Non-technological Innovation: Conceptual Approaches, Impacts and Measurement Issues

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Abstract

There have been increasing efforts to investigate innovation impacts at the firm level. This paper aims to contribute to this endeavour focusing on the non-technological side of innovation, which has been increasingly considered an important, if not crucial, determinant of successful innovation performance. The main objective of this paper is to present a concise literature review on the subject, highlighting three aspects concerning this theme: the main ideas that populate the debate, the perceived impacts and the measurement issues linked to non-technological innovation. Research gaps and opportunities are also explored.

Keywords: non-technological innovation; organizational innovation; innovation indicators.

1 Introduction

A remarkable increase in the interdisciplinary attention devoted to innovation has been noticed over recent decades (Fagerberg, 2004; Fagerberg and Verspagen, 2008), but the formal technological and economic aspects of innovation have received much more attention and been taken into account in a far greater number of analyses, despite the great importance of organizational innovation (Bruland and Mowery, 2004).

Referring to Schumpeter (1939) and other innovation researchers (e.g., Anderson and King, 1993; Damanpour et al., 1987; Totterdell et al., 2002), innovation can be considered to be a complex phenomenon including technical (e.g., new products, new production machinery) and non-technical aspects (e.g., new markets, production methods, new forms of organization).

In this paper we intend to highlight the main ideas that have came out of research on the non-technological dimension of innovation, attempting to integrate diverse and disparate perspectives on the subject, to present evidence on possible generalizations and to discuss eventual research gaps and opportunities for further studies. Two specific aspects will receive more attention in this brief analysis: evidence on the impacts of non-technological innovation, and the measurements efforts that have been made concerning this phenomenon.

2 The issue of non-technological innovation

The technological and non-technological aspects of innovation are both of importance in constituting an innovative firm (Chandler, 1962; Nelson, 1991). Among innovative firms, process innovation and organizational changes are the most significant innovating strategies (O´Sullivan and Doodley, 2009). If not accompanied by organizational change, the effort to implement technological innovation will meet only restricted success and vice versa, as they are interdependent (Freeman, 1995). However, historically, the relation between both dimensions seems to be underexplored.

Nowadays, it seems insufficient to see innovation only through the lens of new product development and process innovation or traditional R&D. Recent literature on innovation highlights the iterative character of innovation processes where non-technological activities play a crucial role, stressing that non-technological factors are a requirement for getting the most of firms' capacity for technological innovation (Sawhney et al., 2006).

Non-technological innovation is an important element of firms' innovation activities that both supplement and complement technological innovation, i.e. the introduction of new products and new processes. Some scholars have point out that innovation in firms is not just about developing and applying new technologies but also to adopt and re-organize business routines, internal organization, external relations and marketing (Baranano, 2003; Boer and During 2001). And other authors also maintain that innovation management literature stresses the importance of integrating product, process and organizational innovation for successfully transferring new ideas and new business opportunities into market success (Tidd,2001; Cozzarin and Perzival 2006) and emphasizing the crucial role of linking R&D, technological innovation and new marketing approaches (Griffin and Hauser 2001).

Computer and information technologies can be an illustrative example of the connection between technological and non-technological aspects of innovation. Brynjolfsson and Hitt, (2000) and Brynjolfsson *et al*. (1997) studies suggest that organizational innovation is vital, since it complements a key technological driver, such as Information and Communication Technology (ICT), uplifting the firm's performance and growth. Computers cannot be simply plugged in and then firms will instantly achieve product/service quality or efficiency gains (Bresnahan *et al*., 2002). They must go through a process of reorganization in combination with making considerable changes to their products and processes. Brynjolfsson *et al*., (1997) argue that a joint effort between ICT and organizational change is necessary. According to these authors, this will be compulsory to achieve success and performance improvements.

3 Defining non-technological innovation

Innovation has long been recognized to have a central role in economic growth. However, the majority of empirical evidence concerning the relationship between innovations and firm growth has focused on technology development. Although the concept of innovation is usually linked to the scientific and technological dimensions, there is now a large consensus that innovation is a complex process that cannot be reduced to the technological side (Romero, 2010). New ideas have proposed new ways to interpret this process. One of them suggests that the innovation paradigm is changing from the closed innovation model to an open innovation model (Chesbrough, 2003). Pursuing this tendency, the Organization for Economic Co-operation and Development, OECD has broadened the innovation concept to cover also non-technological innovation (OECD, 2005).

