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The Impact of Absorptive Capacity on Firm Performance in European Manufacturing Firms: Exploring the Roles of Strategic Alliances, R&D Investment, Government tax incentives, and Appropriability mechanisms

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The Impact of Absorptive Capacity on Firm Performance in European Manufacturing Firms: Exploring the Roles of Strategic Alliances, R&D Investment, Government tax incentives, and Appropriability mechanisms

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Abstract: Drawing on resource-based theory and dynamic capability theory, this research attempts to achieve three primary objectives: (1) to explore the relationship between potential absorptive capacity and realized absorptive capacity with firm performance; (2) to analyze the moderating impact of government tax incentives and R&D investment between the relationship of potential absorptive capacity and realized absorptive capacity and; (3) to understand the moderating role of strategic alliances and the appropriability mechanism between the relationship of realized absorptive capacity and firm performance. Employing a publicly available panel dataset derived from the Community Innovation Survey by Eurostat, comprising data of 39 enterprises within the manufacturing industry of 14 European countries for the years: 2010, 2012, 2014, 2016, 2018 and 2020. This study endeavors to provide empirical evidence by using GMM estimation which sheds light on the underlying mechanics of absorptive capacity from a dynamic perspective, and how it results in improved firm performance. The empirical results validate the proposed hypotheses that both potential and realized absorptive capacity positively influence firm performance. Additionally, the findings indicate that R&D investment, and government tax incentives significantly moderate the relationship between potential absorptive capacity and realized absorptive capacity, enhancing their impact on firm performance. Similarly, strategic alliances and appropriability mechanism act as moderators between realized absorptive capacity and firm performance, further contributing to improved firm

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1. Introduction:

The debate on the creation and sustenance of competitive advantage has become highly significant in the present business environment. (Kostopoulos et al., 2011). This is because, in a contemporary knowledge-driven business environment, organizations are heavily dependent on external information (Cassiman & Veugelers, 2002; Morgan& Berthon, 2008). Therefore, organizations need to cultivate absorptive capacity, indicating their adeptness in attaining novel knowledge and embedding it to derive business utility, as proposed by Cohen and Levinthal (1990). This perspective is gaining prominence as a central catalyst for sustaining a competitive advantage (Lichtenthaler, 2009 Wales et al., 2013; Mehreen et al., 2021). This requires the effective development of internal knowledge and capitalization of external knowledge. Different firms derive benefits from external information in various ways, and the extent of those benefits reaped by the firms depends on the organization's prior knowledge. (Cohen & Levinthal, 1990). However, Arrow (1960) proposes once knowledge becomes part of the public domain, it flows through organizations without any restraint. The development of an organization's absorptive capacity, which encompasses its ability to explore and utilize knowledge, is affected by numerous factors, including investment in research and development (R&D), and strategic partnerships with other organizations. Moreover, absorptive capacity is a dynamic process in which a firm focuses not only on knowledge exploration but also on knowledge exploitation to develop a sustainable advantage. (Zahra & George, 2002). Absorptive capacity hence bifurcates into two components i.e. 'potential absorptive capacity' and 'realized absorptive capacity'. Potential absorptive capacity involves the exploration and assimilation of new knowledge while realized absorptive capacity entails the exploitation of new knowledge to develop a sustainable advantage. (Zahra & George, 2002; Ebers & Maurer, 2014; Bouguerra et al., 2021).

Previous studies have undertaken one-dimensional measures that consider the acquisition component of absorptive capacity and suggested that external knowledge leads to higher levels of absorptive capacity but they ignore the dynamic capability of absorptive capacity asserted by Levinthal and March (1993) as learning myopia. Therefore, it cannot be inferred that external knowledge cannot be transformed and exploited in an organization without considering multiple other factors. Moreover, previous research accounts for the differences and importance of drivers, roles and absorptive capacity outcomes (Jansen et al., 2005; Ebers and Maurer, 2014; Leal-Rodriguez et al., 2014; Khan et al., 2019; Bouguerra et al,2022). Our research also reveals that PACAP and RACAP are interrelated processes, as firms cannot drive positive financial results without each process. This validates our conceptual model that both PACAP and RACAP, are essential for financial performance.

Amid the continuous debate about embracing the multidimensional conceptualization of absorptive capacity, limited studies have explored the underlying mechanisms (Jansen et al; 2005; Ebers &Maurer, 2014). Therefore, we have considered absorptive capacity as a process-based approach to overcome this deficiency in the literature by exploring the underlying mechanisms and their interrelationship with potential and realized absorptive capacity. The main objective of this study is to theoretically and empirically examine the following research questions:

RQ1: To what extent do potential absorptive capacity and realized absorptive capacity impact firm performance?

RQ2: Do R&D investment and government tax incentives act as a moderator between the relationship between potential absorptive capacity and realized absorptive capacity?

RQ3: Do strategic alliances and appropriability mechanisms moderate the relationship between realized absorptive capacity and firm performance?

Our research adds to the literature on absorptive capacity and performance relationships in two ways.

First, we empirically examine the impact of absorptive capacity on firm performance by considering both dimensions (PACAP and RACAP) of absorptive capacity. However, previous studies have investigated the

direct influence of absorptive capacity by considering it as a unified dimension of a firm's performance.

