

Performance Implications of Organizational and Technological Innovation

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The manufacturing environment is characterized by a constant demand for novelty for producing superior outcomes. Bearing in mind the importance of innovation as a constitutive part of the growth paradigm, practitioners and scholars have long recognized the importance of innovation in driving firm performance. Manufacturing firms engage in various innovation activities to achieve a sustainable competitive advantage. Although technological innovation is considered one of the key performance drivers, organizational innovation has become increasingly prominent.

organizational innovation

technological innovation

performance effects

manufacturing sector

return on sales (ROS)

1. Introduction

The manufacturing environment is characterized by a constant demand for novelty for producing superior outcomes. Bearing in mind the importance of innovation as a constitutive part of the growth paradigm ^[1], practitioners and scholars have long recognized the importance of innovation in driving firm performance. Innovation, according to Crossan and Apaydin (2010), includes the “production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems” ^[2]. Thus, innovation is a multifaceted concept that includes the generation, development, and implementation of an idea or behavior, which is novel to a respective organization and conducive to superior performance ^[3].

The previously under-researched topic in the innovation body of literature, i.e., the complementarity effect of innovation activities, has raised heated academic discussions ^{[4][5][6][7]}. Moreover, there are many avenues to advance the researchers understanding in this domain, especially regarding the relationship between technological and non-technological innovation and their relevance as drivers of a firm’s financial performance ^[8]. Here aims to provide a contribution to the discussion of such research questions as: What is the relationship between organizational and technological innovation and what are the effects of their implementation on a manufacturing firm’s performance? Following these debated concerns, this contributes to the innovation–firm performance literature in two main ways. First, this extends the literature on organizational and technological innovation and their individual/complementary effect on firm performance by demonstrating the relationship and nature of their

combined implementation in the manufacturing sector. Second, this contributes to the findings related to the innovation activities and subsequent performance outcomes in the context of emerging and developing economies, which are yet to establish the most prolific innovation strategies or set up adequate innovation portfolios. Although the empirical evidence presented suggests that individual implementation of organizational and technological innovation does not significantly impact financial performance, the results are indicative of their complementarity effect which could lead, eventually, to higher performance. Specifically, digital factory technologies and automation and robotics, strongly mediate the positive effects of the organization of production and management/controlling, on a firm's financial performance.

2. Performance Implications of Organizational and Technological Innovation

While questing for best practices in applying innovation drivers and producing desirable outcomes, including innovation factors interdependencies, researchers have followed numerous, both convergent and divergent, research directions. The complex nature of the innovation phenomenon has raised academic opinions, reflected in terminological discrepancies of certain innovation types. Thus, such a state of affairs has led prominent researchers to use different terms to denote the same/similar innovation concepts and to try to conceptualize the different innovation types [9] adequately. Eventually, the growing importance of practical implications of this subject has resulted in an inductive and converging emergence of the OECD innovation framework, and to a definition of different innovation types, differentiating between (1) product innovation, (2) process innovation, (3) marketing innovation, and (4) organizational innovation. Hence, according to the Oslo Manual (2007), “an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” [10]. The former two may be classified as technological, and the latter ones as non-technological innovations. The prominent studies have mainly adopted the Oslo Manual recommendations and have extensively implemented this perspective in their analysis and innovation conceptualization [3][11][12].

Numerous definitions and innovation typologies [3][13] delineate technological and organizational concepts to distinguish between a firm's technological and organizational, management systems [14]. The concept of technological innovation addresses the adoption of a new product, service, or new components related to the production process [15]. On the other hand, Birkinshaw et al. (2008) refer to organizational innovation as “the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals” [16]. Over time, authors have conceptualized the distinctive phenomenon of organizational innovation from different perspectives, making the present research somewhat fragmented [16]. The term “administrative innovation” was used by Daft (1978) and Damanpour (1991) [9][17], although the terms “management/managerial innovation” [18][19][20][21][22][23] and “organizational innovation” [8][16][24][25] are prevalent in recent literature, and although these notions should not be viewed as completely interchangeable as they carry some specific implications, they do overlap extensively. Nevertheless, they are used to differentiate from technological innovations [14].

The manufacturing imperative to accelerate and intensify innovation has contributed to the viewpoint of the paradigm-changing technologies as key enablers of the enhanced value proposition. Amid the current manufacturing paradigm shifts and the advances in the technology realm, this perspective becomes further reinforced; thus, scholars are of the viewpoint that the industry has remained techno-centric [26][27][28], with a research focus on the technological process innovation [29]; however, to achieve a sustainable competitive advantage, firms should introduce non-technological innovation, especially considering the constraints in their replication [30].

Laforet (2016), Armbruster et al. (2008), and Ballot et al. (2015) have recently made substantial contributions in the attempt to integrate additional insights into the concept of organizational innovation [25][31][32]. Special attention was given to the relationship between non-technological and technological innovation [33], especially regarding the potential facilitating role of organizational innovation in the implementation of technological ones [16][34]. Previous research findings suggest that adopting new organizational concepts has favorable effects on the development of technological innovations and recommend refocusing on both innovation types to achieve more efficient coupled effects [35]. Although Gunday et al. (2017) and Cozzarin et al. (2019) challenge this notion [11][36], Hollen et al. (2013) and Mothe and Thi (2010) agree that organizational and technological innovation reinforce the implementation of each other [33][37].

