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# Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003

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**Abstract**

What is innovation and what determines its development in manufacturing firms? The literature on the topic has evolved exponentially during the last decades. However, the divergence of the research results makes it so that the innovation process is still poorly understood. Relying on a systematic review of empirical studies published between 1993 and 2003, this article propose and discuss a framework which brings together a set of variables related to the innovation process and the internal and contextual factors driving it. The ensuing results highlight several avenues which would help managers and policy makers to better foster innovation and researchers to better channel their efforts in studying the phenomenon.


*Keywords:* Technological innovations; Innovation determinants; Innovation measurement; Manufacturing sector; Systematic review

What is innovation and what determines its development within firms? This question has sparked the interest of researchers, managers and policy makers for decades. The work of Joseph Schumpeter at the beginning of the 20th century was an outstanding stage in this field's evolution. In his two famous books, *The Theory of Economic Development* and *Capitalism, Socialism, and Democracy*, this eminent Austrian economist claims that innovation represents the driving force of economic development (Schumpeter, 1934, 1942). He argues that innovations made by capitalist entrepreneurs ensure a cyclic alternation of prosperity and recession phases, which in turn ensures economic expansion. Today, the economic landscape has changed considerably in comparison to Schumpeter's time. However, his work remains topical. According to several specialists, innovation is now unavoidable for companies which want to develop and maintain a competitive advantage and/or gain entry into new markets (Brown and Eisenhardt, 1995; OEDC, 1997; Rosenthal, 1992; Stock et al., 2002). It also represents one of the main factors underlying countries' international competitiveness and their productivity, output and employment performance (Asheim and Isaksen, 1997; Michie, 1998).

The undeniable importance of innovation for contemporary companies justifies the increasing interest that researchers are taking in it. However, if the number of papers on the topic has evolved exponentially during the last decades, there is still no precise prescription for successful innovation (Rothwell, 1992). Several researchers have tested the effect of a large number of innovation-related variables. However, even though they tested similar variables, they discovered differing degrees of association with the rate of innovation (Souitaris, 1999, 2002; Wolf, 1994). The innovation process is thus still poorly understood (Coombs et al., 1996) and the current state of the literature contributes little to improving our understanding of the phenomenon.

This paper aims to go beyond the highly dispersed work on innovation by providing a systematic review of empirical articles published between 1993 and 2003 on technological innovations in the manufacturing sector. Our main purpose is to integrate the findings of these studies in order to identify where the conclusions converge and diverge. This will help to advance our knowledge of innovative performance in companies and to better channel future research.

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This article is organized as follows. First, we will explain in more details the objective and scope of our study (Section 1) and describe the method used to locate and select the relevant literature (Section 2). Next, we will present some general features of the reviewed studies (Section 3). We will then present and discuss the results of our review (Section 4), and finish with the main conclusions, implications and recommendations for managers, researchers and policy makers.

## 1. Objective and scope of the study

This study consists of a systematic review of empirical articles published in scholarly reviews between 1993 and 2003 on the topic of technological innovations in the manufacturing sector. There were two main objectives: (1) to study how the variable 'innovation' was approached and measured by the authors, and (2) to identify the main explanatory variables which determine the innovative behavior and capacity of the firms. Some details are needed to better understand our research problem.

First of all, the choice of 1993 as the lower limit of the temporal horizon of our study is justified by the publication in 1992 by the Organization for Economic Cooperation and Development (OECD) of the first version of the 'Oslo Manual'. This manual set down the guidelines for gathering and interpreting data on technological innovations. The Oslo Manual (OECD, 1992, 1997) has two objectives: to assist newcomers to the field of innovation and to provide a framework within which research on innovation can evolve towards comparability. To do this, the key concepts related to innovation are explicitly defined and a set of measurements and survey procedures are proposed. Several OECD countries adopted the recommendations of the Oslo Manual straight away, making their research results more comparable and attempts to synthesize them more coherent.

Following the Oslo Manual's lead, we defined innovation as 'implemented technologically new products and processes and significant technological improvements in products and processes.' (1997: 31). Three points need to be specified with regard to this definition:

1. We are interested in technological innovations related to products and processes. Thus, other types of innovation, in particular organizational/administrative innovations and the entry into new markets are not covered by our analysis;
2. An innovation implies a technologically new product/process or a product/process having undergone a significant technological improvement. Consequently, minor modifications to products and processes (e.g. improvement of the product design or package) are not considered as innovations;
3. To be considered, the innovations must have been implemented, that is introduced into the market (product innovations) or used in a production process (process innovations). Thus, aborted innovations and those in progress are not considered.

Also, it should be noticed that in this systematic review we considered only empirical articles published in scholarly journals. Indeed, we excluded non empirical studies (conceptual work, qualitative studies, etc.) as well as those disseminated using a different medium (book, internet, etc.). This allows us to have a better comparable body of research, which enhances the quality of the systematic review results. Finally, it is important to mention that our review covers only the manufacturing sector. As mentioned in the Oslo Manual and confirmed by several recent studies, innovation in the service sector has particular characteristics. Furthermore, focusing on the manufacturing sector will make more sense when summarizing and comparing research results.

## 2. Methods

Before specifying the methodological details of the study, it is worth while answering first the question: why to do a systematic review? In the management field, the traditional narrative literature reviews have been widely criticized for the lack of relevance due to the use of a personal, and usually subjective and biased methodology by authors (Fink, 1998; Hart, 1998). To mitigate this gap, Transfield et al. (2003) propose to apply the specific principles of the systematic review methodology usually used in the medical sciences. The main difference between a systematic review and a traditional narrative review is that, contrary to the later, the former uses a rigorous, replicable, scientific and transparent process (Cook et al., 1997). A systematic review is, however, different from a meta-analysis in the sense that it does not uses statistical and econometric procedures for synthesizing findings and analyzing data (Transfield et al., 2003). The main purpose of a systematic review is to identify key scientific contributions to a field or question and its results are often descriptively presented and discussed. Applying the principles of the systematic review will then help to limit bias (systematic errors), reduce chance effects, enhance the legitimacy and authority of the ensuing evidence and provide more reliable results upon which to draw conclusions and make decisions.

Two steps are particularly important when doing a systematic review: (1) the setting of inclusion criteria and, (2) the strategy of locating and selecting the potential studies (Alderson et al., 2004).

### 2.1. The inclusion criteria

Four criteria were used to select and assess the potential studies. To be included in our systematic review, a study had to: