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Entrepreneurial agility and organizational performance of IT firms: A mediated moderation model

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Abstract

PURPOSE: The Information and Communication Technology (ICT) sector is playing an important role in the growth of the world's economy. However, limited knowledge exists concerning the underlying mechanisms and boundary-spanning conditions under which entrepreneurial agility (EA) affects the organizational performance (OP) of IT firms. This study draws on the Dynamic Capability Theory (DCT) to examine the effect of entrepreneurial agility (EA) on the organizational performance (OP) of Italian IT firms with the mediating role of open innovation (OI) and the moderating role of environmental dynamism (ED). **METHODOLOGY:** Employing an explanatory research design and convenience sampling technique via an online survey to gather data from a sample of 411 Italian IT firms, the study tested the formulated hypotheses using the structural equation modeling technique in AMOS statistical software. **FINDINGS:** The results revealed that EA, directly and indirectly, influences OP of IT firms. Moreover, the mediation analysis unveils that OI plays a complementary, partial mediation role in the EA—OP nexus. Finally, ED moderates this focal relationship, such that in the presence of high environmental dynamism, the relationship between EA and OP gets stronger compared to low environmental dynamism. **IMPLICATIONS:** The findings imply that IT firms should emphasize adopting agile procedures and structures that allow them to react to new problems and opportunities swiftly by building a culture of innovation through the adoption of OI strategies (inbound, outbound, and coupled) to tap into the broader range of expertise and resources in the business environment. To improve the link between OI and OP, managers should prioritize building relationships with external partners, such as customers, suppliers, and academic institutions. IT firms should also prioritize building a diverse and inclusive workforce that can bring diverse perspectives and experiences to the innovation process to enhance their innovation capabilities and create products and services that better meet the needs of customers. **ORIGINALITY AND VALUE:** The study's value lies in extending the ongoing scholarly discussion on the nexus between EA and OP by exploring OI as an intermediary mechanism that connects EA, OP, and ED as a boundary-spanning condition that moderates the focal relationship. This research highlights the interplay between EA, OI, ED, and OP, using the DCT as a theoretical foundation. It is the first to examine such interrelationships in the IT sector. In addition, the study provides new insight for researchers focusing on the information technology (IT) sector.

Keywords: entrepreneurial agility, organizational performance, IT firms, dynamic capability theory, open innovation, environmental dynamism, mediated moderation model, structural equation modeling, information and communication, technology sector, innovation management

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INTRODUCTION

Since the global economy and competitiveness cause quick changes, and intense competition shortens product life cycles, it is evident that conventional management strategies cannot react adequately to these shifts or constantly changing market circumstances (Tajeddini & Mueller, 2018). Scholars suggest that firms should incorporate innovation and entrepreneurial spirit for business success (Etemad, 2015; Tajeddini, Altinay, & Ratten, 2017). Furthermore, academics in strategic management have asserted that entrepreneurial behaviors are crucial to modern businesses' survival, profitability, and growth (Shan, Song, & Ju, 2016).

However, the path to success or failure in entrepreneurial company operations is determined by the decisions made by entrepreneurs (Aujirapongpan, Ru-zhe, & Jutidharabongse, 2020; Robbins, 2003). The most innovative and successful entrepreneurs will maintain Entrepreneurial Agility (EA, hereafter) and outstanding performance (Karimi & Walter, 2021) because firms lacking agility find it challenging to adapt to change in the modern business environment. They will ultimately fall behind their rivals, unable to adapt to market demands and lacking knowledge of emerging business patterns (Wairimu, Liao, & Zhang, 2022; Hindrawati, Dhewanto, & Dellyana, 2022). The term "agility" was coined in 1991 by a committee at the Iacocca Institute, Lehigh University (PA), to explore the US industry's deficiency of international competitiveness (Yusuf, Sarhadi, & Gunasekaran, 1999). Since then, agility has evolved into a paradigm for how institutions should design for digital innovation that prioritizes efficiency and speed (Goncalves et al., 2020). According to Florek, Ujwary, and Godlewska (2021), agility allows firms to persist and overcome tremendous hindrances, such as the global crisis of the COVID-19 pandemic. In this telling, since firms' survival and growth depend primarily on their ability to adapt to the dynamic changes in the business environment, and open innovation (OI, hereafter) involves opening the innovation box to incorporate inside and outside ideas and technologies, the more agile a firm is, the more likely that it will adopt OI (Wang & Kim, 2017). OI represents a company's efforts to develop new resources, ideas, and applications outside its borders (Brown, Davidsson, & Wiklund, 2001; Ireland, Hitt, & Sirmon, 2003).

Chesbrough and Bogers (2014) define OI as "a distributed innovation process which includes purposefully managed knowledge flows across the organizational boundary." It highlights firms' adopting outside-produced ideas and technology in their enterprises while allowing others to exploit unneeded internal ideas and technologies (McPhillips, 2020). Furthermore, a dynamic environment promotes business development by improving organizational flexibility or agility to push across networks by shifting circumstances (Khouroh et al., 2020). When confronted with an environment that is constantly shifting, the capability of the management or owner becomes critical in developing strategies to increase performance.

According to Sharmelly (2017), top firms continue their OI initiatives by enabling agility in organizational culture, while Naqshbandi, Kaur, and Ma (2015) note that corporate culture significantly impacts OI. The EA of high-tech firms is successfully coupled with organizational stability (Jurevicius et al., 2016). EA may serve as a bridge between essential employees and help teams adjust unfavorable attitudes towards outside knowledge to boost collaboration for the OI process (Weissenberger & Hampel, 2021). Yet current scholars are more focused on Organizational Agility (OA) (i.e., Harraf et al., 2015; Trinh et al., 2012), strategic agility (SA) (i.e., Sahid, Maleh, & Belaisaoui, 2020; Doz, 2020), and Marketing Agility (MA) (i.e., Golgeci et al., 2023; Khan, 2020) with minimal attention to EA.

Despite enormous efforts in understanding EA, four critical areas need more attention in this stream of research. First, research on the relationship between entrepreneurship and organization has shown conflicting and inconsistent results. Some researchers have established a positive connection between EA and business success (e.g., Karimi & Walter, 2021; Wairimu et al., 2022). Others have found no or even a negative relationship (i.e., Zulganef et al., 2023). This controversy highlights managers' tensions regarding the trade-off between opportunity foresight, systemic insight, and entrepreneurial mindset dimensions (i.e., Karimi & Walter, 2021). This association may be more illusory than the research suggests. Conflicts in any sector may indicate a promising topic for investigation (Strand, 2011). One area worth investigating is opening the 'black box' in the EA — OP connection to allow for a complete understanding of the relationship.

Second, although some research has been conducted on the impact of EA on OP, more must be done to uncover the intermediary mechanism that connects EA and performance. OI is a strategic instrument that may be a significant source of long-term competitive advantage. Surprisingly, OI has received little attention in this field of study, with few studies examining its impact on OP. Since previous research has assumed chiefly a direct relationship between EA and OP, investigating the mediating role of OI helps us understand the intermediate process by which EA affects OP.

Finally, while the term 'entrepreneurial agility EA' is frequently used to describe the managerial cognitive ability to anticipate, visualize, and exploit entrepreneurial opportunities, little evidence exists to show how much environmental

dynamism (ED), which “refers to the rate of change in environmental factors over time, including technologies, markets, competitors, suppliers, and customers,” plays a role in EA. If a company uses EA to obtain a competitive advantage, it may need to meet the dynamic changes in the environment brought about by the Fourth Industrial Revolution (Seo et al., 2020). What role does ED play in this case? Little has been studied on how ED influences the link between EA and OP in the IT industry.

Because of these research gaps, this study investigates the direct link between EA and OP, the mediating role of OI, and the moderating influence of ED. It does so among IT companies in Italy. The data was gathered from 411 Italian IT firms through an online questionnaire generated by Google Forms. Saracco (2022) claims that Italy has often shown remarkable resilience and ability to adjust to changing market dynamics. Nonetheless, many industries operate in mature marketplaces with low-to-medium levels of innovation. Furthermore, digitalization has been a more prominent focus of European business strategies in recent years. Therefore, we posit the dynamic capacities framework as an effective lens for studying firm performance in IT enterprises. IT firms must have solid dynamic capabilities to remain relevant in the growing digital economy (Teece & Linden, 2017; Karimi & Walter, 2016; Velu, 2017; Teece, 2018).

The study’s specific objectives are examining (1) the main effect path of EA → OI → OP; and (2) the moderating effect path of ED moderating the EA → OP relationship (see Figure 1). In doing so, we contribute to the ongoing scholarly research on the strategic role of entrepreneurial agility (EA), open innovation (OI), and environmental dynamism (ED) in enhancing organizational performance (OP). Furthermore, the study’s results will likely provide managers and practitioners with helpful insight into how EA affects the success of information technology IT firms through opportunity foresight, systemic insight, and an entrepreneurial mindset. Focusing on Italian IT companies opens new avenues and provides vital information to managers and entrepreneurs seeking to perform better in a volatile industry (Tahmasebifard, Zangouinezhad, & Jafari, 2017).

