sum over all phases yields the independent task for the whole curriculum

$$W = \sum_i W_i \cdot G_i$$

The student-independent part of the teaching task for the whole curriculum is

$$Y = \sum_i Y_i$$

The relation between the intakes of students (A), the means (PO) and the tasks (Y and W) is that, in equilibrium, the available number of manhours is equal to the necessary number

$$Y + A \cdot W = PO$$

It is clear that this calculation method - the so-called 'constant cohort' method - is a model of the controlled system of means, tasks and students (Figure 8.4). Consequently one can conclude that this capacity calculation method meets the above-mentioned second condition for effective control.

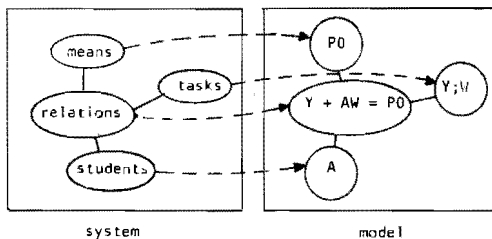


Fig. 8.4. Model of the educational system.

The essence of the method is that it assumes a stable intake of students - the constant cohort. An alternative calculation method would have been to let the admissible intake depend on the number already present, the so-called 'residual capacity' method. The reason that this method was not used is that it leads to enormous differences in admissible intakes in subsequent years. The method is unstable.

Besides the division of the teaching tasks into phases and student dependence, other specifications of the tasks were also proposed¹⁰.

¹⁰ Report of 21st September, 1973 of the 'Werkgroep methodebepaling capaciteitsberekening' to the Academic Council.

Although various universities have criticised the proposed method, only the University of Amsterdam did not follow it in 1974. Since then the method has been accepted by all universities. In the meantime the Academic Council has decided to continue the activities of the informal working-group officially. The working-group was replaced in December 1974 by the Capacity Committee (CC) of the Permanent Planning Committee of the Academic Council.

The method had been developed and proposed as a means of increasing uniformity and comparability of the capacity calculations at the various institutes. This however remained a problem. The method only includes personnel factors of the curriculum whereas numerous other factors play an important role, such as space restriction, research, service teaching to or from other faculties, administrative restrictions, composition of staff, etc. In order to increase the comparability the CC has proposed some changes in the method. Starting point of the proposal was that programs of study for the same field of study should essentially have the same teaching load at all universities, that is, they should cost the same since they produce the same. Deviations in the load (Y and W) leading to other student admissions should only be permitted if approved by the other universities. This induced the CC to calculate weighted average Y and W values per field of study and to use these values to calculate the student capacities. These capacities should then be regarded as 'indicative minima'. This 'indicative minima' method was accepted by the Academic Council in October 1975 so that it could be used in decision-making for '76-'77.

It appears that the capacities calculated by means of the average Y and W are lower than the factual capacities that the universities state. The capacities calculated by means of their own factual Y and W are mostly much lower than their stated maximum capacities. Although these deviations can be considered as showing the extra effort that universities put into preventing *numeri fixi*, one can not deny that there is something lacking in the descriptive-reality value of the calculations. If one assumes the stated capacities to be real, then either the Y and W are false or the teaching norms are exceeded. Although one could explain the deviations as a result of the great administrative effort needed to calculate all variables, they can also be explained as the result of a more normative approach to curricula, which will be discussed later on.

Estimate of expected students

The second essential quantity on which the decisions on *numeri fixi* are based, is the estimate of the expected number of students. This estimate meets the above-mentioned third condition for effective control, that is, the need for information on the

relevant system variables. Let us consider how this control condition has been realised in practice. Students have to register at the Central Bureau for Application and Admission. Every student who wants to register for the first time for the first year of some course of study has to apply to the Central Bureau before 1st December. He has to state his first preference for a field of study, his second preference and his preferred university (place of study). Applications after 1st December are however still possible; for fields of study that have a numerus fixus by 1st May, otherwise 1st October at the latest, or even later with the permission of the Minister. On the basis of these data and estimates of further development in view of previous experience, the CC works out the estimates annually. As is usual with predictions they are not always valid and reliable.

The first reason for this is that by December a great part of the intending students have not yet applied (some 20%). It is therefore probable that predictions will be the more valid the later the data one uses. The second reason is that the development in the applications is greatly influenced by the admission decisions themselves. The decision to restrict admission to a certain field of study at a certain university can have three effects:

1. the intending student turns to the same field of study at another university. A restriction at one university may lead to an overload in the same field at other universities;
2. the intending student turns to his second preferred study. A restriction in one field of study may lead to an overload in 'related' fields;
3. the student registers the following year for the same field of study. A restriction in a field of study may lead to an increasing overload in that field.

The first effect takes place because of the popularity of some place of study. The second effect shows clearly in medicine. The numerus fixus for medicine causes large overflows to related fields like biology. The numerus fixus for biology in fact only serves to stop this type of students who consider biology as a 'parking' study and leave as soon as they are admitted to medicine in a subsequent year (effect 3). In the first years that the law functioned there was little useful statistical data about these kinds of developments in application. Only since '74-'75 did the systemic acquisition of such data in fact start. Nevertheless, the available statistics are still unreliable so that the predictions are certainly not absolute.

The factual calculation of the estimates per university and per field of study proceeds in four stages:

1. the preliminary application data;
2. an estimate of the increase up to June;
3. an estimate of the fall-out by June
1+2-3 = first preference interest;
4. an estimate of the overflow from other fields (second preference)

1+2-3+4 = total real interest = prediction.

A schematic comparison of the CC prediction methods of January 1976 and February 1977 clearly shows the improvements ¹¹ (Table 8.2). The prediction errors in 1977 were half those in 1976. In the evaluation report of 1977 the CC also proposed to split up the estimates of increase (2.) into numerus fixus and no-numerus fixus situations. As further discussion of the prediction technique would lead us into technical subjects, we shall refrain from that.

Table 8.2. Comparison of prediction methods.

CC prediction January 1976	CC prediction February 1977
1. application data per 15-12-'75	1. application data per 18-2-'77
2. estimate of increase Dec-June equal to increase in 1975	2. estimate of increase Feb-June bases on increase percentages in 1975 and 1976
3. estimate fall out Dec-June equal to national average	3. estimate fall out Feb-June with and without restrictions (data 1975 and 1976)
4. estimate overflow only from numerus fixus fields 1975	4. estimate overflow from medicine with and without numerus fixus (data 1975 and 1976)
5. total real interest (1+2-3+4)	5. national real interest (1+2-3+4) divided over universities pro ratio of estimates of applications for June (1+2)

Interrelated control of interrelated elements

In the controlled system of the three interrelated-elements means (PO), tasks (Y,W) and students (A), two variables imply the third variable because of the equilibrium condition $Y + A.W = PO$. If the curriculum is given and the available staff is known, the student intake can be determined (Figure 8.5a). If the curriculum and the number of students is given, the necessary staff is implied (Figure 8.5b). With the same model the teaching tasks can be deduced from means and students (Fig. 8.5c).

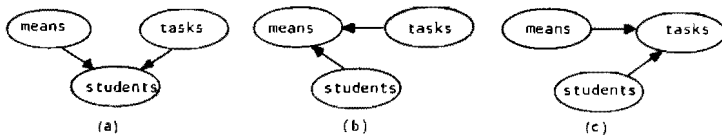


Fig. 8.5. Three possible uses of the model.

¹¹ For an extensive treatment of the computations see Chapter 2.3 of the report 'Evaluatie machtigingswet 1977' CC, Academische Raad, nr. CC-77-60, 7 November 1977.

These three schemes are related to three different control strategies, namely (a) student admission control, (b) division of personnel means and (c) division of teaching tasks. The schemes show that the implied control of the third variable depends directly on the control of the two others. This means that two variables should be controlled independently. If not, nothing else happens than an adaptation of one of the three variables to maintain a status quo equilibrium.

It is therefore not surprising that one can discern a development towards a more active control of the curriculum tasks. In the present situation, in which the available staff can not be influenced - no extra staff will be granted to universities until 1983¹² - and the numeri fixi are determined in long-term plans, the curriculum automatically forms the balancing item of the calculation (Fig. 8.5c), which is not desirable from the viewpoint of the students and staff concerned.

Recently a development has become apparent in the direction of a normative trend of the curriculum tasks away from the purely reactive attitude of taking the factual state for granted. The norm behind this new tendency is to reduce the unjustified differences between universities and fields of study. Nationally one might consider the CC proposal to use indicative minima as such a normative approach. One can also see tendencies to level down the 'luxury' differences between studies inside the universities themselves. Several universities use or are busy developing so-called 'curriculum profile methods'. Although these methods are normative approaches to determine justified curriculum loads, they are used in universities to arrive at a justified division of personnel means¹³.

Although the national method of division of means has gradually evolved from a simple calculation method into a very refined computational method, all methods are still variations on the old staff-student ratio method, where the number of students directly determines the personnel means via a fixed ratio. Means control is only related to one of the two other variables¹⁴.

Summarising, one can state that nationally the determination of student capacity has evolved towards a normative approach to the Y and W values (indicative minima) in order to level down capacity differences as shown in Figure 8.6a. The normative approach to curricula inside universities serves to level down the unjustified differences in personnel means (Figure 8.6b) whereas

¹² Nota beleidsindicaties voor de begroting 1979 en het ontwikkelingsplan 1980-1983 van de instellingen van W.O., Dept. of Education and Science, 4th February 1977.

¹³ See Chapter 6.3.1 of Kickert (1978a).

¹⁴ See Chapter 6.3.2 of Kickert (1978a).

the national division of means consists of a refined staff/student ratio method (Figure 8.6c).

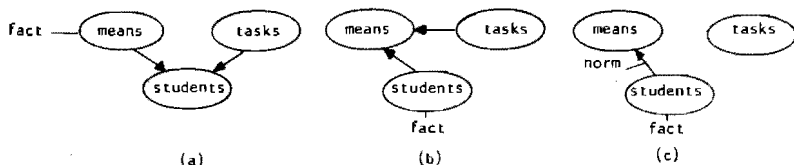


Fig. 8.6. Determination of capacity (a), curriculum profile method (b), and division of means (c).

Although these three variables are strongly interrelated and hence the decision-making concerned is too, the decision processes take place separately. Nationally the capacity decision (Figure 8.6a) is input to the division of means (Figure 8.6c) and locally the capacities (Figure 8.6a) are also inputs to the division of means (Figure 8.6b).

