ABSTRACT. This paper discusses the possible uses of economic analysis for strategic planning decisions in firms. It proposes an approach which emphasizes the role of common knowledge for decentralized parallel decision processes. Planning is interpreted as an interactive process among a set of agents who use a plan to formalize a theory of action and an invalidating procedure. In the course of action the agents are supposed to cope with uncertainty as long as the chosen theory remains justified. This approach has strong connections with some recent trends in managerial economics and in particular with the current work in the production sphere which similarly illuminates the role of common knowledge through objective physical flows to promote global efficiency of the firm.

Keywords: Planning, organizational learning, focal points, model building.

1. INTRODUCTION

Historically the sphere of economic analysis in the firm is closely related with capital investment planning, emphasizing the optimization of financial streams. The assumption that markets are almost complete and subject to perfect competition underlies the foundations of such applications.

More recently, economic analysis entered another avenue to planning problems. This avenue is concerned with business strategy and is best exemplified by the work of industrial organization economists. It relates to diversification—both horizontal and vertical—the study of markets and entry barriers, pricing schemes, economies of scope in production, etc. The notion of strategic group is probably the one that goes furthest in that direction (Caves and Porter, 1977), whereas Porter's textbook (1980) is a well known example of techniques which are explicitly based on the industrial organization literature. In many companies portfolio analyses and references to generic strategies are more commonly used to evaluate strategic decisions than discounted cash-flow methods. However, it seems that the implicit rationality assumptions that underlie the foundations of these strategic tools are more uncertain than the early applications of economic analysis in...
capital investment. Indeed the analysis of the interactions among a few agents is far more complex than analysis of interactions among many agents. Several basic problems arise and are well illustrated by the current stream of research in non-cooperative game theory: multiplicity of equilibria, uses of ad hoc assumptions, lack of robustness of the results (Van Damme, 1987). This difference in modelling capabilities has been recognized on the basis of many experiments over a long time. While it is relatively easy to reproduce general or partial equilibrium results in situations involving many agents, the predictive power of game theoretic concepts is fairly poor as long as the number of agents is small.

From a more theoretical angle, it is clear that the common knowledge assumptions underlying the general equilibrium approach and the game theoretic approach are quite distinct, the former requiring many fewer than the latter (Arrow, 1986; Gérard-Varet, 1989).

This discussion on the foundations of economic analysis is important for applications. In particular, whether or not the use of the associated techniques should or should not be similar to the use of more standard economic tools may merit some attention in order to avoid pitfalls in interpretations of the corresponding results. Two recent research developments seem quite relevant to a further investigation of this question and to casting some refreshing light on an old and recurrent topic: what is the status of an economic model?

The first development concerns the fundamental work that is currently being done on the validity of non-cooperative solution concepts in game theory. Among this research a particular direction seems to be directly related to our question. This direction seeks to explicitly integrate the common knowledge assumption in the reasoning of the players. Solution concepts no longer seek to be generic but may integrate ‘focal’ aspect of the situations. This idea is discussed at length in Ponssard (1990). See Ponssard (1991) for an application of this idea to entry games in case of increasing returns to scale; see also Crawford and Haller (1990) for an application of focal points well in line with Schelling’s original view (Schelling, 1960).

These approaches do have to face the criticism of partially ad hoc definitions but these criticisms are explicitly discussed and partly rationalized because of the singularities of the situation at hand. This is
a somewhat new approach to the notion of common knowledge, as opposed to purely axiomatic approaches (Bernheim, 1988; Aumann, 1976).

The major implication of this trend in the literature is that individual rationality no longer exists as such. The players are linked by a common representation of the problem and the major issue becomes the foundation of that common representation rather than the study of arbitrary rules of games conceived as exogenous. Consequently, to attribute any validity to a strategic tool indirectly referring to a game approach means to have good confidence in the objectivity of its internal structure, including confidence in the computational procedures which are been manipulated by the analyst on behalf of the players. In many applications this condition is not satisfied and this throws a lot of discredit on the corresponding studies (see Carrance, 1988, for a detailed empirical analysis of such pitfalls in the use of the portfolio method).