The relationship dynamics of the organizational and technological components of innovation is a complex and multifaceted concept [5]. The technological component of the innovation process is considered highly relevant in manufacturing; however, additional aspects need to be integrated into comprehensive studies. According to Damanpour and Aravind (2012), there is a dire need to research beyond the analysis of the technological realm, as there are positive indications of the importance of both innovation types [38]. The induction of new technologies into the firm environment has to be followed by organizational change and redesign that involves employee adaption to a changing environment [39][40]. Adequate innovation adoption is an important part of the innovation process [41]. Coupling with knowledge resources acquired by the company is expected to have a favorable effect on innovation implementation [42]. The knowledge-sharing culture leverages innovation performance [43][44]; hence, the organizational environment is an important prerequisite for innovation adoption, but the lack of its individual factors can represent a barrier to successful innovation adoption [45]. Furthermore, the introduction dynamics of organizational innovation has an impact on technological innovation persistence [46], as previous innovation activities enhance the outcomes of future innovation activities [47].

Torres and Augusto (2020) and Arranz et al. (2019) were, among many, intrigued by the potential complementarity effects of the implementation of organizational and technological innovation [4][42]. Hollen et al. (2013) and Battisti and Stoneman (2010) have conducted extensive research to investigate the positive effects of the combined implementation of these concepts [37][48]. Prior studies argue that technological and organizational concepts are intertwined in a way that positive performance implications are reflective of both innovation types, indicating the complementarity effect of their implementation [3][8][48][49]. Lee et al.'s (2019) research findings imply synergic effects between technological and non-technological innovation [50]. Hervas-Oliver et al. (2018) argue that practitioners should have a comprehensive view of the innovation process that allows the integration of these two

innovation types in terms of their performance effects [51]. Chen et al. (2020) state that organizational innovation has an antecedent and moderating role in implementing technological innovation, affecting firm performance [52]. Azar and Ciabuschi (2017) and Camison and Villar-López (2014), in their research of the innovation-performance stream, also argue that organizations need to leverage their organizational innovation capabilities to achieve higher performance outcomes [5][49].

Different criteria are applied in measuring firm performance in terms of efficiency and competitiveness. Financial measures, such as return on sales (ROS), are frequently employed [11][53]. In this research, ROS serves as a proxy for measuring firm performance and indicates return on sales before tax for 2017.

Keeping in mind the complexity of this under-investigated research topic [8] and the scarcity of empirical literature regarding the relationship among different innovation types [11], the researchers have formulated the following hypothesis in an attempt to shed some empirical light on the aforementioned research questions (**Table 1**).

Table 1. Research hypothesis.

Research Hypothesis
<p>Hypothesis 1 (H1).</p> <p><i>The positive effects of organizational innovation on firm performance are mediated by the implementation of digital factory technologies.</i></p>
<p>Hypothesis 1 (H1a).</p> <p><i>The positive effects of organization of production on firm performance are mediated by the implementation of digital factory technologies.</i></p>
<p>Hypothesis 1 (H1b).</p> <p><i>The positive effects of management/controlling on firm performance are mediated by the implementation of digital factory technologies.</i></p>
<p>Hypothesis 1 (H1c).</p> <p><i>The positive effects of human resources on firm performance are mediated by the implementation of digital factory technologies.</i></p>
<p>Hypothesis 2 (H2).</p> <p><i>The positive effects of organizational innovation on firm performance are mediated by the implementation of automation and robotics.</i></p>

Research Hypothesis

Hypothesis 2 (H2a).

The positive effects of organization of production on firm performance are mediated by the implementation of automation and robotics.

Hypothesis 2 (H2b).

The positive effects of management/controlling on firm performance are mediated by the implementation of automation and robotics.

Hypothesis 2 (H2c).

The positive effects of human resources on firm performance are mediated by the implementation of automation and robotics.

Hypothesis 3 (H3).

The positive effects of organizational innovation on firm performance are mediated by the implementation of additive manufacturing technologies.

Hypothesis 3 (H3a).

The positive effects of organization of production on firm performance are mediated by the implementation of additive manufacturing technologies.

Hypothesis 3 (H3b).

The positive effects of management/controlling on firm performance are mediated by the implementation of additive manufacturing technologies.

Hypothesis 3 (H3c).

The positive effects of human resources on firm performance are mediated by the implementation of additive manufacturing technologies.

Hypothesis 4 (H4).

The positive effects of organizational innovation on firm performance are mediated by the implementation of energy efficiency technologies.

Hypothesis 4 (H4a).

Research Hypothesis

The positive effects of organization of production on firm performance are mediated by the implementation of energy efficiency technologies.

Hypothesis 4 (H4b).

The positive effects of management/controlling on firm performance are mediated by the implementation of energy efficiency technologies.

Hypothesis 4 (H4c).

The positive effects of human resources on firm performance are mediated by the implementation of energy efficiency technologies.

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