We have seen that object-level decision-making could be interpreted in control-system terms. The controller is the numerus fixus decision-making, the controlled system is the educational system. One of the conditions for effective control (Kramer, 1978) is that the controller should have a model of the controlled system. The 'constant cohort' method is found to be that model. Information about relevant system variables - another condition for effective control - is given via a prediction method. From a prescriptive point of view it is interesting to see whether the remaining 'conditions for effective control' have also been met. As to the first condition - the goal requirement - there seem to exist at least two conflicting goals, namely the objective to guarantee freedom of choice of study and the objective to guarantee quality of education. As we will see later on these two objectives might account for the tendencies to increase and decrease capacities, respectively. The goal conflict can in fact be recognised as a main source of conflict on almost all levels of the decision-making system. As this issue will be discussed later on we will not dwell upon it here. Suffice it to remark that the first condition for effective control does not seem to be adequately met. As to the fourth condition for effective control - the requisite control variety - it is difficult to draw any conclusions. Obviously many other measures besides the capacity decisions are taken to control the educational system. Whether or not this variety of measures is adequate can hardly be concluded from the data gathered in this case study. Let me emphasise that this fourth control condition stresses the need for flexibility in control and to some extent forms a counter argument against highly formalised bureaucratic forms of control. Finally, it has been shown that the structural interrelationships inside the controlled system imply certain interrelationships between possible controllers. The absence of the implied

relationships between the controllers implies that the conclusion is prescriptive. In fact this is an example of how the structure of the controlled system influences the structure of the controller, or in other words, how object-level control influences meta-control.

8.2. METADECISION-MAKING: THE ORGANISATION OF THE DECISION-MAKING

As this chapter serves as an illustration of the conceptual framework of the organisation of decision-making, the chapter will be structured in accordance with it. Consequently the chapter will be divided into a part about metadecision-making, a part about decomposition and a part about coordination, as these three are the major concepts of the framework. Each part will start with a brief summary of the theoretical considerations and conclusions on the particular concept and subsequently proceed with the practical illustration of that conceptual theory.

Before proceeding with the actual interpretative consideration of the process, the main structural characteristics will be briefly described.

8.2.1. THE STRUCTURE OF THE DECISION-MAKING PROCESS

Legal measures

As the legal measures around *numerus fixus* deal primarily with the procedural side of the decision-making and were scarcely discussed in the previous section, this section begins with a treatment of the various laws.

In the law of 6th July 1972 the procedure to be followed up to the final decision by the Minister was prescribed. A decision as to the restriction of admissions could only be taken when some University Council proposed it. This proposal was to be sent to the Academic Council and to the other universities by 1st March at the latest. The Academic Council sends its advice to the Minister no later than 1st May and he informs Parliament and the Education Council and decides by 1st July at the latest (Figure 8.7).

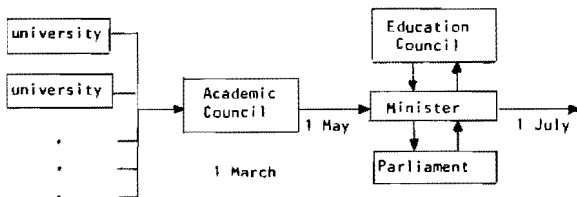


Fig. 8.7. Advice procedure.

The considerations underlying this decision-making structure can be found in the explanatory memorandum of Law ¹⁵ :

- starting point is the responsibility and expertise of the institutions as to teaching and research;
- in the existing organisation pattern the Academic Council is the appropriate authority for the required inter-faculty deliberation;
- an advice by independent educational experts (Educational Council) will guarantee greater objectivity;
- the decision is so important that the highest level of administration (the Minister) should take it;
- early information about proposals and advices to Parliament will guarantee optimum parliamentary control.

Although not included in the law, the explanatory memorandum mentions some additional procedural specifications, namely that the initial proposal will in practice be made by the faculties and that the proposals will be discussed in the other universities and the sections of the Academic Council concerned before being discussed at the plenary meeting of the Academic Council itself (Figure 8.8).

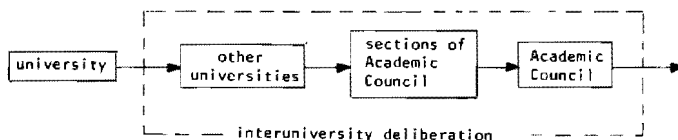


Fig. 8.8. Specification of inter-university deliberation.

The law of 6th July 1972 was accepted by Parliament for a period of two years only. Because the elaboration of the amendments took longer than expected, the law was simply prolonged in 1974 by one year ¹⁶ . A bill to prolonge and amend the law was

¹⁵ Bill 11830, Parliamentary session 1971-1972.

¹⁶ Law of 3rd July, 1974, Staatsblad 432.

introduced in May 1974 and led to the Law of 4th July 1975¹⁷. The alterations were the following:

- the Faculty Council has to inform the Board of Governors of a threatening capacity overload. The Board of Governors (CvB) passes this information on to the University Council, which finally decides and informs the Academic Council and other universities no later than 1st February. These latter universities then also inform the Academic Council as to their maximum capacities;
- if the Faculty Council does not take the initiative, the Board of Governors can do so and, after having consulted the faculty, submit a proposal to the University Council;
- the latest data for the Academic Council and Minister are shifted to 1st April and 1st June, respectively.

In the explanatory memorandum to the bill¹⁸ only the last change is explained: the decisive answers to students at the beginning of August were too late. In the explanatory memorandum it is stipulated that every next higher decision-making authority can only act on the initiative of the next lower authority. If universities do not propose a restriction the Academic Council can not do anything, and if the Academic Council does not submit a memorandum, the Minister can not do anything. If a decision is taken, it also applies however to universities which did not propose restrictions. In view of this right to procedural initiative, it is striking that only at the lowest level the initiative role can be taken away from the faculty by the Board of Governors (CvB). It is alone faculties that are deprived of this right.

The Law of 4th July 1975 was also accepted for two years only. The law was replaced by the Law of 18th May 1977¹⁹ which mainly embodied technical rearrangements. Only one measure was important from the viewpoint of structural decision-making: if the Academic Council does not submit a memorandum, the majority of the universities concerned (i.e. where the field of study is taught), should they have preferred to advice in favour of a *numerus fixus*, can inform the Minister accordingly by 10th April. This measure originated because of doubts as to voting behaviour in the Academic Council by the universities not concerned. Their votes had caused the rejection of several *numerus fixus* memoranda²⁰.

¹⁷ Law of 4th July 1975, Staatsblad 406, 407.

¹⁸ Bill nr. 52929, Parliamentary session 1973-1974.

¹⁹ Law of 18th May, 1977, Staatsblad 326.

²⁰ This was already remarked by the Academic Council and had resulted in a change in voting procedure: first the universities concerned vote, then those not concerned. Since this change in voting procedure the situation did not occur again.

Other structural measures

Besides the formal legal measures, important structural ones have also been taken by the Academic Council. In view of the fact that the decision-making process is rather complex and that the Academic Council is the official deliberating body of the universities, it is not surprising that the Academic Council has a coordinating task in the interuniversity phase. The Academic Council is assisted by the Capacity Committee (CC) in that task. In 1975 the CC started to prepare the yearly decision process by comparing the capacity calculations with the estimates of the expected students. The CC proposed much more numeri fixi than the universities. The reason for this was the incomparability of the data but also the fact that many universities had given their maximum capacities (at the latest by 1st March) with reservations and wanted to change these data if more recent estimates required it. This last phenomenon induced the CC to propose a procedure by assisted by the Capacity Committee (CC) in that task. In 1975 the CC started to prepare the yearly decision process by comparing the capacity calculations with the estimates of the expected students. The CC proposed much more numeri fixi than the universities. The reason for this was the incomparability of the data but also the fact that many universities had given their maximum capacities (at the latest by 1st March) with reservations and wanted to change these data if more recent estimates required it. This last phenomenon induced the CC to propose a procedure by which the universities could indeed determine their standpoints at a very late stage based on the most recent CC data, namely just before the plenary meeting of the Academic Council. The advantages of such a postponment were that the universities could then rely on more recent and thus more reliable predictions, that they had more time to take internal preventive measures and that the division of means was usually not known by February 1st. Therefore the Academic Council adopted the following procedure in November 1976:

- the universities supply all data on threatened fields of study to the CC before January 1st;
- the CC makes a report on capacities, indicative minima and estimates by 15th January;
- the universities state their maximum capacities by 1st March;
- the sections of the Academic Council comment by 1st March;
- the Preparatory Committee of the Academic Council comments by 15th March;
- just before the plenary meeting of the Academic Council the universities state their definitive maximum capacities;
- the Academic Council submits its advisory memorandum by 1st April.

Originally it was only the task of the CC to integrate annually all data into a comparable survey. Clearly the coordinative task of the CC has increased. Now it makes a preliminary survey of

the data at an early stage, coordinates the reactions of the universities, the sections and the Preparatory Committee and processes this extra information at a later stage. Moreover, it evaluates the decision-making and develops proposals for improvement yearly. As to the information processing, it is the central coordinative role of the CC that shows up most clearly. The CC consists of planning officials of the various universities with a secretary from the Academic Council. Note that the central coordinative role is not coupled to any formal authority. The CC has an advisory 'staff' task.

The schematic sketch of the structure of the decision-making is given in Figure 8.9. This scheme is a structural description of the decision-making process. As indicated in Chapter 4.2 such a process can be decomposed into subsystems, aspect systems and phase systems. Assuming that the decision-making is concerned at all levels with one and the same aspect, namely student capacity, so that there is only one aspect system, the scheme is therefore a picture of the two remaining dimensions. The blocks in this figure form the subsystems of the system and the sequence of blocks indicates the phases. In that sense universities, Academic Council and Minister are at the same time subsystems and phase systems.

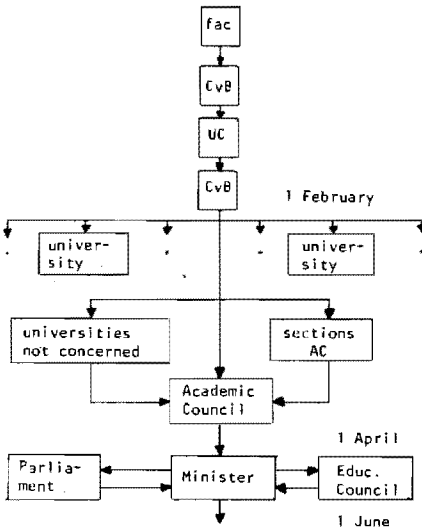


Fig. 8.9. Scheme of the decision-making.

