Technology and its Strategic Implications

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Abstract. *The drawing up of a good strategy is, in many cases, influenced by factors found inside or outside the organization. Concerned to identify and diminish the obstacles created by many of these factors, the managers and the theorists, interested in understanding these phenomena, produced and implemented methods and techniques by the means of which the environment is analyzed and there are drawn up various strategies able to ensure the competitive advantage of a company. In the following, we will analyze the role of the technology on the strategy of an organization and we will see the advantages and inconveniences of certain unprofessional and irresponsible actions.*

The conclusions that result in the end support the need to use the technologies that favour the performance and to create partnerships that should favour an authentic accelerated development.

Key words: technology; strategy; competition; organization; sustainable investment.

1. The impact of the technology on the strategy of the organization

A careful review of the main models of strategic analysis reveals the fact that technology is an un element to which is not paid a lot of attention; the evolution of the technology is generally considered an external phenomenon, imposed to an organization by the competitive environment.

However, the evolution of the technology, either undergone or induced by the organization, has often a decisive effect on its competitive position. There are numerous examples of organizations that encountered significant difficulties or that disappeared as a consequence of some technological changes produced in their field of activity.

The evolution of the technology can represent for organizations a threat or an opportunity to strengthen their competitive position.

According to its definition, technology consists of the concrete use of the scientific and technical knowledge for conceiving, developing and producing a product; this stresses the fact that it represents a decisive factor for the success or the failure of an organization.

The impact of the technology evolution on the competitive situation of an organization can be analyzed at three levels:

a) that of the activity as a whole;

b) that of the competitive positions of the organizations in the same activity field;

c) that of the competitive structure.

The impact of the technology evolution on the competitive situation

Table 1

LEVEL I Activity as a whole	LEVEL II Competitive positions	LEVEL III Competitive structure
Growth Maturity Value	Structure of the costs	Disappearance of the existent competitors
Segmentary limits	Differentiation of the products	Emergence of new competitors

In order to understand these influences, we will analyze each case separately.

a. The impact of the technology on the activity as a whole

The technology evolution can strongly influence the development of an activity field by its effect on the *growth* and *maturity* of the field. Moreover, it can modify the borders between the strategic segments and can thus lead to a repositioning of the organizations in their competitive environment.

First of all, the technology evolutions, either in the segment or in other segments, can influence directly the rhythm of development of the activity and, on the long term, the maturity stage and the potential of development. Some evolutions are able to refresh the increase of the activity, rejuvenating it, while others can slow down its increase, inducing phenomena of accelerated ageing.

Here are two examples that confirm the previous statements:

- The progress of the microelectronics which led to the increase of the performance, the decrease of the cost of the components, the significant reducing of the dimensions and of weight favoured a large spread of the products generating a potential of growth very important in the industry of semiconductors or in the downstream sectors (video, hi-fi, micro informatics, etc.).
- On the other hand, the increased resistance of certain materials, such as the rubber, can reduce the need of renewal of the products that incorporate these materials (ex.: tires), limiting thus the development of this field.

In the models of strategic analysis, especially in the models of portfolio, it can be noticed the fact that technology evolution is an essential determinant of one of the two dimensions on which the model is based: the increase of the sector in the case of the Boston Consulting Group – BCG method, the maturity of the industry in the case of Arthur D. Little – ADL method, the value or the attraction of the activity for the McKinsey method.

Yet, the influence of the technology evolution does not stop here: it can be found in the field of the strategic segmentation. This means that it determines the segregation of the whole activity in homogenous segments and defining the systems or the competitive fields to which the organization belongs. The technological changes can attenuate progressively the borders between industries that, for a long time, have been perceived as different and eventually create a new unique segment.

The technology evolution can also lead to a segregation of the activity segmentation in fields that become distinct. Thus, the field of the aeronautics construction evolved in this regard, being progressively segregated in *jet planes*, *strike planes, commercial planes,* as a consequence of the increased specialization of the technologies used in each of these fields.

b. The impact of the technology on the competitive positions

Technology can be the starting point of the competitive advantages of the organization as it:

- can provide a cost advantage;
- can be a source of differentiation.

Using more performing technologies can allow reducing certain cost elements, offering thus to an organization a global advantage in comparison with its competitors.

