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Production and Operations Management Society

1st World Conference on Production and Operations Management

Links between operational and strategic flexibilities

De Toni A. (University of Udine)
Tonchia S. (University of Udine)

LINKS BETWEEN OPERATIONAL
AND STRATEGIC FLEXIBILITIES

Alberto DE TONI and Stefano TONCHIA
Dept. of Electrical, Managerial and Mechanical Engineering (DIEGM)
University of Udine - 33100 Udine - Italy
e-mail: detoni@uniud.it - tonchia@uniud.it

ABSTRACT
This paper aims at clarifying the concept of strategic flexibility, starting from that much more common of manufacturing flexibility (or operational one). A classification of strategic flexibility is presented which distinguishes four categories. Then two analogies are pointed out with the operational flexibility. The first, of the cause-effect type, is on two levels: at the business level, the operational flexibility estimates the variation of practices, while the strategic flexibility measures the effect obtained on performances; at the corporate level, the operational flexibility estimates the variation of competences, while the strategic flexibility evaluates the change in business. The second analogy, related to the classification variables, permits the main types of operational and strategic flexibilities to be placed in a single framework.
Keywords: Strategic Flexibility, Operational/Manufacturing Flexibility, Performances, Competences

1. INTRODUCTION

Strategic flexibility is becoming ever more discussed both in the academic and managerial fields as it has become one of the major critical success factors of the firm, while operational flexibility, in the sense of manufacturing flexibility, is still sufficiently well discussed by now covering about twenty years of literature. The concept of "operational flexibility" is broader than that of "manufacturing flexibility", taking in *all* the operations (design, purchasing, distribution, marketing, services, etc.) not only the manufacturing. However in the literature the term "manufacturing flexibility" is generally used to refer to *all* the operations that concur to manufacture a product. The theme of strategic flexibility, though more recent than that of manufacturing flexibility, closely follows the variety and difficulties that marked the early years of the discussion on manufacturing flexibility. As a consequence «the confusion and ambiguity about a concept that often represents a critical competitive capability seriously inhibits its effective management» (Upton, 1994).

Not only it is still unclear what is meant by the designation "strategic flexibility" and how this can be measured in real terms, but also links between strategic and operational flexibilities have not been sufficiently clarified within a coherent framework and an explanation given of how strategic flexibility is achieved through operational (manufacturing) flexibility. This article suggests a framework which, starting from the various definitions of strategic flexibilities, collects the essential links.

So, first, a classification of strategic flexibility is compiled which contains four distinct categories: speed of variation of the competitive priorities, range of the strategic options, rapidity of movement from one business to another, variety of the possible new businesses.
 Strategic flexibility considered both as the speed at which competitive priorities can be varied and the speed of shifting from one business to another enables the *first link* between strategic flexibility and operational flexibility to be recognized; as will be shown this link is of the *cause-effect type* and concerns practices and performances within a business, while it concerns competences and businesses at a corporate level. The *second link* found between

strategic and operational flexibility is of the *taxonomic type* and permits the two flexibilities and their relative dimensions to be placed within a common framework.

2. DEFINITION OF STRATEGIC FLEXIBILITY

The definitions of strategic flexibility given in the literature are less numerous than those (De Toni et Tonchia, 1998) for manufacturing flexibility. Nevertheless their significance, as can be expected, is not unequivocal.

Gustavsson (1984) introduces the idea of strategic flexibility in the framework of a temporal classification of flexibility. The author claims that flexibility has different aspects since it is required when problems occur, rising in different time horizons: 1) operational problems (machine failures, lack of materials), 2) tactical problems (such as those caused by changes in the plans or in the production levels), 3) strategic decisions (relative to investments in new plants and machinery due to an expansion in the production or the launch of a new product).

Narasimhan et Das (1999) distinguish the level of: 1) operational flexibilities (machine and shop level); tactical flexibilities (plant level); strategic flexibilities (firm level), this latter in terms of ability to introduce new products and to adapt to or influence the market. Koste et Malhotra (1999), instead, consider five hierarchical levels, which comprise ten flexibility dimensions in all: 1) individual resources; 2) shop floor; 3) plant; 4) functions; 5) business unit. The flexibility at the business unit level is named "strategic flexibility" and puts together the flexibilities of the various functions: manufacturing, marketing, human resources management, R&D, etc. Gerwin (1993) proposes a conceptual framework which also included a meta-level of flexibility known as "strategic adaptability" «in order to quickly adjust company objectives to meet new conditions... and readily change the types, ranges and times of the six dimensions of flexibility».

