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# **Strategic Analysis Evolution: scenario planning and simulation based on the methodology of System Dynamics.**

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*The present study is aimed at developing the optimal instruments for dispelling the uncertainty factors during the formulation of strategies for corporate development. The objective is the creation of a complete model of strategic analysis, which encompasses both the environment (internal and external) and the management rational component. This model – built on the analysis of three corporate cases - is concretized by a simulation for testing the strategy by the means of software which enables the users to cope with a dynamic and complex corporate environment. The research questions regard the development of a complete strategic analysis, which covers the entire decision-making process; the concrete assessment of the business strategy on the basis of quantitative data; the identification and enhancement of the critical variables of business administration, in such a complex and dynamic reality as the corporate environment.*

## **Introduction**

The present study originates from the consideration that strategic analysis tends to focus on the internal corporate environment (Resource-Based View of the firm, Penrose, 1959; Rubin, 1973; Wernerfelt, 1984; Grant, 1988) and the external one -the market- (Industry Analysis, framework developed by Industrial Organization scholars. e.g., Porter, 1985; traditional Scenario Planning), but partly it overlooks the investigation of the human component and corresponding rationality, neglecting their introduction in a complete analytical model (Simon, 1968, 1976, 1985; Tversky., Kahneman, 1988, 1992; Hargreaves Heap et al., 1996).

In the business context, decisional power is handed by the company's management. The management, indeed, takes strategic decisions regarding uncertain and complicated situations. Yet, despite a thorough environmental knowledge, it is very difficult to take optimal decisions. As it happened in the last few years, market trends are very unpredictable and this limits the validity of strategies based on the sole competitive scene. Ever since, strategic analyses have been partially ignoring the study of the

manager's emotions and rationality. These two are characterised by the presence of mental models affecting the objectivity and rationality of the decisional process.

This research aims at identifying useful tools for dispelling those factors generating uncertainty during the formulation of strategies for the corporate development. The starting point is represented by the analysis carried out by Amit and Schoemaker (Strategic Assets and Organizational Rents, 1999) which has only proposed a theoretical approach to the problem. The objective, thereby, is to propose a joint model of strategic analysis which accounts for both the environment -internal and external- and the management's rational component. This approach has been introduced by Warren (2002) and Morecroft (1994) but it has not even been considered by Amit and Schoemaker (1999), Mats Lindgren and Hans Bandhold (2003), Porter (1985) and Grant (1988). In order to achieve a complete analysis, the proposed study will be accompanied by a software-based strategy testing simulation for dealing with the complex and dynamic corporate scene.

Complete information is necessary for the development of a successful strategy. The deep knowledge of both the corporate world and the external environment is widely discussed by the literature, which has particularly appreciated the *Resource-Based View* and the Industry Analysis (Porter, 1985). The joint union of these two theoretical framework on one hand provides for a clear and complete view of the environment and market where the company is positioned, on the other, it sheds light on the company's strengths and weaknesses relative to competition and market demand. However, a critical aspect that is frequently neglected by the traditional organizational studies is the rationality of the management which has to take strategically relevant decisions. Such rationality is used both in daily decisions and in meetings organised for the definition of fundamental long-term development strategies (Simon, 1978, 1976, 1985; Tversky, Kahneman, 1988, 1992; Hargreaves Heap et al., 1996).

Therefore, one of the questions that will be addressed is how to present a complete strategic analysis which encompasses all the aspects of the decisional process -internal and external environment, personality, emotiveness and management uncertainty.

As a matter of fact, despite the availability of all the information necessary for a correct strategy formulation, the unpredictability of the results of its application and implementation is still quite strong, since any immediate testing is missing. Given the impossibility of having a real time match in the external environment when formulating the strategy, it seems natural to concentrate the efforts on the analysis of potential repercussions on the internal environment and, in case, on the external interlocutors. In this respect, the ongoing debate within organizational studies raises the question of how firm strategy can be actually assessed adopting "quantitative" data.