Second, this study explains moderators that develop absorptive capacity to derive better performance. Researchers widely accepted that absorptive capacity does not automatically result in improved performance.

Thus, by embedding various moderators such as strategic alliances, R&D investment, government tax incentives, and appropriability mechanisms, we provide a holistic explanation of the development and translation of potential absorptive capacity and realized absorptive capacity into firm performance.

Additionally, a holistic analysis is essential to comprehend the dynamic perspective of absorptive capacity across multiple organizations. To address this concern, this research considers the entire European region. Therefore, our research explores various mechanisms that establish absorptive capacity and, ultimately firm performance. Secondly, most studies have considered cross-sectional data where causality cannot be properly accounted for (Sancho-Zamora et al., 2021). To address this limitation, we use panel data.

A comprehensive analysis of recent literature reveals that a wide assortment of researchers has validated the connection between absorptive capacity and firm performance. Various studies (e.g. Flatten et al., 2011; Choi and Park**,** 2017) have found that absorptive capacity influences firm performance. For instance, Flatten et al. (2011) examined German SMEs and indicated that absorptive capacity directly impacts an organization's performance. However, there is limited research on the moderators that facilitate the absorptive capacity process.

Todorova and Durisin (2007) elucidated in depth both dimensions of absorptive capacity (Potential Absorptive Capacity and Realized Absorptive Capacity). Despite heterogeneous views, researchers agree that absorptive capacity is a dynamic capability that is necessary to gain a sustainable competitive advantage. However, the literature does not explain mechanisms that influence absorptive capacity and performance relationship.

Moreover, literature examined absorptive capacity and its influence on firm performance. For instance, Liu et al. (2018) conclude that

organizations with absorptive capacity exhibit superior innovation performance. They emphasize the importance of firms' ability to leverage knowledge to gain a sustainable competitive advantage. Furthermore, the study conducted by Zhao et al. (2020) explored the role of absorptive capacity in external knowledge and its influence on firm performance. Their study considers absorptive capacity as a mediator, demonstrating that it serves as a mechanism through which firms effectively utilize external knowledge to drive innovation. These studies emphasize the ongoing relevance and significance of absorptive capacity in understanding firm performance. Recent developments in the literature confirm that a firm's absorptive capacity results in improved performance in terms of product development, and profitability (Tzokas et al., 2015). Additionally, they also concluded that different forms of absorptive capacity and enterprise innovation lead to enterprise performance. While the absorptive capacity concept has been broadly investigated in the literature, the primary aim of this study is to explore the development of absorptive capacity through various mechanisms and assess its effect on the operational performance of manufacturing firms.

Furthermore, several factors foster a strong absorptive capacity. These factors include firms' R&D investment, which makes technology adoption easier; investment in its employees' capabilities; and a firm's appropriability mechanism such as the number of patents etc. This compels the firm to become a research-driven organization. Other factors include strategic alliances with other firms to achieve synergistic gains and government tax incentives that promote innovative processes. This further emphasizes the fact that a firm must make an effort to acquire and implement external knowledge. Additionally, absorptive capacity suggests that a firm's R&D efforts not only contribute to internal innovation; but also foster an environment conducive to learning. Therefore, numerous studies have linked absorptive capacity to other factors such as incentive mechanisms that promote a firm's learning process, a firm's social networking, investment in R&D, technology adoption, and diffusion, among others (Wei et al., 2022). Although multiple scholars have proposed different theories regarding absorptive capacity, they acknowledge its significance in achieving a firm's competitive edge (Vinding, 2006). Internal knowledge is quantified through a firm's R&D activities which are a crucial factor in determining absorptive capacity. Previous research has also examined the importance of absorptive capacity for the development of strategic alliances, which

help firms achieve synergistic gains such as cost reduction, economies of scale, and the ability to handle complexity; however, prior studies considered only one indicator that contributes to absorptive capacity development. In reality, one indicator is inadequate to develop absorptive capacity, ultimately resulting in improved firm performance.

2. Literature Review and Hypotheses Development:

Initially, Cohen and Levinthal (1990) stated that absorptive capacity refers to the identification, assimilation, and application of new knowledge and considered it a unidimensional concept; whereas Zahra and George (2002) questioned this perspective, suggesting that absorptive capacity is a multidimensional concept and that multifarious mechanisms affect a firm's innovation. These researchers introduced a paradigm shift by advocating a multidimensional perspective, explaining that absorptive capacity is influenced by multifarious mechanisms that immensely impact a firm's innovation. Moreover, they proposed that absorptive capacity follows a multidirectional path instead of a unidirectional one, as suggested by Cohen and Leven (1990). They also deduced that absorptive capacity is a dynamic process that can be categorized into two facets: potential absorption capacity and realized absorption capacity. This highlights the dynamic nature of the concept and its significant role in sustaining a competitive advantage. In this paper, our objective is to investigate the absorptive capacity impact on a firm's performance from two dimensions such as PAC (potential absorption capacity) and RAC (Realized absorption capacity. Furthermore, this review underscores the importance of absorptive capacity beyond the development and application of new knowledge, exercising influence over a firm's R&D magnitude and direction. In addition, absorptive capacity emerges as a dynamic process. Additionally, the existence of a certain level of knowledge indicates signals to predict new knowledge, which indicates that the absorptive capacity is path-dependent. (Zahra & George, 2002) This further enhances collaboration opportunities for the firm. Various studies have underscored the importance of absorptive capacity, demonstrating its robust impact on firm performance. Additionally, research has explored the positive effects of R&D contracting and the role of collaboration on organizational networks in technological development (Knott, 2008).