Quite independently there is a recent body of managerial economics research which puts a similar emphasis on objectivity and joint rationality as opposed to an individual approach. This work is mainly related to production planning, an area in which coordination problems are crucial for the overall efficiency of the firm. This work emphasizes the importance of material flows, the analysis of the interactions between successive departments, the need to keep a global view of the process rather than to improve productivity locally using imperfect accounting standards (see Goldratt and Cox, 1986, for a stimulating introduction on Just In Time practices and related issues).

Indeed this area of research implicitly carries with it a different representation of the firm as compared to the more traditional principal agent approach, which would be the natural counterpart of the industrial organization literature for the formalization of organizational behavior (see Aoki, 1990, for a recent survey emphasizing this contrast, as well as many insights on the direct and indirect means to promote horizontal coordination in the Japanese automobile firms).

To be more precise, this recent body of managerial economics research emphasizes interaction between agents (even between external agents to the company), conventional behavior, and common knowledge of the problem to be solved, whereas the principal agent
approach emphasizes incentive compatibility, asymmetry of information, and possible subjective representations of the problem. Again, it can be observed that the emphasis is on joint rationality rather than on individual rationality.

The starting point of this paper originates from this parallelism in both theoretic and applied research in apparently different fields, trying to introduce cross fertilization. This seems worthwhile since, in spite of the parallelism, the advantage obviously is on the theory for industrial organization and strategic planning, whereas it is on the application in the production area. Consequently, this paper seeks to define a use of economic tools for strategic problems which in many ways would be similar to the approach to production problems referred to above. This has been motivated by a number of applied studies in the area of strategic planning, an example of which is given in the appendix.

Section 2 discusses the class of planning problems for which such a change in perspective may a priori be appropriate. Section 3 gives a detailed development of the proposed approach, emphasizing practical ways to introduce and maintain common knowledge in model building. This leads to a definition of planning in which this activity may be considered as the process of eliciting a theory as well as the associated invalidating mechanism. In the concluding section we come back to theoretical issues and discuss some directions for further research.

2. STRATEGIC PLANNING PROBLEMS

The class of planning problems which one may consider as a priori relevant could be characterized as follows.

(i) These problems are more long term than short term in the usual sense; they may concern major capital investments, redesign of a whole range of products, potential breakthrough in R&D programs, etc. Formally, the main idea is that the firm is looking for a plan with respect to a long term complicated decision problem rather than for a decision to a one shot problem.

(ii) The implementation of a plan, whatever it is, will involve several internal agents of the firm, in terms for instance of production versus sales departments, operational versus staff departments,
each of them having a partial view on the environment of the firm, whereas this environment consists of institutions that should themselves be decomposed into agents to arrive at some valid level of analysis of the forces which are at work (this kind of framework is precisely the one suggested by the strategic group approach); at this level the game aspect has some practical content in the sense that the players are no longer pure abstract entities but players with meaningful constraints and standardized procedures to assess new opportunities. Yet to carry out a formal game theoretic analysis would be out of order.

(iii) Going back to the firm—or, more precisely, to the agents of this firm which face a planning problem for a given strategic issue—it is now assumed that these agents' views are potentially conflicting; in other words, this firm has no current standard procedure to coordinate the decentralized actions of these departments with respect to this issue. This is well in line with the organizational behavior literature which distinguishes between incremental decision making and crisis situations (see Mintzberg, 1978, for an insightful discussion of planning and the role of crisis).

Summarizing the ideas, the class of planning problems to be considered contains three ingredients: the search for a plan in a long term problem; the partly decentralized aspect of the implementation of that plan; and the failure of current standardized procedures to directly assess the economic validity of any preconceivable plan with respect to this problem.

In common terms this class of problems is often referred to as strategic problems and the emphasis is put on how to achieve a 'sustainable competitive advantage' (Porter, 1980).

3. ECONOMIC ANALYSIS AS AN INTERACTIVE PROCESS

3.1. The Role of Planning: Designing New References

It is now worthwhile discussing at some length what is meant by the search for a plan, or what is to be expected from a given plan.

From a practical point of view it has long been recognized that
decentralized decision making within an organization requires standards, rules or conventions (for a well known reference on administrative behavior see Cyert and March, 1963). And this is also true for the decentralized use of economic calculus which requires such notions as full, marginal or opportunity cost, transfer prices, rates of depreciation and many other notions which can only be operationally defined through standards. The absence of such standards makes management extremely time consuming and any small problem becomes strategic.

