From anticipation to action

A handbook of strategic prospective

Michel Godet

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From anticipation to action

A handbook of stratégie prospective

Préface by Joseph F. Coates

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Préface

In an âge of anxiety and a period of transition., ail institutions crave insight into the future. The globalizing of the world's économies is creating new complexities for business planning and aggravating uncertainties about the business environment. The imminence of the miliennium is, for many, a social milestone, a point at which the future of nations will be seen to be bright and optimistic or in décline. In every sector, stocktaking, anticipation and plans are the order of the day as we approach that transition.

This attention to the future is surely favourable to the human enterprise. But the anticipation of the future is stérile unless it is accompanied by systematic, well-grounded, comprehensive actionable plans. Since the séminal work of the Marquis de Condorcet at the tirne of the French Révolution, the Western worid has learned that it can identify long-term trends and that it can anticipate many of the conséquences of new developments. Further, it is clear that our actions influence the future. But more important is the récognition that we can consciously act to influence the future in directions in which we wish it to evolve.

Surely no one but a fool would ciaim that we can see the future with crystalline clarity or that we can take actions which will détermine the future. AH we need is to agrée on this modest claim: that we can see the future to a degree that is useful for planning and that we can take actions which will make désirable outcomes more likely and undesirable outcomes less likely.

Central to the current look to the future is the concept of alternatives - that in view of ail the complexity ahead of us, it makes little sensé to say 'this will happen' or 'that won't happen[1]. Taking complexity into

account, we need to recognize a range of alternative futures as the basis for planning and systematic action.

Professor Godet's vvork is an outstanding example of the intégration of anticipation and planning for action. But his strengths as an analyst and as a planner go well beyond that. Too much of the study of the future - even today in this globalizing world - is parochial and provincial. Few British or American futurists, planners and forecasters pay much or any attention to work done outside their national boundaries and even less attention to work done outside their native tongue. One of the accomplishments of Professor Godet is to vvork across cultures and across languages to give his work a value which is enhanced by his catholicity of perspective and broad embrace of materials.

By being cross-national in its orientation, Professor Godet's work is an unusuat, if not unique, contribution to the management and futures literature. It draws on a wide range of expérience and illustrations and offers a broader démonstration of techniques practised by corporations and other organizations than is generally found in other sources. Godet's work is an attractive intégration of theory, the historical évolution of management and planning techniques and the practical tools of the trade, ail amply iliustrated. Again, unlike other vvriters in the field, Professor Godet offers a felicitous combination of technique and substance.

Beside UNESCO's traditional readership of national and régional planners, the primary audience for Professor Godet's book is business and other organizational planners. The secondary, and nearly as important, audience is professors teaching courses in business schools in relation to planning and the future. Along those lines, it might be noted that many American business schools hâve their curricula under re-examination and are moving to intégrale futures thinking into the Master of Business Administration programme. Professor Godet's work shouid make a spécial, positive contribution to that new move.

The book shouid also find a substantial audience among individuals without planning responsibilities, vvho, out of curiosity or concern, seek a better understanding of the choices before us and the tools for exploring those choices,

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1. For another future

1. Dreams create reality

This book is, above ail, a manual of prospective and strategy; its main aim is to provide simple, operational tools for the conspirator of the future, which potentially means ail of us. What does this mean? How can we reconcile intuition and reason? How can we move from anticipation to action? What are the keys to excellence? What should we make of the successive fashions and models which dominate prospective and stratégie thinking? Thèse are the main thèmes which we shal! address in this introductory chapter, before outlining the book's format.

1.1. THE DANGERS OF BEING REACTIVE AND THE BENEFITS OF BEENG PRE-ACTIVE AND PRO-ACTIVE

Unfortunately, anticipation is not widespread among managers. When ail is going well they can manage without it, and when things are going badly it is too late to see any further than the end of one's nose: one has to react, and quickly.

However, reaction alone leads nowhere (remember Seneca's comment: 'There is no favourable wind for the man who knows not where he is going[1]). In other words, if there is no future direction the présent is empty of meaning. This emptiness is frightening; in the absence of a plan, too many managers thus find a constantly renewed outlet in the intoxication of action. Too many managers pedal like crazy

from one stage to another, according to an itinerary imposed by the whim of circumstance. Absorbed in their efforts, with their no ses at the handlebars, they no longer hâve the time to think. Eventually, in full swing and on the verge of exhaustion, they iose their balance. Let us reiterate: action in the short-term reality has no meaning unless it takes place in the long-term context of a plan, because 'the future is the *raison d'être* of the présent'.

Prospective is above ail an attitude of mind (anticipation and will) and a way of behaving (with imagination and hope) mobilized in order to ensure quality and control of our présent and future existence. Prospective reins ta tes désire as the productive force of the future. If it has no future direction the présent is empty of meaning. Thus, dreams do not oppose reality, they create it, and a pian animated by désire is the driving force for action.

1.2. USING INTUITION AND REASON FOR PLANNING AND ACTION

Whilst reflection must not paralyse action, pilotage with vision while keeping a look-out cannot replace strategy. It is because of past lack of anticipation that the présent is full of questions, which yesterday were insignificant but which today are urgent and which hâve to be settled now, to the détriment of what is important for the future.

So it is time we stopped opposing pilotage with vision (intuition) and stratégie pilotage (reason). Both are necessary; it ail dépends on circumstances. A person cannot be reduced to a rational mind (the left brain); he is also driven by the emotional faculties (the right brain). Rational and heuristic schools of stratégie thought are only apparently in opposition; in fact they are complementary. If one or the other is denied, a person's behaviour becomes crippled, because he now has only a debilitated thought faculty.

A sound initial reflection, imbued with relevance and cohérence, reinforces the efficacy of action and réaction in the face of events. In the rire of action the time for reflection is limited to a few moments of intuition and refiex thought. Intuition is the lightning flash which springs from the right brain through the synthesis of information and analysis stored in the left brain; hence the importance of initial reflection and of accumulating such reflection. The same applies to réflexes - they are better after intensive training.

Being reactive should not be confused with being flexible. The first is improvised as an organization's appropriate response to external hazards.

The second is kept up as an intrinsic capacity of the organization to react and adapt to the environment without losing its direction. In other words, internai flexibility is the condition for external reactivity. The first dérives from physical condition, the second from réflexes.

1.3. FROM ANTICIPATION TO ACTION BY MEANS OF APPROPRIATION

Intellectual and emotional appropriation is a compulsory stage if anticipation is to crystallize into effective action. Thus we discover the three components of the Greek triangle: prospective thought gives content to mobilization, maintains motivation (motives for action) and nourishes stratégie will.

We can define thèse three components as 'Logos' (thought, rationality, discourse), 'Epithumia' (désire in ail its noble and not so noble aspects) and 'Erga' (action and realization). The marriage of passion and reason, of heart and mind, is the key to success in action and to individual growth (the body).

Let us give the same message in colour: the blue of cold reason associated with the yellow of warm feeling produces the green of brilliant action. In the Greek triangle we find old debates which are still current. Thus men of thought complaín about not having a grasp on action, and men of action complain that they lack the time for refiection.

One day we realized that the best ideas were those that people discovered by themselves. The phenomenon is well known: a good idea will move up the company hierarchy more easily if the boss believes it cornes from him; one should adopt this same reasoning with people one wishes to convince.

Any thinking which is not appropriated by those concerned and which relates to change will hâve difficulty crystallizing into effective stratégie action. On the other hand, there must be a 'content' to be appropriated. Individual and collective motivation and mobilization are stronger and last longer when there is willingness to be drawn upon for a future project. The Greek triangle has its head at the base, in order to show that reason is not enough to ensure balanced action, and that passion is a necessary stage (Fig.l).

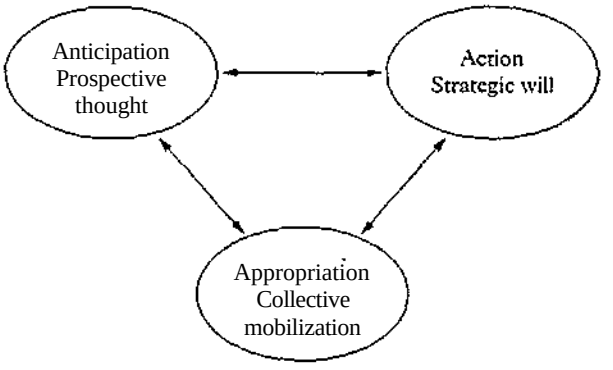


FIG. 1. The Greek triangle: prospective gives content and direction to collective mobilization. © M. Godet.

1.4. CONTINGENCY AND CHANGE: 1,001 KEYS TO EXCELLENCE

According to the principle of contingency,[1] there are no universal key factors of excellence which are valid in ail circumstances. For example, zéro stock and just-in-time hâve been profitable aims for some companieSj but also very expensive or even ruinous for others.

Management theorists should recall that statistics teach us not to confuse corrélation with causality. It would appear that the authors of *In Search of Excellence* (Peters and Waterman, 1982) forgot this distinction. In their X-ray of successful United States companies in i 980, they noted that thèse companies had various points in cornmon which they immediately termed 'secrets of excellence'. Colinearity is not causality, however; they should hâve examined whether poor performance companies also demonstrated thèse same characteristics. In fact, the majority of companiés cited in *In Search of Excellence* experienced difficultés during the 1980s. Should we conclude from this that the secrets of excellence were actually the secrets of failure?

Certainly not - it is simply a matter of recognizing the principle of contingency and admitting that there are combinations of human, organizational, technical and financial factors which are effective in a particular given context but which wiil not be so in other contexts. Thèse combinations are multiple and change over tirne.

1. Contingency: that which couid not be, or which couid be orherwise; in other words, the opposite of necessity.

The only key factor of success whose permanence we can vouch for is preciseiy this principle of change, 'the source of diversity'. Biaise Pascal noted that 'boredom is born out of uniformity'. Variety is an indispensable stimulant for motivation - without it effectiveness is weakj with it anything is possible. Remember the experiments of Elton Mayo in the 1930s: by increasing and then decreasing tlie light intensity in the factories of Western Electric he increased output each time.

A far-seeing manager is one who regularly introduces factors to break habits. In order to remain motivated a person needs to be permanently diverted and stimulated by challenges. Such challenges are more mobilizing if they are new, and more relevant if they form part of a cohérent trajectory. This is how we should understand apparently disjointed attempts to mobilize tlie intelligence of organizations: leadership by objectives, participative management; quality circîes, company plans, etc. Ali thèse attempts are marked by success and failure. In addition, reactivity and management in real time - which, as we hâve seen, it would be dangerous to make a religion of- can prove necessary and even miraculous in certain précise circumstances.

A universal key to excellence does not exist - it must be permanentiy remodeiled according to environmentaî developments, counteracting the habits which fix organizations in the deep sleep of rigidity. What brought success yesterday could perhaps be the cause of failure tomorrow. In order to adapt to a changing worïd, we need to knovv how to change structures, behaviour and habits.

1.5. TOWARDS A RE VI VAL O !" PLANNING

Any exclusive practice quickly becomes abusive, so managers must be careful to avoid becoming addicts of reactiviry and real-time management. In plain language, we say yes to reactivity, but on the condition that it does not become an end in itself. Tactics, fhat is, contingent decision-making, should not take tlie place of strategy. From this point of View, the expression 'stratégie reactivity' is a source of misunderstanding, as normaily reactivity should be placed at tlie service of strategy. The same applies to so-cal!ed 'stratégie management', a beautiful pleonasm, since by définition the aim of management is to put tlie organization at the service of strategy.

Jean Cocteau put it so well: 'Fashion is what goes out of fashion.' Soon reactivity will hâve had its hour and we shall rediscover, perhaps with new words, the virtues of stratégie planning - a skilful mix of voluntarism and flexibiiity. For this comeback to happen, tlie concept of

the plan wili first hâve to be definitively liberated from the bureaucratie corsets in which it has wrongly been laced.

2. Schools of prospective: models which endure in spite of fashion

It is not by chance that prospective is less sensitive to the effects of fashion than strategy. As a matter of fact the horizon of prospective is usualiy long-term (defined as the horizon at which many things could hâve changed), whereas the horizon of strategy is generally shorter: fashion in clothing changes every year; fashion in housing does not.

Although fashion is too ephemeral for prospective, it has nevertheless experienced différent schools of thought over récent décades. Eric Philipart (1986) has written an excellent synthesîs on this subject. Inspired by him we distinguish hère four schools: post-indu striai, neo-Malthusian, long waves, and bifurcations and chaos.

2.1. THE POST-INDUSTRIAL SCHOOL, BHTWEEN OPTIMISM AND PESSIMÏSM

This school of thought, born in the 1960s, a rime of rapid growth, is symbolized by the work of Daniel Bell (1976), *The Corning of Post-industriai Society: A Veniure in Social Forecasting.* The book's subtitle is not neutral; it conveys the idea that change, particularly technological change, can be accelerated and controlled by forecasting and planning. The methods exist-Erich Jantsch (1967) made a survey of them at OECD. This school of thought, on the whole liighly optimistic, had been championed several years earlier by a book by Herman Kahn and Anthony Wiener (1968) on the year 2000 (i.e. the équivalent of 2025 today). Kahn remained extremely optimistic until his death. His last book (Simon and Kahn, 1984) was *The Resourceful Earth: A Response to Global 2000* (i.e. a response to a report to the United States président published in 1980, which was very pessimistic about future ecosystems).

Alvin Toffier is probably part of this schooi of thought. A talented journalist, he received tremendous média exposure with *Future Shack* (1971), which was subsequently enhanced with his later books, particularly *The Third Wave* (1981). Thekey to success is simple: extrapolate technological change and announce the best sometimes, and often the

worst. As a good journalist, he knows that 'bad news is good news[1]. So in *Future Shock* he wrote:

> We are at the dawn of an international révolution which will overthrow parîiaments and houses of congrcss in the coming décade. But this raising of shields against the ravages of the ill-managed application of technoiogy could crystallize into a pathological form, like a futurephobic Fascism under whose régime men of science would replace Jews in the concentration camps.

We shall make no further comment!

None of this was very serious, but it did hâve the merit of making people think. Forecasting and planning's infatuation with controlling the future came to an end with the oil shocks and the économie crisis. However, several years later, at the end of the 1970s, the champions of the third industrial révolution, which it was believed would ensue thanks to new information technologies, biotechnologies and new materials, rekindled the fiame of the post-industrial society. Daniel Bell kept silent, and technological determinism was reborn out of his ashes. It was a vehicle for unfounded clichés about the society of tomorrow, such as the qualifications required for future professions. Tomorrow's jobs would be in the services, linked to the major trends of modem societies (ageing, leisure, security), which meant, in particular, care in the home, house maintenance, gardening - ail jobs where compétition and demand for quality would impose high standards of professionalism, which should not, however, be confused with high qualifications.

2.2. THE NEO-MALTHUSIAN SCHOOL OF THOUGHT

This school of tliought was characterized by the Club of Rome, founded in 1968 by industrialists, académies and high-level civil servants. In a way this school of thought is also the heir of the 1960s wave of ratio-nalism. It rested on the technique of System dynamics, developed at MIT by jay Forrester. The first report of the Club of Rome by Meadows et al. (1972), *The Limits w Growth,* had an explosive impact. Exponential growth could no longer continue, resources would run out and the worid would collapse under démographie pressure. The report did not really pose the right questions, but it did hâve the merit of provoking a great debate, although it was quickly eclipsed by the économie crisis.

OECD's 'Interfuturs' report (Interfuturs, 1979), produced under Jacques Lesourne in 1978, showed that there were not really any physicaî limits to growthj but more particularly problems of régulation on the

global scale in an interdependent vvorld where, according to Daniel Bell's famous phrase: 'Governments hâve become too small for the big problems, and too big for the small problems.'

Ecology was part of thèse big problems, and the Giobal 2000 report in 1980 began with the following terrible prédiction: 'If current trends continue, the world in the year 2000 will be more polluted, more congested . . .'. In an interview in 1982 Gerald Barney, the author of the report, revealed to us that this first phrase had been censored - that is, remodelled; the original version was: 'If current policies continue . . .*, which is not at ail the same thing. The diagnosis was much less fatalistic but also more accusatory of those who govern us. So the Interfuturs author s were right - it was régulation which was lacking.

Since the end of the 1970s there hâve been two other schools of thought: long wave theory and bifurcation theory.

2.3. LONG WAVES AND CRISES AS BEARERS OF HOPE

The theory of long waves re-established Kondratiev's analyses, which explained successive waves of growth and recession by waves of innovation. Each phase of the growth-recession cycle would last for about twenty-ftve years. Thus, after the high growth of 1950-74, there would be a trail across the désert undl the 1990s. Then would begin the era of a fifth Kondratiev cycle, supported by the technological révolution which had been latent since the 1970s. This theory of technological long waves spawned the neo-Schumpeterian gurus, wel! represented by the works of Christopher Freeman (1974) and Scherer (1986), or in France the so-called régulation school. Thèse works generally emphasized socio-organizational obstacles, that is, the rigidities opposing transformation of production structures and curbing the structural changes which the new technologies would necessitate.

Part of my own earlier work to a certain extent descended from this line - but not totally, for I emphasized above ail the actors (in crisis) facing Systems (undergoing change). From this perspective, crisis is perceived both as the conséquence of rigidities and as the main lever to overcome tliem, changing as it does our habits, structures, and behaviour. Crises are bearers of hope and capitalism is a perpétuai hurricane of créative destruction (to quote Schumpeter). The titles of my books over the years - *Demain les crises* (Tomorrow Crises) (1980), *Crises Are Opportunities* (1985) and (with Jacques Lesourne) *La fin des habitudes* (The End of Habits) (1985) - provide a good résumé of my interprétation of crises and change.

But there is a fondamental différence between this work and that of the supporters of long waves and some of their gurus. I hâve always challenged technologica! determinism, which in our modem societies has taken over from the religious determinism of the past (witii the technological fairy replacing God).

There is no fatalism. There are, on one hand, forces of change and, on the other, forces of inertia. Often thèse are in opposition and we speak of résistance to change or (economically, socially) non-viable change, depending on which is in favour. Structures and behaviour are characterized by strong inertia, which curbs adaptation and évolution and then becomes rigidity if change (whether desired or not) has not been prepared for well in advance.

If long waves exist, they are socio-organizational rather than technological, i.e. they are linked to the non-linear rhythms of societies and people. Unlike people, society shows no regularity between cycles of sleep and intense activity. Random external and internai circumstances can precipitate évolution in an unexpected direction and, for example, give power to certain actors who, armed solely with their will and their plans, manage to overturn the course of events and cause bifurcations.

The collapse of the communist régimes in the countries of Eastern Europe provides a good example of bifurcation - it was unforeseen and nothing enabled us to forecasl it, even though the forces which ied to the splitting up of the empire had been spotted a long time ago (I refer to the work by Hélène Carrère d'Encausse (1979), *L'empire éclaté).*

It was assumed that thèse forces were oniy at work over the very long term and scénarios of violent disturbances and repression were imagined, but never scénarios of almost calm évolution, with a forced march towards pluralist democracy and the market economy. A short time ago it was supposed that German réunification woutd inevitably be accompanied by the neutralization of Germany and the Finlandization of Western Europe . . . Today's reality has overtaken yesterday's fiction. It is Eastern Europe that is westernizing and the former German Démocratie Republic which is joining NATO. We rejoice at ail this. However, the new equilibrium is unstable and could lead to other dangerous bifurcations, particularly in Russia and the new republics, where internai difficulties are weakening the reformist forces. We should not forget the lesson of history: external war often served as an outlet for internai contradictions.

The prospecrivist will bear in mind that one shouid remain modest in the face of the future - that nothing is ever hopeless or established, and that probably part of what is still fiction today will be reality tomorrow. Which part, where and how? We shall not reply recklessly,

but say simply that one must remain ready to face any eventuality, vvhich means, for example, not letting down one's guard on the subject of Europe an defence.

2.4. BIFURCATIONS, DETERMINISM AND CREATIVITY OF CHAOS

At the time vvhen thèse upheavals are occurring (still contingencies), the bifurcation and chaos théories from the hard sciences (mathematicSj physics, biology) are encroaching into the social sciences.

It ait began at the end of the Iast century with the work of the mathematician Poincaré (1889-1908). He showed that certain Systems of parametric équations had no stable solution, but an infinité number of unstable solutions, which could go from one extrême to another as a fonction of the parameters and of time. This is Poincaré's 'mathematical indeterminism'. Thus, there exist sets of équations which are sensitive to the initial conditions vvhose solutions diverge in a chaotic manner. It is also to Poincaré that we owe the notion of the 'diagram of bifurcations'.

We note in passing that there is a double uncertainty hère: uncertainty over the measurement of the initial conditions and uncertainty over the conséquences of this lack of précision for the calculation of the solutions. In such Systems, determinism would be hidden, would hâve ail the appearance of chance, and woutd in any case remain indéterminable (if only because of the lack of précision of die original measurement). Much later thèse ideas were taken up again by Lorenz (1963) in simulating weather-forecasting models. He showed that a slight initial fluctuation could reverberate in an exponential and chaotic way over time. This idea was made famous by the image of the 'butterfly effect', according to which the simple beating of a butterfly's vving in one part of the world could in an extrême case cause a storm in another part some weeks or months later. Thus we once again hâve die idea of a 'deterministic chaos'.

In the 1970s Uya Prigogine and Isabelle Stengers (1979) used the théories and experiments of thermodynamics and physical chemistry to go further and develop the concepts of 'order through fluctuation' and 'créative chaos' (Prigogine, 1990). They showed mat, 'far from the initial conditions of equilibrium', there appeared bifurcations leading to other equilibria. Near dièse critical points, slight internai or externat fluctuations in the system can be décisive in determining whether movement is towards one branch of évolution or another. Transposed to social Systems, thèse slight fluctuations could be, for example, chance

disturbances or individua! actions. At thèse critical points 'fluctuations are dangerous', whereas otherwise they could remain insignificant.

This reading of social Systems based on analysis of the évolution of physical Systems is interesting for prospective in that it reconciles determinism on the one hand (the System has a history which conditions its future possible trajectories, and leads- to one diagram of bifurcations rather than another), and freedom on the other (in the bifurcation zone insignificant actions, caused by chance or by free will, can set off major upheavals). Outside thèse critical points, fluctuations are not events. In thèse new interprétations of évolution, chance, necessity and free will, alternately and together, play a determining rôle.

Other scientists from biology, such as Henri Atlan (1979), participated in this movement, implicitly taking up once again Darwin's principle of natural sélection, adaptation and diversity (1859). Certain chance mutations (fluctuations) vvithin living Systems constitute events. Events can also resuit from fluctuations in the environrnent and cause new adaptations — 'complexity through noise' — that is, a superior variant of the organism/superior mode of diversity in die System. Chance is the driving force of évolution, and noise becomes information. In short, this is 'chance as organizer'.

Is it possible to adapt thèse descriptive théories of the évolution of physical or biological Systems to explain die transformation of social Systems? With die current state of knowledge we hâve to answer in the négative, which is just as well. It is not that we are veiling our faces in horror and retreating into some kind of obscurantisrn (rejecting science and its advances). It is simply that the rea! world is much too complex for us to hope mat one day we will be able to find an équation to explain its hidden determinism. Even if we could, *the* inhérent uncertainty over any measurement, especially socia! measurements, would mean diat, at least in our minds, the range of possible futures would remain wide open; rightly or wrongly, this is our mental image of the famous 'diagram of bifurcations'.

So we hâve to act as if chaotic determinism did not exist and take action in order to move in die direction of those evolutionary branches which seem désirable to us. We prefer Pascale's bet and die mydi of Sisyphus tirelessly pushing his rock to the fatality of determinism. The expression 'chaotic determinism' seems doubly unacceptable to us, since it renders human will powerless in die face of the dual games of necessity and chance.

Bifurcation and chaos theory above ail demonstrate, *ex posi,* that change in structure corresponds to one solution of a System of differentiai équations - for a given value of die environmental parameters. However,

ex ante the question remains„ vvhat will be the value of thèse environmental parameters and their eventual évolution? This problem has to be overcome in order to détermine whether the future which will materialize out of the range of possible futures is a rupture, a disaster, or not.

This is precisely die aim of prospective - to détermine what could be the values of the environmental parameters, taking account of forces at vvork and actors' plans, i.e. what are the possible, reaiizable and désirable scénarios regardless of any offence thèse might cause.

Bifurcation and chaos theory relaunched 'La querelle du déterminisme' (the quarrei about determinism), to quote the title of a collective work published in 1990 (Asterdamski et ai.). The resolute rejection of determinism in the social sciences should not, however, lead to a restraint on research in fondamental science. René Thom, the author of catastrophe theory,-' seems to be isolated in this quarrei. Yethe is right to say that: 'Determinism in science is not a given, it is a conquest, The enthusiasts of chance are apostles of désertion' (see his article entitled 'Halte au hasard, silence au bruit' (Let Us Hait Chance and Silence Noise) (Thom, 1990.)

Many European readers did not corne across this debate, which is now so fashionable, until the highly publicized success of the book on chaos theory by American journalist James Gleick (1987). The bestselling management authors sensed that it was a gold mine, and in 1987 Tom Peters published *Thriving on Chaos.*

In 1986 Eric Philipart wrote: 'In the USA, the utilization of thèse concepts seems still to be timited to the adoption of new metaphors (without attempting to demonstrate the validity of this procédure) as an easy way of giving discussions otherwise lacking in great originality the appearance of novelty.'

In Europe chaos theory is favoured by the média. It is true that the vocabuiary iends itself to journalistic emphasis and whets the appetite with words which make us dream, such as 'strange attractors', 'fractals', 'bifurcation cascades', 'the butterfly effect', etc or which inspire fear, such as 'noise', 'disorder', 'catastrophe', 'chaos'.

2, The terni 'catastrophe theory' has become popular, but it is often misundcrstood, bcciuisc of the vcry strong impact on the imagination of the word 'catastrophe'. For Thom, a catastrophe is the disappearance of onc cquilibrium and the establishment of a consécutive one with a continued modification of potential. Simple cxamplcs are provided by the paasing from a liquid statc îo a solid or gascons state, or the metamorphosis of the chrysalis into a bunerfly (it is the same but it is complctcly différent). On this subject we share îhe views of the mathematician Ivar Eckciand (1984): 'Catastrophe theory has no vocation to be normative or even to predict . . . it docs not announce anything, not even catastrophes … the success of this theory rests partly on an initiai misunderstanding caused by the magie of words.'

It is alvvays good to enrich one's vocabulary, especially when thèse concepts écho well-established mathematical conventions or physical mechanisms. The scientists who write on thèse subjects generally respect the potential and the limiis of thèse concepts. They oniy venture to transpose them into the social domain as questions, and vvith extrême caution.

They will nevertheless be reproached for not always giving the same meaning to the same words - giving rise to misunderstandings which cause epic quarrels between specialists about chance, determinism, etc. Unfortunately, in the field of social sciences the 'fluctuation' in the movement of ideas brought about by bifurcation and chaos theory lias only added to the disorder and confusion in 'houses' where the housekeeping of ideas leaves much to be desired.

We are stitl a long vvay from the 'science of complexity' hailed by some experts (cf. Amara, 1984). Meanwhile it is primarily complication that we are confronting. In fact, complexité' has become a great cooking pot into which we haphazardly tlirow ail the concepts we find on the table of advanced ideas (epistemology, information theory, thermodynamics, dissipative structures, bifurcations and of course chaos, not to mention self-organization). To give the resulting soup a réputation of good cuisine we invoke the names of ail the saints (scholars, intellectuals) who protect thèse concepts. But we forget that they are not ail from the same church. Thus, the so-called 'science of complexity' is rather like a new religion which claimed to be superior because it borrowed from Islam, Christianity, Buddhism, etc. It is an idea than we should ponder over no longer than we would over Espéranto.

Representational models do not escape the vagaries of fashion, and fashion always relies on models. This is as true for prospective as it is for strategy and management - except that prospective has a greater propensity for models, and strategy has a greater sensitivity to fashion.

2.5. MUTINEERS AND MUTANTS AS THE BEARERS OF CHANGE

Where should we place prospective in relation to thèse schools of thought? It has to be said that prospective constitutes an unclassifiable mosaic which borrows the most illuminating aspects of various readings,

From religions determinism prospective retains the fact ṁat the question of why (the clockmaker) is not raised by the answers to the question of how (the ciock). Science is advancing but the idea of God does not recède; it continues to assert itself as a defence against the absurd.

The theory of évolution has brought to prospective tlie principles of natural sélection and adaptation, which hâve lost none of their modernity, for both individuals and for organizations facing international compétition, as Hubert Landierhas shown clearly (1987). The mechanisms exist; it is up to us to make use of tliem for our own beneftt, to adapt to and to transform our environment.

Actors are not disarmed in the face of Systems: they can act either to drive or to restrain évolution. The inertias of structures, behaviour and habits are such that often it is necessary to destroy former organizations in order to create new ones.

From chaotic determinism prospective wili retain bifurcations and the possibility that certain mutineers or mutants may be bearers of change: 'Not any individual, idea or behaviour, but the "dangerous" ones, that are ab!e to use for their own benefit those non-linear relations which would ensure tlie stability of the former average state' (Prîgogine and Stengers, 1979).

How are we to recognize bifurcation points? 'Which events, which innovations will remain without conséquence, which otliers are capable of affecting the whole System and determining irreversibly tlie choice of évolution; where are the zones of choice, and the zones of stability?' Thèse are the questions which make up the daiiy menu of prospective. When we identify tlie range of possible futures are we not also recognizing the diagram of bifurcations? Are not the parameters of bifurcations also the key variables of prospective analysis?

Since determinism is indéterminable, we must act as if nothing had been set in motion, as if only tlie rébellion of free witl could overturn tlie tyranny of chance and necessity.

For sorae years we hâve noticed that scientific work has been converging on tlie concept of self-organization. What are we to make of this new fashion of self-organization? Is its success due to the ïact that it is both suggestive and fuzzy? It is as much an écho of Fourierism or workers' struggles as it is of cybernetics (Von Foerster) or Prigogine's 'order through fluctuation'. Now it is penetrating économie science (cf. Lesourne, 1990). In its new acceptance it forms part of the gataxy of concepts mentioned above.

What is it ail about? For Jean-Pierre Dupuy (1982), 'The self-organizing process seems to be a resuit of interaction between an autonomous structure and chance events which are extraneous to it. Because it thus allows adaptation to the new and to production again self-organization achieves, at least localiy, a reversai of time's arrow.'

This 'reversai of time's arrow' is no more than what prospective means by 'The future is the *raison d'être* of the présent'. In other words,

we can say that désire as the productive force of die future is also die main driving force of self-organization.

3. Schools of strategy: contradictory fashions> complementary models

Fashion has a short memory, Many ideas on organizational management and strategy are worthy of die famous comment recalled by Georges Yves Kervern (1986): 'Good ideas and new ideas, unfortunately, are not die same thing.' In fact, in stratégie circles new things are often not interesting and interesting things are often not new, as we can see if we look back to the sources of military stratégie diinking (Clausewitz, General Beaufre), and to the founders of managerial thinking at the beginning of this century (Fayol, Taylor, Mary Parker Follett).

On this subject, Michel Crozier remarks that, despite its inadequacy, 'fashion offers new ways of responding to die new problems' which regularly appear and as a resuit of which former problems go out of fashion. Of course, thèse new problems are pardy generated by die excesses of previous fashions. Thus, fashion is renewed and destroyed by the successive waves of rigour and imagination which by turns are elevated as dogma.

It has to be said that this succession is onty apparent to specialists, and diat consumers dress themselves from one source and anodier in strategy's ready-to-wear boutiques, depending on their history, thetr resources and die information available to them. Some suSl choose goal-oriented planning or strategically segmented profit centres (linking die product with die market), others go for company plans togeiher with quality circles. In order to be like die Japanese, some even go so far as to turn the company into a place of regimentation and psychological conditioning. Heads of companies believe diemselves to be messiahs and hammer out their 'ten commandments'.

The reality is simply a mixture of ail this, confused radier dian intelligent, where we juxtapose the pièces of die puzzle but do not really manage to put them together. The right and left brain form a whole which cannot be dissociated. Warm values (endiusiasm, charisma, désire, plans, wiil) and cold values (reason, analysis, calculation, forecasting) are not in opposition but complément and mutually reinforce each other.

This fact resurfaces throughout the literature on management. We can quote the excellent Riboud (1987) report *Modernisation, mode d'emploi* (Modernization: Directions for Use):

> Today there are comparées performing wcli in ail branches of industry, even the most vulnérable. It is firstîy a question of peopie with indisputable profcssional credibility and proven charisma. Today, motivation of peopie is the *sine qua non* condition for effectiveness and profitability. . . . Peopie are motived if their deep-seatcd aspirations are respected. To do this, managers must listers to them and, through negotiated agreements, arrange with them proposed objectives and positive sanctions. They should neglect neither the aspiration to be nor the aspiration to hâve,

This complementarity does not prevent division, or ratlier a dialogue of the deaf, between, on one hand, supporters of a rationalist approach (économie analysis, operational research, segmentation, portfolio analysiSj planning) and, on the other, supporters of an approach fittingly called heuristic by Marie-José Avenier (1985), because one of its fundamental principles is to act and then to learn from action. We shall stick to thèse terms, which are very close to those suggested by odner authors, such as Thomas Durand (1985) and Alain Charles Martinet (1983).

3.1. THE HEURISTIC SCHOOL: FROM COMMON SENS!; TO THE SIMPLISTIC

The heuristic approach excited Worldwide interest with the success of the book by Peters and Waterman (1982), *In Search ojExcellence,* and in France with the first book by Hervé Serieyx (1982), *Mobiliser l'intelligence de l'entreprise* (Mobilizing Corporate Intelligence), and his second book., vvritten with Georges Archier (1984), *L'entreprise du 3ème type* (The Company of the Third Kind). Thèse books insist, rîghtly, on the importance of the human factor - which managers must know how to motivate, mobilize, make responsible - the indispensability of listening to the customer, and the necessity of (perceived) quality of products and services.

For supporters of the heuristic approach, thought should not be allowed to paralyse action. They claim that the clever methods of the rationalist approach hâve often led to failure. They prefer to proceed by trial and error, by an incrémental approach, developing what works and abandoning what doesn't. So far so good, but care should be taken not to throw the baby out with the bathwater.

The defkiencies of stratégie pilotage musr not lead to pilotage by sight. There must be a meaning to the mobilization of people; it is not an end in itself, flexibility and pi!oting by sight lead nowhere. Moreover, rationalists were quickly able to poke fun at their detractors. In fact, in autumn 1984 a celebrated *Business Week* article tempered initial enthusiasm for the secrets of excellence: a significant proportion of the companies presented by Peters and Waterman in 1982 as successful examples of collective mobilization were in difficulty. Hère was proof that the gymnastics of collective mobilization are not sufficient to ensure flexibility and performance in ail circumstances: in addition, anticipation of change and planning of strategy and innovation are necessary.

A sound initial reflection, imbued witli relevance and cohérence, reinforces the efficacy of action and reaction in the face of events. In the lire of action the time for reflection is limited to a fevv moments of intuition and reflex thought. Intuition is the lightning flash which springs from the right brain through synthesis of information and analysis stored in the left brain; hence the importance of initial reflection and of accumulating such reflection. The same applies to réflexes - they are better after intensive training.

Accused of gross simplification, some champions of the heuristic approach reply that their message is still too complex. Carried away by their 'passion for excellence', they turn it into a religion and their book becomes a catechism where company heads are transformed into mythical heroes playing the rôle of apostles. They thus forget that enthusiastic mobilization around charismatic leaders is not an end in itself, and that flexibility cannot replace strategy. The Gospel according to Saint Mac had the fate it deserved at the pen of Georges Yves Kervern (1986) (seebox).

The Gospel grew by 610 pages in one fell swoop with Tom Peters' book, *Thriving on Chaos* (1987). The author does not beat about the bush. This book, he writes,

> throws into question ail the concepts of management. Today, flexibility and a passion for change must replace our inclination for mass production, destined for mass markets and based on the possibiiity (iong past) of making relativcly reliable forecasts. . . . tomorrow's champions will move ahead of chaos.

This is total deiirium - ail the more paradoxical as the success of this kind of book is precisely the resuit of the effectiveness of a System of mass production and distribution (sales in garage and airport kiosks). In the form of pilotage by sight the heuristic approach is quite insuffkient and may lead to worse just as easily as better.

The Gospel according to Saint Mac, by G. Y. Kervern
{Annales des Mines, Gérer et Comprendre, March 1986)

'Good jdeas and new ideas, unfortunately, are not the same thing'. This cruel phrase, which certain professors amuse themselves by writing on their students' work, would not be out of place describïng the writings of the Apostlcs of Excellence, the celebrated Thomas J. Peters and Robert W. Waterman, both educated at the school of McKinsey and adtnired advocates of what could be called 'The Gospel according to Saint Mac', which has sold in its millions. The Gospel runs to 806 pages of which 306 pages for the Old Testament *{In Search of Excellence,* 1982) and 446 pages for the New Testament *(A Passion for Excellence,* 1985).

Among those ideas which are good but not new, we find ourselves confronted with 'what every chief executive should know': be a good boss, take care of your clients, look after your staff, be vigilant about quality, simplify as much as possible, do what you know how to do, decentralize, and use small motivated groups for innovation.

Thèse are the much-vaunted wonders of excellence which everybody is talking about today as if this were a historié discovery in the annals of management. We can cenainly rejoice that thèse basic truths hâve been esteemed so highiy. We may déplore the fact that they are sometimes ignored by certain chief executives. We can be glad that our US competitors hâve a tendency to ignore them. Wc may tremble at the idea that the japanese are putting them scrupuiousty into practice. But do we need to pay S 12,000 for each conférence devoted to the articulation of thèse holy princtples?

Among those ideas which are new but not good, at least two are currentiy enjoying a great *succès d'estime,* in California at any rate:

- mistrust of human reason;
- mistrust of respect for rules.

Thèse two ideas hâve culminated in rhe paradigm of the 'skunk'. For the authors of *A Passion for Excellence* a skunk today refers to individuais who pursue a highiy créative activity on the margins of a company'.s formai Systems.

There are two rules in the skunk catechism:

- act first, ask questions Iater;
- 'cheating' is OK, and more efficient.

The skunk thus has short ideas. His drug is action, his slogan KISS (FCeep It Simple and Stupid). The word 'scupid' is very important since it accurately sums up the mistrust of the rational model which forms a basis for that 'coming révolution', Let's pray that this KISS, apologist for the rough and ready and the stupid, does not turn out to be the KISS of Death for Science and Management.

3.2. THE RATIONALIST SCHOOL: FROM SUCCESS TO MISUSE, PENDING A REVIVAL

As Marie-José Avenier has quite correctly written (1985): 'If there is a dearth of literature on the operating modes of pilotage, we are, on the otlier hand, witnessing a véritable burgeoning of practica! tools.' Thèse planning tools are well-known: life cycle, the expérience effect, stratégie segmentation, portfolio analysis, muiticriteria choice, etc. The panoply has recently been enriched by compétitive analysis, value chains and compétence trees, and it's not finished yet, since scénarios from elsewhere (prospective) are now disembarking on PSanet Strategy.

Thèse rational methods found great success in the 1960s and 1980s. They had the great merit of imposing a common language and relevant modes of reasoning which allowed générations of managers to be trained in strategy. Since then the concepts of segmentation, of milch cows and of stars hâve been part of ail managers' vocabularies.

The champions of the rational methods often went too far[5] however. They were tempted to présent one scénario or another as the universal key to stratégie analysis.

Reality rebels against panaceas and always contradicts theory with solid counterexampîes.

Thus, for example, according to the expérience effect cited by the Boston Consulting Group, companies having the strongest market share should be the most compétitive. How then can we explain the better performance of smaller companies with a weak market share? The answer is probably to be found in the area of innovation and in the diversification which it permits. Is not the accumulation of expérience with a given technology and mode of production a source of rigidity, a brake on évolution?

The effects of volume, quality and innovation ail, to a greater or lesser extent, play a rôle in profitability, as the authors of the PIMS method (databank on the performance of companies which can be used for simulation) hâve shown (cf. Buigues, 1985, and Thiétard, 1984).

Each tool of the rationalist approach is partly true but also partly false. The degree to which it will be one or the otlier dépends on many other factors, internai and external to the company, which cause the latter to be understood as an élément of a System, of a network, or even of a network of actors and System. In tliis context, Georges Yves Kervern and Jean Pierre Ponssard hâve noted (1990): 'The search for rationality therefore becomes the search for a language adapted to an imperfect state of knowledge which it is nevertheless in one's interest to share in order to structure collective action.' In otlier words, the rational

approach must pollinate the heuristic approach to give action the intelligence, analysis and thought which it lacks. In this way we find the complementarity between thèse two currents, mentioned above, which it is useless to oppose. Stratégie pilotage needs the compass, instruments and maps of the rationalist school of thought.

3.3. STOP BAD AMERICAN SOAPS AND JAPANESE CURIOS

The rationalist and heuristic schools hâve a tendency to follow fashion and to forget the expérience of the past. Thus the SWOT approach of looking at external strengths, weaknesses (human, technical, financial), external opportunities and threats, which vve owe largely to the pioneering work of Igor Ansoff (1965), has appeared out-of-date to some people. It's ail very weil to speak of value chains, compétitive environmental chains, stratégie positioning, or the mobilization of people; to start vvith, one should really know one's products, one's markets, one's costs and one's human, technical and financial resources. The stratégie diagnosis's prescription dépends above ail on the conclusions of this classic check-up. This is how celebrated books speak of business strategy, without saying a word about financial or human aspects.

Speaking frankly, after many and careful readings, I am convinced that most bestsellers in the field of management are the équivalent of American TV sériais. Thèse 'products', usually 'made in the USA', repeat the obvious, which is applicable to everybody, and from gênerai conclusions draw simplistic examples which are easy to understand without any great effort. They are sold in airports like magazines. Letus hope that thèse intellectual sandwiches don't spoil die appeu'te of those just starting out. For the rest, they are not dangerous, since they contain virtually nothing worth remembering.

Most commonly in thèse vvorks, usuaily several hundred pages long, an avalanche of uninteresting maxims of the type 'the boss puts his desk in the middle of the typing pool' (Tom Peters and Nancy Austin) substitutes for démonstration. But, you will say, this définitive comment is particularly applicable to the heuristic school. Alas, not really!

In factj certain stars of the rational school, like Michael Porter, only partly escape criticism. It is not the content which is wanting, it is the spirit of synthesis - and the reader finds him- or herself drowning in a Dde of analytical détails. Thus, for example, in the interplay of actors in the compétitive environment (Porter, 1980), ittakes some time to realize that the author is repeating the same thing over and over again by

considering, each time, each one of the actors in relation to ail the others. Reasoning is diluted by the encyclopédie volume of the writing. The prudent and efficient reader contents him- or herself with the summaries. At the same time, in-depth criticism is becoming rare. One needs to go right to the end and keep a clear head to notice, for instance, that the firm is scarcely ever approached from the angle of its financial reality and human identity!

Mischievous longues are proposing a remedy for the tedium of American soaps on management: wait for the next épisode (book), which will hâve the same defects but the advantage of starting with a short résumé of the previous épisode. The latest vogue to date consists of marrying management with chaos (theory) (Peters, 1987). We hâve already discussed what we think of this unconsummated marriage.

As with a firework display, we must end this introduction with the finale announced right at the beginning. This involves one of the most famous japanese curios, a 'crue lie' which made directors tremble, shook politicians and filled the front page of magazines: everyone gulped it down and it continues to circulate Worldwide.

Let's tell this incredible taie. Everything started with those terrible comments attributed to the président of Matsushita: 'We are going to win and the industrialized Western countries will lose. You can no longer do much about it because you carry the seeds of your defeat within yourseives. Your organizations are Taylorist, but worse stiil, so are your heads . . . whereas we are post-Taylorists . . ."

Widely quoted since the middle of the 1980s, thèse comments provided a saluîary electric shock to the brain: Japan's advance could be explained by its management model, which must first be understood in order then to draw inspiration from it. However, it has been known since 1987 that this rext is a 'true lie' - its author, Serieyx, revealed it in his préface to a book by Isabelle Orgogozo (1987) and confirmed it in 1989 in a new book entitled *!^e zéro mépris* (Zéro Scorned).

3. This œxt w;ss citet! by G. Arehier and M. Serieyx in *L'entreprise du 3bma type,* with the subtitlc 'A Japanese Présidents Speech'; then, wkhout quite knowing how, rumour attribuiecî it to îhe président of Matsushita. For the sake oi'compleîcness, the rest of the test is given herc. The ideas and style of Hervé Serieyx arc casily discernible. 'You arc totally persuadée! tluit you makc your businesscs function wcll by distinguishing bosses on one skie, executives on the other, îhinkers on one side, those who sit right on the other. For you, management is the art of making the bosses' icteas pass convenientiy into the hands of ihe workers. We are post-Taylorists, we know that business luis become so complicated, so difficulté and the survival of a firm so problematic in an increasingly dangerous, unexpected and compétitive environment, that a firm must mobilize îhe intelligence of everyone every day to hâve a chance of making it. For us, management is precisely the art of mobilizing and stacking up ail this total intelligence in the service of the company project.'

Thus the Japanese system of management would hâve become a real fashion based on a false mode]. It would be a kind of rumour, but it is well known that, in order to circulate, rumours need to écho realities. We know that Japanese courtesy is falsely modest and often hides suppressed arrogance. The text was plausible. What a shame! For once a Japanese seemed to be telling us a few home truths.

The story would hâve stopped hère if I hadn't been invited by the Management Centre of Europe in June 1990 to speak to 300 managers from around the world who had corne to Paris for the sole purpose of listening to eminent people such as Henry Kissinger make pronouncements on the prizes to be won and lost today. Among the speakers, I had the opportunity to listen to R. T. Pascale (Pascale and Athos, 1984), Harvard professor, recognized as one of the best specialists on Japan and its management model. Surprise was followed by inward shock - in the middle of his speech, he let loose, in English, the infamous quotaùon attributed to the président of Matsushita. What was I to think? What was to be done - but sound the alarm and check what was going on? By questioning Pascale's assistant, I discovered that he had only been using the quotation for two or three years, while his last interview with the président of Matsushita had taken place in 1982. Persevering, I pushed curiosity so far as to (discreetly) challenge R. T. Pascale himself. Visibly embarrassed - to his crédit - he told me that in fact 'he had one day read this ten-line text' (the English version is identical to the French). He added, in connection with something else, that he 'had met the président of Matsushita in 1982 and that the latter, who was very old, spoke English almost inaudibly'. However, what he 'believed he understood from die président corresponded exactly to what he had later read as one of his pronouncements'. Perhaps Joan of Arc bas rivais across the Atlantic!

To clinch die matter I neverthefess reported ail diis to Serieyx, who laughed hearuly and swore to me that we were definitely dealing widi a 'true lie' (and not 'a false true-lie'), and that he had not translated some obscure United States journalist. Serieyx specified that the quotaùon had been in circulation and published since 1978, following a trip to Japan, in a business review.

Will this déniai succeed in snuffing out the rumour? Rumour is already playing for time by putting the déniai in doubt, Who knows Hervé Serieyx in die United States? Not, in any case, Professor Pascale's assistant, who happens to be French-born: 'Never heard of hinV was her comment. Americans are ignorant of work not written in English, i.e. the greater part of the world's writing . . .

This true-fatse text is only one of a number of Japanese

pronouncements used as références or bogies.*[1] We are dealing with a real management fashion based on a false model. What share does reality hâve in the images we receive of Japanese management?

In order to explain the formidable competitiveness of Japanese firms, we should first cite the will to work to escape the privations of the 1950s, the memory of which is still fresh in people's minds. Japan has no other resources than peopie and their labour. 'Just-iri-time' production methods were developed there because of the acute lack of space and the costof maintaining physical stocks caused by the very high price of land (four-fifths of japan comprises uninhabited wooded mountains). This is why Japanese factories are so compact, which requires great efforts in organizing production but ultimately improves productivity. This model should not be engraved on tablets of stone; Koreans are often more compétitive than the Japanese, with huge factories where zéro stock is not the rule.

Concepts of productivity and quality hâve been imported from the United States, where, in the 1950s, productivity was the highest in the world. Since no one is a prophet in his own land, it was at Japan that the Americans W. E. Deming and J. M. Juran, considered the fathers of the concept of quality, aimed their applied ideas (see Weiss, 1988). At first, it was a question of small groups responsible for improving processes and products at the most gênerai levels. But the idea of 'total quality[1], literally die quality 'of everything together', soon became indispensable and was treated as a collective goal for which responsibility was shared, rendering the very notion of quality control useless (when speaking of the same thing, American authors tend to use the word 'excellence'). If quality has had such success in Japan, it is also for preventative reasons: Japanese products are exported Worldwide without die need to develop costly networks of after-sales service.

Other pillars of the Japanese management System hâve been advanced to explain the success of its companies: first and foremost, employment for life, which in reality oniy involves a fifth of wage-earners but testifies above ail to the attachment and quasi-feudal loyaity of employées to their company.

The Japanese does not exist as an individual but as a member of a group, a clan. This is the context in which we shouid relocate another piliar of the Japanese management System: consensus. Group pressure is essential to explain the apparent social harmony which reigns in Japanese society and companies. Certain sayings like 'hammering down

4. I hâve writtcn a book on this subject, with Picrrc-Noel Giraud (19S7)J cntitkd *Radioscopie du Japon.*

the nail which sticks out' iiluminate the conditions under which the famous consensus is achieved. In addition to the officiai control of hierarchy - 'being beaten on the head' - there is the unofficial but omniprésent controt of colleagues: 'being pulled by tlie feet'.

How could people not stay in line under such conditions? In each case it is a question of doing as the others do: not leaving the office before one's colleagues, not behaving differently. Thus the famed consensus is less the resuit of negoùation than the fruit of a collective self-censuring where each renounces his or her own ideas for fear of compromising the harmony of the group, which, in any case, would not forgive the m for it.

Nor is it at ail surprising that trade unions avoid unreasonable social conflicts and that the 'good' union leaders are rewarded with promotion. Indeed, this occurs to such an extent that, in order to become a manager, it is useful to hâve had union responsibilities at one time or another.

Another cliché of the Japanese mode!: the performance of manufactiiring industry thanks to a longer working day than elsewhere. The officiai statistics are more theoretical than real, for the constraints of production and group life are such that, 'spontaneously', many employées stay late in the evening and corne back on Saturdays - or even Sundays - to achieve their targets. Group pressure is such that it is better to do as one's colleagues do and give up a significant proportion of one's leave.

Motivation and mobilization are thus at the heart of the System. At Honda, for example, the prize goes to whoever makes tlie most proposais for improving productivity. This motivation détermines the significant bonuses (worth severai months' salaries) which are paid twice a year.

Thus, contrary to common wisdom, the Japanese miracle résides neither in management advances nor technology, but rather in the organization of production, in the most concrète sensé of the term. It is a question of doing well what one has to do with order, method, tidiness and, of course, the ail-important wcll-motivated staff. None of this is outside our grasp; the Japanese eiectronic industries set up in the United Kingdom are already performing better than those in Japan itself. However, the United States example demonstrates that simply transferring a model (or rather its image) to another reality does not automaticatly work: production by the tightened/stretched flovv just-in-time method has shown itself to be more costîy than useful in numerous companies. For its part, Germany testifies to another reality: the Germans are as efficient as the Japanese, yet work iess than tlie French,

Ultimately, the principal virtue of the true-false Japanese management modet is to hâve unleashed a véritable mentai révolution in our companies (quality circles, company projects, self-training, the cuit of business). Future historians will perhaps recognize Japanese methods, as vvell as the salutary rôle they hâve played in the West.

4. Spreading the cultures of prospective and strategy

At the end of this introductory chapter, we are resolutely optiniistic. Indeed, debate and dispute over prospective and strategy are fertile and fashions help models to progress and ideas to advance.

We may end by confirming the évidence. If the recipes presented by American business schools and management bestsellers were as useful as claimed, American businesses would be performing better and United States industry less sick. Companies are not the only ones affected by the plotting of a desired future. Authorities, local communities and associations hâve already got the forward-planning itch. The democratization of prospective is only just beginning.

It is safe to bet tliat prospective and stratégie cultures will spread widely through organizations. This démocratie diffusion cannot fail to raise the ievel of debate. American soaps and Japanese curios will be abandoned for books by classic authors and reflection on the strong and durable performance models which are burgeoning around us in Germany, France, Italy and Spain. Thèse models are based on long-term, planetary visions and ambitions, efficient management of the (technical, financial, human) means of production to achieve objectives, and highly intelligent ulilization of tlie human lever, and ail done with respect for identity and in harmony with culture. In a word, the movement being sketched out is indeed that 'of a European school of stratégie management.'[5] As Fernand Braudel said (1980): 'What unités Europe is its diversity.' The common characteristic of this European school is precisely the variety of organizations and behaviours which are proving effective. Thus the principle of contingency is tlie essential basis of this school, which has aiways existed, but which is only just beginning to recognize itself.

5. This was the title chosen by AFŒT and AFPLANE for their international colloquium held on 1-2 February 1990. Proceedings are availablc from AFCET, 16 Boulevard Percire, Paris 75017, France.

5. One logic in ten chapters

The field covered by îhis manual is above al! that of prospective. Developments in company strategy aim primarily to propose a synthesis of widely scattered material. By relying on this synthesis, it wili be possible to illuminate the complementarities anci synergism between the tvvo approaches. In this sensé, this work retains the logic *of Scénarios and Stratégie Management* (Godet, 19S7).

The first two chapters deal with the fundamenta! principles of anticipation. As the future is not written anywhere and lias still to be built, prospective thinking lias nothing to do with the determinism of fururotogy or forecasting. The critique of quantification and extra-polation of trends is necessary to improve the complementarity between approaches: planning needs forecasts with scénarios.

The following chapters iist the methods of the prospective tool-box, illustrated by case-studies. In this way we présent the necessary mathematicaf procédures for identifying the key variables of the future^ analysing the interplay of actors, reducing uncertainty and finally building scénarios and defining stratégie options.

The third chapter is devoted to the scénarios method, whose logical séquence (délimitation of the System, rétrospective analysis, actors' strategy and constructing scénarios) has become established after dozens of prospective studies.

However, this entirely literary logic is an insufficient weapon for tackling the analysis, compréhension and cxplanation of increasingiy complet Systems. Hence the need to call on the more formaiized tools of Systems analysis defined by Barel (1971) in the following manner: 'Systems analysis, in most cases, consists in bringing out the fact that the goal examined nuist be re-placed in a wider context than ils original System. The term "analysis" serves to underline the usefulness of breaking down complex problems into their constituent parts.'

• ïn the chapters which foilow, we shal! présent some of thèse formalized tools to which one can rurn at one stage or another of the scénarios method.

- Structural analysis and the MICMAC® method, particularly useful for délimitation of the system and for determining the essential variables, are presented in Chapter 4.
- Analysis of the past and of future projects is a valuable support for understanding the interplay of actors whose analysis by the MACTOR® method is the basis of Chapter 5.
- Morphological analysis, useful for scanning the field of possibilités

and identifying the key dimensions of the scénarios, is presented at the beginning of Chapter 6.

- Expert méthodologies (DeSphi and cross-impact) allow us to assess die likelihood of différent hypothèses acting on the variables and key dimensions for the future. Chapter 6 is speciaily devoted to one of thèse: SMIC methodology.

By presenting thèse différent tools and mediodoiogical supports, we will at die same time better understand how to utiiize die scénarios method. Let's be clear, however, diat, although the séquence is logical, it is not essential to follow it from A to Z: everything dépends on die degree of knowledge one has of the System studied and the goals being pursued. The scénarios mediod is a modular approach and can, where necessary, be limited to the study of particular modules, for example:

- Structural analysis of, and search for$_3$ key variables.
- Analysis ofactors' strategy.
- Surveying experts on key hypothèses for the future.

One of the biggest constralnts of the scénarios method is time. In gênerai twelve to eighteen months are needed to carry out die logical procédure in its entirety; half of tliis time wiil be spent on construction of die base. If only three to six months are availabte, it is préférable to concentrate one's thoughts on the module which seems most important.

The complète scénarios method has only been applied in just under half die cases quoted in Chapter 3. In order to iilustrate die modular character of the tools of prospective, they are presented via différent case-studies. Ail the saine, for reasons of confïdentiality it has not been possible to présent a complète and detailed example in ail stages.

The outlook is clear, the scénario System will continue to play a référence rôle but will seldom be^arried through from A to Z. That can only be the business of specialists undertaking long and exacting work.

The prevailing winds are blowing in the direction of a democratization of prospective. Prospective is itself moving to embrace the appropriation of methods and is imposing openness and simplicity. This is a strong trend which ought to reinforce still furdier die enthusiasm for prospective workshops and to favour the modular use of tools - as needed, and as appropriate to pariicular probSems, circumstances and tempéraments.

It is dien appropriate to identify and evaluate possible stratégie options. Chapter 7 présents the problematic of the decision-making and évaluation process and develops the principal methods of multicriteria choice available, notably the Multipol method, a pardcularly simple and easy-to-use tool.

Chapter S concerns itself with marrying prospective and strategy (by showing how the meeting and integraùon of thèse two approaches

was inévitable). This chapter also provides the opportunity to return to the sources of strategy and management. On the way, we discover that thèse concepts are as old as the hills and that modem authors hâve invented nothing - the essentials had already been said and written a long time ago by forerunners such as Henri Fayol, Fredėrick Winslow Taylor and Mary Parker Follet. One lesson may be drawn froni this rétrospective: there are a thousand and one keys to excellence.

Chapter 9 attempts a synthesis. It demonstrates that people are at due heart of the différence between organizations that win and those diat lose. It also describes the metamorphosis of structures and behaviours that is indispensable if old habits are to be broken and a true mental révolution is to be iaunched.

The final chapter, entided 'The Dawn of the Twenty-First Century', proposes a review of the main trends and uncertainties which organizations will hâve to face in the future.

2. From determinism to détermination, from forecasting to 'stratégie prospective'

'The future cannoi beforecast, it is prepared'
Maurice Blondel, philosopher

Prospective is neither forecasting nor futurology, but a mode of thinking for action and against fatalism. Prospective recognizes that the future is the *'raison d'être* of the présent', that it is multiple and uncertain, and that prospective is a way for everyone to take controi of their own futures. This chapter looks at the rôle of such qualitative prospective analysis in the context of business planning and forecasting. Scénario-building émerges as more vital than ever for forecasting and stratégie management.

1. Action-orienteci anti-fatalistic thinking

Those who claim to foretel! or forecast the future are inevitably liars, for the future is not written anywhere - it is stil! to be constructed. This is fortunate., for without this uncertainty, human activity would lose its degree of freedom and its meaning - the hope of a desired future. If the future were totally foreseeable and certain, the présent would be corne unliveable. Certainty is death.

Thus, the first aim of prospective thoughtis to illuminate the choices of the présent by the light of possible futures. Good forecasts are not necessarily those vvhich are realized, but those which lead to action to avoid the dangers and arrive at the desired objective.

The fréquent errors that occur in forecasu'ng and the notable absence of forecasts of crises bear witness to the crisis in forecasting itself. The impossibility of seeing ahead into the future solely by means

of using past data explains the futility of classical économie models[3] which fait to include qualitative and unquantifiable parameters, such as projects entertained by, and the behaviour of, the principal actors. The future must be studied with a view to illuminating the présent; that is the basic idea which inspires *la prospective.*

Such prospective anaiysis involves taking a view which is globalj qualitative and voluntarist (a concept created by G. Berger in the late 1950s). It is neither forecasting, with an excess of deterministic quantification, nor futurology, a concept fashionable mainly in the English-speaking world and which embraces ail aspects of research into the future without spécifie référence to die criteria of globatism and vvill. Futurology has had rather a bad press in Western Europe, where it is widely seen as a throwback to the crystal bail or a variant of science fiction. At the same time, the concept of prospective anaiysis has found acceptance mainly in the Latin world (southern Europe, Latin America).

Another significant différence between the two cultural worlds is that the concept of 'technological forecasting' has not been accepted on the European side of the Atlantic as being capable of providing a sufficiently global insight into social developments; rather, it is seen as restricted to trends in science and technology and their conséquences, on the implicit premise that science is no more than a product of society and as such cannot suffice to explain it.

The concept of forecasting is not self-contained, but is subject to fluctuation from one period and from one society to another. To oversimplify, there are threc attitudes to the future (passivity, adaptation and voluntarism)j in practice, hovvever, thèse constantly overlap and intermingle.

The passive attitude to the future is a iegacy of religious fatalism. The 1739 édition of Richeiet's dictionary contains the following: *'Prévision: se dit de Dieu et signifie connaissance de ce qui adviendra!* According to this view, the future is inévitable and virtually pre-determined, having already been written by the hand of God, so that man has no alternative but to submit to his destiny; this being the case, it serves no purpose to encumber the présent with future misfortunesj since tomorrow wil! be tomorrow and there is nothing that can be donc aboutit.

With the advent of the Industrial Révolution and the sharp accélération in the pace of change during the twentieth century, people came to realize that the pages of history, whether or not written in advance, were tiirning faster and faster. If change was inévitable, it was perhaps aîso predictable, in which case it coutd be worth while

anticipating it so as to be ready for it when it came, and to take advantage of the opportunities chat it offered. An adaptative attitude to the future thus developed as a reaction to rapid change, bringing in its train a phénoménal development in économie, technological and social forecasting accompanied by excessive and sometimes blind confidence in the new gods of mathematical model-making and econometric metliods.

This adaptative attitude is essentially reactive rather than pro-active, resigned ramer than voluntaristic, since it has not purged the original sin of determinism and inevitability. Curiously, fatalism has cast off its religions habits to assume the mantle of a new idol - science and technology. Technological forecasting seems to hâve become the modem substitute for divinely inspired prophecy. The passive Svait and see' attitude has been rransmuted into blind faith in the unlimited powers of a technological good fairy, who will soive ail problems, including those for which she is responsible.

Such technological optimism, which has now become so widespread, has also triggered a reaction generating its antithesis - technological pessimism (the world is doomed, \ve are playing with fire$_3$ the problems that technology cannot solve are those which are of its own making), which is just as heavily impregnated with determinism.

In the face of the accelerating pace of change, the uncertainties of the future, and the increasing complexity of phenomena and interactions, résignation is no longer an acceptable response. An anti-fatalistic, pre-active and pro-active attitude is essential.

People are not fated to accept relationships which are necessary, determined and outside their control. They create reiationships through their own wili and their actions.

At the root of ail prospective is an assumption of freedom in the face of multiple and îndeterminate futures. Prospective has nothing to do with the determinism of futurology and crystal-ball gazing. Nor is prospective the same as forecasting, which is too greatly affected by quantification and extrapolation of trends. Prospective does not see the future simply as a continuation of the past, because the future is open to the games of many players, who are acting today in accordance with their plans for the future.

So, prospective is a way of thinking which throws light on présent action by looking at possible futures. In modem society, anticipation is imperative because of the combined effects of two main factors:

- Firsdy, the accélération of technical, économie and social change, which nécessitâtes iong-term vision: 'the faster you drive the further your headlights must shine.'

- Secondly, factors of inertia inhérent in structures and behaviour mean that \ve must sow the seeds of change today if \ve wish îo harvest them tomorrow.