8.2.2. METADECISION-MAKING

In Chapter 5 it has been shown that decision-making about the organisation of decision-making, is a particular mode of metadecision-making. The line of argument was as follows. Decision-making was considered to be a form of control, that is, a form of 'directed influence' of some controlled system. Therefore the organisation of decision-making, that is, the structuring of the decision-making, coincides with the structuring of the controller. Structuring a controller can never be a control mode of the con-

troller itself but must be a structural mode of control of a controller on a next-higher level, i.e. a metacontroller. Hence the organisation of decision-making was identified in Chapter 5 as a structural model of metacontrol. The decision-making system therefore consists of three levels: the lowest level of the controlled system, the middle level of the controller (decision-making) and the highest level of the metacontroller (metadecision-making). It was, however, found that structural metadecision-making is almost nowhere done consciously. One cannot pinpoint a particular body that fulfils the task of metadecision-making. The only bodies that one might interpret in this sense are the Parliament in its legislative function - because the relevant laws indeed regulate the decision-making structure - and the Capacity Committee of the Academic Council because it regularly works out proposals for the improvement of the process structure. Metadecision-making is implicit rather than explicit and the conceptual framework can only be illustrated in an interpretative sense. A general picture of the multilevel decision-making is given in Figure 8.10.

Note that in this figure the structure that has to be decided upon, consists of the relations between the three subsystems shown (Universities, Academic Council, Ministry plus Educational

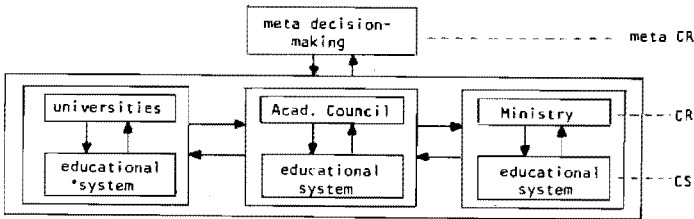


Fig. 8.10. Multilevel decision-making.

System). It is however clear that inside these subsystems structures also exist, so that there is also metadecision-making at a lower level, e.g. inside a university with reference to the structure comprising the relations between Faculty Council (FC), University Council (UC) and Board of Governors (CvB) (see Figure 8.11). By analogy one can also subdivide the 'Academic Council' subsystem into smaller parts so as to get a structure on a lower level of aggregation. The Academic Council (AC), a Preparatory Committee (DR) and sections representing the various fields of study. In this latter case one might even speak of a concrete metadecision-making body, namely the Capacity Committee (CC). See Figure 8.12. Of course one can proceed with this subdivision to a lower level of aggregation, such as that of the individual members of the plenary meeting of the Academic Council (Figure 8.13). One this level, too, there are examples of the organisation of the relations between these subsystems, that is, of structural

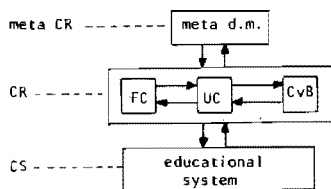


Fig. 8.11. Intra-university decision-making

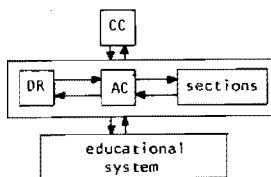


Fig. 8.12. Decision-making in Academic Council

metadecision-making, such as the voting procedure where universities vote first and universities not concerned only vote afterwards.

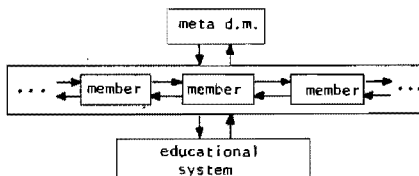


Fig. 8.13. Plenary meeting of Academic Council

8.2.3. DECOMPOSITION

Decomposition was defined as the formation of part systems of the decision-making system, where part system is the general term for subsystem and/or aspect system and/or phase system. Decomposition essentially amounts to the 'subset of' action, that is, its primary meaning is the demarcation meaning. Boundaries are drawn around subsets of the system. It was found that there are two different methods of decomposition: form part systems that are as homogeneous as possible or form part systems that are as autonomous as possible. These methods are particularly distinct from an organisation-design viewpoint, as the latter explicitly aims at minimising the required coordination efforts.

As has been shown in the description of the system (Figure 8.9) the primary subsystems of the system are the universities, the Academic Council and the Minister. These subsystems coincide with the phase systems. On a lower level of aggregation these subsystems can be subdivided into sub-subsystems; universities consist of faculties, University Council and Board of Governors (CvB); the Academic Council consists of its Preparatory Committee (DR), the plenary meeting and its sections. Another subdivision in this representative Council is possible into representatives of universities concerned with a certain *numerus fixus* and such as are not concerned; in the last phase the Minister is advised by the Educational Council and the Parliament. The latter of course ultimately controls the Minister.

All these subsystems are existing systems. The structure of the process coincides with the existing university administration structure. Of course this is not surprising as regards the university subsystems for it is admission to these institutions which is the problem, or to put it in the official legal argumentation ²¹ (see section 8.2.1): "starting point (for the decision structure) is the responsibility and expertise of the institutions as to teaching and research". As to the incorporation of the Academic Council the argument also was essentially a status quo argument ²¹ : "in the existing organisation pattern the Academic Council is the appropriate body for the necessary inter-faculty deliberation". The argument to incorporate the subsystem Minister into the process was that ²¹ "the decision is so important that the highest level of administration should take it". Clearly Parliament was also incorporated because of the importance of the decision. In order "to guarantee greater objectivity", the advice of "independent educational experts (Educational Council)" was also inserted ²¹ . No new non-existing subsystems were formed for the decision process; all incorporated subsystems already existed. So the only real decomposition problem was which existing subsystem to insert in the process. To put it in system terms, the real problem was the demarcation problem of the overall system boundaries; which elements should be inserted in the system and which not. This problem apparently was not so easy in view of the later troubles with the functioning and participation of some of the incorporated elements (sections AC, Educational Council). A decomposition problem involving the demarcation of the subsystem boundaries did not exist. All the subsystems included remained separate entities. Put in system terms: all the elements remained separate, there was no clustering. Mark that as to the phase systems one might speak of a clustering of Minister, Educational Council and Parliament in the last phase system, where the clustering criterion obviously is not the similarity but the strong interrelationships already existing between the three.

Although one might speak of a very meagre decomposition effort in this descriptive sense, we will see later on that the concept of the formation of part systems can surely be used prescriptively (see Chapter 8.2.5). It is indeed not surprising that something which has been omitted can be improved.

8.2.4. COORDINATION

Once the relevant part systems have been formed, the second measure in the organisation of decision-making is the coordina-

²¹ Bill 11830, Session of Parliament 1971-1972 (leading to the Law of 6th July, 1972).

tion of those part systems. Coordination was defined as the control of a system of interrelated part systems. The definition is very broad and coincides with the general definition of control. Hence the control systems framework also applies to coordination, so that corresponding modes of coordination can be deduced, particularly the mode of goal coordination and the mode of structural coordination. Besides one can distinguish between extrinsic coordination - the coordinator is a separate subsystem - and intrinsic coordination - the coordinator is not a separate subsystem. In this section the various modes of coordination will be systematically illustrated. As the case study has in fact primarily focussed on the structure of the decision-making process, it is not surprising that the structural coordination concept is the one to attract most attention. The other goal coordination mode will also be briefly illustrated. Finally some attention is paid to the difference between intrinsic and extrinsic coordination.

As we have assumed that the decision-making deals with one aspect, i.e. the numeri fixi, the structure consists of the relationships between subsystems and phase systems. For instance, let us consider the overall structure of the decision-making. A decision on the restriction of admission can only be taken when some University Council has put it forward; this proposal has to be submitted to the Academic Council and the other universities by 1st March; the Academic Council advises the Minister by 1st May, and he informs Parliament and Educational Council and decides by 1st July (the dates have been changed since). This is clearly a form of structural coordination, where both subsystem and phase system structures are coordinated. As to the phase-system structure the coordination mainly stems from information-processing considerations. The university subsystem has about two months to deliberate and decide, the Academic Council also has two months, as has the Minister. It is assumed that the prescribed time periods have been estimates of the time needed to process all available information and reach a decision. As to the particular ordering of the subsystems in the phase procedure authority aspects clearly play a role: it is evident to let a coordinative council follow the separate part systems; Ministerial status entails his granting the last formal authorisation decision.

One can also clearly distinguish between structural coordination of the subsystems and that of the phase systems in the other coordinative changes in the decision-making since 1972. Let us first consider some subsystem coordinations and then some phase system ones.

Intra-university coordination

Although the explanatory memorandum of the Law of 1972 already mentions the faculties, it is only in the Law of 4th July 1975 that the specification of the procedure within the universities was officially mentioned. The Faculty Council has to inform the Board of Governors of the University (CvB) of a threatening capacity overload. The CvB passes this information to the University Council, which finally decides and informs the Academic Council and other universities by 1st February. These latter universities then also inform the Academic Council about their maximum capacities. If the Faculty Council does not take the initiative, the CvB can take the initiative and make a proposal to the University Council after having consulted the faculty.

This form of structural coordination is an example of the difference between coordination of the whole system and coordination of the structure inside the part systems, that is, it is structural coordination on a lower level of aggregation. The normal phase structure - faculty, CvB, UC - is evident: the coordinating University Council and its Board of Governors follow the separate faculties. The deviation in this phase structure - the taking over of the right of initiative - is not so evident. It is striking that it is only at the lowest level of the whole process that the right to initiative can be taken away. Let us therefore have a closer look at the roles of the various participants in this intra-university procedure.

It is no exaggeration to say that there is often friction between faculty management at one hand and university management (U-Council plus CvB) on the other. In extreme black-and-white terms one can interpret these frictions as the controversy between the faculty objective to guarantee quality of education and the university objective to guarantee freedom of choice of study. In operational terms these objectives amount to lower and higher capacities, respectively. Note that other motives can also explain the facts: faculties are burdened with the high teaching load of their staff, they have to do the work; university management usually gets more means from The Hague the more students are admitted. This difference in view sometimes leads to frustrations of the faculties because they consider their influence on the decision-making very low. Their right to initiative can be taken away, the Academic Council consists of representatives of university management and their representatives - the sections - do not have much influence either. Thus interpreted, the relational structure between faculties and university management is rather a matter of goal coordination. Of course, this version of the facts is rather black-and-white, so let us have a second look.