Moreover, numerous studies have validated the connection between absorptive capacity and firm performance, and the significance of

absorptive capacity is indisputable; given its substantial impact on firm-level performance (Kostopoulos et al., 2011; Wales et al., 2013).

Additionally, the literature review adopts a holistic approach by considering two prominent theories: resource-based and dynamic capability perspectives. The dynamic-capability and resource-based theories explain how firms can achieve and sustain superior performance. Porter (1981) posited a resource-based theory that emphasizes the importance of firms' strategic decisions in attaining competitive advantage. Moreover, Barney (1991) advocated that to attain a sustainable competitive advantage for the firm, it is essential to have resources or capabilities that are; scarce, imperfectly imitable, and irreplaceable. Moreover, Rouse and Daellenbach (1999) hypothesized that components of sustainable advantage are embedded in every organizational process. During the 1980s and the 1990s, two theories were dominant i.e. competitive forces approach proposed by Porter's (1980) and the resource-based perspective (Barney, 1991). Prior theory points out how a firm can gain a dominant position in the industry; whereas the latter emphasizes how a firm can develop a sustainable advantage. Despite having contrasting views, both theories can help firms design behavior that contributes towards sustaining competitive advantage. Porter's theory and resource-based theories are two facets of the same overarching perspective.

Resource-based theory suggests that a company's performance comes from its strategic resources, which emphasizes within-firm focus. Barney (1991) asserted that a company's competitiveness comes from its unique capabilities. The main point highlighted by resource-based theory is that a firm's competitiveness is the result of its unique capabilities. Teece et al (1991). Therefore, a firm's unique resources and capabilities mold its strategy. Rumelt et al (1984). The RBV perspective redirects focus to the internal aspects of the organization. This view emphasizes that possessing distinct capabilities results in differences in organizational competitiveness (Wójcik, 2015). Therefore, cultivating exceptional capabilities results in firm competitiveness and sustainable advantage (Kaur & Mehta, 2018). These distinct resources and capabilities are the reason for the variation in profitability among firms. Conversely, one limitation of Resource-Based theory is that it does not provide any framework to indicate the interaction of various components among firms to achieve sustainable advantage. (Nonaka & Takeuchi, 1995). Furthermore, Alchian and Demsetz (1972) advocated a knowledge-based

view, which states that sustainable advantage cannot be solely attributed to possessing technical or economic resources but rather the ability to utilize those resources. This knowledge can be learned, accumulated, stored, and applied to gain a competitive advantage (Macher & Mowery, 2006; Zollo & Winter, 2002; Nonaka, 1994; Zander & Kogut, 1995).

Cohen and Levinthal (1990) later proposed absorptive capacity and explained its four dimensions. To maintain competitive advantage, a firm must attain, leverage, and employ external knowledge. Furthermore, multiple researchers have expanded this perspective of multidimensional constructs. Liao et al. (2003) hypothesized two dimensions of A.C, external knowledge acquisition, and firm knowledge transfer which include potential and realized A.C as introduced by Zahra and George (2002), who proposed a multidimensional construct for every item involving how business units interact with clients, competitors, and suppliers.

2.1 Relationship between Potential Absorptive Capacity, Realized Absorptive Capacity and Firm Performance:

In our study, firm performance encompasses financial performance, which is gauged by turnover. Numerous studies have examined the relationship between absorptive capacity and financial performance. Most studies have examined the indirect impact of absorptive capacity on financial performance, wherein the mediating role of research and development (R&D) or innovation serves as an intermediary mechanism (Fosfuri et al., 2008). However, the significant point is that few studies have provided empirical evidence directly linking absorptive capacity to a firm's financial performance (Wales et al., 2013). Senivongse et al. (2019) corroborate that absorptive capacity has a direct and positive impact on a firm’s financial performance. Previous studies explored the relationship between absorptive capacity and firm performance. Moreover, earlier researchers proposed a linear relationship between absorptive capacity and firm's performance.

Zahra and George (2002) state that absorptive capacity is multi-dimensional. They argued that absorptive capacity can be divided into potential absorptive capacity (PACAP) and realized absorptive capacity (RACAP). Based on previous research, it appears that both potential absorptive capacity and realized absorptive capacity play key roles in influencing firm’s financial performance. While potential absorptive capacity may have a limited direct impact on financial performance, as it

mainly encompasses acquisition and assimilation, realized absorptive capacity's focus on transformation and exploitation can lead to significant performance improvements. Moreover, utilizing knowledge increases a company's knowledge base and financial success.

H1: *Realized absorptive capacity exhibits a significant impact on firm performance.*

H2: *Potential absorptive capacity exhibits a significant impact on firm performance.*

2.2 Potential Absorptive Capacity (PACAP) and Realized Absorptive Capacity (RACAP)

Zahra and George (2002) introduced a pioneering understanding of absorptive capacity inherent in the dynamic capability perspective. In their comprehensive elucidation of absorptive capacity, they highlight four dimensions. Absorptive capacity encompasses two interrelated facets: potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity entails a firm's ability to seek and assimilate knowledge, which is often acquired through mechanisms such as R&D investments (Crescenzi & Gagliardi; 2018; Schulisfurth & Raasch, 2018). Conversely, Realized absorptive capacity entails a firm's ability to effectively execute the acquired knowledge to develop products and services (Miroshnychenko et al., 2021). Numerous studies have confirmed the relationship between the two dimensions of absorptive capacity (Albort-Morant et al.; 2018; Limaj & Bernroidel, 2019). Our analysis led us to propose a hypothesis that considers the wider scope and impact of absorptive capacity.