Frequently, technological learning is one of the main causes of the experience effect and, consequently, a motor that acts toward the reduction of the costs. However, if the experience effect connects the level of the cost to the size of the market, advantaging thus the big competitors, the technological innovation can counteract the experience effect and the obstacle related to the dimension of the organization, favouring thus the small, but innovative competitors.

Besides its effect on the costs, technology is one of the most important sources of differentiation for an organization. Having performing technologies favours offering certain products with characteristics superior in comparison with those of other products of the competition that exist on the market.

The arguments displayed so far demonstrate that technology, on the one hand, can lead to the cost advantages and, on the other hand, can generate the differentiation of the products. It is useful however to specify that these effects do not exclude one another under any circumstances.

c. The impact of the technology on the competitive structure

Leading to a modification of the key factors in an activity, the technology evolutions can alter the mobility border of the activity and cause the disappearance of certain existent competitors or facilitate the entrance to this sector of other new competitors. Right after the new technologies get a decisive importance in an activity, the organizations that do not master very well these technologies, which do not have the means or the will to purchase them, can be tempted to abandon this activity. On the other hand, the organizations outside the field, which master very well these technologies, can take advantage of the opportunity to enter the market.

2. The technology choices

The choices in the technology field can be influenced by three main concepts:

- the technological patrimony;
- the competitive typology of the technologies and of the portfolio of technologies and,
- the life cycle of the technologies.

a. The technological patrimony

Taking into account the process of drawing up the strategy requires in a first stage the identification of the assembly of elementary technologies necessary for carrying

out an activity. Inventorying the assembly of technologies used in various activities of the organization, as well as of the possible yet unexploited technologies, makes possible to draw up the technological patrimony of the organization.

This inventory points out which are the technologies necessary or the activities of the organizations but which do not belong directly to it (if it appealed to external suppliers) and which are the potential applications (unexploited yet) of the existent technologies. Comparing the technologies used by organization with those used by the competitors reveals technological alternatives and allows indicating the possible weaknesses of the competitors.

The inventory of the technologies is not a purpose in itself; it should lead to an evaluation of the competitive impact of various technologies.

b. The competitive typology and the portfolio of technologies

Not all the technologies involved in the development of an activity have the same competitive impact. Using some of them is essential for the success of an activity and this is determined by the influence of the technology on the cost or on the differentiation. Other technologies are involved only secondarily in the success of the organization, because their impact on the performances of the product or on the cost is extremely low or because they are at hand of the competitors.

Arthur D. Little consultancy office proposes a repartition of the technologies in three main categories:

- *The basic technologies* that are widely spread in carrying out the development of an activity; although their implementation was at the origin of the activity, they do not have any more currently a decisive impact because they are widely spread or paralleled by other similar technologies.
- *The key technologies* are those whose competitive impact is the most important. They are the core of the competition and mastering them confers distinctive competences, essential for the success of an activity.
- *The emerging technologies* are those still in development, in the first application phase, and have a limited impact on the activity. However, they have though an important potential and some of them can become in time key technologies.

In order to enter a technology in one of the three categories, we start rather from the role they play in the competitive game within a certain activity field than from the own characteristics of a technology. One and the same technology can be considered basic in a field, key in another and emerging in others. We can see this phenomenon, for example, if we analyze the computer assisted design and fabrication in the aeronautics, cars or textile fields.

A complementary approach, developed especially by the office of consultancy in strategic problems – SR International –, is based on the concept of *portfolio of technologies*. Inspired from the steps used for constituting the activity portfolio of the organization, this approach positions various elementary technologies applied in a bidimensional matrix:

- the competitive impact of the technologies, measured from the point of view of the efficacy/cost, of the added value and of the differentiation potential;
- the degree of mastering the technologies by the organization.