It is evident that the structure of the *numerus fixus* decision-making is related to the legal-administration structure of scientific education, i.e. the law on university administration reform²². This law, however, only speaks of teaching (research) and means. The Faculty Council organises and coordinates teaching, determines the programs of study, the duration of the study in the various stages and the examinations. The University Council determines the budget. The Board of Governors (CvB) prepares and executes the decisions of the University Council. The responsibility for teaching lies with the faculty, whereas the responsibility for the means lies with the university. The determination of student capacity depends on both the divisions of means and the curricula, so that one can not deduce any one-sided responsibility from there. In practice, however, faculties often increase their maximum capacities with great effort without staff compensation, which obviously amounts to control of the teaching tasks (or a reduction of research capacity). Nationally also, one could interpret the capacity-determination method by means of 'indicative minima' as a normation, i.e. a control of the teaching tasks. Of course, the division of means also plays a central role, but it is clear that university management is surely not the only body responsible.

In reality faculties do not have much influence on the decision-making. An indication of the authority relation between faculties and universities is, e.g. the fact that university councils increase maximum capacity figures provided by faculties. These figures are certainly never lowered. The relations, however, differ very much from one university to the other. Let us take the two extremes of Leiden and Amsterdam. The University Council of Leiden seldom deviates from the maximal capacity figures which the faculties provide. The reason for this is that Leiden has had an integrated system of long-term planning since 1974, by means of which faculties and university management yearly agree on the division of means and the student intake for the coming five years. Neither of the two partners deviates from the agreements. Actually there is hardly any discussion about the *numerus fixus* proposals which the University Council has to make to the Academic Council before 1st February, because these discussions have already taken place during the yearly planning rounds. In Leiden the multi-year agreements are made by faculties and university management together, so that capacity decisions are the responsibility of both. The University Council of the (Municipal) University of Amsterdam nearly always deviates from the capacity figures provided by faculties. The procedure in Amsterdam coincides with the legal procedure: faculties state threatened capacities at the beginning of December; the University Council submits proposals to the

²² Wet Universitaire Bestuurshervorming, Law of 9th December 1970, Staatsblad 601.

Academic Council before February; in a second round, when national data are clearer, the University Council finally decides after having consulted the faculties. The greater part of the Amsterdam University Council is strongly opposed to *numeri fixi*. This primarily political standpoint results in a great pressure on other universities to prevent *numeri fixi*, but also in great pressure on local faculties to prevent it. Maximum capacity figures are therefore usually increased. Some faculties are highly frustrated by this procedure.

Although these illustrations are no proof, one could say that the factual influence of faculties on the decision-making is mostly not in proportion to their formal responsibility and that the influence of university management is usually disproportionately great.

Inter-university coordination

Let us now take a look at the structural coordination of the relationships in the second phase of the process: the inter-university deliberations.

The Minister has chosen the Academic Council as the most appropriate body for inter-university deliberation. In the Law on university administration reform²³ the Academic Council is appointed as the deliberation and advice authority representing the institutions of scientific education. The Academic Council consists of a president, vice-president and ten members appointed by the Crown and three members per university appointed by their respective University Council. Besides this plenary council there is a Preparatory Committee (DR) and sections for the separate fields of study. The members of these sections are appointed by the Academic Council on the recommendation of the faculties concerned. So the plenary Academic Council consists of representatives of university management and the sections more or less represent the faculties.

The sections are mentioned in the explanatory memorandum of the law on admission restrictions²⁴. Their task is to advise the Academic Council annually on proposed restrictions for their field of study. In the CC evaluation report of 1976 it was remarked that the sections could hardly have been able to submit a real report because they only had two weeks time in which to do it. A procedure was proposed in which the sections would have more time to deliberate and to write a report. It is probable that the lack of influence has induced the sections to go over the head of the Academic Council and appeal directly to the Minister, about which the Academic Council was not at all pleased, the more so as the medicine section sometimes succeeded in con-

²³ Wet Universitaire Bestuurshervorming, Law of 9th December 1970, Staatsblad 601.

²⁴ Bill 11830, Parliamentary session 1971-1972.

vincing the Minister that it was right. In fact, we see the disproportionality in responsibilities between universities and faculties reflected at this next-higher level of inter-university deliberation. For the numerus fixus decision-making has been structured parallel to the existing administration structure (Figure 8.14).

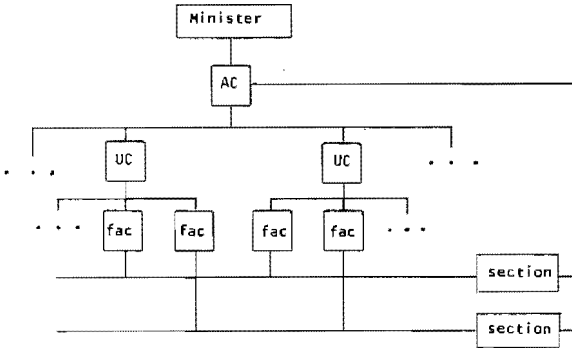


Fig. 8.14. The 'authority' structure of University administration.

This organisation of decision-making is, however, not the only one possible. If we consider the problem as a coordinative one, we have to start by answering the central question of what has to be coordinated. In this case two forms of coordination exist:

- coordination of the differences per field of study between universities;
- coordination of the differences per university between the fields of study.

The second form occurs within the universities, the first within the Academic Council. This is reflected by the course of events at the plenary meeting of the Academic Council where the matter is discussed per field of study. From this point of view a direct coordination between faculties seems a much more simple solution than the present procedure with its additional university level in between. Only if the features constituting the differences between one faculty and another elsewhere are similar for all faculties per place, should one coordinate via the universities. (Consider, for instance, a university with space problems primarily whereas another primarily has staff problems.) Note that this is a problem of decomposition, particularly decomposition by dissimilarity. It will be discussed in the prescriptive reconsideration of the case in Chapter 8.2.5. The conclusion that the existing organisation structure of inter-university decision-making is not necessarily optimal seems plausible however.

Universities not concerned

In the law amended in 1977²⁵ a measure was incorporated which enabled the universities to by-pass the Academic Council. If a majority of the universities concerned (i.e. where courses in the field of study concerned are held) would prefer to advise in favour of a *numerus fixus* and the Academic Council were to come out against such a *numerus fixus* (because of the votes of the universities not concerned), this majority could inform the Minister about their opinions by April 10th at the latest. The situation in which the universities not concerned outvoted those which were concerned had several times led to the rejection of *numeri fixi*. This was already noted by the Academic Council and resulted in a change in voting procedure: first the concerned universities vote, then those not. Since this change in voting procedure the situation did not re-occur. Nevertheless, and in spite of the opposition of the Academic Council, the above-mentioned measure was inserted in the law. The dilemma of inter-university deliberation - that on one hand the objectivity of the universities not concerned might have a good influence on the decision, but that on the other they should not have a decisive one - was solved by making a decisive influence almost impossible. The control action which has been applied here is a control of the relational structure between subsystems, particularly a procedural control action. Its aim is to control the relative influence of the participants in decision-making by means of procedural prescriptions.

Coordination in The Hague

Over the last few years the usual procedure has been that the Minister formed a preliminary standpoint after having received the advice of the Academic Council and then consulted various universities and sections. Particularly in the field of medicine this has several times led to a change of the decision by the Minister from the advice submitted by the Academic Council, which did not please the Academic Council at all, the more so because he reduced the capacities. The reason for this additional consultation after the submission of the memorandum was the lack of consensus about the advice in the Academic Council either between universities or between universities and faculties. Note that this separate consultation between Minister and universities undermines the legal advice procedure and particularly the authority of the Academic Council as the ultimate advisory body of the universities.

²⁵ Law of 18th May 1977, Staatsblad 326.

Officially the Minister has to consult the Educational Council before he decides. Therefore he informs this council as to his preliminary standpoint and the memorandum of the Academic Council. The Educational Council then reacts. Because the department, however, needs about a month to work out a preliminary standpoint which can therefore only be published by May the 1st and because the Minister has to decide before June, the Educational Council only has a month to come to prepare its report. This period is far too short to result in sound advice. The influence of the Educational Council is therefore very slight.

The first task of Parliament in decision-making about numerical fixi is to carry out control on the executive power (the Minister). Parliament therefore hears the preliminary standpoint of the Minister. The same time argument also applies here however, so that Parliament does not exert much influence on the yearly decision-making. The second task of Parliament - its legislative task - is performed at the biennial changes of the law. Though most of the proposed changes seem to stem from the desires of the participants concerned - universities and Academic Council - rather than from Parliament, the last named has influenced one important issue. It has namely consistently prevented any attempt to give the law a less temporary character: periods of validity were kept short and an attempt to introduce in the law the criterion of the labour market for admission was withheld. Nevertheless, Parliament has not prevented numerus fixus being a permanent phenomenon in fact.

As to the control of the relational structure in The Hague one can therefore conclude that the interrelationships between Minister, Parliament and Educational Council are weak. Moreover, the Minister has erected an additional relational structure with universities and sections (faculties) in addition to the statutory one. Apparently the coordinative control of the Minister is not restricted to formal authorisation only.

Let us now consider some examples of the coordination of the phase system structure.

Procedure of inter-university deliberation

In 1976 the Capacity Committee (CC) of the Academic Council proposed a change in the procedure so that universities could give their preliminary indications of maximum capacities at an early stage but wait with their final maximum capacities till the most recent figures were available. The following procedure was adopted by the Academic Council in November 1976:

- the universities supply all data on threatened fields of study to the CC before January 1st;
- the CC makes a report on capacities, indicative minima and es-

- estimates of expected student by January 15th;
- the universities state their (preliminary) maximum capacities by March 1st;
- the sections of the Academic Council comment by March 1st;
- the Preparatory Committee (DR) of the Academic Council comments by March 15th;
- just before the plenary meeting of the Academic Council the universities state their definitive maximum capacities;
- the Academic Council submits its memorandum by April 10th.

The situation which led to this change was that in previous years universities had given their maximum capacities (by March 1st) with reservations and wanted to change these figures if more recent estimates merited it. More recent estimates of the expected student intake were said to be more reliable, by March 1st the distribution of means was not known anyway and, moreover, give more time for internal preventive measures.

This change in structure is a form of structural coordination of the information processing. A procedure is indicated which determines the information sources, the information flows, the information processors and their relative positions. The CC functions as a central information-processing unit gathering all data from the various universities (and from the matriculation of students) and subsequently providing all authorities concerned with a comprehensive aggregate of these data. This is an explicit example of structural coordination by means of an extrinsic coordinator, that is, a separate subsystem functioning as the information-processing coordinator. Note that structural coordination of the information processing is indeed a form of control of the phase-system structure. The information processors correspond to the phase systems and hence the information flows, the time sequence, the relations with the CC, all correspond to the structural relations between the phase systems.

Let us proceed somewhat further along the information-processing line of argument.