H3: *PACAP has a positive relationship with RACAP.*

2.3 R&D Investment and Absorptive Capacity.

Huang et al., (2015) posit that absorptive capacity acts as a mediator in the relationship between research and development (R&D) and firm performance. R&D, as an important determinant of absorptive capacity, plays a pivotal role in enhancing firm’s performance. The frameworks proposed by Cohen and Levinthal (1990), Kufuor et al. (2020), Seepana et al. (2021), and Volberda et al., (2010) emphasizes the significance of

absorptive capacity as a determinant that facilitates inter-organizational knowledge transfer, innovation, and overall firm performance.

Cohen and Levinthal (1990) emphasized R&D as a critical determinant of absorptive capacity, which translates into improved firm performance, as supported by Guo et al., (2020) and Huang et al. (2015). Although previous studies have examined the influence of R&D on an organization's innovative performance, validating its direct role in enhancing absorptive capacity and innovative outcomes (Wang et al., 2022), there have relatively limited research focused on assessing the effect of R&D on an organization's financial performance. Our research explores the role of R&D in fostering absorptive capacity development and its subsequent impact on a firm's financial performance.

Furthermore, our research proposes that absorptive capacity (ACAP) significantly influences a firm's financial performance, aligning with dynamic capability theory as proposed by Zahra and George (2002). According to dynamic capability theory, absorptive capacity acts as a channel that facilitates innovation and financial gains over time in the firm.

Therefore, we hypothesize the following based on previous literature:

H4: *R&D investment acts as a moderator between potential absorptive capacity and realized absorptive capacity.*

2.4 Government tax incentives and Absorptive capacity.

Government tax incentives also play a pivotal role in providing innovation incentives. David et al. (2000) confirmed the significant role of the government in promoting technological progress in different countries. Empirical evidence from Li et al. (2020) demonstrates the influence of tax incentives on the innovation environment and firm performance. Yang and Liu (2019) examine the impact of tax incentives on manufacturing firms' performance from two aspects: tax subsidies and tax incentive policies. They find that tax subsidies have a more pronounced effect on a firm's performance than to tax incentive policies. Moreover, government tax incentives provide an enabling environment for the firm to acquire new external knowledge and embed it into the processes and ecosystem of the firm, thereby reducing financial constraints that discourage firms from accessing and implementing new knowledge. Recent studies have suggested the role of government tax incentives as a moderator between

potential and realized absorptive capacity. Specifically, studies have highlighted that government tax incentives facilitate knowledge assimilation into execution within firms, thereby enhancing the realized absorptive capacity. For instance, a study of the Spanish automotive industry validated that government tax incentives play a pivotal role in the relationship between potential and realized absorptive capacity. (Albort-Morant et al., 2018) In our study, we aim to research the impact of government tax incentives as a moderator between potential absorptive capacity and realized absorptive capacity in the European manufacturing context. Therefore, we hypothesize the following based on previous literature:

***H5**: Government tax incentives act as a moderator between potential absorptive capacity and realized absorptive capacity.*

2.6 Appropriability Mechanism, Absorptive Capacity and firm performance.

A firm's appropriability mechanism comprises various strategies through which a firm can protect it from imitation, such as patents and trademarks. The industrial organization literature has acknowledged appropriability as a mechanism through which firms can prevent imitation and serve as an incentive for innovation (Cohen & Levinthal, 1989). However, there is limited research examining the influence of appropriability mechanisms on firm performance (Ceccagnoli, 2005). In our research, we aimed to investigate the impact of the appropriability mechanism on the development of a firm's absorptive capacity and its impact on firm performance.

Although there are multifarious ways to protect competitive advantage, research indicates that patents result in better firm performance. Patents not only provide protection but also enable firms to license their technology or prevent other firms from attaining patents for the same technology. Numerous researchers have empirically demonstrated that patents prevent other firms from entering an industry (Cockburn & MacGarvie, 2006).

New studies have stated that the appropriability mechanism contributes positively towards absorptive capacity development and firm performance by facilitating effective knowledge exchange (Cenamor et al., 2019). Furthermore, Lee et al. (2018) state that appropriability mechanisms are positively related to a firm's performance. Yacoub,

Storey, and Haefliger (2020) postulate that patent protection is an effective mode of appropriability mechanism, particularly for manufacturing firms. They also suggest that the appropriability mechanism depends on the degree of strategic alliances and is positively related. They further assert that the appropriability mechanism results in improved performance. Prior literature has highlighted the significance and role of appropriability mechanisms as a moderator between realized absorptive capacity and firm performance. For instance (Hurmelinna-Laukkanen; 2012) italicizes that appropriability mechanisms significantly influence the relationship between realized absorptive capacity and firm performance. This postulates that appropriability mechanisms enhance a firm's ability to protect and capitalize on external knowledge, thereby enhancing its overall performance.