One of the main ideas of the interactive approach, then, as opposed to more traditional ones, is that it should take the form of a policy—that is, rules, standards, conventions—with respect to how to handle, not the issue at hand, but a whole class of more or less similar issues.

Now, elaborating a plan in this sense has no direct counterpart in economic analysis, which does not distinguish between planning and acting as such. In fact in a complete formal model there is no difference between the two. Yet a simple example should be enough to illustrate this difference in practice.

Consider an inventory problem. An $(S, s)$ strategy is a policy which may be optimal under some hypotheses. It means that the inventory should be filled up to $S$ whenever it falls below $s$ and this is to be optimized over several types of costs: opportunity cost for lost sales, capital cost for inventory, fixed order costs. When this strategy is not optimal, more complicated strategies may be looked for (for examples in case of successive inventory levels or multi-item inventory or seasonal sales, etc.).

In the proposed approach, an $(S, s)$ strategy is called a policy, independently of the fact that it is or it is not the optimal way to solve the given problem. It is proposed as a starting point, somewhat arbitrarily, to start an incremental search for decentralized behavior. Indeed, it is a policy because it can be improved locally with observations that are directly accessible to any agent along the production process (for instance the agent may update the forecast demand to introduce outstanding sales; he may have information on a change of the required delay to reorder).

By contrast, a production schedule which depends on centralized data and conveys specific orders to the various agents through a central office would not be called a policy, independently of the fact that it
may or may not be more efficient. There may be a policy behind the orders generated by the central office, yet this policy is not accessible as such to the local agents, who carry out the orders given by the central office.

The \((S, s)\) policy, because it is proposed as a policy, cannot only be improved locally but also globally. Each agent can more or less infer the relationship between his own control variable and the parameters on which the others are doing their own local optimization and this allows for some flexibility, provided 'off the record' information is passed along. Such a relationship does not exist in the second approach, the agent is supposed to do exactly what he is told by the central planning office and he has no idea about the overall impact of any local deviation.

The reader familiar with the early work on Operations Research will recognize that this notion of policy is similar to the idea of dynamic programming in which one seeks to embed a given numerical problem into a larger class of problems so as to enhance the qualitative pattern that an optimal strategy may have. The existence of a pattern is an essential feature of a policy. We propose to use a similar approach for the use of economic tools in strategic problems. More precisely two points will be discussed:

- what are the potential policies that may make sense, given what is currently known of the strategic problem (i.e. what are the potential classes of problems which may be relevant and which may generate interpretable plans)?
- how to generate a set of indicators which may eventually invalidate the adopted policy given what will actually be observed through the passage of time (i.e. the potential class of problems used to elaborate the policy may turn out to be inadequate)?

Accordingly, a plan is not a set of decisions to be implemented, \textit{a fortiori} it is not a forecast of the future. It has the same formal status as a theory: it is arrived at through a more or less conflicting mode; it is used as a reference as long as it is not admitted that it should be considered as outdated. Yet the exact procedure through which it may be invalidated is difficult to identify since it is partly interpretative. But
the fact that the plan is defined as a policy that can be invalidated is an important practical aspect of the interactive approach. First, it forces the collective construction up to an operational implementation stage rather than staying at a qualitative and vague recommendation level. Second, it forces the agents to identify the set of data which will be collected to test this validity at the time goes on (see Hall, 1984, for an example of an implicit organizational theory that was never tested and led to bankruptcy). In fact it is often the case that the data and the underlying theory behind the policy be closely linked, so that the idea that purely objective data may exist is meaningless. This explains why in practice new plans may not be economically studied because the relevant data are just not available. This is an argument that gives even more weight to the explicit address of this question of invalidating procedures at an early stage.

This view of the role of planning has several consequences:

- since the elaboration of a theory is a complicated task one should not be surprised that many planning sessions are unproductive;
- if the agents within the company recognize the fact that a plan is indeed the local incarnation of a theory (rather than a 'train schedule' that should be implemented no matter what), they should interpret each other's behavior, giving a broad perspective to this notion of plan (i.e. if necessary go back to the intended pattern that could be associated with the policy).