Consider the phases of the decision-making to be determined by the time the various participants need to process the relevant information. From this point of view one can determine the necessary phase structure from 1st June backwards. The total duration of the decision-making depends on the processing rates and the number of participating bodies. This duration can therefore be reduced by either increasing the processing rate or reducing the number of participants. This result can also be achieved by parallel information-processing, for instance in that part of the procedure where not only the sections, but the universities, as well as the Preparatory Committee (DR) process the CC report in parallel. A series connection of these three information-processing systems would take three times longer (Figure 8.15).

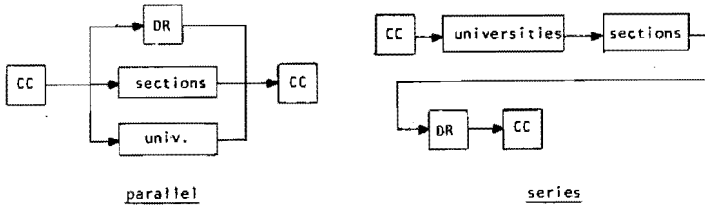


Fig. 8.15. Parallel and series connection of information-processing systems.

In terms of information-processing the bottle-necks are formed by those nodal points where series-processing takes place, e.g. in the sequence of the submission of the Academic Council memorandum and the decision of the Minister. A parallel processing by sending the department relevant information at a much earlier stage would save much time. In these matters authority relations however play the dominant role. In the law the formal authority to decide lies with the Minister. The only formal authority that the other participants have is that they can prevent a decision by withholding their advice. They only have the authority of non-decision (Bachrach and Baratz, 1970). The actual course of events is that often the whole deliberation and advisory reporting process on the part of faculties, universities and inter-university consultation seems to be repeated in miniature in the Department of Education and Science.

Sections of the Academic Council

Another example of the power of information-processing viewpoint in explaining the coordination of the phase-system structure is the following. In order to enable the sections of the Academic Council (as well as the Educational Council) to work out sounder advisory reports the CC has proposed to increase the available time. The sections were to be given six weeks instead of the few weeks they had hitherto. (The same time argument played a role as to the advisory possibilities open to the Educational Council.) The argument which applies to both bodies is that the time available to process the necessary information and to reach consensus on a conclusion and a report is much too short. This consideration has led to a change in the date the sections receive the information. Instead of waiting until the Academic Council gets the information officially (February 1st), the sections now get the comprehensive CC report right away on January 15th and have a processing time of two months.

Change in latest dates

In the Law of 4th July 1975 the latest dates on which universities, Academic Council and Minister should decide or submit an advisory report were shifted forward by one month to 1st February, 1st April and 1st June, respectively. This change in the phase structure was explained with the argument that the decisive answers to students at the beginning of August were too late for them to make necessary arrangements. The implied factual change is that universities have less time left for their part of the procedure, in other words, their information processing time was reduced by one month.

In the previous three examples the phase pattern of the decision-making process has been explained from the viewpoint of information processing. The structural coordination of the phase-system structure could in fact be accounted for quite well. The phase system structure can not be satisfactorily explained with the usual problem-solving phase scheme (see Chapter 3.3): (1) problem identification, (2) information gathering, (3) development of alternatives, (4) evaluation of alternatives, (5) choice of solution and (6) implementation. Such phases could be recognised but did not yield a systematic explanation of the particular phase system structure. Probably this has to do with the fact that the phase systems coincide with the subsystems. The process was structured according to the division into subsystems and the 'authority' ordering of those subsystems resulted in a phase system ordering. Although in principle this might coincide with the problem-solving phases, it is not necessarily so. Actually one could propose to reorganise the decision-making system according to the problem-solving phases. There is, however, an important reason why such reorganisation might be questionable. The problem-solving phase schemes apply to a particular kind of decisions, that is, the non-routine, non-programmed, 'real' decisions (Simon, 1945). And it is very doubtful whether one could identify the *numerus fixus* decision-making as such a decision. Although it is clear that the decisions are certainly not so routinised that they can be fully programmed, yet they are decisions which are repeated annually. Moreover, a computational model has been developed - the so-called 'constant cohort' model - which should at least assist the decisions in a programmed, routine way. It is therefore questionable whether reorganising such a process as if it were a continuous cognitive learning process, is sensible ²⁶. To that end ²⁷ the information-processing view-

²⁶ Note that although the case study in Chapter 4.3 described a unique, non-routine, real decision-making process, this process was not structured in this sense either. A result which seems to underline Witte's (1972) results.

²⁷ It should be noted that the information-processing viewpoint is the key stone of Newell and Simon's (1972) cognitive-learning approach to problem-solving. Both approaches are thus not opposites.

point seems much more promising.

Goal coordination

It now seems appropriate to consider the coordination within the Academic Council from the viewpoint of the classification of goal systems as in Chapter 6.3.2.1 into hierarchy, collectivity, coalition and autonomy. It is not surprising that we now arrive at concepts typical of goal coordination. First, because goals and subsystems are so intertwined that structural control and goal control are directly related. Second, because the typology of goal systems is a very broad one. It is based on the mathematical rational model of decision-making, in which behaviour is explained completely in terms of a goal, so that all differences in behaviour are reduced to goal differences. A non-mathematical layman would perhaps not relate this classification to goals at all, but primarily recognise structural aspects of hierarchy, collectivity, coalition and autonomy.

There does not seem to be one common, overall goal for the decision-making system, there are at least two conflicting goals which can each be recognised as a main source of conflict on almost all levels of the multilevel system, that is the goal to guarantee freedom of study and the goal to guarantee quality of study, or, in operational terms, the goal to prevent *numeri fixi* (by high capacity maxima) or the goal to keep capacity maxima realistic (low). This formulation is exaggerated for the sake of clearness; other objectives could account for the desire for high or low capacities²⁸; moreover it is dubious whether low maxima alone result in higher quality and high maxima in higher freedom, that is, many other factors can realise these goals. It is, however, clear that the classification into 'hierarchical' goal system does not apply. There is no overall common goal.

An above-mentioned example of goal coordination has been the steady effort of Parliament to consistently prevent any attempt to give the law a less temporary character: periods of functioning were kept short and an attempt to introduce the criterion of the labour market into the law was defeated. The only criterion permitted for restriction of admission is the available capacity and not the future labour market demand. These decisions of Parliament can be interpreted as forms of goal control; if one considers the system of goals as consisting of the two opposing goals mentioned earlier (freedom of study versus quality of study), parliamentary goal control obviously consists of the emphasising of the first goal.

Of course other examples of goal control also exist, both in the sense that influence is exerted on certain subsystems to take

²⁸ Such as criteria as to organisational overload, scarceness of room, optimal faculty size, etc.

over the second goal - certain Faculty Councils are principally opposed to any restriction of the freedom of study and hence do not favour a numerus fixus, whereas university management tries to persuade them that this will lead to utter chaos - and, in the sense of favouring the first goal - certain University Councils are opposed in principle to numerus fixus, whereas the faculties have in fact the difficult task of accepting the overabundance of students and do all the work, so that the latter try to influence the former to demand numeri fixi or decrease the maxima.

Intrinsic and extrinsic coordination

In Chapter 8.2.2 it has been said that it is very difficult to pinpoint a particular metadecision-making body. The same applies to coordination, so that at first sight the coordination seems to be intrinsic rather than extrinsic. The only body that one might recognise as a conscious extrinsic coordinator is perhaps the Capacity Committee, but its factual power is restricted to information processing only. The CC has no formal authority. Although an authority like the Academic Council consists of representatives of the participating subsystems and the representation changes from time to time, it has been explained in Chapter 6.3.4 that this body still constitutes an example of extrinsic control; although the representatives are not superiors they are nevertheless distinct from the controlled system and therefore extrinsic controllers (coordinators). From the viewpoint of the coordination of the plenary meeting of the Academic Council itself, the coordination is intrinsic, for the decision procedure is a voting procedure where all votes have the same influence, so that no one can be pinpointed as 'the' controller.

8.2.5. PRESCRIPTIVE RECONSIDERATION

As explained in the introduction to this chapter the conceptual framework of the organisation of decision-making can also be used as a prescriptive tool, for it is an intentional rational model. So let us now reconsider the case study from the prescriptive standpoint. Before doing so it should be emphasised that the prescriptive considerations of this section should not be considered as rigid unambiguously 'best' solutions. The prescriptive considerations merely constitute suggestions as to the direction in which problem-solving strategies might be sought from the point of view of my conceptual framework. The framework is not yet an empirical theory and even then the complex reality of social systems implies that suggested solutions only are possible suggestions without any guaranty of success.

Decomposition

In Chapter 8.2.3 it was stated that the first step in the organisation problem - the decomposition - was only partly carried out. The part systems of the decision-making process are all existing instances mentioned in the law on university administration. The only real problem of decomposition was to decide which existing subsystem to include in the process, that is, the overall demarcation problem. A subsequent clustering of these subsystems did not take place. The system consists of the elementary entities without further clustering. Although this kind of status quo decomposition might be very advantageous from a practical operational viewpoint - no structural changes, reorganisations, adaptation and starting problems - it is dubious whether the resulting pattern of subsystems is really optimum from a theoretical viewpoint.

Let us assume that the elementary entities of the system are the (sub)faculties for they are the faculties in which the students are to follow their studies and hence where the student intake occurs and where the capacity problems occur. In Chapter 8.2.4 the problem has been mentioned of how to coordinate the decision-making as to the capacities and two possible kinds of coordination have been distinguished:

- coordination of the differences per field of study between universities;
- coordination of the differences per university between the fields of study.

In fact this problem should be regarded from the viewpoint of decomposition. This problem is actually the kind of problem that can be solved by the method of 'decomposition by dissimilarity' introduced in Chapter 6.2.1 and which has been discussed extensively in Chapter 6.2.3.1.

The objective is then to group the entities together in homogeneous clusters, that is, to cluster entities according to the similarity criterion. So the important question to answer is what the similarities or dissimilarities between the (sub)faculties are. One should construct a systematic list of important aspects, then determine the similarity relations per aspect, decide what clusters are as similar as possible and finally construct a coordinative control structure on that basis. Let us take an example of some faculties. What are the aspects relevant to the capacity determination problem? First of all the curriculum and the personnel aspect. But besides these aspects many other also play a role in the decision process, such as, scarceness of room (building activities have drastically been reduced), scarceness of materials (e.g. experimental apparatus), organisational aspects (e.g. management overload, optimal faculty size). Moreover, the personnel aspect should not be restricted to man

hours only; an important other personnel aspect is the qualitative one (some faculties have a relatively large amount of young and unexperienced staff). What are the similarity relations on these aspects? As to the major aspect - the curriculum - the answer is quite clear. The curricula will be most similar per field of study. Different fields of study will probably differ much more from each other as to their curricula. Apparently one should cluster all faculties from a particular field of study together (Figure 8.16). This clustering stands perpendicular to the clustering of faculties of different fields of study in one university.

