

# The Non-Technological Side Of Technological Innovation: State-Of-The-Art And Further Empirical Research

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## Abstract

Technological progress leads to economic development by raising firms' productivity and this creates better quality of life for everyone. However, investment in technology does not always reach the expected level of productivity and quality of life.

A main reason why technological investment has failed is the current trend of overlooking the fact that well organised human resources are a major requirement in obtaining the highest profit from the potential of technology. Thus, technological and organisational innovation must go hand in hand (IMIT, 1996).

Although the Oslo Manual (OECD, 1997) recognises both the importance of the organisational dimension of technological innovation and that technological change and organisational change are closely inter-connected, it exclusively approaches technological innovation. In addition, the Oslo Manual qualifies organisational and managerial innovations as a complex topic, and it strongly recommends the creation of indexes to assess non-technological innovations, in order to include them in the next-years studies.

Given both the widely recognised importance of the organisational dimension of innovation, and the need for more detailed research into this topic, this study is an attempt to contribute to knowledge of it. This paper reviews the literature related to three relevant and inter-connected topics: (i) Factors for the success of technological innovation; (ii) Features of the innovative organisation, and (iii) Organisational innovation. The knowledge produced by previous studies on those three topics is the starting point to characterise the innovative organisation. Then, and following the recommendation of the Oslo Manual, we propose empirical research. The objective will be to assess the organizational and managerial factors which characterize the most innovative organizations and to identify feasible paths to embody them. This objective will have four specific elements: (i) *Mechanisms* used by firms under innovation to ensure the characteristics that distinguish innovative organizations; (ii) *Impacts*, i.e., development of indicators to assess the contribution of those mechanisms to the success of firms when launching technological innovations; (iii) *Paths* followed by successful firms under innovation for implementing the previously identified mechanisms; and (iv) *Contingency approach*, i.e., the circumstances in which each path should be followed, and especially the obstacles to overcome, will be identified. In doing so, we assume that the previously identified paths should never be indiscriminately applied.

Thus, the results of proposed research will provide a better understanding of organizational and managerial factors, which should work together to create and reinforce the kind of environment that enables technological innovation to succeed.

**Key words:** Factors for success of technological innovation - Innovative organization - Non-technological innovation - Organizational innovation

## **Introduction**

Technological progress leads to economic development by raising firms' productivity and this creates better quality of life for everyone. However, investment in technology does not always reach the expected level of productivity and quality of life. For instance, in Portugal during the 1990-1993 period, many firms invested large amounts in technology. Now, several of those firms see that their efforts have resulted in neither the expected improvement in productivity nor better quality of life. This failure to achieve the expected outcome is largely due to difficulties of Portuguese firms in coping with the intangible aspects of the technological progress, i.e., its organisational aspect (Corado Simões, 1997). Indeed, an important reason why technological investment failed is the current trend of overlooking the fact that well organised human resources are a major requirement in obtaining the highest profit from technology's potential. Thus, new forms of organising activities must keep pace with the application of new technology. In other words, technological and organisational innovation must go hand in hand (IMIT, 1996).

The OECD's (1996) Report on *Technology, Productivity and Job Creation* discusses a considerable body of research showing that technological and organisational changes are highly interconnected. Indeed, technological change both calls for and results from organisational change. This relationship is clearly demonstrated by the results obtained from the Danish survey on organisational and technical innovation in 1,900 Danish private firms. They show that 68% of the firms that had undertaken major organisational changes in the 1993-95 period had also introduced new products and/or services. Conversely, the corresponding figure for those firms that had not undertaken major organisational changes was only 34%. In fact, 2/3 of the firms that had undertaken major organisational changes reported that organisational innovation took place in order to strengthen the ability of the firm to continuously develop new products/services and renew the firm's knowledge base (Lund & Gjerding, 1996: 17-18). Consequently, it could be assumed that "an entrepreneur who manages to combine technological and organisational innovation has a greater chance of success than one who mainly concentrates on one type of innovation" (IMIT, 1996: 14).