The possibility of testing the effects of the implementation of the strategy on the corporate system before the strategy itself is actually implemented could represent an enormous advantage for the management in charge of formulating it. Because of the reality's complexity and dynamism, the human brain cannot afford to consider all the variables and relations behind the business (Senge, 1990; Sterman, 2000; Argyris, 1990). Thereby, it is interesting to understand how it is possible to identify and highlight the critical factors of the future activity in such a complex and dynamic context as the company environment.



Scenarios are also introduced, so as to better understand the Mental Models and improve the comprehension of the entrepreneur's ideology and relevant information. Consequently, Closed-Loop Thinking is introduced by the means of cause-effect diagrams, so as to go along the manager's logical processes. By so doing, rationality is put under examination. Ultimately, after having defined the main targets, the System Dynamics methodology is integrated at the point of strategic planning. Computer-based simulation models are created by translating cause-effect diagrams into flow diagrams. Such tool is rigorous and provides useful quantitative data, to be used against dynamic complexity. Simulation can be utilised when both formulating the strategy and assessing it, since it permits to play and test various scenarios. Furthermore, a Single Loop Learning can be noticed, in case of short-term strategies, as well as a Double Loop Learning in case of long-term initiatives requiring a complete re-examination of the economic scene (Argyris, 1992).

The presented model for the analysis of business strategy can be interpreted in two different ways. On one hand, as a form of business analysis (descriptive approach), the entrepreneur's rationality is examined through System Thinking before formulating the strategic approach. On the other, as a form of theoretical proposal for the analysis (normative approach), the recourse to System Thinking should be introduced before the definition of the objectives.

Figure 2: Differences between the standard Manager analysis and the methodology proposed.

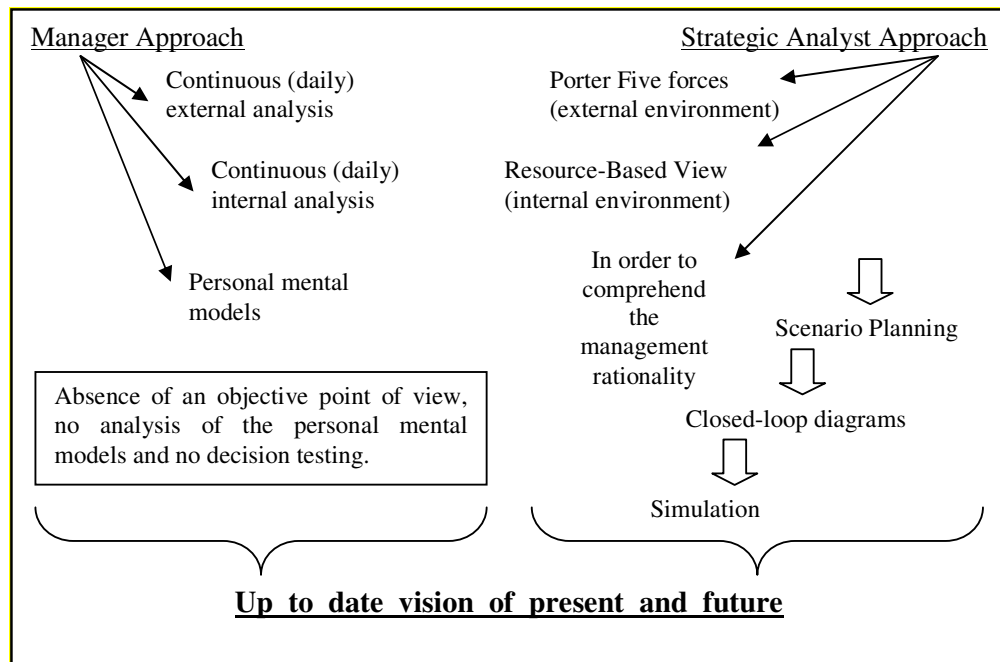


Figure 2 aims at identifying the differences between the manager's and the analyst's (external) view of the company. In order to have an up to date vision of the environment and the internal dynamics the two individuals adopt different approaches. The manager is daily involved in company life, but his/her mental model affects his/her objectivity.