Organizational innovation involves a customary dimension specific to the institution, implying change in the organization, and it is more related to structure, practices, arrangements, organizational beliefs, rules and norms, than to its technical aspects (Pettigrew and Fenton, 2000; Edquist et al., 2001).

However, the definition of organizational, or non-technological innovation, is not stable. For instance, recently Moore (2005) proposed a taxonomy including 12 types of innovation: disruptive, application, product, platform, value engineering, integration, process, line extension, enhance, marketing and experiential innovation along with three value disciplines of product leadership, customer intimacy, and operation excellence. The third edition of the Oslo Manual (OECD and Eurostat, 2005) adopted the concept of non-technological innovation and introduced two new types of innovation, organizational innovation and marketing innovation, which complement the standard concepts of product and process innovations. Organizational innovation refers to the implementation of new organizational methods not used in the firm before, while a marketing innovation is the implementation of new marketing methods.

The point to be made here is that different lines of research apply the term organizational innovation in different ways (Lam, 2004). Ideally, it would be important to use the term organizational innovation in a

somewhat strict sense. Preferentially, the term would not refer to the adoption of any novelty in the organization such as that defined in broad terms by Damanpour (1991) and Sorensen and Stuart (2000). The definition would be narrower, meaning a new or significant change in the firm management methods and structure, usually mentioned by researchers in management/organizational studies (Daft, 1978; Damanpour, 1987, 1991; Kimberly and Evanisko, 1981; Teece, 1980) as administrative innovation.

4 Studies on the impact of non-technological innovation

Recent literature and studies on non-technological dimension of innovation (OECD, 2009) highlights the complex character of innovation processes where non-technological activities play a crucial role (Schmidt and Rammer, 2007; Teece et al.,1997). Ali-Yrkkö and Martikainen (2008), analyzed the impact of technological and non-technological innovations using data from an ad hoc survey conducted in the year 2008. The survey defines non-technological innovations following the Sawhney et al. (2006) approach which includes nine non-technological dimensions of innovation: solutions, brands, networks, presence (where), supply chain, organizational, value capture, customer experience and customers (who). In fact, the positive impact of innovation on firm growth depends on the argument that firms carry out simultaneously tech and non- tech innovations. According to Ali-Yrkkö and Martikainen (2008), in terms of turnover and employment, firms with only technological innovations do not grow more rapidly than other firms. However, firm growth is positively associated with the combination of technological and non-technological innovations.

Schmidt and Rammer (2007) analyzed the determinants and the impacts of non-technological innovations contrasting those patterns with the determinants and effects of technological innovations, using data from the German Innovation Survey (CIS 4) covering the years 2002-2004. The authors analyzed four broad issues: (i) the complementarities between technological and non-technological innovations ;(ii) the determinants of the two types of innovations;(iii) the impact of non-technological innovations on technological ones;(iv) the eventual existence of an innovation rent purely deriving from non-technological innovations (beyond the complementary effect on technological innovations). Comparing the determinants and impacts of non-technological innovations with those of technological innovations, the results show that the share of firms introducing only technological innovations (13%) is lower than share of firms introducing only non-technological innovations (24%) (Schmidt and Rammer, 2007).

In a sub-sample of innovative firms, it was found that those firms investing directly in non-technological innovation activities are 30% more likely to experience positive growth. Growth is also significantly affected by workers and managers' re-qualification (Morone and Testa, 2008).

According to other studies, internal organizational sources are the most important influence on firms' innovative performance (Svetina and Prodan, 2008). Investments in information and communication technology, combined with organizational changes such as the restructuring of production processes, human resource management practices, product/service, quality-related practices and worker skills, are found to contribute to better firm performance (Gera and Gu, 2004).