Here is thus the following matrix:

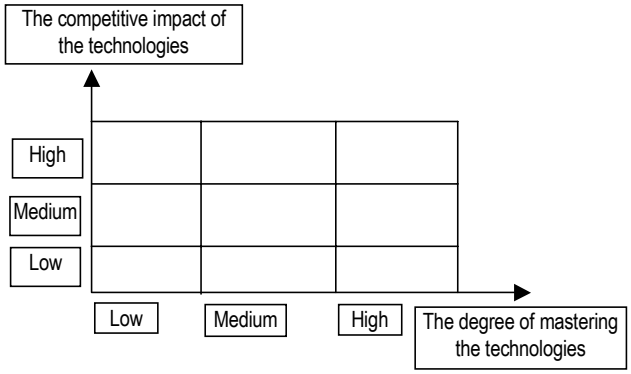

Figure 1. *The portfolio of the technologies*

The positioning of the technologies in this matrix allows the evaluation of the technological patrimony of the organization and confronting it with the activity portfolio; the organization obtains interesting information that can help it strengthen its strategic position.

The various possible classifications of the technologies do not lead though to a static image of the situation of the organization and of its environment. The competitive impact of the technologies evolves in time and, in a more dynamic prospective, is may be useful to examine the life cycle of the technologies.

c. The life cycle of the technologies

In order to guide the technological choices, there are necessary rigorous forecasts regarding the development of various technologies and of the evolution of their competitive impact on certain activities.

A useful concept for orientating the choices in the technological field proves to be the *life cycle of the technologies*, directly inspired from the concept of product lifecycle or activity lifecycle. The development of the technologies seems in fact to be carried out according to a process that can be represented by an "S" shaped curve.

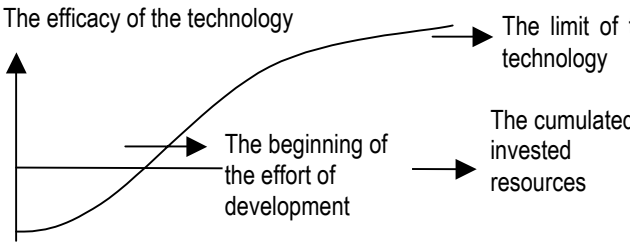

Figure 2. *The development of the technologies*

In a first phase, the organization has to invest substantially in the development of a technology, though the results of this investment should not be felt significantly. In the second phase, when the organization has accumulated a certain amount of knowledge and competences regarding the concerned technology, the progress is much faster. In the third phase, they slow down again because the proper physical limits of this technology begin to come out. Certain analyses point out much more detailed the various development stages of a technology: embryonic, growth, maturity and then ageing.

The success of the positioning of a technology in its lifecycle is a decisive element of the technological strategy of the organization. It can be established if it is justified to continue the investment in this technology or if it is preferable to invest in substitution technologies.

In order to do the technological choice and the resources allocation according to a coherent strategy, it is very important for the organization to draw up genuine technological strategies, starting from a diagnosis of the technological patrimony and from an analysis of the competitive positions in various segments that create its activity portfolio.

3. The technological strategies

In order to harmonize the technological choices of the organization, the global strategy of its activity portfolio and the competitive strategies that it wants to apply for each of its strategic segments, it is essential to take into account the followings:

- the value of various activity fields of the organization;
- its competitive position in each of these fields;
- the degree of mastering the main technologies essential for carrying out these activities.

The efficient management of this process requires some useful specifications:

▪ *The ways to access the new technologies*

The ways to access the new technologies are numerous. We have chosen the following five:

- *Internal competition;* they require time and important investments. This is however the solution that offers the biggest independence to the organization. If it is about technologies whose competitive impact proves to be important, this can ensure the strongest and the most durable competitive advantage. It should not be ignored this aspect: this solution is also the riskiest.
- *Cooperation agreements* associate the efforts of more organizations in the view of the development of new technologies. This solution has the advantage to share the costs and limit the risks, but it emerge only between organizations that reach full agreements regarding the necessary means and the directions of research and development.
- *Acquisition of the organization* that masters the desired technology. Even if this solution can seem very tempting, it can be applied only when such an organization exists and it is for sale.
- *Contracts of external research* – by which the organization resorts to an external body (lab, institute of studies, centre of university research) for carrying out a special technology.
- *Licenses purchasing*. On the basis of very strict use conditions, this solution offers the possibility to access technologies developed by others, often by competitors in the same activity field, but from others geographical areas.

We can also mention the solution to buy finite products or assembling the components. The products are then sold under the brand of the organization, this solution allowing a provisory maintaining of the position got on a certain market.

These various solutions cannot be chosen starting only from technological criteria. Their evaluations have to take into account the global strategic situation of the organization.