A previous study (Seo et al; 2016) investigates how appropriability mechanisms interact with absorptive capacity. The research proposed that the appropriability mechanism when strategically managed, moderates the relationship between absorptive capacity and performance, underscoring the significance of these mechanisms in contributing towards sustainable development.

Therefore, based on prior literature, we formulate the following hypothesis:

H6: *Appropriability mechanism acts as a moderator between realized absorptive capacity and firm performance.*

2.7 Strategic Alliance, Absorptive Capacity and firm performance

A strategic alliance encompasses collaborative business arrangements among firms to achieve symbiotic goals and develop organizational capacity (Bindra et al., 2020; Sharma et al., 2020a). Learning and knowledge exchange between firms within strategic alliances contribute significantly to financial and operational performance by enhancing organizational capabilities (Cirjevskis, 2019; Bindra et al., 2019). Previous literature has highlighted how strategic alliances contribute to firm performance through effective knowledge management and inter-partner learning processes (Shan et al., 2020).

Mowrey and Oxley (1995) emphasized the significance of knowledge acquisition, which forms the acquisition dimension of absorptive capacity. Acquisition refers to firm's ability to identify and acquire

external knowledge that is relevant and crucial for its operations. Thus, firms need to acquire relevant knowledge to sustain a competitive advantage. Additionally, firms with strong internal knowledge bases are better equipped to develop absorptive capacity, suggesting that internal knowledge contributes to the absorption process.

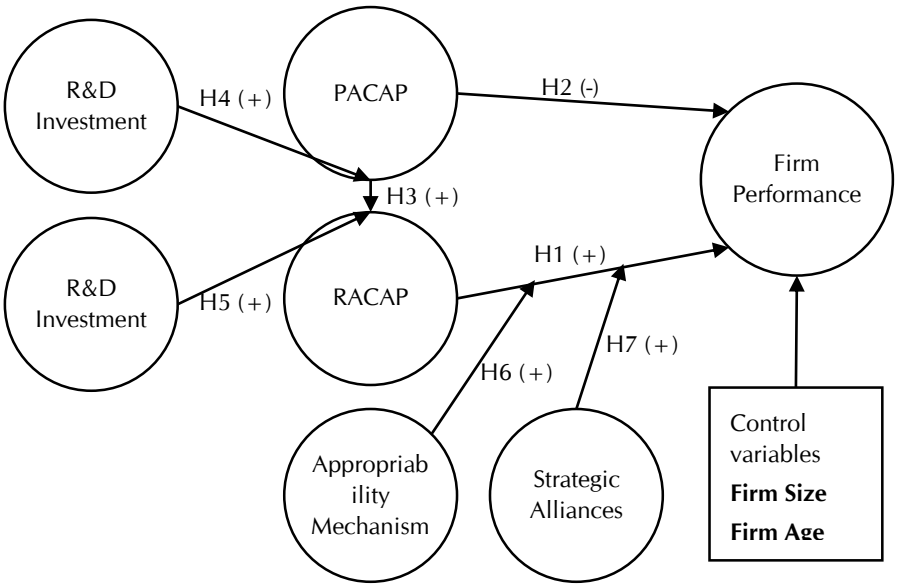
Furthermore, the manufacturing sector is technology intensive, underscoring the importance of knowledge management in absorptive capacity development. To this end, the knowledge-based theory serves as the foundation. According to this perspective, knowledge can be classified into two types: tacit and explicit. Tacit knowledge is considered a strategic resource for companies and can be leveraged to gain a sustainable competitive advantage (Nonaka, 1994; Afiouni, 2007). Conversely, explicit knowledge can be stored in a database, allowing convenient access through communication technology (Nonaka, 1994; Gorman, 2002). Prahalad and Hamel (1990) postulate that a firm's ultimate competence resides in its knowledge, especially in its integration of productive capabilities and novel technology development. Moreover, the knowledge creation process is not only limited to internal knowledge; it is also an external process. Knowledge can be shared among firms through strategic alliances, leading to synergistic gains (Enkel, 2010).

Moreover, the constantly changing business environment, driven by technological innovations, has increased the importance of inter-organizational collaboration among firms. The rapidly rising cost of novel and advancing technology has made it challenging to internally deploy or maintain all the required capabilities and knowledge. In response, firms establish strategic alliances to collaborate with external partners, overcome resource constraints and gain access to external knowledge and expertise. Although previous research suggests that strategic alliances moderate the relationship between realized absorptive capacity and firm performance. A study focusing on multinational enterprises (MNEs) found that strategic alliances enhance the relationship between realized absorptive capacity and performance by facilitating access to various resources and capabilities, thereby resulting in better assimilation and transformation of external knowledge. (Chen et al., 2022)

Based on the insights, we formulate the following hypothesis:

H7: *Strategic alliance acts as a moderator between realized absorptive capacity and firm performance.*

3. Conceptual Framework:



4. Methodology:

4.1 Data and Context:

The primary questionnaire survey collection-based measures are contingent on the context which reduces the generalizability of the results. (Camison & Fores, 2010; Delmas et al., 2011; Flatten et al., 2011; Jimenez-Barrionuevo et al., 2011; Thomas &Wood, 2014) In this study, we rely on secondary data to increase generalizability. Our research employs a quantitative methodology approach i.e. GMM estimation along with 2sls and fixed effect regression. It uses Stata on panel data of manufacturing firms identified through the statistical classification of economic activities in the European Community code (NACE code) of 14 European countries spanning over years 2010, 2012, 2014, 2016, 2018,2 020 to examine the validity of the proposed hypotheses. Doing so will provide a holistic insight for gaining an in-depth understanding (Curado et al., 2018; Munoz-Pascual et al., 2019a, 2020).