On the other hand, due to the nature of their work (external to the company's reality), consultants recur to different, more objective tools of analysis. The present model, in order to clarify the reasoning of the managers, proposes the utilisation of CLD, Scenario Planning and the use of the computer-based simulation (third arrow in figure 2). This model of analysis could be useful also for the internal management because it excludes any subjectivity of the thought, helping understanding personal mental models. The awareness of such differences between internal and external approaches has contributed to build the framework of analysis proposed in the present paper. Particularly in companies characterised by strong personalities (like the Italian Small Medium Enterprises here considered as case study), where the management's word has more decisional power than statistics and facts, this model could be extremely helpful for avoiding negative subjectivity.

### **Theories and disciplines behind the proposed framework**

The Industry Analysis framework (Porter, 1985) accounts for the external environment, including market, suppliers, clients, potential entrants and substitutes. In 1980 Porter himself developed the value chain theory, thus offering a strategic approach based on the examination of three interrelated elements: the environment, the company's attitude and its own market results. Within this framework, the success achieved by the company originates from the interaction of two elements: the attractiveness of the industrial sector the company belongs to and the company's position in the sector. Thanks to the contribution of Porter and the identification of five competitive forces, the company is given the chance to determine a personal strategic conduct and partly contribute to the achievement of its own success. This model is excellent in assigning the potential profit to the various companies in the market, while focusing on the competitive forces and barriers that are prevailing in the environment. Yet, it is incomplete, since it considers the company as a "black box", whose attitude and reactions are unknown.

The Resource-Based View, on the contrary, concentrates on the imperfections in the market. Limited transfer of resources, their scarcity, complementarity and appropriability might increase the opportunity of acquiring a long-lasting competitive advantage stemming from the characteristics of uniqueness of both resources and competences of every single company. These competences, generated by a conscious and particular utilisation of resources, are affected by the Strategic Industry factors. As the definition states (Grant 1988), competences originate from comparisons with the competition. The company's objects, thereby, are the result of an internal and external analysis of the company as a whole, but they are not created by rationality; they are shaped, instead, by ideas, convictions, ambitions and the entrepreneur's personality characteristics (in the specific case, since the present analysis has focused on a small company, reference is voluntarily made to family-run small-mid-sized enterprises). With the *Resource-Based Theory* (Penrose, 1959; Rubin, 1973; Wenerfelt, 1984; Grant, 1988), the attention shifts to the company's resources and competences. Hence, the analysis perspective, which in the past was exclusively focused on the sectorial variables, changes and concentrates on the sole corporate dimensions.

Today we assist to the gradual integration of various approaches, achieved through an integrated research that unifies the tools for the sectorial analysis with the study of the single company, so as to reach a wider view of the strategic analysis (Lindgren & Bandhold, 2003; Warren, 2002). In this respect, following the principles proposed by Amit and Schoemaker<sup>1</sup>, and in order to have a complete analysis of the environment and the opportunities for creating a competitive advantage, it is essential to integrate the conjunct analysis of the enlarged sector and the corporate resources with the study of the mental processes that guide the managers in their strategic decision-making. Strategic decisions, quite often imperfect and discretionary, are usually characterised by unpredictability (the state of the economy and industry, regulations, society, technological development, competitors strategies, fashion and sales trends), complexity (dynamics affecting the company's performance, different competitive strategies emerging from the interpretation of the competitive scene) and internal conflicts (with reference to those dealing with important decisions, their assistants and those who are directly affected by such decisions), rarely governable and understandable.