3. CONTENTS OF STRATEGIC FLEXIBILITY

Hayes et Pisano (1994) define the strategic flexibility as the «capability to change the firm's strategy with the competences selected, developed and exploited according to the previous strategies». That is the firm must be able to modify its competitive profile, adapting it rapidly to market trends, making a dynamic adjustment of the focus of its strategies. Hayes et Pisano's definition of strategic flexibility as the capacity of the firm to successfully vary, in time, the mix of its competitive priorities is one of the most widely accepted definitions in the literature.

Clark (1996), instead, introduces the term of strategic flexibility into an examination of the «possible competitive configurations that the firm may assume». The author observes that a firm placed, at a certain instance, in a competitive position is not limited in its strategic choices only by the traditional constraints of trade-off. In fact they take into account that the firm is characterized by an inheritance of knowledge, competence and specific capability, so it can sell in only some areas of the competitive space: those compatible with its own expertise. Strategic flexibility can then be measured by the number of possible strategic options (in the sense of a combination of competitive priorities) that at a certain moment the firm can assume. Thus also Clark uses concepts that draw their inspiration from a vision of the firm in a "path dependency" evolutionary logic (Nelson et Winter, 1982).

Stalk et al. (1992) introduce five competitive dimensions: 1) "speed" («the ability to respond quickly to customer or market demands and to incorporate new ideas and technologies quickly into products»); 2) "consistency" («the ability to produce a product that unfailingly satisfies customers' expectations»); 3) "acuity" («the ability to anticipate and respond to customers' evolving needs and wants»); 4) "agility" («the ability to adapt simultaneously to many different business environments»); 5) "innovativeness" («the ability to generate new ideas and to combine existing elements to create new sources of value»).

The concept of "agility", in the sense of the «rapidity to move to different businesses» in a competitive environment characterized by "war of movement", fits the strategic flexibility definition, and is developed through the "capabilities predator" figure.

The latest way of defining strategic flexibility is that of Upton (1994), who considers it as the «number of businesses that a firm could potentially attack at a certain instance»: «firms able to move into new businesses which are very different from the existing business are seen as strategically flexible». However Upton also considers the speed («firms that can make strategic changes - e.g. acquisitions or joint ventures - very quickly») and the invariance of the performances in respect to the different businesses («firms who perform well no matter which business they choose to operate in»).

	OBJECT OF THE VARIATION	
	COMPETITIVE PRIORITIES	BUSINESSES
SCOPE OF THE VARIATION	Strategic Flexibility as the Scope of the Strategic Options within a Business (Clark, 1996)	Strategic Flexibility as the Variety of the Possible New Businesses (Upton, 1994)
RAPIDITY OF THE VARIATION	Strategic Flexibility as the Speed of Variation of the Competitive Priorities within a Business (Hayes et Pisano, 1994)	Strategic Flexibility as the Rapidity of Movement from One Business to Another (Stalk et al., 1992)

Table 1: Types of strategic flexibility

4. THE STRATEGIC FLEXIBILITIES AND THE *CAUSE-EFFECT LINK* WITH THE OPERATIONAL FLEXIBILITIES

In the following sub-paragraphs the aforementioned ways of interpreting strategic flexibility are studied in detail. Thus a first link between strategic flexibility and operational flexibility of the *"cause-effect"* type will be defined.

4.1. Strategic flexibility as the speed of variation of the competitive priorities: the cause-effect link between strategic and operational flexibilities at a business level

Figure 1 - elaborated from Hayes et Pisano (1996) and Clark (1996) - shows the curve of the "competitive frontier" of a given industry or business at a certain instance (curve I). The abscissa gives the product range (which the authors mean as flexibility to the range); the ordinate gives the unitary costs of the products obtained. The curve brings to mind the classic idea of trade-off between cost and variety: an increase in the mix is associated with an increase in the unitary costs.