For analysis, we used secondary publicly available data derived from the Community Innovation Survey (Eurostat). The reason for choosing the Community Innovation Survey is that it has been widely used in the prior

literature to measure absorptive capacity (Cassiman & Valentini, 2016; Garriga et al; 2013). Stoic et al. (2020) state that the CIS survey is the most detailed stratified enterprise sample on the innovation activities of European firms. Additionally, the CIS survey and, Eurostat data is a good representative source for European countries conducted by the European government (Tavassoli & Bengtsson; 2018). It covers multifarious aspects of absorptive capacity such as organizational learning, networking, external sources of knowledge, and strategic alliances with external bodies for innovation, and the internal capabilities of the firm. The contextual rationale for considering European manufacturing firms is numerous: First, Europe entails diverse manufacturing industries with a wide range of external knowledge making it an important technological frontier. Second, the presence of multiple players within an innovation ecosystem such as startups, incubators, strategic alliances and partnerships contributes to diversity. Third, European manufacturing firms have access to abundant resources, and it is important to understand heterogeneous absorptive capacity mechanisms to better design policies.

4.2 Dependent variable:

Strategic management has put forward firm performance as a multi-dimensional concept (Sambharya, 2011; Venkatraman et al., 1986) distinguishing between financial (measured through turnover, profitability etc.) and nonfinancial aspects (market share, innovation etc.). To operationalize the dataset, we employ performance as the dependent variable measured through proxy variable turnover

4.3 Independent and moderating variables:

In this study, we employ two independent variables such as PACAP, RACAP and four moderating variables such as Strategic Alliances, R&D investment, appropriability mechanism and government tax incentives. PACAP gauges the manufacturing firm's knowledge assimilation dimension and assess it through knowledge strategies data in CIS. RACAP assesses knowledge exploitation through a proxy variable product and process innovation. Moreover, R&D investment, strategic alliances, government tax incentives and appropriability mechanisms are measured through R&D investment, firm collaboration and partnerships, government tax incentives and the number of patents respectively.

4.4 Control Variables:

We employ size measured through the log of the number of employees and firm age through firm's year in business as previous research indicates that a firm's performance is affected by the size and scale of the enterprise. (Escribano, Cockburn and Henderson, 1994).

Time Effect: We employed year dummies to account for time specific effects and serial correlations (Phene et al, 2012).

5. Quantitative Model:

To evaluate the impact of absorptive capacity and firm performance, we employed the following model where the first model captures the impact of a absorptive capacity impact on enterprise financial performance. The following model examined how several factors such as potential absorptive capacity, appropriability mechanisms, and strategic alliances moderated the relationship between RACAP and performance.

$$lnperfit = \beta 0 + \beta 1 lnPACAP + \beta 2 lnRACAP + \delta itcontrolsit + \mu it \quad (1)$$

$$lnperfit = \beta 0 + \beta 1 lnPACAP + \beta 2 lnRACAP + \beta 3 ln(StratAll * RACAP) + \beta 4 ln(RD\ Invest * PACAP) + \beta 5 ln(AppMech * RACAP) + \beta 6 ln(Govtincent * PACAP) + \mu it \quad (2)$$

Table 1 illustrates full form of abbreviations used in the analysis.

Table 1: Meaning of abbreviations

Abbreviations	Full Form
lnperf	Natural log of financial performance
lnRACAP	Natural log of Realized absorptive capacity
lnRACAP	Natural log of potential absorptive capacity
Strat ALL*PACAP	Interaction term indicating strategic alliances and potential absorptive capacity
RDInvest*RACAP	Interaction term indicating research and development investment and realized absorptive capacity
AppMech*PACAP	Interaction term indicating appropriability mechanism and potential absorptive capacity
Govt tax incentives*PACAP	Interaction term indicating government tax incentives and potential absorptive capacity
uit	Error term

Although operationalization of these variables are given in the appendix.

6. Discussion of results and Post Estimation tests:

First, we conducted a preliminary empirical analysis using summary statistics, correlation analysis and VIF .The descriptive and correlation results in Table 2 and Table 3 respectively. To ease the interpretation of our variables we centered them on their means and examined the correlation and variance inflation factor (Aguiness et al, 2013). Our variance inflation factor was below the threshold level of 10. This indicates that multicollinearity is not a concern. (Cameron & Trivedi, 2009; Kreschmer, 2024). Table 5 represents the correlation among variables where performance is the dependent variable, PACAP and RACAP are independent variables and strategic alliances, R&D investment, and strategic alliances are moderating variables.

Table 2: Descriptive Statistics

Variable	obs	Mean	Std dev	Min	Max
1.performance	3572	6.74	3.99	0.69	18.88
2.RACAP	3572	3.82	2.34	0.69	11.30
3.PACAP	3572	3.98	2.62	0.69	18.87
4.Strategic Alliances	3572	12.26	13.30	0.48	170.49
5.R&D investment	3572	15.74	14.84	0.69	98.15
6.Appropriability Mechanism	3572	13.42	12.67	0.67	99.07
7.Governemnt funding	3572	11.70	11.83	0.48	71.63

All values are natural log mean centered.