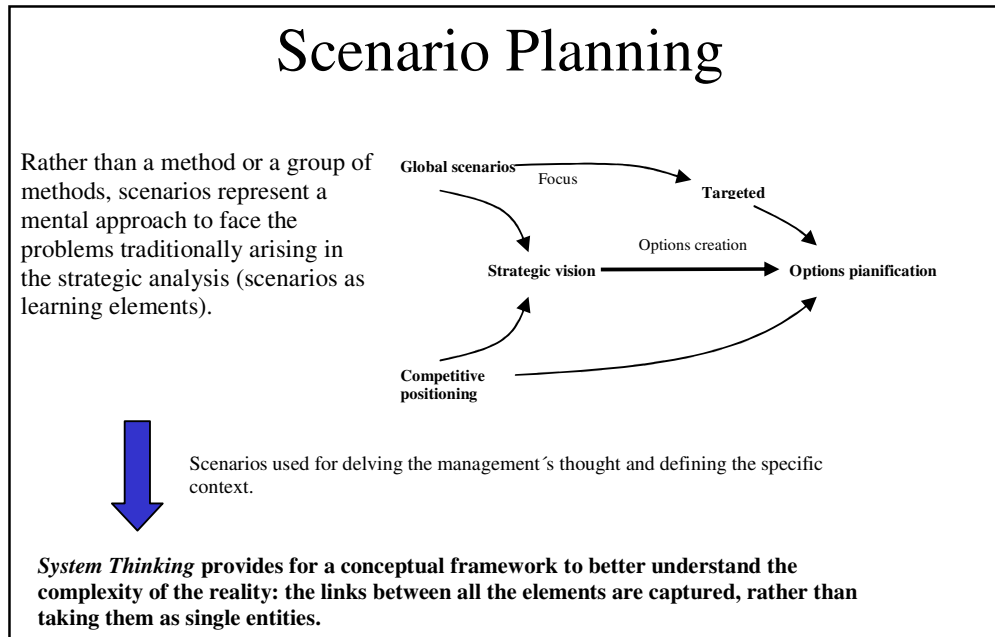
Contrary to the study offered by Amit and Schoemaker, the present model aims at analysing the mental processes, tracing their map, studying them and compare them by the means of simulation models that highlight important discrepancies in the drawn conclusions, even if starting from identical assumptions and available data.

Building a scenario allows for the definition of the objectives, determined by comparing the internal performance and the possibilities of market growth (Kahn, Bown, Martel, 1976; Godet et al., 2000). This analytical tool permits to go along the management's reasoning and build a similar analytical reasoning process starting from the same information. This analysis, which derives from a "picture" of the reality, is nonetheless quite static. When building scenarios, it is necessary to select and define the information collected in the economic scene. That is why the analysis of the management's mental models is essential, so as to better understand the decisional processes and the market dynamics.

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<sup>1</sup> "Strategic Assets and Organizational Rents", Amit and Schoemaker (1993): the heterogeneity of the companies in the market, both in equilibrium and disequilibrium, and the creation of new competitive advantages can be considered as generated by the companies' resources and competencies.

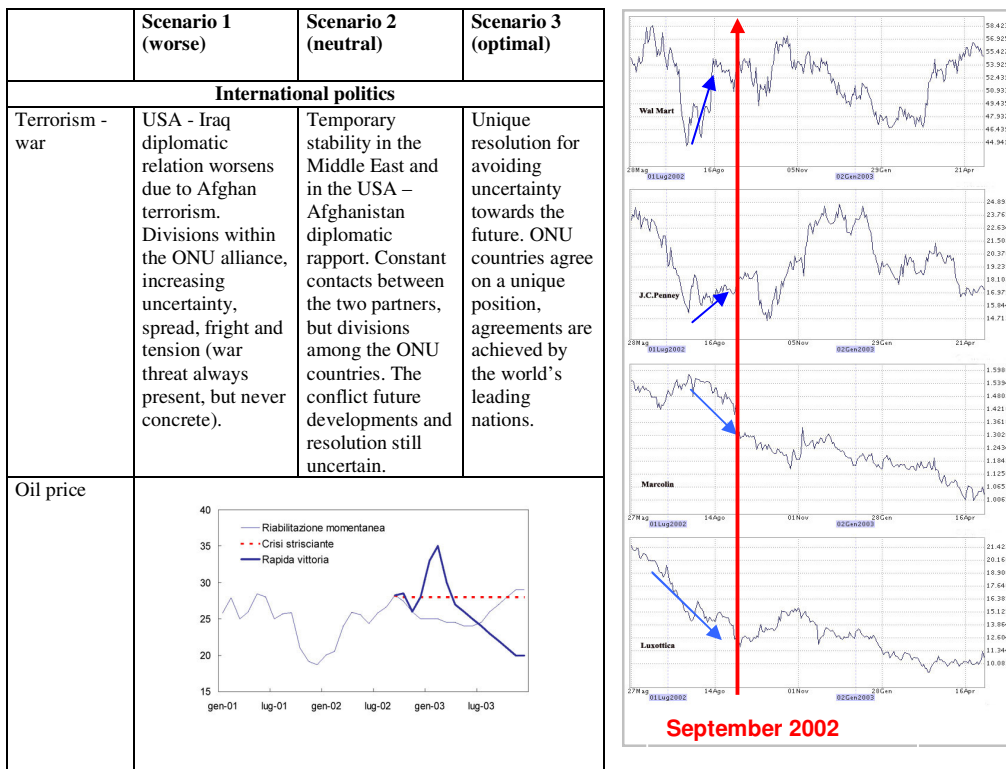
Figure 3: Scenario planning as part of System Thinking methodology.