Although the world is changing, however, the direction of this change is uncertain. For a company or local authority, change carries numerous uncertainties (économie, technological and social) which it must intégrale into its strategy. Prospective does not daim to eliminate this uncertainty tlirough illusory prédiction, but aims simply to reduce it as far as possible, and to take décisions based as little as possible on hypothetical futures (which is a lot in itself).

2. A critique of forecasting

2.1. DEFIN'1TIONS

Confusion between projection, forecasting, prospective analysis and planning is a source of many forecasting mishaps and misunderstandings. The following définitions should serve to reduce such problems (see Table 1).

- *Projection* is the extension into the future of past developments using certain assumptions for the extrapolation or variations of trends. A projection constàntes a forecast onfy where it is based on probability.
- *Forecasting* is the assessment, vvith a degree of confidence (probability), of a trend over a given period. The assessment will generally be expressed in figures and based on past data and a number of assumptions.
- *Exploratory prospective analysis* is a panorama of possible futures, or scénarios, which are not improbable in the light of past causalities, and the interaction between the intentions of interested parties. Each such scénario (a cohérent séries of assumptions) may be the subject of an assessment expressed in figures, i.e. a forecast.
- *Planning*, to quote Ackoff (1969), 'consists in conceiving a desired future and the practical means of achieving it'. It therefore calls for a normative prospective approach. It should be made clear that the plan (an instrument of discipline and consistency) is only one stage in the planning process (an instrument of dialogue). The plan must be simultaneously informative (diagnosis), indicative (remédies) and directive (ends and means). Too many people fall into the classic trap of confusing planning with forecasting, mistaking a divergence from a predetermined objective for a forecasting error.

TABLlî 1. Summary définitions of the main concepts used in the literature on the future

Conjecture Probable hypothesis	*Prospective anaiysis* All-embracing, qualitative, and quantitative^ voluntarist, multiple scénarios (targely a Latin concept)
Projection Eixtension into the future or variation of past trends	*Forecasling* Assessment with a degree of confidence: quantitative, deterministic
Prédiction Fit ut rology Statemcnt of fact before the event (Delphic oracie)	Al! aspects of research on the future (an Anglo-Saxon concept)
Prophecy Prédiction by divine inspiration	*Scénarios* Cohérent séries of assumptions
Planning 'consists in conceiving a desired future and the practical means of achieving it' (Ackoff, 1969)	

The historicai paradox is that forecasting deveioped at a time when it was easiest and ieast necessary. In practice, econometric models, backed up by computers, were being used to demonstrate things that anyone could easily find out for himself; everything was more or less direcdy related to the gross national product; GNP itseif was rising by about 5 per cent a year. Basically, time was the best 'explanatory' variable.

The year 1973 marked the turning-point at which the future ceased to resemble the past, making the need for a prospective anaiysis (to take account of breakdowns in trends) more immédiate. Such breakdowns are associated with new behaviour patterns, so that models based on past data and relationships are powerless as predictors.

This is not the place for a detailed survey of the causes of errors in forecasting, but attention can be drawn to three factors:

- Inaccurate data coupled with unstable models.
- Excessive quantification and extrapolation.
- Explanation of the future in terms of the past.

2.2. INACCURATE DATA AND UNSTAlîLE MODELS

Economies does nor obey rules as rigorous as those applied in the more 'exact' sciences such as physics. Statistical data are often supplied vvithout any estimate of the extent of errors which may hâve been made in compiling them. What purpose is served by sophisticated calculations made to the nearest hundredth or thousandth when the figures to the left of the décimal point cannot be relied upon? In the United States, according to O. Morgenstern (1963), even the GNP figure can only be regarded as accurate to within 10 per cent either way, and there is no reason to suppose that errors are always in the same direction; even the direction of variations in GNP may be in doubt. Economists - and others - should always ask themselves about the sensitivity of their results to minimal changes in input data.

2.3. EXCESSIVE QUANTIFICATION AND EXTRAPOLATION

Most forecasting methods are based on extrapolation of trends, which assumes that 'ail things will be equaP in other sphères. This is quite unrealistic when the environment is increasingly subject to change and the phenomena to be taken into account are increasingly complex and interdependent. In thèse circumstances, uncertainty about the future is reflected in divergences from a trend.

This makes econometric models powerless to anticipate major long-term structural changes, although their users regufariy attxibute their forecasting errors to 'hidden' variables.

Piecemeal forecasting which takes account of only a few (usually économie and quantifled) explanatory variables and ignores changes in balances of power and the émergence of new trends is more misleading than useful. Its înaccuracy is attributable largely *to* the fact that the économie sector is becoming self-contained, so that économie fore-casting is divorced from social and political forecasting, while at the same time it is tending increasingly to be broken dovvn into technological forecasts, population forecasts and so on.

It is therefore ciear that it has become necessary to take a global view; the pace of change is accelerating, there is increasing interdependence and interaction, and nothing can any longer be taken for granted. The time has corne for forecasting based on quantification to be replaced by an overall prospective approach taking account of ail the qualitative parameters (whether or not quantifiable) which may hâve an immédiate or remote impact on whatever phenomenon may be under examination.

Given its relative importance, the anodyne notion of stabilily requires careful study. Various viewpoints are possible.

Lot us suppose a static framework. Given a matrix *A* where coefficient *a(ij)* represenîs the numberof goods ;˙produced in région/ Each *a(ij)* is purchased in this région in the proportion *x(j).* We therefore make the unrealistic assumption that for *x(j)* is an average value *j,* independent of / so that the national output of goods /˙effectivety consumed is *bfi)* = X *a(ij) X (j).*

The following problems can be raised: given that *A = (a(ij)), b = (b(ij)),* what wi!l be thc value of A? If *A* varies by (A)/i, what wilî be the corresponding variation (A)À' of A? Or again, if *b* varies by (S)è, what will bc the corresponding variation (S)A'of A? In other words, the problem is one of the siudy of the stability of A'as a function of the minute variations *(à)AoîAaxu* (5)6 of *b.*

We need not recall the rather restrictive theory of 'appropriating' matrices for problems involving linear équations. The following wcll-known example amply illustrâtes this:

$$A = \begin{bmatrix} 10 & 7 & S & 7 \\ 7 & 5 & 6 & S \\ S & 6 & 10 & 9 \\ 7 & 5 & 9 & 10 \end{bmatrix} \qquad b = \begin{bmatrix} 32 \\ 23 \\ 33 \\ 31 \end{bmatrix} \qquad X = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 10 & 7 & 8 & 7 \\ 7 & 5 & fi & 5 \\ S & 6 & 10 & 9 \\ 7 & 5 & 9 & 10 \end{bmatrix} \qquad b + \delta b = \begin{bmatrix} 32 \\ 23 \\ 33 \\ 3! \end{bmatrix} \qquad X + S X = \begin{bmatrix} 9.2 \\ -12.6 \\ 4.5 \\ I.1 \end{bmatrix}$$

$$A + AA = \begin{bmatrix} 0 & 7 & S.10 & 7.20 \\ 7.S & 5.45 & 6 & 5 \\ S & 5.98 & 9.S9 & 9 \\ 6.99 & 4.99 & 9 & 9,98 \end{bmatrix} \qquad b + 6b = \begin{bmatrix} 32 \\ 23 \\ 33 \\ 3! \end{bmatrix} \qquad X + \Delta X = \begin{bmatrix} -81 \\ 137 \\ -34 \\ 33 \end{bmatrix}$$

\. Whatever the problem under considération, it is essential to carry out a fui! study of the stability factor without which it is impossible ta give significance to the results.

2. Mostj if not ail, statïc linear models are in fact devoid of interest; because of the way real-word values are subdivided, the coefficients obtained are known with a margin of error so large as to make the final results usetess.

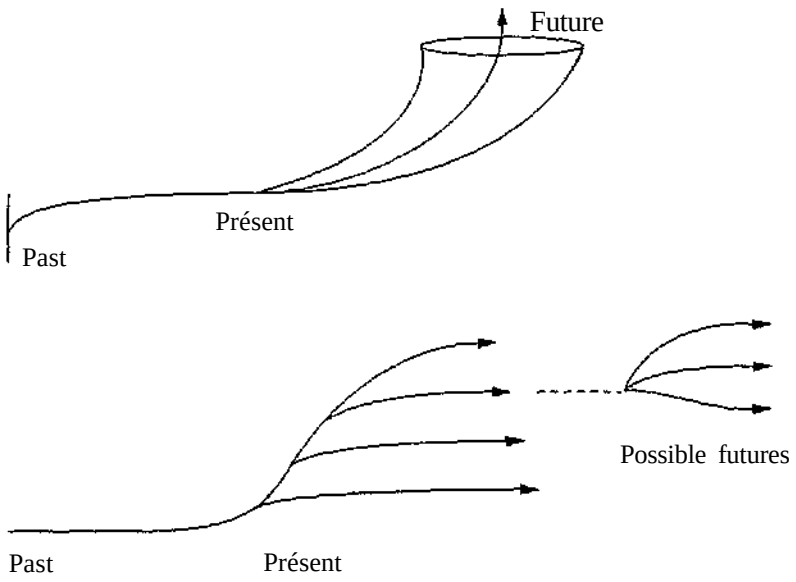
Source: Bruter, 1977, p. 58.

Adopt a global vision for local action

Prospective thinking must be global - hardly any problems can be isolated. In fact, we are witnessing quite the opposite trend - a grovving interdependence., even entanglement, of problems. We cannot hope to find solutions which are not global, even if the point of application of thèse solutions is local. Moreover, the complexity of éléments and reiationships to be caken into account, and the need to put them into a global perspective, makes analysis particularly difficuit. This is why it is necessary to use methods of Systems analysis.

2.4. THE FUTURE EXPLAINED IN TERMS OF THE PAST

The prospective approach accepts tliat there îs a multiplicity of possible futures at any given time and that the actual future will be the outeome of the interplay between the various protagonists in a given situation and their respective intentions. How the fumre evolves is explained as much by hurnan action as by the influence of causalities. The future should not be seen as a single predetermined iine, an extension of the past; on the contrary, it is plural and indeterminate. The pluraiity of tlie future and tlie scope for freedom of human action are mutually explanatory; the future has not been written, but remains to be created (see Fig. 2).



FÏG. 2.

The prospective approach has evolved from the realization that the future is the product of both causality and freedom; that which is undergone in the future is a resuit of past actions (and of course unforeseeable natura! phenomena); that which is willed explains présent actions. In other words, the future is explained not oniy by the past but also by the image of the future imprinted upon the présent. For instance, an individual's consumption at a given time is not determined solely by bis past income (savings), but also by the future income that he anticipâtes (crédit), as Milton Friedman has ciearly demonstrated in his theory of continuing income.

The eye of the future illuminâtes the présent; seen in this light, the future is today's *raison d'être.*

TABLE 2

	Classical forecasting	Prospective approach
Viewpoint	Pièce mcal 'Everything elsc being equaP	Overall approach 'Nothing else being cquaP
Variables	Quantitative, objective and known	Qualitative, not necessarily quantitative, subjective, known or hidden
Relationships	Static, fixed structures	Dynamic, evolving structures
Exportation	The past expOins the future	The future is the *raison d'être* of the présent
Future	Single and certain	Multiple and uncertain
Method	Deterministic and quantitative models (econometric, mathematical)	intentiona! analysis; qualitative (structural analysis) and stochastic (cross-impacts) models
Attitude to the future	Passive or adaptive (future *cornes* about)	Active and créative (future *brought* about)

3. Usefulness and scope of prospective

3.1. USEFULNESS AND CREDIBILITY OF PROSPECTIVE ANALYSIS

The usefulness of prospective analysis dépends iargeiy on the aims pursued by tliose who conduct or commission such studies. The objectives that prospective analysis can serve include:

Stratégie objectives

- Guidance of présent action (the plan) in die light of possible and désirable futures, for example, by aiming for maximum flexibility in the face of uncertainty.
- Staking out possible futures so as to be able to take a sélective view of the multitude of current events, identifying those which point to the future, i.e. 'events whose présent dimensions are minute, bue whose potential conséquences are enormous' (Massé, 1965).

Tactical objectives

- Using warnings in an attempt to pre-empt or foster future developments (inflation rate, économie growth rate, etc.).
- Testing a hypothesis or theory, for example, in order to justify a décision and forestail possible criticism,
- Culrivating a purposeful and dynamic image.
- Developing communication within an organization or between it and the outside world.
- Chalienging received ideas and unconstructive behaviour (scepticism, blind failli, shortsightedness).

Given the wide range of objectives pursued by those who carry out or commission prospective analysis, little purpose can be served by inquiring into its credibility; prospective analysis is not neutral, but dépends on subjective choices regarding the approach employed with regard to spécifie problems, the assumptions tested, the aims pursued. Because of the uncertainly of the future it is necessary to make judgements and then back them; only after a séries of such judgements has been proved right or wrong can the credibility of prospective analysis be assessed.

3.2. WHAT INGREDIENTS GO INTO MAKING AN ACCU RATE FORECAST?

An immédiate observation is that the 'correct' forecast is not necessarily the one vvhich turns out to be true. When we anticipate a future problem, we normaily set in motion actions that ensure that it will not take place or that its effects will be mitigated.

A second observation is that an accurate forecast is not necessarily a useful forecast. In forecasting, as in statistical testing, three types of error can be identifïed:

- Retaining a hypothesis which ultimately is not substantiated.
- Excluding a hypothesis or an event that does in fact transpire.
- Not asking the right questions, i.e. not incorporating in the prospective chinking the hypothèses or events ṁat are going to play a prédominant rôle in the future.

This third risk occurs reguiarly in forecasting and can best be expiained by the 'lamp-post effect' - where the drunk who has lost his keys looks for them under ṁe iamp-post, since that is where the ground is lit.

3.3. WHAT MAKES A GOOD EXPERT?

We hâve a simple answer to this question, but none the less it does not solve the problem: the best experts are generally a minorityj this leaves the question open as to who, among the minorities, has it right.

In practice, in many fïelds, particularly those of a technological nature, expert prédictions are often the main source of information.

The success of methods like Delphi (where a convergence of opinion is sought through a somewhat directed, even manipulated consensus) can readily be expiained. Such methods are appropriate when it comes to obtaining décisions through consensus, but they are more often misleading than useful as forecasts.[1]

As an illustration of this point, the reader should refiect on the results of an évaluation of experts made several years ago (see box).

\. One should bcar in rnind that 'convergence' is not necessarily {i.e. rarely) indicative of smtistical consisteneyj as we shatl sec when we devetop the SMIC Prob-Expert® cross-impact method.

An assessment of experts' forecasting performance

In a 1976 *Futures* article, George Wise, of General Electric's R&D centre, analysée! the accuracy of forecasts made in the United States between 1890 and 1940 on technological progress and the impact of innovation. His analysis was based on 1,556 forecasts of technological advances (some of which materialized, while others did not) in eighteen spécifie areas of technology: and the anticipated social, économie or political effects of thèse changes. He drew five conclusions:

- Experts produeing long-term forecasts (ten years and upwards) arc wrong more often than they are right.
- Experts are slightly more aecurate in their forecasts than non-experts.
- Forecasts made by experts in a field outside their speciality are no less aecurate than those of experts specializing in the field concerned.
- Forecasts concerned with the continuance of the technological status quo at a given moment arc no more aecurate than forecasts concerned with technological innovation.
- The effects of technoîogical development are less casy to forecast than the developments themselves,

Some guidelincs for prospective analysis

- Do it in-house rather than rely on outside bodies.
- Select a 'new consultant' in préférence to one of the traditional type.
- The traditional type seeks to shock the client with his preliminary diagnosis, making him feel guilty so that he allows himself to employ an outside team organizing a major assignment.
- The new type seeks to become a catalyst for communication and new ideas within the undertaking, setting up and helping to run in-house prospective analysis workshops or studies broadening the horizon beyond the confines of the undertaking.
- Approach problems from several angles, according to their complexky.
- Bc sceptical of certainties.

3.4. THE ABSENCE OF NEUTRALITY OF INFORMATION AND FORECASTS

Information about the future, the présent or the past is rarely neutrai: it usually serves spécifie interests. How many studies and analyses are lying hidden in drawers because they are politically undesirable? How many pertinent reports are emptied of tlieir substance by the sélective use of words? How many reaiities are ignored because they do not fit preconceived ideas? Information is manipuiated simply because it is a major source of power.

To inform someone, to give him information which he does not possess, is to divest it from oneself, to relinquish thosc trump cards which could be soid and to make oneself vulnérable in the face of takeovcr attempts, Total communication is impossible. To enter into a relationship with another person, to seek to open up to him, is ai the samc time to hide and to protect oneself behinci fortifications and to oppose him. Briefiy, any relation with another person is stratégie and contains a power component, however buried or subtimated it may be (Crozier and Friedberg, 1977).

Prospective information does not escape from this influence and the conséquent pollution; there seems to be an unending stream of alternately alarmist and reassuring reports on population, environment$_3$ energy, arms, etc., ail mutuatly contradictory in their conclusions. By its nature, prospective information is relatively more durable, but is less of a burning issue than headline news.

Nevertheless, \ve scan thèse futures to illuminate and guide présent action. The future is an emerging landscape with unknown contours; the constraint is that, despite the unknown horizons, we hâve to take décisions today that commit us for the future. Even if the information is degraded we hâve to take out our bets now, to create the future rather than to submit to it.

4. Pluralism and complementarity

4.1. PROBLEMSAMD METHODS

The problem of spécification, identification and calculation of the parameters for a model are classic problems for econometrics. Three problems in particular bave received insufficient considération, despite the fact that the manner in which they are solved conditions die validity of any forecast.

The problem ofidentijying expkmaiory variables

Let the variable to be explained be *x,* whose devetopment is to be investigated and forecast. The First immédiate question is: What are the variables that hâve to be taken into account in order to explain *x?* Some of thèse explanatory variables will be readily identifiable on the basis of thorough knowledge of their past influence on the variable, while others will be more difficult, either because the nature of their influence is not sufficientiy well known or because it bas not yet manifested itself fully.

It is not sufficient to identify thèse variables. It is necessary to specify the form of the relarionship function (linear, exponentiaL, power, iag, etc.). This requires drawing upon theoreticai knowledge, expérience and intuition. It calls for a good knowledge of the past (analysis of corrélations) but, above ail., imagination and creativity. This is why the problems of specifying and identifying variables and relationships also necessitate the use of qualitative methods (e.g. brain-storming, synectics, data analysis, morphological analysis, structural analysis).

The problem of estimating future values of explanatory vaiiables

When the explanatory variables hâve been specified and identified, and the parameters of the function hâve been estimated, the next problem in the forecasting process is to make a quantitative estîmate of the future values of the explanatory variables. This problem can be expressed as follows: either, what will be the value of each variable at instant r, or, alternatively, by what date will each variable hâve reached a given magnitude?

This type of question is often dealt witli by extrapolating or more or less arbitrariiy fîxing the values of the explanatory variables, whereas in theory each of thèse variables should be explained together and in turn. However, this would make for an endless and heavily looped model and; given the constraints imposed by known data and availabîe time and resources, it would not be possible to go very far along such lines. This is why estimâtes of the future values of explanatory variables are generaliy obtained by the use of simple or sophisticated methods of extrapolation (analogies, logistical curves); in short, it is as though each explanatory variable explained itself over time, with time acting as a pseudo-explanatory variable.

The problem of uncertain estimated values

An estimate does not become a forecast until it can be supported with a certain degree of confidence. In coping with this problem of establishing the probability, the uncertainty, the forecaster has little to go on apart from the intuitive judgements of experts when applying methods of the Delphi or cross-impact type.

Sélection of forecasting methods

No miracle forecasting metiiod capable of soiving ail problems exists. In practice, because there are so many différent types of forecasting problem, each forecaster will hâve a more or less complète box of tools

from which he makes a sélection according to the nature of the problem ar hand, his objective and the constraints (data and time available) within which he has to work.

In the absence of an all-purpose tool, a 'kit' has to be made up from the tools available to meet the requirements of each forecasting problem, an appropriate methodological response which shouid include improvisation wherever necessary.

Finally, it shouid be remembered **tliat,** in industrial prospective analysis, the choice of a method for forecasting the development or sales of a product dépends on certain criteria, such as the life cycle of the products concerned (birth, growth, maturity, décline - see Figure 3). It is found, for instance, that conventions! econometric method s are particularly appropriate forecasting tools for products in their mature phase, when plenty of past séries are available. In the early stages of a product's development, on the other hand, methods of the Delphi or cross-impact type are more appropriate (note: *more* appropriate, not 'appropriate').

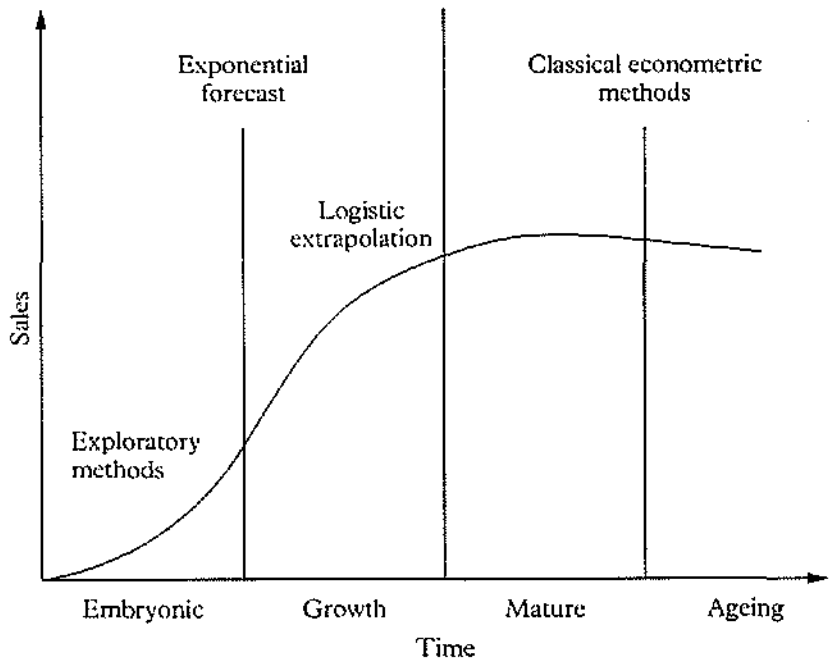


FIG. 3.

4.2. PLANNING NEKDS FORECASTS \VITM SCENARIOS

The dangers of excessive quantification (the ever-present tendency to concentrate on things which are quantifiable to the détriment of those which are not) should not lead to a rejection of s ca ris tics, but merely to cautious use of them. The statistics (mathematical, econometric) contained in forecasting models are essential to an assessment of the conséquences of scénarios. The validity of a forecasting model is determined by that of the assumptions (économie, political, etc.) upon which it is founded; the purpose of prospective analysis is to fill in the background, providing the sets of assumptions which will give the mode! its validity, that is, its consistency with future reality. The complementarity between prospective analysis and forecasting has led to the création of 'new forecasting'. The contribution of prospective analysis meets three essential needs of forecasting;

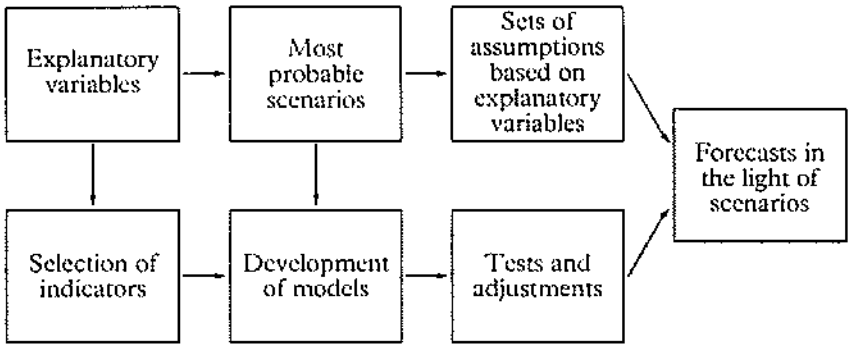
- The need for explanation; détermination of known or hidden essentiai variables makes for improved sélection of indicators.
- The need for assumptions: construction of scénarios - cohérent set of probable assumptions based on explanatory variables - is the process which lends validity to a forecasting model.
- The need for quantification: forecasting according to scénarios provides a means of quantifyîng the results and conséquences of prospective analysis and taking account of that which cannot be quantifkd.

Using the following notation of the above model $y = f(X_i)_s$ the contribution of prospective analysis is to supply, in the form of scénarios, consistent sets of probable assumptions based on the explanatory variables K_i and the function / refattng them. Thèse assumptions provide the background for application of a forecasting model to enable calculation of the desired final resuit, *y*.

This 'new forecasting' is a synthesis of prospective analysis and forecasting, which are two complementary approaches; it incorporâtes the rules and constraints of econometric techniques in the cohérent framework provided by scénarios. This scénario is outiined in Figure 4.

Researchers would therefore do well to make the distinction between forecasting and prospective analysis more often. The value of a forecast is no more than that of the underlying assumptions. More often than not, severa! cohérent sets of assumptions (scénarios) can be considered fairly probable, so that a forecast should never be published without giving an indication of the estimated probabiliiy of the corresponding scénario. Attention should also be drawn to the dangers of only considering the scénario that is îhought to be tlie most probable. Finally, it should be noted that some scénarios may correspond to breakdowns

in past trends. Such scénarios are ouîside ihe scope of projection and cannot be calculated according to the conventional forecasting mediods.[2]



Fi G. 4. New forecasting.

4.3. PROPOSALS FOR S 0 LVIN G THE CRIS! S IN FORECASTING

There can be no sensible planning vvithout exhaustive considération of possible futures and debate on désirable futures and the means of bringing them about. If this debate is to be organized on a proper footing in the light of ail relevant information, statistical forecasts corresponding to each of the alternative scénarios envisaged must be availabie on a regular basis.

It is at the *interface* between *prospective* considération of possible and désirable futures and quantification by means of forecasting models that the greatest difficulties are encountered in national and corporate planning exercises.

Hovv can statisdes be produced in die face of uncertainty? How can scénarios and models be integrated with each other? Thèse are two of the questions which inevitabiy arise; as yet there are no satisfactory answers, and they are eminendy suiîable subjects for research.

2. Ifonc takes *N* assumptions, there will be 2A'sets of possible assumptions covering a period lcading up to a given date, the sum of the probabi!ities of the corresponding scénarios being equal to 1. Assume that *N = 2* and that the four possible .scénarios hâve the fbllowing probabilités: SI, probability 0.4; S2, 0.25; S3, 0.1 S; and S4, 0.20. Clearly, the most probable scénario (SI) is in tact the leust probable outeome - the most probable outeome ss that any one of the three other scénarios will be borne out.

As a contribution to the necessary research effort, the following comments are offered to the researchers concerned. First, economists are too inclined to forget that a *model is not realiiy, but one of a varieiy of possible means of gaining an insighi inw realiiy.*

They should therefore make it their practice, in the interests of prudence and neutrality, to broaden their methodological options (by testing several models and différent approaches., each acting as a failsafe System for the others).

It is not acceptable to restrict the range of possible futures in the name of logic and constraints deriving from a model built on the past. Variants should not be determined according to the nature of models, but scénarios should be taken as the starting-point for the construction of models which are most appropriate for the représentation of the development ïo be explored. In other words, it is truly essential to adjust the models to the reality to be constructed rather than the reverse: the means should not be allowed to outweigh the ends.

Second, the fact that a model is sophisticated and contains thousands of sìmultaneous équations does not necessarily mean that it gives a better description of reality. Such exhaustiveness is ail the more misleading when factors which are unquantifiable, not well known, or controversial hâve been left ou t. In fact, such complex models are becoming increasingly incompréhensible to users who hâve not been involved in their development (trade union représentatives, company economists, researchers working in other fields, etc.). This detracts further from the réputation of modelling, which has already suffered seriously as a resuit of the large numbers of forecasting failures.

This defect in forecasting is felt particularly keenly by public and private undertakings which hâve to take décisions affecting their future by feeling their way without any clear frame of référence or cohérent objectives. Thèse undertakings are disarmed because they hâve nowhere to tu m otlier than to forecasting centres which are ill-prepared or ill-placed to quantify the uncertainty resulting from the muitiplicity of possible scénarios.

Third, some peopie take the view that, since the standard planning period is five years, long-term prospective analysis (ten years or more) is a lower priority than short- and medium-term forecasting. This opinion is groundiess, since the timescale of prospective analysis should be determined by that of the plans of interested parties or of possible breakdowns in trends, which could occur in the near future. Présent action should be guided by the possible futures, since, when fog and uncertainty abound, an excellent compass-setting is a fundamental prerequisite for survivai.

4.4. KEY CONCEPTS FOR A METHODOLOGY

One can conclude that quantitative forecasting and qualitative prospective studies are two approaches where tlie 'qualitative' and the 'quantitative' must be complementary.

Constructing a forecasting approach by scénarios such as those proposed hère is not a simple task, since there is a lack of methods. This methodologicai gap refiects insufficient past research into tlie topic as well as a breakdown between the two networks - that of tlie forecast model-builders and that of the 'prospectivists', i.e. the futures analysts.

In practice, it would be désirable to bring together economists, sociologists, historians, etc., on the same forecast, even though the models may match less well with figures than with reality. In short, the global view of prospective must be based on pluraîism and complementarity of approaches. This is the price to be paid if forecasting is to find its way out of crisis.

5. Practical advice for future thinking

How to implement future thinking? Wc can recommend from expérience four ways to improve the relevance and efflciency of prospective analysis.

5.1. ASK TiłE RIGHT" QUESTIONS AND MïSTRUST CONVENTIONA3., WISDOM

Everybody remembers Woody Allen's famous remark: 'The answer is yes, but what is the question?' As there is no right answer to a wrong question it is essential to pose real questions. Unfortunately common wisdom générâtes numerous false problems, i.e. clichés proved wrong by the facts.

Light créâtes sliadow. If present-day projectors are so powerfuily trained on certain problems, this is in order to hide more effectively otlicr problems which people prefer not to see. Today's dominant conventional wisdom and fashionable ideas must be regarded with mistrust, for they are generally a source of error in analysis and forecasting.

In order to see things more clearly and to ask the right questions., one should not hesitate to think against the flow, even if this means displeasing others. This is an important challenge, for there is little chance of prescribing tlie appropriace remedy if one is mistaken over tlie diagnosis.

In gênerai, che majority of experts are conformists (it is easy to rake refuge in the majority and leave the task of explaining to others) and conservadve.-[1] Very often, good forecasts, that is, those which see things accuratety, are achieved by a minority of experts who demonstrate daring and imagination.

The most difficult thing is, of course, to know how to pick out tlie 'good' minority point of view from the rest. For the practitioner of prospective, the lesson is clear: although it may be difficult and risky a priori to défend one new idea among other possibie ones, he must not be afraid to attack dominant ideas. It is in this spirit that \ve were able, for example, to:

- announce as early as I97S both a new oil crisis and the energy surplus which would render nuclear energy less necessary^
- dispute the thesis of the industriai décline of Europe in relation to the United States and Japan;[5]
- cast doubt on current clichés about the Japanese model;[s]
- question the often-evoked thesis of Gcrmany's décline — at a time when Germany has become the world's leading exporter of manufactured products;[7]
- denounce the myth of technology as the lever with which to émerge from crists.[N]

The day before yesterday (in the 1970s) energy was blamed as tlie cause of ali our ills; yesterday (the 1980s) technology was going to save us; now, the priority is training (renamed, for today's circumstances, 'non-material investment'). After having fallen victim to the technologica! mirage, we are now suffering from 'diploma diseascV It seems that human societies pass from one mirage to another in order to avoid confronting the forest of real problems, which are of a socio-organizational nature: technological and educational changes impty social change and a révolution of the mind.

3. As O. Clarke emphasb.cd: 'Whcn an eminenr and aged expert says that something is impossible, there is a good chance that lie is mistaken.'
4. Energy Horizon Kceps Reccding?', *The Times*, 5 September 1978,
5. Le déciin industriel de l'Europe', *Le Monde*, 21 Deccniber 19S2; 'Le vent en poupe', *I^e Monde*, 5 Fehruary 19S6; 'The USA: Recovery or Concealed Décline?', *Futures*, Vol. 17, No. 3, 1985, pp. 196-201.
6. 'l'en Unfiishioniible and Controversïal Findings on Japan', *Futures*, Vol. 19, No. 4, 1987, pp. 371-84.
7. Sec also: 'Germitny: Faasdoxical Power', *Futures*, Vol. *12*, No. 4, 19S9, pp. 344-60.
S. From the Technological Mirage to the Social Iîreakthrough', *Futures*, Vol. 17, No. 3, Î9S6, pp. 369-75.
9. Worldwide Challenges and Crisis in Education Systems', *Futures*, Vol. 20, No. 3, 19SS, pp. 241-51.

This point applies equaliy to companies. It is often in structures, behaviour and quaiity of personne! that we should seek to understand the situation of companies in difficulty. Otherwise, how are we to explain the fact that other companies, facing the same market and environmentai constraints., enjoy a high degree of success?

Over the last two décades we hâve also noticed that errors of forecasting are often based upon two mistakes:

- Overestimation of the pace of change (of technologies).
- Underestimation of inertial factors (structures, behaviours).

Therefore, when thinking about the future, we suggest it is useful to start by identifying factors which are unlikely to change.

5.2. THINK [N TIt·Ii LOMG '•[• ERM AND IMAGEN*E F 1RS* T W M A T W I L L N O T C H A N G E

Fernand Braudel repeatedly demonstrated the necessity of long-term vision (encompassing several décades, or even severai centuries) in understanding the evolving rhythm of societies, économies or eco-Systems. For example, fourteenth-century Europe experienced a séries of épidémies and famines which eaused the total population to fall by about 40 per cent, but which also halted the excessive deforestation eaused by the previous rapid population growth. This major crisis was to be followed by the Renaissance and finalty, several centuries later, by the progress of the Age of Science and Enlightenment. In a sensé we are still being carried along on thèse waves of innovation, which hâve continued to accumulate for almost six centuries.

So crises - the conséquence of rigidities - are often favourable moments for undertaking necessary adaptations and wide-reaching reforms which would otherwise hâve been held in check by multiple résistances to change. Crises bring opportunity for social and organizational change; unfortunately, in many cases crises are necessary for change to happen.

History does not repeat itself. With the passage of time, however, societies retain disconcerting similarities in behaviour, which lead them, when faced with comparable situations, to react in almost identicai, and consequently foreseeable, ways. Most events which are destined to happen bave already taken root in the distant past. So the past holds forgotten lessons, which can teach us much about the future.

A good prospective study therefore almost always implies considérable anaiysis and rétrospective thought as a preliminary. This may represent two-thirds of the time invested in such a study. A priori,

the past has the advantage of being less cluttered and calmer than the présent; however, it too is liable to many différent interprétations. Thus, looking at the past remains a difficuit task, for it means reconstituting scattered and often controversial information.

We should not underestimate the importance of factors of inertia in relation to forces of poientiaî change. In prospective, there is often the tendency to imagine what could eventually change, while forgetting systematically to record what has at least a good chance of remaining unchanged. Large organizations are characterized by strong inertia, which means thatunless there are discontinuities, changes inevitably take a long time. Tliis makes it imperative to prépare for changes weil in advance.

5.3. USE SIM*P*LE, ADAPTAI?LG METHODS To S TI MU LA TE TMOUGHT AND FACILITA TE COMMUNICATION

There is no universal tool; no one method is a panacea; available data are both overabundant and incomplète. Furthermore, a model is not reaiity, but a means of iooking at reaiity. Ail thèse considérations lead us to point out that the scope of each method or model is relative.

The imperfection of the tools, the inaccuracy of data^ and the subjectivity of interprétations are unavoidable realities, which prompt us to opt for piuralîstic and complementary approaches. As far as possible, the results of a model should be tested for their sensitivity to a variety of data inputs and to the use of another tool. Onîy sufficiently robust results should be considered crédible.

The main interest of mefhods is not only that they provide results, but also diat they should be the occasion for structured thought and intelligible communication on a given thème, From this point of view, our recommendation to researchers and practitioners is ciear; the container matters little so long as one is intoxicated by the content - communication. The most important thing in a study (vvhether it be prospective, strategy or marketing) is not so much the resuiting report as what has happened in the minds of those vvho hâve been invoived in the thought process it has engendered.

This fact has important conséquences for practising researchers and advisers, whose work should increasingly consist of 'making peopie do, radier than doing', of letting each person discover the problems and solutions in his own language radier than revealing ready-made trutlis in a scholarly but alien language. This new advice is to former advice

what psychoanalysis is to conventional medicine. It relies on appropriate methods; i.e. methods which are simple enough to remain adaptable.

What is too simple is srupid and wrong, what is too complex is useless. The idea is to use tools which are simple enough to be appropriable by the users and customers of die results. Such appropriation is necessary to turn anticipation into action (see Fig. 1).

Stratégie management must use relevant, consistent and likeiy scénarios in order to better adapt and reach the stratégie goals. To construct scénarios and stratégies, we need appropriate tools.

For this reason, we hâve elaborated a toolbox which classifi.es problem-solving metliods as followvs:

- Asking the right questions and identifying die key variables: futures workshops and structural analysis with MICMAC® method (see Chapter 4).
- Analysing txends and actors' stratégies: rétrospective srudies and MACTOR® method (see Chapter 5).
- Reducing uncertaindes to likeiy scénarios: morphological analysis$_3$ expert mediods (Delphi, cross-impacts) (see Chapter 6).
- Identification and assessment of stratégie options: multicriteria anaiysis and Muldpol method.

Last but not leasi, we hâve good news for users: most of thèse tools are now available on diskettes (PC and MAC). However, users must be cautious and choose proper tools for each problem. Researchers too often apply the same tool indiscriminately to any problem just because they know it!

5.4. START WITH A PROSPECTIVE WORKSHOP?

In most cases, the collective prospective approach begins widi a one- to two-day residential seminar which proves tlie best vvay to address the problem under study. The working group is introduced to tools and mediods that may prove useful and the group members can become acquainted with each other. They not oniy receive training in metiiodology, but diink productively about die problem under saidy. After die seminar, die group members are in a better position accurately to assess the problem and to adopt an appropriate working mediod. This method vvill not be fully validated undl several weeks hâve elapsed.

The rules of the game are easy: the group divides into subgroups, each choosing as its thème one of die foilowing four topics:

- Andcipating and acdng on change.
- Eiiminadng erroneous preconceived ideas.

- Arbitrating between short- and long-term policy décisions.
- Compétence rrees: past, présent and future dynamics.

The Framework for the vvorkshops can be restricted to just a few overhead transparencies. The workshops can schedule their work sessions into two- to four-hour modules.

An exampie of a prospective workshop in action: the Vierzon tovmship facing its future

After thirty ycars of local communist governmcnt, ail indicators were in the red. The inhabiîants were deserting the town, as were the îrms, with record leveSs of unemployment and strike action; urban planning was haphazard. In June 1990, local town-council élections brought in a new majority (an intelligent bSend of dissident socialists, determined libérais and grass-root ecoiogists). A fortnight later, the new town council decided to give the inhabitants a say and to organise extra-municipal commissions on the town's future. For rwo days some eighty persons (town council officers, trade union représentatives, industriel executives, shop-owners, teachers, senior citizens, civil servantSj etc.) gave diought to the future of their town and drafted some proposais. The two plenary sessions attracted about 300 people and the committec delegates presented their ideas and suggestions, both in the public session but also to the média and to the town couneii members: a mobilisation process was under way, with the aim of seeking a better future for Vierzon. This process can and should continue. It would be a pity merely to be content with the inteliectual stimulus arisirsg from the workshops. From mis point on the image of Vierzon is no ionger the same. Previously it was simply witnessing its own décline; now it intends to contrat its future. More to corne . . .

Prospective workshops may involve groups ranging in size from ten to 100 persons who hâve 'common life expériences' and who wish to think together about possible and/or désirable changes, with a view to controliing them better and re-directing them. The idéal number of participants would appear to lie somewhere between twenty-five and thirty-five. It is then possible to hâve a iimited number of subgroups, each with five or six persons, sharing the work assignments. It is advisable to hâve aï least two subgroups working on 'anticipation of change' (so that they can compare their findings) and there must always be one group working on 'preconceived ideas'. In this way certain unspoken assumptions will be voiced and this particuiar group wiil play the rôle of watchdog (and punchball) for ail the other groups.

Workshops can serve as 'launching-pads' for new thought processes and as a way to take control of change. In certain cases, however, the usefulness of such workshops can be even more immédiate. Thus, for a

consuiting group, it may prove advisable to translate future challenges (as identified by the prospective workshops) into associated objectives, to identify subobjectives, possible actions, projects and other studies that would contribute to thèse objectives (using the 'tree of relevance' method), and to compare this potential overview with the reality of the studies and projects under way. This approach also enables rapid identification of any ongoing actions whose aims are imprécise, as well as major challenges which require nevv action.

Stratégie prospective workshops
(organisations involved with the author since 1985)

- Renault (automobile consortium)
- Bongrain (agrofood)
- Chanel (cosmetics)
- L'Oréal
- EDF-GDF (electrical and gas utilities)
- Frcnch Army Command
- Ministry for Education, France
- Fédération for Private Education, France
- Moselle Régional Amenities Board
- Montpellier town council
- Vierzon town council
- Sollac (steel products)
- Adidas
- Bull and ICL

The summing-up sessions which follow the workshops enable everyone to gain a better insight into the key problems that should be given priority treatment. This enables the group to define a commonly agreed working metliod (i.e. whether they should use given tools or not) which is compatible with time constraints, available resources, lead-times and finally with the agreed objectives.

5.5. PRACTICAL GUIDELINES FOR PROSPECTIVE CROUPS

Composition and modus operandi of the group

The group mandate must be carefully defined (outlining the problems set, the aims, die source of the study, the target audience and the lead-times). Draftingof intérim documents and the final report should be the collective responsibility of the group.

The group should ideally be steered by a 'pilot', chosen from among the group. The pilot's rôle wilf be to lead and co-ordinate the assignment of individual tasks among the group members. The pilot wili be required

to provide leadership throughout the entire study, i.e. he should not be changed. It is his rôle continuously to revievv lead-times and to make necessary adjustments, primarily revising means and tools rather than objectives.

Meetiṅgs: scheduling and contera

The best frequency appears to be: three or four closely spaced meetings to begin vvith, then at least three annual meetings once the study is under way and finally three to four meetings to conclude. It is also advisable to establish in advance the schedule of meetings and the agendas by about five to six sessions.

Every meeting must hâve an agenda and minutes rnust be taken. For each session, ail group members should file a status report for each session on the work for which they are responsible. At the end of each meeting, individual assignments should be detailed and the agenda for the following session approved.

Compétence, group action and 'subconîracting'

One should consult specialists before seiecting méthodologies, and particularly before launching an application; similarly, one shouîd consult external and internai experts (for technical expertise and operational specialities); each interview shoutd be conducted by two team members and the conclusions written up immediately. If need be, certain spécifie technical (or other) points could be subcontracted out.

Rôle of the group leader and occasional external experts

It is not ahvays easy to put together a study group (bringing together a wide variety of talents and tempéraments). The most difficult point is choosing a group leader capable of investing a considérable amount of his availablc time, both during working hours and off-duty, should this be deemed necessary. The group leader prépares the meetings, takes notes, drafts the minutes, and must involve ail members of the group by assigning the individual tasks. The group leader must also plan ahead and draw up a programme for the ensuing phases, identifying the problems and the most appropriate methods as he or she sees it.

It is in this way that the external expert's rôle can prove useful. His input is not only methodological; he can be calied upon to react to group ideas and even to be provocative on occasion. The présence of the

external expert is not required for ail meetings and it is the group leader who détermines when it is most relevant to call upon his services.

Choice ofmcthod: efficiency, motivation and communication

There is no a priori choice of method; however, making a choice is vital if the meetings are to be effective. Where there is no method, there will be no common language, no valid exchanges, no cohérence, no organization of ideas. Method is not an end in itself and one should not be shackîed by its results; method is merely an aid to make the group's thinking more relevant.

A rigorous method is also conducive to group cohésion and motivation; intérim status reports - vvhich should be circulated - and visibility of progress also contribute towards motivation. Lastly, the choice of a method will be dépendent on the type of problem under study (cf. start-up seminars), on time constraints and on the simple wish to see results published. The tooSs should be sufficiently simple to remain within the grasp of both the end-users and the target population.

Efficient running of meetings is not something that can be improvtsed. To quote Dr Victor Bataillard - author of the COM-Tables - tlie foilowing common déviations vvere noted:

- Endless discussions on minor points which make participants lose sight of the main objectives.
- Those who direct the debates prefer listening to themselves rather than listening to others. They are convinced that tlie meeting was a success, whereas others in the group hâve been unable to express their views.
- The debate focuses on points which are unciear and which interest only a fraction of the audience.
- Major contributions are not included in the minutes, nor recorded in any other way, especially when they are not initiated by the most important person présent.
- The people running the meeting do not keep to tlie agenda.
- The people in charge of the meeting prefer indulging in sma!l-talk rather dian running the meeting.

In order to run a meeting efficiently, several methods can be used, such as COM-Tables, METAPLAN and CREAPLAN. They ail hâve points in common, apart from their Germanie origin (a concern for efficiency, even in créativité') • Foi' example, the utilization of coloured cards of varying shapes and sizes (rectangular, ova!, circular), of green cards for positive ideas and orange cards for critical points, of adhesive stickers, etc. .. .

According to such methods ail participants are allowed to express themseives freely but briefly in writing (no more than three lines or seven words per card) or in a présentation not exceeding 30 seconds. Ideas that are beyond the scope of the thèmes under debate are posted up for later discussion. Différences of opinion are identified by a lightning symbol. Each group member contributes to the logistics for the entire group. The results - as posted up - to a large extent reflet:t the ensuing minutes of the meeting.

3. The scénarios method

The scénarios method which we discuss hère was largely developed ac the time the author was in charge of the Department of Futures Studies with tlie SEMA Metra Consulting Group, from 1974 to 1979.

With hindsight, it is now clear that setting up such an approach in *prospective,* with twenty or thirty actual applications undertaken in companies and public administration, contributed to:

- stimulating stratégie thought and communication within companies;
- improving internai fiexibility of response to environmental uncertainty, and providing better préparation for possible System breakdowns;
- reorienting policy options according to the future context on which their conséquences would impinge.

In the course of this chapter we revievv the origins of scénarios methods, define the main concepts on which they are based and set forth the aims and the logic of die underlying process.

1. Origins and définitions

The future is multiple and several potential futures are possible; the path ieading to this or that future is not necessarily unique. The description of a potential future and of the progression towards it comprises a 'scénario'. The word 'scénario' was introduced into futurology by Herman Kahn in his book *Lan 2000* (The Year 2000) pubiished in 1968, but the usage there was primarily iiterary, imagination being used

to produce rose-tinted or apocalyptic prédictions previously attempted by audiors such as Anatole France *{Island of thc Penguins)* or George Orwell *{1984).*

In France, die OTAM team vvas die first to use a scénarios method, in a study of geographical futures undertaken for DATAR (1971). Since that time, this method has been adapted to industrial futures, notably in a study of 'chemical-agriculturaP futures carried out by C. Kintz and G. Ribeil at SEMA in 1977.'

The US researchers Gordon, Helmer, Dalkey and otliers hâve deveioped several radier more formai methods to construct scénarios. Ail thèse are based on discussions among experts: Defphi, cross-impact matrix, etc. Developments are regularly published in the journals *Futures*[2] *and Technological Forecasting and Social Change*.*

In practice, diere is no one scénarios rnethod, but radier a variety of methods of construction (some simplistic, odiers sophisticated). However, a kind of consensus seems to hâve been reached; the term 'scénarios method' only applies to an approach which includes a number of spécifie steps (Systems analysis, rétrospective, actors' stratégies, élaboration of scénarios) which interrelate as discussed belovv.

The foilowing concepts can be defined:

» *An invariant:* a phenomenon assumed to be permanent up to die horizon studied. Example: climatic phenomena.

• *Sirong trend:* a movement affecting a phenomenon in such a vvay diat its development in time can be predicted. Exampie: urbanization.

• *A germ:* a factor of change hardiy perceptible at présent, but which wili constitute a strong trend in tiie future. In fact, a germ variable is what Pierre Massé (1965) described as a harbinger of the future: 'A sign which is slight in terms of présent dimensions but huge in terms of its virtual conséquences.'

• *Actors:* those who play an important rôle in the System through variables which characterize their plans and which they, to some extent, control. Example: the consuming countries, the producing countries, the multinationals, etc., are actors in the energy System.

• *A strategy:* a set of tactics (set of conditional décisions) determining each actor's acts relative to his plan under every possible contingency.

1. See also 'Three Scénarios ibr Hmploymem by thc Ycar 2000', in 'Employaient or thc Obsession with the Future', *Fmuribks* (spécial issue, 1977).
2. Published in the United Kingdom by Burcerwonh/Heinemann.
3. Published by Elsevicr, New York.

- *A conflict:* may resuit from die confrontation between opposing stratégies of the actors, and may take the form of an outbreak of tension between two trends (overcrovvding and lack of space, constrained tirne and free uirne). The outcome of thèse conflicts détermines the évolution of the balance of power between actors, or strengthens the weight of one trend or another.
- *An event:* the notion of an event is defined by E. Borel in the following manner: 'An event is an abstract entity vvhose only characteristic is to happen or not to happen.' An event can be considered as a variable takingonly one of two values, in gênerai 'î' if the event happens, and '0' if the event does not happen; such an event will be called an isolated event.
- *Randoinness, subjective probabilities:* we refer to the long-established but still relevant work of Professor Ville (1937), A phenomenon is said to be random[4] when it can take a certain number of values, to each of which is attached a subjective probability. We 'can consider the calculation of the probability of an isolaîed event as a subjective judgement, insofar as the considered event is classified in a category of events which subjectively hâve the same degree of probability. It is thus the expert who, in passing his judgement, establishes his catégories.' A subjective probability is a gamble[5] which is almost always listed if we consider an event which will in fact either occur (probabitity 1) or not (probability 0), but which must be considered as won if, among ail the events to which we hâve attributed À"chances in 100 of occurring, there are actually À'in 100 which occurred at the given time.'[1]

4. Any event in the past or future of which we possess only partial information (i.c. we are incapable of confirming or otherwiso whecher the event took or will take place) shall bc considered a random event. To attribut*! it probability to this event is équivalent to assigning to ail or part of the information a number denoting the degree of randomness' (Ville, 1937).
5. A judgement of probability must be capable of embodiment in a gamble and the overall success of a certain number of thèse wugers will bc the measure of the relevance of the judgement.'
6. When a person says: '1 estimate the probability of an (isolated) event at 75 per cent,' we follow Ville in understanding this judgement to mean: 'If you were to note ail the events to which I woisld nssign u probability of 75 per cent, and if you were to observe, Ébr *a* large number of cases, the freqi:ency with which the supposed event did in fact occur, I predict that the frequency would be in the vicinity of 75 per cent.'

2. Types of scénarios and stratégies

Scénario: 'A totaiity made up of die description of a future situation and of the séquence of events which facilitâtes évolution from tlie original situation to this future siatation.' To tliis définition, proposed by J. C. Bluet and J. Zemor (1970), vve would add that the set of events must demonscrate a certain cohérence.

Classically, a distinction is made between tlie following:

- *Possible scénarios,* i.e. everything that can be imaged.
- *Realizable scénarios,* i.e. ail that is possible, taking account of constraints.
- *Désirable scénarios,* i.e. which fall into the possible category, but which are not ail necessarily realizable.

According to their nature or their probability, thèse scénarios may be termed 'référence', 'trend-based', 'contrasted' or 'normative'.

In principle, a *trend-based scénario,* whether or not it is probable, corresponds to the extrapolation of trends at ail points where choices are to be made.

Often the most probable scénario continues to be termed 'trend-based', afthough it may not correspond to a pure and simple extrapolation of trends, as its name suggests. Certainly, in the récent past, when the world changed iess rapidly than today, die most likely development vvas in fact the continuation of trends. For the future, however, the most probable scénario in many cases seems to entait a severe breakdown of current trends.

The extrapolation of trends can lead to a situation which contrasts markedly with the présent, as was shown by a study carried out for DATAR (1971), published in *Metra* under the ride 'Trend-based Scénario for France', and by La Documentation Française under the title *Une image de la France en l'an 2000, scénarios de l'inacceptable.* In this case the trend-based scénario is based on extrapolation of trends, but is not the most probable scénario.

Since then, following the repercussions of this study, a certain amount of confusion of language set in. We therefore propose to use die terni 'référence scénario' to refer to the most probable scénario, whether or not it is trend-based.

A *contrasied scénario* is die exploration of a deliberately extrême thème, the a priori détermination of a fuaire situation. Whereas the trend-based scénario corresponds to an exploratory approaeh towards the évolution of a future situation, die historié contrasted scénario corresponds to a normative, imaginative, anticipatory approaeh; a scénario for a future situation is chosen that generally contrasts markedly

with the présent (for example, coastal France, France with a population of 100 million); tlien one examines in reverse the course of events, tliat is, the evolutionary scénario, which could lead to tliis situation.

Practice has aîso given rise to another définition of the contrasted scénario, also corresponding to an exploratory attitude, examining the évolution of events to arrive at a situation. In tliis case, the contrasted scénario is defined as a highly unlikely course of events, and it is precisely ils generally highly contrasted nature tliat makes it uniikely. This is die définition which we shall adopt hère. However, tliis does not mean tliat we are abandoning the normative for the exploratory; in our View, this distinction is only of operative interest. In fact, once the évolution and the situation are described, in one direction or the other, the corresponding course of events is both exploratory and normative.

It is among the realizable scénarios, which hâve a higher than zéro probability, that we ftnd contrasted (unlikely) scénarios and the field of development where the most probable scénarios are found. As regards *désirable scénarios,* thèse are found somewhere witliin the possible zone, and are not al! necessarily realizable (Fig. 5 and Table 3).

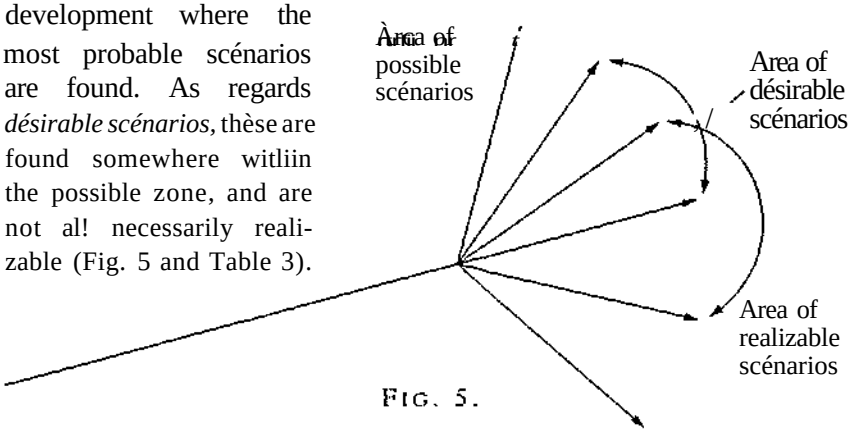


FIG. 5.

T A B L *E* 3 . Classification of scénarios according to probability and ovcrali vision

^^•^^ Probabiiiiy / Vision ^"~\^^	Probabiiity of scénario	
	Likcly	Uniikely
Exploratory, From **rhe** présent to the future	Extrapolation base référence scénario (may or may not bc trend-based)	Extrapotation-based contrasted scénario
Anticipatory, Imaginative, normative (from the future towards the présent)	Anticipatory référence scénario	Anticipatory contrastcd scénario

Sonie areas of application oft/ic scénarios method
(total or partial application by the author since 1975)

- Air transportation parameters
- Long-haul passenger demand
- Aircraft construction
- Shipbuilding in Portugal
- The world petrochemical industry
- Off-shore industries
- The European automobile industry
- The cosmctics industry
- The dairy produce sector
- Pairs and exhibitions in France
- Distribution of industrial products
- Distribution of electrical goods
- Demand for public transport
- Transportation modes in the Paris région
- Demand for environmental products
- The nuclear power sector
- French water networks
- Migration in the EEC
- Motivation of business executives
- The Trois Vallées ski région, France
- Postal services
- The insurance sector
- The Banque de France
- « Household consumption of banking products
- Vidéotex
- Geopolitical developments
- The Sahel région
- The Paris région
- * The William Saurin Company (agrofood)
- Aluminium
- Personal wcapons
- Tourism and leisure
- Mail order services
- Noise
- Power distribution networks
- Building
- The steel industry

There is often confusion between scénarios and stratégies. While scénarios dépend on the type of vision adopeed (exploratory, normative or resxoprojective) and on probability, stratégies dépend on attitudes adopted in the face of possible futures.

Apparently, it is the concept 'normative' which gives rise to this confusion. In the case of scénarios the word 'normative' is used in a rétroprojective sensé, vvhereas it naturally refers to the notion of norms and objectives when we are îalking about strategy. In other words, there are no scénario-objectives, but only stratégies.

It is important not to confuse the dimensions or key components of the scénarios (démographie, technological, économie, polilicai, social., etc.) with the configurations that each of thèse components can présent. This is where morphological analysis cornes in.

A system made up of four components, each having four configurations, will in principle hâve 256 (44) possible states. How can we navigate in this morphological space without being swamped by the sheer number of possible combinations? One answer is provided by the combined utilization of the methods of morphological analysis and

probabilization of combinations of configurations (interplay of hypothèses) through the SMIC method.

3. Objectives of the scénarios method

Increasing uncertainty, grovving interdependence, the quickening pace of change in certain areas (political, technological, industrial, etc.), and the noticeable lack of action in others (démographie, energy, socio-cultural) are ail factors which call for a futures approach when considering présent actions. Specificaliy, the following are required:

- *Alternative scénarios* for future development, along with identification of die associated problems and opportunités, given the objectives which bave been selected.
- *The possible actions* required to remedy such problems or take advantage of such opportunities.
- *The conséquences of possible actions,* given the scénario envisaged and the objectives selected,

The scénarios method specificaliy tries to conceive al! possible futures and to explore the paths leading to them in order to clarify présent actions and their possible conséquences. The objectives of the scénarios method are:

- *To detect* the priority issues for study (key variables), by identifying retationships between the variables of the spécifie System under study through systemic analysis.
- *To détermine,* especially in relation to key variables, the main actors and their stratégies, and the means at their disposai for bringing their projects to a successful conclusion.
- *To describe,* in the form of scénarios,[7] the development of the System under study, by taking into account the most probable evolutionary path of the key variables and by using sets of assumptions about the behaviour of the varions actors.

The scénarios method comprises two phases: the construction of the database; and, on this basis, the setting out of scénarios which lead to the génération of forecasts.

We can, in fact, use the techniques of classical forecasting vvithin the framework defined by a scénario to convert it into quantitative terms.

7. Scénarios develop: on the onc hand, the situation of the phenomenon being srudied and its environment for a chosen horizon, as well as the best route to it *{référence scénario);* on the other hand, the extrême situations within which the phenomenon is located *(contrastai scénarios, both pessimistic and optimistic).*

The complementarity between the scénarios of prospective and die models of forecasdng work opérâtes in one direction but not in reverse: models hâve to be tested in the framework of die interplay of probable, cohérent hypothèses supplied by the scénarios, and not die other way round. In other words, designating die variants arising from simulation witli a single model as scénarios *is not prospective.*

By taking die différent scénarios into account, vve can then evaluate die conséquences of previously decided orientations and, with tlie aid of muldcriteria metiiods, vve can deduce die priority stratégie aedons to be taken in order to exploit the expected changes, dius helping to devise die stratégie plan (see Figure 6). It will be seen later in diis book diat the choice of stratégie options, taking environmental scénarios (external diagnosis: direaîs and opportunitẽs) into account is preceded by die stages of an internai audit (strengths and weaknesses) and compeddve positioning. See Figure 7 for a schéma of die scénarios mediod described below.

3.1. CONSTRUCTION OF THE BASE

The first stage attempts to construct the 'base', i.e. an 'image' of the présent state of die system, which will serve as a stardng-point for die futures study. This image musi be:

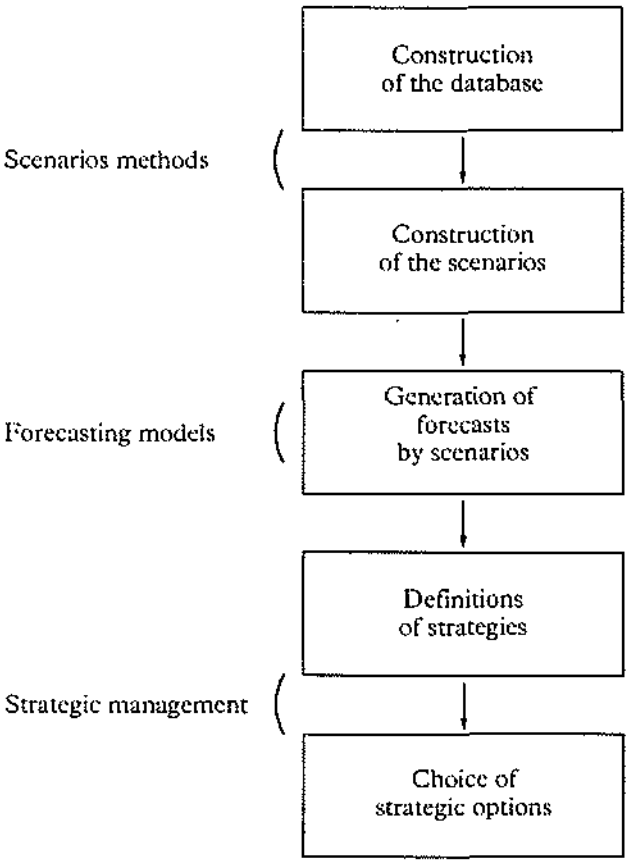
- detailed and comprehensive, both quandtadvely and qualitative ly;
- broad in scope (économie, technological, political, sociological, etc.);
- dynamic, clearly idendfying past trends and harbingers of die future;
- explanatory of mechanisms of change and of actors (movers of die system).

The base is constructed in three phases:

- The délimitation of the system studied and die gênerai environment (polidcal, économie, technological, etc.).
- Identification of the key variables.
- Rétrospective and actors' stratégies.

Délimitation of the sysiem studied

This forms a very important phase, Care should be faken not to exclude a priori from die field of study diose technical, économie and political éléments tiiat are novv widiout influence on die phenomenon under study, but which might, in die longer term, begin to exercise significant influence on the development of die system. Conversely, one should avoid fatling into the trap of carrying out a futures study for society at large, whatever the subject of die actual study.