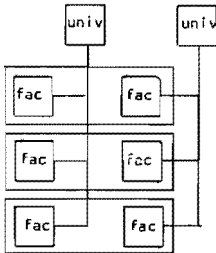


Fig. 8.16. Clustering of faculties per field of study

Let us now consider another aspect. Imagine the case where the similarity relations according to that aspect yield differences between faculties of the same field of study in different universities which are much greater than those between the faculties of different fields of study in one university. In this latter case the cluster boundaries of similar faculties would coincide with the university boundaries (Figure 8.17). Consider e.g. the aspect of scarceness of room. Some old university

might have huge space problems whereas recently built universities might have little or no space problems. The example looks however quite artificial. Why should scarceness of space be a typical university characteristic and not a typical field of study characteristic? For evidently some studies require more room than others. The same applies to the other above-mentioned aspects. It is not clear why scarceness of materials, organisational aspects or qualitative personnel aspects should be typically similar per university in stead of being similar per field of study. In fact the three aspects do seem to be typical field of study characteristics rather than typical university characteristics. Consequently there seems to be little or no evidence to cluster faculties according to the university boundaries (Figure 8.17). The clustering per field of study (Figure 8.16) seems to be more adequate.

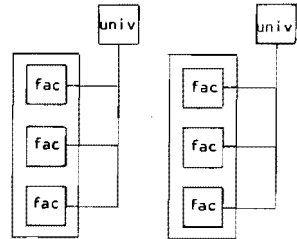


Fig. 8.17. Clustering of faculties per university.

Although we have now arrived at the two possible clustering forms, one might still wonder what the relationship with coordination is. The relationship is in fact very straightforward. As has been shown in Chapter 6.3.3.1 the control (coordination) of

a 'hierarchical' system, i.e. a system consisting of parts within parts and so on, will itself also be hierarchical in form. From the viewpoint of control, and more particularly from the viewpoint of information processing, the control of a hierarchical system will itself have a hierarchical form (see Figure 6.2) in Chapter 6.3.3.1); the coordinative controllers at the lowest level will apply to the lowest-level clusters, the next higher controllers to the coordination of the next-lower controllers, and so on. This implies that the structure of the coordinative control is determined by the decomposition of the system into clusters. Returning to our example, this implies that, depending on whether the faculties per field of study are perceived as similar, i.e. faculties are clustered per field of study, or whether the faculties are perceived as similar within a university, i.e. they are clustered per university, the coordination will consist of an interuniversity instance or of the university itself. An existing interuniversity authority more or less representing the faculties in one field of the study is the section concerned of the Academic Council, so that the matrix configuration of the 'authority' structure of the Dutch university administration system in fact reflects both perpendicular forms of coordination of faculties (see Figure 8.14 in Chapter 8.2.4).

In conclusion one might state that it is by no means certain that the existing coordination structure - faculties, universities, Academic Council - is the optimum. One should first realise fully what precisely has to be coordinated and this corresponds to the decompositional question of what exactly the similarity relations between the faculties are. One should first obtain a systematic list of important aspects, then determine the similarity relations per aspect, decide what clusters are as similar as possible and finally construct a coordinative control structure on that basis. It has been shown that actually there seems to be little theoretical evidence for the existing clustering of faculties per university and the implied interuniversity coordination. According to our conceptual framework on decomposition and coordination a clustering per field of study and some interfaculty coordination would be more adequate. People who want to link up with existing organisations can be reassured that both possible forms of coordination already have existing 'authorities', namely the university administration and the sections per field of study. A change in coordination structure would only imply a change in relative influence of both 'lines'. Note that the sections have almost no influence at all.

Coordination in context

Before considering the structure of the system of the decision-making about numeri fixi, in fact before considering any system at all, one should concern oneself with the problem of the boundaries of the system, in other words, the demarcation

problem. As de Zeeuw has repeatedly stipulated the great danger in analysing closed systems is that of overlooking side effects caused by the influence of the environment on the system, the so-called 'problem of context' (de Zeeuw, 1977a, 1979). In the description of the case study one context problem was emphasised in particular, namely the fact that the numeri fixi decision-making is directly related to the decision-making about (personnel) means and curricula. It was shown in Chapter 8.1 that the educational system could be represented as a system of three interrelated entities, namely means, tasks and students and that the control of such a system should itself also consist of the interrelated controls of these three entities (see Figure 8.3 in Chapter 8.1). Consequently the control system for numeri fixi has strong relations to the two other control systems; in systems-theoretical terms this control system has a strong external structure. Thus in terms of external structural control (coordination) of the decision-making system, serious attention should be paid to the integration of the three decision-making systems. For the three factual decision-making processes do take place separately.

Structural coordination of the phase systems

In Chapter 8.2.1 the organisation of the decision-making system has been discerned in two kinds of structures, namely a phase-system structure and a subsystem structure. It has already been mentioned that in fact both structures of the process coincide: the subsystems in fact form the phase systems (see Figure 8.9). This coincidence, however, does not mean that both structures should be considered from the same point of view. The relationships differ to a great extent in both cases. So let us first separately consider the structure from the phase system point of view. As remarked in Chapter 8.2.4 the phase system structure could not be fully explained with the usual phase scheme which considers decision-making as a sequence of cognitive, learning phases of a problem-solving process. Such phases could be recognised but did not yield a systematic explanation of that particular phase system structure. It was found to be more useful to consider it from an information-processing viewpoint. The phase systems are identical with the subsystems but the relationships between these phase systems can be considered as being determined by the time the phase systems need to process the relevant information. Several recommendations for improving the phase system structure can be derived from this point of view. The total duration can be reduced by either increasing the processing rate (decreasing the time needed inside the phase systems) or by decreasing the sequence of processing systems by means of parallel information processing or, very simply, by omitting processing systems. The change in structure proposed by the CC in 1976 consisted, among other things, of a parallel processing

of the information by universities, sections of the Academic Council and Preparatory Committee (DR) together. On the other hand, the Minister has on several occasions reprocessed a lot of information which had already been processed. Parallel processing by sending the department the relevant information at a much earlier stage would save much time. Here authority relations between subsystems, however, play the dominant role.

One can draw parallels between the information processing approach and the general decomposition and coordination approach. One might namely interpret the information processing approach as a method of determining the similarity relations according to the time aspect, in other words, as a method of decomposition into phase systems. Very roughly speaking the information processing considerations yield the time intervals needed per element of the system, so that an integration of these intervals yields an absolute time dimension on which the elements of the decision-making system can be identified. A subsequent clustering of adjacent elements then yields the phase systems. The information processing approach might hence be considered as the basis of the decomposition into phase systems, that is, the formation of phase systems according to the 'similarity' clustering principle discussed in Chapter 6.2.

Phase systems can also be formed by the 'interrelationship' principle. According to that principle some time related aspect should be found. Then the relationships between the elements of the system according to that aspect should be determined. Subsequently the cluster boundaries should be drawn where the relationships are weakest. Actually the same information processing approach might be considered as an example of this second clustering method. Determine the information transfer flows between the elements of the system and determine their strength. Now cluster those elements between which there are large information transfer flows and draw the cluster boundaries where the information flows are weakest. In our example universities, Academic Council and sections have considerable mutual information flows. Minister, Educational Council and Parliament also have considerable mutual information flows. The information flow between the former three and the latter three are much smaller. Hence the decomposition should yield a phase system consisting of the former three and one consisting of the latter three. An extension of this consideration by remarking the strength of the information flows inside a university adds one more phase system, namely that consisting of all faculties in one university. Notice that the thus obtained three phase systems coincide with the factual phase systems of the official advice procedure (see Figure 8.7 in Chapter 8.2.1).

So we see that the general decomposition and coordination framework can indeed be applied to the organisation of whatever part system structure. Although the framework was presented as a

theory on the formation and control of part systems in general, the theoretical elaborations and practical illustrations might have given the impression that it was restricted to subsystem structures only. The above-mentioned examples show that this is not the case. The methods of decomposition by similarity or interrelationships can be applied to aspect and phase system structures as well.

Structural coordination of the subsystems

The first paragraph of Chapter 8.2.5 indicated the procedure in accordance with the conceptual framework of decomposition and coordination. From a theoretical point of view one should first realise what the elementary entities are (the faculties), then decompose - or actually compose - them into a 'hierarchical' system of clusters and structure the 'hierarchical' coordination accordingly. With the decomposition approach, clusters are formed on the basis of the similarity relationships between the elementary subsystems: the cluster boundaries are chosen for a maximum of similarity inside clusters. The same recipe is applied on a next-higher level and so on, resulting in a multilevel 'hierarchical' system. From the viewpoint of control and, in particular, from that of information processing, the corresponding control structure will then have the same hierarchical form. Structural coordination applies to the relationships between the subsystems. In the extreme case that some clusters of subsystems have no relationships at all to each other - in the autonomy case - the answer is simple: there is no need for coordination between them and hence the coordination splits up into a set of separate coordinators of the clusters. Clearly the same argument applies to nearly-autonomous clusters. First form the coordinators of these clusters and then coordinate the remaining weak relationships between the clusters.

This line of argument has already been pursued in the first paragraph of this chapter. Apparently two forms of coordination were possible, that is, a coordination of the faculties per field of study or a coordination of the faculties per university, and apparently it was not clear whether the existing second one was the best in fact. It should first be determined precisely what is to be coordinated instead of simply accepting existing coordinative structures.

As has been mentioned repeatedly, the 'authority' relationships between the subsystems apparently play a much more important role in factual coordination. Chapter 8.2.4 indicated how one could try to determine the legal authority relationships by relating the structure to the legal administration structure of scientific education. It was found, however, that officially the responsibility as to student admissions is nowhere settled once and for all. The pyramidal 'hierarchy' of faculties, universities, Academic Council and Minister has been followed, mainly

because it already existed at the time of the introduction of the legal measures.

Goal coordination

Goal coordination, i.e. the control of the system of goals of the decision-making, does take place. Examples of the directed influence on goals have been presented. Parliament secures the 'freedom of study' goal. Faculties and university management alternately influence each others' goals, sometimes in order to decrease numeri fixi, sometimes to increase them. Although it is obvious that the control of goals is a rather difficult activity, one might, however, think of additional coordinative measures here. If one perceives the controversy between faculties on the one hand and university administration on the other, and if this controversy is not immediately regarded in terms of authority relations, it might be a good idea to try to introduce some procedure by means of which goal consensus could be achieved.