The third discipline utilized in the hereby presented analytical model is System Thinking, which provides for a conceptual structure that helps improving the understanding of the reality's complexity by considering all the relationships among elements rather than taking the single elements at such (Senge, 1990). Thanks to such methodology, it is possible to study the management's personal component and relative decisional process. The analysis starts from the perception of events and environment, identified and represented by scenarios; it follows the translation of the thought (logical processes) into cause-effect diagrams related to the links existing among those variables determining the company's life as a whole. A further step for deepening the knowledge of the management's System Thinking is represented by the introduction of tools for the contextualisation and testing of the environment and the mental processes, respectively. The contextualisation can be carried out by recurring to descriptive scenarios, which allow to forecast a potential future development of those variables affecting the corporate system, together with providing a representation of reality.

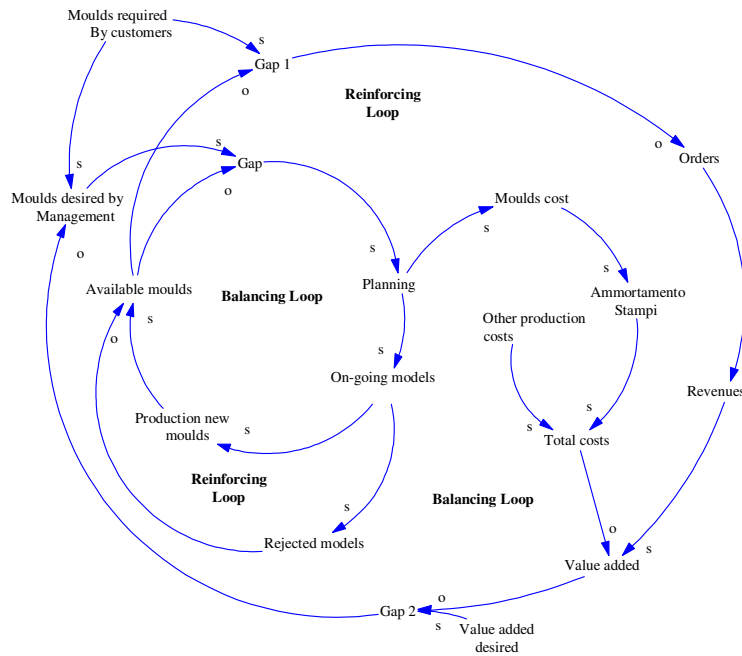


Figure 4: An example of scenario building utilised for the study of the Mirage Spa Case.