▪ *The exploitation of the technology patrimony*

The exploitation by the organization of their technologies can have two main forms:

- using these technologies for conceiving, developing, producing and selling of the products and,
- the transfer of these technologies to other organizations that will use them for their activities.

These two options do not exclude each other. Certain organizations chose deliberately not to use the technologies they developed, becoming thus study societies; others, from reasons rather psychological than strategic, refuse to sell and thus to share with others the technological competence they dispose of.

Most of the organizations have though intermediate behaviours, exploiting directly certain technologies and renouncing to others. Thus, they can use the own technologies on certain markets and can transfer them to the partners to exploit them on other markets. The choice between various options of exploiting, combining these options according to the considered technologies, activities and markets, within a coherent policy, must be made taking into account both the strategic criteria and the technological one.

▪ *The models of the technological strategies*

According to the classical models of strategic analysis, the technological factors are taking into account when the competitive position of an organization is evaluated and are lost among many other factors. In order to eliminate this disadvantage, there were drawn up analysis scales that

isolate the technological dimension and articulate it around other two more classical dimensions of strategic analysis.

Arthur D. Little consultancy office, which proposed the most complete analysis of the connection between strategy and technology, take into account at the same time the maturity of the activity, the competitive position and the technological position of the organization and deduces, starting from here, the best technological strategies for each situation. In the following we can see the synthesis of these analyses:

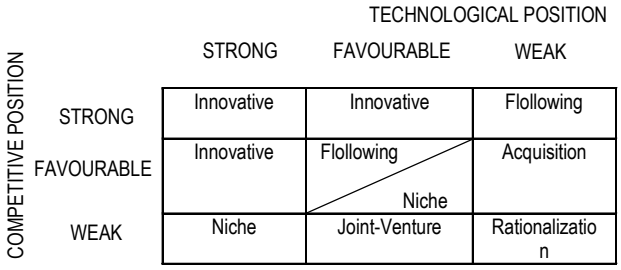

Figure 3. *Branch in the phase of starting/at the beginning of growth*

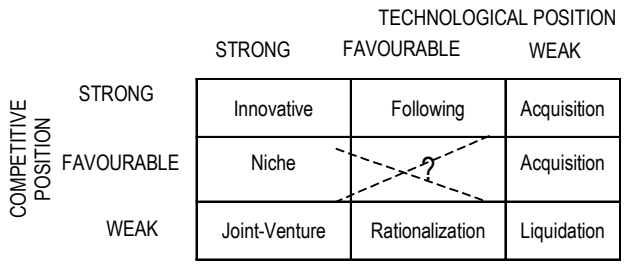

Figure 4. *Branch in the phase of starting at the beginning of growth*

This approach allows though a certain ambiguity, because the competitive position of the organization is not independent from its technological position. For this reason we retain the following analysis scale taking into account three much more differentiated possibilities:

- the potential of the development of the activity (its value), a classical variable in the models of strategic analysis;
- the commercial presence of the organization on the market, measured according to its degree of penetration, to the distribution network, to its notoriety or image; this second variable shows the control power that the organization has on its consumer;
- its technological position, measured by the degree of mastering the technologies considered to have a major competitive impact, of the key technologies of tomorrow, according to the ADL typology; this last variable reveals the extent to which the organization can count on the technology to ensure itself a strong competitive position.

Doubling to a certain extent the competitive position variable to make more visible the technology variable, we can reanalyze the activities of the organization and deduce the allocation of the resources necessary for developing activities on the one hand and technologies on the other hand. The ways of development will be based either on the stronger technologies or on the strongest commercial presence. Adopting a binary evaluation – weak/strong – for each variable, we obtain a classification of the activities of the organization in eight categories, resulting from the following possible combinations:

1. Activities with strong potential of development for which the commercial presence of the organization and its technological position are strong. These activities correspond to the "star" activities in the traditional matrices; the organization has to maintain its position on the market, to strengthen the technological progress and to allow the development of the activity.

2. Activities with limited potential of development for which the commercial presence of the organization and its technological position are weak. These activities are "deadlocks" to which the organization should give up, except from the cases when it succeeds into making them profitable without investing excessively.