The curve separates out two areas: that above the curve, the so-called one of possible options, and that below the curve, known as the area of impossibilities. The best feasible positions of the firm - in terms of combinations of technological, organizational and managerial choices - are those along the line of the curve. Above the curve can be found those firms that have not yet carried out interventions that are potentially possible thanks to

the introduction of new technologies, organizational reengineering and the use of managerial practices such as Just-In-Time, Total Quality Management and Current Engineering. When a firm moves beyond the curve it means that it has advanced and so has gained a competitive advantage in respect to the competitors (new frontier). So the curve is displaced in time (curve II) creating new competitive conditions. The trade-offs are thus superseded by the improvements that displace the competitive frontier: the trade-offs are not so much eliminated as displaced.
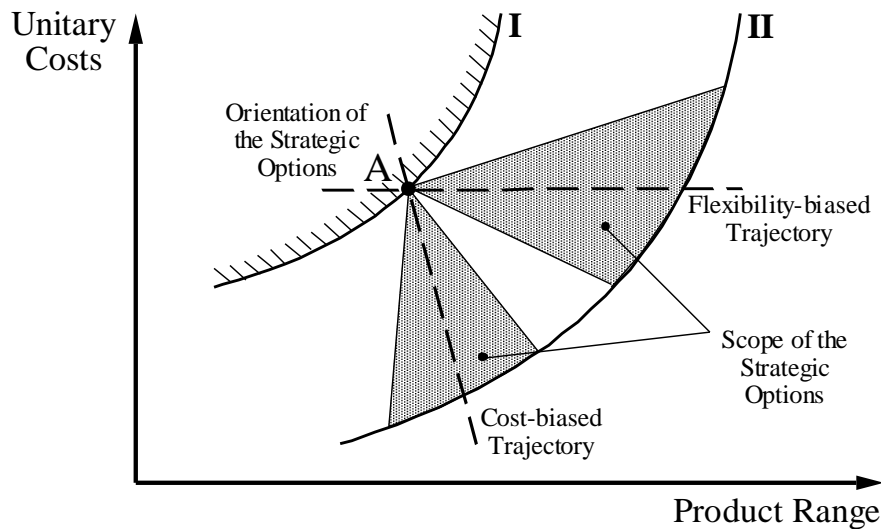

Figure 1: Strategic orientations in terms of trajectories and strategic flexibility as the scope of the strategic options (sources: Hayes et Pisano, 1996, and Clark, 1996)

Corresponding to the frontier curve of trade-offs between classes of performances, it is possible to individuate a curve *practices - competitive priorities* (Figure 2.1), which represents the totality of the best positions possible as a result of performances obtained and intensity of action on the organizational, managerial and technological practices. Like the preceding trade-off curve also the practices - competitive priorities curve has an area of impossibility (above the curve) and it is displaced upwards in time, as new synergy in the application of technical and managerial solutions for the running of the firm unfold.

Imagine now that a firm operating on the frontier in position A decides to move along the curve to position B by carrying out an internal re-organization. For the sake of simplicity let us assume that the firm decides to manufacture the various product lines not in a single productive system but according to the cellular manufacturing logic, in productive cells each of which is dedicated to a family of products. The overall result is that the unitary cost of the products is reduced thanks to the lower set-up costs, lower investments in work-in-progress and faster throughput times. Thus the performances of the firm improve (reduced unitary costs, shorter response times, etc.) in connection with a set of practices ("cellular manufacturing"). It can be hypothesized that starting from an instant t_0 the firm achieves these changes in a certain interval of time t_1-t_0. If the time taken had been greater, for example t_2-t_0, exactly the same results in terms of unitary costs would have been reached, but not in terms of temporal speed.
It is possible to analyse this difference in behaviour from two different points of view:
• *the point of view of effects*, that is of the performances, or *strategic*, in other words the speed at which unitary costs, response time to the customer, etc. are reduced i.e. improved on the ordinate (Figure 2.2); the path from point A towards point B_1 and B_2 is shown, representing the distance covered from instance t_0 to instances t_1 and t_2

respectively;