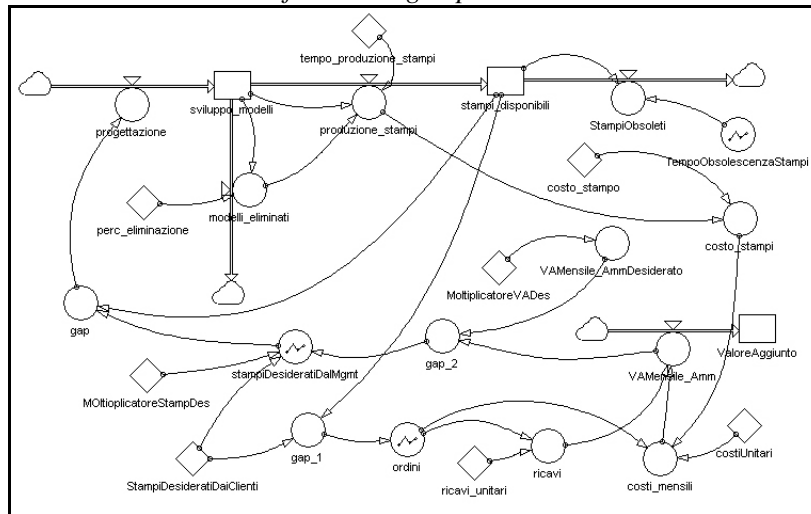
In accordance with the System Thinking methodology, the analysis of the mental processes is carried out also by introducing the System Dynamics methodology. The testing method here adopted consists of the creation of closed-loop thinking, its successive application to caused-effect diagrams (which check the consistency of the management's strategic reasoning) and the translation of the found bonds into flow diagrams. Such diagrams give useful help in evaluating the reasoning correctness and completing the study with the provision of quantitative output, while offering a simulation model appropriately built for the company in question. This final process, based on the System Dynamics methodology, makes even more dynamic the reality, which appeared pretty static with Porter's theory and the Resource-Based View. The strategy outcomes are, thus, determined by the internal and external analysis of the company, by the managers' personality component and rationality, as well as by those events that will occur during the strategy application.

Figure 5: An example of the closed-loop diagram utilised for the study of the Mirage Spa Case.



The model utilised for the business analysis consists of two sections: production and planning. Here are presented two figures representing the planning section.

Figure 6: An example of the flow diagram (first simulation model) utilised for the study of the Mirage Spa Case.



Simulation allows the necessary testing for further improving the strategy by reducing uncertainty, due to the possibility of setting the model with real data and a structure

faithfully representing the corporate one (Senge, 1990, 1994; Sterman, 2000). The same strategy is then reproduced through cause-effect diagrams and subsequently translated into flow diagrams, which help share knowledge and favour the growth of a managerial group collectively working in a *learning organisation* context (collegiality).

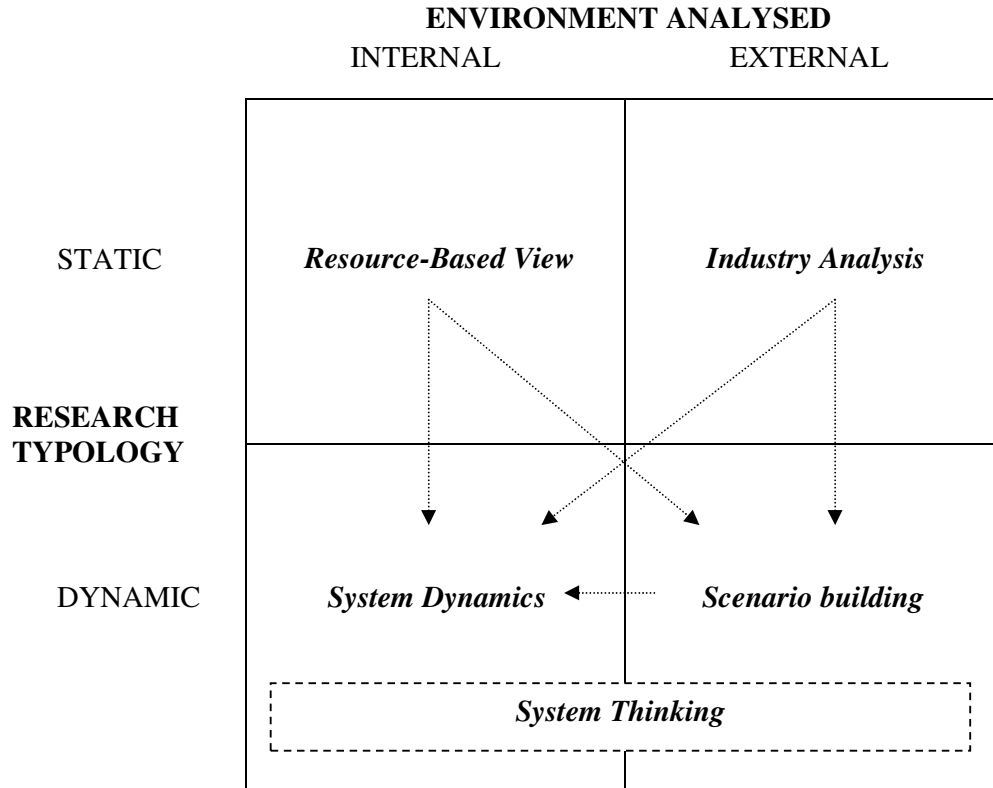
Thanks to the structure and flexibility of this tool -which permits the isolation and separate simulation of sectors and single variables- it is possible to identify the company's critical elements, that is those variables subjected to high levels of stress due to the strategy implementation. A further development is represented by the opportunity of avoiding a non-equilibrated business growth, thanks to the identification and probable enhancement of the departments/sectors/variables that are having more problems (Sterman, 2000).