3. Activities with limited potential of development for which the commercial presence of the organization and its technological position are strong. These are the "milking cow" activities from which the organization has to obtain the maximum of liquidities, limiting to minimum its investments. As regards the technology, they have to try to exploit their capacities, either applying them to fields with a stronger potential of development or making a transfer.

4. Activities with strong potential of development for which the commercial presence of the organization and its technological position are weak. These are the classical "dilemma" activities, for which it is recommended either to invest a lot in order to improve in the same time both the aspects connected to mastering the technology by the organization and to its force on the market, or to retreat.

Taking into account separately the two dimensions – "technological position" and "commercial presence" – reveals the fact that there are risky dilemmas on both levels.

The four cases examined previously are those that correspond the best to the classical situations analyzed by the means of the traditional portfolio methods; these are situations for which evaluations are made on the basis of the two dimensions "technological position" and "commercial presence", are convergent and, consequently, separating them brings only supplementary further information.

When these situations are divergent, the separations enrich considerably the analysis.

5. Activities with strong potential of development for which the organization has a strong technological position, yet a weak commercial presence, are also "dilemmas"; though, taking into account the solid

technological bases, the undertaken risk is low. Under these circumstances, the organization, first of all, has to try to develop its market and to try an association with a partner which has a strong commercial base, but which does not master the essential technologies. If the organization does not want to invest in such an activity, it should exploit its potential by selling its technology.

6. Activities with important potential of development for which the organization has a strong commercial presence, but a weak technological position are also partial dilemmas. It is necessary in this case to purchase as soon as possible the necessary technological competences, so that to exploit the advantage that the organization has at the level of the market. The time is decisive here and it is recommended to proceed to an external acquisition of technologies rather to try to create internally the competences, which is a much longer process. In this two last situations, taking into account separately the two variants "technological position" and "commercial presence" allows to highlight the strategic complementarities between organization and its external partners; the organization searches for partnerships and alliances so that it could capitalize the strengths and compensate its weaknesses.

7. Activities with weak potential of development for which the organization has a strong commercial presence, yet a weak technological position, have to be managed as "milking cows", limiting strongly the investments in order to obtain maximum of liquidities. Purchasing technologies for strengthening the position of the organization should be made only if it is immediately profitable.

8. Activities with low potential of development for which the organization is weakly presented from the commercial point of view, but disposes of a strong technological position should be considered rather "deadlocks". The main objective to the organization should be in this case to restrict progressively, if it is possible by generating liquidities, and especially to try to exploit their technological capacities, either applying them to fields with a stronger development potential or accepting the transfer to external partners.

The explicit introduction of the technological variable in the strategic analysis allows a more detailed interpretation of the reality of the encountered situations and the proposal of more diverse strategic options in comparison with the monolithic recommendations of the traditional models.

It is obvious the fact that, for certain strategies, the technology represents the central point while for others these strategies are based firstly on the market domination.

▪ *Strategies based on technologies and market*

Some organizations have the tendency to make from the technology the main axis along which they develop their strategy; mastering a technology or a convergent assembly of technologies represents their main distinctive competence. The dominant characteristic of these technologies reveals in the context of certain strategic changes, such as diversification, when the organizations manage to exploit the technological competences on new markets and within new activities.

The development of certain companies, especially the Japanese ones, is founded on the application of these strategies based on the technology. Based on an assembly of generic technologies, these create an own, sound and coherent technological and industrial potential, used for very different products, on various markets.

The strategies based on the technology in the Japanese companies were represented as a tree, a bonsai, in which:

- the roots are the generic technologies;
- the trunk is the own technological potential, developed by the company;
- the branches are the sectors in which it is applied and,
- the fruit represents products/markets.

Things are different in the case of the organizations that follow a commercial logic. For these, the main axis of their development is the client and the technology is only a way among others, which helps to satisfy the client. The organization passes easily from a technology to another and gets progressively the technical competences necessary to enlarge the product range and to serve the client.

These two axes of development, based on technology or on market, are in fact extremes of a high range of situations in which organizations define their field in an own combination of competences that involve, as we showed above, mastering the technologies or the commercial presence on the market.

All the arguments used for presenting the role and the implications of the technologies on the strategic options of the organizations reveal the complexity of the strategic process and the need to reinforce complementary points of view in the analyses that we make and in the decisions the managers make.

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