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High radicality of product innovation and high flexibility and high agility of system of manufacturing: Towards the Smart Factories

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Abstract

This research aims to verify the effect of the high radicality in product innovation on the high agility and high flexibility in manufacturing system. Furthermore, this research examines how the high agility and agility flexibility affect the business results (outcomes). The study was tested in smart factories of different sectors in Europe: automotive, chemicals, foods, and electronics. The data were extracted using an assessment matrix. Finding of the study revealed that radicality in product innovation and agility and flexibility have a strong relationship. Furthermore, the study also found the high effect on the business performance.

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Keywords: Radicality in product innovations; Agility; Flexibility; Manufacturing system; Business Performance; Smart factories in Europe.

1. Introduction

Recently, relevant changes have made organizational boundaries more fluid and dynamic in response to the rapid pace of knowledge diffusion [1];[2];[3];[4], innovation and international competition [5]. This helps to reconsider how to succeed with innovation [6]. Therefore, the supply of innovative products is presented as a quality standard in the race for pressing demands. New product innovations are generally considered to be a key driver of firm

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performance. It is feasible to offer innovative products as it enables companies to have incremental gains and competitive advantage, in particular industries dealing with radical innovations. Radical innovation is critical for many firms and for society [7]. Although the importance of radical innovations is widely recognized, developing them is still rather poorly understood [8]. In this dichotomy, technical efficiency is a parameter of the developing capacity of innovative products, which translates into one of the most remarkable logical arguments to potentialize and encourage competitive advantage. Solutions to these challenges have been offered by the companies' equally innovative technical capabilities. In this perspective, new agility and flexibility practices have hardly been investigated in the field of new products development. Agility in manufacturing involves being able to respond quickly and effectively to the current configuration of market demand, and also to be proactive in developing and retaining markets in the face of extensive competitive forces. And Manufacturing flexibility has been heralded as a major competitive weapon for manufacturing organizations operating in increasingly uncertain environments and turbulent markets. In this sense, the manufacturing system should not only produce high-quality products at the lowest possible price; it should also be able to react quickly to market changes, consumers preferences and a higher performance of manufacturing process agility and flexibility. Current manufacturing industries are experiencing a paradigm shift towards more flexibility and agility to respond quickly and efficiently to constant changing customers' requirements, new technologies and increasing product variety [9].

Deciding on an ideal balance regarding radicality of product innovation and agility and flexibility in manufacturing system is a complicated issue. The study intends to fill an existing gap of the literature. In this sense, this research aims to verify the effect of the higher radicality in product innovation on the higher agility and higher flexibility in manufacturing system. Furthermore, this research examines how the higher flexibility and agility affect the results. The study was tested in smart factories of different sectors in Europe: automotive, chemicals, foods, and electronics. The research questions at the heart of this study are: Is there a effect of the higher radicality in product innovation on the agility and flexibility of the manufacturing system? To what extent or degree, the agility and flexibility affect the business performance of companies in context of high radicality in product innovation? Understanding these issues will shed light in finding answer to whom the agility and flexibility in manufacturing support should be emphasized in product innovation. Findings of this study may help decision makers about selection appropriate of resources to ensure a profitable return on investment in the future. This study offers clear guidance to management on ways of stimulating the flexibility and agility in radical innovation context. To achieve the research objectives, the remainder of this paper is structured as follows: The next section will provide an overview of the relevant literature and concepts that will provide the theoretical lens through which the research is being viewed. The subsequent section of the paper focuses on the research method, findings and underlying analyses. The last section of this paper presents the conclusions

2. Theoretical Background

Although the importance of radical innovations is widely recognized, developing them is still rather poorly understood [13]. As such, radical innovation is a priority for some though not all firms, with the hope that radical innovativeness leads them to success [7]; [9]. Many factors can be identified as being associated with the product innovation success as higher flexibility and agility in manufacturing process [14];[15]. Agile manufacturing is defined in this paper as a production model that integrates technology, human resources and organization by creating an information and communication infrastructure, granting flexibility, speed, quality, service and efficiency and making it possible to respond deliberately, effectively and in a coordinated way to changes in the business environment. Most studies have focused on analyzing the individual influences of certain agile manufacturing practices on business performance. Manufacturing agility is associated with a firm's ability to survive and prosper in a competitive environment that changes constantly and unpredictably [16]; [17]. This ability is not only a matter of flexibility and responsiveness. It also means offering high-quality products at low cost, with better service and delivery conditions. In summary, the integrated use of agile manufacturing practices promotes manufacturing competitive strength, leading to better operational, market and financial performance. On the other hand, "traditionally flexibility is interpreted as the ability of a system to change its behavior without changing its configuration [18]. Chrysolouris defines flexibility of a manufacturing system as its sensitivity to change and states: "The lower the sensitivity, the higher the flexibility" [19]. In [19], flexibility is defined as "the sensitivity of a manufacturing system to changes. The more flexible a system, the less sensitive to changes occurring to its

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