Table 3: (2SLS) regression table

Performance	Model 1 Coef/Std errors	Model 2 Coef/Std errors
PACAP	0.084***	0.092**
	(0.027)	(0.043)
RACAP	0.284***	0.033***
	(0.038)	(0.087)
Govt tax incentives*PACAP		0.007***
		(0.019)
Strategic Alliance*RACAP		0.007**
		(0.016)
RDInvest*RACAP		0.006**
Appropriability Mech*PACAP		(0.013)
		0.016**
		(0.012)
Constant	5.83	0.161***

Performance	Model 1 Coef/Std errors	Model 2 Coef/Std errors
R-squared	0.512	0.612
Number of obs	3572	3572
Prob > chi2	0.000	0.000

**** p<.01, ** p<.05, * p<.1. All values are natural log mean centered.*

Table 3 indicate results for 2sls regression equations. Both models provide substantial evidence indicating strong relationship among potential, realized absorptive capacity and firm performance. Model 2 further elaborates the moderating effect of government tax incentives, appropriability mechanism, R&D investment and strategic alliances. The interaction terms are statistically significant advocating the significance of moderating variables on absorptive capacity and firm performance relationship. The overall significance is confirmed by chi squared test and high R-squared value.

Table 4: Matrix of correlations

variables	1	2	3	4	5	6	7
Performance	1.000						
PACAP	0.219	1.000					
RACAP	0.224	0.014	1.000				
Govt tax incentives	0.105	0.620	0.010	1.000			
Strategic Alliances	0.016	0.023	0.642	0.020	1.000		
RD Investment	0.097	0.606	0.010	0.350	0.039	1.000	
Appropriability Mechanism	0.34	0.24	0.23	0.35	0.19	0.22	1.000

Correlation coefficients higher than 0.06 are statistically significant at 0.05 significance level.

Table 5: Variance inflation factor

	VIF	1/VIF
PACAP	2.281	.438
Strategic Alliances*RACAP	1.721	.581
RACAP	1.71	.585
Govt tax incentives *PACAP	1.633	.612
RDinvestment*RACAP	1.595	.627
Appropriability Mech *PACAP	1.678	.592
Mean VIF	1.788	.

All values are natural log mean centered.

Table 6: Regression results (Fixed effect and random effect)

Variables	Fixed effect	Random effect
PACAP	2.70	10.87
RACAP	9.60	5.60
Strategic Alliances	3.70	2.98
R&D Investment	2.09	1.91
App Mech	2.47	2.07
Govt Funding	3.97	2.98
Firm size	2.09	2.30
Firm age	2.19	2.22
Constant	8.081	6.741
R squared	0.60	0.57

The above results are at 5%significance level. (All these values are mean centered and logarithmic values)

Table 6 represent results for fixed and random effect regressions. We have a panel data spanning over six years; therefore techniques such as fixed and random effect are pertinent over here and the results of our Haussmann test p value =0.02 implies that fixed effect model is the feasible method over here.

Table 7: GMM estimation results

Variable	Model 1 (one-step)	Model 2 (one-step)	Model 1 (two step)	Model 2 (two step)
PACAP	0.0212*	0.2212**	0.0312*	0.2912*
	(0.0181)	(0.1181)	(0.0281)	(0.1281)
RACAP	0.986*	0.986**	0.886*	0.806**
	(0.2867)	(0.2867)	(0.2167)	(0.2367)
Strategic		0.2860***		0.2860***
Alliances*RACAP		(0.2673)		(0.2373)
RD		0.4691***		0.4691***
Investment*PACAP		(0.0713)		(0.0713)
Appropriability		0.3092***		0.4109***
Mechanism*RACAP		(0.0812)		(0.0819)
Government		0.2980*		0.3201*
incentives*PACAP		(0.0781)		(0.0791)
Firm size	0.4872*	0.4872*		
	(0.4273)	(0.4273)		
Firm age	0.5672*	0.5672*		
	(0.4773)	(0.4773)		

Variable	Model 1 (one-step)	Model 2 (one-step)	Model 1 (two step)	Model 2 (two step)
constant	5.82	0.002	34.57	0.005
Year dummies				
Year dummy 2010			0.04	0.04
Year dummy 2012			0.01	0.07
Year dummy2014			0.10	0.18
Year dummy2016			0.14	0.17
Year dummy 2018			0.17	0.19
Year dummy 2020			0.20	0.25
Year effects			Yes	Yes
P value chi2	0.11		0.14	0.07
	0.04			
P vale of AR(1)	0.07		0.07	0.07
	0.07			
P value of AR(2)	0.13		0.15	0.15
	0.18			
No of Obs	3527	3527	3527	3527
R squared (centered)	0.50	0.64	0.54	0.60
F statistic	285.71	303.71	185.71	203.7
Post Estimation test				
Sargan test	0.24	0.24	0.25	0.25
Basmann	0.43		0.43	0.43
	0.43			