Now the most interesting consequence can be discussed:

- the degree of incompleteness may vary from one set of policies to another one but some incomplete policies may be more efficient than more complete ones as long as the same culture is shared by the agents (everybody can make reference to the same class of problems to cope with local uncertainty); to voluntarily eliminate this incompleteness at the planning stage (that is, to explicitly introduce these uncertainties into the formal reasoning which generated the policy) may inhibit adaptiveness and flexibility for the organization at the implementation stage.
This third point is now well documented in the production sphere in which less structured horizontal coordination schemes are much more effective than the more vertical approach related to Taylorism. This is particularly true given the current trends towards nonstandardized production, as in the automobile industry (see Aoki, 1990 for empirical evidence, and Hatchuel and Sardas, 1991, for a simulation study of the robustness of MRP methods under various organizational schemes).

The subsequent question that comes to mind is the following: to promote this more effective use of economic analysis, is there a difference in the tools themselves or is it only a judgmental issue? The thesis of this paper is that it is both a technical matter and a judgmental issue.

3.2. New Tools for New Uses

Let us first discuss some judgmental issues related to the promotion of common knowledge in model building.

Given that the firm is structured by a number of policies—budget control, organizational chart, production policy, etc.—the fact that a strategic question arises does not mean that a complete reshuffling of the current standards and procedures should be done. How many of them should be affected is a difficult practical question.

Leaving this problem aside, the idea is that the goal of the interactive process is to construct partial common knowledge among some agents of the firm. At the beginning of the approach the conflicting views are supposed to result from the partial information that each agent has about the future and from the constraints that are imposed upon him through the current set of company standards. Then the role of the economic analysis is to promote common knowledge. It should start with a policy that can be agreed upon, presumably a very simple and unrealistic one, and then incorporate more realism through local incrementalism, keeping in mind who in the organization is providing what kind of data and when. The emphasis is on joint rationality, i.e. on the analysis of the interaction between the agents; in this sense the model parallels the actual organizational chart (or possibly suggests changes in this chart).
Accordingly, the economic model which is produced emphasizes objective references, such as material flows and global financial results for the firm, rather than the economic benefit to each department. Here economic modelling offers a partial solution to the inherent complexity problem of internal coordination and the model building activity is conceived as the key ingredient of an organizational learning procedure (for a similar emphasis on organizational learning, see Argyris and Schon, 1978; Hatchuel and Molet, 1986; Midler, 1990). Economic models developed in this approach are closer to accounting tools, with their conventional and incomplete aspects, than to models involving utilities and subjective probabilities (see de Jaegere and Ponssard, 1989, for a conclusive experimental test of this idea).

This approach leaves aside the incentive problem (which has been the major focus of the principal agent theory). In a way this approach seeks a Pareto improvement for everybody, but—and this should be emphasized—without explicitly computing individual utilities or for that matter explicitly discussing the incentive mechanism that can be used to implement the plan. It seems that to explicitly introduce this dimension could provoke a complete change of attitudes; everyone defining his behavior in his own interest within the most narrow perspective. This is also to say that the approach suggested in this paper has strong limitations; in particular it is most useful when the current situation is perceived as dramatic (for strategic decision problems, and this is well exemplified by the study detailed in the appendix), or when an adequate promotion scheme has been designed to promote team work and long term goals (for problems related to the production sphere as discussed in the case of the Japanese firm).

This idea can be illustrated by means of two extreme ways to handle production streams within a company. The standard approach would typically use cost allocation and transfer prices to promote individual incentives. The proposed approach would typically identify the overall objectives to be achieved and decompose them into coordination objects for the various departments using a simplified view of the underlying production function, which may integrate some specificities of the firm.

From a practical point of view it should be recognized that the first
approach can be completely operationalized independently of its intrinsic value (and for that matter it may be very inefficient; for a historical perspective on cost allocation procedures and their limits, see Kaplan and Johnson, 1987), whereas the second approach often leads to partial and incomplete procedures. This explains the emphasis that is put on cultural aspects to 'complement' the incompleteness of the approach. This may be interpreted in economic terms as providing a culture to promptly identify new focal points (as defined by Shelling, 1960). As such it should build on the singularities of the situation and on the ability of the agents to spontaneously re-coordinate themselves in a somewhat changing environment.