- *the point of view of causes,* that is of the practices, or *operational*, in other words, for example, the speed of lay-out modification, of the introduction of new managerial techniques, etc. (Figure 2.3); now the amplitude of the changes regarding practices are on the ordinate and the time on the abscissa (the Cartesian quadrant has moved through 90°).
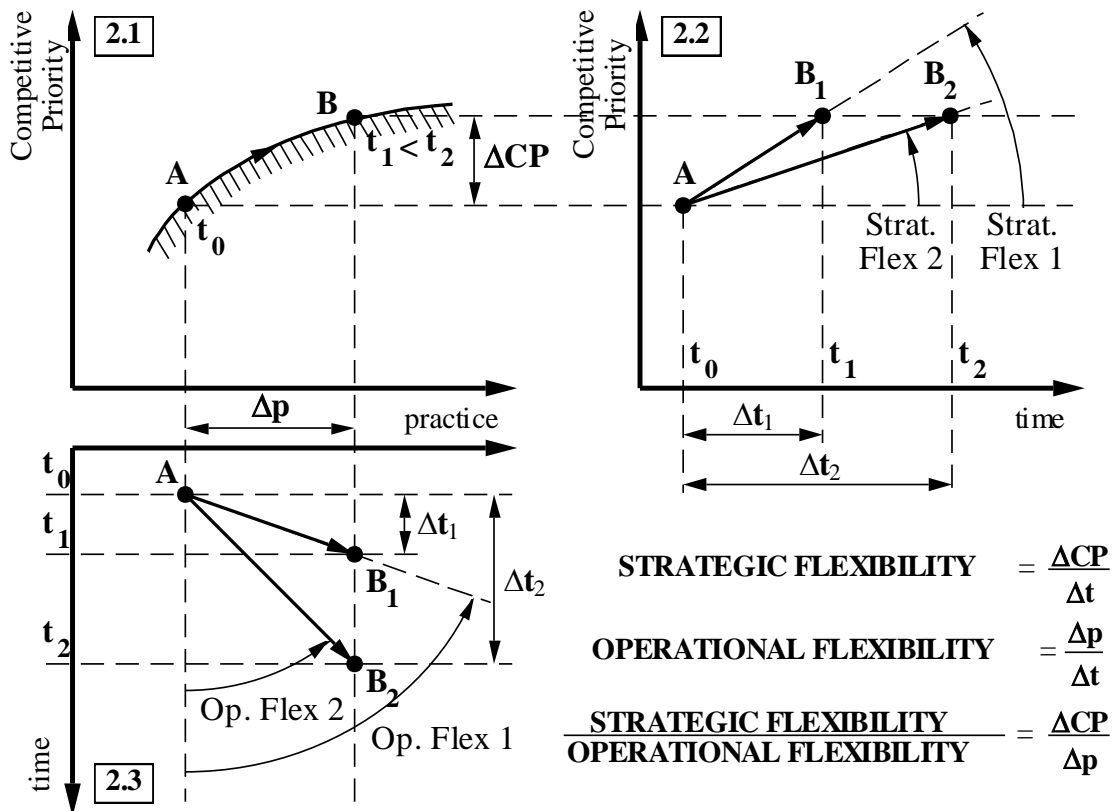

Figure 2: The first link between strategic flexibility and operational flexibility
(CP = performance result in the competitive priority; p = practice intensity)

In the simplification of the proposed scheme at last it is possible to "operationalise" Hayes et Pisano's (1994) definition of strategic flexibility, meant as the capacity to vary the competitive priorities in the time. In fact, we have (CP = competitive priorities i.e. classes of performances, t = time, Δ = difference):

strategic flexibility on the competitive priorities $= \dfrac{\Delta CP}{\Delta t}$ \hfill (1)

In a similar way it is possible to propose an "operationalized" definition of the operational flexibility on the practices, understood as the capacity of variation in the time of the practices themselves. In fact, we have (p = practices):

operational flexibility on the practices $= \dfrac{\Delta p}{\Delta t}$ \hfill (2)

In Figure 2.2 it can be seen that the quickest path AB_1 is that characterized by a greater

strategic flexibility, equal to the tangent of the angle of the half-line. In the same way in Figure 2.3 the path AB_1 corresponds to a greater operational flexibility, whose value is equal to the tangent of the angle of the half-line.

The definitions above permit the value of the strategic flexibility to be related to that of the operational flexibility in the following way:

$$\frac{\text{strategic flexibility on the competitive priorities}}{\text{operational flexibility on the practices}} = \frac{\Delta CP}{\Delta p} \qquad (3)$$

Within the limits of the hypotheses adopted, the significance that can be extracted is interesting. Along curve AB in Figure 2.1 *the tangent at every point of the curve identifies a line whose angular coefficient is the relation between strategic flexibility and operational flexibility*. That means that in the tract where the curve is very steep a slight action on the practices determines a strong impact on the performances (i.e. a little operational flexibility determines a great strategic one). Vice-versa in the tracts where the curve is almost flat a strong intervention is necessary to obtain significant results (i.e. a notable operational flexibility determines only a modest strategic one).