****p<0.01, **0.05, *p<0.1. All values are natural log mean centered.*

Endogeneity is a possible concern here and causality runs in both directions, which is addressed through the GMM estimation. (Mackey et al; 2017, Roodman; 2012).The GMM estimator results in consistent results compared to traditional techniques and is a better technique for use in the presence of heteroscedasticity.(Woolbridge,2010)Table 8 and Table 9 provide the results for the GMM estimation on panel data. Table 7indicates results of both model where model 1 captures the impact of PACAP and RACAP on firm performance and model 2 captures the impact of moderating variables (interaction terms)on firm financial performance. Column 1 indicates that the results of Model 1 shows that PACAP and RACAP have a significant impact on firm performance. Column 2 indicates that the moderating variables affect the relationship between absorptive capacity and firm performance relationship. Our results indicate that the coefficients are statistically significant at the 0.01, 0.05, 0.1 significance levels. Therefore, the results support our hypotheses 5

and 6.It provides support for 1, 2, 3, and 4. Table 7 provides the results for the GMM estimation using year dummies. Models 1 and 2 provides support for all hypotheses. All coefficients are statistically significant at the 0.05, 0.01 and 0.1 significance levels. Furthermore, the year dummies capture the year's effects on firm performance. All the coefficients are statistically significant indicating a positive influence of years on the dependent variable i.e. performance. Both models have p-value of AR =0, indicating no autocorrelation issues. Our post estimation Sargan and Basmann tests indicate that there is no bias and that our inference is valid. Thus, it demonstrates the validity and reliability of our results.

7.1 Managerial Implications:

Our findings indicate that managers should consider the significance of absorptive capacity and conceptualize it as a dynamic capability. They should design policies and aim to develop both the PACAP and RACAP to derive positive financial results. In accordance with this, our study indicates that managers should pay closer attention to strategic alliances, R&D investment, appropriability mechanisms and available government funding's that positively influence PACAP and RACAP and firm performance.

Moreover, measuring and evaluating absorptive capacity will help managers stay abreast of key performance indicators necessary for facilitating knowledge transfer. Thus, it contributes towards firm alignment with strategic goals and rectifying where necessary.

These aforementioned have significant implications for similar enterprises. They will focus on establishing stronger strategic alliances, spending substantial amounts in R&D in tandem with developing appropriability mechanism through the number of patents and taking advantage of government funding, which generates good profit margins for them which is one mode to develop competitive advantage.

7.2 Limitations and Conclusion:

Our research investigated the impact of absorptive capacity on firm performance using panel data on European firms spanning over six years. Our results broadly indicate a positive relationship between absorptive capacity and firm performance. Firms with absorptive capacity tend to perform significantly.

We contribute towards the strategic management literature by capturing absorptive capacity from both dimensions i.e. potential and realized absorptive capacity and thus explaining both conceptually and empirically how does PACAP translates into RACAP and results in enterprise financial performance. Moreover, we also consider interorganizational (strategic alliances, R&D investment) and (appropriability mechanism, government funding) moderating factors that contributes towards absorptive capacity and firm performance relationship. Therefore, deciphering absorptive capacity as a multidimensional construct would guide managers regarding where to put their efforts to drive higher performance.

Secondly, future studies should examine the individual and team level behavior of organizations to further the understanding of organizational access to external knowledge and how it is deeply rooted within individual level behavior. Due to the limitations of our data, we were unable to examine team and individual level behavior and how it can contribute towards absorptive capacity and firm performance. Thus, it opens avenues for future multilevel studies and examines absorptive capacity from a micro-foundational perspective. Moreover, this research asserts a previous study by Song et al. (2018) that identifying and integrating conceptual, empirical distinctions among absorptive capacity dimensions will result in an improved theoretical version and decipher the holistic significance of absorptive capacity; and the extent to which it matters. Investigating the role of the dimensions of absorptive capacity (potential and realized absorptive capacity) and measuring them combines theoretical perspective with empirical validation.

Another limitation is that we did not consider the service industry where impact of human capital, service related factors on absorptive capacity and firm performance can be considered, and how these factors develop assimilation and utilization of external knowledge. (Uwitonze &Heshmati, 2017; Bouguerra, 2024)

Appendix:

Table: Includes operational definition and source of variables

Variables	Definition	Measurement
Performance (Dependent variable)	Performance is the dependent variable measured through turnover of manufacturing firms in terms of revenue	Turnover (CIS ,public data Eurostat)
PACAP	PACAP is measured through knowledge flow strategies	(CIS ,public data Eurostat)
RACAP	RACAP is measured through product and process innovation of firms data	Product and Process (CIS ,public data Eurostat)Innovation
Strategic Alliances (Moderating variable)	Strategic alliances is measured through firm collaboration and partnership data	Firm Collaboration and Partnership(CIS ,public data Eurostat)
R&D Investment (Moderating Variable)	R&D investment is measured through R&D investment of firms data	R&D investment(CIS ,public data Eurostat)
Appropriability mechanism(Moderating variable)	Appropriability mechanism is measured through no of patents	No of patents and IPR(CIS ,public data Eurostat)
Government tax incentives(Moderating variable)	Govt incentives is measured through Public funding and tax incentives.	Public funding and tax incentives(CIS ,public data Eurostat)
Control Variable		
Firm size	Scale of firm (medium or large)	(CIS ,public data Eurostat)
Firm age	Years of firm in business	

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