The findings of the European Commission's Competitiveness Group confirm that firms' organisation innovations contribute to the improvement of business performance. The same message comes from the German and the Scandinavian programs on Work and Technology, showing that firms which have restructured their work organisation and industrial relations are far more successful than those attempting to meet the challenges solely through the introduction of advanced manufacturing technology (European Commission, 1996).

Organisational innovations are indeed a necessary condition for the successful and full exploitation of any technological innovation. This usually happens in a specific kind of organisational and managerial environment that influences its rate and quality. On the other hand, organisational innovation may also result in substantial improvements of effectiveness quite independently of the technology used (e.g. lower costs for administration and control or better use of work force motivation and skills). Thus, the importance of organisational innovations as an economic growth factor that can contribute to the firms' competitiveness and success is quite clear.

In spite of this, many European firms still maintain hierarchical organisations, with a high degree of specialisation, low degree of integration and product innovation, defensive methods of restructuring, and political demands for reduced responsibility in relation to the workforce (European Commission, 1996). The diffusion of new practices seems to be slow, finding barriers among European countries. Broadly, European firms are not performing well in that sense, especially when compared to their American counterparts. American firms outdid their European counterparts because organisational innovations diffuse much faster and more fully in the US than in Europe. Furthermore, organisational innovations rarely stem from European countries (IMIT, 1996: chapter 3).

Some advances have however occurred recently. Namely, the Organisation for Economic Co-operation and Development (OECD) has reviewed its Oslo Manual. In its latest version, the Oslo Manual recognises that non-technological factors are a requirement for getting the most out of firms' capacity for technological innovation. Moreover, it specifically highlights the paramount importance of the organisational dimension for the success of technological innovation:

[O]ne key element of innovation is organisation. ... Organisation is essentially a process for the gathering, management and use of information, and for the implementation of decisions based on such information. Such processes have a strong intangible dimension, but taken together they make up the learning capacity of the firm and as such are a central element in innovation capability. These are specific institutional "rules of the game" which regulate possible modes of organisation on a broad level. (OECD, 1997: 43)

On the other hand, the organisational dimension of innovation is rather difficult to approach because of the problems in measuring it. This is likely to be the reason why little effort has been made to define a theoretical framework and accurate measurements. The clearest example of this situation is the Revised Version of the Oslo Manual which focuses on product and process innovation issues and merely dedicates a three-page annex with a few succinct comments on the compilation of non-technological innovation data.

Given the widely recognised importance that the organisational dimension plays in innovation and the lack of adequate research on this topic, this paper focuses on contributing to the existing body of knowledge. It reviews the literature related to three relevant and inter-connected topics: *(i)* Factors for the success of technological innovation; *(ii)* Features of innovative organisation, and *(iii)* Organisational innovation, in section 1. Going through the

knowledge produced by previous studies on those three topics allows us to suggest, in section 2, some directions for further empirical research on this topic. The main objective of this research should be to define and assess the organisational and managerial factors which characterise innovative organisations and to identify the feasible paths to embody them. The results will allow us to get a better understanding of the non-technological factors that should work together to create and reinforce the kind of environment that enables technological innovation to succeed.

### **Factors For Success Of Technological Innovation: Towards The Innovative Organisation**

Studies on factors which help technological innovation to succeed started in the late 1950s, when Carter & Williams (1957) studied the characteristics of 200 technically progressive firms in the UK. Since then, other authors have tried to identify the non-technological factors associated with the success of the innovation process. In this paper twelve empirical studies are reviewed because they constitute a major contribution to knowledge of this topic (see Table 1).