4.2. Strategic flexibility as the range of the strategic options (within a business) and as the variety of the possible new businesses

The trade-off frontier curve of Figure 1 represents the best competitive position in which theoretically a firm can place itself. Placing itself high up or low down along the curve, the firm pursues a cost-leadership strategy or a differentiation strategy, according to the standard perspectives of the Industrial Organization (Porter, 1980). If we think of the same firm using the interpretative key supplied by the Resource-based Theory (Barney, 1991; Grant, 1991), it qualifies because of the growth in knowledge, competences and abilities over a period (beginning from the available resources), which permit it to reveal its competitive potentiality according to specific orientation and scope, which depend on the competence itself. In Figure 1, this concept is represented by the shadowed cones (Clark, 1996), distinguishing:

* *a scope of the strategic options* (represented by the shadowed area), a function of the level of accumulated competences (compatible with the distance between curves I and II) and the variety of the developed competences (compatible with the amplitude of the shadowed area);
* *an orientation of the strategic options* (represented as the direction in which the shadowed surfaces are positioned), a function of the type of competence accrued.

So, essentially the firm's possible strategic options at a given time depend on the competences developed in the learning process, and these are characterized by three variables: 1) type of competency (technological, organizational, managerial); 2) variety of competences (numerousness); 3) level of development of the competences (degree of advancement).

indirect path   *direct path*

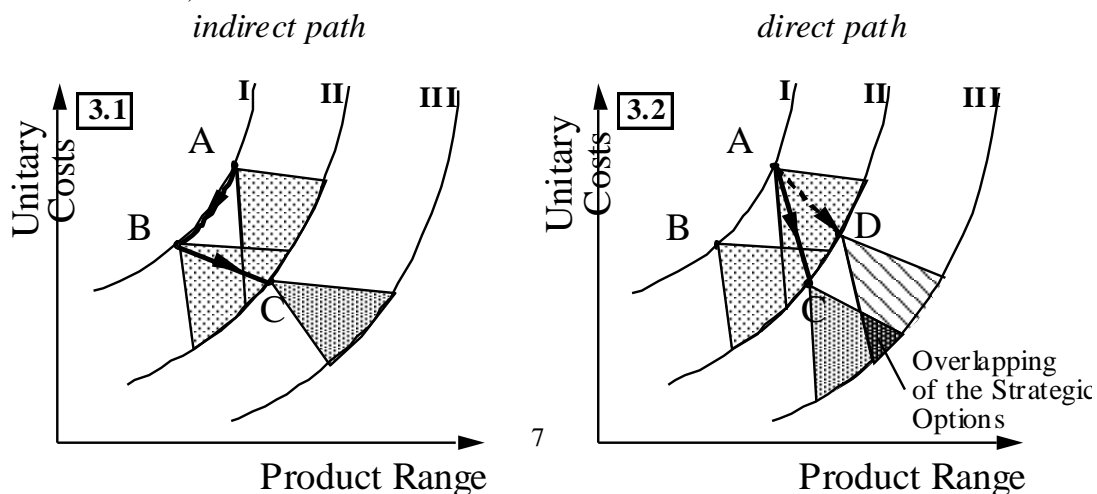Product Range   Product Range

Figure 3: Strategic flexibility as a function of the learning processes A-B-C (indirect path) and A-C (direct path)

Figure 3 schematized how the developed competences and the consequent strategic options depend on the trajectory of learning accomplished ("path-dependency" approach). Two alternative paths of a hypothetical firm which moves from A to position C are represented. In Figure 3.1 the firm decides on first restructuring, reaching situation B by means of - for example - redefinition of its layout and creating productive cells starting from the traditional job shop. Successively the cells are automated by the introduction of flexible manufacturing systems (FMS) bringing about an improvement both from the point of cost reduction and an increase in the mix obtainable (final point C). In Figure 3.2 instead a straight path is shown from point A to C; still with reference to the above example the firm decides to bring out families of products directly starting from its job shop, producing them in newly acquired FMS and thus by-passing the restructuring typical of cellular manufacturing (which would have meant passing through B).