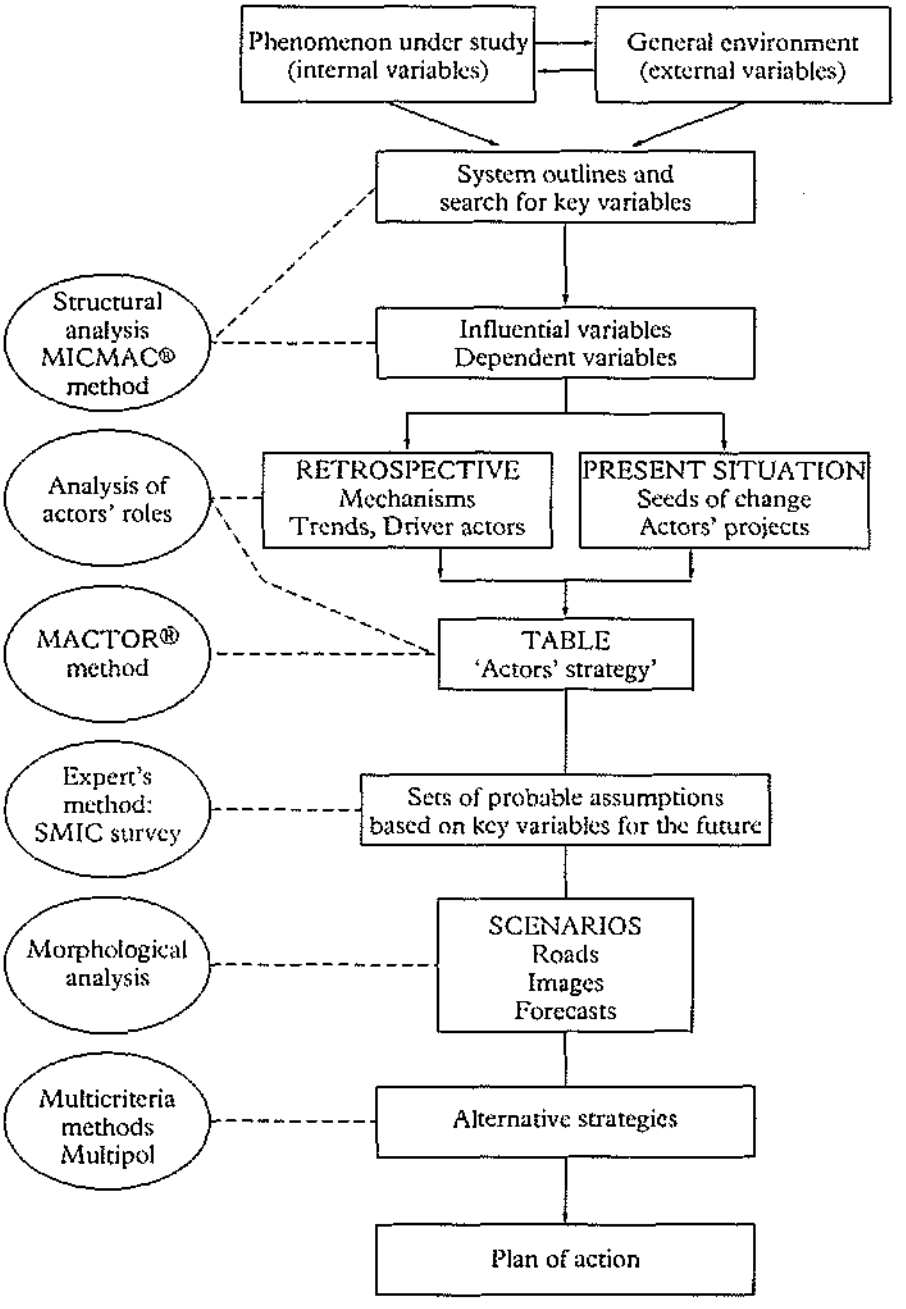


*F*IG . 6. From scénarios to strategy.

When delimiting the System, one dravvs up as complète a list as possible of the variables that should be taken into considération, whether quantifiable or not, tliereby providing an overall vision of the System under study and its environment. In this way, we develop a reasonably accurate définition of the System. In order to achieve this resuit, a number of methods are used: interviews, seminars with specialists, brainstorming, checklist-building, etc.

One thus establishes the list of variables that apparentiy characterize the System, and one then divides them into two groups:

- *Internai variables,* which characterize the phenomenon.
- *Externat variables,* which characterize the gênerai explanatory environment of the phenomenon as studied in its démographie, political, économie, industrial, technologicat and social context.



F *i* G . 7. The scénarios method.

The search for the principal déterminants of tlie System and their parameters is implemented by an examination of the direct and indirect effects of gênerai environmental variables (external variables) or the variables characterizing the phenomenon under study (internai variables).

The technique used in this research - *structural analysis* - is a commonly used, valuable tool. We will see that structural analysis demonstrates a hierarchy of variables (both driver power and dependence).

Highlighting certain variables confirms our initial intuition and raises questions about other variables that would not otherwise be asked. The rypology of variables enables a better understanding of the system's structure.

The explanatory analysis is carried out across the groups of key variables as identified by structural analysis: it consists of a rétrospective and current analysis of the actor's situation. The rétrospective avoids overemphasis on the current situation, tlie resuit of which would be to bias the study witli conjunctural factors. The aim is to identify tlie mechanisms and the leading actors which hâve influenced the development of the System in the past, and also to throw light on the invariant factors in die System and the major trends.

Analysing the contemporary situation also identifies the seeds of change within the movements of the key variables, as wel! as the stratégies of the actors behind thèse movements. To that end, the analysis takes into considération not only the quantified or quantifiabSe data, but also the qualitative parameters: économie, sociological, poiiticai, ecological, etc.

This analysis - at the end of the database stage - results in the identification of tlie 'actors' stratégies'. This Seads to a confrontation between the actors' intentions and to tlie résultant development of the balance of power between them, which détermines the future. This provides a synthesis (in table form) of the analysis of past developments and the current situation.

3.2. BUILDING SCENARIOS

Given tlie influential factors, the trends, tlie actors' strategy and the seeds of change that we hâve touched on in the preceding section, we can set in motion the scénarios method[8] by having the evolutionary mechanisms inîervene and by confronting the actors' stratégies (ail possible convergences and divergences).

8. A scénario is the set formée! by the description of a future situation (or 'final image') and the consistent route which interconnecta the présent and final situations.

The choicc offinal images

If the developmental possibilités arising from the problem under considération are characterized by *n* hypothèses, then there are 2" possible final images.'*

The SMIC" method altows a hierarchy of the 2" final possible images to be obtained from the probabilities assigned to the hypothèses ranked in order of decreasing probability. A choice is then made of the image corresponding to the most probable scénario, together with the images of the contrasting scénarios.

Allowing for the degree of uncertainty which governs the hypothèses, the method relies essentially on the consultation of experts. This consists of:

- Questioning the experts as to the probability of the hypothèses occurring or not: the simple probabilities of each hypothesis together with the conditional probabilities, since the probabilities can be interconnected. The experts (twenty or thirty) are consulted by questionnaire. They are chosen from différent sectors, depending on the field to be explored (government, entrepreneurial, international, university, etc.).
- Calculating the probabilities assigned by each expert to the various scénarios possible, and ranking them by hierarchy.
- Carrying out a sensitivity analysis: while varying slightly the probability of a hypothesis, the variations induced in the other hypothèses are then observed.

Thèse procédures then allovv déduction of the influential and dépendent hypothèses. The results provided by the various experts and the resulting hypothèses are then compared, allowing identification of:

- On the one hand, the final image of the référence scénario, which is the image most often quoted among those best 'placed' by the experts, and which corresponds to the most probable overall outeome.
- On the other hand, the contrasted images selected from among the images most often cited by the experts and having a significant mean probability of occurrence. The corresponding scénarios

9. If» = 2, there arc two hypothèses, *H(\)* and *H(2),* and four possible final images: *H(ï)* and *H{2)* occur; *H(\)* occurs, *H(2)* docs not occur, and vice versa; nefcher *H(\)nor H(2)* occurs.
10. SMIC (System and Matrix of Cross Impacts), presented in Chaptcr S on expert consensus methods.

T A B L:]• 4 . Dimensions and configurations of the Interfuturs scénario

Dimensions	Configurations envisaged		
Relations berween deveioped countries	Collégiale management		Partial fragmentation between pôles
Internai dynamics of devclopcd socictios	Consensus ïavouring lîgh growth	Rapidly changing values and moderato growth	Conflict between social groups and moderate- growth
Evaluation of relative productivité	Convergence		Divergence
Relations between North and South and among deveioping countrics	Large inercase in North-South économie exchange	Increased North-South divide	Fragmentation of the South by regionj in liaison with the dcvelopcd countries

A scénario associâtes a spécifie configuration wiih cach dimension. Thus therc arc thirty-six possible combinaiions hère. Imerfuturs focused ils analysis on some of thèse.
Source: Lesourne and Malkin, 1979.

describe an environmentai évolution vvhich is typically ver y différent from that of the référence scénario. Often images that are pessimistic or optimistic (from a desired point of view) are selected.

Developments and 'pathways'

At this stage the scénarios are still embryonic, since each is iimited to the outeome of hypothèses. The main problem is now to describe the 'pathway' from the présent situation to the final images selected for the référence scénario and the contrasted scénarios.

The élaboration of a scénario usually calls for a division of the period under study into successive subperiods with intermediate images. Naturaliy the number of thèse subperiods dépends on the natural cycles présent in the System.

To ensure cohérence of the 'pathways' between the différent images (présent situation, intermediate and final images), the basic hypothèses are worked through thoroughly. They resuit either from the conclusions deveioped progressively (using information gathered from the base, particularly the table of actors' stratégies) or by induction from the fundamental hypothèses.

Thus the scénarios method consists of coherently describing the developments as and when they arise, between the présent situation and

the chosen horizon, by bringing to bear the evolutionary mechanisms compatible with the hypothèses while following the trends of the main variables for the phenomena as reveated by structural analysis. The scénario is completed by a detailed description of the final image (and the intermédiare images if necessary).

The scénarios méthode as described hère, represents a path, die logic of which (délimitation of the system, rétrospective anaiysis, actors' strategy, vvorking out of scénarios) has been confirmed by numerous futures studies (see Figures 8 and 9).

However, this logic proves to be an inadéquate tool when it cornes to undertaking analysis, understanding and explanation of increasingly complex Systems; hence the necessity of using the more formai tools of Systems analysis as defined by Y. Barel (1971) as follows.

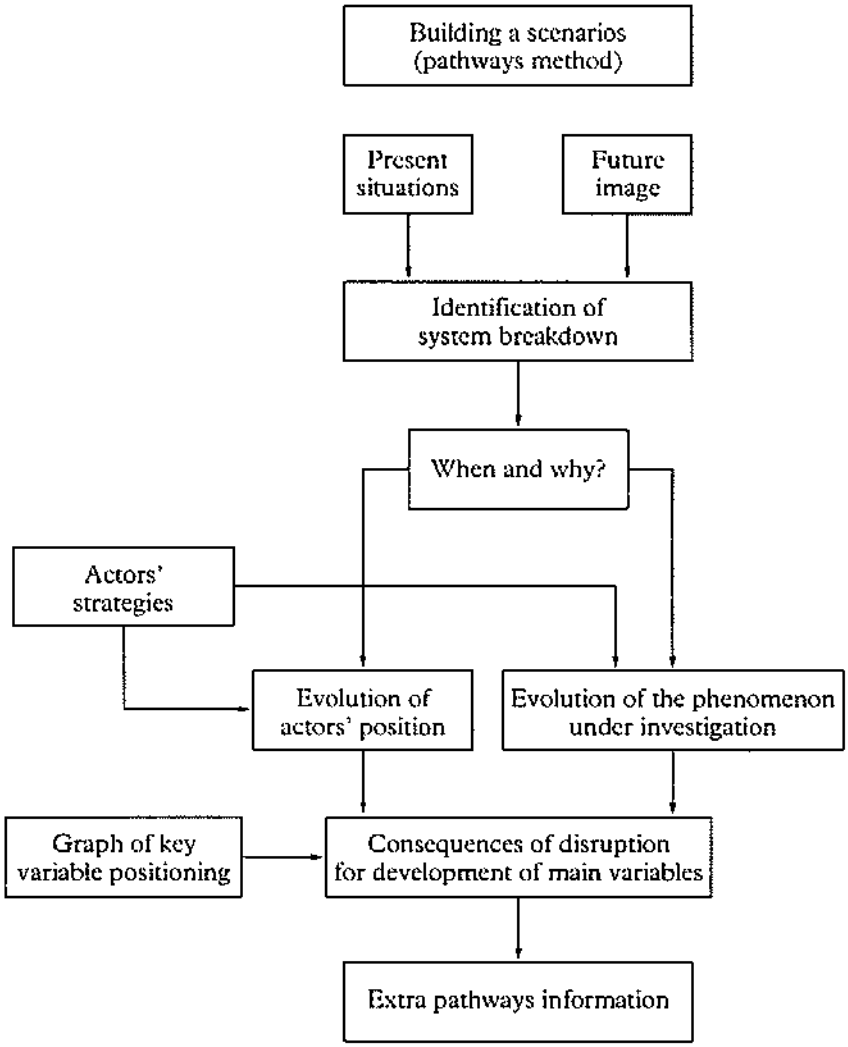
In most cases, Systems analysis consists of emphasizing the fact that the objective under investigation must be placed in a wider context than the original system. The term 'systems analysis' underlines ṁe fact that it is usefu! to break down complex problems into their elementary components.

In the chapters which follow we présent some of thèse formai tools, which may be needed at various stages of the scénarios method.

- *Structural analysis and the MICMAC® method,* particularly useful for delimiting the system and determining the key variables, are set out in Chapter 4.
- *The analysis of the actors* is the main topic of Chapter 5.
- *Expert methods (Delphi and cross-impact)* allow probabilities to be assigned to the hypothèses for the key variables of ṁe future probabilities. Chapter 6 describes one of them: the SMIC method,
- The methods allowing *décisions* to be taken in the présence of *multiple criteria* and in an uncertain future are essential to move from prospective to strategy. To *û\e* extent that multicriteria methods are décision aids, useful in both prospective and stratégie management, they receive spécifie attention in Chapter 7.

Through presenting thèse différent methodological tools, at the same time we gain better insight into how to put the scénarios metiiod into opération. However, although the path is logical, it is not absolutely necessary to follow it from A to 2: everything dépends on the level of knowledge one has of the System being investigated and of ṁe objectives being pursued, The scénarios method is a modular approach: one can limit the study to this or that moduie, as required, for example:

- Structural analysis and the search for key variables.
- Analysis of the strategy of the actors.
- Expert inquiry on key hypothèses for the future.



Fie. 8.

One of the main constraints on the scénarios method is time: it generally takes twelve to eighteen months to follow the whole path through, and aï least half of this is taken up with construcning the base. If there are only three to six months available for the study, it is préférable to concentrate on the module which seems to be the most important.

The full scénarios method has been applied in under half of the cases quoted in the box on page 73. To illustrate the modular nature of the

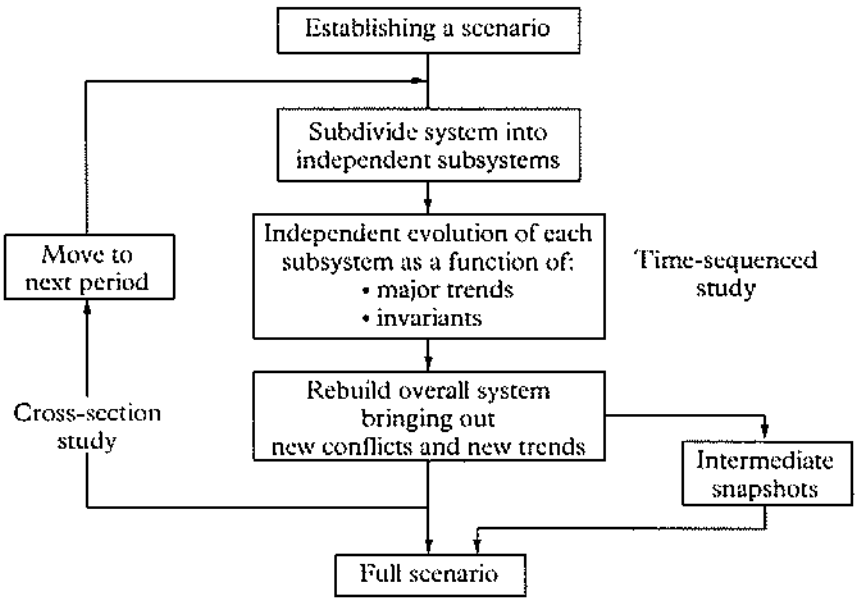


FIG. 9.

tools of prospective; we présent tliem in a number of case-studies. For reasons of confidentialité', it is not possible to présent a complète and detalled case in ail its phases.

The logical pathway which must îead to the présentation of a plan of action consisis of constructing a basis for thought, the working out of scénarios and the évaluation of alternative stratégies. Although the method does not aspire to universality of application and is no sort of panacea, it at least has the merit of being the fruit of expérience; over neariy ten years, more than thirty prospective studies hâve been successiùily concluded on similar bases.

We must not expect from a prospective method that which it cannot provide, however sophisticated it might be: that is, that it should tell us what the future *reaily* hoids for us. No one can do that, because the future is composed not only of the interplay of determinate factors but also of individuals' freedom.

However, the scénarios method can provide simple help towards thinking constructively about the future. It can help us (and this is a strong point in its favour) to choose the strategy which, in the midst of ail kinds of constraints, will prove the most likely to bring our plans to fruition while retaining a maximum set of possible advantages.

Exainple ofa scénario: doubling life expectancy

We could live, on averagc, to an âge of 140 for men, and 150 for women. If we suppose that the âge for marriage does not vary much, there would be an average of at lcast four or five générations alivc at the same time in eacli family. What would the retirement âge be? If it were 65, ṁe number (proportion) of old-age pensioners would become intolérable for socieiy. As this would be impossible, the retirement âge would be postponed. Thus strong expansion wouid be required in order to create full employment, and we would work to 100 or more. But to work for 100 ycars implies keeping abreast of progress: gênerai retraining wouid become a lifelong commitment. Since one cannot envisage learning sciences **chat** would still be useful 100 or 200 ycars hence, a change of objective for primary and secondary éducation would be needed. It would hâve to provide the basic toois and prépare the intelligence to adapt itself to change by exercises in mental gymnastics (mathematics and Latin, for exampte, as well as exercises in creativity). There would be an imbalance between générations and conflicts (short of radical change in éducation). Hxtra accommodation would be required, since the population itself would double, even though the birth rate might remain stable. There would be profound changes in inheritance: we would not inherit goods or power until nearly 100 years of âge. Power would tend to remain in the hands of thc over-lOOs. But that would be unacceptableand the younger générations would claim their autonomy. They would be treated as minors until they were nearly 50. Thanks to contraception - accepted by ail under the absotute necessity of restraining population growth - women would be free of maternity at around 35. They would thers hâve around 115 years of life left. Hecausc their services would be needed to support the aged they would ail take up employment. Their salaries woutd no longer be considered as incidental and they would hâve access to ail positions. A number of female geniuses would be revealed — ail those who had not hitherto been able to break out of the sufling sociological web that had up to then been the binding ruie. Public opinion would accept them. Ail those men and women who had neither passion nor creativity nor adéquate spirit or soûl would find life too long and would commit suicide. The troublemakers would last for a long time, with a concomitant growth in criminality. Moral independence would be sought by other means: psychiatry would be revolutionized, etc.

Source: lost in the mists of ïimd

4. Illustrations

Selecting illustrations is problematic. On tlie one hand, many interesting examples of corporate scénarios cannot be published for reasôns of confidentiality. On tlie other hand, most scénarios published by public administrations or international organizations hâve had no impact on their strategy.

4.1. SCÉNARIOS AS TOOLS OF STRATEGY AND/OR MANAGEMENT

As regards companies, \ve need to dravv a distinction between those that are carrying out highly confidential prospective studies for Uie sole use of the directors making stratégie décisions (Lafarge, Péchiney, Mercedes or Nestlé come to mind), and those which are rather using prospective as a tool for collective thought and mobilization of minds (such as Renault, RATP or the Ministère de l'Équipement with the Direction Départementale de l'Équipement) and which make communication compuisory.

In the first case - prospective as a stratégie tool - the Lafarge group represents one of the best examples of 'cold' prospective thought which has had an impact on strategy: by the mid-1970s this group had anticipated the décline of cément (~1 per cent annualiy between now and the end of the century), and had decided to invest in a leading-edge field (biotechnology, with tlie take-over of tlie Coppée group) vvhose sole characteristic in common with cernent vvas its low manpovver requirements. Companies of this type are always in step with the future, and hâve already anticipated the conséquences of the création of Europe and the opening up of Eastern Europe.

In the second case - prospective as a tool for mobilization and management - the process of involving staff, which thèse prospective exercises facilitate, allows the company to be better informed as it faces change. The restructuring carried out at Renault (a one-third réduction in manpower between 1985 and 1989) was probably facilitated by the new awareness which emerged from the collective considération of company change carried out between 1982 and 1984 - Opération IESC (Industrial, Economie and Social Change) - in which several thousand middle management and supervisors participated. In this case$_3$ transparency is mandatory, and just as there was an IESC notebook, so there are prospective and management notebooks at tlie Ministère de l'Équipement. Thèse notebooks act as sound-boxes for tlie circulation and amplification of ideas.

Between thèse two extrêmes lie one point in common and several intermediate positions. The common point is the permanent but cyciical naaire of prospective, marked by strong upbeats every four, five or seven years. The long-term backcioth must be of sufficientiy good quality to !ast for several years. It is a little like driving a car - by switching onto full beam a few limes, we are able to drive even better with dipped headlights.

As examples of intermediate cases of prospective, where it is both a stratégie tool and a directors' tool for mobilization, we can cite the big oil groups Shell and Elf. Both hâve used scénarios for over twenty years and would even go so far as to advertise this practice as one of the key éléments of their stratégie management.

We shail not dwell hère on the expérience of Shell. We merely note that they use a fairly rudimentary method of scénario construction. Scénarios hâve primarily acted as a way of uniting and encouraging stratégie activity and of creating a shared basis for thought for me directors of a highly decentralized group. The success of the scénario method lias been greatly enhanced by the oil shocks which were already foreseen in 1971-72.

Our impression, after several accounts by Shell management, is that they are concerned above ail to stimuiate the imagination of their strategists and to make them think together, for example by constructing scénarios of a technological society where information would universaily replace energy. Yet it is not for this reason that the Shell group has moved out of the energy field somewhat and into telematics. Although the scénarios hâve a high level of internai transparency (a too! for communication between directors) and a good degree of cohérence (intellectual logic), they seem to be much weaker when it cornes to examining die relevance of questions and their probability.

At the methodological level, this work was inspired by a Frenchman, Pierre Wack (1985), whose own inspirational sources came from the founders of the École Française de Prospective, vvho are not well known in Europe and even less in the United States. Pierre Wack has a number of spiritual successors such as Peter Schwartz, who in 1984 took over from Wack within Shell's prospective group, and who left for the United States in 1986 to set up the Global Business Network (GBN), a network of prospective practiu'oners serving an international club of companies.

Today Peter Schwartz is popularizing scénarios in the English-speaking world, and has even managed to win over his well-known friend, Michael Porter, who has incorporated tlie notion of scénarios in his most récent works. In mis way French scénarios will soon be rediscovered and imported into Europe under tlie 'made in the United States' label.

Planning al Shell, 1945-80

The chronologica! ïist beiow illustrâtes how **Shell** movccl from linear, highly quantified forecasts to the acceptancc of uncertainty and the description of possible futures based on scénario analysis.

1945-55 Physicai planning
1955-65 Planning by project and sclcctivity
1965-72 Unified Planning Machinery (UPM) System
1967 Start of the Horizon 2000 study
1969-70 Horizon Year Planning Exercise (with a fifteen-year horizon)
197 î Expcrirnenting with scénarios at the company's registered offices in London
! 972-73 Introduction of planning by scénarios
1975 Introduction of medium-term cyclical scénarios
1976-77 More thorough study of'societal analysis' in planning
1978-79 Deeper analysis of geopolitical and political risk
1979-80 New examination of the very long term + development of planning capacity within the Group.

The method described by Pierre Wack is now wetl adapted. Group planners hâve accumulatcd a great deal of expérience in analysing the crucial factors intervening in their fteld of activity, in identifying the relationships which develop between the various actors présent and in describing the process of évolution of thèse balances of power. AH thèse analyses are incorporated into the cohérent diagrams put forward for considération by the decision-makers.

The task of constructing global scénarios is carried out as a service by part of the Sheli Group, which acts as a global environmental observatory. It produces global scénarios of dcvelopmcnts in the économie environment, the energy environment, the oil environment and so on. In thèse scénarios there are analyses of, among other things, démographie phenomena, political dcvelopmcnts, changes in values and lifestyles, technological and économie developments, monctary problems, energy demand as a function of thèse factors, energy supply, the spécifie position of oil, the possible évolution of relations between the producer and consumer nations, the formation of crude oil priée structures and the hypothetical évolution of thèse priées, etc.

Starting with scénarios of the global environment presented by the Group, the subsidiary eompanies construct their own scénarios, by studying thosc aspects which are more spécifie to their national environment and which hâve an impact on their activities. Conceived as toots to aid stratégie thoughtj the national scénarios must be multiple and yet not too mimerons; they must be the resuit of thorough and rigorous analysis, yet remain simple and easy to use; and they must cover a broad spectrum of possibilités, while remaining in the reaim of the probable. In 1981 ail the oil eompanies, fearing the conséquences of the confiiet which had just broken out between Iraq and Iran, built up reserves of oil. Shell, thanks to the method described above, got rid of its surpluses before the rnarket became overcrowded and priées coltapsed.

4.2. SUCCÈS S FUI. UTILIZATION OP SCENARIOS - THE CASE OF ELF

Hère we wave die French fiag with die case of" the Elf Group, which carried out three prospective exercises in fifteen years; the first in 1969 looking ahead to the horizon of 1985, the second in 1978-79 with the horizon of 1990, and die third in 1985-87 with the horizon of 1995. We were fortunate to be associated with the last of thèse., and reasons of confidenuality force us to limit our comments to die menodological aspects and to what François Didier was able to say and Paul Alba (1988) to pubtish.

First exercise in 1969: Elfup to 1985

A small team, repordng to die Research Director (Bernard Delapaime) and made up of several internai and external consultants, was setup and produced a report. With hindsight it is interesting to note that although die oil shocks were not foreseen, nevertheless the vulnerability of the Group's situation in oil and in Algeria was perceived. Hence the recommendation diat die Group diversify, both geographically (into the North Sea) and sectorally (into chemicals, pharmaceuticals), which was acted upon effectively. In the field of technologie developments in batteries for fuel (electric) vehicles and aruficial proteins were generally overestimated: two or diree years Iater the Group halted its research in this field. The arrivai of telematics and the growing importance of environmental problems were foreseen, with the création of a centre for information and research into possible harmful effects on the environment. Overall, the success rate of this first exercise is largely positive. It recommended that the Group double its size in relation to its competitors between 1969 and 1985. This objective was achieved.

Second exercise in 1978-79: Elf up to 1990

This study, under die responsibility of the Director of Strategy, François Didier, engaged the équivalent of eight full-time staff. The main goai was to define stratégies in the face of three identified scénarios of global development (black, grey and rosy). As in the preceding exercise, developments in die energy field were wrongly perceived: it was at the height of the second oil shock, yet die price of oil in constant dollars fell. On die otlier hand, die study was very prudent as regards technological change. This did not prevent it from emphasizing innovation in the technical froid, as well as in the économie and socio-organizational fields,

and reorganizing its chemical activities while deveioping biotechnologies vvith Sanofi. Also to the crédit of this study is a recommendation which was effectively acted upon: the setting up of Groups for Reftection and Study on Stratégie Thèmes (GRETS). Around twenty of thèse were operating during the 1980s.

Third exercise in 1985-87: Elfitp to 1995

Still under the responsibility of François Didier, the study took eighteen months and invoived several dozen people in the group. It was carried out in two phases: an exploratory phase, in order to construct environmental scénarios; and a normative phase, in order to define stratégies in the face of thèse scénarios. During the exploratory phase about ten working groups were formed according to branch of activity and thème (environment, research, geopolitics). During the normative phase, three sample stratégies were studied: 'natural resources', 'commodities' and 'high tech, high growth'.

This exercise, like the earlier ones, was undertaken without a particular methodology^ but with a high level of professionalism in activating the groups and respecting deadlines. The collective mobilization was undertaken in an upbeat manner: meetings with the président, branch directors, etc.

I had the opportunity to follow this exercise ciosely in my rôle as external consultant to the pilot commitîee - an exciting and, at times, difficult rôle of observer, I was required to remain silent for hours and to react, if possible in a critical manner, to what had been said and put forward by différent members of the group., some of whom were high-level managers.

The two external consultants were also used sensibîy, as they were placed at the disposai of groups which felt the need for Hvely input, but were not imposed upon them. It is prématuré to assess the success record of this exercise. P. Alba (1988) merely notes as a conclusion: 'Once a company is important it cannot make leaps.' Elf Aquitaine has thus confined itself to basing its future development on its three industrial branches (oil, chemicals and health and hygiène) and on thèse alone.

The exercise to 1995 led to a mémo from Président Pecqueur on company direction, written on 17 July 1987 and distributed *to* ail staff.

The Elf and Shell groups make good use of scénarios precisely because of the high degree of internai involvement that they hâve been able to develop. This does not prevent errors in forecasting and stratégie diagnosis, and we therefore believe that thèse groups would be well

advised to make a little more use of existing prospective tools in order to strengthen the relevance, cohérence and probability of their analyses. As regards transparency, it would hardly be possible to do more for collective memory whiist observing necessary confidentiality.

Intelligent use of prospective and of scénarios (as a tool for strategy and management) has aiso long been évident in companies such as the RATP (Paris public transport system) and for some years at EDF (French electricity board).

5. Anticipation and scénarios: myths and realities

The very use of the word 'scénario' can prove dangerous for future thinking: there is a risk of being swamped by média successes with littie or no scientific grounding. Let us examine two preliminary questions:

- Does using tlie term 'scénario' for any combination of hypothèses (for a given analysis), however attractive this may be, confer a degree of future respectabilité'?
- Need one necessarily draw up full and detaiied scénarios when undertaking future thinking?

The answer is most assuredly 'No!' on both counts. A scénario is not a future reality but a way of foreseeing the future, thereby throwing light on the présent in terms of ail possible and désirable futures. The test of reality, and a concern for efficiency, should be used to guide prospective thinking in order to gain a better mastery of history. A scénarios approach can only be crédible and useful if it compiles with four prerequisites: retevance, consistence, tikelihood and transparency.

In other word s, one must ask die right questions and cîearly formuiate the true hypothèses which are keys to the future. Without rhis procédure, tliere is a risk of leaving out some 80 per cent of ail possible futures. With modem probability tools, such as the microcomputer package SMIC-Prob-Expert®, it takes only a few minutes to provide resutts for a group study. Curiously, certain proponents of rhe prospective approach refuse to submit their own thoughts on an issue to a system which is akin to a tie-detector, or which would at least reveal contradictions in their reasoning.

The last prerequisite mentioned above (transparency from A to Z) impties thaï: 'a clear concept can alvvays be stated clearly'. This should apply to any problem, the methods used to solve it, the reasoning behind it, the results and the conclusions in regard to the scénarios envisaged. Far too often, unfortunately, either die simple reading of the scénarios

proves laborious and the reader must invest considérable effort in ascertaining the prerequisite conditions (relevance, consistence) or the Hterary quality is so low that the reader finds it indigestible and sets it aside. Thus, owing to a lack of close and critical review, a number of scénarios remain crédible, i.e. they are given the benefit of the doubt and the reader is left feeling somewhat guilty that he has not read the text through to a iogical end.

Without transparency, resulis will be unadaptable and vvill not enable implication of the actors (the public) that we wish to involve through the scénarios. Naturally, the transparency and attracdveness of scénarios do not preclude quality of content; scénarios with catchy ntles, or which are presented in an emotion-ridden, pleasurable or doomsday style - such as *l-'uture Shock* - can be convincing. Such works are fiction, that is, a literary genre which *per se* is quite honourable and often makes for superb reading. A famous example is George Orwell's *Ninetecn Bighiy-l'bur.* However, they rarely contain relevant, cohérent or even lîkely scénarios.

By replying negatively to the second question above, we want to make it clcar that *anticipation and scénarios are not synonytnous.* Too many studies in prospective hâve become bogged down over lime because a group decided to launch into 'die scénarios method'. Butwhy, we may ask, did they do so? A scénario is not an end in **îtself;** it only becomes meaningful vvhen its results and implications are embodied in real action. Undertaking a scénarios approach is dme-consuming (tweive to eighteen months is not uncommon) and there must be several persons involved in order to establish a team context and make the process viable. After three years the leaders of the OECD Interfuturs team (1976-79) announced that they had insufficient uirne usefully to exploit ail the results! (see Lesourne and Maikin, 1979). We can safely add an extra year for circuladng and publicizing results.

In most corporate and administrative organizadons, such teams will be required to report within the year. In extrême cases, policy-makers may launch a prospective stiidy that they wish to see finished in a matter of a few weeks. Thus the prevailing conditions are rarely ideai and it is better to throw a little light (rather than no light at ail) on die impending décisions. Sheer common sensé dictâtes die simple questions that one shoutd raise at the outset: What can be donc in the given time, using the means available? How can it be donc in such a way as to be bodi crédible and useful to die decision-makers?

From tliis point of view, it will often be advisable to iimit die scénarios to several key hypothèses, say four, five or six. Beyond such numbers, die sheer magnitude of possible combinations is such that the human mind

simply gives up. Such straightforward scénarios are used as backgrounds for stratégie options such as \vhat if… ?' or 'what for … ?'. Short-cuts in a scénarios approach make it ail the more crucial to do some pretiminary thinking about the key variables, the trends and the actors' stratégies.

One final difficulty that arises when building scénarios and selecting methodology relates to lead-times. Even if one has months, or even years, to finish the assignment, there is a risk inhérent in the start-up phase because team members or even the team leader may change as the study progresses. A futures study rarely survives after the departure of the initiator. In major organizations — given existing staff mobility factors — it is préférable to limit the length of the project to one year and to plan for intérim status reports. It is also advisable to identify a preliminary exploratory phase, during which the éléments atstake are identified, and a reguiatory phase during which the various stratégie policy choices are defined, in terms of items identified in the preceding phase.

Hère we end our gênerai présentation of the scénarios rnethod. In the fotlowing chapter we shall return to each of the stages involved and présent the problems that arise, as well as the tools avaiîable to overcome them.

This will involve, in turn, identifying the key variables for the structural analysis (Chapter 4), analysing actors' games with the MACTOR® method (Chapter 5), surveying the field of possibilités with morphological analysis (Chapter 6) and reducing uncertainty by the use of expert metliods (Chapter 6).

4. Identifying the key variables: structural analysis

1. Origins and objectives of structural analysis

A System consists of a set of interrelated éléments. The System structure, i.e. the network of reiationships between thèse éléments, is essential to an understanding of its évolution, because this structure maintains a certain permanence. The aim of structural analysis is to highlight the structure of the reiationships between the qualitative variables - quantifiable or not - which characterize the System under study (for instance, a company and its stratégie environment).

Structural analysis enables one to describe a System by using a matrix which interconnects ail the System components. This method permits analysis of thèse reiationships and identification of the main variables.

With regard to the techniques used, as J. Barrand and C. Guigou (1984) noted: 'Structural analysis is based on Leontiev's input-output matrices, on the theory of graphs and the simulation exercises of operational research carried out soon after the last war in the USA, and in particular by the Rand Corporation to fulfil American army requirements.' Some Systems analysis and technological forecasting methods hâve their origins in defence research. This was the case in France for the method of 'relevance trees' developed by the Centre de Prospective et d'Évaluation (CPE) (Centre for Prospective and Evaluation) of the French Ministry of Defence. This was not the case with structural analysis, however, which seems to hâve been introduced into France by Professor Wanty, who worked for the Belgian subsidiary of the METRA International Group and who taught at die University of Paris Dauphine in 1969 and 1970. Since then structural analysis has become more

widespread through, in particular, die work of Professors R. Saint-Paul and P. F Teniére-Buchot (1974), and our own work at SEMA.

Structural analysis has two complementary objectives: first, during the initial phase to obtain as thorough a représentation as possible of the system under srudy, in order, second, to reduce systemic compiexity to its main variables. In his thesis on structural analysis and its dcvefopments, J. E Lefebvre (1982) lists several of its applications:

- It can help in thinking about a System in order to build a more elaborate model such as Systems dynamics.
- It can be used on its own in order to assess stratégie choices.
- It can form part of an overall approach such as die scénarios method,
- It can help group communications and discussions or group adhérence to a spécifie objective.

In practice, structural analysis has been used in two main ways:

- In decision-making (research, identification of the variables on which to act to achieve the selected objectives): the POPOLE model of P. *F.* Tenière-Buchot (1973) is a good example.
- In forecasting (research on the key variables which bear on the future dimension). This use was developed in the early 1970s and we were attracted, in particular, by the development of the MICMAC® method, where die importance of a variable is measured less by its direct interreiationships dian by many indirect interreiationships (Duperrin and Godet, 1973).

The next section deals mainly with the latter use of structural analysis in forecasting. This comprises several stages:

- Listing ail the variables.
- Location of interreiationships within the structural analysis matrix.
- Search for the key variables by the MICMAC® method.

2. Listing ail the variables

In order to develop as exhaustive a list as possible of the variables which define the system formed by the phenomenon under study and its environment, no research path is, a priori, excluded. Ail brainstorming and intuitive methods are useful hère.

The process of listing ail die variables should be assisted, preferably, by non-directed interviews with the représentatives of the actors presumed to be invotved in the system under study. The questions should be open, such as: 'In your opinion, what are the factors which will condition die future évolution of such and such a phenomenon?'

To identify thèse variables, several différent politicaL économie, technoiogical and social viewpoints shouid be adopted, in order to build up files and to organize several sessions of collective thinking. Following the accumulation of raw data, the actuat listing of ail variables is based on aggregating and reftning the data so that a homogeneous list is obtained. Also, given the nature of the phenomenon under study, it is often advisabk to reclassify the variables by disdnguishing between internai and externa! variables; the internai variables characterize the subsystem under study whereas the external variables make up its environment.

Finally, detailed explanations of thèse variables are essential to identify the varions interrelationships. Indeed, such an explanation can provide the detailed analysis of everything implied in the définition of a variable. Without the création of this common base, the analysis and identification of interrelations could be rendered impossible or meaningless. Thèse files, once compieted, are kept open and they are updated as and when required. They thus form an information database which can systematically sort data.

Below, we describe me scale models built, under our supervision, by J. Barrand and C. Guigou (1984) as a case-study of structural analysis. We concentrate on the déterminants of employaient and unemployment; the analysis was reduced to the forty-one variables shown in Table 5.

3. Location of relationships within the structural analysis matrix

Within a systemic world-view, a variable can only exist because of its interrelationships; intuitive récognition of the existence of certain interrelationships enabled us to pinpoint some variables when pre-paring the list.

T A B L *E 5* . Déterminants of cmpioyment and unemployment

Intentai variables	1	Unemployment rate
	2	Unemployment rate for women
	3	Unemployment rate for young people
	4	Number of long-term unemployed
	5	Employaient in services
	6	Employment in industry
	7	Employment in agriculture

Environmental variables (extertml)		
Economie and financial	8	Household income
	9	Rate of économie growth
	10	Household consumption
	il	Inflation
	12	Savings
Internai	13	Financial situation of eompanies
	14	Interest rate (savings}
	15	Rates on the money market
	16	Money supply
	17	Budget déficit
	18	Constraints on the external balance of payments
	19	International context
International	20	Degree of opcnness of che economy
	21	European harmonization
	22	Energy price and raw matcrials
Techrtological and industrial	23	Investment for rationalization
	24	Investment for expansion
	25	Operational productivité' per hour
	26	Company competitiveness
	27	Technological and 'ndustrial évolution
Sociodemographic	28	Working population
	29	Employment rate among women
	30	Geographical concentration of unemployment
	31	Immigrant workers
	32	Parallel economy, moonlighting
	33	Sociaî relationships
	34	Uncertainties for the future
	35	Evolution in ways of iife
Institutionat	36	Work législation and régulations
	37	Work-sharing and income-sharing
	38	Distribution of mandatory wage déductions
	39	Total value of mandatory wage déductions
	40	Training
	41	Work costs (average hourly wage)

Structural analysis attempts to interrelate the various variables in a dual input table (see Figure 10).

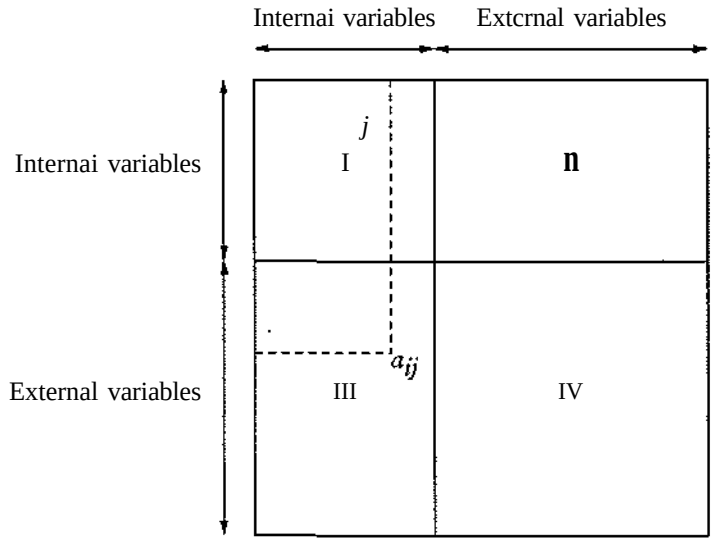


FIG . 10. Structural analysis.

Before establishing whether there is a relationship between the two variables, the prospective group must systemaṅcally answer the foltowing three questions:

- Does variable *i* causaliy affect variable *j,* or is this relationship the orṅer way round, i.e. *j* to /' (Fig. 11 (a))?
- Does *i* hâve an impact on *j*\ or does some coUinearity exist, i.e. die third variable *k* lias an impact on *i* andj ? (Fig. 11 (b)).
- Is the relationship between z'andj direct, or does it operate through another listed variable? (Fig. ll(c)).

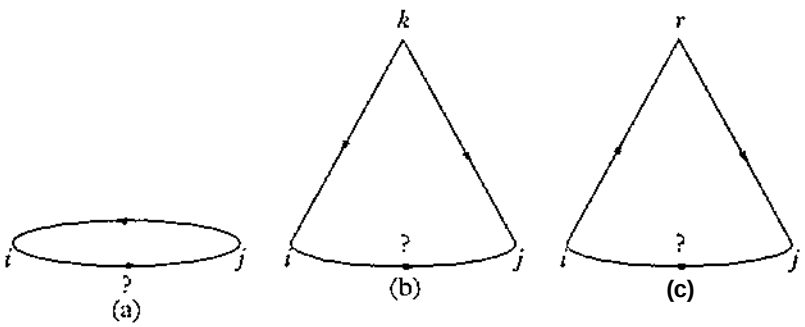


FIG. II. Threc possible cases suggesting thnt ; has a direct impact on/

Many errors can be avoided by using this procédure when fîlling in the matrix. At présent some variables only hâve a weak influence. However,

they could become much more important in a différent context in the future; this is the case, for example, with the 'new technologies for industry and agriculture' variables. Therefore, we should take into account *poteniial* relationships which, depending on the case, are to be added to the référence relationships, that is, to those certainly in existence.

Normally, filling in the matrix is a *qualitative* exercise: we only state whether a relationship exists or not, although the strength of a particuiar relationship can also be specified. Thus, severai direct relationship strengths can be distinguished: ver y strong (VS), strong (S), average (A), weak (W), very weak (VW) and potential (P). The term 'potential' refers to incipient relationships which still oniy hâve a weak influence but which couid, in a future context, become very infiuential (for example, the conséquences of technical change). Thus, a certain dynarnic can enter into the structural analysis, and the sensitivity of some resuits can be tested against the intensity of the relationships that are being taken into account. (See Figure 12 for matrix example.)

One of two methods can be used to fi.ll in the matrix:

- In rows, by identifying the influence of each variable on ail others.
- In columns, by recording the other variables infiuencing each variable.

Theoretically, it is useful to use both methods and to compare the resuits by superimposing the two compteted matrices in order to identify différences and, consequently, the errors made. However, this practice often proves to be a time-consuming luxury the researcher can rarely afford. Indeed, most structural analyses completed thus far interrelate severai dozens of variables; that is, severai thousand questions hâve to be asked, which takes severai days of hard work.

Also, structural analysis is a systematic quesù'oning procédure; without the insights offered by the matrix, many of thèse questions would ne ver be asked. Moreover, new variables are sometimes discovered that nobody had thought of when drawingup the original list of variables.

Filling in the matrix is a good technique for stimulating dialogue. Indeed, it stimulâtes exchanges of views and discussions to help create a common language within a prospective group. As it is, the structural analysis matrix remains qualitative. With more time available, with a more refined method and, especially, if we were aiming at a différent objective, we could develop a more quantitative matrix:

- *Giving a positive or négative value w direct relationships,* as in the first experiment of J. C. Duperrin and M. Godet (1973). This can be a profitable exercise and reveals positive (ampiifying) and négative (regulating) feedback. To perform such an exercise without making an

effort disproportionate to its anticipated usefuiness, the exercise shouid deal only with a small number of variables (ten or fîfîeen). First, it is not always clear whether an impact is positive or négative; second, the désignation of a particular variable could be open to question because turning variables into their opposites (for instance, increase and decrease) does not automatically alter the value of the row and column relationships. For example, there is the case of consumption as a function of income: as income increases, consumption increases; when income decreases, consumption does not necessarily decrease.

- *Quantifying the strengths of variables.* The coefficients a_{ij} can, for instance, be considered as elasticities (the percentage variation in variable j following a relative variation in variable 0- In this case, we assume that we can reasonably estimate such elasticities (ranging, a priori, somewhere between less than infinity and infinity).

This means that it is impractical or îoo costly to perform this exercise for a matrix with more than ten or fifteen variables. In any case, it is not very useful arbitrarily to attach a quantitative value between 0 and 10 and then perform caicutations which will hâve little meaning because the accurate value of the starting coefficients is not known (Lesca, 1982).

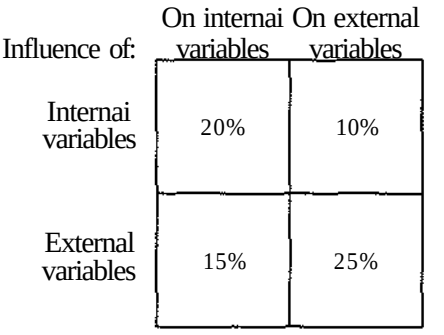
Although such refmements may be interesting in principle, they are ill suited to the future use of structural analysis. The search for key variables requires an overall vision of the System under study and excludes restricting the analysis at the start to several variables, since one is actually trying to identify the main variables from among severa! dozen others.

Practical recommandations

Sufficiently considered preliminary thought usually leads us to characterize the System under study by a list of about seventy variables (iess structured considération can easiîy lead us to keep about 100 variables), This point is important in terms of the number of questions to ask, which can vary by a factor of two (5,000 or 10,000). We need to allow a minimum of three months to carry out a good structural analysis, incîuding internai and external interviews.

Expérience seems to show that a correedy filled in matrix shouid be between 15 and 25 per cent full, depending on the size of the matrix. Higher levels (30 to 35 per cent) are indicative of excessive filling in, with a secondary relationship having wrongly been considered as direct.

The influence of external variables on internai variables is much stronger than the other vvay round, which is not surprising. In the same way, the effects of the internai and external variables on themselves are greater, as one would expect.



Fi G . 12. Example of normal density of direct relationships per section,

The higher the rate of entry of direct relationships, the iess relevant will be the considération of indirect relationships by the MICMAC® method. Thus, if the matrix were filled in 100 per cent, the indirect relationships would merely be a similar multiplication of direct relationships,

To fitl in a matrix of seventy variables will require about three days' work by a group of five to ten people. During the first half-day, vvhich is often laborious, the group will barely be able to examine more than four or five variables and their impacts on the whole of the System. In doing tliis a common language and a certain cohérence in world-view are created, so that quite naturally the rest of the exercise proceeds much more quickly and easily (a rate of 1,000 questions per half-day is common for the rest of the process). But the group must be open to debate, and should sometimes mark any doubts with question marks, so that diey may corne back to thèse afterwards.

Measuring intensity and taking into account potential relationships also represent acceptable compromise solutions to enable collective thought to proceed without causing excessive individual frustration.

4. Search for the key variables with the MICMAC® method

Having developed an exhaustive list of the variables to be taken into account, we now hâve to reduce the complexity of the System and to identify which key variables should be studied first.

When dealing with an internai subsystem, related to an external environment, there are two kinds of major variables: first, the external variables which are the most infiuential and the most useful in explanation (the system's main déterminants); second, the internai

variables which are the most sensitive to this environment. The environmental variables which do not seem to affect the System under study can be discarded.

MICMAC® tries to pinpoint the independent and dépendent variables (the key variables) by building a typology of thèse variables in both direct and indirect classifications.

4.1. DIRECT AND INDIRECT CLASSIFICATION (MICMAC®)

Straightforward examination of the matrix reveals which variables hâve the greatest direct impact,[1] but is not enough to reveal the hidden variables which sometimes greatly influence the problem under study.

Indeed, in addition to the direct relationships, there are also indirect relationships between variables, through influence chains and réaction loops (feedbacks). A common matrix comprising several dozens of variables can include several million interactions in the form of chains and loops. The human mind cannot conceive and interpret such a network of relationships.

The MICMAC® method,[2] a System of multiplication of matrices applied to the structural matrix, is used to study the diffusion of impacts through réaction paths and loops; thus, a hierarchy can be developed for the variables:

- In order of their influences by taking into account the number of paths and loops of length 1, *2,. . . n* . .. arising from each variable.
- In order of dependence, by taking into account the number of paths and loops of length 1, 2, . . , « , , . accruing to each variable.

1. The firsi set of information can be obtained by tirât analysing the direct impacts: the su m of the fîrst Une represents the number of times that variable ï lias an impact on the System. This number is the indcpcndencc factor of variable ï. Similarly, the sum of thej column represents the number of times; was influenccd by other variables and represents the dependence factor of variable *j*. Thus, for each variable, an independence factor and a dependence factor can be obtained, to classify variables according to thèse two criteria.
2. MICMAC*: Matrice d'Impacts Croisés - Multiplication Appliquée à un Classement (Cross-Impact Matrix - Multiplication Applied to Classification). This meîhod was developed atthe CEA between 1972 and 1974 byj. C. Duperrinand M. Godet (1973).

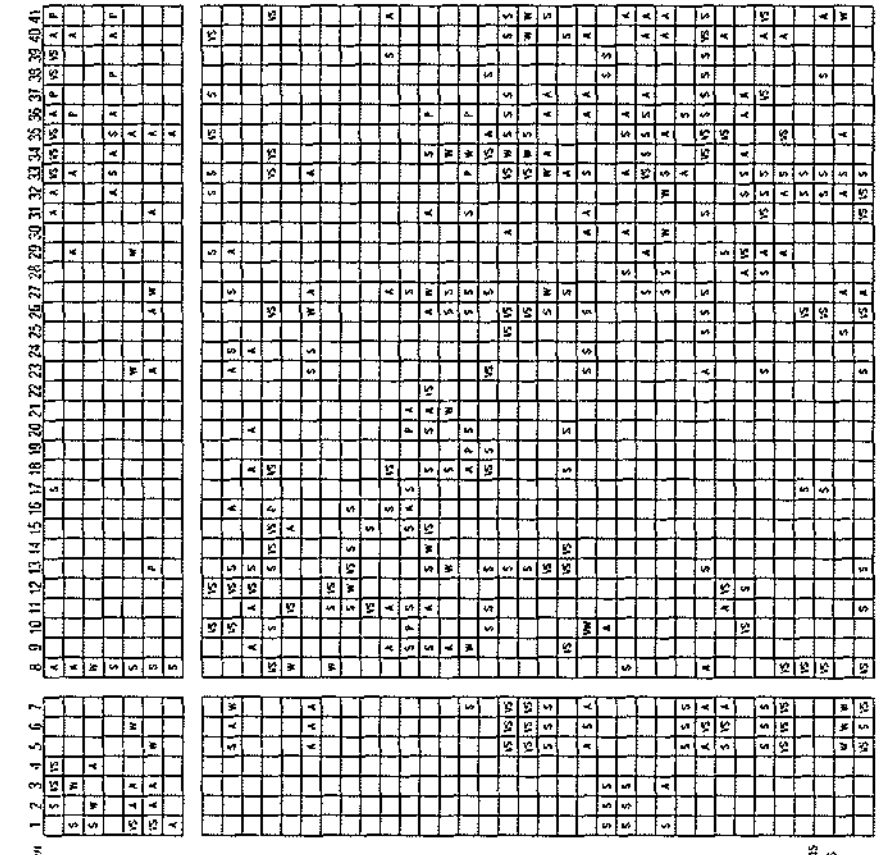
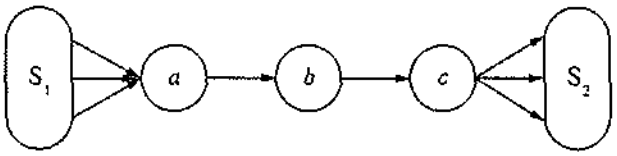


FIG. 13. Dcterminants of employment and unemployment in France during the 1980s.

4.2. THE MICMAC® PRINCIPLE: RAISING THE POWER OF THE MATRIX

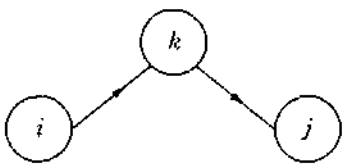
The MICMAC® principle is a simple one, and is based on the classical properties of Boolean matrices, which are summarized as folîows.

Let us examine the foliowing cxampie where the System of variables can be broken down into two subsystems, S[and 83, which are not indépendant

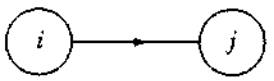


since they are interconnected through variables *a, b, c.*
As regards the direct effects:
• *a* is strongly dépendent on subsystem S],
• *c* dominâtes subsystem *Sj-*
When anaiysing the direct effects> variable *b* is neglected, although it can represent an esscntial clément of the system's structure since it is the relational cross-section point between both subsystems S; and 82-

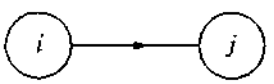
If variable 2'directly influences variable *k* and if *k* directly influences variable *j*, we hâve the foliowing:



In this casej any change affecting variable *i* can hâve repercussions on variable *j*. There is an indirect connection between Î and *j*. Numerous indirect relationships of the



type which exist in the structural analysis matrix cannot be taken into account in a direct classification. When the matrix is squared, second-order relationships are revealed^ such as:



Indeed, $A^2 = A \times A = \{a^2_{ij}\}$ where $a^2_{ij} = \sum_k a^1_{ik} \cdot a^1_{kj}$

When a^2_{ij} does not equal 0, there is at least one k where $a^1_{ik} = a^1_{kj} = 1$, i.e. tliere is at least one intermediate variable k where variable i has an impact on k ($a^1_{ik} = 1$) and where variabie k has an impact on variablej ($a^1_{kj} = 1$).

We can say that a second-order patli goes from i to j; if $a^2_{ij} = N$, there are N paths of second-order length going from i to j via N intermediate variables. In particular, when $a^2_{ii} = N$, there are N circuits (or influence Ioops) of second-order length going through variable i.

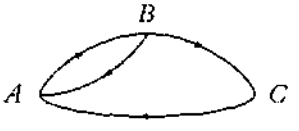
Similarly, by calculating $A^3, A^4, \ldots, A^n$ the number of influence paths (or influence Ioops), of the 3rd, 4th, . . . , nth order, interconnecting the variables, can be found.

Each time this process is repeated, a new hierarchy of variables can be deduced. Their classification is based on the number of indirect actions (influences) they hâve on the other variables. When raised to a certain power (usually the power of 7 or 8), tliis hierarchy proves to be stable. This hierarchy is tlie MICMAC® classification.

When the linear sum $\sum_j a^n_{ij}$ is raised to a power for variable i (a^n_{ii} being one élément of die matrix raised to the power of n), this means that there are a large number of paths of length n rising from variable i, and that variable z'subjects the other System (or subsystem, when dealing with a block) variables to a large number of influences.

Hence the MICMAC® classification can classify the variables according to the influence that they hâve (or that they are subjected to) by taking into account die whole network of interrelationships described by the structural analysis matrix.

To niake this less abstract, let us take the following example from J. E Lefebvre's thesis (1982): a System is identified by three variables, *A*, *B* and C, which interact in the following way:



The structural analysis matrix can thus be written as follows:

	A	B	C	
A	0	1	0	1
M = B	1	0	1	2
C	1	0	0	1
	2	1	1	

Sum of the elements in each row

Sum of the cléments in each column

In this first matrix, the diagonal éléments are always set at zéro: this means that the influence one variable lias on itself is not taken into account, whereas in the indirect effects (updated by squaring the matrix) this influence is taken into account (thèse effects always occur through another variable).

$$M^2 = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 0 \end{pmatrix} \begin{matrix} 2 \\ 2 \\ 1 \end{matrix}$$

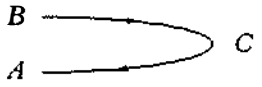
$$\boxed{2 \quad 2 \quad 1}$$

The digit 1 in the first row, first column, means that there is a circuit of length 2 going from *A* to *A.*

Indeed:

The digit 1 in the second row, first column, means that there is a path of length 2 going from *B* to *A.*

Indeed:



$$M^3 = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \end{pmatrix} \begin{matrix} 2 \\ 3 \\ 2 \end{matrix}$$

$$\boxed{3 \quad 2 \quad 2}$$

It is clear that ail éléments of a matrix raised to the power of 3 show that the paths and loops of length 3 go from one variable to the other. It should be noted, and this has already been underlined, that the row and column classification becomes stable when the éléments are raised to a certain power. But the classifications of this matrix raised to a certain power emphasize clearly the importance of certain variables by the indirect effects (feedback) that they hâve.

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

$$\boxed{4 \quad 3 \quad 2} \qquad \boxed{5 \quad 4 \quad 3} \qquad \boxed{7 \quad 5 \quad 4}$$

Hère, the row and column classifications become stable from the power of 4.

We obtain the same stability, after several répétitions, with a starting matrix filled in using 1, 2 and 3, depending on the intensity of relationships. Taking immédiate account of the relationships in this way is understandable in so far as we can consider a relationship between two variables of intensity-level '2' to be the équivalent of two direct relationships of intensity levé! T between thèse variables.

4.3. COM PARIS ON BETWEEN DIRECT, INDIRECT AND POTENTIAL CLASSIFICATIONS

Our concern is to pinpoint the most influential and the most dépendent variables. It is understood that the influential variables are those whose évolution will hâve the gréa test effect on the system, while the dépendent variables are those that are most sensitive to the évolution of the system.

In addition to a simple examination of the matrix, which allows us to discern which variables hâve the highest number of direct connections with the system, it is a good idea to pick out the 'hidden' variables, i,e, those which, taking account of indirect relationships and feedback loops, a!so appear to be very important.

Variables are thus classified according to the number and intensity of relationships in which they are involved, either in an influential or a dépendent capacity. There are three classifications, direct, indirect and potential, according to the nature of the relationships taken into considération.

Comparison of direct, indirect and potential classifications is ail the more interesting in that we can associate an approximate time horizon with each of thèse différent classifications:

- Direct classification results from the short- to medium-term interplay of relationships; its horizon often corresponds to less than a décade.
- Indirect classification intégrâtes chain reactions which necessarily take longer and the time horizon recèdes *ta.* the médium- to long-term (10-15 years).
- Potential classification goes further than the indirect classification, as it intégrâtes relationships which will not émerge until much later and which will only hâve repercussions on the system in the very long term,

Obviously the comparison between the classifications (direct and MICMAC®) can confirm the importance of certain variables and also reveal other variables which were previously thought to be unimportant but which play a leading rôle because of indirect actions. It would be wrong to neglect them during the explanatory analysis. The example

given hère explains how a hidden variable linked to the development of nuciear power in France was reveated (see box, p. 98). Every structural analysis using the MICMAC® method revealed two gênerai points:

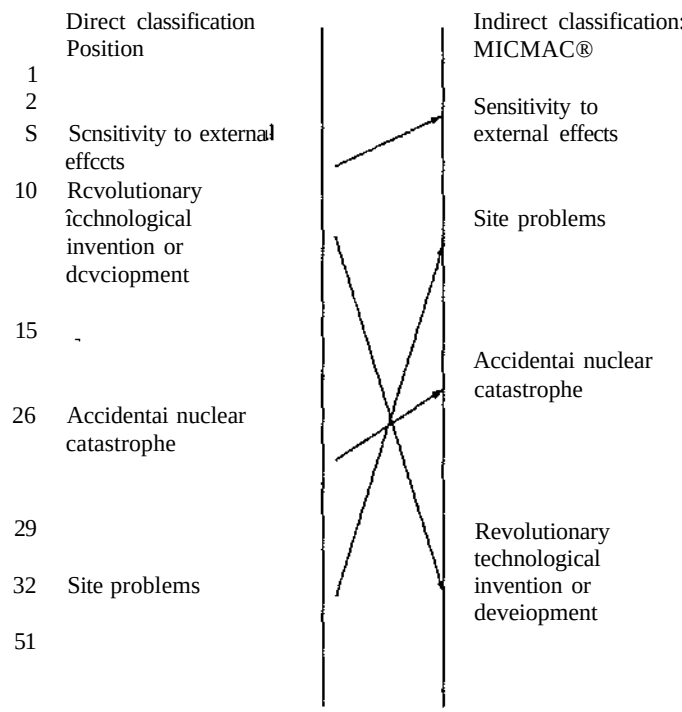
- (At least) four-fifths of the results confirmed initial expectations, and for many variables the indirect classification does not differ from the direct classification. Therefore, the highest-ranked variables can be selected without too much hésitation, whereas those which seem in ail cases to be secondary can be rejecced.
- Between 10 and 20 per centof the results seem counter-intuitive since, in the différent hiérarchies, certain variables move quite noticeably up or down ṁe order.

This analysis stimulâtes discussion within the prospective group and new questions arise. Some of thèse question preconceived ideas; while other questions arise because of the ideas themselves.

We can still remember the shocked reaction of die management of the French Post Office in 1978 to the classification of the positions of thèse variables with respect to their dependency *vis-à-vis* the gênerai environment. The direct classification seemed the logical one, ṁe mail traffic variables being tlie most dépendent, whereas the workforce policy variables (manpower levels, wages) or the quality of service were considered as internai controi variables. The MICMAC® classification rurned this hierarchy upside-down. After long discussions, ṁis a priori counter-intuitive resuit became self-evident: on the one hand, mail traffic since 1973 had been recording quasi-autonomous development, almost independent from variations in économie growth, to which it had been closely correlated in the 1960s, On the other hand, one had to admit that the workforce policy of a public service has practicaily nothing to do with what its gênerai management wants, but is closely linked to overall government policies for tlie public sector, the latter also being connected to the political situation. The policy of upgrading the lower salaries and of creating more jobs in the civil service after May 1981 had strong repercussions on the French postal services: over 50 per cent of the workforce belonged to the lowest catégories, C and D, of the public sector.

Uncovering hidden variables

The following example is based on a prospective survey of French nuclear power. This survey was carried out in 1972 by the CEA {French atomic cnergy commission). By adopting several viewpoints (politicat, économie, technological, etc.), the think-tank for this survey prepared a list of fifty-one variables which should be taken into account. The results obtained are as follows:



The variable 'sensitivity to external effects' moved up from fifth to first position. Thus, since 1972 structural analysis has enabled us to foresee how important collective psychology and public opinion reactions would be for the deveiopment of nuclear energy. This évolution is even more striking in the case of the variable location problems for the siting of nuclear plants', which moved up from thirty-second position in the first classification to tenth in the second. Thus, *the kind of problems thaï EDF (French central electricity generating board)had toface ai Plogott hadbeen identifiaialmost lenyears bcfore they became a reality.*

4.4. THE INFLUENCE-DEPENDENCE CHART

Each variable is associated with an influential indicator and a direct dependence indicator across the whole System. The sum of variables can then be positioned on an infiuence-dependence chart (Fig. 14).

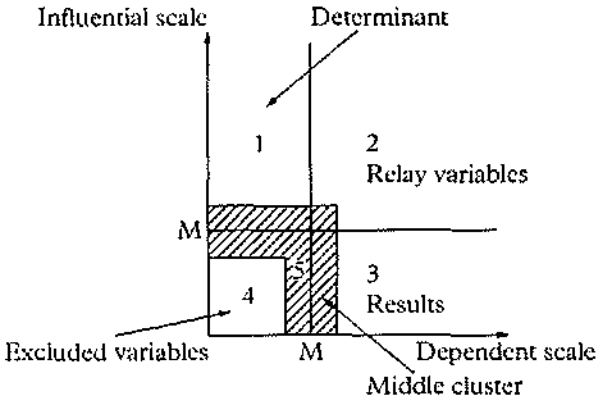


FIG. 14.

This chart can be divided into five sectors:

Sector 1: Influentia! variables. Thèse high influential, low dépendent variables are the explanatory variables which condition the rest of the system.

Sector 2: Relay variables. Thèse variables, which are both highly influentiai and highly dépendent, are unstable by nature. Any action on thèse variables will hâve repercussions on other variables; this will feed back to the relay variables, amplifying or defusing the initial impulse,

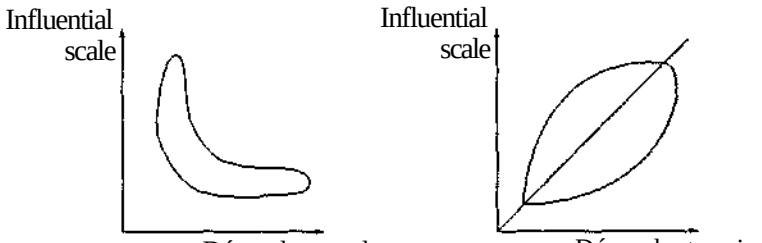
Sccior 3: Résultant variables. Low influentiat and high dépendent variables. Thèse resulis variables are infiuenced by the déterminants (sector 1) and the relay variables (sector 2).

Sector 4: Low influential, low dépendent variables (near the zéro point). Thèse variables constitute marked trends or factors which are relatively unconnected to the system, having only a few relationships with it. Because of their relatively autonomous development, they are not déterminants of the future of the system and we can therefore exclude them from the analysis without too many scruples.

Sector 5: Averagely influential and/or dépendent variables. We can say nothing a priori about thèse 'middle clusters' of variables.

. . . regarding ihe system's stability or instabiliiy

A iow number of relay variables confers relative stability on the System. In facr, in an unstabie System (cluster of points around the main diagonal — see Figure 15), each variable is both influential and dépendent, and any action on one variable has repercussions on ail the others and in uirn on tlie original variable. The advantage of a stable system is thaï it introduces a dichotomy between the influential variables, on which one can or cannot act, and the results variables which dépend on them.



1. Relatively stable System 2. Unstabie System

F i G . 15.

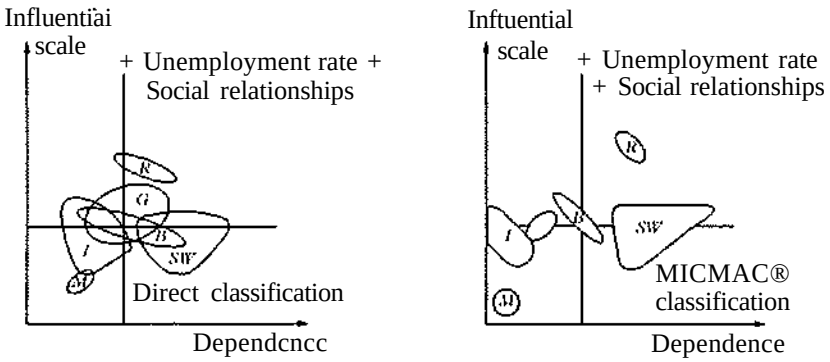
A major benefit of constructing the influence-dependence chart is that it can check whether what is being explained is related to what is assumed a priori to be an explanatory factor and which should normally be considérée) to be influential. This chart often provides surprising resutts (see Fig. 16).

The relay variables of the north-east section are, a priori, the key variables at stake in the System - those over which the actors will fight, because of their unstabie character.

Freqnently, among thèse key variables, vve find taboo subjects that nobody speaks about, precisely because they are important. On the other hand, many topics which figure among the declared priorities of the company or organization are often situated in the zone of excluded variables, because they are neither influential nor dépendent.

In addition to the scénario exercise, a structural analysis should be carried out as a preliminary to the construction of any econometric forecasting model.

This analysis could be usefully completed by the method which breaks down the various parameters into carefully related components so as to reveal related (hierarchical) or unrelated subsystems, and to display die key rôle played by certain relay variables, as suggested by J. F. Lefebvre (1982).



Kcy:
I: International variables
M: Monetary variables
R: Tcchnical and économie relay variables
G: Global économie variables
B: Business variables
5 11[7]: Social and work variables

FlG. 16.

There is no single, officiai, scientific interprétation of the MICMAC® results. The think-tank has to ask the right questions and propose explanations. Thus, for instance, in our example we might hâve wondered why the unemployment rate - the parameter which is influential and has a high level of dependence - seems likely to be abie to explain unemployment through the biasing of social relationships. It might mean tliat unemployment is not onîy a résultant (the conséquence of rigidities) but also a change factor which, when raised to a certain level, affects the social climate and imposes politically motivated measures of flexibility to create jobs and job-sharing schemes.

Ail thèse questions hâve to be answered. This is the aim of the next step in the scénario method. This step essentially deals vvith the key variables identified by structural anaiysis, locates which actors are involved with thèse variables and for whom the past, présent and future roies hâve to be carefully studied. Prior to initiating this anaiysis on the rôle of actors, we offer hère a (provisional) conclusion on the value and limitations of structural anaiysis.

5. Value and limitations of structural anaiysis

The analytical method described above attempts to identify the key variables (whether hidden or not), to ask the right questions or to analyse counter-intuitive aspects of the system's behaviour. The method should helpj but not replace, the decision-maker. It does not try to describe

accuraîely how the System works, but rather its aim is to pinpoint the main éléments of the system's organization.

The results should be used while bearing in mind the limitations of the analysis.

- The first limitation dérives from the subjective character of the Iist of variables. The précautions taken offer some guarantee of objectivity, but for practical reasons the number of variables should not exceed a few dozen. Therefore, some subvariables related to one of the problem's dimensions hâve to be regrouped, more or less arbitrarily. For this method, tliis is a disadvantage as well as an advantage because any model arbitrarily favouring the quantitative éléments to the détriment of the qualitative éléments is rejected.
- The choice of a typology of relationships conditions the results. Usually, two types of relationship are taken into account:
  (a) the so-called référence relationship (known reiationships which are true today and should remain so in the future); and
  (b) the potential relationships (possible relationships which hâve not yet appeared, but whose development is incipient).

On the plus side, this typology is simple. On the minus side it considers as potential not only what is incipient., but also what is doubtful or disputed. A more extensive study, having more time and means at its disposai, would classify the relationships and their nature (conditional, causal, technicai, instituûonal, psycho-sociological, etc.).

- Processing the structural analysis matrix only détermines the existence or non-existence of various relationships. However, this matrix includes relationships with widely varying intensity. Its characteristics should be borne in mind when interpreting the results. That is why the intensity of thèse relationships should be determined, even it only on a qualitative view, in order to carry out sensitivity analyses. However, we should not walk into die trap of excessive!}' quantifying the relationship in order to obtain a semblance of accuracy.

While keeping in mind the above limitations of structural anaiysis, tlie results obtained and their essential value should be recalled. This method, first of ail, is a tool which should be used to classify ideas and to tackle a problem systematically. Since several thousands of questions hâve to be asked, certain questions hâve to be asked to uncover variables which would never hâve been thought of otherwise.

First, the structural analysis matrix acts as a matrix of discovery and helps to create a common language within a think-iank on the prospective exercise.

Second, since a certain number of feedback effects involving each variable hâve to be taken into account, a hierarchy based on tlie influence

and the dependence o(" thc variables should be prepared for such variables. Thus, the main influential of the phenomenon under study can be revealed. The control variables and the résultant variables thus uncovered help beiter to understand the organization and the structure of the System under study.

One can scoff at the fact that 80 per cent of the results obtained confirm initial intuition and are obvious, It should first be noted that obvious points are easy to prove with hindsight, but it is more difficult to forecast accurately what, in the quagmire of preconceived ideas, is undeniably certain and obvious. Furthermore, *80 per cent of the obvions resuhs show that Uns approach is logical and commomensical. This requirement is essenrial to give some crédit to liie 20 per cent of 'counter-inniiiivc' results.*

5. Understanding the actors' stratégies: the MACTOR® method

This stage is essential. Proper prospective thinking cannot be carried out unless there is an in-depth rétrospective study. Notably, this means considering ail the key variables and questions identified earlier, and building up a database (both quantitative and qualitative) which should be as extensive as possible. Ail sources of statistical information should be drawn upon to identify the major evolutionary trends, to analyse past discontinuities, the conditions under which thèse came about and the rôle played by the main actors of this évolution.

As in the case of structural analysis, the above information should be supplemented by qualitative interviews with the actors themselves; this approach enables one to identify the main events which point the way to the future, and to gain a better overview of the interplay of events and a better compréhension of the relationships between the actors. It is only when a solid database is available and there is a thorough knowledge of future challenges that the MACTOR® method can be usefully implemented.

The future is never totally predetermined - however influential past trends may be, the future remains open to several possible scénarios. The actors in the System under examination possess various degrees of freedom which tliey will be able to exercise, through stratégie action, in order to arrive at the goals they hâve set themselves., and thus successfully to carry out their project.

From this, it follows that analysis of thèse actors' moves, confronting their pians, examining the balance of power between them (in terms of constraints and means of action) is essential in order to throw light on the stratégie issues and the key questions for the future (which are the outeomes and conséquences of foreseeable battles).

If \ve focus our attention on energy, for example, thèse key questions will be concerned mainly with the priée of oil, the demand for energy, the maintenance or coilapse of solidarify among OPEC member countries, and so on. To take another example, in a 1976 futures study of cosmetics consumption up to 1990, anatysis of actors' stratégies showed that the existence of companies with specialized distribution was threatened by the moves of other actors (such as mass distributors., consumer movements and trendsetters).

In ṁe field of prospective there is général consensus on tvvo points regarding analysis of actors' moves.

On the one hand, everyone concurs in recognizing it as a crucial - and perhaps the most important - step in constructing a basis for thought that will enable scénarios to be built. Without careful analysis of actors' moves, scénarios will lack relevance and cohérence.

On the other hand, the same people lament the notable lack of a systematic tool for analysing actors' behaviour. This lack is ail the more remarkable in that anaSysis of actors' behaviour is so often preceded by a radier clumsy structural analysis, using tools (the MICMAC method) to help identify the key variables and ask the right questions - in other words., to improve the pertinence of the thought process.

We recall that this is a matter of focusing on those actors who directly or indirectly control the key variables identified by the structural analysis. We then construct an 'actors' stratégies' table, presented in the form of a square matrix (actors X actors) in which:

- each diagonal cell contains the aims and objectives of each actor, in so far as thèse can be identified;
- the other cells contain the means of action which each actor may use against the others in order to achieve its aims.

Fiiling in this table is a group discussion activity, sharing the information gathered on each actor and its relationships with the others. This information on actors' behaviour can be collected or compiemented by conversations with experts who are représentative of each group of actors. Given that it is generally difficult to ask an actor to reveal his own strategy and his own strengths and weaknesses, it is much easier to get him to talk about the other actors. By sifu'ng through sets of partially true information, a more or less cohérent picture of the whole situation émerges.

It is often said that it would be good to take advantage of information derived from game theory., in order to make intelligent use of the near-complete data coilected in the actors' strategy tables. We support this view, and hâve no doubt that one day young researchers will propose significant ways forward. In the meantime, to our knowledge, the available tools hâve hardly developed at ail over the past few years.

In 1985, however, we outlined a path which seemed to us promising, and by taking up this idea once again we hâve now created and developed the MACTOR® method (Matrix of Alliances and Conflicts: Tactics, Objectives and Recommendations). Our aim is to create an analyticai toot which will allow us to make better use of the informational added value contained in actors' stratégies tables. Although the 'game theory' patli still appears to be of interest, we did not pursue it rigorously in creating MACTOR®. Others will certainly do so, but we would suggest that they bear in mind the following recommendation: develop tools that are sufficiently simple to be appropriabie (understandable) by the users and which lend themselves easily to multiple and varied applications.

Analysis of actors' moves, as we propose with MACTOR®, proceeds in ttie foliowing six stages:

1. Note down each actor's plans, motivations, constraints and means of action (construct the 'actors' strategy' table).
2. Identify the stratégie issues and objectives associated with thèse battlefields.
3. Position each actor on each battlefield and note the convergences and divergences.
4. Rank the objectives for each actor and assess possible tactics (interaction of possible convergences and divergences) in terms of their objective priorities.
5. Evaluate the relationships of power and formulate stratégie recommendations for each actor, in keeping with the actor's objective priorities and available resources.
6. Raise key questions about the future - i.e. formulate hypothèses regarding the trends, events and discontinuities which will characterize the évolution of the balance of power between actors. It is around thèse key questions, and hypothèses as to their answers, that the scénarios will be constructed.

The added value created by the MACTOR® method dérives primarily from stages 3 (positioning actors in relation to their objectives); 4 (tactics for possible alliances and conflicts); and 5 (stratégie recommendations). In future, more attention will be devoted to thèse stages, for until now we hâve too often passed rather quickly from stages 1 (constructing actors' strategy tables) and 2 (stratégie issues) to stage 6 (key questions for the future).

How do we conduct this analysis of actors' behaviour in six stages? What exactly does the MACTOR® method consist of?

To answer thèse questions, we hâve once again chosen to illustrate the method with an example which relies on material coltected while

carrying out several prospective studies in the field of air transportation. Most of thèse studies were carried out in the 1970s (at the time when we ran SEMA prospective), for Aérospatiale, for the Directorate General of Civil Aviation (DGCA) in France, and especially for the Paris Airport Authority.

An example like this has not dated - it is now that it is most valuable, for we can check whether or not the conjectures made about the future (which is now the présent) were well founded. Moreover, more récent analyses of actors' moves, relating to futures yet to arrive, are almost systematically confidential. The example of air transportation is currently one of the onty ones that can be made public. Other examples, relating to the Post Office or other iîrms, may perhaps émerge from their wraps of confidentiality after a longer prescribed period. The directors of the Paris Airport Plan hâve confirmed to us that this example of 'retrofutures' retains a certain topicality. Furthermore, a new study of actors' moves in air transportation up to 2010, using the MACTOR® method, has been set up; naturally its results cannot be published, whether they are relevant or not. If an actor reveals to others the nature of the questions he is asking himself, and the way in which he is formulating them, he has already said too much about his strategy . . . unless of course part of his strategy is to use the effect of declaring his hand, as in poker.

1. Constructing the actors' strategy table

We are focusing, then, on the behaviour of actors in air transportation in the Paris région up to 1990, as analysed in 1978. The first question concerns the number of actors to take into account. Should we consider the airline companies as a single actor, or should we subdivide them according to a particular characteristic (size, légal status, nationality, etc.)?

Similarly, the state is generally a polymorphous actor - there is the DGCA, but also the Ministry of Finance, the government, and so on. Thèse actors, which together make up the state, differ in their objectives, their behaviour, and their criteria for decision-making. A complète analysis would hâve to integrate other actors such as the trade associations, the European institutions, and the international air transportation organizations. One could thus multiply the number of actors at will, and almost inevitably run the risk of making analysis of the System impossible. Expérience shows that a total of ten to twenty actors constitutes a realistic and operational compromise.

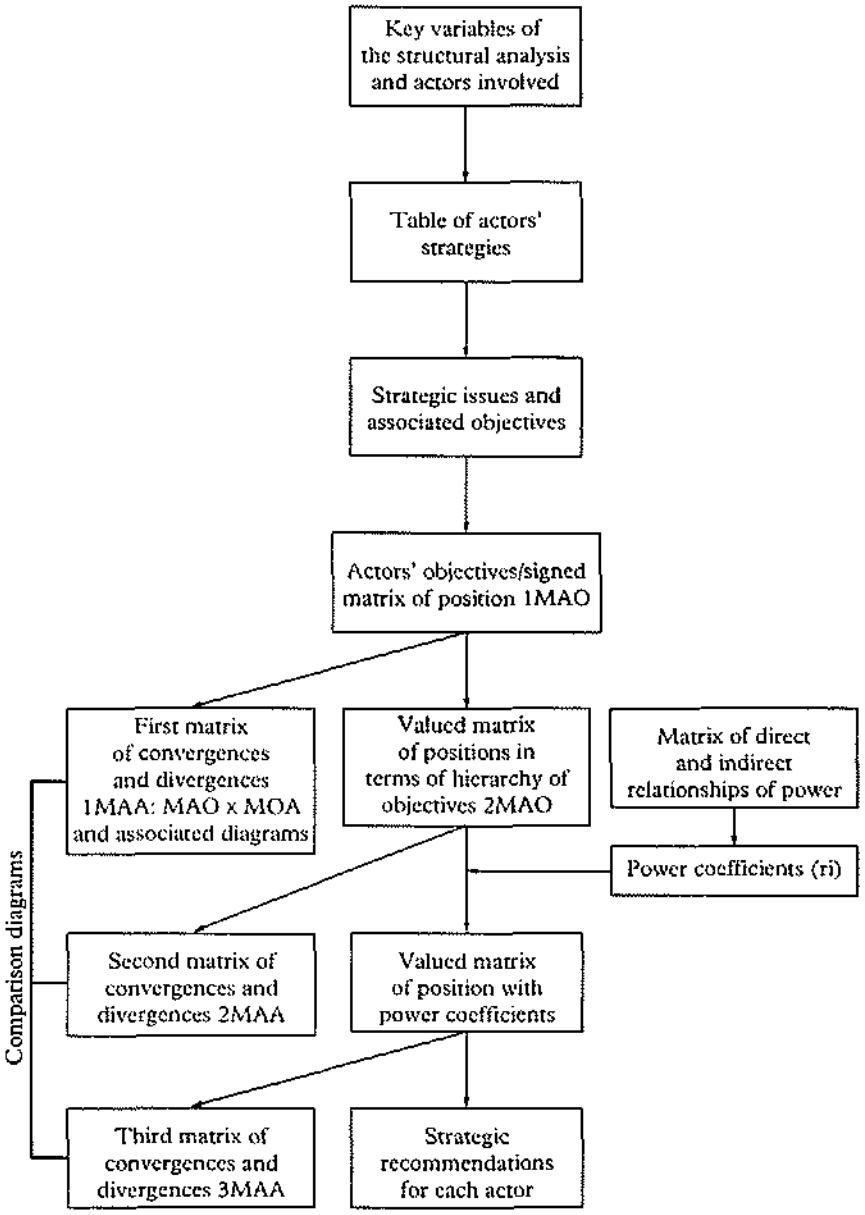


FIG . 17. MACTOR® method: séquence of stages.

The actors' strategy table (based on Godet, 1977) is constructed in a square matrix (actors X actors) (Table 6)$_3$ which we hâve redravvn from memory. The cells on the main diagonal are generaliy thc fullest, for in

TABLE 6

Action of	Action on manufacturera	Action on airlincs	Action on state
Manufacturera	*Objïctivï:* to survive and avoid crisis *Pmblems:* Plan for higher • performance aircraft • specitic noise and fuel consumption standards to mect *Menus;* Association beiween consiruciors Military orders Diversification of activities Demand aircraft better suitcd to their needs	Pressure on airlines lo purchase new aircralï Diversification of needs and aircraft Standarcliïation of ihe flcet for each constructor Avaiiability of entire range No signifkant lechnological progress *Objectivé:* To mainmin market sliarc	Exercise 'blackmail' in regard to jobs Demand finance for new projects Scek protection from compclilion in the form of discriminaiory rights in relation to long-haul traffic
Airlines	*Dominant crilcrion:* Cosi per passenger mile per ton effectively transporicd Relucuince to use large aircrnft I'o proictt ihe nation;]] aeronautica! industr>'	*Pyoblmis:* Financial invesimcni and salaries To maintain high frtquency and occupancy *AL'tws:* Co-opcKitioii between airiines (ATLAS) Incrcascd use of branches Standardisation and opcraiing flexibility of the flecl Development of freight Concentration at the teriiary levé! (feeder îines) Prateciionism Presstire on airlines to purchase Mercurj'	*Objective:* Prestige and a French présence in the world
Sintt	(VSiiitar\[p and civil aircrni't order Pinuncc for new projecis Approaches to forcign govcrnmenis Appeal 10 privjite finance	Airbus wiih financial aid Siate protects airlincs provided they develop and improve their section	*Probkms:* Unemployment Inflation *Mains:* Sustained growth

thèse cells we are seuing clown in black and white each actor's identity card. In contrast, many of the other cells (actions of one actor towards another) are almost or totally empty.

In order to simplify this account of MACTOR®, we shall consider only six actors: aircraft manufacturers (A1), scheduled airiines (A2), charter airline companies (A3), the state (A4), Paris Airport Authority (A5) and the local résidents' associations (A6). In the case analysed on behalf of Paris Airport in 1990, twelve actors were considered, as well as seven stratégie issues and over thirty associated objectives.

2. Identifying the stratégie issues and associated objectives

Through group reading and discussion of the actors' strategy table, the stratégie issues - i.e. the battlefields on which the actors will confront each otlier - are brought to light fairly easily. Hère we concentrate on five stratégie issues regarding which the six actors hâve converging or divergent objectives (convergences or divergences). Thèse five issues concern the fotlowing:

E1: *Définition of aircraft.* The aircraft manufacturers want to impose their own new aircraft designs on airline companies and on Paris Airport. For example, Boeing 747s were developed at a time when the existing runways were too short for them.

E2: *Aircraft market.* National aircraft manufacturers rely on the state to develop their share of the national and international market. The other actors under considération are not concerned with this objective.

E3: *Allocation of tmffic righis.* Hère the scheduled airiines rely on the state to curb the aspirations of the charter companies, who favour deregulation. For its part, Paris Airport supports the opening of new lines which would allow an increase in the number of flights to Paris.

E4: *Market for 'organized' flights.* The interests of charter companies regarding the 'organized' flights market are opposed to those of the scheduled airlines. The main concern of Paris Airport is to avoid having to turn traffic away, and from this point of view it is an objective aiiy of the charter companies.

E5: *Noise pollution and disiurbance naar airports.* This issue is at the crossroads of actors' stratégies, for it involves ail of them. Résidents demand less noisy aircraft, are opposed to the authorization of

night fiights, and their concerns are naturaiiy echoed by the state (résidents are aiso voters). Aircraft manufacturers represent an objective ally of the résidents, in that more restrictive noise-conîrol standards could lead to the abandonment of old aircraft in favour of new, less noisy craft. Scheduled or charter airlines and Paris Airport are naturaiiy opposed to anything which couid curb traffic. Each of thèse stratégie issues (battlefields) can be presented in the form of one or more précise objectives over which actors are in convergence^ in divergence, or neutral.

For ease of exposition, we shall limit our analysis to the battlefields (Ol, 02, O3, 04, 05), which constitute only part of the objectives associated with issues E1-E5. A complète analysis of actors' stratégies would hâve to take ail objectives into account.

TABLE 7

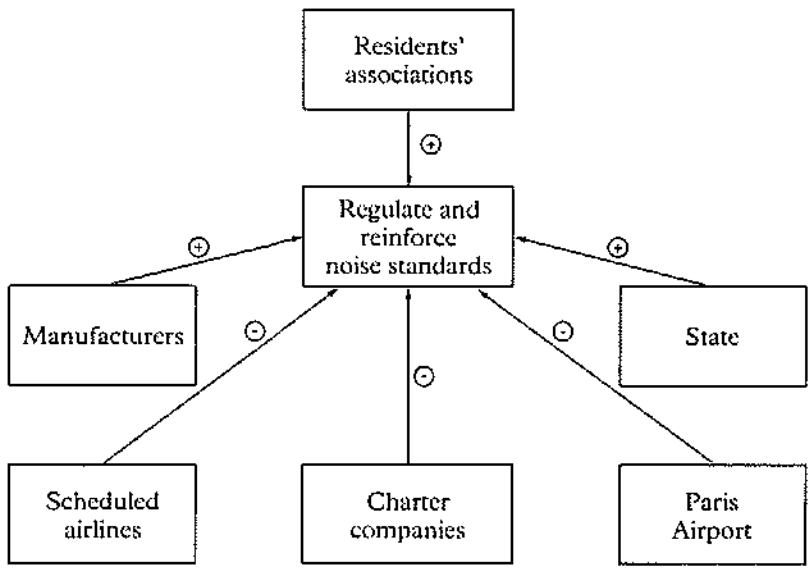
Issues (battlefields)		Associated objectives	
El	Définition of aircraft	01	• Impose aircraft spécifications (size performance) • Define aircraft spécifications together
E2	Market for aircraft	02	• Défend and increase the national manufacturers' market share
E3	Allocation of traffic rights	03	• Maintain allocation of traffic rights • Partial deregulation • Total deregulation (free opening of new lines)
E4	Organized fiights market	04	• Develop 'organized flights' • Control 'organized flights' • Avoid turning traffic away
E5	Noise pollution and disturbance near airports	05	• Regulate and reinforce noise standards

3. Positioning each actor in relation to the stratégie objectives (signed position matrix)

The relationships between the actors on each battlefield can be represented in the form of a diagram of possible convergences and divergences. Of course, in order to understand the stratégie situation as a whole, it is necessary to construct ail the diagrams of possible convergences and divergences associated with each stratégie objective} as well as diagrams of corresponding resources.

We soon see that stratégies of convergence and divergence betvveen actors vary from one objective to another. In order to maintain cohérence, there can be no question of flghting against a certain actor on one battlefietd while counuing on his support for another, and vice versa.

For any given actor, the question is therefore to identify and evaluate possible stratégie options and a cohérent sélection of objectives and alliances. Visual comparison of the diagrams of convergences and divergences is not easy; however, a matrix représentation (MAO - Matrix of Actors and Objectives) enables ail thèse diagrams to be summarized in a single table (Table 8). In Figure 18 we see the positioning of actors towards the objective of regulating and reinforcing noise controi standards.



Objective: régulait' and reinforce noise controi standards
+ = In favourof objective
- = Opposée! to objective

Fi G. 18.

TABLÏÎ 8 . MAO: signed matrix of positions (actors X objectives)

		01	O2	**03**	04	**O5**	Total +	Total -
Manufacturera	Al	+ 1	+ 1	0	0	+ 1	+3	0
Scheduied airlines	A2	—î	0	+ i	-1	-1	+ 1	-3
Charter eompanies	A3	-1	0	**--1**	+ 1	-1	+ 1	-3
State	A4	0	+ 1	+ 1	0	+ 1	+3	0
Paris Airport	A5	-1	0	–j	+ 1	-1	+ 1	–3
Résidents' associations	A6	0	0	0	**0**	+ 1	+ 1	0
TOTAL +		**+i**	*+2*	*+2*	*+2*	+3		
TOTAL -		**–3**	0	-2	-1	-3		

O1: Impose aircraft spécifications.
O2: Défend and increase national manufacturer»' market share.
03: Maintain allocation of craffic rights.
O4: Develop 'organîzed fiights'.
O5: Regulate and reinforce noise control standards.

The iMAO matrix (actors x objectives) (Table 8) is fiiled in as foUows:
(+1) Actor (in favour of objective /
(-1) Actor *i* opposed to objective/
(0) Actor ;" neutral in relation lo objective/
So, for cxample, we find the fifth column represents tlie diagram associatcd with objective 05: regulating and reinforcing noise control standards.

Commeiilary

Simply examining the positive and négative totals of the iines and columns of the MAO matrix provides a wealth of information. Thus we see, on one hand, that tJie résidents' associations (A6) are only concerned with one objective (noise, A5), white ail the other actors are involved in four out of five battlefields. On the other hand> objective O5, noise pollution and disturbance near airports, is the one which most divides the actors and involves them ail. Defining aircraft spécifications (O1), allocation of traffic rights (03) and to a tesser extent the development of the 'organized' fiights market (O4) are also highly contentious objectives.

4. Ranking the objectives for each actor (valued position matrix) and assessing the range of possible convergences and divergences

For each pair of actors it is interesting to note the number of objectives over which they are in convergence or divergence. This can almost be picked out visually from tlie MAO matrix. But for largcr tables incorporating about ten actors and twenty or so objectives, we must make use of a classic property of binary matrix caiculation: by multiplying a matrix by its transposition we obtain the number of factors in common for each pair of Unes in the original matrix (to transpose a matrix ail we hâve to do is to place in columns the factors which were previously in lines). The transposed form of MAO (actors X objectives) is called MOA (objectives x actors). The product of matrices MAO x MOA, respectively (6.5) and (5.6) in format, gives matrix MAA (actors x actors) (6.6) in format (Table 9).

In order to be able to distinguish which of die factors common to two actors (two fines of the MAO matrix) correspond to motions in favour of certain objectives (indicated by +1) or opposed to others (indicated by -1), we carry out the matrix caiculation MAO x MOA, applying the following conventions:

- *ncjj* is obtained by the matrix product which retains oniy positive scalar products. This is aîso the number of objectives towards which actors *i* and *j* hâve a common attitude, either favourable or unfavourable (number of convergences).
- *ndjj* is obtained by the matrix product which retains only négative scalar products. This is also the number of objectives towards which actors *i* and j hâve a divergent attitude (number of divergences).

The matrix MAA (actors X actors) is therefore made up of ail pairs *ncjp ndjj*. For example, MAA23 = +2, -2 means that scheduled airlines (A2) and charter companies (A3) take up the same position on two objectives (in this instance Ol and O5), and are in opposition on two other objectives (03 and O4) (cf. the MAO matrix, Unes 2 and 3).

Matrix MAA therefore indicates for each pair of actors the number of objectives on which they are in convergence (ne_{ij}) or in divergence (nd_{ij}) matrix MAA allows us to obtain two complète diagrams of convergences and divergences. Thèse diagrams are shown below; the thickness of the lines is proportionate to the number of objectives concerned.

TABLE 9. MAA: Matrix of convergences and divergences (actors x actors)

	Ai	A2	A3	A4	A5	A6
Manufacturer	A1	0 / -2	0 / -2	+2 / 0	0 / -2	+1 / 0
Schcduicd airiines	A2	0 / -2	+2 / -2	+1 / -1	2 / -2	0 / -1
Charter companies	A3	0 / -2	+2 / -2	0 / -2	4 / 0	0 / -1
State	A4	2 / 0	-ri / -1	0 / -2	0 / -2	+1 / 0
Paris Airport	A5	0 / -2	+2 / -2	4 / 0	0 / -2	0 / -1
Résidents' associations	A6	+1 / 0	0 / -1	0 / -1	+1 / 0	0 / -1

First complète diagram of convergences and divergences

The most striking thing is the strong convergence of interest between Paris Airport Authority and the charter companies, and to a lesser extent the scheduled airlines. We also note the lack of common objectives beiween Paris Airport Authonties (A5) and the state (A4) (at least for the objectives under considération).

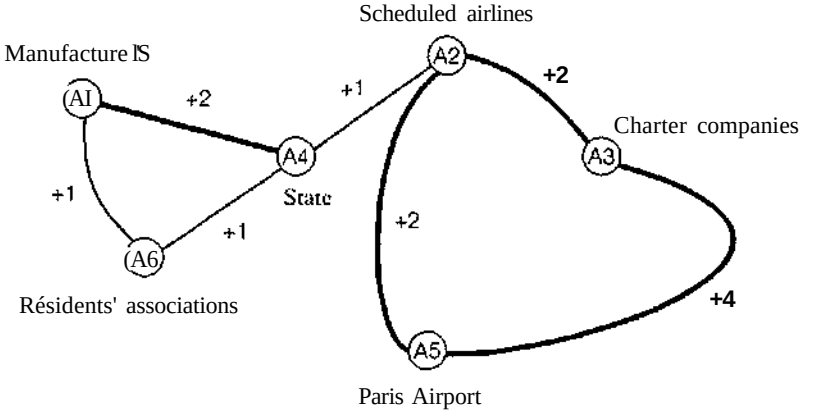
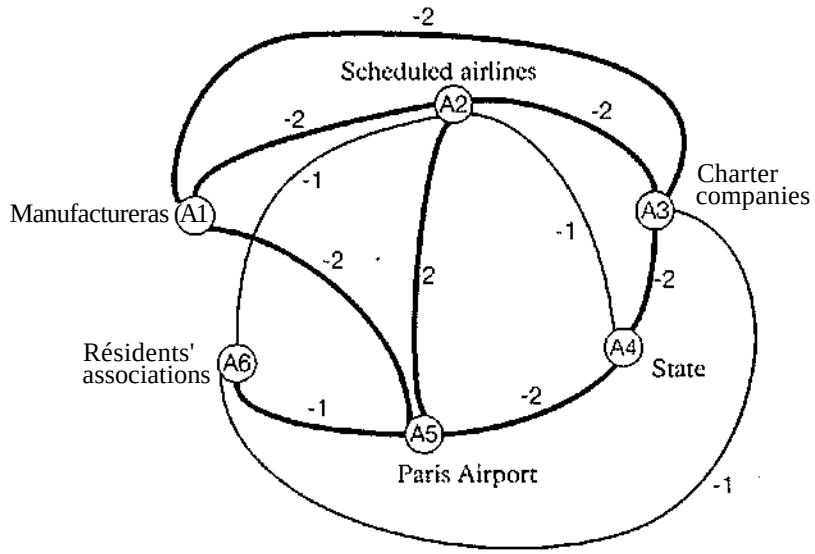


FIG. 19. First complète diagram of convergences over objectives *(ncjp.*

For their part, die aircraft manufaciurers, the state and the local résidents' associations constitute another group of allies on several objectives.



F1G. 2 0. First complète diagram of divergences over objectives *(jicljp.*

Complète diagram of divergences

Some actors are in potential conflict witii almost ail the others over two or three objectives. This is the case for Paris Airport (A5), the scheduled airlines (A2) (the actor most at risk), aircraft manufacturer (Al) and the state (A4).

Thèse first completed diagrams remain radier elementary because they only take into account the nuniber of convergences and divergences over objectives. To bring the model closer to reality, it is advisable to introduce two dimensions which hâve so far been omitted:

- The hierarchy of objectives, which varies from actor to actor.
- The relationship of power between actors.

Thèse dimensions also affect the interplay of possible convergences and divergences. Before looking at how to integrate the second of dièse two dimensions, we shall examine the first.

In order to take into account each actor's spécifie hierarchy of objectives, it is sufficient, for example, to note the positioning of actors in relation to objectives on a scaîe from -3 to 4-3, according to whether the levé! of opposition or agreement is high, médium or low. The more the actor feels concerned witii an objective which is important for him, the higher the absolute value recorded.

We thus obtain a second vaiued position matrix of die MAO type, which we shall cail 2MA0 (Table 10); by muhiplying it by its transposed form we obtain a second MAA-type matrix, called 2MAA (Table 11).

T A B L E 10. 2MAO: valued positions matrix (actorsx objectives)

		Ol	02	O3	O4	O5
Manufacturer	Al	2.0	3.0	0.0	0.0	1.0
Scheduled airlines	A2	-2.0	0.0	3.0	-1.0	-3.0
Charter companies	A3	-1.0	0.0	-3.0	3.0	-2.0
State	A4	0.0	3.0	2.0	0.0	1.0
Paris Airport	A5	-1.0	0.0	-2.0	2.0	-2.0
Résidents' associations	A6	0.0	0.0	0.0	0.0	3.0

T A B L E 1 1. 2MAA: valued matrix of convergences and divergences (actors x actors)

		A!	A2	A3	A4	A5	A6
Manufacturera	A1		0 -4	0 -3	+4 0	0 -3	+2 0
Scheduled airlines	A2	0 -4		+4 -5	+2.5 -2	+4 -4	0 -3
Charter companies	A3	0 -3	+4 -5		0 -4	+8 0	0 -2.5
State	A4	+4 0	+2.5 -2	0 -4		0 -3.5	+2 0
Paris Airporc	A5	0 -3	+4 -4	+8 0	0 -3.5		0 -2.5
Résidents' associations	A6	+2 0	0 -3	0 -2.5	+2 0	0 -2.5	

The matrix 2MAA is made up of ail pairs of valued convergences (2c.y) and divergences *(2d;p.* Each élément is obtained as the average intensity (in absolute values) of, respectively, convergences and divergences on objectives. Example:

Valued convergence between A2 and A3

$$2c_{23} = \frac{|-2| + |-1|}{2} + \frac{|-3| + |-2|}{2} = 4$$

Valued divergence between A2 and A3

$$2d_{23} = \frac{|3| + |-3|}{2} + \frac{|-1| + |+3|}{2} = 5$$

By définition convergences are noted with the positive sign and divergences with the négative sign.

We can thus construct a second version of the complète diagrams of possible convergences and divergences, which in the event does not differ noticeably from the first (which is why thèse second diagrams are not presented hère), except on one point. Between the first and second diagram of conflicts we note an increased degree of antagonism between the scheduled airlines and the charter companies. This dérives from the total opposition of thèse two actors over allocation of traffic rights. Of course, if we had chosen a différent scale for measuring the importance of objectives the results would perhaps hâve developed more noticeably from one diagram to the other.

The interptay of possible convergences and divergences does not dépend solely on each actor's hierarchy of objectives, but also on the ability of an actor to impose its priorities on others - that is, on relationships of power.

5. Evaluating the balance ofpower and formulating stratégie recommendations (valued matrix of position with power coefficients)

If we place ourselves in the position of an actor, for example Paris Airport, we see that this actor is in potentiai divergence with almost ail the others over a given objective, while at the same time it may form convergences over other objectives. A cohérent strategy of objectives will therefore hâve to impose certain objective priorities. Conversely, defining objective priorities obliges one to formuiate convergence policies.

Let us develop the example. Paris Airport has every interest in joining forces with the charter companies (A3) and the scheduled airlines (A2) if it wishes to fight for aircraft spécifications which respond more closely to its constraints (O2), and to oppose new standards and régulations on noise pollution and disturbance near airports (05). This being the case, Paris Airport, out of concern for cohérence, should place

on the back burner those issues in which its own interests diverge from those of the scheduled airlines, i.e. traffic rights allocation (O3) and the development of the organized flights market (04). This is particulaiiy important as it is precisely over thèse two objectives (O3) and (04) that the scheduled airlines' interests are opposed to those of the charter companies. For Paris Airport this tactic can only be put into practice if its potential allies., the airline companies., also pursue the same tactic.

In reality, everything dépends on how objectives are ranked, which differs from actor to actor, and we should probably expect open conflict between the scheduled and charter airline companies over traffic rights and the 'organized' flights market. Thèse objectives are also very important for Paris Airport, which in principle should first make a bid for convergence with the charter companies.

However, merely being in divergence with an actor is not sufficient actively to oppose it - also required are the direct or indirect means to oppose it. The tactical sélection of convergences and divergences is necessarily dépendent on thèse means. Sometimes it is even the existence of a favourable balance of power which sparks off conflict.

It is therefore useful to guide one's tactical choice by analysing relationships of power through two matrices - the matrix of means of direct action (MDA) (Table 12) and the matrix of means of indirect action (MIA) (Table 13). The first matrix., MDA, is simply a table (actors X actors) in which the potential influence of one actor over another is recorded on a scale from 0 to 3 (none, weak, average, stxong) - one could use other catégories. This first table aiready reveals relationships of power; simply reading the totals for each line and each column reveals that the state is by far the most influential actor in the System, while at the same time it is one of the most susceptible to the influence of others. In contrast, the charter companies are the least well equipped to achieve their objectives, and are also among those actors most subject to pressure from others.

But in iooking at relationships of power, we cannot restrict ourselves simply to means of direct action: an actor can influence another via the intermediary of a third actor. It is therefore useful to examine matrix MIA - means of indirect (second order) action - obtained simply by multiplying matrix MDA by itself (MIA = MDA X MDA) (according to the principle of the MICMAC® metliod).

By doing this, we discover that the local résidents' associations are in a stronger position of power than one would hâve thought a priori (ranked second in terms of total indirect influence over actors' moves). This is thanks to their direct influence on the state, the most powerful actor in the System. The charter companies' position of power seems

even less favourable than before (they hâve very weak influence, and are highly sensitive to pressure, particularly from the state and the scheduled airlines).

TABLE 12. Apparent reiationship of power: matrix ofmeans of direct action. Total influence

		Al	A2	A3	A4	A5	A6	Total influence S
Manufacturas	Al	0	1	1	3	0	2	7
Scheduled airlines	A2	2	0	3	2	1	1	9
Charter companies	A3	1	2	0	1	1	0	5
State	A4	2	3	3	0	3	2	13
Paris Airport	A5	0	2	3	1	0	2	8
Résidents' associations	A6	0	1	1	3	2	0	7
Total dependence	S	5	9	11	10	7	7	

TABLE 13. Real relationships of power: matrix ofmeans of indirect action MIA = MDA x MDA. Total indirect influence

		Al	A2	A3	A4	A5	A6	Tûlal indirect influence M;
Manufactureras	Al	9	13	14	9	15	7	58
Scheduled airlines	A2	7	17	12	13	il	10	53
Charter companies	A3	6	6	13	8	5	8	33
State	A4	9	16	22	24	10	13	70
Paris Airport	A5	9	11	11	13	12	4	48
Résidents' associations	A6	9	15	18	5	il	11	58
Total dependence	D_i	40	61	77	48	52	42	

As for the Paris Airport Authority, it is in an average position of power in relation to the System as a whole. Its capacity for indirect action over the local résidents' associations is much weaker than its potential for direct action. On the other hand, Paris Airport has significant leverage for exerting indirect pressure over the state vvhile almost totaily

lacking means of direct action. We also observe that the aîrline manufacturer can, if necessary, exert strong indirect pressure over Paris Airport, probably via the intermediary of the state.

As we can see, reading the MDA and MIA matrices is a fruitful exercise. Looking at 1978 from the standpoint of 1990, in tlie final analysis Paris Airport Authority had practically no interest in allying itself too openly with the charter airlines, because thèse were the weakest link in the overali balance of power. So it should corne as no surprise that in 1990, at the height of a euphorie growth in air transportation Worldwide, the European charter companîes were 'on their last legs'., to quote *Aviation Internationale* magazine (No. 996, 15 December 1989). What they should do is to air their common interests with the scheduted airlines, while putting pressure on the state for a degree of liberalization of traffic rights.

Naturally, our exampie is oversimplified, and it would be unreasonable to expect to make any définitive stratégie recommendations based on it. We should aiso recall that everything dépends on how each actor prioritizes its own objectives in terms of tlie balance of power.

We hâve seen that it was possible to take account of each actor's hierarchy of objectives through the matrix of positions (2MAO). To say that one actor is twice as influentiat as another in tlie overail balance of power is impficitly to ascribe twice the power to this actor's influence over objectives. Its relationships of power between actors are characterized by r_i coefficients; it is tlien sufficient to weight the lines of the valued position matrix by thèse coefficients. Thus we pass from matrix 2iVlAO to matrix 3MA0, tlie valued position matrix, weighted by relationships of power. By multiplying 3iMA0 by its transposed form we obtain a third matrix of convergences and divergences.

How should we define thèse ?y indîcators of relationships of power? The first idea that cornes to mind is to consider tlie M_i- indirect influences in the matrix of real relationship of power. The measure of relative indirect influence (M_i-/SMy) gives a good indicaior of die power of one actor over the others.

However, with identical relative influence, one actor will be in a better position of power tlian another if its overall dependence is lower. So we must balance the preceding coefficient M_i(7XMj· with an inverse function of dependence M_i7(Mj · + D_2-).

$$\text{With } 37_i \equiv \frac{M_i}{\Sigma M_i} \quad x \quad \frac{M_i}{M_i^2 + D_i}$$

if Dj- dependence is zéro, ?y = *Mj/ibAf,* if Dj· dependence is strong in relation to influence, then the ?y relationship of power will be much weaker than the simple reiationship M^/XM,-.

Moreover, in order îo facilitate understanding and calculation, we suggest considering

$$r^*_i = \frac{r_i}{\overline{r_i}} + \frac{nr_i}{\Sigma \overline{r_i}}$$

Starting with tiie matrix of real relationships of power, in our example, we obtain the balance of power coefficient for each actor:

$$r,^* = 1.23,\ r_2^* = 0.88,\ r_3^* = 0.36,\ r_4^* = S.49,\ r_5^* = 0.83,\ r_6^* = 1.21$$

The sum of thèse coefficients is equat to six. If ail the actors had the same relationship of power, ail the r,- would be equal to one.

In this example the hierarchy of power relations coefficients is exactly the same as chat of overall influence. It is the state (A4) which has the most favourable position of power, followed by the manufacturers (A1) and the résidents (A6). At the other end of the spectrum, the charter companies (A3) represent die weakest link in the game.

We pass from the valued matrix of position 2MAO to the matrix of vaiued positions balanced by relationships of power 3MAO by multiplying each Une of 2MA0 by the *rj* coefficient (Table 14).

TABLE; 14. 3MAO

	Ol	02	03	04	05
Al	2.5	3.7	0.0	0.0	1.2
A2	-1.8	0.0	2.7	-0.9	-2.7
A3	-0.4	0.0	-1.1	1.1	-0.7
A4	0.0	4.5	3.0	0.0	1.5
A 5	-0.8	0.0	-1.7	1.7	-1.7
A6	0.0	0.0	0.0	0.0	3.6

We thus obtain a third matrix of convergences and divergences (3MAA) balanced by relations of power (Tabie 15).

TABLE 15. 3MAA

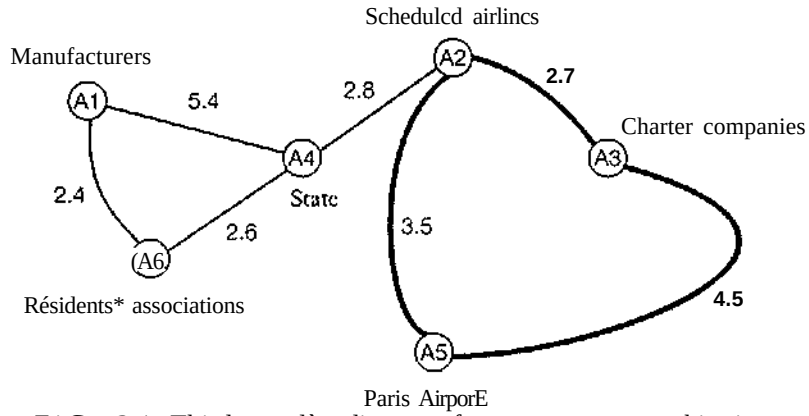
		A1	A2	A3	A4	A5	A6
Manufactureras	A1		0 -4.1	0 -2.4	5.4 0	0 -3.1	2.4 0
Scheduled airlines	A2	0 -4.1		2.7 -2.8	2.8 -2.1	3.5 -3.4	0 -3.1
Charter companies	A3	0 -2.4	2.7 -2.8		0 -3.1	4.5 0	0 -2.2
State	A4	+5.4 0	+2.8 -2.1	0 -3.1		0 -3.9	+2.6 0
Paris Airport	A5	0 -3.1	3.5 -3.4	4.5 0	0 -3.9		0 -2.6
Résidents' associations	A6	2.4 0	0 -3.1	0 -2.2	2.6 0	0 -2.6	

Commentary

Betvveen the ftrst and the third complète diagrams of convergences (Figs. 19 and 21), certain deveiopments are worth pointing out.

The state manufacturers' convergence over objectives becomes noticeably stronger and appears twice as important as the state résidents' convergence over objectives, which initially appeared comparable. The convergence over objectives betvveen Paris Airport and the scheduled airlines and charter companies is confirmed as much stronger than the convergence of interests between the companies (scheduled and charter), and is probably a card to be played by Paris Airport.

Comparison of the diagrams of divergences over objectives (Figs. 20 and 22) allows us to note certain remarkable changes in the actors' strategy when hierarchy of objectives and balance of power are taken into account. Thus, for exampfe, the opposition of interests between the scheduled airlines and the manufacturers seems to be twice as signiñcant as that between the charter companies and the manufacturers or scheduled airlines, which initially appeared comparable. In the same way, the conflicting objectives of the state and Paris Airport become much more critical than the conflict of objectives between the state and the airline companies.



F i G . 2 1. Third complète diagram of convergences over objectives.

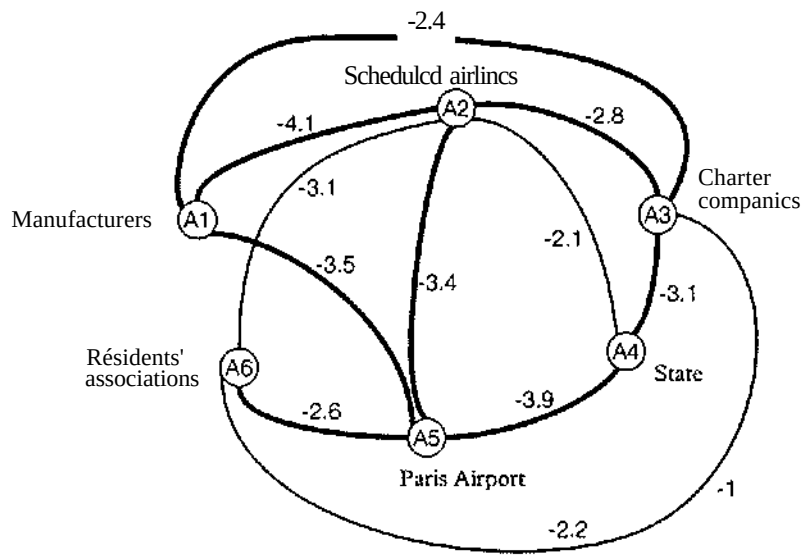


FiG. 22. Third complète diagram of divergences over objectives.

From the above, it is not unreasonable to conclude that tlie state should support the manufacturers in their struggie for market share, and should strengthen régulations and standards vvhich favour the development of new aircraft. Paris Airport, which is subject to the powerful protection of the state, must above ail rely on the scheduled airlines to exert pressure on the state, for the charter companies are in a much less favourable position of power. In doing so, Paris Airport should logically tone down its support for development of charter flights, because the scheduled airlines are opposed to this.

In the example \ve hâve considered, taking into account hiérarchies of objectives and relationships of power did not cause major upsets to the fîrst anaîysis. Other scales of notation would probably provide a clearer contrast in results. Other indicators of power relations could also be tested, for example, by relying on the matrix of net balance of power between actors (derived from MIA matrix through the différence between a_{ij} and a_{ji}).

TABLE 16

		A1	A2	A3	A4	A5	A6	
Manufacturers	A1		6	8	0	6	-2	+ 18
Scheduled airlincs	A2	-6		6	-3	0	-5	-8
Charter companies	A3	-8	-6		-8	-6	-10	-38
State	A4	0	3	8		-3	8	+ 16
Paris Airport	A5	-6	0	6	3		-7	-4
Résidents' associations	A6	2	5	10	-8	7		+ 16
		-18	+8	+38	-16	+4	-16	

Three actors (manufacturers, state and résidents) are overall in a very favourable position of power in relation to the group comprising Paris Airport and the scheduled airlines, which are overall neutralized; and the charter companies are completely dominated, i.e. in an unfavourable position of power in relation to ail the other actors. Paris Airport is better placed in relation to the state than one wouîd think a priori. The potential direat cornes primarily from the manufacturers and the résidents.

We shali not pursue this simpiified example any further. For the most complex cases - around fifteen actors or ten stratégie issues and about forty objectives - one certainly has to break down the problem by studying each battleñeld separately. This modular utilization of the MACTOR® method implies, of course, the never-ending task of developing a cohérent overall picture with each further addition.

6. Key questions for the future

The évolution of relationships of power between the actors can be presented in the form of hypothèses which may or may not be realized

within the time horizon under considération. Thèse hypothèses are concerned with trends, as much as with events or discontinuities.

The subséquent application of the scénarios method consists of using expert methods to reduce precisely this uncertainty over hypothèses concerning futures hypothèses deriving from the actor strategy analysis.

We believe that MACTOR® will disseminate rapidly, as it is a simple and appropriate tool which will lead to a better understanding of tlie actors' games and power relationships, The air transport example developed hère was rather illustrative, We assume that the use of MACTOR® by Paris Atrport Authority and by the French Electricity Authority to face the new European context proves that MACTOR® certainly has a promising future.

6. Reducing uncertainty: expert consensus methods

In the same way that the past can be summarized by a séries of significant events, possible futures can be identified by a list of hypothèses which, for example, demonstrate the persistence of a trend, its disruption or the developmental genesis of a new trend.

In concrète terms, thèse hypothèses relate to the key variables and the balance of povver between the actors as analysed when the base was constructed. Scanning possible futures is done through morphological analysis. The implementation or otherwise of the hypothèses within a given time-frame is marked by a degree of uncertainty which can be reduced with the aid of subjective probabilities provided by experts.

In fact, when one looks to the future, personal judgement is often the oniy way to account for events which might occur (there are no statistics of the future). Expert methods prove useful for reducing uncertainty and also for comparing the views of one group with those of others (bell-weather function) and, at the same time, for becoming aware of the scope and span of opinions held.

The Delphi mediod, developed in the 1950s, is the best known expert method. It suffers from a number of weaknesses, however, notably in its failure to account for die interdependence of the questions asked. A new method then appeared at the end of the 1960s in the United States and at the beginning of the 1970s in Europe: cross-impact matrix. Foliowing an inventory and historical review of thèse tools, we provide as an example a method which we developed in 1974: the SMIC method.

1. Scanning possible futures: morphological analysis'

This is a sophisticated title for a very simpie, yet often unappreciated (or forgotten) method which should be reinstated, for it can prove very useful for stimulating tlie imagination, hclping to idenu'fy hitherto unknown products or processes and scanning the fieid of possible future scénarios.

The originaior ofjthe method, *F.* Zwicky, envisaged that this method wouid 'make invention routine', i.e. a commonplace procédure. Zwicky, who was the first to imagine dwarf stars, developed the method in the 1940s while vvorking for the United States Army. According to legend it was through this method that Polaris missiles were first thought of.

1.1. THE FIELD OF POSSIBLE FUTURES, A MORPHOLOGICAL SPACE

The principle underlying the method is extremely straightforward. The System or function under study is broken down into subsystems or component parts. Thèse components must be as independent as possible and yet représent the total!ty of the System under study.

An aircraft is composed of wing structures, tail units, engines, etc., and each of thèse components could be assembled in différent configurations, for example, one, two, three, or more, wings. A given aircraft will therefore be characterized by the chosen spécifie configuration of the components. There are therefore as many possible technical solutions as there are possible combinations of the configurations.

A System of four components, each having four configurations, represents no fewer than 4 x 4 x 4 x 4 = 256 combinatory possibilités. This field of possible combinations is called the 'morphological space'.

In the example proposed by E. Jantsch (1967), concerning propulsion units, there were more than ten components, each with two to four possible configurations: thus tlie total number of imaginable solutions was 36,864. Fortunately, constraints exist (technical incompatibility, for example) which make several families of solutions unworkable and thus reduce the morphological space. It is also possible to give préférence to those combinations of configurations which appear

I. To Icarn about morphological analysis, sec E. Jantsch (1967) and R. Saint-Pau! and P. F. Ténière-Buchot (1974). UnfominaEely thèse two excellent studiesiiavcbeenout of print for severai years now. See also F. Zwicky *(1947).*

more propitious than others, in terms of such criteria as development costs, safety factors, feasibility, etc.

It is useful to compare the existing with the total morphological space: the harvest of new icleas will be ail the richer in that the potential space is unknown (the ratio of the number of known solutions to the number of possible solutions is particuiarly interesting in this respect).

Areas of application are numerous and extend to many innovation and research procédures. R. Saint-Paul and P. E Ténière-Buchot (1974) remind us of the amusing example of the shaving function (Table 17).

TABLE 17. Shaving

Energy sources	Electrical	Chemical	Manual	Mcchanical	
Shaving agents	Heat	Elcctricity	Blade	Chemical	Bactcria
Dynamics	Circular	Linear	S ta tic		

This morphological space contains 4 x 5 x 3 = 60 possibilités. We recognize the currently used methods in the above table: the linear dynamics manual blade and the circular blade electric shaver. The authors cite some solutions worth studying, such as *'sélective burning ofthe beard hair, or bactcrial ingestion ofthe beard by siatic application of a crcam'.*

Curiously, morphological analysis has been used primarily in technoiogical forecasting and far less in gênerai futures studies. Hovvever, it lends itself well to the construction of scénarios. Let us consider a globat System broken down into components: démographie., économie, social and organizational factors, with a certain number of possible states (hypothèses or configurations) for each of thèse components (Table 18).

TABLE 18. Configurations (hypothèses)

Components (dimensions)					
Démographie factors					
Economie factors					
Technotogica! factors					
Social factors					

In essence, a scénario is no more than a path combining a given configuration for each component. The morphological space defines the range of possible scénarios very precisely. It is probably the fear of

drowning in the huge number of possible combinations that has curbed the utilization of morphological analysis for the construction of scénarios. We propose below a methodologicai approach which sidesteps this obstacle and enables one to make the most of the analysis.

1.2. PROBLEMS AND LIM ITATIONS

Specifically, the utilization of morphological analysis poses several problems relating to the question of comprehensiveness and to the limitations and illusions inhérent in the number of combinations.

Firstly, the choice of components is particularly critical and requires considérable thought. By multiplying the number of components and configurations, the System expands very quickly, to such an extent that analysis rapidly becomes practically impossible; on the other hand, vvith too few components the System is impoverished. Hence the requirement that there should be a compromise value. One must be careful to ensure that the components (dimensions) are independent and that they are not confused with the configurations (hypothèses).

Secondly, scanning ail possible and imaginable solutions may give the illusion that ail combinatory possibilities hâve been expiored, whereas in reality the field has no définitive limitations but is simply evolving witli time. Should one leave out some component or configuration which is essential for the future, one risks mtssing a whole facet of the field of possibilities (had such a study been applied to timepieces at the start of tlie 1950s or 1960s, everything woutd hâve been imagined except me quartz watch).

Lastly, the user is very quickly submerged by me number of combinations and simply articulating the possible solutions becomes physically impossible once they exceed several hundred in number (we saw above that for a System with four components and four configurations each, there were already 256 possible combinations!). In such conditions, how can we identify the useful morphological subspace?

1.3. THE USEE-UL MORPHOLOGICAL SUBSPACE

Reducing the morphological space is necessary because it is impossible for the human mînd to cover, step by step, the whole field of possible solutions generated by the combinations; it is also désirable since there is no point in identifying solutions which in any case will be rejected once certain sélection criteria (technical, économie, etc.) are taken into

considération. Choices are therefore imperative to identify the key and secondary components which relate to thèse criteria. In a récent example, concerning a future, we suggested the following procédure:

- First identify the économie, technicai and stratégie sélection criteria which can be used after the morphological analysis, to assess and sélect the best solutions among the total number of possible solutions (the morphological space).
- Then identify those components which are deemed crucial according to the above criteria and classify thèse components in terms of criteria weighted differently according to the policy décisions adopted.
- Initially restrict exploration of the morphological space to the key components identified in this way.
- Finally introduce constraints of exclusion or préférence (thèse combinations being excluded). In fact, many technicai solutions are meaningless or irrelevant, either because of their intrinsic incompatibility (impossible combinatory associations) or once certain criteria (for example cost, competitiveness) are taken into account.

This procédure enabled us to give priority to examining four main components out of nine under considération. The initial morphological space, comprising 15,552 possibilités, was thus reduced to a useful subspace containing about 100 solutions (i.e. a réduction factor of 150). Taking the technicai incompatibilities into account enabled us to eliminate more than half of thèse. The remaining half were subjected to individual assessment, each criterion being assigned a weighting value according to its importance in the policies under investigation. Thus, for each policy (set of criteria weightings) we were able to rank the fifty or so remaining solutions. A comparison of the various rankings then !ed to the identification of a hard core of twenty solutions, comprising the best solutions in terms of ail criteria and policies, as weli as certain solutions which were outstanding in terms of certain spécifie criteria, and which for this reason were supported by a particular member of the working group.

The twenty solutions at the hard core of the useful morphological space were then grouped into families, i.e. in terms of their relative degree of kinship (identicai solutions, give or take one or two configurations). Each of thèse twenty solutions was then subjected to detaiîed analysis and évaluation, specifying tliose configurations relating to the five secondary components.

From this experiment, we note two important lessons for the implementation of morphological analysis:

- It forces us to think in a structured way about which components and configurations should be taken into considération and enables a systematic scan through the range of possibilities.

- Aithough the sum of possible combinations should not give the illusion of comprehensiveness, it shouid not be ailowed to paralyse the thought process. It is fairly easy to reduce the analysis to a useful morphological subspace (10, 100 or 1,000 times smaller). To do so, one only has to introduce sélection criteria (with die help of Multipol, a multicriteria method) and, for example, constraints of exclusion or préférence.

The method developed above is now integrated into a microcomputer software package (Morphol®). Morphological analysis can no longer stand accused of being difficuk to implement. It is our feeling that this method will be the subject of renewed futures studies. Theory can only be crédible when confronted with the test of a practical application.

2. An inventory of expert-consensus methods

Methods involving expert consultation can be ranged under three headings: 'Delphi', the voting machines and 'cross-impact'.

2.1. THE DELPHI METHOD

The Delphi method[2] involves 'The systematic use of the intuitive évaluation of a group of experts' (N. Dalkey and O. Helmer (1963)). According to O. Helmer, one of the founders of the technique, 'Delphi' was developed from the middle of the 1950s to meet the needs of the United States Army.[3] According to some authors, it has seen several thousand applications in the United States and several hundreds in Europe. Thèse esùmates should be viewed widi some caution inasmuch as Helmer himself refuses to propose figures.

The Delphi method interrogates experts by means of successive questionnaires in order to bring out convergence of opinions and to identify clearly a possible consensus. The inquiry is carried out by mail and is anonymous in order to adjust for 'leading opinions'. The questions, by way of an example, deal with die probabilities of impfementation of a certain hypothesis or event. The quality of the results is heavily dépendent upon the care taken when dravving up the questionnaire and in the choice of the experts.

To be relevant, the method présupposes, on die one hand, diat

2. The word Delphi commémorâtes the town of Delphos, and its famous oracle.
3. Interview given in Scpiember 1984 at Carmcl, California, where Dr HeJrrter is in retirement.

genuine experts are consulted, i.e. people who are really able to answer die questions, and on the other hand that the view of a group of experts is superior to that of a single expert.

The Delphi method compounds a séries of mailed questionnaires, their analysis and interprétation. As G. Ducos (1983) reminds us, each expert is offered 'compensation and asked to answer only those questions for which ȟe regards himself as most compétent, or better still, to evaluate his own level of compétence with regard to each question*.

The aim of successive questionnaires is, as R. Saint-Paul and P. F Ténière-Buchot (1974) note, 'to reduce the interquartile space whiie specifying the mean value'. To illustrate the method we will take an example which is very similar to that in their book.

This Delphi inquiry covered a whoie range of économie questions. We will follow up one of them: In what year will the gross individual income in France be double that for 1984?

The first questionnaire aims at idenrifying the mean value and the interquartile space.[4] The distribution of the responses to the first questionnaire (see bar chart) shows that the mean is located in 2000 and the interquartile space (Ql, Q3) is between 1997 and 2005 (see Fig. 23). *The second questionnaire* is aimed at reducing the interval (Ql, Q3) by

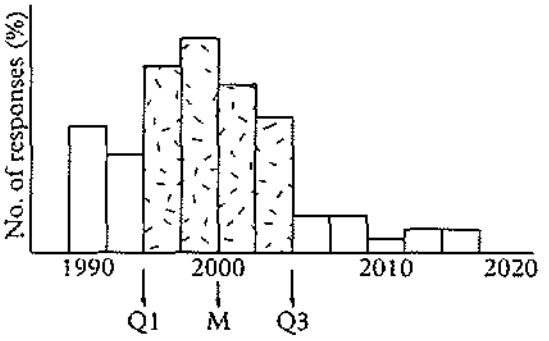


FIG. 23. Question: In what year wifl the gross individual income in France be double that for 1984 (in constant francs)? (After Saint-Paul and Ténière-Buchot, 1974.)

askîng for justifications of the extrême values. Each expert is informed of the first round results, is asked to supply a new response and to justify where itlies outside (Ql, Q3):

Response	Justification: when replying outside range (Q1.Q3)
Former New	

4. Hère the mean value (second quartile) is the year that 50 per cent of the experts think that the doubling will occur 'beforc', and 50 per cent think it will take place 'after'. In taking the 2 5 and 75 per cent thrcsho!ds, then 75 and 2 5 per cent, wc défi ne respectivcly the first quartile (Ql) and the third quartile (Q3). The interquartile range is the interval (Ql, Q3).

It is easier to conform, i.e. to answer in the întervai (Ql, Q3), than to maintain thereby an extrême point of view that has to be justified (if you think like everyone else, no one asks you why). The simulated convergence gives a new reduced interval (Ql, Q3) 1998-2004 and a new mean value 1999.

The ihird questionnaire is designed to oppose the two extrêmes by bringing their arguments together. In addition, each expert is asked to criticize those who fail short of Ql (1998) or beyond Q3 (2004).

On this occasion the convergence is forced, and even manipulated, since only the extrêmes are opposed, whereas taken together they represent as many replies as are in the interval (Ql, Q3). Also, those at the extrêmes are not asked to criticize the views of those situated in the interquartile space:

Arguments 'beforeQl'	Arguments 'after Q3'	New response	Criticism and arguments

Thefourth questionnaire gives the final response: 1999 for the mean value, 1998 for Ql and 2003 for Q3 (Fig. 24).

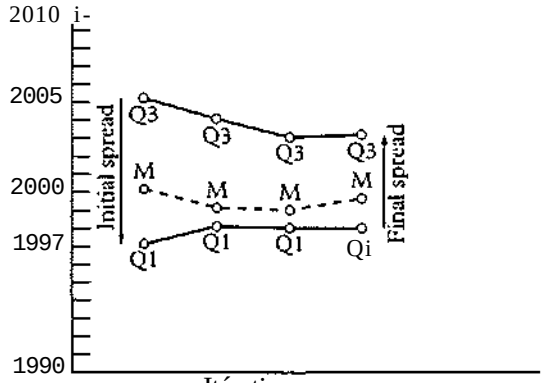


FIG. 24.

The Delphi method, as described, to the extent that there seems to be a convergence of opinions around a central value, provides the right way to prépare a consensus for certain types of decision-making (technological investment with high économie and social risks). However, convergence does not imply cohérence and consensus does not necessarily mean a correct forecast (everyone could be wrong at the same rime). The history of forecasting errors teaches rather that we should distrust prédominant ideas; the correct viewpoint is often to be found in the minority.

In short, if the Delphi process appears to be weil adapted to normative applications in its classical form, it could prove more misleading than useful for forecasting applications. There is naturally no reason why one shouîd not alter the method and make Delphi a more usefuî forecasting tool by abstaining from reducing the extrêmes. There is less need to put out severaî rounds of questionnaires, vvhich proves long, costly, painstaking and sometimes risky (since at each itération a certain number of the experts evaporate).

For forecasting applications the mini-Delphi technique (see Ducos, 1983) seems more appropriate. Using this technique, firstexperimented with in the early 1970s (see Helmer, 1972), the experts are in the same venue and discuss each question before responding individually. The mini-Delphi process is likely to expérience a vogue in various forms owing to the new possibilities opened up by microcomputers in the use of voting machines. We must mention hère two promising developments, one in France (Regnier's Abacus) and the other in the United States (Consensor).

2.2. VOTING MACHINES: REGNIER'S ABACUS AND THE CONSENSOR

Regnier's Abacus (Régnier, 1983, 1989) is a novel method for expert consultation. Its originator, Dr Régnier, a consultant economist specializing in organization and communication methods, believes that the method (successfuily used in the pharmaceutical industry) could now be developed more systematically.

The main idea of the Abacus is to start with the three traffic-light colours of green, amber and red, and then to add pale green and pink to allow more shades of opinion. White is a bîank vote, black is an abstention. The colour-coded votes are then placed on a grid like a crossvvord puzzle. Each participant ha s a column and each élément of the problem a row.

The mosaic image sketches out a map which guides verbal discussion. Nevertheless, the procédure remains open and anyone can change their colour at any time. The Abacus is not a test but a tool vvhich stimulâtes interaction among individuals. While we can only talk in turns, the Abacus image reveals everyone's opinions on the problem simultaneously. The Abacus is therefore an instrument tending to make communication efficient, for example, in a group where certain individuals are often stifled. What is more, the act of announcing a colour before the discussion expresses an individual's feelings and goes beyond mère rationaïities.

Questions	Green	Light green	Orange	Pink	Red	White	Black
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
II							
12							
13							

f/tw *to make your choice using ihe grid*

The colours hâve thc fotlowing meaning:
Green, like traffic-light green, is a rather favourable responsc. *Red,* like traffic-liight rcd, is a somewhat unfavourabte reply. *Orange,* like the traffic-light amber, is the intermediatc colour between reci and green. *Lighi green* is a shade more positive than orange, but less positive than green but not as unfavourable as red.

Thus wc hâve a décision scaie with five steps: five shades: *green, light green, orange, pink, red.* Moreovcr, a sixth coiour, *white* (= bîank vote), implies you do not wish to décide on a cotour. *Black* means you wish to abstain from voting.

Regnier's Abacus was published, with its associated pack, in 1975. It comprises four coloured cubes vvhich slot into a honeycomb tray and has been used in various firms and institutions and in higher éducation (the National Polytechnic Institute of Lorraine, the Strasbourg Institute of Social Psychology, the École Supérieure de Commerce de Paris etc.).

The automated Abacus, programmed by microcomputer, is more récent. Image processing, for example the permutation of the rows and columns for sorting, has become instantaneous. This manipulation of the coloured texture allows an easier reading of the pattern in the mosaic.

The tool also has the attributes of efficiency, time-saving and simplicity, Learning time is ver y short and the meaning of the image is

understood internationally. The Abacus reconciles the individual with the group through exchange and it introduces an approach which allows us better to exploit qualitative aspects, with which our society is less familiar than it is with quantitative anaiysis.

In its current form Regnier's Abacus makes clever use of familiar colours to exploit collective opinion, yet it possesses certain characteristics spécifie to manual coding that limit its applicability.

Consensor, an electronic voting machine developed in the United States by the firm Applied Futures,[5] allows a synthesis that is:

- immédiate: a histogram shows participants' reactions within a few seconds;
- confidential: the anonymous votes of each individual can be transmitted;
- scaled: the votes range from 0 to 10;
- weighted: the opinions of the participants are weighted according to their respective compétence;
- continuous: the expert can change his vote in the course of the discussion.

Consensor is portable and allows a group of up to twenty or so experts to express their opinions at a time. Given that tools such as Regnier's Abacus and Consensor are apparently simple to use and inexpensive, why hâve they not yet received the development they merit in Europe? There are apparently numerous applications, both in prospective studies and in décision-support. Consensor would also appear to be useful for collecting information necessary for cross-impact anaiysis and for Regnier's Abacus.

2.3. CROSS-IMPACT METHODS

Although the Delphi method enables a fairly good synthesis of opinions to be obtained from which a convergent resuit can be determined, its shortcoming is that it does not allow for interaction between events. On the other hand, the cross-impact method (CIM)" has the advantage that it takes into account expressed opinion and simultaneous interdependence between questions, providing an interprétation grid which proves cohérent.

The cross-impact method is the generic name for a family of techniques which attempt to evaluate changes in the probability of occurrence of a given category of event, followvving a previous occurrence

5. Applied Futures, 22 Greenwich Plaza, Grccnwich, CT 06830, United States.
6. Somc authors, îike G. Ducos (1980), speak of interaction anaiysis.

of such an event. The method starts with a list of events and their associated probabilities; the basic hypothesis of the method is that the individual probabilities account for interactions, but only incompletely. Taking the interdependencies into account allows us to move from a System of unprocessed initial probabilities to a set of net probabilities, i.e. corrected probabilities.

The rest of the method consists, first, of analysing the sensitivity of the event analysis System, and, second, of building scénarios. The working out of the scénarios is implemented by highlighting the most probable final images.

In practice, if we hâve a System *oîN*hypothèses *(h\,h2 . .. hn),* there are 2" final images (interacting hypothèses), that is, ail the scénarios possible for the System. For example, let there be *h\, h2,* M ... *hn* but not *}ii:* this is one of die *2".* If we take into account the order in which the events occur, there are A/! 2^n development scénarios.

Several methods of cross-impact analysis hâve been put forward. To start with T. J. Gordon (Gordon and Hayward, 1968), interactions are evaluated with impact coefficients ranging from +10 to -10, the transition between rough and final probabilities usually being achieved by fairly sophisticated techniques: the Monte Carlo itération method. Later research, mainly that of J. Kane (1972), fell into the methodological framework set up by T. J. Gordon and continued to mix impact coefficients with rough probabilities in the formulae leading on to final probabiiities. From this viewpoint, N. Dalkey (1972) was an exception: his mode! relied on a conditional probability matrix exisu'ng between every pair of events, to modify the original System of probabilities. This approach, which represented a definite improvement with respect to CIM as proposed by Gordon and developed by Dalkey, is not very crédible.

In effect, the results obtained dépend on the transition formula adopted for calculating the final probabilities. Several formulae hâve been proposed, often a judicious mixture of quadratics, mathematical expectations and coefficients with subjective weighting. In practice none is convincing and, as Dognin and Florentin (1973) demonstrate, there can be as many results as formulae tested for a given single example.

Moreover, the method ought to be used to control the cohérence of the estimâtes relative to the classical constraints on the probabilities. In practice, most methods, whatever their degree of complexity, resuit in clearly incohérent probability values, with, for example, results such as *P(i) < p(ilj).P(ijnot j),* which is not compatible with the relationship *P(i) = P(i!j)Pj + P(i\noi j).P(not j),* which must always be valid. Many writers confuse convergence with cohérence: because results are cohérent, that does not mean that the process is necessarily convergent.

Two methods, EXPLOR-SIM and SMIC,[7] presented in 1974 represented a décisive step forward by insisting on working with homogeneous data (probabilities only) to seek cohérent results and work out scénarios, The first method was developed by researchers at the Battelie Institute, Geneva (Duval et al., 1974) and the second by Duperrin and Godet (1973).

Other methods hâve been proposed since, and hâve been the subject of numerous présentations and polemic debates in *Futures* and *Tcchnological Forecasiing and Social Change.* Several French researchers hâve played an active rôle in this development, for example J. Eymard (1975) with a Markovian model or G. Ducos (1980) with the MIP (1) and MIP (2) methods.

The debate mainly centres on one essential point, namely: 'What questions may reasonably be put to an expert and how does one dérive cohérence from the answer?' Under certain conditions, an expert can answer with simple conditional probabilities for severai pairs of hypothèses *i* and *j*. Unfortunately it is practically impossible for his responses to validate the classic axioms governing probability: summing and product rules (constraints *(b)* and *(c)).*[K]

The search for cohérence is ail the more délicate in that it is Iegitimate to présuppose that some answers are more reliable than others (unevenly distributed incohérence). Each method provides a spécifie solution to the problem of cohérence, but none is totally satisfactory. Thus, for example:

- EXPLOR-SIM only asks the experts for simple probabilities *P(i)* and certain conditional probabilities *P(ijj)* to caiculate *P(ijnotj)* taking into account the summing rule. Although this practice has the advantage of constructing a matrix cohérent with respect to constraints that are anyway insufficient, it nevertheless has the serious deficiency that it regards the estimate for *P(ilj),* for example, as fully reliable.
- SMIC invites the experts to answer a grid of ail questions *P(i)P(ijj), Pftlnotj),* and seeks to develop information as cohérent as possible with the initial set of data,, by minimization of a bounded quadratic form. In so doing, however, data with différent degrees of reliability are processed identically.

7. The SMIC method (French acronym for Cross-impact Systems and Matrices), developed at the Programmes Department of the Atomic Energy Commission (CEA) from 1972 to \ 973, and further developed at SEMA.

8. *(a)* $0 \leq P() \leq 1$;
(b) P(i.j) = P(ijj) PO) = POU) PO);
(c) P(i) = POU) Pj + P(i!noi j).P(noi j).

The debate is still open, though at a standstill, and the methodological progress of the past few years, with oniy a few exceptions," relates to minor refinements (see the excellent summary by O. Helmer, 1981).

Finally, on both sides of the Atlantic, certain methods, in spite of their imperfections, hâve demonstxated their usefulness through a significant number of practical applications. Such is the case, at any rate, with the SMIC method, which is described belovv.

3. The SMIC method

Among cross-impact methods, the SMIC method offers the advantage of very simple and inexpensive implementation (drawing up a questionnaire), provides rapid results and is generally easy to interpret.

The SMIC method consists of intervievving a panel in the most rational and objective way possible. A set of formai interviews could be conducted and an overall measure of agreement obtained, but unless a great deal of time vvere devoted to this, it would be difficuit to see many more than twenty persons. With the metliod used hère, two or three times that number can be questioned. Thus it is possible to exceed the threshold (around thirty peop-le) beyond which past expérience shows ṁat the law of large numbers opérâtes within a somewhat restricted overall professional environment. In other words, much the same results will be obtained, whether we ask 100 or 150 people.

The method usually takes the form of a mailed inquiry, thus allowing the élimination of subjectiveness due to the researcher's présence, since, instead of a verbal opinion, évaluation will be based on replies couched in figures. The inaccuracy of expert answers is reduced: experts are asked to estimate the probability of a hypothesis occurring, on a scale from 1 (very low) to 5 (event highly probable). They are also asked to estimate in the form of conditional probabilities the likelihood of a hypotliesis coming true as a function of the other hypothèses. The value 6 corresponds to the independence of a hypothesis. As a resuit of this, the expert has to revise his assessment several times and, to some estent, he must reveai the implicit cohérence of his reasoning.

The reverse side of the coin is the difficulty of representingthe future of a complex phenomenon by a limited number of hypothèses, which runs contrary to the approach in some opinion-gathering methods.

9. Cf. Dr Enzer's (1980) INTERAX method at the Ccnter for Futures Research of tlie University of Southern Caiifornia.

Thèse,, however, do not take account of the interdependence among the questions and quite often resuit in contradictory answers. That too can prove an advantage: the method requires the préparation of information and that the issues be considered carefuily before sélection of the key hypothèses. This underlines the importance of structural analysis and the need to understand actors' stratégies in order to identify key variables and formulate stratégie hypothèses.

The amount of information gathered in the course of a SMIC inquiry (sixty to eighty questions usuaîly answered by forty to sixty experts) is of the same order as the amount furnished by a conventional survey asking a représentative sample of 1,000 people two or three questions. Thus, the choice lies between canvassing a wide spread of opinion for a small number of questions and an in-depth analysis of the 'global vision' of a small number of experts.

3.1. THE PRINCIPLE AND THE ASM OF SMIC

An event is a hypothesis coming true at a given time horizon and the set of hypothèses constitutes a référence frame within which there are as many possible states, i.e. final images, as there are combinations of outeomes of the hypothèses. The SMIC method, starting from information supplied by experts, allows a choice to be made from among die 2^n possible images to sélect those which merit a more detailed study, allowing for their probability of occurrence.

The experts are asked (as a group of individuals) to tender information on:

- die list of *N* hypothèses considered fundamental to the objectives of the study: $H=(Hl, H2, \ldots H_N)$;
- die probabilities of an implementation at a given time horizon: *P(i)* probability of hypodiesis *Hi;*
- die condidonal probabilides of die hypodieses (paired): *P(i/j)* probability of *i* if y occurs; *P(ilnotj)* probability of *i* if y does not occur.

In practice, the opinions supplied in response to some spécifie questions regarding non-independent hypodieses are not cohérent vvidi respect to the conventional constraints bounding probabilities.

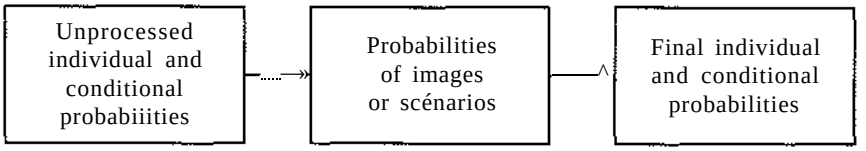
Thèse unprocessed opinions must be corrected in such a way that the final results validate the following conditions:

(a) $O \wedge PQ \wedge 1$ •
(b) $P(i!j).P(j) = P(i!j).P(i) = P(Lj).$
(c) $P(ilj).P(j) + P(Hnotj).P(noij) = P^{*}(i).$

The principle of the SMIC method is to adjust the experts' unprocessed opinions in such a way as to obtain cohérent final results (satisfying the normal constraints bounding probabilities) which remain as close as possible to the initial estimâtes.

We could envisage optimizing some function of the individual or conditional probabilities subject to the above constraints. However, non-linearîty of the constraints governing the isolated hypothèses imposes spécifie conditions on the optima; this leads us to concentrate on the combinatory probabilities of hypothèses., i.e. situationa! scénarios.

The principle adopted attempts to obtain cohérent final probabilities from the hypothèses"[1] which resuit from the combined probabilities of the hypothèses, and which form global, unexpressed but implicit opinions relating to the scénarios:



3.2. RELATIONSHIPS EETWEEN HYPOTHESES AND SCENARIOS: THE SEARCH FOR COHERENCE

The *2N = r* possible situations of die System *Er* comprising *N* hypothèses, are:

El = (M, A2,. . .*hi*. .. h_N)
E2 = (not /d, *h2*, , . . *hi*. . . *hpj)* (/il not implemented)
Er = (not *h*\, not A2,… not *hi*... nol *hj**j)* (no hypothesis implemented)

Each situation (or image) *Ek* has an unknown probability n^ which we wouîd like to identify. Individual or conditional theoretical probabilities^, expressed as a function of FI^, can be associated with each isolated hypothesis *hi.*

(1) Probability of h_i

$P^*(i) = \Sigma_k \Theta_{ik} \Pi_k$
where $\Theta_{ik} = 0$ if h_i does not occur in E_k
$\Theta_{ik} = 1$ if h_i occurs in E_k.

10. In somc cases, when it is préférable co speak of events rather than hypothèses, this number is rescricted to five or six.

The relation (1) expresses the fact that the probability of hypothesis í is the sum of the probabilities of the situations where $h^{\wedge}$ in fact occurs.

(2) Probability of *hj* if h_j is realized

$$P^*(i|j) = \frac{\sum_{k=1}^{r} T(ijk)\,\Pi_k}{P^*(j)}\ V(ij)$$

where $T(ijk) = 1$ if $/_{;}$- and l_u occur in $E^{\wedge}$
$T(ijk) = 0$ if h_{-t} or h_j do not occur in $E^{\wedge}$

In fact we hâve $P^*(i.j) \simeq P^*(Hj).P^*(j)$ and the probability that $h^{\wedge}$ and h_j occur simultaneously is equal to the sum of the probabilities of the situations where *i* or *j* both occur simultaneously.

(3) Probabilities of *i* if not/

$$P^*(i|not\ j) = \frac{\sum_{k=1}^{r} S(ijk)\,\Pi_k}{1 - P^*(j)}\ V(ij)$$

where $Sftjk) = 1$ when $/(_{;}$- and not $//_j$• are part of $E^{\wedge}$
$S(ijk) = 0$ when $h^{\wedge}$ and not $/_j$• are not part of $E^{\wedge}$.

The necessarily valid conditions are:

(a) $0 \leqslant P^*() \leqslant 1$;
(b) $P^*(i|j).P^*(j) = P^*(j|i).P^*(i) = P^*(i.j)$;
(c) $P^*(i|j).P^*(j) + P^*(i|not\ j).P^*(not\ j) = P^*(i)$.

Constraints (a), (b) and (c) are verified by tlie theoretical probabilities but not by the estimated probabilities: as a resuit the objective function that we propose to optimize consists of minimizing the différence beuveen tlie products $P(i/j).P(j)$ which resuit from the estimâtes supplied by the experts and the theoreticai products $P^*(i!j).P^*(j)$ which are expressed as a function of the $11^{\wedge}$.

This is équivalent to seeking the probabilities $(Yl_{l}\} Yl_{2},..$ • 11^ . . . n_r) of the 7' situadons possible, which minimize for example:

$$\sum_{k=1}^{t}\left\{\begin{array}{l}\sum_{i}\left\{P(i)-\sum_{k=1}^{t}\Theta(ik).\Pi_k\right\}^2\\ +\sum_{ij}\left\{P(i|j).P(j)-\sum_{k=1}^{t}T(ijk).\Pi_k\right\}^2\\ +\sum_{ij}\left\{P(i|\text{not } j).P(\text{not } j)-\sum_{k=1}^{t}S(ijk).\Pi_k\right\}^2\\ \text{Subject to the constraints} \qquad \sum_{k=1}^{k=1}\Pi_k = 1\\ \qquad\qquad\qquad\qquad\qquad\quad \Pi_k \geq 0, \forall k\end{array}\right.$$

This is a standard quadratic minimization programming problem under linear constraints.

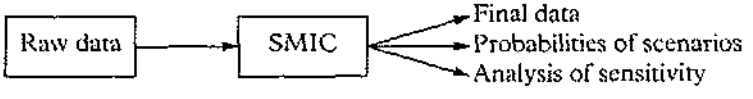
Ai this stage it can be shown that there are multiple solutions for the n^ while the *P** remain singular. A choice criterion is introduced: die solution taken to be optimal is diat which corresponds to the set of the n^ in such a way that the most likely scénario has the highest possible value, corresponding to 'reality', most of the experts bearing in mind that when they responded to the SMIC questionnaire this was a final image that they considered more likely dian any other.

The solution corresponding to this criterion, Max (Max Iï^)$_3$ is obtained easiiy using the simplex aigorithm, since it is a linear function in II, to be optimîzed under linear constraints.

3.3. RE3ULTS: MIERARCIIY OF SCENARIOS AND SENSITIVITY ANALYSIS

For each expert the SMIC programme gives the probability séquence (II], n_2, • • • FI,,) of the ?• scénarios which provide the highest value of the most probable scénario Max (Max 11^).

We thus obtain a *cardinal séquence of possible scénarios,* which enables us to define the *domain of the possible outcomes,* retaining only those which hâve a non-zero probability.

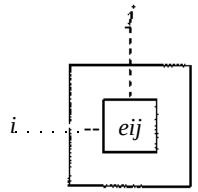


Widiin die domain of the possible outcomes we can distinguish diose scénarios which are more probable than others, from which die refe-

rence situations and the contrasted situations can be chosen. From the probabilities of the scénarios vve can deduce the cohérent, simple and conditional, probabilities of the hypothèses, i,e. satisfying (a), (b) and (c). The rest of the method consists of sensitivity analysis to identify the driver or dominant variables and the dépendent variables.

Sensilively analysis

This is a matter of estimating the variation *APj* of the probability P_j of the event *j* following a variation *àP^* of the probabiîity *P^* of the event *i.* The results take the form of an elasticity matrix:



$$e(ij) = \frac{P(i).\Delta \quad P_G)}{P(j).\Delta \quad P(i)}$$

The effects of an action on each hypothesis are measured by the coefficients of elasticity *eij.* We construct an elasticity matrix whose row totals give the sums of the relative induced in the probabilities of the other hypothèses for a relative probability variation of *i* (10 per cent for example). To some extent this sum translates the driving force of the hypothesis *i* on the others. Similarly the column totals allow an estimation of the degree of dependence of the hypothèses.

Sensitivity analysis informs us as to which hypothèses should be enhanced or inhibited, thus orienu'ng the System in a desired direction. Thèse elasticides can be calcuiated by simulation (cycling the model of the relauonships several times through the probabilities). However, for technical and financiai reasons, it is established practice to measure the impact of one event on another by shifting the bar chart of the *P(i), P(ijj)* and *P(ijnotj).*

Choice of the final images

For each expert consulted, we now hâve a tist of the *2"* images, ranged in decreasing order of probability. A list of some of thèse images (ten or so) can then be drawn up so that:

- for each expert the sum of the probabilides of the images absent from the list is smatl;
- for each image retained on the list there is at least one expert who assigns a large probability to it;

- we can then catculate the mean of the assigned probabilities for each image, obtaining a hierarchy of final images, and the corresponding scénarios.

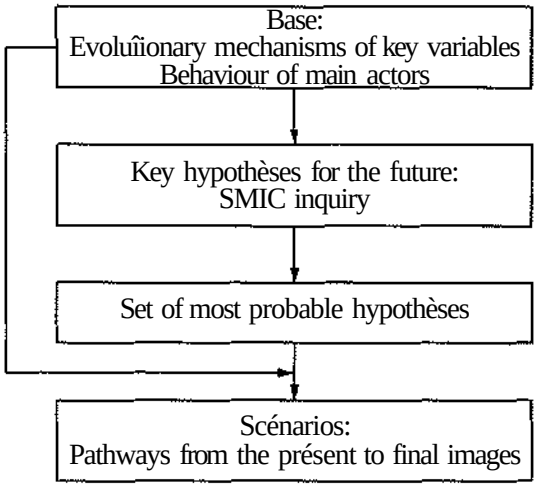


FiG. 25. Domain of possible outeomes.

The référence scénario (a scénario often quoted and with a high mean probability) and contrasted scénarios are then chosen from among the available scénarios.

The SMIC method can be summarized in essence as highlighting the most Iikely futures that will be dealt with by the scénario technique (see Figure 25),

Once the final images hâve been worked out, the aim of the scénario method is to describe coherently the various pathways by which - starting from the présent situation and inciuding evolutionary mechanisms and the behaviour of the actors analysed in the base - the future can be predicted.

3.4. APPLICABÎLITY AND LIMITATIONS

Several criticîsms were levelled at the SMIC method, at Ieast as regards its first applications, notably:

- A too limited mechanical application.
- The objective function and the multiplicity of solutions.
- The amalgamating of the responses of several experts.

It is worth considering each of thèse points.

Limited and mechaniccd application

Every new instrument requires a learning period, during which time its use becomes an end in itself. Fortunately, for the SMIC méthode this was a short period and today it is only with great circumspection that it can be used within the framework of the scénarios method. The number of hypothèses or events that can be handled by tlie SMIC method is generally limited to six, this figure being chosen less for mathematical reasons than to limit the maximum number of questions that can reasonably be put to the experts.

Objective funaion and the multiplicity of solutions

First, the objective function is in some ways arbitrary. Another function couid be chosen. Nevertheless, the one we hâve used has the advantage of conforming to the 'philosophy' of least squares. In effect, as in linear régression, we hâve a host of points (the unprocessed answers) and we seek the 'best fit' resuit that respects certain constraints (a straight line relation for the régression and the axioms of probability in our case). In any case, it is true that the optimum of the objective function is not unique and that there is an infinity of solutions for the probabilités of the *k* scénarios.

In 1976 we suggested introducing a choice criterion and retaining- as the optimal solution among the infinity of solutions - that which gave die highest value to the most likely scénario. The solution corresponding to this criterion, Max (Max lï^), can easily be obtained by using the simplex algorithm. This criterion has the advantage of partly removing the contradiction we hâve often noted among SMIC results^ which tends to assign a relativeiy low probability to the most likety scénario as well as to the initial viewpoint held by the expert being questioned, according to whom one or two scénarios were clearly more likely than others.

Amalgamating responscs

Given computing costs, it is not possible to run as many passes of the SMIC method as there are experts polled; besides, there would be as many solutions as experts and arbitration problems would constantly arise. The solution we offer is to construct a typology of experts as a function of the proximity of their responses and to retain only those scénarios which seemed most probable to the majority of experts, grouped by type; i.e. as représentatives of a category.

Given thèse limits, the usefulness of cross-impact methods such as SMIC remains considérable when it cornes to choosing the most likely

scénarios that are reievant. They aiso help us to gain a better understanding of the stratégie behaviour of the actors driving the System by closely examining the image of the future that they generate. To better appreciate die technique's usefulness, we can now look at some examples.

4. Case-studies

Around fifteen international surveys hâve been carried out using the SMIC method by mail and with very satisfactory response rates of the order of 25 to 30 per cent. The results hâve always provided an invaluable source of information for the relevant prospective studies.

To iliustrate the SMIC method, we refer to two early applications to show the extent to which they hâve stood the test of time (which seems to us the least that can be expected of a prospective study). The first example concerns the probable trends in air transport in the Paris région to the year 1990 as they were envisaged in 1974 when a SEMA study was carried out for the Paris Airport Authority.

Some areas of application o/SMIC over the pasi décade

- Long-haui passenger demartd to 1990-2000
- Aircraft construction
- Air transport in the Paris région
- The French E[3]ost Office in 1990
- World geopoliticai évolution
- France and world developments
- The conséquences of a îeft-wing victory in France in 1978
- Firms in late 1978
- The world petrochemical industry
- Offshore industries
- The European automobile industry
- The cosmetics industry
- Fairs and exhibitions in France
- The nuclear industry in the year 2000
- Corporate activities and jobs to the year 2000

In this application, tliere was no inquiry involving outside experts, but a group opinion survey was undertaken by a working party which wished to test the cohérence of their views as they resulted from the exercise, together with certain assumptions about the 'most likely' scénarios. The issues in this prospective study were not trivial, since die

aim was to assess whether the u-affic outlook for the year 1990 required the construction of a third airport in the Paris région in addition to Roissy. In the cvent of a positive response it would hâve been necessary as of 1974 to acquire the land for this future development.

Thinking back on events, it appears that the négative conclusion of the study was well founded. In any case the study clearly identified bottlenecks like passenger handling on the ground, average take-off delays, etc., the importance of which has since been confirmed. However, the conclusions which turned out to be relevant relied partly on hypothèses that were not borne out by facts: for exampSe, the forecasts for économie growth were excessively optimistic (in 1974 the économie crisis was not generally considered likely to last).

The second application relates to the global needs and prospects for nuclear energy to the year 2000, incorporating some results of the international survey published in *Economia* in 1977 and which, despite the passage of time, remain accurate today.

By as eariy as 1977 it was clear that new forms of energy would not prove économie by the year 2000 compared with oil and nuclear power. It also seemed that the experts were divided about the development of nuclear power; some, particularly those outside France, maintained that nuclear power was only an intermediate step of minor importance, as an abundance of oil was expected: oil would be more abundant because of high priées (we were then on the eve of the second oil crisis)."

Since then, history has shown that although the development of nuclear energy was necessary, it should hâve been carried out in a more flexible and less massive way because of the high degree of uncertainty about économie growth, the energy component of future growth, energy prices and conventional energy resources. In 1977, at any rate, very few experts believed in the development of breeder reactors. The décisions taken in France in 1984 with regard to that of Creys xVlalville confîrm the soundness of this opinion.

4.1. AIR TRANSPORT SCÉNARIOS[12]

We examined those events which could affect traffic at Paris Airport for the period 1974-1990, an event being defined as the materialization of a trend to which a threshold is assigned, even if this trend is at présent only a potentiality. We identified six events which couid bc taken to characterize certain spécifie trends in air transport in the Paris région,

\ 1. Thèse resuits ;irc akin to those quoted previousiy.
12. Study carried ont. by SEMA for the Paris Airport Authority; soc M. Godet (1975).

The question asked was: Given that a System with six events can assume $2^6 = 64$ states at the given time horizon, what states (or scénarios) are most likely, or most unlikeiy? The six events were:

(e^J More than 50 million lourist-class passengers. This event characterizes an extrapolation of two trends: on the one hand, continued growth of passenger traffic and, on the other, a growing proportion of the tourist class in passenger traffic.

(e^ An average ofover 150 passengers per aircraft movement. This event implies a certain load factor and aiso assumes increased and widespread use of wide-body aircraft.

(e-^) An average take-off delay in excess o/20 minutes. This event includes a number of phenomena such as the saturation of airspace, which could be aggravated by the banning of night fiights.

(eq) Air ticket priées decreasing by more than 3 per cent per annimi, in constant ternis. This means, for example, that if the price of an air ticket in 1974 is 100 francs, the same ticket would cost less than 63 francs in 1990, in 1974 francs. It could be said that if this particular event does not occur, air transport has little chance of becoming a mass transport option.

(e^) French gross national product growing in volume at more than 4 per cent per annum. This event is favourable to air transport, to the extent that économie growth créâtes some business-class traffic and that a rise in real income increases the potential market for air traffic in gênerai. In the long term this event seems to be a limiting factor for the development of air traffic in the Paris région. Growth in traffic is often accompanied by urban development, notably around airport zones. This in turn threatens to aggravate environmental problems.

(e^) Regulatory constraims involving a 20 per cent réduction in potential traffic movements. This could lead to limits being imposed on the total number of movements or even a ban on night movements.

Unprocessed data

Events up to 1990 are characterized as shown in Figures 26 and 27:
(a) by the probability of occurrence of isolated events (Fig. 26);

	P(ei)
• e_x More than 50 million tourist-class passengers in 1990	0.4
• e_7 An average of more than 150 passengers per flight	0.7
• <3 An average take-off delay of more than 20 minutes (air-traffic control saturation)	0.6
• e^ Constant franc ticket price falls by more than 3 per cent per annum	0.4
• e_5 French GNP grows by more than 4 per cent per annum	0.6
• $e_{\&}$ Regulatory constraints involve a réduction of 20 per cent in pocential traffic movements	0.7

FIG. 26.

(b)by the conditional probabilities of paired events (Fig. 27).

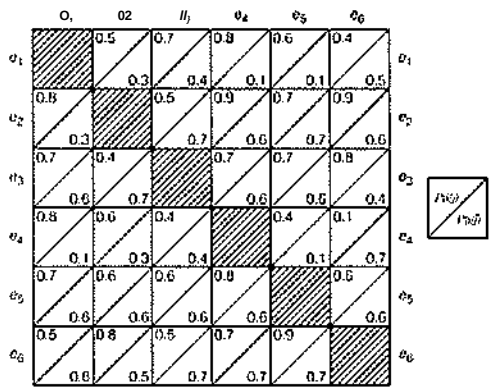
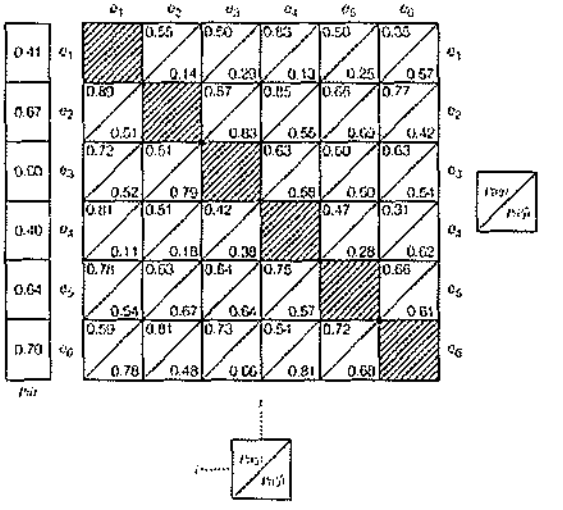


FIG. 27.

This information is incohérent if one refers to the meaning describsd above. To obtain corrected results., we calculate the probabilities of the States^ which at the same time indicate the most likely scénarios.

The final values



P i G . 2 8 ,

To faciliiaie the explanatioiv, we shall first présent and comment on the corrected individual and conditional probabilities. We then discuss the probabilities of the states that enable us to modify the initial information.

In Figure 27 the initial individual probabilities are hardly modified: in gênerai; without being fondamental, the changes are a **little** larger. On the other hand, some of the conditional probabilities hâve undergone non-negligible modifications and this can easily be explained: of course, if is often easier to estimate a simple ramer than a conditional probability. Thusj large corrections hâve been made to:

- the probability of a tourist-class traffic levei of 50 million passengers in 1990_3 knowing that the average take-off delay will, by men> be over 20 minutes: *P (eje^)* moves from 0.7 down to 0.5 (ıhis probability had clearly been overestimated by the group of experts).
- the probability of a decrease of over 3 per cent per annum in ticket prices in constant terms, under the hypothesis that the French GNP growth rate would not exceed 4 per cent per annum in volume: *P (cjnoi e$)* moves from 0.1 to 0.28 (this probability is much higher than that estimated by the experts).

The probabilitics of ihc scénarios

For six events there are $2^6 = 64$ possible states (Table 19).

TABLK 19

	e_1	e_2	e_3	e_4	e_5	e_6
E_1	**1**	1	1	**1**	**1**	**1**
E_2	**0**	**I**	**I**	**1**	**1**	I
El	**1**	0	**1**	**1**	**i**	**1**
E_4	-	- '	-	-	-	-
Es	**1**	0	Û	**0**	**0**	**0**
E_6	0	0	**0**	**0**	0	**0**

For each state $E^{\wedge}$ there is an associated probability $il^{\wedge}$ witli $SII^{\wedge} = 1$ since it is certain that one of the states wiil occur.

The most likely scénarios, in decreasing order of probabilité, are:

£, (111111) where n, = 0.218
$E\backslash_4$ (010011) where $n_{,4} = 0.161$
E_{26} (011001) where $II_{26} = 0.094$
% (001011) where $n_{i2} = 0.079$
$^{\wedge}28$ (001001) where $I1_{2S} = 0.066$
E_{37} (110110) where $n_{37} = 0.056$
£*3 (101010) where $TI_{43} = 0.052$
E_{44} (001010) where $n_{44} = 0.047$
E_{30} (010001) where $n_{30} = 0.045$
E_{49} (111100) where $II_{49} = 0.042$

Some twenty states in ail hâve a non-zero probability; tiiey comprise the domain of possible scénarios. The other forty-four states witli a zéro probability must be considered as not realistic; however, this does not mean tliaî it is not worth commenting on them. For exampSe:

- £"$_{54}$ witli $n_{64} = 0$. The probability that none of the events takes place is zéro: this resuit shows that we hâve chosen sufficiently relevant events for at ieast one of them to occur during tlie period.
- £$_s$ (00011 i) with $n_s = 0$. It is not possible that tlie last three events 6$_4$, e_5, t$_6$ wiil occur without at least one of tlie events t'|> e$_2$, $e$$ occurring too. If one considers that the last three events e_4, e_5, e$_6$ are external variables and ej, e$_2$, t'3 internai variables of the Paris région air transport system, this shows that tlie System is necessarily sensitive to domestic developments.

The basic irend

There is an 80 per cent chance that the situation in 1990 wili correspond to one of the first ten scénarios on the listgiven above. More precisely, E_{l3} E_{JA}, E_2& E_n constitute *the basic tretid:* there is a more than even chance that one of thèse scénarios will actually happen between now and 1990.

- iï[(111111) with II; = 0.218. This is *the conflict scénario,* in which everything happens. Problems do not inhibit the growth of the economy or air traffic, but this growth reinforces the difficulties, creating a tense situation.
- £"$_{14}$ (010011) with $n_{i\,4}$ = 0.161. *Traffic growth is îimited by the number offlights.* Only e_2> *e$*> *e&* occur. There is strong French économie growth (t'5), urban development continues around the airports of the Paris région, environmental problems worsen and regulatory constraints *(e_6)* are enforced, restricting traffic. In order to absorb the growth in traffic, without increasing movements, the airlines extend the use of wide-bodîed aircraft and there are more than 150 passengers per flight *(e_2)* etc.
- £'26 (011001) with FI_26 = 0.094, *the ecology scénario.* They are regulatory constraints (e_e) which slow down the growth of the traffic and especialiy the tourist class passengers *(e{).* On average iake-off delay is more than 20 minutes *(e_3)* which restricts the number of flights.
- £'$_{]2}$ (001011) with fi]2 = 0.079, *the saturation scénarios without strong traffic grozoth.* There are less than 50 million tourist passengers and less lhan 150 passengers per flight and the ticket price, in constant terms, is not reduced; on the other hand, the average take-off delay is more than 20 minutes, French économie growth is strong and regulatory constraints invotve a réduction of 20 per cent in potential traffic movements.

Stratégie sensitivity analysis

It is necessary for policy-makers to be aware of the possible states or scénarios for the évolution of the System under study in order to détermine their strategy. In addîtion, the choice of actions available is conditioned by a previous examination of the direct and indirect effects that each décision could hâve upon the whole System. In particular, décisions with 'boomerang' effects often tend to work against the person taking them and ought to be identified; that is, actions whose primary effects are as desîred, but whose secondary effects run counter to initial objectives.

On the other hand, it is often more efficient for attaining a given objective to operate indirectly on the target variable, and the desired effect can thus be obtained in an indirect way: thèse are décisions with 'ricochet' or 'sling-shot' effects.

Sensitivity anaiysis consists of measuring the variation APy of the probability P_j-of the event/ foliowing a variation APj- of the probability P_i- of the event *i.* Constructing an elasticity matrix allows the driver or dominant events and the dominated events to be deduced, Beginning with the final results, we then calculate the elasticity e_2y.

As a reminder, we recall the list of events:

- cj: More than 50 million tourist-class passengers in 1990.
- e_2: An average of more than 150 passengers per flight.
- e_3: An average take-off delay of more than 20 minutes due to, for example, air-traffic-control saturation.
- e_4: Constant franc ticket price falls by more than 3 per cent per annum.
- » a_s: French GNP grows by more than 4 per cent per annum.
- e_6: Regulatory constraints involve a réduction of 20 per cent in potential traffic movements.

Figure 29 summarizes the results. The calcutations hâve been performed with a step fonction ÀPj· = 0.1 for ail *i.*

	1	2	3	4	5	6	$\sum_j \lvert e_{ij} \rvert$
1		-0.04	-0.06	0.11	-0.06	-0.13	0.40
2	0.10		-0.26	0.05	-0.18	-0.05	0.66
3	-0.08	-0.28		-0.19	-0.22	-0.19	0.96
4	0.10	-0.05	-0.10		-0.07	-0.15	0.47
5	-0.02	-0.21	-0.22	-0.07		-0.20	0.72
6	-0.40	-0.04	-0.21	-0.48	-0.24		1.36
$\sum_i \lvert e_{ij} \rvert$	0.70	0.62	0.87	0.90	0.76	0.72	

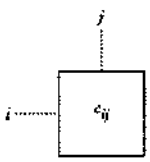


FIG. 29.

Reading the marginal row totals we can observe that the impact of some events is greater than others; for example, e_6 and e_3 with:

$$\sum_J |e_{6J}| = 1.36 \text{ and } \sum_J |e_{3J}| = 0.96$$

Régulation and take-off delays are *déterminant events* for the development of air transport in the Paris région.

We can likewise note that:

$$\sum_j k\backslash_{sj}\backslash = 0{,}47 \text{ and } \sum_j 1\, le_{y}\text{-}i = 0.40$$

Ticket prices, in constant terms, and the number of tourist-ciass passengers hâve no greac impact on the System of events.

$$\sum_j \backslash e_{i,}\backslash = 0.87 \text{ and } \sum_j 2\, le_{\cdot,}i = 0.90$$

Reading the column totals, we see that certain *events* are more *dominated* titan others. Noteworthy, in this respect, are e_3 and e_4 with: As far as e_4 is concerned, this resuit is mainly explained by $e_{64} = -0.48$, which means that if the probabiiity of e_2 increases by 10 per cent, then that of c_4 reduces by 5 per cent. *Airlines loiîl hâve to offset the ticket priée willi the extra cost due to regiilatory constraints.*

Event e_3 is both a déterminant and an influential variable. The saturation of controlied airspace is therefore the most sensitive event from the point of view of the deveiopment of air transport.

As a spécial case of elasticity, we may note the value $e_{6I} = -0.40$. The enforcing of regiilatory constraints is thus a very unfavourable event for the deveiopment of tourist-class traffic via chartered flights.

On the other hand, for $c_{51} = -0.02$, air traffic generated by a demand for tourism is not very sensitive to économie grovvth. We may note in any case that $e_{24} = + 0.05$. The gênerai use of wide-bodied aircraft does not resuit in any measurable réduction of tarifs.

4.2. NUCLEAR ENERGY SCÉNARIOS TO THE YEAR 2000

In this example we rely on the results of an investigation into global nuclear energy to the year 2000, carried out by SEiVlA and *Economia* in 1977 (see Godet and Maalouf, 1977). The experts from thirty countries from whom some ninety replies were received were asked to détermine the probabiiity of occurrence of around thirty hypothèses relating to the économie growth rates, the availability of oil_3 the competitiveness of nuclear power, the prolifération of nuclear weapons, the price of oil, the risk of accidentai nuclear catastrophes, etc."

13. See Section 4.3 below: 'Excerpts i'rom the SMEC questionnaire".

The main conclusions

- The experts considered that nuclear power would be the main source of energy in the year 2000 but they also considered that it was not yet a clear-cut success.
- If nuclear energy became prédominant, opposition to nuclear power would be quelled: but if, for any reason, opposition remained significant, that would jeopardize the future of the nuclear industry. At the end of the century there would be a final struggie between opponents and proponents.
- If a serious accident were to occur, îhis battle would turn in favour of the opposition. It would be impossible to dîspel opposition and the chances of pursuing the devetopment of nuclear power would be considerably diminished as a resuit. Such an accident, however, was seen as unlikely, buta significant number of experts did not exclude die possibilité
- The prolifération of nuclear weapons, on the other hand, would onfy hâve a limited influence on the opposition and would not affect the future of the nuclear industry.
- Nuclear energy would undoubtedly be the most économie source of energy in the year 2000, but oil - much more so than new forms of energy - would remain a serious competitor.
- The price of oil would double between now and 1985, reaching S25 a barrel in constant priées.
- The deveiopment of nuclear power would be aided by sustained économie growth; reciprocally it would be necessary to guarantee growth.
- Measures for energy conservation would not be effective unîess the économie crisis prevailed.
- Western Europe would be a leader in the nuclear world by the year 2000, both technologically and commercially. Elsewhere, the nuclear industry would be at a standstill, especially in die Third World.

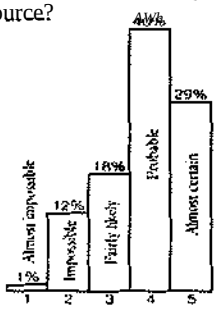
The unprocessed results of the study are given in the bar charts in Figure 30. The significance of such bar charts lies not only in clearly identifying consensus or several differing schools of thought, but also who said what.

At the end of die day, it matters little which responses are reliable and which give an accurate forecast: from the prospective point of view what counts is identifying rightly (or wrongly) *what image each expert questioned lias of the future* (in principle representing a group of actors at least to some extent), *since it is in relation to this image of ihe future that each actor makes tip his mind in the présent.* In short, *prospective* investigation throws a powerful light on the actors' stratégies, this analysis

being essential for constructing scénarios. Let us not forget that the SMIC method will txansform the unprocessed results in order to discern the most likely and the least likely scénarios.

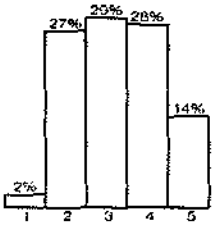
The experts' answers to our questions about the nuclear industry, opposition to it, new forms of energy, oil and growth hâve been reduced to only tvvo responses: 'yes' or 'no' for each item. Therefore, thirty-two scénario outcomes were possible. The method has assigned a probability to each scénario, according to the experts' estimations. In Table 20 we summarized the fifteen most likely scénarios, numbered in order of probability and representing nearly 80 per cent of the total probabilities. The scénarios were ranged into four groups according to the relationship indicated between nuclear energy and growth.

What is the probability thaï by the ycar 2000 nuclear energy will be more econo-mical thart any other energy source?



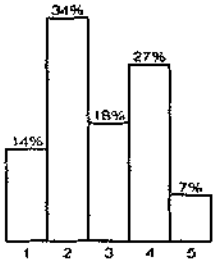
Nuctcar energy should be more econo-mica! than new energy sources.

What is the probability that the price of oil will reach *$25* per barre! in 1985 (in 1977 S), that is, rwice the présent price?



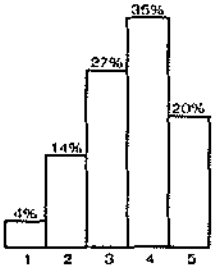
In 1977 the experts were divided on the question.

What is the probability that oil and other fossil fuels will remain widely available by the year 2000?



The experts are divided on the question of resources: some chink that there wifl be a glut, oîhers that supplies will run short.

What is the probability that thir-teen countries witt possess nu-clear weapons by the year 2000 (compared with six today)?



Accelerated prolifération of nu-clear deviecs appears very likely.

FiG. 30.

TABLE 20

	Nuelcar etiergy	*Opposition*	*New eticrgy*	*OU*	*Grovilh*	
The miclcar industry and économie growtii: the possible scénarios and. . .						
1	Yes	No	Yes	No	Yes	The nuelcar world: unchailengcd power with strong économie growth
2	Yes	No	No	Yes	Yes	
3	Yes	No	No	No	Yes	
4	Yes	No	No	No	No	Nuclear energy ac any cost: well-developed nuclear, weak économie growth
7	Yes	Yes	No	No	No	
9	Yes	Yes	No	Yes	No	
11	Yes	No	No	Yes	No	
13	Yes	No	Yes	Yes	No	
6	No	No	No	Yes	No	The ecologicat world: weak nuclear energy, weak économie growth
8	No	No	Yes	Yes	No	
10	No	Yes	No	No	No	
12	No	No	Yes	No	No	
14	No	Yes	Yes	No	No	
15	No	Yes	No	Yes	No	
5	No	Yes	Yes	Yes	Yes	Sober growth: économie growth without nuclear energy
. . . the impossible outeontes						
!1	No	Yes	No	No	Yes	
12	Yes	Yes	Yes	Yes	No	
13	No	Yes	Yes	No	Yes	
14	Yes	Yes	Yes	Yes	Ycs	
15	No	No	Yes	No	Yes	

The five scénarios which exhibited a zéro or very smail probability were every bit as revealing as the fifteen most likely ones. They reveal both what the experts rejected as impossible and illuminate their opposites, i.e. an image of the possible. Let us begin with the least likely:

- In scénario 11, without nuclear energy, oil or new forms of energy, économie growth would be sustained. In fact, it is difficult to see how the world economy couid enter an expansionary phase without a source of energy.
- Scénarios 12 and 14 are similar with one exception: growth is slow in one and rapid in the other. The meaning is clear: if there were oi!,

new energy sources and strong opposition to nuclear energy, it is impossible to see how nuclear energy woutd devefop, whether growth were strong or not.

- Scénarios 13 and 15 are also similar with only one negligible différence: opposition. If the experts rejected them it was because they computed that if économie growth were to be rapid and there was a shortfalî of oil, new energy sources would noi be sufficient to supply the world economy and it would be inconceivable that nuclear energy would not develop, whatever the opposition.

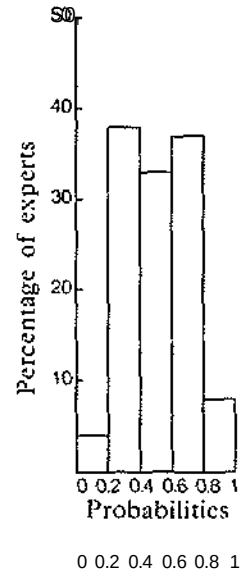


FiG. 3 I . Soiidarity of the oil-exporting countries.

On the whole, it can be seen that tlie experts hâve a stereotyped view of the energy problem: if the world économies are expanding, oil and nuclear energy will be necessary. If die crisis is prolonged, one of the two will be sufficient and it is not impossible that it would be oil.

As another example, when we asked in 1975 *'whether or not the soiidarity of the OPEC countries would be intact in 1990'* the experts appeared divided on the question, which, naturally, implied two scénarios: on tlie one hand, maintenance of the soiidarity of the OPEC countries and, on the other, the breaking-up of the cartel (see Figure 31).

In addition it was interesting that, on the whole, the experts close to tlie American administration and the oil companies thought that die break-up of OPEC was unlikely, while this idea was often considered likely by energy experts of OPEC member countries. This has obvious stratégie implications. // *is important, for an actor (in this case OPEC) to be aware that, even ifhefeels he is weak or vulnérable, others may think him strong.*

There are numerous exampies that spring to mind. It is not our intention to présent them atl hère, but rather to reiterate that it is aîways prudent and stimuiating for a future studies group within a firm, a government department or a research centre to juxtapose its own ideas about the future with those of other experts outside tlie group. The practice of conducring an external inquiry is an excellent inteltectual safeguard and often serves to test critically the certainties and received ideas in which any group is likely to become enmeshed.

We now end this survey of prospective methods which a!low the degree of uncertainty about the future environment of the enterprise to be reduced. Illuminating stratégie action by the light of future studies is the route which leads from prospective to stratégie management.

4.3. EXCERPTS FROM THE SMIC QUESTIONNAIRE[14]

SEMA-Prospective and the international économie and political monthly journal *Economia* are organizing an inquiry among 300 international experts on the thème, 'An évaluation of future nuclear energy Worldwide to the year 2000'. We wouid be grateful for your participation in this novel type of inquiry by replying to the attached questionnaire before 15 August.

The metliod used[15] has already been established in the political field and in the area of energy prospects, where the unforeseeable nature of certain developments during this décade has shown the need for new methods of prospective study. By taking twenty minutes or so to reply, you will allow us to evaluate the significance of the interaction between différent aspects of the nuclear question.

The detailed results of the survey will be sent to participants. The main conclusions will be published in *Economia,* as well as a list of the persons questioned. In the event that you prefer that your name does not appear, please let us know.

Thanking you in advance for your contribution, we are, yours sincerely,

Michel Godet — *SEMA-Prospective*

Antin Maalouf — *Economia*

14. Inquiry carried ont in 1977.
1 5. The SMIC method.

Namc of participant.....
Address.....
Street.....
Town.....
Country.....
Téléphone.....

The detailed résilies of the survey will be sent to you at this address. The main conclusions will be published in *Economia* and you will be sent them on publication. If you prefer your name not to appear on the list of people vvho participated in the inquiry, please say on this page.

Please return before 15 August to: *Economia-*, Nuclear Inquiry, 51 avenue des Ternes, 75017 Paris, France.

Evaluation of tha future of mtekar energy Worldwide up to theycar 2000

This particular study was fairly unusual. V/hile taking only a little time for the selected respondents, it enabled a wide range of the facets of the question to be examined in détail. In most surveys on major international problems, the questions asked are treated separately, *céleris paribus,* and the subtieties of opinion are distorted in the gênerai conclusions.

We consider it is important not only to evaluate the probabiîity of this or that hypothesis, but also to work out the conditional probabiîity resuttingfrom the interaction between various hypothèses, since thèse are rarely independent. The survey is enhanced by a séries of supplementary questions wliich allow the overal! value of the opinions expressed to be assessed.

The latter are proffered by persons who know more and hâve greater influence on the course of events in their field, allowing new knowledge relating to the problem to émerge. To this extent, the results of the inquiry themselves are to be viewed as an event.

Main hypothèses

The five hypothèses for the development of the future of nuclear energy worldwide up to the year 2000 are as follows:

Hj: Prédominance of nuclear energy (nuciear-generated energy will represent more than 20 per cent of total energy production in the world by the year 2000: the présent figure is 2 per cent).

H2: Popular opposition reduced (the various forms of opposition to nuclear energy will reduce rapidly by the year 2000).

H3: New, économie forms of energy (new forms of $energy_3$ mainly solar energy, will be compétitive in the year 2000).

H4: Oil available (reserves of oil and other fossil fuels will continue to satisfy world demand in the year 2000).

H5: Sustained économie growth (the average annual growth rate of GNP for the developed countries will be higher than 4 per cent during the period 1978-2000).

The inquiry method

The five main hypothèses above are presented for assessment, in three phases:

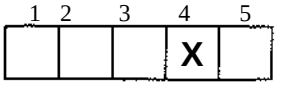
1. First, a simple probability: ail other things being equal, what probability would you assign to the accuracy hypothesis?
2. Second, the conditional probability: we correct the simple probability by considering in turn that each hypothesis is - then is not - accurate, and then by evaluating the impact of this event on the four other hypothèses.
3. Finally, we evaluate the probability of ten subsidiary questions which will serve to clarify certain important aspects: simple probability first, followed by conditionaî probability as related to one or other of the main hypothèses.'"

Meaning of the probability scale

1. Event nigh-impossible.
2. Event improbable.
3. Event of average probability.
4. Event likeîy.
5. Event quasi-certain.
6. The two events under considération are independent.

Examples ofansiuers

- Simple probabilités



16. If thc numbcr of hypothèses *(Ji)* is large, the number of scénarios *(2(li))* would makc the reading of trends difficult. By reducing the numbcr of main hypothèses to 5 we obtain 2(5) = 32 scénarios and thc subsidiary questions serve to refine the rcsults by introducing further nuances.

- Nuclear prédominance

Meamng: AH other things being equal, I estimate that it is likely that energy of nuclear origin vvili be prédominant, Worldwide, in the year 2000.

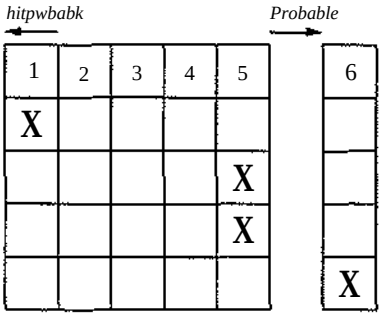
- Conditional probabilities (and associated subsidiary questions).
- What is the probabitity in your opinion that each of the following four hypothèses will be impiemented, given that hypothesis H-j (reduced popular opposition) *is not verified.*

H,: Nuclear prédominance

H_3: New économie forms of energy

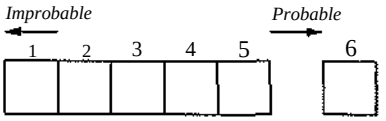
I-I_4: Oil available

H_g: Sustained économie growth

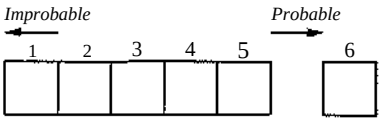


Meamng: If popular opposition does not weaken, it is aimost impossible that nuclear energy will be dominant in the year 2000; it is aimost certain that the development of new energy techniques will be more rapid and that new oil reserves will be discovered. Thcre is no connection between opposition and économie growth.

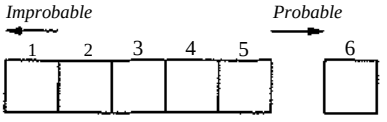
Simple probabilités



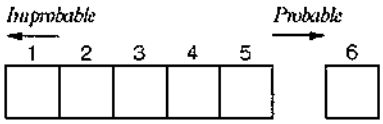
Hj: Prédominance of nuclear energy



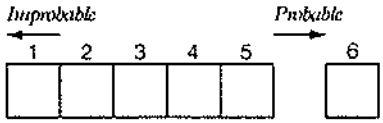
H7: Reduced popular opposition



H3: New économie energy forms



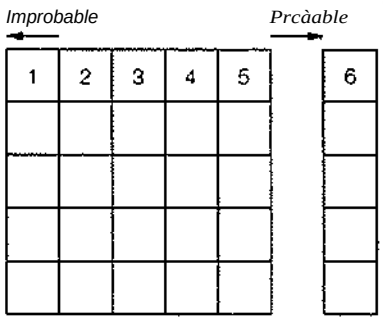
H_4: Oii available



H_5: Sustained économie groweh

Conditionai probabilities as afunction of H_1

What is the probability, in your view, that each of the following hypothèses wili turn out to be true, assuming that H] (prédominance of nuclear power) *is truc?*



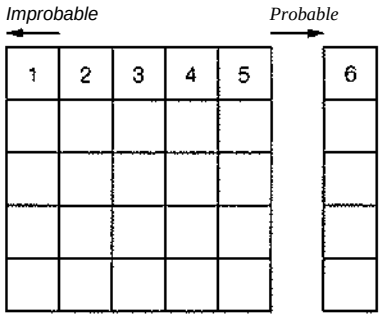
H_Z: Reduced popular opposition

H3: New économie energy forms

H_4: Oil available

Hj: Sustained économie growth

What is the probability, in your view, that eacii of tlie following hypothèses will turn out to be true, assuming that H] (prédominance of nuclear power) *is not true?*



H_2: Reduced popular opposition

H3: New économie energy forms

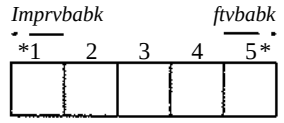
H^: Oii available

H_5: Sustained économie growth

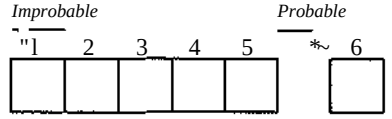
and so on for H_{23} H_3, H_4 and H_5.

Subsidiary questions (examples)

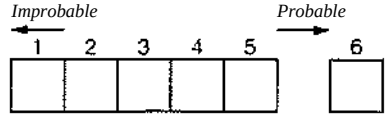
What is the probability that event Q! will occur: 'A non-similar nuclear catastrophe causing more than 100 deaths between now and the year 2000'?



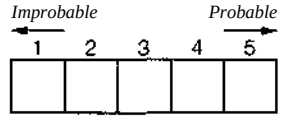
What is the probability that event Q, will occur, assuming that hypothesis Hj (prédominance of nuclear power) *is true?*



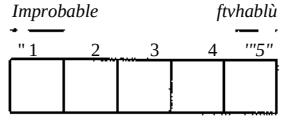
What is tiie probability that hypothesis H_2 (reduced popular opposition) will be true, assuming that event Q] occurs?



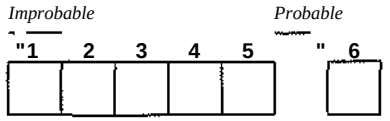
What is the probability that event Q_6 will occur: 'The price of oil will exceed 825 per barrel (double the présent price) by 1985, in constant 1977 dollars'?