### **A multidisciplinary view for strategic analysis**

The effectiveness of the proposed business analysis is subordinated to the presence of rich information, necessary to delve, understand and explain the managerial decisional process and the organisational routine entrenched in daily events. Specifically, such information affects the simulation model building process. Moreover, each single analytical theory contributes to the creation of a reliable model, which is thoroughly representing the reality in question.

The Resource-Based View defines the simulation model structure, also reflecting the presence of the corporate resources, and affects the choice of the variables to be analysed for planning scenarios. Industry Analysis helps identify the environmental variables that, linked to the internal factors, are crucial for simulation modeling and scenario planning. Scenarios offer an assessment of the possible developments of key external variables. System Thinking methodology encompasses both System Dynamics and scenario building: the relevant variables are selected through the perception of reality, and consequently examined and translated into causal loop diagrams and flow diagrams.

Figure 7: Matrix representing the bonds between classical static theory (Porter, RBV) and dynamic analysis (System Thinking, System Dynamics), in the internal and external environment under analysis.



The advantages stemming from an accurate creation of the simulation model regard the possibility of identifying contradictions within the strategy (*Future learning*), the identification and development of potential hidden strategic opportunities (*Spotting hidden strategic opportunities*) and the discovery of possible unexploited levers. It should not be underestimated the fact that an accurate model building implies the deep knowledge of the complex dynamics regulating the functioning of the company business, as well as it favours knowledge sharing using a simple and clear exposition of the desired outputs.

The functioning mechanisms of simulation make this instrument very useful in every moment of a company's life, since it permits to test one's own ideas and persuasions by the means of a simulated objective and immediate reality, where the constraints generated by the strategy execution time span are avoided.

It is, however, difficult to distinguish the corporate skills and outcomes from the market trend, especially in positive periods and throughout long-term temporal horizons, when there is no lack of orders and the production process goes smooth. Yet, business inefficiencies tend to emerge in critical instances, an aspect which several managers tend to overlook during positive times. The simulation model, thanks to the dynamism of the reproduced environment, might enlighten the internal business management, by

separating the product demand and the external events from corporate results. As a result, the management effectiveness appears the only aspect to be analysed and on which basing the company's strategy.

## **Conclusions**

Some interesting advantages may result from the proposed model.

First, the possibility of implementing and testing strategies based on the theory, as well as combining the knowledge derived from the simulation to the direct experience. The presence of theories for the analysis of both the external-internal environment and rationality guarantees a solid foundation for identifying and classifying the main pillars of the on-going or completed strategy. The possibility of combining such research methodology with the direct experience and with computer-based simulation tools allows for a complete vision of the corporate system, based on precise precepts, as well as for relevant data availability. It also offer the chance of relying on a software program capable of simulating the forecast scenarios. The conjunction of method, knowledge and testing permits the formation of a *shared vision* and the introduction of *learning organisation* elements.