This discussion provides a natural transition to discuss the change of perspective in economic theory which may be helpful to confront this approach. From a purely formal standpoint the corresponding models can be seen as tentative solutions to decentralized control problems; i.e. dynamic decision processes carried out by several agents, each one observing some private information relevant for the whole process. These problems are known to be extremely difficult to solve numerically (Paradimitriou and Tsitsiklis, 1986). The idea, then, is to search for a solution within a class of well-defined admissible policies that can be decentralized because they are meaningful as opposed to a purely numerical solution. The range of validity for the set of parameters for which a given policy is optimal should be explicitly identified, possibly in a simplified version of the original problem. Given this information, and given the fact that most of the time the optimality could only be proved in a simplified framework, one should design an invalidating procedure to interpret the inevitable deviations observed in the actual decision process. The exact theoretical form that this invalidating procedure should take will depend on the chosen class of problems which is used to embed the original one. But the underlying idea is that, since planning as defined here is extremely costly, the invalidating procedure should leave enough freedom to cope with the uncertainty locally as long as the overall credibility of the policy is not endangered (for a detailed implementation of this whole process on an illustrative example see de Jaegere, 1991; see Kervern and Ponssard, 1990, for its practical counterpart for capital budget decision problems).
This approach to the use of economic analysis emerged from the consulting practice of the authors. It is an attempt to restore the use of quantitative methods in planning after a period of decline. It is clear that intuition, feeling, leadership, etc. play a strong role in practice. Yet it is also true that quantitative tools implicitly embedded in capital budgeting, accounting, cost allocation, control, also play a major role in the functioning of organizations.

It is believed that the economist has something to say with regard to these tools and on the way they are used. The current emphasis on strategic planning tools directly derived from the industrial organization literature may be deceiving in the long run if the relationship to economic analysis is not changed because of the inherent weakness of the underlying rationality assumptions.

By contrast, the proposed view on the use of economic analysis seems to open new avenues for their applications. Moreover these considerations are believed to lead to new theoretical developments as well. Indeed the emphasis on the construction of common knowledge which is at the root of the approach addresses similar issues to those investigated in some theoretical developments on individual versus collective rationality, the role of institutions, conventions or culture.

The applied view described in this paper could possibly offer hints on how to address such difficult questions. In this respect the main contribution may be the emphasis on the contextual aspect of rationality and on its collective structure, these two characteristics going together. Then a model becomes a way to learn how to collectively behave in a sensible manner in an environment which cannot be perfectly anticipated in advance.

APPENDIX: AN INTERACTIVE PROCESS AT WORK

1. The Basic Problem

This company operates in the Champagne sector. This is both a high-tech environment related to the new biotechnological field and a
traditional one with many medium-sized firms, the management of which is mostly based on rules of thumb to cope with an important source of uncertainty: the quality and quantity of crops due to climate fluctuations.

The company under study has been recently acquired by a large firm under the following circumstances. First, an entrepreneur took hold of this traditional firm and considerably changed its relatively stable behavior to impose a significant growth strategy. This growth strategy benefited from favorable environmental conditions (increase in productivity, low reactivity of competitors) but eventually ran into strong financial troubles that could not be solved through price cutting and market share increases. The entrepreneur had to sell the company.

When the large company took over its new subsidiary the local management was in some disarray. Strong tensions could be perceived between the sales department (how to modulate price and volume considerations?), the production department (what explicit policy should be followed on quality and quantity?) and the financial department (how to restore profits?). Moreover the management coming from the holding company had little experience in this field; such an acquisition was evidently highly risky and was taken as a challenge.

Since strategy and operations are strongly intertwined for such medium-sized companies, it seemed important to restore a sense of cooperation between the different operational departments. How to do it? How to make this cooperative effort productive of a new, deliberate strategy when the new management does not have one ready to propose and moreover does not want to constraint its ability to improve its future creativity? Further, how to act quickly given the poor present financial situation and the possible pressures from the holding company? (For a complete report on this study see Tanguy, 1989.)

2. Some Background Material

i. Champagne is a wine that results from the blending of several qualities of grapes
The vineyard associated with Champagne are strictly delimited in the
area of Reims. These vineyards are of different qualities depending on exposure, soil, etc. These vineyards are scattered among roughly 7000 active vine growers. Given its relative northern location, the size of the vintage and its overall quality are quite variable (for instance, quantities may vary from 1 to 3).