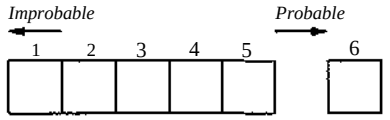
What is the probability that event Q_7 will occur: 'Nuclear energy will be the most économie form of energy in the year 2000'?



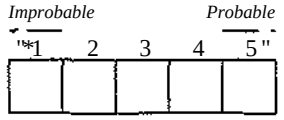
What is the probabiiity that event Q_7 will occur, assuming that hypothesis H,, (oil available) *is iriie?*



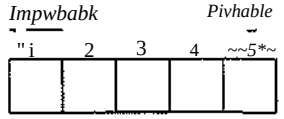
What is the probabiiity that event Q_7 will occur, assuming that hypothesis H_4 *is noi irue?*



What is the probabiiity that event Q_8 wili occur: 'Accelerated nuclear prolifération: more than twelve countries will possess nuclear arms by the year 2000 as compared with the présent'?



What is the probabiiity that event Q_{10} will occur: 'Fast breeder reactors will represent more than half of ail nuclear power stations built between now and the year 2000'?



7. Identifying and evaluating stratégie options

1. The décision process: identify^ evaluate^ choose and implement

Decision-making is a classical question of strategy, over which many writers hâve laboured. I. Ansoff (1965) distinguished three types of décisions (see Table 21):

- Stratégie décisions., concerning the external affairs of the company.
- Administrative décisions, relating to manpovver management, the organisation of labour, circulation of information, organizational structures, etc.
- Operational décisions, which aim to improve the efficiency of transformation of internai resources into added value (production programmes, rationalization programmes, price policy, sales promotion, etc.).

Although interesting, this typology is now somewhat out of date as the setting up and possible success of the strategy hâve become increasingly dépendent on décisions of an administrative or operational nature. Four stages are ordinarily distinguished in the décision process:

- Perception of the necessity of making choices.
- Formulation of possible décisions.
- Evaluation of options.
- Décision and implementation.

The necessity for choice is not always perceived: how many companies unreasonably retain at least some declining activities with a glorious past whose losses they consider only temporary? How many firms launch out

in a particular direction without serious considération of ail the diversification possibilities that are available?

TABLE 21. Principal décision catégories

	Stratégie	*Admitnśtmtive*	*Qpcralional*
Probîem	Chûicc of tlie range of products and markets which hnvc ihe chance of giving the Company an optimum retum on investments	Structure of corporate resources to achieve optimal success	Trading in conditions of optimum rciurn on capital
Nature of problcm	Judicious distribution of resources between produefs and markets	Organization, acquisition and devetopment of resources	Budget allocations to departments Planning the application and conversion of resources Management and control of opérations
Kcy décisions	Définition of stratégie objectives Mcasures of diversification Mcasures of expansion Administrative sirategy Financial strategy Choicc of growth média and their distribution through time	Organisation: structure of authority, responsibilkies and communications Structure for the conversion of resources: distribution of work and assignments Acquisition and dcvelopmcm of resources: financial cquipment, personnel, raw malcrïals	OpcrationaS objectíves Fixing prices and production levels Production planning and stock management Marketing policy R&D policy Controls
Nature of décisions	Centralized Madc in part ignorance Non-repctitive Non-regcnerativc	Conflict between strategy and commercia! activity Confiict bciwcen individus] and coilecsive goals Close link between économie variables and social factors Décisions required by stratégie issues and/or operational problerns	Decentralized Carrying risk and uncertainty Répétitive Very numerous Limited ability to optimize due :o compfexity of issues Regcnerativc

Source: Ansofl', 1965.

TABLE 22

Areas	Possible actions
1. Products	Change the product range: • Discontinue unprofitabte lines - add on item(s) EO tlic range offered • Replace some outdated products • Change the quaiity of certain products (improve or reduce the quaSity) • Change the packaging of some products • Change existing product priecs (higher or lowcr)
2. Markcls	Romain in the same market: • Seek a greater market share, either by selling more to existing customers or looking for new customers • Select existing cuswmers, seeking to eliminate the least profitable • Divcrsify customers for greater sales' security • Ex tend the market (other areas in the home market, exports, possible new users in existing geographical areas, etc.)
3. After-sales service	Jmprove the service offered, or reducc its cost, or make it more sélective (types of customers, etc.)
4. Distribution channols	Improve ihe utilisation of existing channels; • to make them more effective (more customers affected) • to reduce the cost • look l'or new channels
5. Sites	Look for betler sites: • for manufacturing (présent or extensions) • for warehousing
6. Produclion cosis	Search for new production methods: • by internat research • by subcontractïng • seek supply économies • stock Icvels • purchases
7. Organiziiiion	Scek a more dynamic organisation: t by reorganizing production and sales for prociuct iines • Siim down functional or support departmems • Subcontract some acišvities
8. Personne!	Change the profile and the recruiting methods for any new managers needed: • Improve training • Improve career policy (assignments, promotion, etc.)
9. Finance	Hxpand linancing capability: • shrough leasing • through réduction of assets (buildings, stocks, etc.) • by looking for iess expensive sources of finance • by improving the ratios; $\frac{\text{sharchotdcrs' funcis}}{\text{permanent capital}}$ $\frac{\text{fixed assets}}{\text{permanent capital}}$
10. Management	Introduce a managemeni information System (budget forecasting) Make exisring controls more effective

Becoming aware of a *stratégie gap* between corporate objectives and its growth trend should lead a company to explore first of ail the expansionary possibilités identifiée! by the product-market matrix - improvement of market shares in traditional markets, sales of nevv products in old markets and old products in new markets. It is only when expansion is not sufficient to fill the stratégie gap that one lias to resort to total diversification (new markets for new products), since, as Ansoff emphasizes, this is always riskier.

In certain cases one also has to revise growth objectives, and take financial and human characteristics into account, aligning them wîth corporate culture and the existence of possible synergies. Finally, growth is not an end in itself, and must first of ail be effective. For many companies, a return to profitability is achieved via intelligent surgery of iîs activities and, as a resuit, a réduction in turnover, while not forgetting to look for improved internai efficiency for a given level of production.

Some authors such as de J. de Guerny and J. C. Guiriec (1979) hâve developed useful checklists for stratégie idea-seeking (Table 22).

Once the possible décisions hâve been formulated, they hâve to be evaluated. This phase is often sidestepped because of a désire to get on with the job. It is a rough évaluation of possible actions according to certain criteria which hâve been weighted in some way. We hâve already made référence to the fact ṁat it is better to use multicriteria choice methods for an uncertain future, such as Electre, for such an évaluation and sélection. Thèse methods allow us to corisider the most likely scénarios for the stratégie environment and the enterprise diagnosis, in order to identify which actions should be undertaken, which rejected, and which are in some way risky.

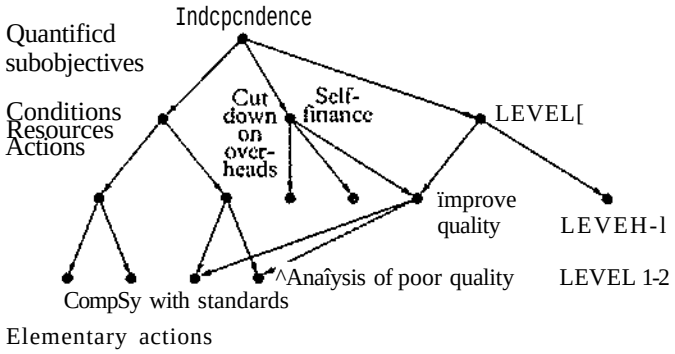
2. Relevance trees: from objectives to action

This method, originally used mainly in the technological and military fields, aims to rationalîze the sélection of elementary actions or opérations (the trunk of the crée) with a view to achieving overall objectives (the top of the tree).

2,1. THE QUALITATIVE HIERARCHY: AIMS, OBJECTIVES, MEANS AMD ACTION

Although tiie process is similar to a fiow chart, we shall use the term 'relevance tree'. The aim of the method is to relate the différent hierarchy levels of a probîem, moving from the gênerai level (the top) down

to the more detaited levels (the lower levels). This process, characteristic of trees, excludes reaction from lower to higher levels. (See Fig. 32.)



F i G . 3 2. Rclevancc tree. General objective.

A distinction is made between the gênerai aims (higher levels, including policy décisions, missions and objectives) and the means (lower levels, including resources, subsystems and subsets of actions and elementary actions). The various levels therefore correspond either to the increasingly detailed objectives of the décision System or to the means implemented (the tree is usuaily organized into five to seven levels).

When, for instance, the overall corporate aim is to strengthen the company's independence, level I will contaîn 'increase self-finance' as a subobjective. To achieve this subobjective, a certain number of conditions (I-1) will be needed, among them lowering overheads or improving quality. To satisfy the latter condition, one would need to comply with standards or carry out an analysis of décline in quality, among other things.

The apparently simple process of constructing the tree must comply with the following conditions:

* There are no Sinks between nodes at any given level, i.e. éléments at die same levé! are independent.
* There is no direct link between nodes on non-adjacent levels.
* When filling in the contents of the levels at the top, one must balance them out at the base in order to stabilize the construction: what one loses in terms of generality one gains in variety (and vice versa).

The définitive choice of objectives and actions can only be made aïter prior analysis of the system under considération, using tvvo complementary approaches:

The ascendant approach starts with the actions consîdered relevant and then studies the objectives to which thèse actions lead.

The descendant approach starts with the list of final explicit objectives and seeks out and analyses the appropriate resources needed to attain such objectives, and variables liabîe to modify them.

Each item (action or objective) must be ciearly specified so as to maintain a précise and detaiied sensé of meaning (so that we know at ail times what we are talking about).

In practice: the use of a writing board and self-adhesive notelets will permit a dynamic and evolving construction of the retevance tree.

2.2. FLOW CHART NOTATION AND ACTION EVALUATION

The objective of this phase is to measure the contribution of each action to the objectives of the System; in order to do so, a reievance grade is assigned to each line of the chart. The grade assigned to an action at level I-I spécifies its contribution to the achievement of actions at the level immediately above (I).

At this stage of the study, différent méthodologies (Pattern, CPE) can be used to rank the décision paths according to the significance of their contribution to the achievement of the initial objective 1-1, that is$_3$ the aggregation stage. What we propose hère is a simple methodology whereby the action at level I constitutes an évaluation criterion for actions at level 1-1.

Matrices (multicriteria grids) are set up for each level. The rows contain the *m* items (actions) at level 1-2 and the columns the *n* criteria at level 1-1; for each criterion we evaluate the contribution of each action towards satisfying that criterion.

TABLE 23

	Level ï-1	Criterion 1	Criterion 2	Criterion *n*
Level 1-2				
Action 1				
Action 2				
Action *m*				

A grid matrix can be established for each pair of levels: the actions at level 1-2 can be graded in terms of the actions (criteria) at levei 1-1. Actions at level I-1 are considered as the criteria for those at level 1-2 and they in turn are considered as the actions for criteria at level I.

The matrix calculation explained in the boxes belovv enables us to ascertain the quantitative contribution to realization of the initial objectives of the actions at the lowest level: it is also possible to identify the most relevant paths which allovv optimum attainment of the objectives.

Paiterri: a grading and aggregation method

Each level of the tree is characterized by a certain number of spécifie criteria which constitute performance measurements for actions at the lower levels. In this method, the nodes of the system at ieve! I (actions) and the criteria used to assess level 1-1 are not équivalent.

The grades are assigned on a spectrum (from 0 to 1); the assessment of each criterion and the weightings are standardized. The reievance of each node also lies between 0 and 1, with the total reievance factors equal to 1, for a given level.

The fact that the différent levels are graded independently enables us to identify the most relevant paths which will ensure attainment of the gênerai objective under optimal conditions. The reievance of a path, which follows the links to the tree, is equal to the product of the reievance values of the nodes passcd on the way.

Evaluation oj overall reievance oj ihc lower levais in relation to the gênerai goal

Lcvcl I es[1] *p* subobjectives
Level 1-î es[h'] n mcans
Level 1-2 &′ *m* elementary actions

- Evaluation of the *m* elementary actions at level 1-2 in terms of the *n* criteria (means) at level 1-1: matrix A *(jn; n)*
- Evaluation of the *n* means at level 1-1 in terms of the *p* criteria (subobjectives) at level î: matrix B (H; *p)*
- Evaluation of the *p* subobjectives of level I in terms of their contribution to the gênerai objective of level 1+1: vector column C *(j>;* 1)

Evaluation of the overall reievance of the elementary actions at levé! 1-2 in terms of the gênera! objective of level 1+1 is obtained by multiplying the matrices:

$$A \times B \times C = P$$
$$(m, n)(n, p)(p, 1)(m, 1)$$

Within each évaluation *t* matrix (A, B, C) the items in rows are graded in terms of the *n* items in columns (criteria). In order to facilitate the calculations, the criteria are weighted on a standardized scale (total weighting points amounting to 1).

2.3. USEFULN'ESS AND LIMITATIONS

A partial qualitative utilization, i.e. restricted to construction of the tree, is relatively easy and can prove very useful and productive at certain stages of the prospective thinking process or of dravving up action stratégies by a group of actors.

This method is an excellent thinking aid and allows one to avoid redundancy (there must be no imbalance in the tree); to discover new ideas by throwing light on obscure areas (objectives which hâve no connection with resources and vice versa); to clarify choices made; to improve cohérence; and, finally, to structure objectives and the resources to achieve them.

The relevance tree method when applied fully (grading of the flow chart and aggregation) can prove difficult and awkward to implement: représentation of the tree form is somewhat inflexible, there being little room for taking uncertainty into account.

It is worth considering ṁis method in many cases, because of the rigour it imposes, and because of the simple and appropriable nature of its qualitative élément.

Before stating how multicriteria choice of stratégie action can be made, it is appropriate to revievv other possible metliods which could be called on, notably those commonly used for investment options in an uncertain future (Holl et al., 1973).

3. Classical methods for options evaluating

There is a broad gamut of classical methods. We discuss below the weighting method and metliods arising out of the theory of investment choice based on the anaîysis of forecast discounted cashflow: the method of average cashflow, and 'minimax' methods.

Weighting

Suppose there are six new products, judged on five criteria (launch cost, supply risk, correspondence with image, sales, profits, etc.) in order to décide which products are to be launched as a priority,

The weighting method gives the following classification:

6, 5, 4, 1, 2, 3: therefore 6 and 5 will be launched.

There are drawbacks to relying on a classification if, for any reason, there is a supply interruption (criterion 2) halting production. Products

5 and 6 are badly placed with regard to this criterion, while for product 1 there is no risk of supply interruption. A policy seeking to spread risk factors (absoluteiy essential in a period of uncertainty) ought to lead to the launching of products 1 and 6.

TABLE 24

Weighted sums	^v. Policy P_1 / Products	3	2	3	1	1
		1	2	3	4	5
11!	1	10	20	5	10	16
51	2	0	5	5	16	10
43	3	0	10	0	16	7
120	4	20	5	10	10	10
148	5	20	10	15	10	!3
166	6	20	10	20	13	13

Methods ofinvestmcnt choicefor an unccrtain future

To simplify the présentation we make tlie assumption that the future is totally uncertain: the company is not in a position to assign probabilities to the différent possible outcomes. We draw widely on the exampie given by J. C. Hollj J. P. Plas and P. Riou (1973) - a company is seeking to détermine the best policy to apply to ensure the success of its development strategy in an overseas country where the course of events is uncertain. We assume that three policies, denoted P_s to P_3, are open:

- P,: To export finished products and conclude an agreement with a local distribution chain.
- P_2: To export finished goods and create the company's own distribution chain.
- P_3: To export parts, build factories for local assembiy and set up a distribution chain.

The discounted cashftows which each strategy would generate wiil dépend on the policy pursued by the host country with regard to domestic investment. We assume that tlie company considers the future policy to be followed by the country being studied as completely unknown, but that five attitudes, denoted E! to E_5, are possible:

- E,; Low customs duty and total freedom of foreign investment.
- E_2: Low duties on parts but high duties on assembled products, togetiier with freedom for foreign investment.
- E_3: Very high duties on ail imports, but freedom of investment.
- E_4: Nationalization of foreign investments, but freedom for imports.

- E5: Nationalization of foreign investments and limitations on imports for every policy option.

Presented with each outcome the firm estimâtes the forecast discounted cashflow (Table 25).

TABLE 25. Outcomcs

Policies	E,	E_2	E_3	E_4	E_5	C
P.	+ 10	+3	+3	+3	+2	4.2
P_2	+ 15	+6	+6	-10	-12	1.0
P_3	+ 13	+ 13	+5	-12	-13	1.2

A first idea, which requires some thought before adopting a policy in the light of the five outeomes, is to compare the average discounted cashflow corresponding (C) to each policy. This criterion leads us to choose policy Pj.

If vve knew the probabilités of the scénarios' outeomes we would only need to catculate an average^ weighted by the subjective probabiiity of each outcome, to détermine the optimal policy from the point of view of weighted average discounted cashflow.

A second idea would be to play safe and choose a policy which would maximize the normal foreseeabie gain — hence the term 'minimax' given to this criterion. From this point of view, P] is again the best policy. Howeverj this décision rests on a fragile base. If, for example, the policy P_2, faced with the outcome E_{1}} corresponded to a cashflow of 15,000 instead of 15, then the minimax criterion which leads to adopting policy P_J would be very questionable, since the maximum loss from policy P_Z (-12) is a drop in the océan compared with the gain forecast, if outcome E, occurs. One can entertain the idea of risking a little to gain a lot.

A third, more subtle, idea consists of considering the misgivings the company would expérience as a resuit of not having taken the right décision. 'Let us suppose, for example, that the company adopts policy P]. If the attitude of the country concerned turns out to be E_{15} the best policy would hâve been poiicy P_2, since this woutd hâve produced the largest discounted cashflow. In relation to this policy, policy P, leads to a loss of 5 in terms of extra gain. The "misgivings" corresponding to policy P, and attitude E_s are valued at 5. We can construct a table of misgivings for each policy and each stance of die foreign country' (Table 26).

Making a choice is tantamount to giving up other options: once the décision is made, one must accept the conséquences of the chosen course, thus 'regretting' not taking the others. From this point of view, it is reasonable to fix, as a criterion for the choice of policies, the

minimum value for the maximum misgivings (the Savage criterion). This criterion also leads to policy choice Pj.

TABLE 26

	E,	E_3	E_3	E_4	Es
Pi	5	10	3	0	0
p_2	0	7	0	13	14
P_3	2	0	1	15	15

If ail the décision criteria lead to the choice of a given policy., that in itself is an additional argument in favour of that policy. However, this case is rare; in most cases one must décide by necessarily favouring certain criteria.

At the end of the day; the 'minimax' criterion is also subject to criticism. The vvriters envisage a fourth policy for the firm (P_4), characterized by the distribution of discounted cashflows shown in Table 27.

TABLE 27

	E,	E_2	E_3	E_4	E_5
Pi	+4	+20	+ 10	-10	-12

The introduction of this new policy significantly modifies the 'misgivings' table (Table 28).

TABLE 28

	E,	E_2	E_3	E_4	E_5
P.	5	17	7	0	0
P_2	0	14	4	13	14
P_3	2	7	5	15	15
P_4	11	0	0	13	14

The minimax misgivings criterion leads the policies to be preferred in the order P_4, P_2, P_3, P_t: 'otherwise expressed, the order of classification of policies P_1; P_2, P_3 according to the Savage criterion dépends on whether policy P_4 is taken into account or not. This conclusion is obviously embarrassing'.

Hère we run up against the external problem of the sensitivity of the results to a change in the initial data. Testing the initial data^ vvhich are usually both unreliable and not comprehensive in coverage, leads to the rejection of the results derived from the use of a single method. An appea! to pluralism and employment of a complementarity of approaches before

deciding on a particular stratégie direction is recommended. Faced witli future uncertainty, multicriteria methods of choice appear the most appropriate since they lend themselves to such sensitivity analyses because of the vvay they are constructed.

4. Multicriteria methods

Décision support provides 'models[1] comprising a set of variables and relationships, and of a unit which is a function of its values, called the économie function, or the criterion, The latter represents the préférences of the decision-maker. In thèse models, a so-called optimal solution is sought, i.e. a solution that gives the highest possible value to the function.

For some problems thèse methods are still perfectly satisfactory. However, for many other problems they do not appear adéquate. They neglect the non-quantitative aspects; require the évaluation of ail quantitative aspects in a common unit of measurement; put emphasis more on seeking a theoreticai optimum than on correctly modelling préférences, They then take on an artificial appearance with false accuracy.

Devising a single criterion raises serious problems in most cases. Indeed, every decision-maker must take into account the multiple conséquences of the décisions he is thinking of making. And thèse cannot necessarily be analysed in a natural and obvious way in terms of a common unit: a civil engineering project for a motorway, for example, will hâve conséquences for finance, the environment, urbanization, traffic, etc.

In this way, the problem of press support for an advertisîng campaign amply illustrâtes the risks of using only a single criterion. We hâve worked over a long period in this area, using only numerical data which we tried to optimize. The unit decided upon was the cost per thousand effective readers. In terms of budget, one first took out maximum coverage in the periodical with the lowest cost per thousand readers, then the second, then the third and so on until die budget was exhausted.

Many other aspects hâve to be taken into account, for example, the affinity of the periodical for the message: the impact of an advertisement for perfume in a do-it-yourself magazine, even one for women, would be poor since the reader is not sensitive to this type of advertisement; the gap between his or her current interest and the message of the advertisement is too wide. Technical aspects are involved, for instance colour, coupon offers, or cutting out ads (it is known that the readers of some magazines do not like to eut them up).

Reader loyalty can be seen as an essential criterion for an advertisement that is designed for a séries.

Analysis of the results of the décision must therefore be carried in a way which seeks to avoid translating everything into a single formula, or considering only what can be reduced to figures.

4.1. AID TO DÉCISION-MAKING

A décision can generally be framed in one of the three foilowing problem areas:

- In favour of a single action.
- In favour of ail 'good' actions, rejecting ail 'bad' actions (a bank which authorizes overdrafts to firms can duly authorize them to ail customers who hâve a clean bil! of health).
- Décide on a list of priorities that are sufficiently satisfactory (for a programme of long and costiy research on opérations).

Whatever the problem area in which the décision lies, multicriteria analysis will be of assistance to the decision-maker:

- in taking différent points of view into account (or criteria);
- in deñning tlie trade-offs between thèse criteria explicitly in terms of the objectives;
- in formalizing this global view into a model, without a sophisticated mathematical process which would risk producing an illusory optimum founded on schémas which do not correspond adequately to reality. In this way we can corne up with practical advice which. relates to the responsibilities of the person or the company whose préférences we wish to reveal.

The analysis of 'situations' calling for choices (décisions) leads us to define the characteristics of the conséquences of thèse choices. Thus the time élément in the problem of routing motorways will be taken into account when comparing the différent possibilities dirough the users[5] time-saving dimension as they transit from town A to town B. Time-saving must be specified: is it at peak times or off-peak times? The time-saving dimension will be introduced by means of an indicator which could be the time saved in going between town A and town B.

In the same way the élément of 'noise' generated by the motorway could be brought in by means of an indicator, 'number of people suffering from a certain level of noise' (sleeping difficulty, difficulty in hearing télévision, in conversation etc.).

The analysis continues by identifying the significant îndicators: from this émerges a certain number of criteria through which various aspects

are taken into account, sometimes simply ranked and not measured.

For an anti-pollution campaign projecc, for example, costs are considered, using money indicators, i.e. the cost to the local authorities and to the users.

We likewise introduce savings in human lives as a resuit of the expected réduction in severe illnesses. Again, the sulphur dioxide content of the atmosphère can be used as an indicator to take into account less serious iilnesses. Finally we look at acceptance by public opinion (excellent, moderate, no view, hostile). The analysis being complète, one must then evaluate each project along each dimension.

Multicriteria procédures altovv for a comparative assessment on différent courses of action, and the resuit lies in identifying the best action or set of actions, or a ranking depending on the nature of the problem studied.

It thus appears both désirable and possible to improve the quality of major décisions which are taken every day: defining régional development policy making a rapid transport connection or siting a new factory, launching a new product, selecting an advertising campaign, adopting a research project, choosing a personnel policy, etc. Ail such décisions can be prepared by using muiticriteria methods, implementation of which must be incorporated in a fairly systematic set of procédures.

Expérience in the accepted methodoiogy and practice of décision support allows us to point to a set of solutions in five major phases which stem from imptementation of such procédures:

» Phase 1: taking stock of ail possible actions.
• Phase 2: analysing the conséquences of actions undertaken.
• Phase 3: specifying the criteria and assessment, according to criteria,
• Phase 4: définition ofpolicies.
• Phase 5: ranking the actions and sensitivity analysis.

4.2. LISTING POSSIBLE ACTIONS

Every décision process necessarily begins with a survey and définition of the opportunities or the actions open to the decision-maker. There is more than one way of going about impiementing procédures that will provide an inventory of the possible actions.

Intervening in the sélection of research projects is a typical metliod. The consultant (in liaison with the Director of Research) draws up a questionnaire, i.e. a présentation of ideas for research, and then organizes meetings in research centres to explain the objectives of the

Research Division and circulate the questionnaires. Afterwards, the îdeas or plans for research accumuiated are structured to constituée the set of ail possible projects.

This exampie shows that the collection process must necessarily be organized around the systematic search for ideas, and that actions must, where possible, be collected by questionnaires as weil as by personal interaction (brainstorming sessions).

4.3. ANALYSIS OF THE CONSÉQUENCES OF ACTIONS

The results of various actions usually appear unclear, intermingled and badly diffèrentiated. If we exclude difficulties associated with factors of multiplicity, the analysis will encounter further obstacles, for four main reasons:

- The conséquences to be understood sometimes require long and costly investigation.
- The conséquences are often marked by uncertainties that can, to some extent, be probabilized.
- The conséquences are ciosely related to the actions of other partners.
- The conséquences are not directly measurable and require qualitative estimâtes.

The way in which the conséquences of various actions are to be understood dépends on the nature and size of thèse difficulties.

Thus, in the choice of a motorway route, SEMA carried out a séries of open, undirected conversations within a broad brief, in which the interviewées were invited to imagine the changes that would corne about - mainly as regards traffk patterns and the environment - and the repercussions on their way of life. The interviewées then enumerated various aspects of the conséquences which should be taken into account to make comparisons between the various motorway routes—investment costs, time savings, compulsory purchases, noise, aesthetic considérations, etc.

4.4. DEFINING CRITERIA AND EVALUATING ACTIONS IN TERMS OF THESE CRITERIA

The originality of multicriteria methods lies above ail in the fact that, to build a criterion, we convert every statistical indîcator or qualitative magnitude into a simple System of notation, consisting of a scale with a limited number of levels. The number of levels varies according to

the importance or the uncertainty appertaining to the results. However, it is most important to ensure that the assignment of values shouid not be open to discussion: it is unnecessary to use too fine a scale of values, but it is important to attain a précise définition of the method of assessment,

To define a commercial strategy, the criterion 'advertising expenditure' will be expressed, for example, on a scale witli four ievels. At the same time, when it cornes to assessing each product, in terms of its quality as perceived by the consumer, the associated criteria are expressed only in terms of qualitative measures of évaluation. Thèse shouid, however, be defined accurately: the product is identified not only by the norms of compétitive standards but also witli respect to the customers' reactions to différences in quality.

Once the criteria hâve been defined, each action is evaiuated as a function of each criterion. This phase of the procédure can sometimes involve returning to the définition and notional limits of the criteria.

Assessment of actions is attaîned either by addressing a questionnaire to qualified individuals - researchers, users, etc. ~ and collecting the responses, or by organizing meetings of experts, during which actions and criteria are compared and the actions evaiuated, the rule being to obtain a consensus.

4.5. DÉFINITION OF POLICIES AND RANKING ACTIONS

In order to advise on a given action or set of actions, one must necessarily define explicitly the main objectives of the decision-maker; in other words, he must specify the weight that he assigns to the différent criteria.

In choosing the technical activities for tlie promotion of certain computer hardware, the decision-maker involved hesitated between a policy of immédiate market development or a policy of a more long-term development: the first led to emphasis on the vveights for criteria, favouring the short-term items such as rapidity of implementation, commercial costs and response time in tlie market-place, and assigning little, if any, weight to die criterion iong-term profitability', while tlie second approach led to an entirely différent set of weights.

As soon as the évaluations of each action by the various criteria are available (be they quantitative or qualitative) and once the différent criteria hâve been weighted, the problem then becomes one of comparing the différent actions, using appropriate methods that reflect the préférence of the decision-makers.

Three methods (the method of comparative reverse ranking, the Electre II and the Multipol method) vvhich allow the ranking of comparisons are described below.

It is then necessary to verify the stability of the rankings, by checking whether slight changes in évaluation of actions or the weighting of criteria basically affect the resuit: this is known as sensitivity analysis.

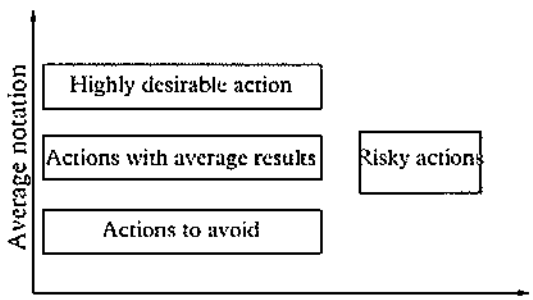
4.6. MULTICRITERIA DECISIONS IN STRATEGIC MANAGEMENT

A strategy is built up from a set of actions such that:

- their conséquences in the shorts médium and long term do not run counter to the objectives, but, on the contrary, lead towards their attainment;
- they are internally consistent;
- at ail times the set of actions to be undertaken or continued with is relevant to developments in the environment.

This latter point is fundamental. Although it is relatively simple to deflne a strategy which seems well adapted to the présent situation., one should be prepared to bend it to take account of internai and external changes in its context. It could turn out that thèse changes are slight and that the change of direction can be achieved by sail-trimming (contingency actions). However, it could also be that thèse changes force us to question décisions already taken and to make a fresh start with a new set of actions (structural actions) in order to adapteffectively. Thèse actions could be directed towards:

- working, if possible, to implement those scénarios most favourable to corporate objectives;
- limiting the damaging conséquences of developments as envisaged in the pessimistic scénario;



F i G. 3 3. Classification instability pointer.

- facilitating the company's future involvement in an environment undergoing constant change.

Evaluation of risks of actions:

- The average classification pointer for an action can, for example, be the average of the classifications of actions under the various hypothetical scénarios, weîghted by the scénario probabilités.
- For example: standard déviation - min - max déviation.

The multiplicity of possible actions raises the problem of choosing the most judicious among them, taking into account the objectives being sought by the company and the constraints that are présent. Methods of choice (in tlie face of an uncertain future under multiple criteria, for example, Electre II) allow:

- an évaluation of the conséquences of each possible action, in the différent contexts described by the scénarios;
- a judgement of each action according to the criteria the company must take into considération (financial, technical, stratégie, commercial, etc.);
- highlighting the set of priority actions to be undertaken, allowing for the likelihood of the différent scénarios coming about.

Certain actions are correct under ail scénario hypothèses, while others are only right under spécifie hypothèses and therefore carry a risk which needs to be assessed, and which can be represented as in Figure 33. Hence the risk being taken in the choice of strategy is specifically accounted for by multicriteria methods.

4.7. SOPHlSTiCATED TOOLS, LIMITED APPLICATIONS

The originality of multicriteria methods lies in their ability to exploit the information made up of actions and criteria, and the évaluation of actions according to criteria. If one action is better than a second according to certain criteria, less good according to others, and équivalent according to a third group of criteria, the decision-maker cannot actually state a priori that one of thèse two actions is préférable to the other. lie needs a tool which wiil enable him to make an objective décision.

AU that has been said above regarding the interest of multicriteria methods is true. However, thèse methods hâve not really been taken up widely. There has even been a taiiing off in their application and diffusion. At the same tirne, thèse methods hâve become tlie subject of académie research and of adultération.

In other words, by becoming more complex, the methods hâve become inappropriate and hâve been implicitly rejected by potential

users, who hâve contented themselves with rudimentary évaluation based on two or three criteria, ail generally calculated manually on a corner of the table. It is to avoid a return to the Stone Age that we dreamt of the development of a simple and appropriable tool: this was hovv Muîtipol was born, which we shall présent after two other methods: comparative reverse ranking and Electre II.

By considering thèse two methods, we can identify the problem which détermines whether one metliod rather than the other should be employed **first.**

The meihod of comparative reverse ranking

- Actions are first ranked in équivalent classes. The classes are then placed in a hierarchy such that within the same class ail actions are considered to be equal.
- The list of actions is not closed: at any time, new actions can be considered. This method **is,** therefore, particularly appropriate to new products coming out of research laboratories over a period of time: the new product, once evaluated according to the criteria$_3$ is immediately assessed as 'good' or 'bad\
- The number of criteria is limited (less than ten or so in practice).
- The method is simple to implement.

The Electre II method

- It provides a ranking of actions.
- The list of actions is closed: introducing a new action means that the method must be reprocessed from the start.
- There is no limit to the number of actions or criteria.
- The method is computer-based (the Electre II programme).

5. The method of comparative reverse ranking

The method of comparative reverse ranking consists of drawing up a number of rules relating to the problem and the objectives of the decision-maker, which allow a summing matrix to be constructed. A scale (quantitative or qualitative) with several levels is associated with every criterion. The summing table allows an action to be assessed directly, taking into account the ievels it reaches for each criterion.

5.1. THE REVERSE RANKING RULES

The reverse ranking rules translate the policy or the objectives by showing ho\Vj ail other things being equal, the movement of an action from one level to a lower one against a criterion reclassifies it, i.e. moves it from one class to another. Thus, in the sélection of certain research projects, after assessing the différent projects qualitatively according to ail the criteria, it was first necessary to assign numbers to the various Ievels of one scale such that the numbers defined the scale Ievels and were représentative of the reclassifications. Three criteria were used: the volume of sales expected, the cost of development and the technical chances of success, vvhich for each of them gave die Ievels shown in Table 29.

TABLE 29

C, Sales	Excellent (E)	Good (G)	Moderate (M)	Poor (P)
	1	2	4	7
C_2 Cosrof development	Low (L)	Average (A)	High (H)	
	1	3	5	
C_3 Chances of success	Excellent (E)	Good (G)	Poor (P)	
	I	2	4	

There is thus a reclassification of one class if sales are good instead of excellent (1 to 2); of two classes if they are moderate instead of good (2 to 4); and of three classes if they are poor instead of moderate (4 to 7), The policy expressed by die decision-maker is thus interpreted by the way in which the Ievels vary within the various scales.

The criterion 'sales', therefore, bas a relativeiy higher weight than the 'chances of success' criterion, since the maximum amplitude of a rectassification is cvvice as large for the first as for the second.

5.2. THE RANKIMG OF ACTIONS

The évaluations for each project, according to the criteria, are aggregated by a summing matrix which allows a class number to be given each combination of possible estimâtes according to each of the criteria.

ïn the above example the criteria were aggregated by treating ail other things as being equal; the interaction of the criterion 'chances of success' with 'cost of development' gives the matrix shown in Table 30.

The first column of this matrix corresponds to projects for which the chances are excellent (E) and the costs low (L), average (A) or high (H). The chances being E, the projects considered are in class 1, as long as

costs are low. If costs, instead of being low, are average, a reclassification of '2' takes place and the project in question moves to class 3, etc.

TABLE 30

^^^-^^ Chances Cost ^^^-^^	E	G	**P**
L	1	2	4
A	3	4	6
H	5	6	8

The second column of the grid is deduced directly from the first; in effect, 'ail other things being equal', the chances are good instead of excellent, and that leads to a reclassification of '1' (cf. the rules defined above). As a resuit, tlie second column is equal to the first incremented by'l'.

The third column is deduced from the second in the same way that the second is from the first.

One needs, however, to take account of sales (tlie third criterion) which could be excellent, good, moderate or poor. The principle is exactly the same as that above: reclassifications corresponding to this criterion are inserted and vve finally obtain a *summing matrix* (Fig. 34).

Sales excellent

Chances / Cost	E	G	P
L	1	2	4
A	3	4	6
H	5	6	8

Sales good

Chances / Cost	E	G	P
L	2	3	5
A	4	5	7
H	6	7	9

Sales moderate

Chances / Cost	E	G	P
L	4	5	7
A	6	7	9
H	8	9	11

Sales poor

Chances / Cost	E	G	P
L	7	8	10
A	9	10	12
H	11	12	14

Reclassification of 1 . . . of 2 . . . . . of 3

FIG. 34. Summing matrix.

The consolidation grid enabies a comparison of projects with différent modes of assessment ranked in ordered classes. Thus, for example, ail projects with the foilowing assessments will be ranked in class 6:

- Sales E, chances P, costs A.
- Sales E, chances G, costs H.
- Sales G, chances E, costs H.
- Sales M, chances E, costs A.

At the end of the aggregation procédure used in the reverse ranking method, the whole set of actions is ranked in a certain number of classes numbered 1, 2, 3 ... in decreasing order of priority. In this way the number of classes is reduced with respect to the number that could hâve been created if a class had been set aside strictiy for actions with the same évaluation mode according to each $criterion_3$ since the degree of uncertainty which clouds die results of any action does not warrant using too précise a classification.

Thus, in the above example ail the projects end up ranked within a previously established classification; the choice is generally made by setting up three groups of research projects:

- A group of projects with a high enough ranking and whose total cost does not exceed the resources available as incorporated in the research programme.
- An intermediate group of projects retained either as information or in expectation of further or more resources.
- Finally, a group of projects with too low a ranking and which, at least provisionally, are put to one side.

Although the purpose of the method is to décide in favour of several actions, it is sometimes necessary to consider them as no longer independent.

When considering thèse interconnections, it is enough to accept actions sequentially, class by ciass, so as to be abie to transform the various estimâtes attached to an action which has links with other actions once they hâve been accepted.

Différent reclassification rules can be adopted to account for non-independent viewpoints vvhere 'nothing is equal to anything else\ In the exampie shown in Table 31, the more costs rise, the more the 'chance' viewpoint prédominâtes and vice versa.

TABLE 3 1

Cost ^ ^ ^ ^ ^	E	G	**P**
L	I	2	4
A	3	4	8
H	5	7	12

6. The Electre II method

The Electre II method is based on the idea that from deveioping a comparison of actions in a hierarchy one can thus détermine their prioritics. The ranking takes into account the évaluation of every action in terms of every criterion and weightings representing the objectives of the decision-maker. Ranking is obtained from the définition of 'super-ranking' between tlie products.

6.1. 'SUPER-RANKING' RELATIONSHIPS

If one action is at least as good as another in terms of each criterion, we can deduce, without too great a risk of error, that that action is better.

In gênerai, one action will be better than another on some criteria but worse on others and équivalent with respect to some third group of criteria. In this case we hâve to define the conditions under which we can say that that action is better overall. This concept of 'globally better' is formalized by the so-called 'super-ranking' reiationship: *a* is globally better than *b* (or *a* outclasses *b),* if two conditions are simultaneously fmifilled:

- *Condition I:* the sum of the weights of the criteria according to which *a* is assessed as at least as good as *b,* is sufficiently high (concordance);
- *Condition II:* for every criterion on which *a* is worse than *b,* die différence in value is not too large (non-discordance condition).

Example: Ranking régional development projects wilhin the framework of a development assistance siudy. The projects to be ranked could be in éducation, research, sanitation, technical txaining, etc. There are seven projects: A, B, C, D, E, F, G. Each is evaluated according to ten criteria, among which are:

- the impact on mortality, estimated by experts;
- sanitary and socio-economic priorities;
- régional requirements;
- technicai feasibility.

The experts who met to estimate the relative importance of each criterion were divided into two groups. We vvanted to obtain die rankings that corresponded to thèse two hypothèses. The numerical data are given in Table 32.

Hère criterion I is scored from 0 to 20, criteria 2 and 3 from 0 to 12, criteria 4, 5, 6, 7, 8, and 9 from 0 to 8, and finally criterion 10 from 0 to 4 (Table 33).

TABLE 32

Criteria	Projccis A	B	C	D	E	F	G
1	20	10	5	5	15	10	0
2	9	6	3	6	12	0	3
3	6	9	3	12	6	3	0
4	8	4	2	4	6	0	2
5	4	8	2	4	6	2	0
6	8	6	0	4	4	2	2
7	2	4	4	6	8	2	0
8	6	4	2	8	4	0	2
9	6	6	2	9	4	2	0
10	2	4	!	3	3	0	1

TABLE 3 3

Combinationofweights:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Hypothcsis 1	5	3	3	2	2	2	2	2	2	!
Hypothesis2	4	3	3	3	2	2	2	2	2	1

If we designate by:

- P+ *(a, b)* the weight of ail the criteria for which *a* is better tlian *b;*
- P- *{a, b)* the weight of ail the criteria for which *a* is worse than *b*\
- P= *(a, b)* the weight of ail the criteria for which *a* is equal to *b;*
- C the threshold of concordance;
- *di* the discordance for the criterion *z*;
- x*i*fty the évaluation of the action *a* on the criterion *i*\

a outclasses *b* if the following three conditions are true:

$$\frac{\mathrm{P} + (a, b)}{\mathrm{P} - (a, b)} \geq 1$$

$$\frac{\mathrm{P} + (a, b) + \mathrm{P} = (a, b)}{\mathrm{P} + (a, b) + \mathrm{P} = (a, b) + \mathrm{P} - (a, b)} \geq \mathrm{C}$$

P + *(a, b)* + P = *(a, b)* + P - fo 6J

yi(b) - yi(a) < *di* for every criterion *i* for which *a* is worse than *b.*

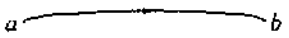
The Electre II programme offers standard concordance thresholds and discordance values. There exist in fact two séries of standard concordance thresholds and discordance values which enabie définition of a 'super-ranking' relationship that is strong (maximum severity) and a relationship that is weak (minimum severity).

The procédure allowing actions to be compared, taken two by two, is easier to understand if we assume that the various criteria are like the

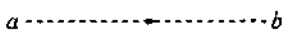
members of a jury having a number of votes which correspond to the weight of the criteria, The jury never advocates one action rather than another unless there is an adéquate majority for it and unless the minority is insufficiently strong to oppose the views of the majority.

6.2. THE RANKING OF ACTIONS

From the set of outranking relationships of ail the actions taken two by two, the Electre II programme générâtes a graph, the nodes of which are tlie actions and the arcs between them the 'super-ranking' relationships: *a strongly* outclassing *b* given by:



and *a* outclassing *b weakly is* given by:



If the seven actions *a,* è, *c, d, e, f, g* are to be ranked, a graph of the type shown in Figure 35 is obtained for the évaluations and weightings. From this the Electre II programme supplies three rankings: directj inverse and mean. Thèse rankings are established from the *strong* 'super-ranking' relationships;, the *zoeak* 'super-ranking' relationships serving to separate those that were originally considered equal.

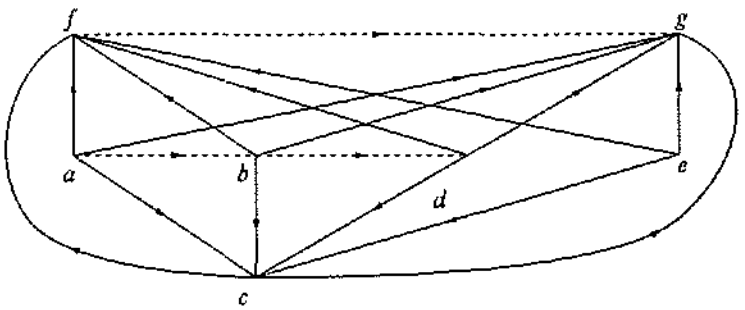


FIG. 35.

The direct ranking

Direct ranking is obtained by considering the length of the routes *terminating* at each node, the lengtli being measured by the number of nodes passed en route. A node that is not strongly outeiassed by another will be ranked first, ṁe node at the end of the longest path will be ranked last.

The direct ranking taking into account the strong outranking relationships looks as follows:

- Class 1 : *a, b, d, c.*
- Class 2: *e.*
- Class *3;f,g.*

If \ve consider the weak relations it becomes:

- Class 1 : *a, e.*
- Class *2: h.*
- Class 3: *d.*
- Class 4: *c,*
- Class 5 : /
- Class 6: *g.*

The inverse ranking

In this ranking, a node will be ranked ail the higher, the longer the routes *away from* the node are; the node at the origin of the longest route will be ranked first and the node that strongiy outclasses no otlier will be placed tast.

The inverse rankings are as follows:

- Class 1: *a.*
- Class 2: *b.*
- Class 3: *d, e.*
- Class 4: *c.*
- Ciass 5 : /
- Class 6: *g.*

The mean ranking

The mean ranking which will be retained as the final ranking is the average of the direct and the inverse rankings. In the example given, the mean ranking is as follows:

- Class I : *a.*
- Class 2: *b, e.*
- Class 3: *d.*
- Class 4: c.
- Class 5 ; /
- Class 6: *g.*

We obtain as many rankings of actions as there are combinations of criteria weightings which correspond to the uitimate objectives of the decision-maker. We can then verify whether a later modification of the weightîng of the criteria will change the basic results or not, and

détermine the set of actions that the decision-maker must décide upon and those he would be well advised to imptement.

6.3. CONCLUSION

Multicriteria metliods attempt to corne to grips with the reality of problems, by taking into account not only the quantitative, but also the *qualitative aspects'* of the conséquences of various actions among which a choice has to be made. The methods deveioped by the SEMA group and the whole anaiysis System that is required resuit in practical advice which involves the participation of the managers involved in decision-making or advising. The methods provide *a tool for dialogue* between the people invoïved, as it occurs through questionnaires, during meetings or brainstorming sessions which allow deeper levels of thought, by highlighting throughout the main factors which make up the environment of the décision. Considered opinions are then validated by a rational support method that allows the decision-maker to take *a global, stmctured view of problems.*

7. The Multipol method

7.1. A SIMPLE OPERATIONAL TOOL

The need to take account of the présence of multiple criteria in decision-making problems has motivated the development of multicriteria meṁods as decision-making aids and led to a very extensive range of concepts and procédures (fuzzy logic sets, the utility function, etc.). The Multipol method (combining the terms multicriteria and policies) is certainly the simplest, but by no means the least useful. It is based on the évaluation of actions by means of a weighted average method, just as pupils in a class are assessed by crédit weighted units.

As stated by B. Roy, any décision about a set of actions to be undertaken can be identifled as belonging to one of the fotlowing problem classifications:

1. Wc must cmphasize agaïn that the basic strength of this type of method lies in the fact that it suffices ÎO be abte to evaîuatc the différent actions with respect to each criterion qualitarivcly. Thcrefore one docs not necessariîy hâve to commit oneseif to costly investigations co obtain numerical information the accuracy of which is often doubtful.

- Selecting the best actions (choice).
- Classifying the actions into subgroups (sorting).
- Ranking the actions.

The Multipol procédure responds to thèse three problematics in that it enables a comparative évaluation to be made about the actions, whilst taking account of the différent contexts of the study: envisaged policies and expected scénarios.

In Multipol vve find the various classical phases of a multicriteria approach: listing of possible actions, analysis of conséquences and élaboration of criteria, évaluation of actions, définition of policies and classification of actions. The originality of the Multipol method lies in its simplicity and flexibility of utilization. Each action is evaluated in respect of each criterion, using a simple grading scale (0-5) or (0-10). This évaluation is obtained through questionnaires or expert meetings in which a search for consensus is a necessary factor.

The assessment of actions is not undertaken in a uniform manner: one must take into account the différent contexts linked to the objectives of the study. One policy is a weighting scheme applied to the criteria which interprets one of thèse contexts. Such weighted criteria could also correspond to the various value Systems of the actors involved in the décision, to undecided stratégie options, or to multiple scénarios and to évaluations which incorporate a time factor. In practice, the experts apportion a given total weight to the set of criteria for each policy.

Finally, for each policy, me Multipol procédure assigns a mean score to the actions. In this way a table of comparative classification profiles of actions is drawn up according to the policies under considération.

Accounting for the risk élément related to the uncertainty factor or to conflictual hypothèses is done by means of a stability classification scheme for actions, according to policies. In this way one can test the robustness of the results.

7.2. CASE-STUDY: LAUNCHING A NEW PRODUCT

Suppose we hâve six new products to be evaluated according to five criteria (launch cost, risk of supply breakdown, image suitability, turnover, profits, etc.) in order to décide which two products should be launched as a priority.

The évaluation of actions according to criteria (hère on a scale from 0 to 20) closely resembles the grading system used in French classrooms, with pupils obtaining one mark for each subject taught (criterion) (Table 34).

TABLE 34. Evaluation of actions according to criteria

Products	Launch cosi	Suppiy breakdown	[mage suitability	Turnover	Profits
1	10	20	5	10	16
2	0	5	5	16	10
3	0	10	0	J6	7
4	20	5	10	10	10
5	20	10	15	10	13
6	20	10	20	13	13

We know that the gênerai ranking ofthe pupils in a class dépends not only on the marks obtained in each subject but also on the coefficients assigned to each course. If you change the weights, you are in essence adopting another sélection policy.

Let us suppose that for the new products to be launched we define an initial policy P_{1}} the so-called short-term mixed policy;, which puts prime value on low cost (weight 3 for criterion 1) and high profile image (weight 3 for criterion 3) and which distributes the other weighting values as follows: 2 for criterion 2 and 1 for criteria 5 and 6 (Table 35).

TABLE 35

Weighted sums	^v Policy P_1 / Products \^	3	2	3	1	1
		1	2	3	4	5
111	1	10	20	5	10	16
51	2	0	5	5	16	10
43	3	0	10	0	16	7
!20	4	20	5	10	10	10
148	5	20	10	15	10	13
166	6	20	10	20	13	13

According to policy P_{13} simple calculation ofthe weighted averages leads to the following ranking: 6, 5,4, 1, 2, 3; we would therefore choose to launch products 6 and 5.

Relying on this ranking could présent difrîculues if for any reason there were a breakdown in suppiy (criterion 2), causing production to corne to a standstill. Products 5 and 6 are badly placed in respect to the risk criterion, whereas for product 1 there is no risk of suppiy breakdown. A policy designed to spread the risk - vital in a period of uncertainty - would lead one to launch products 6 and 1.

In a muiticriteria choice, it is essential to ask oneself the following question: how stable is the ranking? In other vvords, is the ranking obtained according to one given poiicy (set of criteria weightings) tlie same as for other policies that one might envisage?

In gênerai, rankings will vary from one poiicy to another and it is advisabie to evaluate their sensitivity so that in making a décision one has a better awareness of the possible risks one is taking.

Product ranking in tenus of policies

In practice., tliis entails defininga set of possible policies. In the example hère, six policies are envisaged and transiated into différent sets of criteria weightings.

Pj: *Short-term mixedpoiicy* emphasizes low launch cost and high-profile product image.

P_3: *Profitability poiicy* emphasizes low cost, profits and turnover.

P_3: *Médium-jlong-term mixed poiicy* vvhich aiso seeks profitability (profit and low cost) but without risk in terms of security of supplies.

P_4: *Image/prestige poiicy.* In this poiicy économie constraints are secondary to concern for a strong image, even if limited in scope, where a fîag-flier product is launched.

P_5: *Markct présence.* The poiicy hère is to be aggressively présent in the market-piace, taking a high-profile stance. From **tliis** viewpoint turnover and image are important criteria.

P_6: *Safe supply poiicy* with the single constraint of profitability.

We could also hâve considered a seventh undifferentiated poiicy according equal weight to ail criteria. This poiicy was rejected as showing a singular lack of intentionality or sensé of stratégie priorities by the decision-makers. Table 36 shows the sets of criterion weightings. To facilitate calculations, the sum of weightings to be distributed is fbced at 10.

T A B L E 3 6. Set of weights

	Launch cost	Supply brcukdown	Image sukability	Turnover	Profils	Total
ST mixed	3.00	2.00	3.00	1.00	1.00	10
Profitabiiity	3.00	1.00	1.00	2.00	3.00	10
MT/LT mixed	2.00	3.00	1.00	1.00	3.00	10
Image/prestige	1.00	3.00	4.00	1.00	1.00	10
Market présence	1.00	1.00	3.00	4.00	1.00	10
Safe supply	1.00	5.00	i.00	1.00	2.00	10

Using thèse data, the Multipol programme immediately provides two tables of resutts and two sets of graphies synthesizing them.

For each action (product to be launched) the first table (Table 37) gives a score for each policy (on a weighted scale from 0 to 20). The ranking value is in parenthèses. The gênerai average (score average) and the mean déviation of the weighted scores appear in the last two columns.

TABLE 3 7. Product ranking as a functionofpolicies (scores and général avcrages)

	Proc!uc[					
Policies	1	2	3	4	5	6
ST mixed	11.10(4)	5.10(5)	4.30(6)	12.00(3)	14.80(2)	16.60(1)
Profitability	12.30(4)	7.20(5)	6.30(6)	12.50(3)	14.80(2)	15.50(1)
MT/LT mixed	14.30(1)	6.60(6)	6.70(5)	10.50(4)	13.40(3)	14.20(2)
Image/ prestige	11.60(3)	6.10(5)	5.30(6)	9.50(4}	13.30(2)	15.60(1)
Market présence	10.10(4}	9.40(5)	8.10(6)	10.50(3)	12.80(2)	15.50(1)
Safe supply	15.70(1)	6.60(6)	8.00(5)	8.50(4)	12.10(3)	12.90(2)
Gênera! average	12.52(3)	6.83(5)	6.45(6)	10.58(4)	13.47(2)	15.05(1)
Standard déviation	1.92	1.3Î	1.36	1.37	0.91	1.19

The table reads as follows: product 1 scores 11.10 for policy Pj and 12.3 for policy P_2, etc. Its gênerai average for the policies overall is 12.52 witli a standard déviation of 1.92. In policies $P^{\wedge}$ and P_2, product 1 is in fourth place, and it is in third place overall.

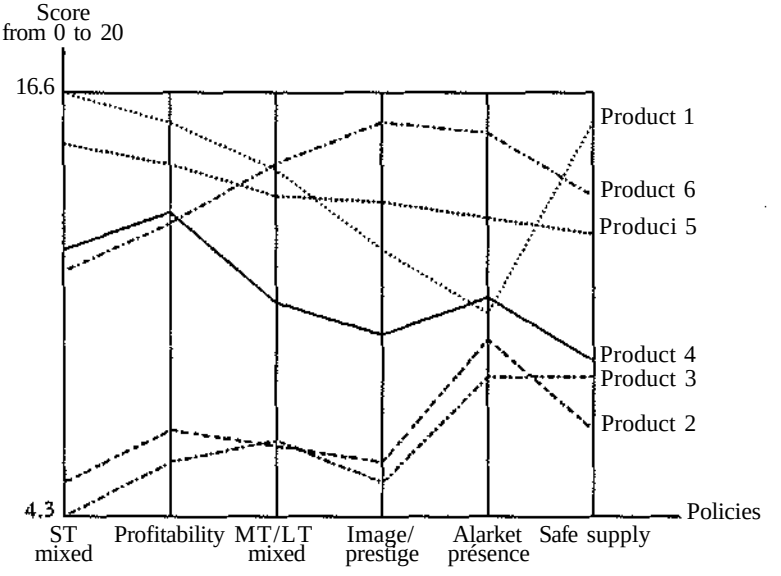
TABLE 38. Scores and ranks (same resulîs ranked from best to worst)

	Product					
Poiicies	1	2	3	4	5	6
ST mixed	16.60(1)	14.80(2)	11.10(4)	12.00(3)	5.10(5)	4.30(6)
Profitability	15.50(1)	14.40(2)	12.30(4)	12.50(3)	7,20(5)	6.30(6)
MT/LT mixed	14.20(2)	13.40(3)	14.30(1)	10.50(4)	6.60(6)	6,70(5)
Image/ prestige	15.60(1)	13.30(2)	11.60(3)	9.50(4)	6.10(5)	5.30(6)
Market présence	15.50(1)	12.80(2)	10.10(4)	10.50(3)	9.40(5)	8.10(6)
Safe supply	12.90(2)	12.10(3)	15.70(1)	8.50(4)	6.60(6)	8.00(5)
General average	15.05(1)	13.47(2)	12.52(3)	10.58(4)	6.83(5)	6.45(6)
Mean déviation	1.19	0.91	1.92	1.37	1.31	1.36

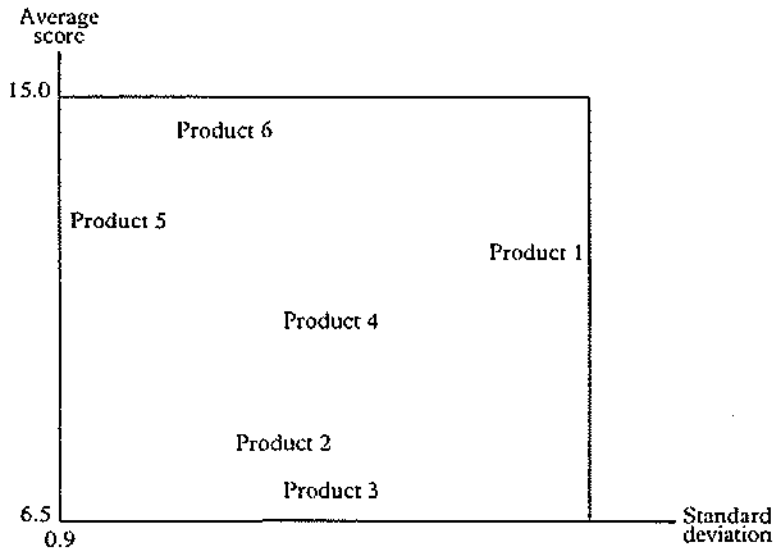
The second table (Table 38) provides the same information as the first one, except that the actions (products to be launched) are placed in order of rank obtained by the average policy values.

We note that the calcul ation of the gênerai average s above is the resuit of a simple average of scores according to poiieies. Multipol sofuvare also allows policies to be weighted in terms of possible rankings.

The tables of results are visualized by tvvo graphie représentations. The first (Fig. 36) shows each product's ranking profile according to the différent policies. The software enables one to sélect those subsets of actions whose profiles one wishes to dispiay (a diagram of ail the profiles would be unreadable). The ranking profile is independent of the possible weighting of policy.



F I G . 3 6. Diagram of profiles.
Profile of product ranking graph accordïng to policies.



FlG. 3 7 . Mean déviation.
Stability graph for product ranking according to policies.

Notes

The diagram of profiles allows us immediately to see the validity of the initial remark: products 5 and 6 hâve the same profile and hâve top ranking in respect to most policies, except for P_1 (the safe supply policy), where product 1 clearly outclasses ihem. However, this product ranks very low in terms of other policies. In other words, product 1 has a relatively high average score but with a high standard déviation (a strong variation in average score from one poiicy to another). If we hâve to launch two new products, it would probably be préférable to opt for products 6 and 1 rather than 6 and 5.

Ranking of policies according lo scénarios

The décision regarding which products to launch dépends on the policies envisaged. And thèse policies are more or less adapted to the most probable scénarios of tlie future environment. Hence the obvious idea of using Multipol once more to rank the policies according to the scénarios.

In the second Multipol run, it is as if the policies were 'actions' to be ranked according to the 'policies' (which are in fact scénarios). To facilitate our account, we shall assume that only three scénarios could occur.

- *Scénario A,* the. référence scénario, characterized by slow but balanced growth, has a high probability of occurrence: 0.7.

- *Scénario B,* financial shortfall, has a probability of 0.2.
- *Scénario C,* international political crisis, has a probabiiity of 0.1.

Ranking of policies wilh respect to scénarios

Data 1 input

Number of'objects':	6	*policies to be ranked according to scénarios*
Number of 'criteria':	5	*the same criteria as before*
Number of'policies':	3	*the three scénarios*

Probabililies/weightings 'oflJie policies'

Scénario A	0.70	
Scénario B	0.20	*The scénarios probabililies zuill*
Scénario C	0.10	*be iisedto weight the 'policies '*

TABLE 39. Marking table

	Launch cost	Supply breakdown	Image suitabitity	Turnover	Profit
ST mixed	3	2	3	1	1
Profitability	3	1	I	2	3
MT/LTmixed	2	3	1	1	3
Image/prestige	1	3	4	1	1
Market présence	1	1	3	4	1
Safe supply	1	5	1	1	2

Table 39 is simply the set of weightings for die five criteria according to the six policies studied in die first Multipol run, only this time they are considered in a dual fashion: as an évaluation of the importance (reievance) of die criteria for each policy.

TABLE 40. Sets of weights

	Launch cost	Supply breakdown	Image suitability	Turnover	Profit	Total
Scénario A	2.00	1.00	2,00	2.50	2.50	10
Scénario B	3.00	3.00	0.00	1.00	3.00	10
Scénario C	2.00	4.00	1.00	i.00	2.00	10

Scénarios A, B., C - the new 'poîicies' - also reflect différent weightings (Table 40). As before, we obtained resutts in table form and graphie représentations (rank profiles and stability diagrams) (Figs. 38., 39). Only die latter are shown hère. Reading diem suggests the following

points: the safe supply policy is best for scénarios B and C but the least favourable for scénario A (slow growth). In this référence scénario, policies P_2 (profitability) and P_5 (market présence) are by far the most préférable.

What risk is one taking by favouring one policy rather than another? To answer this question., we must take account of the scénario probabilities, since the profiles alone are not enough, and we must examine the stability graph (Fig. 39) for policy ranking (which incorporâtes this dimension in the form of vveighted scores).

In Figure 38, the scores are evaluated on a scale from 0 to 4, and, as previously, the profile graph is independent of the weightings (probabilities) of the scénarios.

It émerges clearly that the profitability policy (P_t) outclasses ail the others, while the medium-term mixed policy (P_3) is in second overall position. The safety policy (P_6) is much further down, in third position, and dispiays a high standard déviation in its scores: optimal for scénarios B and C but tail-end for scénario A (which is also the most likely). Finally, taking into account the probable scénarios, we would therefore recommend poîicies P_2 and P_3, according to which launching product 6 should be given priority and a choice made between products 5 and 1.

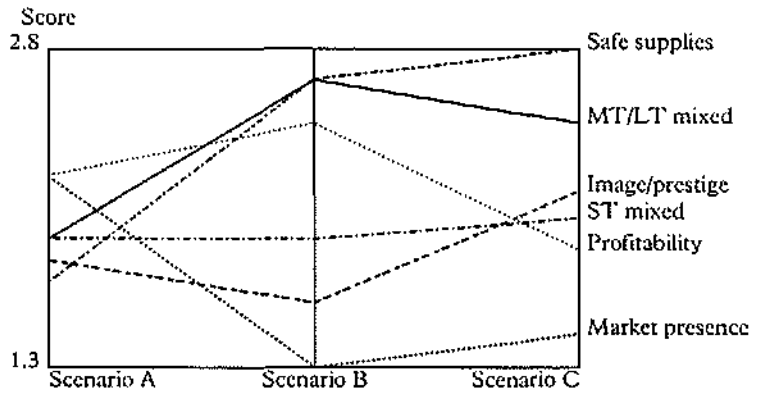


FIG . 3 8. Profile of poltcy ranking graph according to scénarios.