Williamson (2010) has conducted a study that discusses market structure in relation to technical and organizational innovation. It proposes a systems approach to the innovation process with the purpose to permit the realization of the distinctive advantages of both small and large firms which apply at different stages of the innovation process. This analysis also examines the relation of organizational innovation to technological innovation.

Referring to services firms an aspect that must be taken into consideration is that innovation is mainly non-technological (organizational, marketing, management, service delivery) with "softer" attributes such as workforce skills or cooperation practices playing a decisive role (Tether, 2005). Hertog (2000) proposes to analyse service innovation in terms of conceptual, client-interface and service delivery innovation. The latter is considered as key to service innovation (Gallouj and Weinstein, 1997; Evangelista, 2000; Flikkema *et al.*, 2007). Sundbo (1997) also argues that innovation in services tends to be market driven.

The effects of non-technological innovation on technological innovation vary according to the type of industry. Organizational and marketing innovations significantly increase the likelihood of technological innovation. However, few studies have taken into account the role of innovative strategies such as organizational and marketing innovations (Schmidt and Rammer, 2007; Mothe and Thi, 2010; Jensen et al., 2007). Thus, it seems that future research should address specificities of firms regarding the way non-technological innovation may support technological innovation (Schmidt and Rammer, 2007; Mothe and Thi, 2010; Evangelista and Vezzani, 2010; Wu, 2009). Sector specific or technology specific characteristics of firms may result in significant variance concerning non-technological innovation. Research should also investigate the impact of firm size on non-technological activity strategies to enhance performance as far as technological innovation is concerned. Differences between large and small firms should be a matter of future research (Mothe and Thi, 2010).

5 Non-technological innovation measurement

Although the measurement of the scientific and technological dimensions of innovation is now an established practice, so far there has been little research on possible approaches to measure and monitor organizational or other non-technological forms of innovation (Armbruster et al., 2008).

Using data from the Innobarometer innovation survey which covers more than four thousand innovative firms**,** Arundel et al. (2008) state that 52.5% of firms innovate without performing R&D, 40% carry out in house R&D and 7.5% outsource R&D to other agents of the innovation system. These authors start from the assumption that firms innovate by different methods beyond R&D. Therefore, analyzing how non-R&D innovators innovate should be of interest.

A revision of the innovation dimensions for the EIS 2008-2010, both for technological and non-technological innovations was proposed by Hollanders and Cruysen (2008). According to the authors suggestion, the EIS 2005-2007 uses five innovation dimensions, two of which reflect innovation outputs (applications and intellectual property) and three of which reflect innovation inputs (innovation drivers, knowledge creation and innovation and entrepreneurship). However, these five dimensions do not cover appropriately non-technological or non-R&D innovation, such as organizational and marketing innovation.

Referring to the proposed model by Hollanders and Cruysen (2008) for the innovation process and its dimensions, non-technological innovation could be described by four categories of dimensions:

- Human resources;
- Entrepreneurship and the availability of finance;
- Throughputs;
- Applications (Hollanders and Cruysen, 2008).

Hollanders and Cruysen (2008) have introduced a new category defined as throughput indicators. These indicators measure knowledge diffusion, including collaboration between firms and other several actors such as suppliers, clients and competitors. They also might measure new organizational arrangements. It is the intention of this category to cover not only technological innovations but also non-technological ones. These authors argue that it is quite relevant to take in consideration where innovation takes place including the sectoral structure and the socio-economic environment (Hollanders and Cruysen, 2008). Applying this systemic approach three main categories of indicators are highlighted: inputs, throughputs and outputs.

Analysis of the determinants of non-technological innovations and comparisons with those of technological innovations have been performed by Schmidt and Rammer (2006) by analyzing marketing and organisational innovation activities of German firms during the three-year period 2002 to 2004. After this research they have conclude that the determinants of technological and non-technological innovations are quite similar. Actually, firms have a propensity to innovate in every form if their tangible and intangible assets (e.g., human capital and financial resources) are high. Common aspects between the

factors of technological and non-technological innovations are found also for the export status, the share of highly qualified labour and the size of the company.

Schmidt and Rammer (2007) stressed that the principal factor that influences firms' innovation behaviour is the competitive environment. The parameters that significantly increase the likelihood that a firm introduces both technological and non-technological innovations are fast changing technologies and short product life. Whereas organizational innovation is not considerably affected by the degree of diversification of the products/services, less diversified firms are less likely to introduce marketing innovations. Also it is important to say that the likelihood to introduce non-technological innovations itself is not influenced by the number of main competitors (Schmidt and Rammer, 2007).

While it has been proposed that the category "non-technological" shows the absence of a technological dimension, excluding thus product and process innovation, there is a dispute that this distinction may seem to be oversimplified and that both technological and non-technological innovation may be actually part of any form of innovation. Fructuoso (2009) states that the process innovation indicators constitute the non-technological part of a technology dimension. Yet if we can accept that technological innovation may include characteristics of non-technological ones and vice versa, we should be aware that such a distinction enables us to understand new forms of innovation that differ from the traditional ones.

The so-called Community Innovation Surveys, CIS, have been an important source of information regarding data on non-technological innovation. Some studies based on these data have compared the relevance of technological and non-technological innovation activities. Schmidt and Rammer (2007) have compared, using German CIS4 data, non-technological innovations (organisational and marketing) with technological ones. 60% of all manufacturing firms introduced technological innovations and also 60% introduced non-technological innovations. For knowledge intensive services the resultant figures are 52% and 66%, and for other services 37% and 48%. Arundel et al. (2008) confirmed the same for 25 EU member states. More particularly, a lower percentage of all service sector firms (34.0%) than all manufacturing firms (39.3%) are technical innovators (introducing product or process innovation) (Arundel et al., 2007) There are no differences in the percentage of all industrial and service sector firms that introduced an organizational and/or marketing innovation, according to CIS4 data.

Firms with an intermediate market share are deliberate to have a broad innovation strategy consisting of both marketing and product/process innovations. A particularly weak or particularly dominant position on the market tends to become pure organizational or marketing innovators. The larger the resource base (information, human, capital, etc) of the firm, the greater the probability of introduction of organizational and marketing innovations.

Concluding, we can say that an increasingly important role has been assigned to non-technological innovation, organizational innovation in particularly, due to the necessity of understanding its impacts on firms´ competitiveness. Nowadays there is an increasing consciousness of the significance of organizational innovation, although the empirical basis for its measurement still lags behind. The PORCH (Patterns of organizational Change in Europe Industry) Project has developed attempts to strengthen the empirical basis of policy and research of organizational innovation. According to these Project findings the majority of organizational innovations surveyed have a different impact on output dimensions although there is no sector specific importance. Moreover it is perhaps not prudent to think of organizational innovations as a homogeneous phenomenon and to measured them in an excessively standardized way. Organizational innovation various effects on firms´ processes and structures have to be understood when measuring organizational innovation.

6 Implications for future research and concluding remarks

The measurement of organizational innovation and its effects is methodologically challenging due to the complexity and variety of organizational innovations. The relationships between non-technological innovation and technological innovation are in need of further exploration. Research approaches

understand organizational innovation either as a necessary adaptation to the introduction of new technologies, or as a precondition for successful product or technical process innovations. In fact, it will be important to understand how and under which circumstances organizations change.

Definitions of innovation have altered a number of times and also the indicators in the several Community Innovation Surveys (CIS). Indicators measuring marketing and organizational innovation were added to indicators of product and process innovation. Indicators of marketing and organizational innovation reflect non-technological innovation, although the distinction between the two types may be oversimplified because probably they are related, and both technological and non-technological activity and knowledge may be part of any form of innovation. Moreover, the way in which innovations are perceived may vary between size classes and sectors of economy.