Table 1: Studies on the non-technological factors for success of technological innovation				
AUTHORS	CONTENTS	INDUSTRIES UNDER SCRUTINY	SAMPLE DIMENSION	SAMPLE NATIONALITY
Carter & Williams (1957)	Characteristics of innovative firms	No criteria	200 firms	UK
Myers & Marquis (1969)	Characteristics of successful technological innovations	Railroad supplies, Housing supplies, Computer manufacturers, Computer suppliers	567 innovations	USA
Langrish et al. (1972)	Factors associated with success and factors causing delay in innovation	No criteria	84 innovations	UK
Hayvaert (1973)	Innovation strategy and product policy	No criteria	12 firms	Belgium
Schock (1974)	Factors affecting the innovation potential	Metal working	45 firms	Netherlands
Rothwell et al. (1974)	Factors affecting success and failure in innovation	Chemicals; Scientific instruments	43 pairs of successful and unsuccessful innovations	International
Szakasits (1974)	Factors affecting success and failure in innovation	Electronics	12 pairs of successful and unsuccessful innovations	Hungary
Freeman (1974, 1982)	Economics aspects of innovation	Chemical and oil processing plant, Nuclear energy, Synthetic materials, Electronics	Non available	Non available
Utterback et al. (1975)	Factors affecting success and failure in innovation	Automobiles, Industrial chemicals, Computers, Consumer electronics, Textiles	164 innovations	France, F. R. Germany, Netherlands, Japan, UK
Rothwell (1976)	Factors affecting success and failure in both radical and incremental innovations	Textile machinery	53 innovations	International
Barañano (1994, 1995)	Characteristics of innovative firms	Information technologies	35 firms	Spain
Corado Simões (1997)	Attitude and behaviour of SMEs on the innovation and management areas	Dairy products, Knitting wear, Foot wear, Manufacturing of taps and valves, Machines to wooden works, Car components, Automation and Electronics	21 SMEs	Portugal

SOURCE: Carter & Williams (1957); Myers & Marquis (1969); Langrish et al. (1972); Hayvaert (1973); Schock (1974); Rothwell et al. (1974); Rothwell (1976); Szakasits (1974); Freeman (1974, 1982); Utterback et al. (1975); Barañano (1994, 1995); and Corado Simões (1997)

We learn from the revised studies that a single factor cannot determine on its own either technological success or failure. As Rothwell (1977) pointed out:

Technological innovation is a complex technico/socio/economic process which involves an extremely intricate web of interactions, both intra-firm and between the firm and its economic, technical, competitive and social environment. It might not, therefore, be expected that success or failure will often be satisfactorily explained in terms of one or two factors alone, and indeed, ... innovation studies very strongly underline the *pluralistic* nature of explanations for successful and unsuccessful innovation. (Rothwell, 1977: 203)

Tidd et al. (1997) assured that "No single element in isolation is likely to be effective, and no single tool or technique however fashionable, will create and sustain an innovative environment." (Tidd et al., 1997: 332), so informing us that twenty years later the Rothwell's statement remains a current claim.

Instead, we find in the studies reviewed a set of different (though interrelated) determinants which can be classified into eight categories. These are as follows: (i) Good communication and effective collaboration; (ii) Marketing and user needs; (iii) Planning and management techniques; (iv) Quality of management, personnel policy and management style; (v) Innovation as a corporate-wide task; (vi) Key individuals; (vii) Efficient development work; and (viii) After-sales service and user education.

Although all those studies implicitly make known the characteristics of flat, light organizational structures, only Barañano (1994) and Corado Simões (1997) explicitly identified organizational components as crucial factors for success. Some other authors (e.g. Tornatzky *et al.* (1983); Frost & Egri (1991), Wolfe (1994), and Tidd et al. (1997)) have also recognised the importance of the organisational dimension in the success of technological innovation. Indeed, organisational factors have gained growing attention during the recent years, leading to the definition and characterisation of the so-called innovative organisation.

We define the innovative organisation as the integrated set of managerial and organisational elements which work together to create and reinforce the kind of milieu stimulating successful technological innovation. Hence, in full agreement with Tidd et al.'s (1997) view, we assume that organisational and managerial factors are so intimately inter-related that we must examine them jointly.

These authors made a great contribution in identifying the managerial and organisational elements that characterise the innovative organisation. These elements are as follows:

*Extensive communication* - Since much problem-solving and idea-generation depend on combining different kind of knowledge widely distributed across the organisation and across different organisations, when speaking about extensive communication, the authors mean communication within and between the organisation and outside. Internally, communication must be multidirectional and use multiple channels and media.

*Customer focus* - It involves the firm's orientation towards both internal and external customers, as well as the implementation of a total quality culture. At the external level, it means concentrating attention on lead users and/or major technological developments. On the other hand, as pre-condition for the satisfaction of the external customer is the satisfaction of the internal customer, we should consider the organisation as an inverted pyramid. That is, employees in direct contact with external customers are the customers of the employees whose activity's output is the input to the former activity. These employees at the second level will be customers of those employees whose activity's output is the input to their activity, and so forth. Thus considering all employees as internal customers of some other employees.

*Vision, leadership and the will to innovate* - Obstacles to innovation such as "different cognitive, behavioural and structural ways of reinforcing the status quo; the 'not invented here' problem; and the core rigidities" (Tidd et al., 1997: 307-8), frequently arise within organisations. When those obstructions exist, the need for changing the organisation's way of thinking by articulating a new vision appears. Within the required new vision, considerable energy and enthusiasm should be devoted to ensuring that individual inventors champion their ideas, entrepreneurs build businesses through risk-taking behaviour, and organisations manage to challenge the accepted rules of the game (Tidd et al., 1997). All evidence suggests that top management's long-term commitment to innovation and acceptance of risk bring about the required new vision.

*High involvement in innovation* - It has been proved that the performance of in-house R&D is an element of paramount importance for firms to produce successful innovations (Freeman, 1982). However, creative and problem solving skills should not only be confined to technical specialists in R&D, engineering or design departments, because anyone within the firm may possess these abilities (Tidd et al., 1997). In fact, as each worker knows his/her job better than anybody else does, he/she is be in the best position to propose any improvement related to his/her tasks and duties. This fact sets the grounds for the continuous introduction of incremental innovations. The sum of each individual incremental innovation can have far-reaching impacts. Hence, to involve every member in the innovation process and to foster individual creativity across the entire company is a crucial point.

*Effective team working* - The growing complexity of innovation shows the great potential of team working. Indeed, those teams formed upon diversity in background, ability, and behaviour are proved to offer more than individuals do in terms of both fluency of idea-generation and flexibility of solution development (Tidd et al., 1997). Probably because of this, currently both academics and entrepreneurs are quite concerned with getting knowledge of best team-building practices.

Unquestionably, team-building requires the managers' ability to make the most suitable decisions about team size, team structure (i.e. good balance of team roles and harmonisation of individual behavioural styles), team process (i.e. the way in which meetings are organised, decisions taken, and conflicts within the group solved), team environment (i.e. how to ensure continuing liaison with the organisation), and how to achieve effective team leadership, as well as to clearly define the team's tasks and objectives (Tidd et al., 1997).

*Continuing and extending individual development* - Innovating firms increasingly implement training programmes to provide their employees with the knowledge and skills they need to make the best use of new equipment or to generate new or improved products, services and/or processes. In addition, training programmes have important secondary effects. They act as motivators because people value the acquisition of new skills and knowledge and feel valued by their organisations. They are a means of empowerment since qualified people feel more confident and equipped to take more responsibility and show more initiative. Finally, given that qualified people feel less threatened by the introduction of changes within their organisation, training programmes may be part of a wider agenda for change.

*Learning organisation* - Firms must set the context in which continuous learning will most probably take place. That context is the learning organisation, which develops mechanisms to enable and even encourage the continuous learning process.

*Creative climate* - Many of the elements mentioned so far just will be fully useful in a creative climate. A creative climate involves the pattern of shared values, beliefs and agreed norms that develop inventive behaviour among all members of the organisation. Thus, innovative firms' managers must fight for the creation and maintenance of that kind of climate, "involving themselves in the systematic development of appropriate organisational structures, communication policies and procedures, reward and recognition systems, training policy, accounting and measurement systems and deployment of strategy." (Tidd et al., 1997: 326)

*Key individuals* - Tidd et al. (1997) have further developed Rothwell et al.'s (1974) contribution on the crucial individuals to innovation. They agree that one of those key individuals is the product champion. He/she is a person prepared to champion a new or improved product, service or process by providing much energy and enthusiasm to help it to progress through the organisational system. They also agreed about the importance of the technical innovator (in the Rothwell et al. (1974) terminology) or inventor (in the Tidd et al. (1997) one). He/she is the person responsible for an invention; he/she has a wide understanding of the technology behind the innovation, as well as the inspiration to solve the many development problems. However, Tidd et al. (1997) split Rothwell et al.'s (1974) business innovator role into three different roles: the organisational sponsor, the project team leader, and the business innovator (in a narrower sense). The organisational sponsor is the person who copes with "issues such as procuring resources or convincing sceptical or hostile critics elsewhere in the organisation, [...] has power and influence and is able to pull the various strings of the organisation (often from a seat on the board). ... Such sponsors do not necessarily need to have a detailed technical knowledge of the innovation ... but they do need to believe in its potential" (Tidd et al., 1997: 316). The project team leaders "are deeply involved and have the organisational power to make sure things come together" (Tidd et al., 1997: 316). The business innovator role is played by "someone who could represent ... the broader market or user perspective." (Tidd et al., 1997: 317). Finally, Tidd et al. (1997) confirm the importance of the gatekeeper previously identified by other authors (Allen et al. (1971) and Rothwell & Robertson (1973) among others). The gatekeeper is the organisation's informal structure's key individual "collecting information from various sources and passing it on to the relevant people who will be best able or most interested to use it." (Tidd et al., 1997: 317)

*Appropriate structure* - All the above mentioned features of the innovative organisation must be supported by a structural form which should fit the organisation's contingencies. If the structure fits well, it will enable all the above mentioned features and will even reinforce them. Otherwise, it will halt, or at least delay, any innovation initiative.

As usually in management, there is not a single best solution of overall application. We cannot suggest a unique suitable structure to fit the mostly non-programmed and uncertain tasks that innovating firms perform within the current highly complex and uncertain environment. However, it is clear that appropriate structures must be characterised by their flexibility and capacity to co-ordinate their different units in order to match the current conditions of rapid change.

The Burns and Stalker's organismic system fulfills these requirements. According to these authors, "the organismic form is appropriate to changing conditions, which give rise constantly to fresh problems and unforeseen requirements for action which cannot be broken down or distributed automatically arising from the functional roles defined within a hierarchic structure." (Burns, 1990: 70). Within Burns & Stalker's (1994, first edition 1961) organismic system, responsibilities, functions, methods and powers are constantly redefined through interaction between workers participating in common tasks or in the solution of common problems. Each individual had to do his/her job being aware of the overall purpose and situation of the company as a whole. Interactions ran laterally as much as vertically, and communication between people of different ranks tended to resemble lateral consultation rather than vertical command.

Henry Mintzberg's proposal (1979, 1992) is adhocracy. Adhocracy is a team based structure with high levels of individual skills but also able to work together. Co-ordination is warranted by mutual adjustment. In addition, the few existent internal rules are subordinated to get the job done (Mintzberg, 1979).

More recently, Castells (1996) proposes the horizontal corporation model. He defines it "a dynamic and strategically planned network of self-programmed, self-directed units based on decentralization, participation, and coordination" (Castells, 1996: 166). A similar conclusion was reached by Barañano (1994, 1995) when defining the ideal organization for innovation as "the one that, having the material and human resources required for R&D activity, introduces into its organizational structure a sufficient dose of flexibility to adapt quickly to external changes" (Barañano, 1995: 340).

No doubt, to incorporate and/or maintain all the above-mentioned features, innovative firms need flexibility, so to continuously implement organisational innovations into their organisational arrangements and their managerial styles. In other words, organisational innovation is an essential means to reach and maintain the so-called factors for success of technological innovation, or characteristics of the innovating organisation.

Probably this is the reason why organisational innovation issues have attracted the interest of researchers. However, according to Wolfe (1994), the results of organisational innovation research have been inconclusive, inconsistent, and characterised by low levels of

explanation. It seems that further in-depth research is required. A precise definition of the concept handled, as well as the careful selection of the universe to be analysed may be two critical points in determining the quality of the results. Some comments in this direction will be presented in next section.