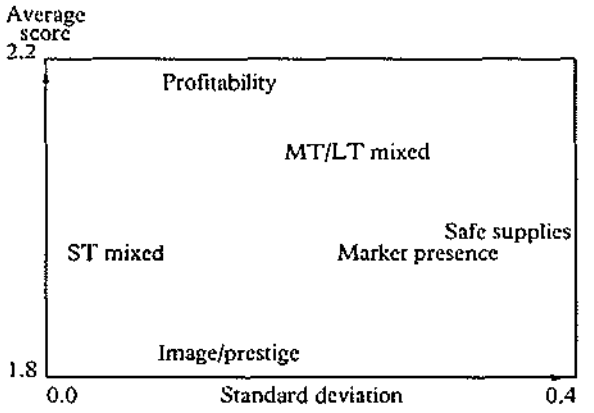


FIG. 39. Stability graph for policy ranking according to scenarios.

8. Integrating scénarios and strategy

The prospectivist and the strategist are faced with the same challenge - to anticipate action - yet their frames of référence and their forms of practice are very différent. In 1987, in *Scénarios and Stratégie Management* (Godet, 1987), we identifkd a high level of synergy between thèse two complementary approaches, although without attaining total synthesis. This degree of intégration is now possible, as is compensation of the weaknesses of one through the strengths of the other.

We can now envision a marriage between prospective vigilance and stratégie détermination. However, to be fruitful, this marriage must incorporate daily reaîities and lead on to a real mobilization of collective intelligence. This *'appropriation-incarnation* h* necessary for reflection and anticipation to crystaltize and translate into efficient stratégie action. Thèse three golden rules (anticipation, appropriation, action) are the apexes of the Greek triangle.

The encounter between prospective and strategy is not the resuit of chance, but stems from need and the détermination of several persons since the early 1980s.

Although intégration of prospective and stratégie management was inévitable, it has not brought an end to confusion between genres and concepts. If we liken strategy to fiexibility and planning to rigidity, we are in danger of forgetting that reactivity is meaningless without the proactivky (the future project, the objective) which is characteristic of planning.

It is not so much planning itself which is in question, as the way in which it has been implemented. The grafting on of stratégie planning can only be successful if it intégrâtes the culture and identity of die

organizations concerned. The levers of development are not only rational but also emotionai and behavioural.

Are we concerned hère with stratégie management in the sensé used by Igor Ansoff? Not solely, since management is normally piaced at the service of a strategy - it does not constitute a strategy in itself. Strategy shapes management but also présupposes the existence of objectives and associated tactics. It is therefore high time that ail thèse concepts were clarified, The best way to do this is deliberately to return to original sources and use them. Most modem concepts in strategy and management hâve a long history.

1. Back to square one in stratégie management

1.1. TWO AGE-OLD CONCEPTS

In prehistoric rimes men came together in groups to hunt large animais. Tribes were formed and rules were established. The objective and the tactics were clear: to isolate a few animais, frighten them and make them rush headlong into some ravine or guily where the hunters were lying in wait. Is this not already an exampie of strategy and management?

General André Beaufre (1985) defined strategy simply as 'the art of uniïng force in order to achieve political goals'. Strategy should not be confused with tactics ('the art of empioying arms to obtain the best possible outeome') nor with logistics ('the science of movements and supplies')- So, there cannot be strategy without tactics (satisfactory and contingent décisions to reach the set objectives); in addition, a minimum of logistics (resources) is needed in order to attain the goals. By integrating tactics into strategy we can concur with General Beaufre that: 'The aim of strategy is to attain the objectives set by policy, by making the best use of the means at one's disposai'

It is useful to remind corporate economists and strategists of thèse clear définitions, as it is often forgotten in such circles that a set of tactics has never been sufficient to make up a strategy. Reactivity is not an end in itself; flexibiiîty alone leads nowhere; we need to know where we want to go in order to choose the 'best' tactic.

The concept of management is also often used but rarely defined, We shall take the simple définition proposed by Luc Boyer and Noël Équilbey (1990): 'Management is the art of placing the organizarion at

the service of strategy.' Note in passing that 'stratégie management' is a pleonasm, since management is, by définition, at the service of strategy.

On the basis of thèse définitions we can see that the history of management and strategy goes back several millennia. People must hâve organized themselves in order to build the pyramids, or to embark on conquests.

1.2. TWO EXEMPLARY MODELS: THE CHURCM AND THE ARMED FORCES

The continuance of certain models of organization - both military (the Roman army) and religious (the Cafholic Church) - is évidence of their pertinence. As Luc Boyer and Noël Équilbey (1990) remark: 'The superiority of the Romans was based on discipline and organization; this was how they were able to triumph over more numerous or more intrepid enemies.' There are several explanations for the longevity of the Catholic Church, among them individual commitment to a collective project and membership of a very structured community which works on the principle of subsidiarity and has a limited number of hierarchical levels (the priest, tlie bishop, tlie Pope) for such a varied mass organization.

Already we are talking of stratégie centralization and operational decentralization. The Pope is the guardian of the doctrine, and the hierarchy affords a high degree of local autonomy to the priests, on the condition that they respect certain dogmas (obédience, the infallibility of the Pope, etc.). A long and sound theological training gives priests what Henry Mintzberg (1982) would cail a 'standardization of qualifications'j and guarantees a degree of identical behaviour.

Alongside the secular organizations in the Catholic Church we find monastic orders functioning according to différent rules, outside tlie traditional hierarchy, fairly independent of the Pope, and revolving around a contemplative or productive set of aims. Is this not what Igor Ansoff, much later, would term 'dual project-oriented structures'? Generally organizations disappear precisely because of their previous success: they gradually corne to seem rigidly set, incapable of adapting to new contexts and changing strategy (the question of the celibacy of Roman Catholic priests is just one example of such rigidities which are suicidai for an organization).

The army is another organizational example which is too rareiy called upon when looking at corporations, except when warlike language is being used, So it is of interest to quote Sun Tzu, a contemporary of Confucius (about 500 B.c.). In his book *The An of*

War (1972), he insists on the importance of team spirit in the troops and of reciprocal confidence between the gênerai and his army: he stresses the necessity of knowing the battleground and the environment, and the usefulness of taking into account the enemy's psychology. Some of his remarks remain surprisingly relevant today. In particular, he devoted a great deal of thought to the rôle of leaders, and saw 'too many rewards or penalities as tlie sign of a general's lack of authority to command'; according to Sun Tzu, 'if punishments are to be effective and legitimate they should be perceived as such by the soldiers'.

Without going back so far, we could also draw sorae topical lessons from Machiavelli or Clausewitz, Clausewitz was a Prussian gênerai, a theoretician during the Napoleonic Wars. He also noted the importance of troop adhésion and team spirit for the success of an army. He was one of the first to draw a comparison between économie and military organization. He insisted in particular on diagnosing one's own strengths and weaknesses and those of the opponent, and on taking the initiative in action (choice of battleground, timing and resources).

More recently, Claude Sicard (1987) points out clearly the similarities between the military world and the business world, and the éléments of comparison: the leader, the enemies, victory, the army, the motive are ail the same, it is only the fields of application which differ. For Sicard, Charles de Gaulle's book, *L'armée de métier* (The Professional Army) lists the modem components of any stratégie effort: the project, opening up to the environment, anticipation, sensé of structural reactivity, sensé of behavioural reactivity.

Claude Sicard also remarks: 'The military does not teach strategy to the young sublieutenants, but only to officers who hâve acquired a degree of maturity and who already hâve significant expérience of being in command.' So much for the (useless) teaching of strategy in our business schools!

For a more complète account of the lessons in économie strategy ṁat can be learnt from military strategy, we would hâve to quote at greater length from General Beaufre. Hère we shall restrict ourselves to a final remark from him: 'To be a good strategist, you need a great deal of resolution, a cool head so that your décisions are calculated, and a ñerce désire to maintain your efforts towards attaining the set goal. Thèse qualities are rarely found together, hence the scarcity of real men of war, for they hâve to be both thinkers and men of action.'

We should also mention Bernard Nadoulek's (1988) stimulating research on 'stratégie intelligence[1] and his typology of conflicts: 'direct, indirect, anticipation', His work forms part of the history of strategy

management accumulated over the centuries, which we hâve only been able to outline hère.

In 1934 Charles de Gaulle, in his book *L'armée de métier* (The Professional Army), indicated five essential components which he believed were at the basis of any stratégie effort:

- A project (in this case the defence of France);
- An opening onto the environment:
  - international poiitical environment;
  - technological dcvelopment (key rôle, for cxamplc, of the internai combustion engine).
- Anticipation through prospective analysis:
  - on the one hand, Hitler's policies (attacks on weak countries);
  - on the other hand, future arrangements (armoured divisions^ infantry, aircraft).
- A sensé of structural reactivity:
  - in the ovcral! conception of the army;
  - in the tactical use of this army;
  - in the utilisation of new communications Systems (radio transmission).
- A sensé, finaSly, of behavioural reactivity: thus, General de Gaulle requested at this time:
  - 100,000 trained professional soldiers;
  - a new kind of officer, capable of taking initiative on the battieground;
  - ~ poiitical wiil and détermination on the part of the government (which, as we know, was uîtimately lacking).

This brief history of strategy and management at least has the merit of relativizing the scope of contemporary 'discoveries[1] in strategy as applied in the field of économies. Every year the language is enriched with new words, but the underlying concepts hâve long been knovvn. Thèse lessons in the history of organizau'ons were clearly set out as early as the beginning of the twentieth century by the precursors of modem strategy and management: Henri Fayol, Frederick Winslow Taylor and Mary Parker Follett.[1] We shall now discuss the ciassics of modem management.

1.3. Two PIONEERS: HENRI FAYOL AND FREDERICK WINSLOW TAYLOR

The first attempts at corporate planning date from the end of the nineteenth century with the work of the French pioneer, Henri Fayol

1. Sec the very interesting 'bible' of core writings, pubiished by the American Management Association and ediced by H. F. Merriî (1960).

(perhaps better knovvn in the United States than in France). His *Principes généraux d'administration* (gênerai principles of administration) has withstood the test of time remarkably well. Thèse principles form part of a publication entitled *Administration industrielle et générale*, which first appeared in France in 1916 (Fayol, 1979).[2]

Fayol spent his entire career in a French mining and industrial company, retiring as chief executive officer after achieving remarkable success in reorganizing and expanding the business. ïn his book, which was the resuit of several décades of expérience, Fayol drew attention to the existence of an 'administrative [fonction, responsible for] drawingup a gênerai policy programme of action for the company, constituting the corporate structures, co-ordinating efforts and harmonizing activities'.

'Administration[1], Fayol stated, 'is forecasting, organizing, directing, co-ordinating and controlling':

- *Forecasting* is examining the future and setting up an action programme.
- *Organization* provides the company with everything required to enable it to function: skills, tools, funds and manpower.
- *Directing* is ensuring that the staff carry out their functions.
- *Co-ordination* is to bind together, unify and harmonize ail activities and efforts.
- *Control* ensures that activities comply with the orders given.

Although Fayol offers a list of fourteen gênerai principles of administration, he spécifies that this list is not restrictive, and that the word 'principle' must be understood in a broad sensé, which excludes any idea of rigidity, 'for there is nothing rigid or absolute about administration; everything shouid be kept in perspective'. Fayol's fourteen principles are: (1) division of labour; (2) unique authority; (3) discipline; (4) single chain of command; (5) single hierarchy; (6) the subordination of private interests to the gênerai interest; (7) rémunération; (8) centralization; (9) hierarchy; (10) order; (11) fairness; (12) stability of the workforce; (13) initiative; and (14) unity among the workforce.

Some of thèse principles, like 'single command' and 'single hierarchy', are well known. Others, like 'initiative' and 'unity among the workforce', or 'centralization' and 'decentralization', hâve been forgotten and then rediscovered under another name. In order to return directly to source, the reader may like to peruse an excerpt from the fourteen principles of administration (see box, pp. 214).

2. 1E is regrettable that in the 1979 édition the word *prévoyance* (foresigrtt) disappeared from the subtitlc.

At the turn of the century, the development of rational organization. and the division of labour under the influence of F. W. Taylor also saw the création of large industrial conglomérâtes. Mass consumption implied mass production. Growth and diversification of activities raised organizational problems of a new order tliat are still relevant today.

For example, on the one hand there is the problem of deciding between centralization and the organization of groups by main functions and, on the other hand, the decentralization of responsibilities by sector of activity in order better to identify what is profitable and what is not, but where a certain amount of co-ordination at the centre must be presupposed. This question had already been taken up by Fayol. Further, we see below that Taylorism is but a poor reflection of Taylor's ovvn thinking.

He would perhaps hâve been the first to bring Taylorism to trial. In fact, the fundamental goal he pursued was, in his own words, to 'achieve high salaries with a lovv cost in manpower[1]. To achieve this aim, it was of course necessary to install a 'précise time and motion study', but in his eyes this was only one of the many instruments of the 'scientific management' whose arrivai he was ardently hoping for as early as 1912, and which would bring about a real 'mental révolution[1] in the company (see box, p. 215). Thèse ideas, half a century old, found a new lease of life with Hervé Serieyx's 'enterprise of the third kind\

1.4. A l'ROl'Hlir IN THE DESERT OF MANAGEMENT:[3] MARY PARKER FOLLETT[4]

Was it possible for a woman at the turn of the century to write about management? Moreover, could she be understood if her innovative ideas were several décades ahead of conventional thinking? Mary Parker Follett answers thèse questions.

3. This description is citcd by Dimitri Weiss (19S8), and has been attributed to S. C. George, a management historian.
4. Mary Parker Foliert (186S-1932) was an American who snidied in the United Kingdom and France. în 1918 she published a book cntitled *The New State.*

- *Initiative.* To conçoive a pian, and successfully implcmcnt ir, provides one of the deepesr satisfactions that an intelligent man can expérience: it is also one of the most powcrful stimulants to human activity. This ability to conceive and exécute (a plan) is callcd initiative. Freedom to makc proposais and freedom to carry them outarc différent aspects of initiative.
- *Uniiy among the luorkjorca.* Evcry chief executive shouîd reflect on the fact that corporate harmony and a united workforcc are gréai assets, or, as the proverb lias it: 'Power stems from unity.' One must respect the principle of the single chain of command and avoid two dangers: (a) *dividing t/ie workforce.* Dividing the enemy's forces in order to weaken them is a clever strategy; but dividing one's own groups is a grave error committed against the enterprise. No spécial skill is needed to create discord and strife; it is within easy reach of any imbécile among subordinates. On the other hand, real talent is required to co-ordinarc effort, to stimulate zeal, to use each individual's capabilities and reward them, without arousing jealousy and without disturbing harmonious relations; (b) *overusing wriuen communication.* It is generally simple and quicker to communicate verbally than in writing. Fayol also shows that mémos are 'sources of complications, conflicts and delays, damaging to the enterprise'.
- *Division of labour* aims at producing more, better, and witli the same amount of effort.
- *Aulhority and rcspotisibilily.* Authority is the power to issue orders and the right to be obeyed.
- *Officiai authority* in a manager (which is right of office) is distinct from Personal authority derived from intelligence, knowledge, expérience and moral strength. . . . To make a good manager, personal authority is the indispensable complément of officiai authority.

  There can be no authority without responsibiiity, that is without some sanction - be it reward or punishment - accompanying the exercise of power. Responsibility is the coroilary of authority.
- *Discipline.* Discipline is compliance with the conventions agreed between the company and its employées. The state of discipline in a social entity dépends essentially on the quulicy of its leaders. I hâve ahvays found French workers obedient, even devotcd, when well managed. It is important that the conventions be clear and, as far as possible, give satisfaction to both parties. Discipline is as relevant to the highest executives as to the humbles: employées.
- *Single chain of command.* For any action, an employée must reçoive his orders from a single superior; people canno: stand having a dual authority above them, which is a source of conflicc and inefficiency.
- *Single authority.* This principle may be expressed as having onc boss and one programme for one set of opérations with the same goal. A single chain of command cannot exist without single authority, but does not follow on automatically from it.
- *CentralizatioH.* Centralisation is not, of itself, a good or bad system of administration and can be adopted or abandoned at will by the directors according to circumsutnees; it aiways exists to some degree, and centralization (or décentralisation) is purely a matter of balance. The probiem is one of finding the limit which is best for the Sirm. The goal to aim for is the best conjugale use of resources and the workforce as a whole.

  Inasmuch as the absolute and relative weights of the executive and the employées are continuously changing, it is understandable tliat the degree of centralization (or décentralisation) itsclf can vary constantly.

> Scientific management is not a recipe for efficiency... it is not a tirne and motion study nor tiie printing, filling in and circulation of a ton of forms to a team, saying: 'Hcre's your System, sort yourselves out and use it.' It is not a System of divided or fvmctional management. . . . Scientific management implies a gênerai mental révolution by both workers and managers. . . .
>
> The major révolution which will occur in mental attitudes by the two parties when scientific management is initiated is that both will cease to consider the sharing of added value as the most important point and that they wit! turn their joint attention to the growth of the added value.
>
> The two parties will understand that in replacing antagonism and conflict by amicable co-operation and mutuai assistance, they can jointly carry ṁis added value to such a degree . . , that there is a possibilité[1] of a steep rise in the wages and an equally high rise in the profits. . ..
>
> But the increase is only the smallcst item of the project. The harmony which scïentific management will introduce between the employer and the employée is the best mutuai outeome that couid happen.

Her ideas arc disturbing because they are unclassifiable; for a long time they were considered no more than a psychological approach bordering on manipulation. However, the school of behaviourism invented nothing - it is to Mary Parker Follett that we owe the formulation of the principle of intégration in order to make group interests coincide with those of the individual. In this her views were in. opposition to those of Henri Fayol, for whom individuat interest should be subordinated to the gênerai interest. She believed in individual self-control and in the povver of bonds between individuals within a group as a factor of intégration (this is close to self-organization).

As Dimitri Weiss (1988) emphasized: 'She remains to this day one of the most neglected major eariy authors on management, She will remain unclassifiable due to the variety and richness of her interests, from industrial relations to international relations.' Some modem writers, such. as William Ouchi (1983), hâve become famous for concepts such as theory Z, whose discovery should without doubt be credited to Parker Follett. In her writings we find most of the modem ideas which can be grouped together under participative management: decentraiized decision-making, the integrating rôle of groups, the autliority of compétence, hierarchical control replaced by trust and communication, 'the logic of responsibility ramer than the logic of obédience'.

Mary Parker Follett still seems to be ahead of the ưrnes when she lists the essential qualities of a leader:

> The rôle ofthe man at the top is not to take décisions for his subordinates but to teach them how to résolve their problcms themselves. The best manager does not persuade people to foliow his wishes, he shows them what they must do in order to carry ont their explicitly defined responsibiiities. Such a manager does not wish lo think for others; on the contrary, he trains them to think for themselves.

In fact, the best managers try to train thcir disciples to become managers themselves. A second-rate executive will try to suppress the initiative of his subordinates for fear of rivalry.

The message hère is that the real power of a leader cannot be measured by the domination which he exerts over others, but by his capacify to deveiop autonomy and responsibility among his subordinates.

The Z theory and îts precursors

It was William Ouchi who coined this term in his book of that titlc, published in the United States in 1981. It is a deliberate référence to the distinction established previously b>- Douglas McGregor (1906-64) in his book on *The Human Side of Enterprise* (I960), between what he called theory X and Y.

According to theory X, people are passive, hâve an aversion to work, and try to avoid it. They must be constraincd, controlled, rnanaged, and threatened with disciplinary sanctions, in order to elicit from them any effort in iine with the pursuit and accomplishment of the organization's objective. A person is driven to work by acting on the négative aspects of his character and on what, according to Maslow's needs hierarchy, are his inferior needs - such as his phystological needs.

Theory Y assumes a person capable of acting in a responsible, participative and co-operatïvc way - and able to set himself as objectives what are, according to Maslow's needs hierarchy, superior levels of motivation, such as the need for esteem, récognition and status. .. In theory Y it is necessary to ensure that particular interests are subordinate to the gênerai interest.

The Z company is seen as a community of equals who co-operate to achieve common objectives. The company manages the behaviour of this community by relying on commitment, loyalty and trust, instead of counting only on hierarchy and supervision. . . . The values of the clan give rise to a team spirit, working groups in which members feel solidarity towards each other, and workers who are wetl integrated into their company.

Probably, without knowing it, many successfui writers on management hâve produced hits by (re)discovering some of the ideas of Parker Follett. The term 'minute manager' (Blanchard et al., 1984) - so-called because he or she requires so little time to iead staff to produce impressive results - obviously resembles Parker Follett's 'first class director', although less complète.

2. The émergence and development of stratégie management from 1920 to the présent

In the United States, the inter-war years saw the birth, notabiy at Dupont and General Motors, of the first experiments in dissociating stratégie (objective-setting) from tactical (ways of reaching objectives) responsibilities. Over the same period, statistical and fînancial control techniques to monitor plans and programmes multiplied, vvithout, however, becoming integrated into any real corporate plan *per se.*

After the Second World War, large firms committed themselves much more systematically to forward planning and organizing for growth and diversification in their activities, beginning with short-term analysis of products and markets under the familiar heading of *marketing.* It would not be a distortion to consîder the development of corporate planning and marketing as two interrelated phenomena.

It was not until die 1960s that planning really became a fundamental activity within companies. In France, such companies were stimulated to plan by the existence of die national plans which provided économie projections that were sufficiently well defined and crédible as to provide a frame of référence for companies. In the United States ṁis kînd of planning became known as long-range planning, to emphasize the fact that companies were moving beyond die horizon of the annual budget and wondering what was to happen to them, to their investments and to their physical organization over a span of several years.

It rapidly became clear diat long-term planning efforts had to be directed to *planning and organizing the growth and diversification of the activities oftite enterprise* in its entirety - hence the expression 'corporate planning'.

Over die same period long-range planning - novv corporate planning - had become the object of theoretical inquiry. Chandler (1962) emphasized harmonization between a company's external strategy and the internai company structures; I. Ansoff (1965) examined the evoludonary trends of planning and décision Systems. Ansoff (1978) amply demonstrates the historical link between, on the one hand, the opportunités presented by the environment and, the deveîopment of the hierarchy of production fonctions and, on die other, the development of intra-company structures - staff, line management, international project orientations, and so on.

During the 1960s, many factors contributed to the development of corporate planning and long-term stratégie thinking. In particular, we can single out:

- The accélération of technicai and économie change, i.e. the change occurring in the compétitive environment of the company.
- The development of factors that create inertia within the company with regard to ever-larger investments, ṁe length of R&D time cycles and the dual structure of the workforce, this last factor being both quantitative (one could no longer hire and fire according to variations in demand) and qualitative (time was needed to train staff for the new skills required).
- This rising level of éducation among staff and iower ratios of managers to vvorkers made it no longer possible to run the company efficiently without internai concertation. Preparing the pian offered exactly the right opportunity for dialogue within the firm.

Following the events of 1973, corporate planning has not escaped the wave of criticism and scepticism that ail attempts at anticipation and forecasù'ng encountered. In a rapidly changing climate, with shifting, fickle winds and unreliable forecasts, it is often deluding (and even dangerous) to try to maintain a given direction. It quickly became évident, however, that *environmcntal iincenainiy reinforced the need for corporate planning,* then aptly renamed 'stratégie management'. Companies, then, must adapt their stratégies and demonstrate *flexibility.* Increased efforts in *prospective* and anticipation of events are necessary, if one wishes action to be directed in ways likeiy to safeguard maximum flexibility.

In an increasingly turbulent world, the very concept of planning as an a priori objective becomes irrelevant, since it is not objectives which count most - even if they are indispensable. What realiy counts is the capacity to react and adapt to changes in the environment: G. Archier and H. Serieyx (1984) speak of *reactivity;* I. Ansoff (1978) states that we hâve shifted from planning to stratégie management.

Tvvo apparently distinct research paths} in reality complementary, were initiated during the 1970s. The first approach, calied stratégie portfolio analysis, conceived at the end of the 1960s and made famous by the Boston Consulting Group (BCG), was enormousîy successful in popularizing some valuable tools of rational anatysis for a public of business leaders, who realiy needed them (product îife cycles, expérience effects, etc.). Encompassing the compétitive, technological and financial dimensions, the proponents of this rational approach were seeking universally applicable rules for stratégie analysis (PIMS formuiae, for example), the application of which wouid ensure économie success for the company.

The second patli, which we can cal! heuristic, adopting Marie-José Avenier's (1985) term, singles out a corporate dimension which had

been neglected by stratégie analysis - the human factor. The key to a dynamic enterprise, in this approach, is to be sought in organizational structures and behaviour radier than in ready-made recipes of technological, économie and financial rationality. Thar is the main message repeated on nearly every page of a major work by T. Peters and R. Waterman (1982), which made a uremendous impact in the United States and Europe (if only in terms of sales), and was entitled *In Search of Excellence.*

During a period of crisis and heightened économie compétition, success dépends on mobilizing total corporate intelligence (Serieyx, 1982) to attain objectives and counter constraints, and this will succeed ail the better if thèse hâve been debated with concerted effort. Dialogue within the company has become a necessity (gênerais don't fight their own troops). Preparing the plan provides a spécial opportunity for introducing and implementing concerted agreement, which is indispensable for interna! cohésion.

History does not repeat itself. This adage is undoubtedly true, except witli regard to ideas. Numerous principles of stratégie organization are curiously close to principles elaborated by the French pioneer, Fayol, and a little later by Taylor. Taylor's famé dérives mainly from his division-of-labour axiom, aitliough this was only a secondary élément compared to his call for a total mental révolution on the part of both workers and management. In addition, we should of course mention Mary Parker Follett's prophétie views, described earlier.

After nearly a century of debate on organizational strategy and management, can we distinguish a unifying message? We shall retain one only, which is paradoxical, since it concerns the principle of contingency, which is presented in Chapter 9. Finally, we shall venture to make a forecast: there will be a return to the concept of the plan and the project.

Stratégie planning has been laid to rest by stratégie management; does this not point to an unconscious camouflaging of the lack of objectives and tlie loss of direction which charactcrize modem societies? Not knowing where we vvant to go and why, we take pieasure in commentary - ṁat is, in analysis of tactical ways and means to adapt in the face of change. The ship no longer has a prow, but the captain knows ail tlie secrets of the tiller and tlie ship's instruments; pre-activity and proactivity are alien to him, he knows only the reactivity of stratégie management.

Being reactive should not be confused with being flexible. The first is improvised as an organization's appropriate response to external hazards. The second is kept up as an intrinsic capacity of the organisation to react and adapt to the environment without losing its

direction. In other words, internai flexibility is the condition for externai reactivity. The first dérives from physical condition, the second from réflexes.

3. The inévitable encounter

3.1. THE RISE OF PROSPECTIVE THINKING

In *Scénarios and Stratégie Management* we put forward the strong potential synergy between thèse two complementary approaches. We did not, however, manage to realize the desired synergy. Since then, prospective has continued along its own path, and lias spread into companies and public administrations. But it is primarily the prospective state of mind - global, systemic and long-term - which has been taken up. This attitude can be summed up by some simple formulae: 'Global vision for local action'; 'Clarify présent action in the light of the possible future[1]; 'Mistrust the effect of fashion and conventional wisdom'.

At the same time, spécifie prospective methods, such as structural analysis, cross-impact studies, Delphi and scénarios, hâve not advanced significantly, but hâve been diffused. Theoretical research and sophisticated tools hâve been neglected in favour of multiple applications. Operational imperfection is worth more than inoperational perfection. In order to approach a complex world, we need simple and appropriate tools (appropriate because they are adaptable).

In factj prospective increasingly often takes the form of collective thought - a mobilization of minds in the face of changes in the stratégie environment. Such mobilization is indispensable in preparing for and successfully implementing action. This trend towards wider diffusion and appropriation of prospective — formerly the préserve of experts - is to be applauded. But die methodological weaknesses - which are persisting and even becoming accentuated - are regrettable.

The plea for research in prospective is ail the more justified as some people confuse simple tools with simplistic tools. We should recall thaï the scénario method, as conceived almost twenty years ago, remains as useiùl as ever, and has, above ail, the great merit of demanding intellectual rigour: qualitative and quantitative analysis of marked trends, rétrospective stiidy of actors' moves, pinpointing seeds of change, tensions and conflicts, constructing cohérent and complète scénarios (patlis of progress and future images),

The word 'scénario' is increasingly misused and abused - it is used to refer to any use of a hypothesis at ail, without checking the relevance and cohérence of the hypothèses or considering their likelihood (probability). Another common confusion is to take one's wishes (objectives) for realities, to mix die exploratory and the normative. Ali possible scénarios are not equaily probable or désirable, and a distinction must be made between environmental scénarios and actors' stratégies.

Some spécifie tools of prospective, such as structural analysis and the MICMAC method, are today so successful as to be almost a cause for concern to the people who worked on dieir development. Structural analysis is too often applied in a mechanical fashion, without purpose and to the détriment of real thought. The lesson from this is that it takes time to diffuse a tool (over fifteen years) and even more time for it to be used well. When we présent a method in a manual, we should also tell die reader what to do if he or she wishes to avoid using it badly.

Rapid diffusion of such mediods is novv partly due to computer support software, which makes thèse tools highly accessible at low cost. We hâve put together a *toolbox of prospective methods*, each îdentified in terms of the type of problem area one is working in (asking die right questions, understanding the past and actors' stratégies, scanning die field of ail possible futures and reducing uncertainties, idenùfying and assessing the stratégie options).

The toolbox lias recently been completed by adding the new tools MACTOR®, Morphol and Multipol, which join MICMAC and SMIC. The software is available on diskette for PCs and compatibles and Macintosh, We believe diat thèse tools in turn will become widespread. We should, however, remember their uses and limitations - they should be used to stimulate die imagination and reduce incohérence, but not as a substitute for thought or to restrict freedom of choice. Before going on to see how prospective can be integrated into a stratégie approach, let us recapitulate on how the latter has developed over die past fifteen years.

3.2. QlIESTiONING PLANNING.

In the 1970s, there was an interesting corrélation between the décline of national planning and die rise of corporate planning. Since die early 1980s, corporate planning too has apparendy been falling into disrepute, or at least losing prestige. The French national plan diat Président de Gaulle considered to be a 'binding obligation' may be seen as a useless form of agitation for die analydcal ivory towers denounced by T. Peters and R. Waterman (1982).

Why should one set stratégie objectives and invest die means necessary if, given the turbulent market-places and changing environment, thèse very objectives must themselves constantly be modified? The technical use of 'sliding scales' of objectives does not satisfactorily solve this sort of dilemma.

Double crisis of stratégie planning

First, there is the crisis of planning, which has been thrown into question by the turbulent environment and the rise of liberalism. The *laissez-faire* attitude towards market forces is considered the best remedy when faced with imbalances, for which governmental and regulatory intervention are held responsible - hence the deregulation movement originating in the United States, vvhere planning has always been considered almost evil (as in Gosplan).

In Europe, planning has above ail been the victim of its own success. Adaptation in the face of uncertainty cannot accommodate sacrosanct and therefore rigid goals (whereby a project is rejected because it was not foreseen in the plan); nor can it accommodate procédures which hâve become oppressively bureaucratie and paper-generating (at a time when the paperless office is in vogue). At the same time, however, we hâve too often thrown out the baby with the bathwater, forgetting that the planning report is less important than the process of consultation which !ed to it (consultation without a final report is better than the opposite). Today, we could make the same observation about company projects; it is better to undertake a company project without saying anything than to talk about it while doing nothing.

Second, there is the crisis of stratégie analysis: product-market segmentation and portfolio analysis, successfuliy popularized by Anglo-Saxon consultants (for example BCG, MacKinsey, ADL), were severely critieized because of their mechanical; reductionist approach. Thèse methods hâve practically fallen into disuse by those who invented them, yet they are taught more than ever in management and business schools. It would be wrong to smile too readily at this irony, for, obsolète though it may be, portfolio analysis remains a good tooi for famitiarizing oneself with the concepts of stratégie analysis (segmentation, life cycle, the effect of expérimentation/expérience).

However portfolio analysis is improved, one of the main weaknesses of this method remains - it produces an image of the présent (actually of the récent past, due to the delay in obtaining figures) fr.om which it is often very dangerous to extrapolate: the future balance of a portfolio of activities can vary according to which environment scénarios are envisaged.

This crisis in stratégie planning is also a crisis in the rationatist school of thought, which favours 'cold' values (reason, analysis, calculation, forecasting) and relies on économie and stratégie tools of analysis, and operational research; such metliods hâve gone into décline, particulârly in the United States, because of their success, misuse, and the effects of fashion. This has followed the classic pendulum phenomenon, with oversophisticated methods making way for common sensé, and then for the simplistic ideas of the heuristic school of thought, whereby pragmatism became a religion recognizing oniy the 'warm' values of enthusiasm, charisma and will. This is how there was a graduai shift from research into excellence, to a passion for excellence, leading fmally to 'chaos management'. We hâve already discussed what we think of this new fashion. Opposition between reason and passion is as useless and stérile as that between the right and left brain. The human mind constitutes an indivisible whole: witliout reason, passion is blind, and without passion to activate désire and projects, reason leads nowhere.

The rationalist trend has not had its last say, however. Pioneers like I. Ansoff hâve always preferred stratégie pilotage to pilotage with vision, even though they hâve sacrificed the concept of planning to promote that of stratégie management: their approach in terms of internai organizational strengths and weaknesses, and threats and opportunities presented by the environment, remains as valid as ever.

During the 1980s the rationalist school of thought experienced a revival through the works of Michael Porter (1980, 1985). This Harvard prof˙essor demonstrated the importance of analysing die compétitive forces in a given environment (for example, rivalry of competitors in the same sector, power of suppliers and customers, threats of potential new entrants and substitutc products). He also identified two generic stratégies (domination by costs and diversification) and finally he re-established analysis in terms of value chains. The overall resuit is an improved analysis of the key factors of success in différent corporate stratégie domains of activity (SDA).

This revival is, however, inadéquate: in particular it conceals the fmancial, human and organizational aspects of a company, and negîects the irrational framework, i.e. the identity and die values of the organization, which are indispensable for defining a fuit and cohérent stratégie project. In order to answer the question: 'Where do we vvant to go and where can we go?', we need to know where we are and where we hâve corne from.

The most radical advance with respect to classical rationatist approaches was made by Marc Giget (1989). lie was able to deat with the deep-seated reality of the company, taking into account historical,

économie, technological, human and financial aspects and calling on the prospective dimension as required.

There remains, however, one délicate question: although stratégie anaiysis and the préparation of a developmental plan constitute exceptional opportunities to enhance communication and stimulate internai mobilization around common objectives, nevertheiess the genres often hâve to be separated. If planning is really stratégie, it must remain confidential or at least subject to restricted circulation. Diagnosis of internai strengths and weaknesses and threats and opportunities for a development provides stratégie information which should only be circulated widely if it seems tactically opportune to do so. Unfortunately, as Thomas Durand (1985) stresses: 'this désire for secrecy contradicts the need to mobilize people around this common project: the company plan.'

Faced with this dîlemma, companies hâve various responses, which go from one extrême to the other. At Thomson CSF, in Rhône Poulenc, France, for example, fifteen copies of the plan are circulated. At Elf, several hundred copies of a single version of the plan are circulated to company executives. At the other extrême we hâve the RATP (Paris public transport System), which circulâtes several thousand copies of the company plan. Obviously what is possible for a public company with a monopoly is not possible for a company operating in a more compétitive System.

4. An integrateci approach: stratégie prospective

For Marc Giget, the director of Euroconsult, a company must be seen as a tree of compétence, and cannot be reduced to its products and markets. In a tree (Fig. 40), the roots (technical skills and know-how) and the trunk (capacity for industrial implementation) are as important as the branches (product-market lines).

The image of the tree has its advantages. First, it appears that, to quote Giget, 'the company must not die with its product'. Just because a branch is ill, one should not saw through the trunk. In this case it is better to redirect the sap (i.e. the skills) towards new branches of activity which correspond to its genetic code. There are the French examples of Bollore-Technologies (from cigarette papers to specialized packages), Graphoplex (from siide-rules to précision thermopiastics) or la Règle à Calcul, the weli-known Boulevard Saint-Germain slide-rule distributor which became a distributor of calculators and electronic products.

The image of the tree also has its limitations. The dynamic of the tree is not unidirectional, from roots to branches - it fonctions in two directions; the branches in turn nourish the roots through photo-synthesis and the humus produced from fallen leaves.

The image of the tree of compétence was born out of a stratégie analysis of large Japanese companies. It appeared that, implicitly or explicitly, most organizational structures in Japan are represented in the form of a tree; thus, for example, three concentric circles to symbolize research, then production and finaliy commercialization, also represent a tree projected into a plan. Marc Giget's approach has attracted attention, and has been taken up by major companies throughout the world.

Naturally, the stratégie approach, defined through trees of compétence, felt the need for prospective study of the compétitive environment. It is therefore understandable that the marriage between prospective and strategy came about through a rapprochement between scénario methods and trees of compétence. The marriage wili be ail the more fruitful in that there is total compatibility of blood groups between thèse two approaches; both imply simple tools, capable of being appropriated by those who must use them, by and for themselves, within the company.

Before presenting tlie integrated diagram (Fig. 41), constructed with Marc Giget, we should recall the three stages of the scénario method:

1. Identify the key variables. This is actually the aim of structural analysis.
2. Understand the past and analyse actors[1] games in order to ask key questions about the future.
3. Reduce uncertainty on the key questions and pick out the most probable environmental scénarios with the help of expert methods.

Thèse stages are represented in tlie left half of Figure 41. The first stage is not limited to a structural analysis of the company in its environment> but also comprises a thorough X-ray of the company, from know-how to product iines, achieved by use of the tree of compétence. Stage 2 concerns the rétrospective dynamic of the company in its environment - its past developmentj its strengths and weaknesses in relation to the main actors in its stratégie challenges - which allows us to locate the key questions for the future. Stage 3 involves reducing uncertainty over key questions for tlie future. Eventually expert survey methods are used to show up marked trends and risks of rupture, and finaliy to outline the most probable environmental scénarios. Stage 4 aims to identify a cohérent project, that is, the stratégie options which are compatible both with the company identity and with the most probable scénarios for its environment. Stage 5 is devoted to the évaluation of stratégie options. A rational approach would encourage reliance on a rmalti-

criteria sélection meiliod, but this rarely happens. This stage ends the preliminary phase of reflection before decision-making and action. Stage 6, from project to stratégie choices, is crucial, as it involves the transition from reflection to decision-making. Making stratégie choices and priorifizing goals are tasks for the board of directors or its équivalent. Stage 7 is concerned vvhoily with impiementing the plan of action, It involves the negotiation or setting up of goal-oriented contracts, establishing a System of co-ordination and follow-up, and the development of,(externat) stratégie vigilance.

This integrated approach does not proceed in a totally linear way. It includes a possible feedback loop from stage 7 to stage 2: implementation of the pian of action and the results of stratégie vigilance may lead, in some cases, to a reconsideration of the dynamic of tlie company in its environment.

Finaliy, the transition from prospective reflection to stratégie action assumes that the actors concerned enter into the process. This means that the whole staff, and not just die managers, must be involved as far as possible in thèse différent stages, without changing the necessarily confidential nature of certain stratégie choices. For a successful transition from thought to action there must be appropriation - which brings us back to the three éléments of the Greek triangle.

Of course, this integrated diagram of prospective and strategy is aimed primarily at companies which can be represented in the form of a tree of compétences. There remain many other questions concerning global or sectoral (démographie, energy, industrial) prospective for which the classica! scénario method is indispensable.

In ail cases, choice of methods dépends not only on the nature of the problem, but also on the availabte resources (ñnancial and human), and we should not forget that urne constxaints are probably the most restricting.

The marriage between prospective and strategy is still too récent to bear fruit, but the union seems promising! In this integrated scheme, the rational skeleton does not prevent the circulation of irrational marrow. Collective appropriation serves to prépare for effective action without, however, opposing the restricted, partly confidential nature of stratégie décisions.

As we see it, the rationalist and heuristic schools of thought are simply two sides of the same reality. It is pointless to look, for example, to théories of deterministic chaos and bifurcations for 'scientific' explanations which are not directly transposable to the social sciences. The advances made in determinism may push back the frontiers of chance, but they will never eliminate it, and the possibiiity of 'bifurcation points' confers on human action a degree of freedom to

exercise will and express desires in the face of the range of possible futures. In short, between chance and necessity there is room for mutineers and mutants bearing change.

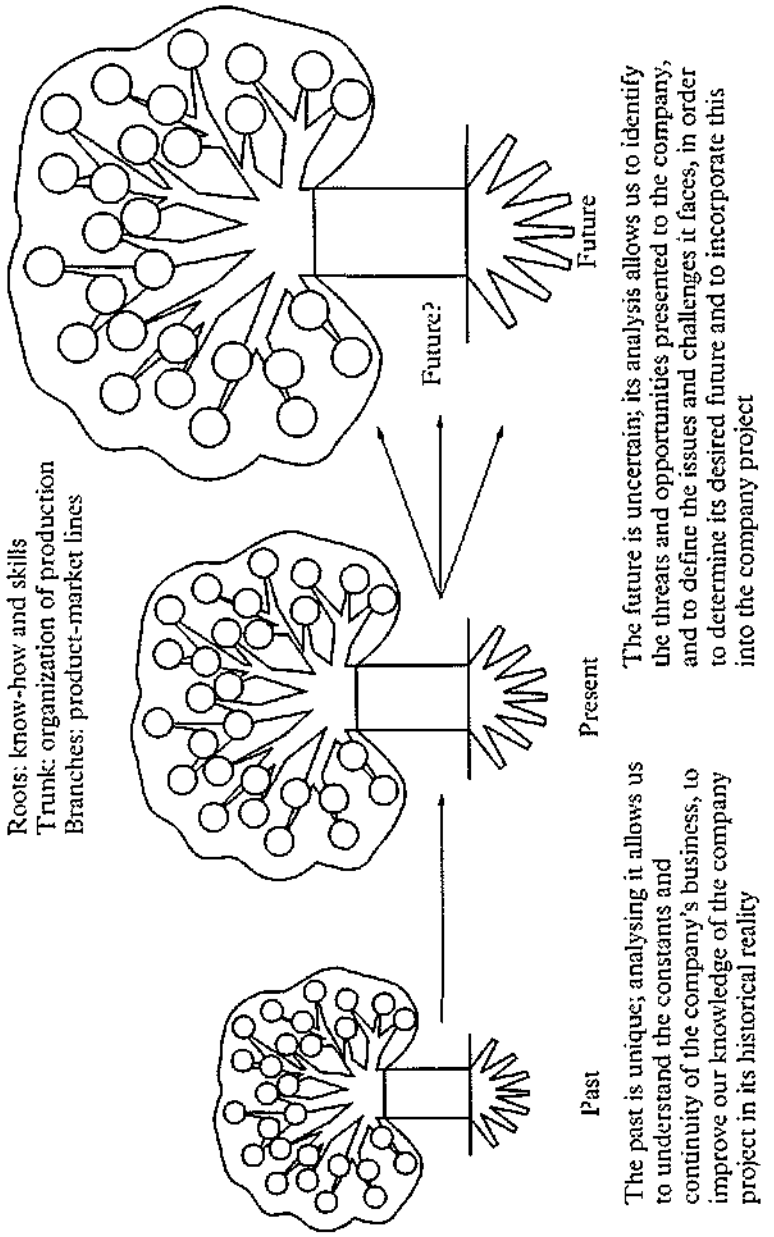
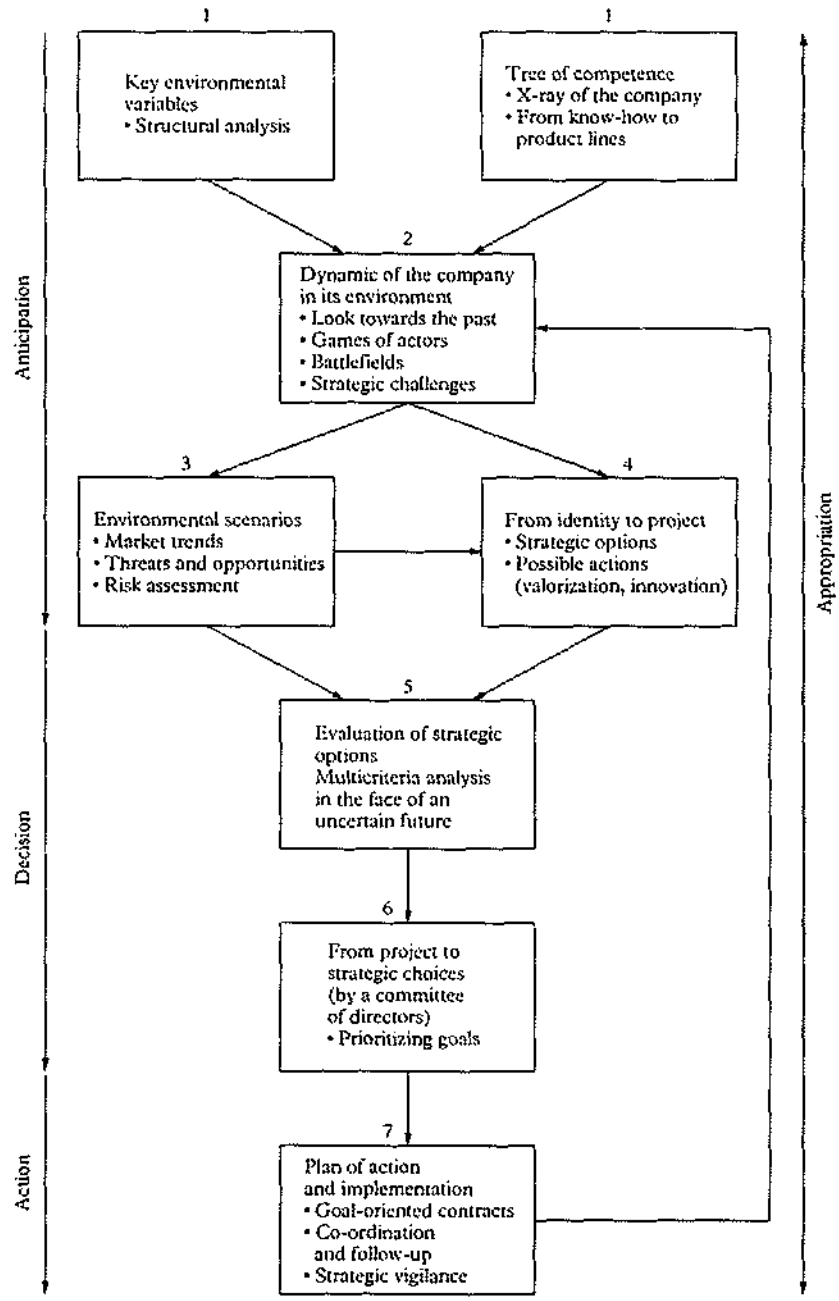


FIG . 4 0. The tree of compétence and its dynamic
(after Marc Giget, *La conduite de la réflexion et de l'action stratégique dans l'entreprise,* Euroconsult, 1988). {© M. Giget 1988)



Fi G. 4 1. Intégration of prospective and stratégie approaches (after Giget and Godet).

9. People and organizations make the différence

How can we not conclude with the essential point: 'It is people and organizations which make tlie différence.' Tools of prospective and strategy are nothing without the hand which uses themj they can equally well lead to better or worse - it ail dépends on the mind which directs the hand,

As we come to tlie end of this book, two dangers are worth stressing. The first arises out of excessive rationalism, leading to a blind and mechanical reliance on tools which are designed primarily to stimuiate thoughr and imagination, and to facilitate communication, but never to substitute for the human mind. The second danger, almost symmetrically opposed, would be to succumb to excessive arrogance; inadéquate tools do not prove that the mind is adéquate. In other words, it is good to increase the human mind's povvers of analysis and synthesis by using the lever of tools which it has constructed.

This last chapter wili proceed in three stages. First, we shall show how and why people are at tlie heart of the différence between a winning and a losing organisation. The second stage will be devoted to company and team projects - tlie importance of thèse should not blind us to the pitfalls. The third stage will discuss the métamorphoses in structures and behaviour which are necessary for companies to face up to change.

1. Quality of leaders and winning teams

Throughout this book we hâve constantly referred to the human and organizational factor as *the* key out of the 1,001 keys to excellence (and also to failure), We hâve thus (re)discovered tlie principle of contin-

gency. That which created yesterday's success may well be the cause of tomorrow's failure. In order to adapt to a changing world we must know how to change our structures, behaviour and habits.

A far-seeing manager is one who regularly introduces factors to break habits. In order to remain motivated a person needs to be permanently diverted and stimulated by challenges. Such challenges are more mobilizing if they are nevv, and more relevant if they form part of a cohérent trajectory. This is how we should understand apparently disjointed attempts to mobilize the intelligence of organizations: leadership by objectives., participative management, quality circles, company plans, etc.

Ail thèse attempts are marked by success and failure . . . which goes to show that the bottle alone does not cause drunkenness, it ail dépends on the conditions of application. This is how it is with prospective and strategy: in order to move from anticipation to action, appropriation is a compulsory step.

For people to be really good at doing something they hâve to understand it. As Henri Fayol stressed: 'If to govern is to foresee, to obey is to understand.' Mary Parker Follett's famous first-class manager does not give the orders but, rather, instigates the initiatives which move towards implementing the orders he could hâve gîven. The quality of leaders is a déterminant factor: without a good captain there can be no winning team.

During the course of our consultancy work in companies and public administrations we hâve corne across a number of thèse first-class managers - more often (although not exclusively) in small organizations than in large ones and more often in companies in difficulty than in companies in apparent good health. When ail is going well a company can afford the luxury of médiocre or unnecessarily domineering managers (a gênerai should not fight his own army).

We shall présent just a fevv cases because of their exemplary nature, without naming names. The carefui reader wil! easily be able to locate them.

Firstiy, there is the case of Sollac, which made a spectacular recovery in iron- and steel-making. In a few years it was able to émerge from the red, while remaining in the same business, simply by moving from a production logic to a commercial logic. Today it is the leading, most profitable European manufacturer of steel products, with over half of its production going to export.

According to Sollac's directors, almost 80 per cent of the increase in productivity achieved in récent years has been due to human and organizational factors. Among the levers used were the company plan

and shared vision, the development of a common culture, total quality, the customer action plan, training, and, more generalty, the 'crisis' itself seized as an opportunity to leap forward, etc.

Another example of a remarkable recovery during the 1980s is a small company in the iron- and steei-making business: FFM (La Fabrique de Fer de Maubeuge). As the chairman proudly declared: 'What saved us was the fact that \ve had never had any state aid.' Hère again, recovery was achieved vvithout significant material investment, but with considérable reinforcement of non-material investment, mobilizing thinking around tlie thèmes of quality, flexibility and responsibility, as well as innovation.

It was a joy to discover the Crédit Agricole de Haute Normandie, which showed us that the reality of tlie world in gênerai and companies in particular sometimes exceeds tlie idéal fiction of books on strategy and management.

Hère we met compétent, open, listening and simply contented managers, surrounded by happy executives who were praising their bosses even behind their backs. We were also impressed by the high level of stratégie culture. What a contrast with so many large organizations paralysed by their gigantism, where most internai energy is devoted to quarrels over territory, and battles between bosses for power.

There remains public administration. Our last example demonstrates our belief in people and our hope for the évolution of structures and behaviour. It concerns die French Ministry of Equipment, and more precisely the Moselle Departmental Director of Equipment (DDE). Faced with the new compétitive challenges resulting from regionalization in France and tlie opening up of Europe, and despite its iron collar of administrative rules and régulations, tlie DDE set itself tlie task of inventing new ways of working.

It was a matter of doing better with fewer resources. The apparatus put in place comprised a whole panopiy of measures: keeping a look-out collectively by means of an observation network made up of every individual; problem-solving groups; training groups; and quality circles aptly named ARC (Active, Responsible, Creative). So we can see that, despite the administrative iron collar, there do exist degrees of freedom, and thèse must be appropriated or even created.

The strengths of the above examples also constitute their weaknesses: a number of highly charismatic people were able, at the opportune moment, to stimulate the adhésion and even enthusiasm which saved the organizarion. They must take care not to départ prematurely and thus nip in the bud what are still fragile dynamics,

2. 'Yes' to the plan and shared vision, 'no' to its pitfalls

Let us déclare our own belief straight avvay: ic is better to devise a company plan and shared vision without saying so than to talk about it without really making one; srnall concrète projects are better than one grand, iilusory plan and shared vision, for the process of appropriating the plan and shared vision counts for more than the plan and shared vision itself.

We believe in the necessity of the plan and shared vision as a bénéficia! point around vvhich to mobilize the company's intelligence, and as a décisive trump card in the search for competitiveness and excellence. This is precisely vvhy we are afraid of seeing this 'passionate obligation' obliterated by unfortunate or desultory experiments.

Talk among managers, the désire for internai communication and the (real or supposed) genius of consultants are not enough to justify a company plan and shared vision or to ensure its success; what is also required is serîous initial reflection, real conviction at ail ievels and many précautions in its use. Fashion, for the company plan and shared vision, is not 'ready-to-wear' but 'made to measure': it is up to each company to define the timing, forms and content of the plan and shared visîon(s) which best suit it.

A company plan and shared vision normally comprises four aspects: a vision of the future; collective résolve; a system of shared values; and major medium-term stratégie objectives (see Giroire, 1985):

- An ambitious future vision, in terms of main aims and overall objectives, which should be subject to broad debate. More than one main thrust is possible, but it is also necessary to take environmentai uncertainties into account. For example, a large company may adopt die long-term objective of becoming the market leader in certain markets for certain products, services or techniques. Ambitions are often expressed openly and quatitatively. This is the indispensable rôle of dreams in helping to create reality.
- A collective résolve to maintain course even more firmly if the storm blows harder. This means tliat each partner must speak die same language and be open and responsible under ail circumstances, including in conflictual situations. This résolve to attain objectives which correspond to corporate aims is everyone's business, to be adhered to at ail tîmes, and in a real and practical way at ail Ievels.

Pitfalls lo avoid in a company plan
(Vision for the future)

- *Lack of reai content.* In this case, the project is a communication gimmick for the directors, who arc not really involving the company's vital forces in a process of reflection and collective questioning. There is thus the danger that those who respond to the initial appeal arc demobilized for a considérable time. A good way of avoiding this trap is occasionally to undertake a company pian without saying so, and to set the process in motion without initialty holding out bright prospects for the resuit.
- *Considering the company plan as an end rather titan a means.* The main benefit of a company is that it is an opportunity for sîructured reflection and collective debate on die company strengths and weaknesses in the face of the threats and opportuniťés of its présent a'hd future environments. For the project, as for the company plan, the process is more valuable îhan the resuit.
- *Sitbcontrading a 'ready-io-ivcar' company project* assembled in kit form by specialisis outside the company who are experienced in the art of reducing complexity to simple, \vel!-fitting images. If we wish to darify too muchj we are in danger of biinding ourseives. The idea of adopting an *à la carie* project based on the company's own culture can be attractive. However, is it reasonable to engage the company's future on the strength of a blueprint which is probably ephemeral and which may be debatable? Would it not be more suitable to examine provocative changes in the environment, and changes in individuals' aspirations and behaviour? This type of examinadon, focused on Connecting mechanisms and contrastïng forces of change with forces to inertia, is indispensable if one is to arrive aE an undemanding of the inévitable résistance to change, and to identify the levers of action which are capable of bringing about the necessary transformation of structures and behaviour.
- *Setting up a company project in the liope of avoiding ihe metamorphosis of structura and behaviour zuliich ihe project implies and lohich it will bring about.* The company project imposes on managers and directors a real 'révolution of the mind'; its aim is that authority should no longer be based on function and title, but on compétence and ability to develop initiative and responsibility among subordinates. To say diat the future belongs to flexible structures which are decentraiized around projects, on a human scale, autonomous and responsable, is also to say that fhere will be fewer hierarchical levels, and consequently fevver managers.

If thèse pitfalls are not avoided, the company project is in danger of going out of fashion. This would be a shame for companies, which will hâve lost an opportunity and will hâve to look for other ways of initiating the necessary metamorphosis of structure and behaviour in the face of major change.

. A shared System of values among the company's partners with respect to: récognition of individual rôles and différences; the virtues of dialogue and murual compréhension; dissémination of information; mutual trust in responsible behaviour; pride in belonging to the same team, in producing quality goods, in being compétitive, and in playing a leading rôle in innovation in the face of technical, économie and social change.

- Some major objectives to be set as short- and medium-term priorities (such as self-financing, investirent, market share, training, working conditions, etc.) and also as longer-term priorities (R&D, diversification, etc.). As vvas expressed so well at the Crédit Agricole de Haute Normandie: 'Profit is not sufficient as an ambition; however, one should keep an eye on the profkabiiity of ambitions.'

In other words, a company plan and shared vision is not simply the déclaration of aims; it is also the expression of corporate résolve to reach thèse goals, the récognition of a shared System of values, and mobilization around thèse objectives, which are more fully accepted if the corresponding main aims hâve been clearly set out and hâve been the subject of broad debate.

3. Metamorphosis of structures and behaviour

Analysis of environmental changes must not lead us astray. If we train our projectors on externalities we run the risk of leaving the interior in the dark. It vvould be îllusory to believe that the future of a company could dépend solety on good external stratégie ehoices wittiout making any changes to internai structures and behaviour.

Mastering change is achieved by breaking habits and having the courage to face up to certain issues which are often avoided or evaded, such as:

- Job security.
- The adequacy of existing qualifications for meeting future needs.
- The effectiveness of Systems of communication, training and research.
- Criteria for evaluating performance and promotion.
- Ways of designating and legitimizing managers and higher executives in the company.
- The crisis in trade unionism: causes and conséquences,

Should the company subordinate its strategy to the maintenance of existing manpower levels, structures and behaviour? If the ansvver is yes, what developmentaf objectives should be favoured, what resuits

should be expected from them and what stratégie deadlocks should be considered acceptable? If the ansvver is no, on the other hand, what conséquences wili the demands of the chosen strategy hâve for manpower levels, qualifications and structures? The fact that the question is being asked indicates an inclination to find the ansvver.

3.1. ADAPTABLE OR ANTICIPATORY STRUCTURES?

Ideally, structures shoutd not only adapt to environmentai developments but also anticipate them, for structural inertias necessarily give rise to a delay in adaptation.

This debate is not new. It was popularized by A. Chandler (1962), for whom adaptation of internai structures was achieved 'by trial and error', foilowing changes in the environment (products, markets, technologies, etc.). In such a process, the majority of companies submit to change rather than manage it. This delay effect means that structures are constantly inadéquate to cope with an environment which is changing with ever-increasing rapidity. Hère we hâve the classic opposition between forces of change and forces of inertia (structures), which are the source of so many crises.

In the 1970s there was a realization that such rapid obsolescence of structures had to be avoided and that necessary internai changes had to be carried out with each new change in stratégie direction. But structures take much longer to evolve than the environment. This is why Igor Ansoff proposed inverting Chandler's séquence of events. For him, internai évolution can précède external change and this is precisety what stratégie management consists of: setting up structures through anticipation, not solely through adaptation.

Adaptive or anticipatory - this is still an open debate. The dual structure proposed by Ansoff- where new forms coexist with older ones - seems to us the most realistic option, especially as the évolution of structures dépends not onty on stratégie and environmental imperatives, but is also the complex resuit of the firm's history and culture.

As D. J. Hall and M. A. Saias (1980) state: 'Structures resuit from the complex interplay of factors other than strategy: culture, values, the past and présent functioning of the organization, the history of successes and failures . . . there is, therefore, no reason to subordinate structure to strategy.'

Behind the organizational structure there is a corporate concept covering its policy and objectives, its inhérent priorities and power games. To be effective under thèse conditions, the structure must be adapted to

the corporate culture and behaviour patterns. It is not possible to refer to structure without associating behaviour and management. There is no idéal structure and the most dynamic companies hâve simply found some kind of harmony between strategy, culture and structure.

Finally, in place of the much too linear theoretical diagram of company behaviour (Fig. 42), proposed by R. E. Caves (1980), we propose substituting Figure 43, where ail relationships are reciprocal. If future performance dépends on harmony between strategy, culture and structure, past performance in turn conditions strategy, is wedded to structure, and shapes culture.

It is commonplace to recall ṁat formulae which enable companies that are aiready performing well to improve tlieir resuits still further are not necessarily suitable for companies in difficulty: generally, a balanced meal for a heatthy person has little in common with the diet that an ill person should be given.

For a company in difficulty, it is rarely appropriate to behave as if it were in good health, if only because the économie and financial situation is différent. On the other hand, companies which hâve always had an easy time are more fragile than others when difficulties suddenly émerge. There are several possible explanations for this phenomenon: times of hardship are character-building, and individuals are self-seleo ted, whereas easy times hardty encourage a capacity for reactivity. In addition, it requires a différent type of management to manage growth and to overcome crisis.

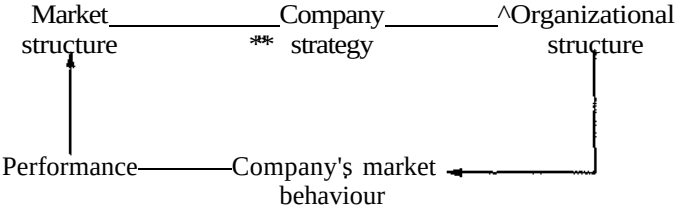


FIG. 42.

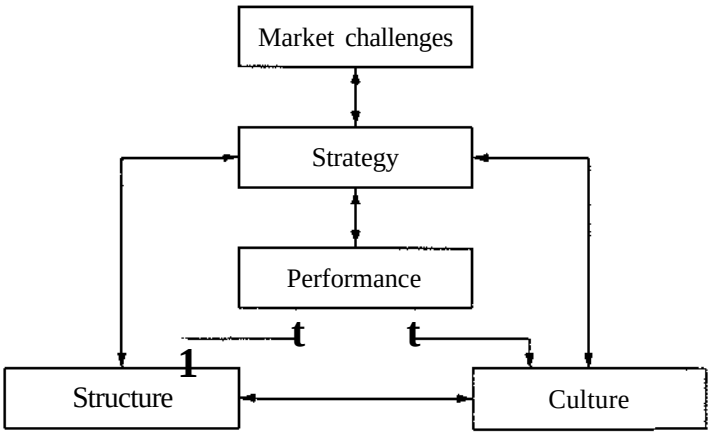


FiG. 43.

3.2. SIMPLE, LEAN STRUCTURES

How can this harmony between strategy, culture and structure best be realized?

First of ail, we note that in tlie srructures-power-environment trilogy, power is attacked by environmental developments and défends itself by means of structures. One characteristic of structures is that they become die property of those who set them up, and this is a source of rigidity.

Any structure risks sclerosis if it is not regularly subjected to a reorganization exercise, redistributing responsibilities and power. As far as possible, habit-breaking factors, as mentioned above, should be introduced into structures. Somevvhere between a state of rigidity-sclerosis and unrest-alibi, which give rise to anxiety and ineffectualness., it is necessary to find die appropriaîe speed of transformation which can respond to environmental developments without poindessly upsetting estabiished equilibria. The search for harmony présupposes an intentional step which takes into account úrne and its inertia - inertias are weaker if one is dealing with simple, lightweight structures.

Companies are confronting an increasingly complex compétitive and stratégie environment. Increasing the size of the company and consequently its internai complexity is not die best way to respond to external complexity. For a company to funcuon well it must remain simple and compréhensible to ail concerned.

Operational structures (responsibilities allocated by product Une and market strucaire) seem to be préférable to functional structures (responsibilities allocated by major function: design, methods, purcha-

sing, production., sales), and the least effective structure is to attempt to cross the two with so-calied matrix organizational structures. The smailer the structure the better its heaith. Not only is 'small beautiful', it can also be profitable. The organization of a company into small, human-scale operational units is the *sine qua non* for an ability to adapt constantly, and the key to innovation. A System of shared values within the framework of a company plan and shared vision is essential to act as living cernent between thèse smali units, for if flexibility is to be effective it requires a certain rigour.

3.3. STRATEGIC CENTRALIZATION AND OPKRATIONAL DECENTRALIZAT1ON

A form of the 'subsidiarity principle' could be applied to the company: decentralize everything that can be decentralized, and centralize everything that has to be centralized. In order to attain this strategic centralization and operational decentralization, rigour and flexibilité hâve to be reconciled; this means the coexistence of a firm managerial Une and maximum individual autonomy.

Hère we find once again, implicitiy and under another name, tlie well-known debate on decentralization. This signifies more than autonomy and delegated responsibility; it présupposes a certain amount of central coordination for the overall cohérence and effectiveness of the company, without at the same time transformîng decentralization into déconcentration.

Decentralized structures are better adapted to complex, dispersed and evolving situations. The functionat set-up for this type of structure may require a preliminary centralizing opération. The keys to successfui decentraiization are:

- strongly to assert the centrai managerial line on certain fondamental values (quality of production and service, basic internai poîicy rules);
- to base individual and group autonomy and responsibilities on rutes that are clear and respected (negotiation of objectives, évaluation of results, profk-sharing, sanctions, etc.).

Responsibility, for exampie, means that quality control is incumbent upon every individual, and is not the sole responsibitity of a specialist department. Autonomy also means the development of a certain amount of internai compétition.

In view of tlie cornplexity of the décisions to be taken and the aspiration of tlae majority towards better control over ail aspects of theîr functionsj traditional Taylorian compartmentalîzation needs to be

questioned. Gathering experts together around the same object (such as a product or a resource), and sharing common objectives, stratégies and information are essential. One must avoid diluting responsibility, however, whilst at the same time choosing structures which encourage a synergy of skills.

3.4. STRATI-GIC CONSEQUENCES OF ENVIRONMENTALCHANGES

Witliout claiming to be exhaustive, we hâve considered nine main trends which characterize changes in the gênerai corporate environment and we hâve shown some of the conséquences for corporate organization and strategy. We shall comment briefly on Table 41.

TABLE 41 '

Environment	Stratégie conséquences
1. Uncertainty	Flexibility Versatility Actor's project
2. Interdependencc and complexity	Globai vision and simple structures
3. International imbalanecs	Régulation by \vorld Systems*
4. Globalisation	Redeployment of activities Internalization of management
5. Slow, irregular and unequal growth	Battlc for markeî sectors> productivity, quiitity^ diversification
6. Technoiogical change	Automation
+	
7. Deregulation	New competitors
8. Economy of diversity	'Smal! is profitable'
Mass production of variety	Responsible, autonomous teams
+	
9. Autonomy, diversification	Entrepreneurs, intraprencurs
End of habits, mental révolution	

1. The reader looking for a deeper analysis may refer EO Chapter 10.

The uncertainty of the environment certainly demands flexibility and versatility, but also reinforces the need for a plan and shared vision, if only in order to take one's bearings in relation to the objectives.

The growing interdependence of phenomena makes understanding them a more complex task. In addition, action increasingly requires a global vision. In order to tackle ùhis environmentai complexity, it is no use equipping oneself with complicated structures; simple, lean forms are far préférable.

Mides': thc beginnings of a mental révolution at Renault in 1983

' *Mides: a necessity*

Thc performance of a company is directly rclntcd to its organisation, i[s management, and to the priées and quality of the products and services it puts on the market. Expérience today shows that thèse are iargcly determined by the dynamics of working relationships and quality of lit'e within tSie company.

To romain in the top league of workl manufacturers mi-ans constantly icnproving our competitiveness (better prices, bctier quality). This dépends on our simuiîaneously taking into account différent devclopmcnts, in tcchnology, in the economy and in business . . . but a!so and above ail on our capaciry for innovation and adaptation, i.e. on thc way in which each onc of us transforms the life of thc company through our work, thus facilitating thc company's devclopment in a changing world.

• *Mides: a résolve*

If wc do not immediately mobilise our cnergy, in ail sectors and at ai! levels of the company, the world will change without us and perhaps against our interests. Because wc want it to change with us, becausc our future is our business, wc hâve to develop within the company, through our daily setiviry of preparing for our future, a widespread, constant, concertcd effort: wc hâve to learn to live and to work differcntly.

• *Mides: a siatc of mind*

The Mides spirit is based on a number of simple principles:

- Openness and anticipation.
- Understanding better what is happening around us and knowing how to disringuish between the constraints and the opportunities in our environment, in order to influence them or adapt oursclves to confiront them.
- Pluralism and concerted action.
- Recognizisig and accepting our différences, taking confiicting opinions into account, knowing how to liston: thèse form the basis of concertée! action. Knowing how not to abandon options or responsibitities in the course of concerted action: this is thc basis of relationsliips within the company.

• *Mcthod and imagination*

Stating problcms clearly before trying to résolve them, promoting individual self-expression, stimulating imagination and creativity, displaying ai! possible choiecs and their advantages and drawbacks, associating ai! the actors involved at ail levels of analysis and decision-making: thèse are the principles which guarantee that responses correspond ctoscly to the problcms and nceds of thosc concerned.

• *Autotiomy and responsibiliiy*

Taking better account of people's aspirations in the praciical organisation of daily work (the désire to manage their tĩmc better, to work in small groups, to know what wc are manufacruring, etc); basing authority on thc capacity to motivate pcople and unité their skills: thèse arc the principles which guarantee everyone an arca of autonomy in keeping with thc rcsponsibilities conferred upon them.

1. Mides siands for 'Mutations Industrielles et Dynamique Économique et Sociale' (Industrial Change iind Economie and Sociji] Dynamics). Tiiis box summarizes the content oi'iiie Mides brochure No. 1, issuccl in 198-1 by Ren;iult. This opération to promotc a collective awareness of change w;is not able to be complcted, owing to difiieukies experieneed by Renault in 198-t and *a* change of chairman, Howcver, it played a uscful rolc in the developmeni of tlie internai company nienlalily, and involved almost 3,000 pcople. Thc opération, led byjean Lagassc, then the highly charîsmatic Dircctor of Research, deserves a place among the management classic.s.

The persistence of international imbalances (geopolitical, démographie, environmentai, économie, etc.) and the absence of global regulators are partially compensated for by new forms of régulation, new 'world Systems', to coin Fernand Braudel's phrase. Thus, the international financial network fonctions twenty-four hours a day, from one end of the globe to the other. Multiple international disturbances and non-tariff barriers to trade hâve not prevented a trend towards globalizatîonof activities (processes-products-markets): every year since 1945 exports of manufactured products hâve increased faster than production. Companies hâve to deptoy their activities at the global level, which is also happening through a degree of internationalization of management.

Three trends (slow and irregular growth, technological change in processing and deregulation) are combining to organize compétition and the battle for market sectors becomes the search for the best quality-price ratio. . . . Companies hâve simultaneously to diversify, to automate in order to boost productivity where possible, and to confiront new competitors.

The human and organizationai factor is crucial for competitiveness, so it is wise to take advantage of new information technologies and communication networks to move towards being 'smalt, beautiful and profitable'. We hâve entered tlie âge of the economy of diversity; in other words, the future trend is towards mass production of variety and small-scale profitable production. This techno-economic évolution is taking place in step with tlie transformation of individual needs and aspirations towards more autonomy and diversification. For companies this means setting up smali, autonomous teams of responsible intrapreneurs. Thus new forms of management, attitudes and behaviour are graduatly emerging at ail levels of the organization.

3.5. FROM AN END TO HABITS TO A MENTAL REVOLUTION

Developments in the environment require a company to hâve a capacity for rapid response and flexibility, which is largely dépendent on structures. From now on, structures will hâve not only to adapt to environmentai developments but also to anticipate them, for structural inertia causes a delay in adaptation. The future belongs to flexible structures, which are decentralized around projects, on a human scale, and autonomous. Autonomy means responsiblity, and consequently being subject to market sanctions or to assessment of performances in relation to objectives.

This trend towards the appropriation of the company by individuals or groups of intrapreneurs demands new qualities from executives and managers. For many companies in difficulty, the shipvvreck is due more to internai management inadequacies than to the storm which is raging outside. What other explanation can there be for the fact that other companies thrive under the same conditions?

Among thèse managerial inadequacies, absence of power fearures just as much as constant power struggles which paralyse action. It is not so much the notion of power which is in question as its misuse: the pieasure of dominating others is ail too often sought as an end in itself, to the détriment of the power of domination over oneself, and the power of creativity and realization of projects.

Let us reiterate Mary Parker Follett's message: the real power of a leader cannot be measured in terms of his or her domination over others, but in terms of his or her ability to deveiop initiative and responsibility among subordinates. This obliges executives and managers to participate in a true 'mental révolution' which aims no longer to base authority on fonction and job titles, but on compétence and the ability to motivate.

Authority in gênerai is the renouncing of autonomy, which is conceded to someone else in exchange for something (for example, salary, security, expertise). It is a contract. The authority of someone at a particular level in a hierarchy must be based on compétence., an ability to synthesize, and plenty of responsibility and autonomy. Authority is open to criu'cism when it is not based on compétence or when it is exercised in an abusive way, The notion of 'little chiefs' represents abusive authority which is no longer adapted to feltow workers' qualifications and type of work. It is more an authority to delegate based on superiority in the hierarchy than authority through compétence: it forms a filter, and poses the problem of possible recourse against abuse of authority. Such possible measures include the following: définition of functions, the format right (or not) to appeal to levé! N+2, and having recourse to trade unions, quality circles, or office or shopfioor committees.

On the otlier hand, an executive who can base his authority on compétence and motivation can let his feilow workers take the initiatives; he no longer needs even to negotiate objectives, as thèse émerge naturally. The principle of subsidiarity is stated at every level of the organization: this operational decentxaiization présupposes contracts over objectives, and évaluation and control a posteriori. With this new way of aliocating responsibility in terms of skills, staff can receive higher rémunération as the number of hierarchical levels is reduced (the German model). In order to install such a mode!, which is open to communication and change, the size of production units is important

(not exceeding 300 people per industrial or administrative unit, for example, is a target which some companies already aim for).

Responsibility is no longer hierarchical but coilegiate; however, neither the boss nor authority hâve disappeared. The manager commands respect solely for himself and his abiliry to mobilize, arbitrate and successfully manage human conflicts and économie risks in a positive way. lie is co-opted rather than appointed. Management is open and plurai; in other words it no longer questions traditions, beliefs and values but relies on them in order to adapt itself to national and régional particularities, like a fish in water,

The whole organizadon of the company is feeling the effects of this mental révolution. The company is a vast arena of social expérimentation. The rules of the bureaucratie game are being swept away by executives who wish îo take on the same responsibilities within the company as they hâve in society. Economie effectiveness is not incompatible with aspirations when it is achieved via autonomy and, consequently, initiative and responsibility.

TABLE 4 2. The new rôle of management

	Ycsterday	Tomorrow
S cale	Large	S m ail
Tasks	Dividcd	Compiex
Compétences	Limited	Polyvalent
Authority	Derived from status	Derived from compétence
Relurionships	Hierarchical directive	Autonomous: responsiblc communication
Siscccss	Through dévotion	Through initiative and reactivity
Objectives Contracta	Imposée!	Negotiatcd, stimulatcd
Actions	Control a priori	Control a posteriori

But how to reconcile aspirations towards autonomy and security?

Security is found mainly in large private companies or in public administrations or companies, which are hierarchical Systems par excellence; autonomy, on the other hand, is found mainly in less formai, more exposed forms of work, such as self-employment or craft companies.

From the point of view of social innovation, ail possibilités are worth exploring, except those which lay claim to universality but which in reality only make change uniform, thus threatening to constrain change or introduce new rigidities. The flexibility we dream of involves a re-examination of non-reversible career paths, promotion by seniority, and tlie principle of increased responsibiLities with âge; responsibilities, and the advantages and disadvantages that go along with them, are thus dissociated from âge and cease to be the object of social envy, as a symbol of power, New castes émerge, but this time they are alive, open and constantly renewed, because they are made up of people who hâve proved themselves socially and economically. Having once passed a highly compétitive examination no longer counts for much.

We should not dream too much! The ravages of 'diploma disease' hâve only just begun. It will probably take major upheavals before a new division of work is established, breaking the sequential rhythm of éducation, work and retirement, and setùng up flexible, alternated formulae: for example, each year of work could entitle people to free time to dispose of as they wished, both later in life and atso at 30 or 40 years of âge, in order to become a soldent again, to travel, to educate their children or to dévote themselves to any other activity that interested them.

In the meantime, training, in ṁis instance renamed 'intellectual investment', has become fashionable. It is legitimate to ask ourselves whether the educational mirage has not simply replaced the lech-nological mirage of the early 1980s. As Pierre Caspar (1989) remarks: 'Spending a lot on training does not necessarily mean making real investments.' Training is certainly essential for the mental révolution, but only so long as it promûtes, as far as possible, collective self-education, for it is by teaching that we learn; in addition, periods of passive éducation need to be abolished, and fraining needs to be accompanied by action which allows theoretical knowiedge rapidly to be accompanied by action which alîows theoretical knowledge rapidly to be put into practice.

In fact, any training which is not followed up by action is wasted effort, The function of internai training should also be entrusted to the best staff, for example to executives who are awaiting promotion, as at IBM. Without exception, taking on the function of trainer should be no more than one (or several) phase(s) of one's career.

How are we to distinguish those companies where the mental révolution is already under way from those where it has not yet begun? We propose a simple test: ask informally, at the beginning of the week: 'How are tliings?' If die answer is: 'As you'd expect for a Monday', the company is in a bad way. Happiness cannot be compartmentalized. To be

happy in society, a person needs also to flourish at work, and the reverse is also true; the company cannot ignore the issues of the society around it.

In the face of the major changes taking place as we near the end of the cenrury, people must agrée to acquire new attitudes and practices. The metamorphosis of structures and behaviour has already begun. It is up to each one of us to décide whether we wish to submit to or to lead the mental révolution - whether or not we wish to change the présent by conspiring for the future.

10. The dawn of the twenty-first century

Without for a moment claiming to construct real scénarios of the environment, it seemed useful to us to throw some Hght on stratégie thought through a synthesis of the probable trends, major uncertainties and risks of discontinuity for the developed countries in the 1990s.

This synthesis does not ciaim to be exhaustive. Some questions would require in-depth study, which we hâve not yet been able to undertake. Among the areas not tackied the ex-Soviet Union and Eastern Europe stand out, This omission has at least spared us the diagnostic errors which are so common on thèse topics.

Although a deadlock situation is impossible in the geopolitical arena, it is more évident in économies., in so far as the ex-sociaîist countries represent in total less than 10 per cent of international trade. For the same reasons, économie questions relating to the Third World countries will receive little attention hère. Whether we like it or not, by the year 2000 three-quarters of the world's solvent demand will be in the developed countries of the North America-Europe-East and South-East Asia triad. Our attention will focus particuiarly on the political, démographie, social and environmental aspects which could hâve greater repercussions in the developed countries.'

One could question this rather restrictive choice of coverage. We would empiiasize that, although it may be limited^ this area remains very broad and that 'first we must put our own house in order'. As regards the developing countries, we consider the concept of the 'Third World' to be

1. In the section below on 'The Lie of the Land in the Year 2000', we hâve considered the changes as a whote without restricting thèse to géographie régions.

more or less obsolète. It is not wealth of natural resources or the extent of external domination vvhich makes the différence between nations, but the mobilization of the population and the quality of their leaders. Too often Third World aid only serves to prolong the lives of corrupt régimes and translates into a chain of perverse effects. For example, food aid ends up modifying consumptîon habits or gives rise to a coliapse in prices - i.e. it has quite the opposite effect to that which is necessary to stimulate local production. In short, we despair of certain Third World countries, and the principle of non-interference, although it allows us to denounce apartheid in South Africa and throws a chaste veil over the male-femaie racism which still persists in many countries.

Thus, the right to différence, taken to the extrême, throws into question those apparently accepted universai principles. In such a context, the best service one can render certain peoples is not to help their leaders to maintain their oppression, their obscurantism or quite simply their wastage.

Europe as such will receive spécifie attention., since we dévote a" whole section to this thème. This chapter is divîded into five parts of unequal length, but logically following on one from another. In the introduction we set out the multiple geopolitical uncertainties linked to the lack of an international regulator. Second, we identify a quasi-certainty: Europtimism. Third, we note eleven probable trends in the national and international environments of the 1990s. Fourth, we note three major uncertainties. As a conclusion, we propose a list synthesizing the probable trends, major uncertainties and risks of possible discontinuity beyond the year 2000.

1. Multiple uncertainties linked to the absence of a regulator

The world is changing; the geopolitical, monetary, energy, technological, économie and social environments which we will face in the next ten or fifteen years will also undergo profound upheavals. By définition, prospective thinking up to 1995 is easier than up to the year 2000. Notably, it enables us to disregard the conséquences of the main change in the coming décades, which is of a démographie nature - at the beginning of the next century the European Community will hâve fewer inhabitants than the Muslim countries of the South Mediterranean basin, whilst the population of Brazii and Nigeria combined will be comparable to that of Europe.

Looking to 1995;, ieading experts rightly put forward hypothèses which would hâve seemed improbable some years ago:

- A lovv inflation rate of less than 5 per cent.
- Positive real interest rates.
- Relatively Iow growth.

Reading between the lines, however, one sees that thèse hypothèses are fragile: independently of the 1990 Gulf crisis, one could expect new oil shocks between now and 2000. Furthermore, growth could be sustained for several years on vivid memories of the recession of the early 1980s; but fundamentally the conditions for a lasting and steady recovery of the world economy are not ail présent. In an increasingly interdependent world, the lack of international régulation makes itself cruelly felt. A new 'world economy' (to use Fernand BraudePs term) will not take over tomorrow.

The absolute value of power does not prevent the relative décline of power itself. The United States today represents only 22 per cent of world GNP and 37 per cent of the total GNP of industrialized market economy nations, compared with 40 and 57 per cent, respectively, in 1955. The United States is no longer sufficiently powerfui to impose itself as the regulator (of a bipolar world), but is still sufficiently powerfui to play a disruptive rôle. It retains a minority freeze on the world System and is thus capable of preventing any other regulator taking its place (in a multipolar world).[2]

In other words, fluctuations in United States économie policy could themselves be enough to trigger off Worldwide inflation again. In the meantime, we share the uncertainty expressed by some economists over exchange rates, with the dollar at between 4 and 10 French francs. We may regret the scale of this uncertainty, but it would be irresponsible not to take account of it.

For its part, Japan has no désire to become the centre of a new 'world economy'. The myth of Japan at the centre of a Pacific Rim which would definitively relegate the Atlantic Old World, and consequently Europe, to its periphery is without foundation:

- At most, from now until 2000, Japan will account for only 12 per cent of global GNP, as compared with 10 per cent today - Le. roughly half that of the United States or Europe. Certainly the growth of the South-East Asian NICs is spectacular, but it is primarily a catching-up phenomenon (GNP per capita in the Republic of Korea is six times less than in Japan).

2. This thème of the relative décline of the United States follows on from our analysis in 'United States: Recovery or Conccaled Décline', *Futures*, Vol. 17, No. 3, June 1985, pp. 195-201.

- Pax Nipponica will not take over from the defunct Pax Americana, for, in any case, Japan lacks the miiitary power. United States-Japanese co-management of the global system would be a more realistic hypothesis, on the condition, however, that the United States managed to reindustrialize. The Japanese are working on this through investment, but they believe less and less in the United States' ability to maintain its leadership, and criticisms of United States économie and monetary policies, which are incapable of ensuring exchange rate stability, are increasingly intense.

The Japanese might in fact find much more responsible partners in Europe, particularly in Germany. Will Japan's slogan become *'Out of America, into Europe'?* This is an open question. We should already applaud Japan's renewed interest, which gives European countries an additional stimulus to modernize their production Systems.

Due allowance being made, some stratégie and military giants are économie dwarfs (for example, Russia) and some économie giants (for example, Japan, Germany) are military dwarfs. This imbalance is a source of tension. The bipolar world no longer exists, but will the multipolar world be able to émerge without profound upheaval?

In fact, there is a risk that the combined effects of démographie and polidcal impacts, unequal rates of development, growing nationalism and the absence of regulators will engender conflicts and feed a climate of international insecurity. In thèse conditions the management of growing interdependence has little chance of working by means of dialogue, foresight and planning.

Defence issues are central. Will the West and the East combine their forces to become the police force of the United Nations? Will Europe remain oriented towards the Atlantic for defence and towards the EC for its economy? The opening up of the East European nations to the market economy has not yet been achieved. An eventual failure of internai reforms in the CIS (Community of Independent States) would be extremeiy serious for Europe. In history external war has often served as an outlet for a country's internai contradictions. Russian military potential remains colossal and Europe should not let down its guard.

Let us propose a medium-case scénario: as a counterpart to increasingly heavy Western aid, Russia coutd refocus on the internai problems of CIS republics and leave the United States and its allies the task of plugging the breaches which will inevitably erupt among Third World countries. Since it is impossible to eliminate uncertainty it is necessary to master its conséquences, Country risk is an evolutionary key variable, which demands prospective thought. Taking account of

uncertainty also means not seeking salvation in an idéal development of the situation, but preparing oneself for survival in the most unfavourable circumstance (the worst-case scénario).

2. A quasi-certainty: Europtimism

The Old World has not uttered its last word, as one would believe.

2.1. FROM EUROPESSIMISM TO EUROPTIMISM

What has happened to the Cassandras who, only yesterday, were predicting the inexorable décline of Europe? With die centre of world gravity shifting aimost inevitably from the Adantic to the Pacific, the Old World was, according to them, doomed to become a peripheral zone., tagging behind the United States and Japan.

In fact, it was only a few years ago, at the moment of the flash in the pan of the American recovery and when the dollar was at its highest, diat it was aimost automatic to point to the technology gap in Europe, Europe's weak économie growth, endémie unemployment and social and political rigidities. It also appeared as though the word 'crisis' had disappeared from the North American vocabulary and was replaced by 'Europessimism',

The analysts of Euro-sclerosis had forgotten that a crisis can be a harbinger of hope provided mat it jolts a nation into overcoming the forces of inertia and habit which slow change and adaptation.

It is in mis manner that the majority of die European countries hâve learned over the past few years to win the battle against inflation by reducing wage escalators, apply die value added tax in a manner more favourable to business, acquire flexibility (almough sdll insufficient) in matters of employment and salary, and establish limits on protectionism.

We hâve seven good reasons to hope. This belief is in particular built upon the following considérations:

1. Like a sea serpent, the thème of the décline of Europe resurfaces periodically. Already in the 1960s a false alarm was sounded with *The American Challenge* by J. J. Servan-Schreiber. None the less, Europe experienced a rate of growth even stronger than that of the United States during the period between 1967 and 1973. Since then, économie growth in the two régions has been comparable.

2. Europe has maintained its position as a turntable of international trade: more than one-third of international commerce is conveyed through Europe, and Europe is the principal supplier and the principal channel for trade for most of the other régions of the world (except Japan).
3. Even if one excludes in this instance the United Kingdom, it is clear that European countries hâve had the good sensé to significantly reduce energy dependence: up to 53 per cent in France and Germany. Europe has thus done better than Japan, which continues to be dépendent for over 80 per cent of its energy.
4. Europe aiso had the good sensé, with the European Monetary System, to endow itself with relative monetary stability in a turbulent international environment.
5. Europe possesses the strongest scientific potential in the world and showed with the Airbus and Ariane that co-operative research and development can be profitable.
6. Industrial rénovation in the Old World is being accompanied by a higher level of investment and higher productivity gains than are being realized in the United States (this is the counterpart of less job création). Europe had the sensé to gain stratégie positions in key industrial sectors (aeronaurics, space, nuclear, communication), and it also reinforced its place in traditionai sectors (agriculture, chemicals, textiles).
7. Last but not Ieast, the sociocultural diversity of the European countries, often seen as a barrier to Europe's cohesiveness and as an élément of weakness, represents a potentia! advantage for adapting in the face of future uncertainty. The odds are that the tours organized for leaders in the direction of California and Japan are now turning towards southern Germany and northern Italy.

2.2. EUROPE 1993: THE DREAM AND THE REALÎTY

Europe, the greatest (solvent) market in the world, is put forward as the new El Dorado for European enterprises in the 1990s. The Europessimism so prévalent until the mid 1980s is no longer in fashion. Europe had previously seemed to be stagnating in a phase of décline and rigidity, incapable of emerging from crisis and unemployment; the world's focal point was supposedly shifting from the Atlantic to the Pacific. The strong dollar and the Japanese économie triumph were irréfutable évidence of this apparent shift. But today, Europe,

the wortd's leading trading power, lias once again become the économie focus for the end of the tvventieth century. What has happened?

The announcement of tlie great internai market of 1993 did not hâve an immédiate effect. Indeed, tlie signing of the Single European Act by the European Council of heads of state in December 1986 in Luxembourg passed almost unnoticed, with the Council's délibérations marked by dissension and apparent failure. This historical context has been strikingly analysed by Jacques Nemrod (1987).[3]

In Nemrod's book we learn that in addition to the Single European Act tliere is also a Final Act (which is never publicly mentioned)> composed of twenty déclarations, some made jointly and some made unilaterally, which express many réservations.

Among tlie joint texts adopted we find that: *'Fixing the date of 31 December 1992 does not hâve any automatic juridical ef/ects. '* Réservations are also expressed, notably by the Fédéral Republic of Germany and tlie United Kingdom; thèse réservations are concerned with maintaining national sovereignty over areas such as heaith, consumer protection, the environment, and so on. Nemrod states that: *'Most of the infringements of the principle offree circulation of goods resl on thèse pretexts . . . ifwe do not change anything, why do we wîsh to persuade people that everything is going to change?'*

In fact, the Treaty of Rome in 1957 envisaged the fuil realization of a Common Market by 1 January 1970. It was therefore highiy unlikeiy that on 1 january 1993 the great European internai market would be fully reaiized. Nevertheless, the goal of 'Europe 1992' played a bénéficiai mobilizing rôle, since it encouraged people to think about coming changes, and about habits which wouid hâve to be called into question,

The road to the realization of thèse ambitions is now harder tlian ever. The easiest part has been done, and in order to achieve further progress states wiil hâve to agrée to give up part of their national sovereignty, which does not seem likely. For instance, Germany will never accept the idea of a Central European Bank whose opérations would to a greater or lesser degree be influenced by politica! forces. The Germans do not wish to import inflation at any price, and tliey already feel tliey are paying more than their due for Europe.

3. Sec also M. Godet (19S9).

Limiting the cosis

It is probable that the internai market will not be achieved in the short term. While avvaiting the putative benefits, we should take care to limit the costs of a single Europe. The establishment of a single market with universally accepted norms coutd benefit Japanese and United States businesses first, which, moreover, will enjoy dominant positions in their ovvn countries with complète impunity. The benefits of the European market must not be bestowed on the rest of the world without compensatory measures. New compétition within Europe must be balanced with greater protection from external compétition.

Let us therefore take care that the Euro-illusion does not sow the seeds of disillusionment, otherwise the mobilization of minds could turn against its initial objective.

3. Eleven likely trends

At the heart of the numerous uncertainties bearing down on the future of Western societies., severa! very probable trends can be discerned:

- Démographie imbalances and South-North and East-North migratory flows.
- Threats to the physical environment and the négative legacy of past growth.
- A lawless and turbulent international environment.
- « Slow, irregular, unequal and interdependent growth.
- New energy price rises: bénéficiai if they are graduai.
- The flood of new technologies: a new compétitive order.
- Deregulation associated with new international and régional régulation.
- Economie compétition on a global scale with states playing a key rôle.
- Décline in industrial jobs and rise of service industries.
- Crisis of the Welfare State.
- New forms of exclusion.

3.i. DEMOGRAPHIC IMBALANCES AND SOUTH-NORTH AMD EAST-NORTH MiGRATORY FLOWS

A population explosion in the poorest countries, and relative, followed by absolute, population décline in the richest countries: this is the

marked trend which, if it continues for two or three more décades, will alter the map of the world and cause upheaval in our societies. By 2020, for example, the population of Europe will be comparable to that of Nigeria and Brazil. In 1990 the population on the southern shores of the Mediterranean exceeded that of the northern shores; in 2030, if current trends continue, i.e. without discontinuity, it will be twice as great.

The near-stagnation of population levels in the devetoped countries is the resuit of a fail in birth rates which began in the mid 1960s in both the West and the East. The United States, Japan and Europe are no longer securing the replacement of générations and are ageing in the face of Third World countries which are increasingly young and densely populated. The prospects of migration waves coming from Eastern countries will certainly increase the pressure to control and limit the flows, and pose new problems to East-West relationships.

Beyond the inévitable questions concerning pension provisions and healtli expenditure, it is the problems of integrating people of the 'third[1] and 'fourth' âges which will be raised (will we be able to continue excluding people from économie activity, through retirement, when they can expect to live for another twenty or thirty years?). At stake is the capacity of our societies to demonstrate dynamism and imagination in the face of increasingly complex global problems.

Of course thèse projections are not forecasts and are unlikely to correspond to future reality, if only because of migratory pressures. By 2030, some of today's rninorities could represent one-fifth of the total population in countries such as Germany, France or the United Kingdom. Is this a passing phenomenon or a lasting concern?

3.2. THREATS TO THE PHYSICAL ENVIRONMENT AND THE NEGATIVE LEGACY OF PAST GROWTH

The environment once again is the focus of attention, and it has taken accidents like Seveso, Three Mile Island and, especially, Chernobyl to mobilize opinion. Is this a passing phenomenon or a lasting concern?

At the start of the 1980s it was believed that the environmental policies of the preceding décade had borne fruit. The improvement in air and water quality, facilitated by resituating certain primary activities which were among the most polluting (chemicals, steet-making) gave the (illusory) impression that most environmentai probiems could be solved. Today this calm assurance is no longer apparent, for several major future environmental problems hâve burst onto the scène and are fuelling a number of controversies. What are they? What should we make of them?

Firstly, it is tliought that the reguiar increase (by over 10 per cent in the îast twenty-five years) in the levels of carbon dioxide in the atmosphère will gradually cause the atmosphère to become warmer (che greenhouse effect). Estimâtes of average température increase give a range of between +2 °C and +6 °C between now and the middle of the next century; this would not be sufficient to cause a meiting of polar ice, but could increase rainfall in certain régions such as the Mediterranean and could even cause some déserts to recède. Will yesterday's worries corne to be considered as a hope for tomorrow? Although most experts are in agreement over the trend, they are much more divided over the degree of significance of the phenomenon and the scale of its eventual conséquences (the same applies to the ozone layer). The subject demands reflection and thought needs to be given to régional agricultural specializations which could find themselves overturned. .

Secondly, tîie dégradation of the environment in the Third Worid is a very worrying phenomenon because it will affect the daily lives of hundreds of millions of peopîe. The unconsidered development of human activities, unplanned démographie and urban explosions, excessive deforestation, overexploitation of land, the perverse effects of irrigation (soil salinization) - ail thèse trends hold the beginnings of a number of crises, over vvater, firewood and arable land. This environmental dégradation in the countries of the South will only aggravate the conséquences of certain naturaï phenomena such as drought and floods (see box).

Thirdly, the risk of a réduction in biological diversity is severe, owing to the rapid rate of disappearance of animal and plant species, particularly in the tropical forests, whose stiil considérable surface area is expected to shrink dramatically (by as much as one-third between now and the end of the century). Hère again, it is information that is lacking; ail those spectacular figures such as 'one million of the 5-10 million species of living organisms will disappear' (Global 2000, 1980) are almost meaningless: how can we appreciate a réduction in stock which seems to be five limes smaller than the margin of error on the size of the stock itself? It is the stock of species - i.e. our héritage - which we hâve to understand better and record in order to préserve the fumre by conserving threatened stock.

Fourthly, acid rain and its catastrophic effects on the lakes and forests of Europe and North America is a typical example of a problem identified long ago, but without foreseeing preventative action or even enough research to aîlow the real causes to be identified - they still remain the subject of controversy. Some scientists beiieve it would be unreasonable to set up expensive control Systems which would hâve no

effect on this phenomenon of transborder pollution, whose sources are diffused and multiple (for example, exhaust fumes). Conversely, some ecologists fear that proof of links between causes and effects will not become évident until it is too late: after ali, 25 per cent of German forests were affected before there was any reaction.

Environment and thc Third World: after the footing, the massacre

In the coming décades Third World countries will reap the harvest of thc counterproductivity of previous output in many fields. One could call this 'the Aswan effect', after the Aswan dam in Egypt, where there now appear to be so many problems of such magnitude that présent and future drawbaeks (soil salinization, diminished downstream fertility due to decreased siltation from flooding, a drastic fall in fish catches in the Nile delta, etc.) could sweep away the benefits derived from irrigation in the past.

Bad or overexploiîation of land, together with soil érosion, salinization and calcification, will bring about a graduai spread of désertification everywhcre. According to some estimâtes the increased spread of désert régions in the world could amount to an area the size of France between now and the end of the century. Some countries, in order to pay food and energy bilis and to service their debts, hâve no option but to export primary materials (ores, wood, tropical products) and industrial products. Thcy are forced to overexploit and irreversibly destroy their stock of natural resources.

Thus, at the current rate of exploitation, 30 per cent of tropical forests will hâve disappeared between now and the end of the century. The prospects are particularly worrying as regards firewood since, by the year 2000, demand couid be 25 per cent higher than the suppiy normaliy available. In underdeveloped countries, confronted with considérable démographie, urban and social probiems, there is a great risk that we shalî see environmentai problems taking a back seat as an unaffordable luxury.

In particular, anarchie urbanization will put extra pressure on space and we must expect a quadrupting of urbanized areas at the expense of agricultural areas. Coastal régions (60-80 per cent of which dépend on fishing) and forested areas are the most vulnérable.

The situation is expected to deteriorate because industrialisation and hunger give rise to a rural exodus (aid always arrives in thc towns firsî), not to mention the fact that having a large family is protection against poverty and unemployment (when jobs are scarce, having several children increases the chances of securing one or severat sources of income for the extended famiSy).

Poverty, violence, insecurity, disease - this will be the lot of an ever-increasîng number of human beings crowded into enormous megalopolises (about 30 million inhabitants in Mexico City in îhe year 2000). It is not difficult to imagine the scale of the problems posed for urban living conditions and environmentai conditions: pollution is the priée of poverty.

Finally., some of the environmental problems which are emerging today are a resuit of the vulnerability and négative fallout of environmental protection policies carried out up until now: \ve vvould point to the damage caused by fikering devices, the concentration of txeated waste, the transfer and diffusion of pollution. We should also mention tlie consumption-destrucrion of certain protected spaces such as overexploited nature parks, not to mention the widespread invasion of open spaces, and tlie massacre of landscapes, particulariy by industrial or agricultural buildings. We could also cite the concrète belt along the coast. . .

Beyond tlie need for information and scientific knovvledge, which is hugely lacking in the environmental field, and which renders politicians blind, tlie major problem for the environment is primarily a problem of anticipation, prévention and responsibility towards future générations. The behaviour and practice of économie caiculation is in question.

Let us take a sad example of short-term vision: the pollution of groundwater by nitrates from agricultural ferulizers. The phenomenon is slow and almost irréversible. Notliing is done as long as the critical threshold has not been reached., and afterwards it is too late to fight tlie effects of nitrates distributed in the subséquent ten to twenty years. Is it not urgent to apply to agriculture the poliuter-pays principle to which industry has been subjected for years? Past growth has planted time bombs under our feet. Let's not wait for them to explode - let's defuse them.

3.3. A LAWLESS AND TURBULENT INTERNATIONALENVIRONMEMT

The lack of regulators (mentioned in section I) appears ail tlie more critical as we hâve to expect interna! social explosions within the Third World and an upsurge in the number of régional or local conflicts.

The seeds of tomorrow's social éruptions are buried in today's trends: rapid population increase, glaring inequalities (where luxury sits side-by-side witli poverty), massive urbanization in gigantic megalo-polises which are nearer to siums than to cities.

Beyond the multiple uncertainties of the lawless and turbulent international environment, two permanent factors can be discerned:

- International monetary instability (currency refîects geopolitics), and particulariy the persistence of a strongly fluctuating dollar in relation to other currencies.
- The 'self-centred' deveiopment of tliemselves by the developed countries (for most products and services, four-fifihs of sol vent markets will remain witliin the triad).

3.4. SLOW, IRREGULAR, UNEQUAL AND INTERDEI'HNDENT GROWTH

Interdependence is not a fiction but a reality which can be measured by means of many indicators, such as the ever-increasing proportion of national production devoted to export. This increasing openness to the outside means that no country can claim to be in sole command of its own growth: the accelerator is international and only the brakes remain national.

Because of the impossibilîty of establishing international and national structures and rules adapted to the new context of interdependence and technical and économie change, a new phase of gênerai, concerted économie growth seems to us unlikely. We would add that population ageing is hardly likely to stimulate growth.

It is irregularity, rather than siowness of growth, which will hâve serious conséquences for investment décisions, as it wili lead to forecasting errors and to erra tic behavîour shifting from optimism to pessimism and vice versa. Periods of recession will be followed by periods oi" recovery as if the powers of recall were acting to maintain growth rates around a low average of about 2 per cent - which, considering leveis of development, is considérable - four to five times higher in absolute terms than an average year in the last century.

The gaps in development between countries of the South are becoming accentuated. Thcre is no longer 'one' but 'many' Third Worlds. This unequal development, which explains the émergence of a North movement within the South, is expected to be another source of tension beCween neighbouring countries, some of which are developing rapidly, with médium population leveis, while others are prey to the difficulties of underdevelopment and overpopulation.

3.5. NEW ENERGY PRICE RISES: BENEFICIAI. IF THEY ARE GRADUAL

Expensive energy is abundant and rising prices encourage economy measures and energy substitution. Unfortunately, the fall in the real value of oil prices in the 1980s makes further sudden price rises (shocks) more likely after the mid 1990s. Already in 1990 one detonator (Iraq's invasion of Kuwait) has been enough to trigger off a price explosion.This new shock will prove ail the worse if we let up on our efforts.

3.6. THE FLOOD OF NEW TECHNOLOGIES: A NEW COMPETITIVE ORDER

New techniques of production and organization bring hope (of productivity gains, new products and services) but also threats (to jobs, freedom, etc.): it will ail dépend on the political and social choices which are made in thèse new technologies and on their rate of diffusion (we shall return to this point, which constŕuites a major uncertainty).

Compétitive differenu'als between companies will increasingly stem from the quality of organization and mastery of the information Systems which surround new technologies. After the hardware and software, ṁe 'org-ware' will be a determining productivity factor for a company's compétitive position.

Five major trends, which hâve serious conséquences, are at work for the coming years:

- Mass production of variety, by small-scale production Systems.
- The comparative advantage of low salaries becoming less and iess important as a determining factor.
- Flexibility of production equipment, indispensable for adapting to the fluctuations which characterize changing markets.
- The need for alliances and co-operation with other companies at the level of pre-competitive research, or development and indus-trializau'on, owing to the globalization of markets which atone will enable expendiuire on technology to be profitable.
- A stronger coupling between scientific research and marketing, within the framework of an efficient strategy for managing a company's technological resources.

3.7. DEREGULATION ASSOCIATED WITH NEW INTERNATIONAL AND REGIONAL REGULATION

The process known as 'deregulation' which started in the United States almost hTteen years ago is being reproduced throughout the world. In reality it is an évolution rather than a disappearance of régulations. This évolution is taking place along two fondamental axes, each with its own spécifie conséquences.

Firstly, the opening up to compétition of certain types of activîty (transport, télécommunications or, more generally, services), of certain types of market (certain public markets, for example), or of géographie régions Qapan) which unùl now hâve in fact been excluded. It is an

extension of the field of industriai compétition, in terms of physical space and sectors of activity.

Secondiy, the increased effectiveness of régulations on hygiène and health (for consumers and workers), safety and environment. The current trend is to make régulations more cohérent and précise in order to improve their effectiveness. On the whole this does not lead to a relaxation of constraints - quite the contrary - but it does guarantee that the same rules are applied universally, and this makes their deveiopment easier to forecast correctly - which aiso makes international harmonization easier.

At the European level, régulation and the introduction of standards wiil be a factor reducing uncertainty over the rules of the game, but aiso generating new areas of compétition and hence of turbulence. The international compétition to which, until now, manufacturing industries hâve especially been exposed wili extend to activities such as services (banks, Insurance, etc.), which hâve until now been 'protected'.

Finaily, the methods of instituting thèse new régulations are themselves evolving; the stratégie decision-making bodies are increasingly the EC, international bodies such as GATT, or even the American Congress. Moreover, companies hâve a greater say in thèse processes, as they hâve the expertise and as they are recognized as being fully responsible for ail the conséquences of their activities.

3.8. ECONOMIC COMPETITION ON A GLOBAL SCALE WITH STATES PLAYÏNG A KEY ROLE

Keen industriai and commercial technological compétition between companies to acquire parts of a market which has become global wili continue. The transnational arena is the place for this compétition between the large muitinationals, which are tending to form giobal oligopolies through broad sectors of activities. To this compétition wili be added increasing co-operation and stratégie alliances, for example in the technological field, which wili tend to reinforce still further barriers to entry for companies not co-opted into the oligopoiy. Those multinationals which fonction as global information Systems hâve, furthermore, two characteristics which distinguish them from other companies.

Firstly, tiiey hâve the ability to take the results of fondamental research and transform them into adaptable technologies. Thèse results, which we shall call 'stratégie basic research', are produced and published by the scientific community of the world's universities, and by virtue of this they are free; this capacity for transformation is due to

the quantitative and qualitative levels attained by tlie laboratories of thèse multinational companies.

Secondly, they hâve access to the world capital market, a huge source of finance, which moreover allows the continuous fluctuations in interest rates and exchange rates to be used as an opportunity.

Thèse multinational interact with many smaller companies, often small and medium-sized enterprises, which are rooted in régional, social and économie realities. Thèse régional companies are specialized subcontractors and product innovators and often maintain a symbiotic relationship with the muitinationais, each needing the other to ensure its competitiveness and longevity.

Between the transnational and the régional, the national level often détermines very différent comparative advantages through three distinct mechanisms. In the first place, a nation's public policies on training, standards and public markets define tlie technicai environment of the companies. Secondly, national social dynamics détermine collective attitudes towards distribution of value-added, towards the rules of tlie game between social groups and towards the individual's relationship to work and the company.

Thèse three factors détermine the social environment and the company's working conditions. Thirdly, monetary realities, as manifested in exchange rates and interest rates, constitute the company's financial environment. Thèse three mechanisms contribute to tlie 'structural competitiveness' at national level; increasingly, it is the interface between the transnational, national and régional space which forms the basis of a company's competitiveness.

3.9. DÉCLINE IN INDUSTRIAL JOBS AND RISE OF SERVICE INDUSTRIES

The décline in industrial jobs, which started in tlie early 1970s in Europe (between 1970 and 1990 industrial output rosé by 40 per cent in Europe, and at the same time employment fell by 30 per cent), is expected to spread to ail developed nations (numbers of industrial jobs hâve been declining noticeabiy in the United States since 1980, and in Japan hâve remained constant since 1973). It appears thaï what happened in tlie agricultural sector is being reproduced in the industrial sector: because of technicai progress an increasingly smali proportion of the population is sufficient to produce growing quantifies of industrial goods.

This uncoupling of production and classical industrial jobs could reach the point where, as in agriculture, tlie labour of 10 per cent of tlie

active labour force is adéquate for production needs. It is the 'knowledge workers' who will take over - they will become more numerous, even within industry, than traditional blue- and white-collar workers.

Services, i.e. commercial and financial activities, transport, ieisure, utilities (water, electricity), public administration, éducation and health, today employ 55-65 per cent of the active labour force in the industrialized nations; this growth of employment in services is as huge as it is récent. The proportion of household consumption spent on services is growing continually (45 per cent of the total) and it appears that expenditure on health and éducation can only continue to grovv in future.

As for companies, functions other than production are developing rapidly. At each stage, from ravv material to finished product, activities involving organization, stock controi, maintenance, repair, co-ordination and information hâve increased to the extent that they now make up the most significant proportion of product cost.

This 'tertiarization of the secondary sector' also affects the product itself (often made up of an integrated whole of products and services), and investment is becoming increasingly 'non-materiaP (training, software, R&D, marketing, etc.) and is growing at four times the rate of material investment. This development of services both within and outside the firm is central to performance improvement.

However, this rise in services is running into three différent kinds of limitation which are mortgaging its growth in the médium term. First, collective services see their development limited by public finance problems; financial restraints, moreover, are bringing to a head the problem of the growing differentiation of some consumer services (health, social security, éducation) as they are privatized. Second, the growth of services in the home is reaching its limits as consumers produce thèse services themselves by purchasing the product which performs the service (for example, buying a washing machine înstead of using a laundry service); there are also limits to the amount of free time devoted to consuming services.

Finally, and more fundamentally, technological advances hâve still not produced a new wave of activities which go beyond mère gadgets and which satisfy real needs. Prospects are starting to shape up, however, for some services to companies, where information technologies play a key rôle. But this will only émerge after a period of social learning and the installation of major infrastructures (telematic networks), which means that they remain hypothetical for the présent.

In fact, services are creating three times fewer jobs in France today than fifteen years ago, and do not compensate for the réduction in jobs in agriculture and industry; thus, the 'white tide' has not managed to

submerge unemployment. So will opportunities arise out of strengthening service exports? (France is well placed on this score, ranking second in the world, just behind the United States). Tourism makes up a large part of this item. When a country does not hâve enough products to export, it sells its landscapes, its way of life - another reason to préserve them.

3.10. CRISIS OF THE WELFARE STATE

In most developed countries (in Europe, the United States and even Japan) the size of compulsory déductions (taxes and social security payments) in relation to GDP bas increased sharply since 1973, and now, in Europe, often represents 45 per cent of the national product. This percentage, which has climbed by 10-15 points in the space of ten years, cannot grow indefinitely without damaging gênerai économie acu'vity. In many cases, limits are imperative, particularly in Europe, where social security is facing an exponential growth in heaith expenditure.

Reducing the scale of compulsory contributions and at the same time diminishing the rôle of the state in the economy would seem indispensable in order to heip restore companies' ability to finance themselves and to avoid penalizing those who wish to vvork more and thereby earn more. If this réduction in the tax burden is to happen without worsening the budgetary déficit, it can oniy be at the cost of either a réduction in the wage bill of public employées or by imposing limitations on social transfers - the choice has to be made. Contributions are oniy one aspect of the problem. Public expenditure must also be considered. In France in 1990 this represented 52 per cent of GDP, and public debt rosé from 20 to 40 per cent of GDP in a few years. This will hâve to be repaid, and the return of inflation, *'That momentary agreement in reported confusion'* (according to Pierre Massé), could prove politically convenient.

Beyond the fînancial crisis there is also a crisis in the legitimacy of the Welfare State. With the présence of a strong, dominant and omni-interventionist state, it becomes more advantageous for citizens to seek to manipulate (or to take possession of the state apparatus) than to base their relationships on mutual reciprocity, creating an optimal social increase in value. The logic of the state, whether right or left, can oniy be 'corporatist'. Some social groups are better placed than others to apply pressure and obtain extra benefits from the state, to the détriment of the collectivity. In the struggle of redistribution the state becomes party to the law of the strongest.

The state must, however, support the infantry of the économie machine and tend those wounded and left out for the count by the savagery of the market. To préserve social peace it must brandish the imperatives of solidarity and give a quasi-wage to the unemployed, ready to recoup the corresponding costs (unemployment, benefits, national insurance payments) through taxation.

Finally, there is a crisis of effectiveness: the administrative machine is no longer accountable. The state is the worst of bosses. Financial crisis is forcing it to accept the relative impoverishment of public employées. In many administrations absenteeism has increased threefold since 1980; as one administrative director commented: 'Civil servants hâve compensated for their reduced buying power by taking time off.' Perhaps what is needed is fevver, better paid civil servants - except that some see the civil service as being rather like a day hospital

We also recall the French Government giving lessons on wage policy to the Peugeot group in autumn 1989. Some catégories of worker were better paid in one establishment than another, despite being equally qualified. But the state wouid do well to put its own house in order - after ail, it currendy pays the same Central Administration Director 50 per cent more if he vvorks in the Ministry of Finance than if he works in the Ministry for National Education! And members of ministerial cabinets receive cash subsidies - which are not subject to any kind of taxation. The example of what not to do cornes from above - not to mention those politkal parties which vote to amnesty their financial misdeecls and bribes. How dare they still put people in jail for stealing apples?

When taxation kills work, when the state holds its civil servants in contempt and sets a bad example for its citizens, when the state plays a disruptive rather than a regulatory rôle, then it becomes intolérable. We would add that the crises of effectiveness and of legitimacy are merging. In reality, power is in the hands of a state aristocracy which is very few and happy. Hence several thousand families, seemingly by chance, hâve a monopoly ho!d over the best jobs from one génération to the next.

3.11. NEW FORMS OF EXCLUSION

In order to break down the ramparts of résistance and rigidity built up by the social oligopoly (organized pressure groups) towards any change which could call into question benefits acquired in the past in another context, there wili probably be a high price to pay in terms of crises and unemployment. However, in a world where everything is changing,

advantages must also change. Unfortunately there is good reason to believe that in this clash between the forces of change and the forces of inertia, some people vvill fatl by the wayside in a rearguard battle - young people, older workers . . .

The unemployed are often excluded from die job market by those who control the éducation System. Unemployment is very destructive in a world vvhere work has become the essential channel for social récognition and value, and where the overworked man or woman is the syrnbol of success. Exclusion from the job market is a form of social death.

4. Three major uncertainties

If die above trends seem probable, what exactly would resuit from a conjunction or confrontation between them is a question full of uncertainties. Hère vve cail attention to three uncertainties vvhich it wouid seem important to take into account.

4.1. WlLL THE RATE OF DIFFUSION OF NEW TECHNOLOGIES BE AS RAPID AS FORECAST?

In answer to this question vve can only postuiate that generally progress vvill remain slow, due to the inertia inhérent in production and social Systems. We couid note numerous cases of résistance to the effective introduction of new technology.

Résistances are perhaps even stronger in the tertiary sector, in so far as this sector has so far been less affected by ṁe stimulus of international compétition. At the end of the 1970s it vvas beîieved that in a few years' time new office technology Systems would take over ail service industries (banks, insurance companies, administration, etc.). Today vve realize that this has not been the case at ail. Many factors combine to explain die slow rate of ṁis pénétration. In the first place there is the question of reallocating time freed by new techniques (of production, organization, etc). What is die point of investing in order to obtain productivity gains which cannot be translated into expanded producdon (due to saturated markets or slow growṁ rates), or into staff réduction? The staff are there, and must be kept busy, and a reducdon in working hours can only be graduai (if it is to be equitably shared out between sectors).

In the second place the généralisation of office technology means that the world of work becomes relatively transparent, which works against estabiished hiérarchies. Information technologies are not neutral *vis-à-vis* power structures. It is therefore hardly surprising that certain actors at the heart of companies (often managers) feel threatened and resist innovation.

Furthermore, we should not forget that what is technologically possible is not necessarily economically profitable (we should beware of creating a Concorde in the field of telematics) or socially désirable. As évidence we can take the issue of teleworking and homeworking. It is unlikely that homeworking wili develop to the point that a significant amount of office work disappears. Several factors militate against this maximalist hypotliesis. For one thing, the actual physiognomy of urban housing estâtes in France - their pokiness, iack of comfort and the mediocrity of the environment - makes it unlikely that tliey vvill be lived in for whole days at a time. Moreover, we should take into considération the fact that work is a social activity and meets a need for communication which is satisfied to a lesser degree elsewhere.

4.2. METAMORPHOSIS OF WORK AND EMPLOYAIENT

Unemployment today affects 10 per cent of the active labour force in France - tomorrow it may weil affect 15 per cent, then 20 per cent or more if there is no change in structures, organizations, rules of the game and behaviour. This means we are heading for a dual society - vvith a growing proportion of the population (the young and the old - who are becoming younger and younger) - excluded from the labour market. Such a scénario can only be explosive,

Ultimately, there is only one way out - a sharing out of work and income, matched with greater mobility of existing jobs (if there are only four jobs for five workers, this is not a probtem if the jobs are rotated - but rather an opportunity to increase créative breaks from work). If a continuation of the secular trend towards a réduction in working hours seems probable and désirable to us, it does not hâve to mean a decrease in hours of reai activity. People do not want to work less, but to work differentiy. Reducing the working hours of one's main activity in fact means opening the door to a variety of activities.

In order to avoid the dual society, we must promote the pluralistic society (where each individual could hâve several jobs and where each job could be occupied by several people).

4.3. EVOLUTION OF LIFESTYLES AND SOCIAL ORGANISATION EN DEVELOPED COUNTRIES

The most persistent question concerns the évolution of values and ways of life. At this level, conjecture fails, as fururists do not see clearly and sociologists hâve difficulty in understanding the présent or even the récent past. As for analyses in terms of lifestyle, thèse hâve no prédictive value. They record changes without explaining them. Lifestyle studies do not explain household purchase behaviour, but rather traditionai sociodémographie catégories. In technical terms, the percentage of 'variables' explained by 'lifestyles' is almost systematically negligibie, and in ali cases is ten times less important than any sociodemographic indicator such as the level of éducation ofthe housewife or lier profession.

After the Second World War new values emerged to replace tlie traditionai values of fulfilling one's duties, of making one's efforts pay, of saving, and of hiérarchies. Thèse new values were to become dominant during the 1960s - they gave priority to consuming, to the attraction of novelty, and to the importance of keeping up appearances.

From the end ofthe 1960s, however, this model, which had been taken on board by the majority and even become hégémonie, found itself challenged by the émergence of new values, characterized by the rejection of the criterion of social excellence, and of the motives of status, large organizations and bureaucracy, in order to give importance to conviviality, personal and cultural life, relationships, quality of the environment (personal and collective), decentralization, small groups, autonomy and self-realization.

Were the values of the 'post-materialist' society about to sweep avvay those of the consumer society, just as fifteen years earlier thèse had supplanted traditionai, rural, bourgeois values? The 1970s were to bring many surprises, and in particular they were to strip this question of its meaning.

As they spread, the new values amalgamated in a heterogeneous way vvith tlie values of the consumer society, which assimilated them. Conviviality was translated into Club Méditerranée, autonomy into tlie suburban detached house, and self-reaiization into hi-fis. Beyond a small minority fringe, were the new values to become anything more than gadgets, simple avatars ofthe consumer societies?

Double socialfragmen talion

Beyond the current phase of adj'ustment of demands and behaviour to new opportunities and new constraints, it seems that we are heading towards a double fragmentation of tlie social scène:

- Deepened and renewed fragmentation at the ievei of the classical major social partnerships (employers, unions, the state, socio professional actors), who are negotiating over the way revenue is shared out, and over the status and development of the Welfare State. We hâve a social oligopoly, whose game will be further complicated by the appearance of new social partnerships and the often unstable institun'onalization of minorities or groups representing other values.
- Fragmentation of the représentatives of 'new values' into many groups and minorities, expressing différent values or even différent interfaces between common values and varied opportunities and constraints. This juxtaposition between the believers in moral excellence (the 'militants'), the small, more or less closed groups (even sects), the 'new consumers', those who live for the moment, the minority who hâve a satisfying job, the 'new agriculturalists', those without work (or without declared work), etc., will translate into growing disparities in lifestyles, demands and behaviour.

In this variety we shall find ail the possible degrees of compromise between partially contradictory trends developing in parallel, such as the search for -both autonomy and security, for both freedom and a sensé of roots.

5. The lie of the land in the year 200(1, in brief

The main fieids which we tackle hère are as follows: international environment; energy; economy, technology and industry; ways of life and socio-economic organization.

It is best to treat the terms 'uncertainties' and 'discontinuities' as if there were a question mark at the end of each variable. Thèse terms indicate propositions subject to doubt and controversy, whereas the term 'trends' corresponds to probable developments, even quasi-certainties. We ask the reader to excuse the sometimes pleonastic and incomplète nature of this Prévert-like list.

5.1. PROBABLE TRENDS

Lawless and turbulent international environment

- Absence of an international regulator (the old bipolar order is dead but the new multipolar order is not yet ready to be born).
- International monetary instability: strong fluctuations in exchange rates.
- Worldwide démographie pressure - 5 billion people in the world today, at least 6.5 billion in the year 2000, then 8-12 billion during the first décades of the next century.
- Démographie concentration in developing countries (70 per cent of the Third World population concentrated in eight countries).
- Development inequalities between countries in the South increasing more rapidly (greater économie and ecological inequalities).
- A minority in the South (400 million inhabitants) with access to Western-style consumption patterns.
- Explosive and anarchie development of the megalopolises of the Third World (Mexico City will hâve 30 million inhabitants in the year 2000); domestic pollution, destitution, violence ('polluted poverty').
- General overexploitation of our héritage (forests, water, petroleum, ores, agrîcultural land, fish, etc.) in order to satisfy local needs and to obtain, at any cost, export earnings or import substitutes.
- Development of nationalism, growing number of régional conflicts.
- Nuclear proliférâtion and sophisticated arms (several countries will acquire nuclear armaments in the 1990s).
- Rise of religious - particularly Islamic - fundamentalism.
- International migratory pressure; flow of illégal immigrants and refugees.

Energy

- Rising energy priées (in the order of a doubling in real value up to the year 2000).
- Decelerated increase in global energy consumption (about 1-2 per cent per year in volume).
- Strong inertia in production and consumption structures.
- Variety and heterogeneity in energy poîicies among developed nations.

Economy, technology and industry

- Increasingly interdependent économies, despite protectionist threats and increasingly global market.
- Four-fifths of the soivent world markets situated within the txiad of North America, Europe and Japan.
- Slow, irregular growth in the North, unequai growth in the South.
- Painful new industrial restructuring (for exampie, the car industry, electronics).
- Process innovation (automation) ratlier than product innovation.
- New era of growing profits (earnings from capital and labour).
- Development of smali, decentralized, forma! and informai production units, altowing mass production of variety.
- Industrialization of tertiary activities and tertiarization of secondary activities.
- Deregulation and new régulations in services (banks, insurance, transport, distribution).
- Continued décline ofthe numbers of jobs in industry.
- Scarcity of professionaîs in traditional areas of employment (services, building industry).
- Persistent unemployment and rise in social tensions.

IVays of lifc and socio-economic organization

- Attitudes and behaviour evolving more slovvly than économie and technological developments.
- Disappearance of the peasantry and rise in the power of retired people (the 'grey panthers').
- New forms of inequality (qualitative, status, lifestyles) increasing together witii inequaiities in income and wealth.
- New forms of frustration and exclusion as a resuit of the perverse effects ofthe rise in the number of diplomas - 'the diploma disease'.
- Growing burden and declining effectiveness ofthe Welfare State.
- Extension of the market to collective goods and services: éducation, health, environment, culture.

Socio-economic trends

- Ageing population and increasing health costs.
- Increasing dichotomy between vvorkers assessed by their status or qualifications and the rest, exposed to risk, compétition and insecurity or excluded through unemployment.

- Worsening of unemployment until the end of the 1990s.

Trends in lifestyle and aspirations

- Growing heterogeneity and differentiation in lifestyles.
- Development of contradictory trends - the need for security (social protection, job., etc.) and aspirations to autonomy.
- Growing feelings of insecurity - individuals withdrawing into themselves or into the nuclear family ('the family as social shock absorber').
- New forms of social, cultural and technological exclusion (computer illiteracy, the perverse effects of the race for diplomas).
- Increasing incompatibility between aspirations, training and jobs; demotivation for work.
- Qualitative extension of the 'third âge' (people are old at an increasingly young âge and young at an increasingiy advanced âge; it is diffkult to find work after the âge of 45, and yet people are fit for longer).

Trends in cily life and transportation

- ïnertia ofurban forms.
- Rejuvenation of town centres and small villages.
- Social ségrégation in urban areas and decay of certain areas.
- Saturation point reached in car parks.
- More hours spent on transport.
- Long and fréquent journeys.
- Continuation of the rapid development of air transport.

Trends in lourism

- Search for new tourist sites - including the rediscovery of what there is in one's own country.
- Spread of the tourist ghetto phenomenon in Third World countries, particularly on the coast.
- Differentiation of holidays and the development of business.

5.2. MAJOR UNCERTAINTIES

International environment

- Significant immigration fiows into Europe from the South and the East.
- Economie renewal of the ex-socialist countries.
- Break-up of the Soviet empire and conséquences for European security.

Energy

- Graduai or graduated oil price rises.
- Another Chernobyl-type nuclear accident.
- Future of nuclear power and coai.

Economie, teclmology and induslry

- De-industrialťzau'on of certain developed countries (United States, United Kingdom).
- Rate of diffusion of new technologies and associated products and services.
- Impact of robotization and automation on the size of production units - end of gigantism, 'small is profitable'.
- Return to their Northern birthplace of certain industrial activities which hâve emigratecl to the South (such as textiles).
- New export opportunities (construction, environmentai industry).
- Décline of the traditional wage-earner (with one, full-time job).
- Rise in multi-occupatťons and entrepreneurship.

Ways oflife and soeîo-economie organization

- Reinforcement of inequalities in income and particularly in wealth and lifestyles.
- Reducedj increased or flexible retirement âge.
- New forms of work organization.
- Job sharing, part-time work, legalization of mooniighting.
- Emergence of aspirations to order, due to feelings of insecurity.
- Far-reaching revision of fiscal Systems and levying of social taxes.
- Importance of the social power of people of the 'third[5] and 'fourth' âge.
- Measures taken to reduce the burden of public expenditure.

- Impact on professional mobility of the need for a sensé of roots (living in rhe country).
- Future of inner cities and dense peri-urban areas.
- Development of multiple home ownership.
- Rôle of spiritualité' in advanced societies.
- Intégration of immigrants/émergence in Europe of American-style urban ghettos.
- Privatization and regionalization ofthe éducation system.

5.3. POSSIBLE DISCONTINUITIES (EXAMPLES)

International etwironment

- Fîerce US protectionism.
- Serious social conflicts in Japan.
- Break-up ofthe EC.
- Blockade of the Gulf and embargo on petroleum exports, political and économie blackmail and embargoes through technical and industrial embezzlement.

Energy

- Nuclear accidents and a sudden stop to nuclear programmes.
- Technological breakthrough in fields such as fusion, gasification of coai, geopressure, etc.
- Discovery of huge oilfields outside the Middle East.
- Harsh and lasting rupture in supplies from the Gulf.

Economy, lechnology and indus cry

- Changes in means of production (carbon chemistry, chemistry of wood).
- Revolutionary breakthroughs in bio-industries.
- Major accidents.

Ways oflife and socio-economic organization

- Self-organization ofthe unemployed (huge démonstrations).
- Pogroms, new religious wars, conflicts between cultural communities.
- Résurgence of religious practices in advanced countries,

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