To provide as much as possible for both a constant flow and a constant quality of product, Champagne wines are made from a mixture of quality of grapes and from reserves from the preceding years. Ordinarily a Champagne House makes several qualities of Champagne, each of which necessitates a production cycle of two to five years, sometimes longer. Most of the well known Houses have some vineyards, but this accounts for a small fraction of their total sales, so they buy grapes or even Champagne wines at various stages of production. These Houses are medium sized companies originally owned by wealthy families. Progressively their growth and profitability enabled a number of them to become large companies active in a variety of high quality sectors, Moët being probably the most well known example.

\textit{ii. The input market is quite complicated}

If there are 7000 vine growers, there are approximately twenty large Champagne Houses. The market for grapes between the two communities is a long story. To simplify, one could say that the power has progressively moved from the Houses to the vine growers organized in cooperative production units.

Under the current conditions the grapes have to be bought at a price directly related to the observed price of the bottle of Champagne. Moreover any House can only buy as much of the total harvest as is in proportion to its current sales. On the other side, the vine growers agree in advance on the relative amount they will put to the market. They will keep what remains and proceed along the successive stages of Champagne production themselves, eventually selling part of it later on in the speculative market. Progressively, the vine growers have integrated forward, whereas the Houses cannot integrate backward due to regulations. Yet the latter hold the highest quality of grapes internally, and have the highest reputation for their products. Given
Fig. 1. A strategic group analysis of the Champagne sector.
the high volatility of the harvest, the presence of both a regulated and a speculative market, the purchase policy can be extremely complicated, with feedbacks coming from sales that cannot be detected at glance. How to balance an average trend of growth due to increased productivity of the vineyards with a less favorable buying power is a major strategic question. See Fig. 1.

iii. The company under study went into a growth process that could eventually deteriorate its position

The entrepreneur that acquired the company in the seventies imposed a major growth strategy. This could be observed in terms of market share.

Large capital investment policies were also undertaken to modernize the production process. The purchasing policy evolved accordingly. In fact two Houses were acquired at the same time and, if their sales and production facilities remained disjoint, the purchasing departments were combined into one to obtain a higher leverage over vine growers.

In the early eighties the subtle balance between purchases and sales began to deteriorate. Two successive good harvests made inventories very high with corresponding financial costs. Increase in sales could only be obtained through a deterioration of prices and more importantly through a deterioration of reputation. Champagne of this House would now begin to compete with the low class Champagne made directly by the vine growers themselves. Financial drain precipitated a change in ownership.

3. The Interactive Process

The planning procedure of the holding company that acquired this Champagne House follows systematic guidelines that operate for all subsidiaries. General strategic objectives are set in the Spring. These encompass: competitive position, capital investment and productivity, labor management, etc. Each subsidiary is entirely responsible for its tools to elaborate the discussion and to advocate its proposed orientation. Subject to approval, this orientation is followed in the Fall by a very detailed five year budget plan issued according to the format uniformly designed by the holding.
The Champagne subsidiary had been acquired the year before the study took place. The Spring meeting had been somewhat simplified but it had been decided to formally follow the planning procedure in the Fall; that is, to propose a meaningful five year budget plan to set the stage for more elaborate thinking the year after. Accordingly strong budget control had been enforced for the current year: procedures and standards had been defined. For the first time this medium sized company could analyze the profit of each product line, evaluate its large inventory and the corresponding working capital, and observe its low financial performance compared to standards of the holding.

Rules of thumb that had been developed over time to implicitly coordinate the three main functions (sales, production, finance) had been somewhat disrupted by the two successive acquisitions. Yet, because of the specificity of the business, the standards of the holding company required major adaptation to be effective. This was considered as the major task of the study.

The interactive process focused on how to reduce the complexity to enable the three main functions to develop a common model of the business and to design a reference for the five year budget that would be consistent with the holding company's standards. It was decided that two 'objective' interconnected models would be built.