## **Suggested Research**

### *Objectives*

Based upon the Oslo Manual definition (OECD, 1997: 54), we define organisational innovation as the introduction of significant changes in the organisational structure of the firm and/or the implementation of substantially new management techniques. We consider that a firm introduces an organisational innovation when it implements one (or more) mechanism(s) leading to some of the innovative organisation features identified by Tidd et al. (1997). Thus, the firm will introduce as many organisational innovations as the mechanism implements.

Bearing this concept in mind, we propose an empirical study which objective is to feature successful innovative firms within a dynamic framework. More specifically, this research will assess the organisational and managerial factors that characterise the most innovative organisations and will identify feasible paths to embody them. This objective should have four specific elements (see Figure 1). They are as follows:

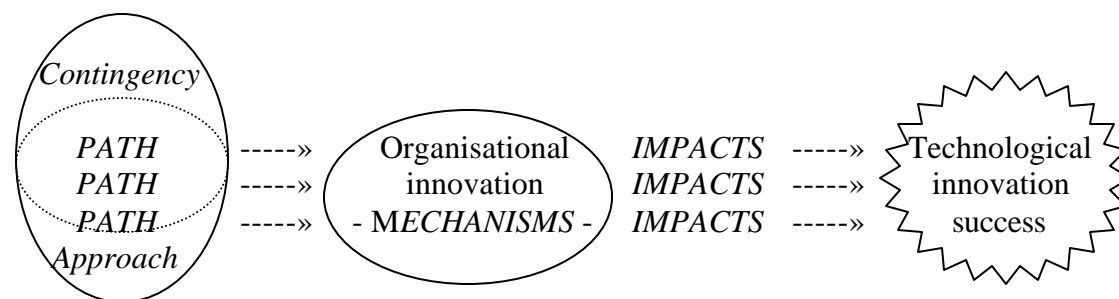
*Mechanisms* – We propose the empirical identification of the mechanisms used by firms under innovation to ensure the characteristics that according to Tidd et al. (1997) distinguish innovative organisations. This will allow us to gain knowledge of the characteristics of innovative organisations in a specific and even operational manner.

*Impacts* - We propose the development of suitable indicators to assess the contribution of those mechanisms to the success of firms when launching technological innovations. As a result, we would be able to rank those mechanisms and so help firms in defining their priorities for the implementation of mechanisms.

*Paths* - We propose to trace the paths followed by successful firms under innovation for implementing the previously identified mechanisms. This would provide in-depth know-how of how to become an innovative organisation. As a result, proven feasible and useful paths, which could be followed by firms experiencing managerial and organisational obstacles against their launching of successful innovations, will be discovered.

*Contingency approach* - Bearing in mind the contingency approach, the circumstances in which each path should be followed, and especially the obstacles to overcome, will be identified. In doing so, we assume that the previously identified paths should never be indiscriminately applied.

Figure 1: Elements of the empirical research proposed



SOURCE: Own elaboration

## Methodology

### *Universe*

It is obvious that our unit of analysis must be the successful innovative firm. But, what is a successful innovative firm? The main point concerning this question is the measure of the degree of success in launching technological innovations. To identify it we should follow the recommendations of the Oslo Manual. Thus, to determine the innovative firms' degree of success we should take into consideration the output of their innovative activities during the last three years.

In addition, we must keep in mind that the more homogeneous the universe is, the more consistent and reliable the research results will be. Hence, we must carefully define the universe to be analysed in order to target a homogeneous group of firms. In this sense, we suggest the application of three criteria. They are as follows:

*Country criteria* –It would be advisable to select a universe of firms located in the same country. As we propose to follow a contingency and systematic approach, we must not overlook the fact that firms are part of the National System of Innovation (NSI), in which different agents interact in a more or less continuous basis. These interactions, as well as the other determinants of the NSI, surely influence the paths followed by firms to turn themselves into innovative organisations. Thus, firms from different countries and so belonging to different NSIs merit separate analysis.

Of course, this does not mean that international comparisons would be meaningless. On the contrary, the simultaneous performance of the proposed research in several different countries would allow us to reach comparable results.