A second advantage is represented by the possibility of making dynamic a reality that, when analysed, appears static. Similarly, the peculiarities of the corporate scene and the bias of the economic situation are highlighted. Porter's analysis and the Resource-Based View make the reality static, producing a sort of still picture. Both System Thinking and System Dynamics allow the dynamic transformation of the reality under question, thus enabling the simulation of developments and attitudes over time. Furthermore, thanks to the chance of obtaining quantitative data in output, the employed strategy acquires a concrete value before being implemented. This way, it is possible to make comparisons, formulate statistics and assessments of the impact on the company's business - in the areas of productive capacity and financial equilibrium, for instance.

A third advantage comes from the model flexibility, which gives the opportunity of experimenting new ways of development and interrupting the simulation for assessing the results - the taken decisions are thus memorised and catalogued. Once obtained all the necessary information, the strategy may be formulating. The simulation tool not only tests the effectiveness of the corporate projects, but also plans the future strategic operations at best. This is possible due to the utilisation of a computer-based software program capable of memorising the entered data and, hence, simulating multiple scenarios and potential business strategies. Simulation could also be useful when formulating and planning the strategy, for example in case it is necessary to estimate the economic consequence of a choice or the exploitation of the productive capacity and workforce. All these scenarios can be simulated and compared -thus choosing the best one for the company- by modifying the input figures or the figures assigned to the crucial variables of the company business. Also, simulation is certainly important when optimising the strategy: in this case, in fact, the extent of those interventions considered optimal and necessary is assessed and refined.

The level of openness achieved after having implemented this analytical framework is very high (Senge & Sterman, 1994). By following such scheme, it is possible to detect one's own assumptions and mental models, as well as the whole reality. The ability of self-questioning and capturing the ensemble from a different perspective can provide

essential hints for discussion. Thereby, the complete view emerging from combining the details together becomes a useful tool for formulating the strategy. As a matter of fact, the perspective enlargement results into a better comprehension of actions, and relative consequences, done by other actors within the market. The ability of reasoning without Mental Models and mental restrictions can, therefore, represent a fundamental benefit. By so doing, everyone is able to identify his/her own position and plan the strategy, accounting not only for the single events, but for their evolution. The company is interpreted as a dynamic systemic element, which is constantly under control and continuously affecting –and affected by- the other elements of the system, according to the taken choices and respective repercussions.

Naturally, the model of formulation and analysis of business strategy here presented shows some holes. Firstly, the great quantity of information necessary for scenario building and model simulation will never exactly replicate the company's situation, even if the information at hands are pretty numerous. The System Dynamics main purpose is to make a complex reality simpler and understandable. Thereby, the creation of a simulation model should be finalised to the resolution of a problem by rationalising and simplifying the real complexity. Secondly, it is necessary to say that this model has been tested only in three cases of Small-Midsized Italian companies: a sunglasses manufacturer (with the purpose of testing the internationalisation process), a start-up company in the furniture sector and a small family business handling important investments. Unfortunately it is not possible to say if the advantages of this method of analysis are strong yet, because it takes time to clarify the evolution of the company's environment. Lastly, in order to get the best out of this methodology of analysis it is necessary the help of specialists, especially in scenario building and simulation modelling.

A fundamental question that still needs answering concerns the starting point of the present study. Scenario building -subjective and immediate- does not affect the validity of the methodology and simulation model presented here, but it could be fundamental when entering external variables: this way, a "closed" reality (such as the modelled one) is transformed into an "open" reality, dependent on the external events (such as the real one). In this situation, the forecasting skills and the management experience will play a crucial role, thus making more interesting the analysis of the personality and rationalisation of the decisional process.

To conclude, the validity of the simulation model and methodology here presented persists. By avoiding the relevant uncertainty factors, such tool provides the management with a helpful instrument for formulating and testing the strategy.

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