The first one would concentrate on the material flow from grapes to the end products (various qualities of Champagne). This material flow was modelled and the internal inventory was detailed on a month-by-month basis (the sales of Champagne are very seasonal, the peak being at Christmas). All at once it appeared that all that could be sold in the next three years was already known, except for external purchases that, if needed, could easily be quantified and priced. The past urge to grow and the relatively high prices of these external purchases were identified as being partly responsible for the current poor financial results. Clearly this imbalance between sales objectives and durable access to the main resources, hidden by record harvests, could not be a successful long term strategy. This was agreed upon.

Second, in June (at the time the study took place), the October harvest can almost be known so that interesting hints could be derived on what to do in terms of quality of end uses with this forthcoming harvest. This gave another year of useful data and the model helped to
understand the associated long term impact. In particular the fact that
the current year was expected to be very low in quantity could be
traced in limited sales available much later, in spite of the internal
smoothing process due to reports of wine from one year to the
following one. This was a second reason for limiting growth; an
attitude which was very counterintuitive at first for the managers
coming from the holding company. Their initial attitude was to in-
crease growth further and they were considered as potential di-
lapidators of a very valuable inventory which was not reflected by its
financial opportunity cost as defined through the standard accounting
rules of the holding company. A fine tuning between the sales forecasts
and the early selection of the product mix became possible, and *vice versa*, since most of what could be sold in the near future was already
known; marketing efforts could be made accordingly. The mutual
interdependence and how to exploit it to the company's best interest
was agreed upon. Previously the production was the leader because of
the quality requirement and the sale function adapted itself to the
actual production schedule. A more balanced and cooperative relation-
ship emerged.

Third, it appeared that because of its financial strength, the holding
company could help its subsidiary to act in counter cycles relative to
the profession; that is, to buy a lot when the harvest is strong and
prices low, and to buy only a little when the harvest is weak and prices
high. Over time this strategy should provide a significant competitive
advantage, and implementing such a strategy became feasible through
the use of the model. Instead of following static rules of thumb shared
throughout the industry concerning the desirable level of the total
inventory relative to sales, the model emphasized the level of available
bottles, month after month, compared to sales objectives. Assuming a
bad next harvest and reasonable future ones, knowing the structure of
the initial inventory, it became clear through the simulations that the
company need not buy immediately over quantities on the speculative
market to match its future sales objectives, even if its usual inventory
ratio was momentarily under the reference level. Of course it should
buy as much as possible (no matter the need inferred from the static
ratio) as soon as the level of the harvest became high and the grapes
less expensive. At the last minute it was agreed upon that the model
would not be substituted for this traditional rule of thumb and that simple static optimization was good enough. Yet, the following year, it was agreed to give up static ratios and to coordinate on the material flow model, thus enlarging the set of feasible strategies.

The second model was designed to translate the material flow into a five year budget, given outputs and input prices. This was done using the specifications of the holding company. At this point it clearly appeared in the financial figures that some yearly ratios such as ROI used by the holding were very volatile because of the high uncertainty of input quantities and prices and because of a production cycle that largely exceeds the year. Much care should thus be devoted to a strategy based on such indicators. It was agreed upon that this point be re-emphasized when discussing the budget with the holding company. Other ratios, such as inventory to sales, uniformly used, would also be simply dismissed as irrelevant for this type of business. The models provided the arguments for doing that, as well as to propose substitute indicators directly based on the projected five year performance.

Finally it was agreed upon that these two models were simplifications and they could only be operated using many judgmental inputs about the future environment that required active collaboration of the three operational managers. Still, any run made plain to the three managers that each one of them had to operate in interdependence with the others. Then, if the achievement of some general objective required that some local constraints be occasionally violated, more flexibility could be achieved since everyone had a better global view of the whole process.

The models were used without the consultant's help. The consultant had only a partial view of the process and of the idiosyncrasies that were developed on the side to make sense of the models. The process was used to elaborate a scenario that was translated into the five year plan. More than a dozen trials were necessary to provide a satisfactory adjustment because the initial guesses were very far apart. Without the models only two or three scenarios could have been found by hand using unrealistic simplifications, i.e. references that would almost surely be quickly violated for good reasons, leading the company to a strenuous centralized management style later on during the year. The model was also used at a more operational level, such as how to
precisely allocate the harvest between the different qualities of wine, given the various production cycles and the marketing and sales strategy. Several contacts were maintained, both with the company and with the holding, and it can be said that this process with its associated tools is now part of this company's culture.

REFERENCES


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