8.3. META-METADecISION-MAKING: THE PROCESS OF ORGANISING DECISION-MAKING

As has been noted in Chapter 8.2.2 structural metadecision-making has not been done consciously, that is, in the sense that there is no specific metadecision-maker. The only bodies that one can 'interpret' as doing this are the Parliament in its legislative function and the Capacity Committee of the Academic Council. In fact the same subsystems that perform the object-level decision-making - universities, Academic Council, Ministry - are also the metadecision-makers. It is therefore not surprising that one can not pinpoint a certain meta-metadecision-maker which fulfils the task of organising the process of organising decision-making. Again, the same object-level decision-makers in fact perform that meta-metataask. Meta-metadecision-making is also implicit rather than explicit and can only be illustrated in an interpretative sense.

The process of organising

In Chapter 7 a distinction has been made between 'the process of organising decision-making' and 'the process of organisational change'. A description of the latter process has in fact been given in Chapter 8.2. There we have described the major organisational changes that have occurred since the law of 6th July 1972: the change in the intra-university procedure as to faculties' right of initiative, the change in latest data, the change as regards the universities not concerned, the change in the interuniversity procedure up to the Academic Council, and the change in the

procedure regarding the sections of the Academic Council. On the 'process of organising' one can actually be very brief. All the organisational changes apparently have a strong ad hoc character; something went wrong and the corresponding details in the procedure were adapted. The result of this kind of organising has been legislation containing a large number of articles all dealing with specific part-problems. Even in the Ministry it is admitted that the law does not come out particularly well in systematics and comprehensiveness. One of the reasons for this is that the law was originally intended as temporary, emergency measure. This is indeed reflected in the law itself. It is no wonder that the organisational changes being rather ad hoc, the process of organising is itself rather unstructured. In fact the only structure in this process is the parliamentary procedure for bringing in and deciding upon bills. In the case of the change of procedure in interuniversity deliberation which the CC proposed, the process of organising was determined by the organisational setting. The Capacity Committee is a subsystem of the Permanent Planning Committee which is a subsystem of the Academic Council whose plenary meeting is prepared by the Preparatory Committee (DR).

Summarising one can say that neither of the specific organisational changes really are the result of a consciously controlled process of organising, nor do the organisational changes together form a consciously controlled overall-process of organising.

Situational organisation

The situational character of the process of organising was obvious. In fact the organising was extremely situational in character as the existing situation was usually retained. As has been shown, only existing subsystems were introduced into the decision-making, and the existing relational pattern between those subsystems - the 'authority' structure of Dutch university administration - was taken over. Although the formulation perhaps sounds somewhat negative, from a situational point of view such organisation of the decision-making is quite understandable. The *numerus fixus* decision-making does not stand alone. As has been shown, a simple model of the educational system reveals that it is strongly interrelated with the distribution of means and the curricula. In a broader context *numerus fixus* decision-making is just one of the very many decision-making processes taking place in the university administration system. Hence it is quite obvious that its organisational structure is the same. A simple process inside a system with a completely different structure is indeed inviting difficulties.

PART FOUR

FINAL CONSIDERATIONS

CHAPTER NINE

CONCLUSIONS AND DISCUSSION

This study did not pretend and did not result in a ready-made, directly-applicable theory on the organisation of decision-making. There is still a long way to go before that can be achieved and the author does not pretend to have covered a large part of that long road. But before plunging into the self-relativism common to epilogues, what the study did contribute should be pointed out.

Science of prescription

Organisation science in general and organisational decision-making science in particular is primarily aimed at practical problem-solving. Although this statement might seem trivial and in fact it would seem to hold good for all sciences - after all science is not 'l'art pour l'art' - it has been shown that its implications were less trivial. The statement implies that this kind of science is prescriptive rather than descriptive and that is where difficulties start. The problem is that an explanatory aim is generally attributed to 'science'. Science serves to formulate explanatory theories on empirical reality. Consequently methodology of science is restricted to the procedure of obtaining explanatory theories. In other words, there is no explicit methodology of prescriptive science. The scientific method to be followed in order to arrive at sound prescriptions is an open question. In Chapter Two the attempt has been made to give some indications of how to approach this problem. First the 'classical' scientific approach to prescription has been outlined. In this view the logical pattern of prescription coincides with that of explanation. First find your theoretical laws or at least a good predictive model, then you are allowed to perform your normative activities. On the other hand I have briefly indicated alternative methodologies of prescription which do not stipulate requirements as troublesome as the finding of scientific laws. The latter methodologies however still entail many unanswered questions. Obviously the dilemma is to choose between the safe and sound but troublesome classical methodology or the search for new directly prescription-oriented, hence convenient,

but rather unsound alternatives. Although some readers might gain the impression from all these seemingly endless considerations that it would be better to solve problems than talk about problem-solving, I must emphasise that I am strongly opposed to this opinion. In my view it is this straightforward attitude - a rather mild qualification of 'don't think, just do' - that is the root of all evil: it constantly blocks scientific progress because of its assumed 'inutility' and in my opinion it could in the end undoubtedly even make useful problem-solving impossible. It is very true that practitioners are mostly better problem-solvers than 'academics'. The reason for this however is not that all science is senseless but that scientists perhaps developed the wrong science, that is, that there is not yet a prescriptive science. And the fundament of any prescriptive science must be a science of prescription, i.e. a methodology of prescriptive science.

Framework for organisation of decision-making

Besides some considerations on rationality which in fact formed an introduction to the main theme in that they showed the importance of structural rationality, the book has been mainly devoted to the development of a conceptual framework on the organisation of decision-making.

First it has been shown that, by adopting a control systems viewpoint, organising decision-making could be identified as a form of metadecision-making. Some theoretical considerations on this structural mode of metadecision-making have been presented. The advantage of explicitly adopting a metasystemic approach is that it emphasises the distinction between the roles of the system and the metasystem such that it becomes clear that the former carries out procedures and implements standards whose design is formulated in the latter. This separation, taken for granted by many decision-makers, receives more emphasis by showing two different systems with separate functions. The case study in Chapter Four had already shown how very important the metadecision-making about the organisation of the decision-making process was. Although most decision-makers are busy dealing with the 'substantive' decisions to be taken, there are many situations where the structural aspect is predominant.

After these metasystemic considerations the main subject itself was dealt with. From a systems-theoretical point of view on organisation two key-stones of the conceptual theory were derived: decomposition and coordination. Decomposition yields a set of part systems of the decision-making system. Coordination is the control of these part systems. It has been shown that, essentially, there are two methods of decomposition. In the classical one elements are clustered according to their similarity into homogeneous part systems. The alternative method is to form part systems so that the relations between elements inside the part systems are maximised and the relations between elements in differ-

rent part systems are minimised, in other words, maximise intrarelations and minimise interrelations. The latter method was found to be particularly suitable from an administrative control point of view. Contrary to the common organisation-science definition of coordination, which is generally restricted to structural coordination only, our broad definition explicitly also incorporates goal coordination. Both the goal and the structural modes of coordination have been considered in depth. The advantage of the control-systems approach is that it enables a consistent and comprehensive treatment to be made, thus preventing the failure to restrict oneself in advance to one specific form of coordination.

Finally, the process of organising decision-making has been considered. It was shown that by following the metasystemic line of argument, the same frame of reference could actually be used for this subject; it simply becomes meta-metadecision-making. We have focussed on a situational approach. First some comments have been given on the well-known situational approach, called 'contingency theory'. It was found that 'contingency theory' is conceptually rather vague both as to its theoretical fundamentals and its empirical research methods. Hence we have briefly outlined an alternative situational approach to the process of organising decision-making. Although one might object that the practical fruitfulness of contingency theory is much larger than that of my alternative, the alternative at least possesses conceptual clarity. Moreover, it seems rather fashionable to do contingency research nowadays whereas I am no dedicated follower of fashion.

Relevance of control systems approach

In view of the fact that one of the primary reasons for my conceptual theory was to attain some consistency and completeness, it is not surprising that I used systems theory as the underlying approach. The conceptual frameworks presented are based on the assumption that decision-making can be regarded as control, where control is interpreted in a broad sense as any form of directed influence. This conceptual identification of decision-making and control consequently opens the way to using the whole framework of concepts on control systems as a basis for my conceptual framework on organisational decision-making. The advantage of the use of the particular framework on control systems is that it offers a framework of abstract non-empirical concepts which are not restricted in advance to some specific field of application. The control systemic concepts are abstract empty concepts which can be given any desired empirical content. As a matter of fact we have seen an illustration of this flexibility in the derivation of a conceptual theory about meta-decision-making: the same control-systemic framework that could be applied at the object level of decision-making

could also be applied at the next-higher metalevel of decision-making about the decision-making. Indeed the degree of freedom made possible by this control-systemic interpretation of reality is very great. The concepts are object-independent and different points of view or levels of consideration yield different results. In other words, the framework is inherently pluralistic. For a traditional scientist striving at uniqueness of solutions this pluralism might seem a horror. From a methodological theory-pluralism point of view (Feyerabend, 1975) this inherent pluralism of the control systems framework, on the contrary, constitutes one of its main advantages. The explicit obligation to consider some problem from different viewpoints, in my opinion too, is very fruitful. One might even go a step further as to the evaluation of the role of systems theory in the development of a science of organisational decision-making, or more generally of organisation science. Instead of restricting the pretensions to the statement that systems theory, particularly the control-systems framework, forms the conceptual metaframework for a science of decision-making and organisation science, one could say that this particular systems theory might form the methodology of organisation science.

Let me explain this claim. First of all it should be observed that in this statement methodology should not be understood as the science of science in general, that is, as that part of the philosophy of science which deals with the reconstruction of the scientific method (Koningsveld, 1976). Methodology here has a more restricted meaning. There are, namely, several interpretations of the term methodology. The first interpretation is that of the methodology of science as part of the philosophy of science. The second interpretation is that of a way of approaching problems, that is a method of praxeology. Kramer (1978) presents four different versions of this second interpretation of methodology: a theory of practice, a science of goal-oriented action, a metamethod and a normative theory about the approach to problem-solving of which he chooses the last version. The third interpretation of methodology is that of the term method, that is, a prescription of how to solve a particular class of problems, which is a singular form of the second interpretation. If one interprets methodology in the second sense as a normative theory about praxeology, the control systems framework can indeed be considered such a methodology for organisation science. It has been shown that the control paradigm, being a normative intentional model, can indeed be considered as a prescriptive theory. This fact, together with the conceptual identification of decision-making and control, indeed seems to justify the claim. A factual support for this claim can be found in a number of recent studies where control-systems theory is used as a methodological basis for organisation science (Kramer, 1978; van Aken, 1978).