The fact that the scope of the strategic options are determined not only by the positioning but also the trajectory accomplished introduces another point fundamental to decision making: that of the *degree of reversibility of the choice*.

This phenomenon can be represented as in Figure 3.2. The amplitude of the darker surface represents a measure of the degree of reversibility of the choice made by the firm, if one must decide between the two different decisions/directions AC or AD. It is evident that the greater the overlapping the greater is the degree of reversibility of the choice made in A. The play between the scope and the orientation of the areas of strategic options determines the amount of overlapping and in the final analysis establishes the degree of reversibility - irreversibility in the choice made.

Similarly to what was done before at the *single-business level* (evaluation of the range of the possible strategic options), also at the *corporate level* a strategic flexibility can be defined, evaluated as variety of the businesses that can potentially be added by a firm starting from the set of available capabilities (Upton, 1994).

4.3. Strategic flexibility as the rapidity of movement between businesses: the cause-effect link between strategic and operational flexibilities at a corporate level

It has been seen how the competences play a determinant role in the strategic positioning of the firm at the business level as they determine the dimension ("scope") and localization ("orientation") of the areas of strategic options. But the competences have another role. In fact their growth does not only permit the increase of the strategic options at the business level, but also the insertion into other businesses. In this case also, as before, it is possible to formulate an "operationalization" of the definition of strategic flexibility now given by Stalk et al. (1992), understood as the capacity of the firm to transfer from one business to another in the time. Expressly:

$$\text{strategic flexibility on the businesses} = \frac{\Delta b}{\Delta t} \qquad (4)$$

Similarly as was done before for the practices, we can define an operational flexibility on the competences, understood as the capacity to keep, develop, combine and acquire competences in the time. As a formula:

$$\text{operational flexibility on the competences} = \frac{\Delta c}{\Delta t} \qquad (5)$$

If at the corporate level strategic flexibility is measured as the capacity in the time to successfully transfer to other businesses, the condition for obtaining strategic flexibility is to have operational flexibility available on the competences in the sense above mentioned.

Similarly as defined on a business level, one can say at the corporate level:

$$\frac{\text{strategic flexibility on the businesses}}{\text{operational flexibility on the competences}} = \frac{\Delta b}{\Delta c} \qquad (6)$$

Thus it is possible to distinguish, also in this case, between effect (strategic flexibility on the businesses $\Delta b/\Delta t$) and cause (operational flexibility on the competences $\Delta c/\Delta t$).

5. THE *TAXONOMIC LINK* BETWEEN OPERATIONAL AND STRATEGIC FLEXIBILITIES

It is possible to individuate a second link of the taxonomic type (that is classifying) between the above mentioned classes of strategic flexibility and the principal types of operational (manufacturing) flexibility described in the first part of this paper. The link is possible if one considers, for all types of flexibility, in addition to the *object of the variation*, also the *characteristics of the variation*, in other words:

- the *state conditions*;
- the *type of transition*, that is the degree of reversibility or irreversibility of the variation.

The use of these two variables (state conditions and type of transition) enables us to reach the link, reported in Table 2, between the different types of strategic and operational flexibilities. It can be seen how the use of the variable "state conditions" permits to consider simultaneous, as descriptive characteristics of the situation in the firm at a given instance, the following variables: 1) productive capacity; 2) range of products; 3) scope of the strategic options; 4) variety of businesses in which the firm is present. They are related, respectively, to the following "objects of variation": 1) quantity of output (that is, the productive volume); 2) composition of the output (that is, the production mix); 3) competitive priorities (understood as classes of performances); 4) businesses.

If it is assumed that flexibility is a *capacity for variation in the time of a certain "object"* (productive volume, mix, competitive priority, business), then it is possible to assert that it is not formally correct to attribute any significance of flexibility to the four descriptive variables of the state. However other authors (such as Mandelbaum et Buzacott, 1990) consider our "state conditions" as "state flexibility" and our "transitions" as "action flexibility".