*Size criteria* – For the sake of homogeneity concerning the universe under scrutiny, it would be imprudent to target a group consisting of different sized firms. Thus, what firm size would be most advisable to analyse? According to Arundel et al. (1998), the disparity among firms concerning several variables can reduce the reliability of the results of innovation surveys. A significant source of disparity is the firm's size. First, the range of activities performed is

partially explained by the firm's size, since it is widely known that large firms are frequently active in more than just one industry. Moreover, the number and type of sites where innovation may be generated also vary along with the firm's size. In some firms innovative activities are totally performed within one unit, while in other firms different types of innovative activities take place in a range of locations (e.g. central R&D laboratory, diversified and specialised research facilities, production unit, and so forth). Finally, the concentration of managerial responsibilities related to innovative activities usually decreases as the firm's size increases. Consequently, the most convenient situation to start with will be that in which all relevant innovative activities are located in a single place, just one person (or a small team) is responsible for all relevant managerial activities, and the firm is only active in one industry. Most small firms meet these requirements, so it would be advisable to include in the universe firms with 50 employees or fewer. In addition, in analysing small firms, we should have more chances to find the organisational and managerial features of the innovative organisation since they are known by their structural flexibility which, as previously stated, is a pre-condition for ensuring those features.

*Sector criteria* – Regarding the industry in which the firms' activities are classified, we must bear in mind two separated aspects. First, it seems advisable to restrict the scope of research to a single industry (namely at two-digit ISIC level). It will facilitate the achievement of a homogeneous universe since this two-digit level sector will consist of firms performing the same kind of activity. Secondly, as we intend to study highly innovative firms, it makes sense to restrict the scope of research to high-tech sectors because they encompass more innovative firms than more traditional sectors. The final selection of the specific industry whose firms will be analysed will of course depend upon the country under study, since not all countries show active firms in all high-tech sectors.

Summing up, to achieve reliable results, the proposed research should target a homogeneous universe. This universe should consist of small high-tech firms acting in the same two-digit level industry and located in the same country.

### **Method for gathering information**

The firms included in the selected universe (or at least a representative sample of them) should be deeply analysed through the case study methodology.

Case studies are extremely useful for the research proposed because they make it possible both to analyse contemporary phenomena within a real context, and to deal with those situations involving many variables. In addition, since case studies are supported by many sources of evidence, they provide us with large amounts of information. In fact, the case study methodology will allow us to explore three different sources of evidence: written documents and files, observation, and personal interviews. Written documents and files will supply stable, exact, and wide-ranging information. Direct observation will give us a sense of realism and the needed contexts. Finally, personal interviews (with questionnaires) will allow us both to focus on the gathering of information under specific topics and to make some inferences.

## **Final Comment**

The non-technological side of technological innovation has attracted the interest of researchers since the late 50s. However, the results of research are not currently satisfactory enough in terms of their levels of explanation. Further and more operational research seems to be required. Thus, this paper proposes in-depth, qualitative, and systemic analysis to produce information that will certainly help us (and less successful innovating firms) to obtain practical knowledge on how the matters related to the organisation and management of innovating firms may be handled.

The ultimate goal of this research is to take advantage of the best lessons from the most successful innovating firms, in order to diffuse them to less successful innovating firms. This diffusion will surely lead to the improvement of the competitiveness of the latter, and, largely, of their country's overall competitiveness. Of course, this result will arise only if diffusion is developed under a contingency approach, with due regard for the different firms' circumstances.