Relevance of conceptual framework

Finally we can not sidestep the characteristic of the book that has probably been most disliked by many readers, even those who managed to hold on as far as this point, that is, the fact that the conceptual orientation made the whole thing so abstract, or to put it in less neutral terms, that the book gave the impression of a sterile exercise in the manipulation of abstract and empty concepts, that it aimed at some pretentious 'grand theory' with the ambition to provide universal solutions for all kinds of specific practical problems. These readers, however, totally misunderstood the nature and aim of a conceptual framework. Its claims are much more limited and modest. A concept is defined as a method of perception, a way to create order in the chaos of impressions. A conceptual framework basically tries to develop a useful way of looking at reality and in this sense tries to serve as a helpful guide in empirical investigations of ill-structured, messy problems. Such conceptual tools do not provide final solutions to problems, they only constitute the basis for their adequate handling.

The frequent objection that the formation of such conceptual frameworks is premature in view of the limited present-day knowledge of the field, is also a fundamental misunderstanding. The argument that only the accumulation of many more findings will enable theories to be developed at such a high level of abstraction, completely misunderstands the process of scientific progress. This empiricism, typical of Logical Positivism, has long since been overcome. Critical Rationalism (Popper, 1959) proved that theories do not arise from empirical reality. Theories are tested against reality. And the tentative theories to be tested are the result of a foregoing process of formation of concepts, operationalisation into variables, isolation of relevant concepts, finding of relations. It is only after the stage of conceptual framework formation and the stage of the formation of a framework of variables that the scientific process proceeds with the tentative construction of theories, their testing and their validation. Obviously the path to be travelled before anything practically useful can be achieved is very long. It is therefore no wonder that scientists prefer shorter ways. An example of such a shorter way is to start directly from so-called 'practical experience'. Classical organisation science might be considered an example of that shorter way. From 'practical experience' with organisations, prescriptive statements are derived that should be applied to solve practical problems. In extreme form these prescriptions are given without any underlying empirical confirmation. In still more extreme form almost universal validity is moreover attributed to these statements. Apparently this has little to do with science, notwithstanding the fact that the proposed prescriptions might appear to be very practical, useful

and effective. Modern organisation science has luckily learned from the historical fallacies and took a more scientific path. Contingency theorists are busy constructing an empirically validated theory about organisations before going over to construct prescriptive recommendations. In fact, as a reaction to the empirically non-validated and universal utterances of classical organisation theory, modern contingency theory seems to be concentrating exclusively on empirical research. Instead of yielding non-validated theories they seem to have ended up in the usual social scientific other extreme, that is, empiricism. Although there is nothing wrong with the proper scientific modesty that contingency scientists show, which implies that they only present singular empirically validated statements, it is a fallacy to believe that this empirical overemphasis guarantees the development of theories. This logical positivistic attitude has been proved to be wrong. And in my view one of the most important reasons for this theoretical non-productivity lies in the omission of underlying conceptual frameworks. Without this kind of framework it seems impossible to connect all the singular statements or even restricted part-theories together into a more comprehensive theory. That is why I claim that my method of starting with the development of a conceptual framework is scientifically more fruitful.

The method being scientifically fruitful, how about the end result, in other words, to what extent are the conceptual frameworks developed in this study fruitful? The answer to this question is rather difficult because of the meaning of conceptual framework: it serves as a way of looking at reality and thus as guidance in empirical investigations. Whether the way of looking is useful and the guidance is helpful is not a matter of descriptive validity of the concepts. Whether or not some practical phenomenon fits into one of the proposed concepts is not important. It is not the isomorphic representation of reality which guarantees the usefulness and helpfulness of a conceptual framework. In view of our scheme of the process of scientific progress the fruitfulness of a conceptual framework lies in its fertility in the development of a theory. A conceptual framework is a first stage. It should be extended, elaborated but, above all, disaggregated towards a 'real' theory. The fact that my conceptual theory is based on an abstract and empirically empty system of concepts might be advantageous from the point of view of completeness and consistency and above all from the point of view of theory-pluralism, it however implies that, in order to attain an empirically non-empty theory, empirical reality should be added. A first empirical filling up of the abstract empty concepts has of course taken place by means of the conceptual identification of decision-making and control. The control-systemic concepts were thus given a first empirical content. This first empirical filling-up however is only very preliminary. The con-

cepts remained very abstract. In order to arrive at a set of variables which have an empirical content sufficient to form the basis of an empirical theory, much more filling up has to be performed. Here the conceptual framework and particularly systems theory however cease to play a role any longer. The empirical filling up does not come from the conceptual framework or systems theory but should come from the particular field under consideration. That is why one can not attribute to my conceptual framework more than a heuristic value.

The completion of the process eventually leading to an empirically significant theory on the organisation of decision-making should proceed along the line of a steady mutual interaction between the conceptual framework and the empirical field of study. Of course this dialectical adjustment process can not be predicted. The iterative application of the conceptual theory on the field of study and the resulting iterative adjustment of the conceptual theory, implies that from now on empirical reality should play a much more important role than it did in the construction of my conceptual framework. An important additional implication of my emphasis of the need for a dialectical interaction process is that my conceptual framework is merely a first preliminary one. I explicitly add the adjective 'first' in order to stress that it is equally unpredictable whether during this process it will not be found that a different conceptual framework might serve scientific progress better than mine.

That is the personally less hopeful prospect for any scientist.

In view of the foregoing there is probably no need to bring this book to a close with the usual plea for the necessary and inevitable further research.

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STELLINGEN

behorende bij het proefschrift

ORGANISATION OF DECISION-MAKING

van

W.J.M. Kickert

16 november 1979

- I. Het veelvuldig gebruik van de term 'paradigma' voor een nieuw wetenschappelijk idee is een kwalijk modeverschijnsel aangezien het vermoedelijk berust op een verkeerd begrip van de term. De term is namelijk methodologisch multi-interpretabel.
- M. Masterman: The nature of a paradigm, in I. Lakatos and A. Musgrave (eds.): Criticism and the growth of knowledge, Cambridge Univ. Press, 1970.
- II. Er zijn empirische aanwijzingen voor het zetten van vraagtekens bij de wijdverspreide acceptatie van het fasenschema van een probleemoplossingsproces - identificatie, ontwikkeling, evaluatie, keuze, implementatie - als fundamenteel raamwerk in besluitvorming, planning en beleid.
- E. Witte: Field research and complex decision-making processes - the phase theorem, Int. Studies Man and Org., 1972, pp. 156-182.
- III. Steinbruner's 'cybernetic paradigm of the decision-process' lijkt te zijn gebaseerd op een gebrek aan kennis t.a.v. zowel de laatste ontwikkelingen in de cybernetica als die in de besluitvormingstheorie.
- J.D. Steinbruner: The cybernetic theory of decision, Princeton Univ. Press, 1974.
- IV. Ofschoon Nutt's poging om tot een situationele hantering van verschillende besluitvormingsmodellen te komen, toe te juichen valt, begaat hij de logische fout om het kenmerk waarnaar hij de modellen classificeert tevens te gebruiken als contextuele variabele voor de keuze van een model. Zijn contextuele hypothesen zijn derhalve tautologieën.
- P.C. Nutt: Models for decision-making in organizations and some contextual variables which stipulate optimal use, Acad. Man. Review, 1(1976), pp. 84-98.

- V. Mintzberg benadrukt in zijn verhandeling over de structuur van strategische besluitvormingsprocessen terecht dat die structuur geen rechtlijnige maar een zeer gevarieerde aaneenschakeling van de diverse fasen is. Het is echter betreurenswaardig dat Mintzberg niet verder uitweidt over de wijze van gevarieerde aaneenschakeling, m.a.w. over de besturing van de structuur (decision control).
- H. Mintzberg et al.: The structure of unstructured decision processes, Adm. Sci. Qu., 21(1976), pp. 246-275.
- VI. Etzioni's "mixed-scanning" benadering van besluitvorming is geen synthese van rationaliteit en incrementalisme aangezien zijn "first overall-view scan" en zijn "second detailed scan" bij nader inzien niet overeen blijken te komen met respectievelijk rationaliteit en incrementalisme.
- A. Etzioni (1967): Mixed scanning, a 'third' approach to decision-making, Public Adm. Review, 27(1967), pp. 385-392.
- VII. Indien "chaos" geïnterpreteerd wordt als het cybernetische begrip "variëteit", kan bewezen worden dat het openbaar bestuur wel degelijk "chaotisch" moet zijn.
- "De verzorgingsstaat - bestuurlijk een chaos?", Congres Vereniging voor Bestuurskunde, Amersfoort, april 1979.
- W.R. Ashby: Introduction to cybernetics, Chapman and Hall, London, 1956.
- VIII. Het rigide hanteren van methoden en technieken bij empirisch onderzoek naar strategische besluitvorming gaat veelal niet gepaard met relevantie van de resultaten van dat onderzoek.
- IX. Indien men organisatiekunde opvat als wetenschap gericht op probleem oplossen, is het essentieel dat aandacht wordt besteed aan een methodologie over prescriptie.
- Zie hoofdstuk 2.1 van dit proefschrift.
- X. Relevante problemen binnen het vakgebied der organisatiekunde zijn zo 'complex' dat ze bij voorkeur door onderzoeksteams aangepakt dienen te worden.
- Mede gezien de tendens op universiteiten dat het relatief aantal promotie-onderzoekers toeneemt, zal het aandeel van promotie-onderzoek in het totale universitaire onderzoek toenemen.
- Promotie-onderzoek impliceert meestal individueel onderzoek. Derhalve zijn de condities niet optimaal voor succesvol en relevant universitair organisatiekundig onderzoek.

XI. In de pers wordt vaak de indruk gewekt dat de democratische bestuursstructuur van universiteiten - de WUB - mislukt is door een overmaat aan invloed van studenten op vakgroepe-niveau. Serieuze onderzoeken hebben dit in zijn algemeenheid niet aangetoond. Incidentele steekproeven tonen aan dat het tegengestelde soms waar lijkt te zijn op Technische Hogescholen.

Het bestuur van universiteiten en hogescholen onder de WUB, IVA, Tilburg, juni 1978.

Gewubd en gewogen, rapport commissie Polak, maart 1979.

XII. De positieve connotatie van de uitdrukking "het gaat iemand voor de wind" berust op een misverstand. Een voor de windse koers is voor een modern getuigd zeilschip juist een van de moeilijkste en gevaarlijkste en bovendien niet de snelste.

XIII. Rectificatie dient niet verward te worden met falsificatie.