CHARACTERISTICS OF THE VARIATION \ OBJECT OF VARIATION		OPERATIONAL LEVEL		STRATEGIC LEVEL	
		QUANTITY OF OUTPUT	COMPOSITION OF OUTPUT	COMPETITIVE PRIORITIES	BUSINESSES
STATE CONDITIONS		Productive Capacity	Product Range	Scope of the Strategic Options	Variety of Businesses
TRANSITION	REVERSIBLE	Volume Flexibility	Mix Flexibility	Speed of Variation of the Competitive Priorities	Rapidity of Movement between Businesses
	IRREVERSIBLE	Expansion Flexibility	Product Flexibility		

Table 2: The second link between strategic flexibility and operational flexibility:

a unitary classification of the main types of strategic and operational flexibilities

As regards the variable "type of transition" (reversible or irreversible) it enables us to differentiate *volume flexibility* (generally evaluated over a short period because of fluctuating and reversionary variations in the demand and therefore in the production quantity) from *expansion flexibility* (evaluated over long periods, because of irreversible variations in the quantity to be produced, connected for instance with a plant capacity increase). In the same way *mix flexibility* is considered over a short period in relation to reversible fluctuations in the output composition, while *product flexibility* is evaluated for variations in the output composition over long periods (for instance new products are introduced).

The different temporal horizons which, in general, characterise both reversible and irreversible variations also explain why flexibility to volumes and mix (reversible) are evaluated, above all, in relation to costs (the interval of the variation is brief in respect to the times at stake). Vice-versa the irreversible transitions, as they come at significantly longer intervals (think of the introduction of a new product that could require a number of years), is evaluated both in terms of costs and time.

As far as strategic flexibility is concerned, it is reaffirmed that scope of the strategic options and variety of potentially accessible businesses are state conditions and thus are not truly flexibilities. According to our scheme, then, strategic flexibility is the capacity to successfully modify the competitive priorities and to move to new businesses. It should be noted that these "transitions" can be either reversible or irreversible (Table 2). However they seem to be prevalently irreversible. In fact strategic flexibility of priorities is evaluated on tendentiously long temporal horizons, a characteristic typical of irreversibility; besides, according to a cumulative approach of improvement of performances in "sand cone" logic, the trajectory is often one-way. Likewise flexibility of businesses most often shows characteristics of irreversibility in view of the long temporal horizons involved.

6. CONCLUSIONS

We have tried to clarify the concept of strategic flexibility and its linkages with the operational flexibility (or manufacturing flexibility, which is a term more diffused in the literature and generally refers not only to manufacturing in a strict sense, but also to all the *operations* that concur to manufacture a product: design, purchasing, distribution, marketing, services, etc.).

A classification of strategic flexibility - which is a concept more recent and vague - is presented (summarized in Table 1) which distinguishes four categories, considering the competitive priorities and businesses as *objects of variation* and the amplitude and the speed as *characteristics of the variation*.

The strategic flexibilities individuated thus regard: 1. the scope of the strategic options, 2. the variety of the possible new businesses, 3. the speed of the variation of the competitive priorities, and 4. the rapidity of movement from one business to another.

The work carried out has enabled two links between strategic flexibility and operational/manufacturing flexibility to be determined, evaluated and measured.

The *first link* individuated permits the operational flexibility and the strategic flexibility to be placed in formal relation in a cause-effect logic. After assuming a unitary definition of flexibility (the capacity of variation in the time of a determinate object), a link of the cause-effect type between the two flexibilities, both at the level of single business and corporate (that is multi-business), was pointed out.

• At a business level, the link of the cause-effect type regards "practices and performances"; the operational flexibility measures the variation of the practices to set in motion, while the strategic flexibility measures the effect obtained on the performances (or competitive priorities).

• At a corporate level, the cause-effect type link regards "competences and businesses":

in the proposed logic, the ratio between strategic flexibility and operational flexibility is given by the business change as a result of the change in the firm's competences.

The *second link* is represented by the unitary scheme of classification of the various types of strategic and operational flexibilities. Thanks to the individualization of the variables "state conditions" and "type of transition", the various flexibilities presented have been placed in a common scheme, in which only the object under consideration changes (the production volume and mix for operational flexibility, the competitive priority and the business for strategic flexibility).

In conclusion, this study has tried to provide a framework - not been proposed in prior literature - for analyzing and evaluating the correlated concepts of manufacturing and strategic flexibilities, to create a theoretical foundation for future research and empirical testing.

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