## References

- Allen, T.J. et al. (1971) "The International Technological Gatekeeper" *Technology Review* 73
- Arundel, A. et al. (1998) *The Future of Innovation Measurement in Europe – Concepts, Problems and Practical Directions*. STEP Group's IDEA paper series, nº 3, July
- Barañano, A.M. (1994) *La empresa española innovadora y los programas RACE, ESPRIT y EUREKA: Un enfoque organizativo*. Unpublished Ph.D. Thesis on Business. Madrid: Universidad Autónoma de Madrid
- Barañano, A.M. (1995) "The Spanish innovative firm and the ESPRIT, RACE and EUREKA programmes: an organisational approach" *Technovation* 15(6) 339-350
- Burns, T. (1990) "Mechanistic and Organismic Structures" in Pugh, D.S. *Organization Theory*. London: Penguin
- Burns, T. & Stalker, G.M. (1994) *The Management of Innovation* 3<sup>rd</sup> ed. Oxford: Oxford University Press
- Carter, C.F. & Williams, B.R. (1957) *Industry and technical progress*. Oxford: Oxford University Press
- Castells, M. (1996) *The Rise of the Network Society (The Informational Age I)* Massachusetts: Blackwell
- Corado Simões, V. (1997) *Inovação e Gestão em PME*. Lisbon: Gabinete de Estudos e Prospectiva Económica do Ministério da Economia
- European Commission (1996) *Green Paper on Partnership for a New Organisation of Work – Summary*. Distributed on the occasion of the Round Table organised by the Commission with the social partners on 30 April 1996 on the "Pact of Confidence for Employment Growth, Competitiveness, Employment: The Challenges and Ways forward into the 21<sup>st</sup> Century"
- Freeman, C. (1974) *The economics of industrial innovation*. London: Penguin Modern Economic Texts
- Freeman, C. (1982) *The economics of industrial innovation*. 2<sup>nd</sup> ed. London: Frances Pinter (Publishers)
- Frost, P.J. & Egri, C.P. (1991) "The political process of innovation" in Cummings, L.L. & Staw, B.M. (eds) *Research in Organisational Behaviour*, vol. 13 229-295 Greenwich: JAI Press
- Hayvaert, C.H. (1973) *Innovation research and product policy: clinical research in 12 Belgian industrial enterprises*. Belgium: Catholic University of Louvain

IMIT [Institute for Management of Innovation and Technology] (1996) *International Transfer of Organisational Innovation*. EIMS Publication n.45

Langrish, J. *et al.* (1972) *Wealth from knowledge*. Macmillan

Lund, R. & Gjerding, A.N. (1996) *The flexible company. Innovation, work organisation and human resource management* DRUID working paper n°96-17 Aalborg: Danish Research Unit for Industrial Dynamics.

Mintzberg, H. (1979) *The Structuring of Organizations* Englewood Cliffs: Prentice-Hall

Mintzberg, H. (1992) *Structure in five: Designing Effective Organizations* Englewood Cliffs: Prentice-Hall

Myers, S. & Marquis, D.G. (1969) *Successful industrial innovation*. Washington: National Science Foundation

OECD [Organisation for Economic Cooperation and Development] (1996) *Technology, Productivity and Job Creation*. Paris: OECD

OECD (1997) *Oslo Manual*. Paris: OECD

Rothwell, R. & Robertson, A.B. (1973) "The role of communications in technological innovation" *Research Policy* 2: 204-225

Rothwell, R. (1976) *Innovation in textile machinery: some significant factors in success and failure*. Science Policy Research Unit, Occasional Paper Series N°2, June

Rothwell, R. (1977) "The characteristics of successful innovators and technically progressive firms (with some comments on innovation research)" *R&D Management* 7(3) 191-206

Rothwell, R. *et al.* (1974) "SAPPHO updated: Project SAPPHO phase II" *Research Policy* 3: 258-291

Saxenian, A. (1996) *Regional Advantage. Culture and Competition in Silicon Valley and Route 128*. Cambridge, Massachusetts: Harvard University Press

Schock, G. (1974) *Innovation processes in Dutch industry*. Apeldoorn: T.N.O. Industrial Research Organisation

Szakasits, G.D. (1974) "The adoption of the SAPPHO method in the Hungarian electronics industry" *Research Policy* 3

Tidd, J.; Bessant, J. & Pavitt, K. (1997) *Managing innovation: Integrating technological, market and organisational change*. Chichester: John Wiley and Sons

Tornatzky *et al.* (1983) *The process of technological innovation: Reviewing the literature*. Washington DC: National Science Foundation - Division of Industrial Science and Technological Innovation

Utterback, J.M. *et al.* (1975) *The process of innovation in five industries in Europe and Japan*. Massachusetts: Center for Policy Alternatives, M.I.T.

Wolfe, R.A. (1994) "Organisational innovation: Review, critique and suggested research directions" *Journal of Management Studies* 31 405-431

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Track 4: Industrial Innovation

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