Research in defining and measuring organizational innovation still lags behind compared to indicators of tangible innovation. Comparing the approaches to measuring organizational innovations in the existing surveys by the CIS there are four main implications for measuring organizational innovation:

- Life-cycle of organizational innovation: It is not enough to enquire about the introduction of organizational innovations within a very limited period (usually, the last 3 years) as it is vital to determine the proportion of firms which have implemented any organizational innovation at all. It is of common knowledge that organizational innovations do not age as fast as product innovations do. Applying in surveys questions limited to a very narrow period of time will incorrectly classify early adopters as non-innovative and only latecomers as innovative.
- Complexity of organizational innovation: It is important not only to enquire about organizational innovation in general but it is necessary to include particular questions about different types of organizational innovations. In fact, different organizational innovations have different effects on performance indicators.
- Quality of organizational innovation: When enquiring about organizational innovations the use of general labels must be carefully considered, in order to take account of interpretative variability in organizational innovations across firms.
- Extent of use of organizational innovations: It is compulsory to identify the extent to which organizational innovations have been implemented into business processes and so it is not sufficient to only ask about the use or non-use of organizational innovations. This additional information will surely give insights of the utilized and non-utilized potentials within a firm.

In order to effectively survey firms' innovativeness as it regards the adoption of organizational concepts these four points should be taken into consideration when measuring organizational innovation.

It will also be of great interest to cover strategies (i.e. role of innovation and costs), structural (hierarchy, functional lines, and organizational boundaries), and behavioural dimensions. Work processes including the use of different production inputs, the flow of work, job design, work allocation, and use of suppliers and subcontractors; human resource management practices including hiring and firing and the firms´ relation practices involving the strategies and institutional structures affecting the labour-management relationship should also be investigated. In addition, the restructuring of production processes, which includes business re-engineering, downsizing, flexible work arrangements outsourcing, greater integration among functional lines, and decentralization; human resource management practices, which include performance-based pay, flexible job design and employee involvement, improving employees' skills, and institutional structures affecting labour-management relations; and product/service quality-related practices emphasizing total quality management (TQM) and improving coordination with customers/suppliers should be emphasized.

Shapiro (2006) argues that innovation measurement needs to be dynamic. In fact, novelty is required for innovation measurement in order to make it possible to catch up with changes in the innovation field. The need to update innovation metrics' is evident also in the European Innovation Scoreboard (EIS) editions

revised every year. Referring to Hollanders and Cruysen (2008), future editions of the EIS are expected to deal with four challenges:

- Assessing overall innovation performance;
- Improving comparability at national, regional and international level;
- Measuring new forms of innovation;
- Measuring progress and changes over time.

A new EIS methodology that confirms the importance of non-R&D innovation is needed to develop due to a stronger focus on non-technological aspects, on outputs of innovation demands and on services.

The outcomes of organizational innovations are difficult to define and measure and specific (new) set of performance indicators are necessary for the organizational innovations´ measurement.

In face of the market orientation of firms, innovation has become more market driven. A broader scope has been taken by innovation policy increasing emphasis on non-technological forms of innovation, knowledge transfer and firm's capacity to capture and use knowledge and market driven innovation. The use of non-R&D data for innovation measurement is of great importance. R&D inputs are not sufficient to assure that innovation activities will end up with the market introduction of new products.

Innovation is in fact much more than R & D. Firms can achieve competitiveness through different innovation paths (e.g. non-technological innovation- organizational and marketing innovation).

Nowadays the current innovation indicator systems focus more on technological innovation and on R&D. Non-technological innovation needs to be properly measured:

- Need to ask for single elements of organizational innovation. Different organizational innovations affect different output dimensions (quality, costs, flexibility, etc.);
- Need to apply novelty criterion for more extended periods concerning organizational innovations. A narrow (e.g., three years) period might be misleading once latecomers are captured rather than early adopters;
- Need to ask for absolute effects of organizational innovations instead of relative subjective assessment. It is true that estimations might vary depending on the starting level of adoption.
- Need to obtain information on quantifiable effects.

Organizational innovations can be understood both as enablers for other types of innovations and as a distinct form of innovation (direct source of competitive advantage). The measurement of organizational innovations and their effects is methodologically challenging due to the complexity of organizational innovations. In fact, organisational innovation is a multidimensional phenomenon including different aggregation levels with longer life cycles than of product or service innovations (e.g., novelty less important). There are significant differences regarding the intrafirm diffusion of organizational innovations (e.g., extent of implementation). It is also important to point out the multidimensional relationship between organizational innovations and their outcomes (e.g., complementarity vs. conflicting effects).

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