The rest of the paper is structured as follows: Section 2 offers a literature review and hypothesis development related to the research topic. Section 3 provides the research focus and methodology adopted. Section 4 presents the analysis of the result, and finally, section 5 provides a discussion and conclusion.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Dynamic capability view (DCV)

A firm’s ability to “integrate, build, and reconfigure its internal and external competencies for dealing with rapidly changing environments” is called dynamic capability (Teece, Pisano, & Shuen, 1997). Warner and Wäger (2019) have recently conceptualized and explained the scope and digital transformation process. Digital sensing abilities imply the capability to detect new customer-centric tendencies and the relevance of digitalization trends like artificial intelligence, blockchain, and big data analytics in providing excellent customer service. Digital seizing capabilities need strategic agility to develop. “Digital innovation laboratories” gather consumer input and respond to emerging customer-centric trends via digitalization transformation. Lastly, the digital transforming abilities imply constructing a digital ecosystem to engage with new collaborative stakeholders, which necessitates co-opetition and co-creation practices that enhance the pace of business model renewal (Warner & Wäger, 2019). According to Teece, Peteraf, and Leih (2016), entrepreneurial managers who decide to develop solid dynamic capabilities within their firm become better at sensing emerging developments and making more efficient use of their EA. As a result, they will be more potent at sensing, seizing, and transforming. DC and OI have many shared characteristics, including organizational and management implications that complement one another. Implementing OI could expand management’s views on sensing seizing. Páez, Pinho, and Prange (2022) revealed that DC influenced technological capabilities and marketing performance. Similarly, a solid DC will boost the success of OI activities (Teece, 2020). Therefore, the DCT can help us understand the interplay between a firm’s EA, OI, and OP in the IT context in a developed country, Italy.

Teece et al. (1997) emphasize that dynamic capability refers to a firm’s ability to respond to changes in its external environment and integrate and reconfigure its internal and external competencies proactively. Warner and Wäger (2019) expand on this concept by highlighting the importance of digital transformation processes in enhancing dynamic capabilities. They argue that digital sensing enables firms to identify emerging customer-centric trends and leverage digitalization trends like artificial intelligence, blockchain, and big data analytics to improve customer service. Digital seizing capabilities, on the other hand, involve strategic agility to develop innovative solutions based on the insights gained

through digital sensing. The authors also mention the significance of digital transforming capabilities, which involve the construction of digital ecosystems to engage with collaborative stakeholders through co-opetition and co-creation practices, facilitating business model renewal. The theoretical link between dynamic capabilities (DC) and open innovation (OI) is further explored by Páez et al. (2022), who find that DC positively influences a firm's technological capabilities and marketing performance. Similarly, Teece (2020) argues that dynamic solid capabilities can enhance the success of open innovation activities, emphasizing the complementary nature of DC and OI in and improving a firm's overall innovation performance. In this study, we aim to examine how entrepreneurial agility (EA) interacts with open innovation (OI) and organizational performance (OP) within the context of the IT industry in Italy, building on the dynamic capability view.

Entrepreneurial agility (EA) and organizational performance (OP)

EA is the cognitive management capability to predict, visualize, and utilize entrepreneurial opportunities (Karimi & Walter, 2021). These cognitive abilities relate to opportunity foresight, systematic insight, and an entrepreneurial mindset, which become managerial cognitive capabilities and mental models for influencing entrepreneurial thinking rather than actual participation (Karimi & Walter, 2021). They differ conceptually from sequential entrepreneurial measures to create and execute opportunities (Valliere, 2013). The ability to notice and act on weak signals and poor information is called opportunity foresight (Hajizadeh & Valliere, 2022; Rego et al., 2012). Foresight may assist managers in thinking outside the box (Spaniol et al., 2019). Systemic insight refers to an entrepreneurial cognitive ability to visualize technology-enabled business opportunities and associated risks when designing aggressive actions for new products or services and anticipating possible competitor countermoves (Karimi & Walter, 2021). The entrepreneurial mindset is a sentiment and conviction with a distinct method of looking for opportunities and challenges (Nabi et al., 2017; Solesvik et al., 2013). From the DCT perspective, firms adopt new strategies to mirror changing market situations by integrating and transforming available resources in novel ways (Morgan, Vorhies & Mason, 2009; Wang & Kim, 2017; Teece et al., 1997). Various investigations have examined how EA might help IT firms improve their performance. For example, Karimi and Walter (2021) found that EA directly influences the development of digital platform capacities for the business model and product innovation. The findings of Werder et al. (2021) show that EA may greatly enhance process and product performance. The results of Hosseini, Alizadeh, and Abedi (2019) revealed that EA was positively and significantly linked with human resources management. According to Khan and Rehman (2023), the degree of EA increases investors' confidence and interest in investing in the enterprise. Thus, we expect EA to influence OP, leading to the study's first hypothesis.

H1: Entrepreneurial agility (EA) is positively related to the organizational performance (OP) of IT firms.

Entrepreneurial agility (EA) and open innovation (OI)

As mentioned earlier, EA displays itself via three primary comments: opportunity foresight, systemic insight, and an entrepreneurial mindset. In this vein, Calof, Meissner, and Razheva (2018) found that foresight could help improve OI by offering analysis that examines critical OI concerns such as technology selection, diagnosing future consumer demands, and monitoring for disruptions. Foresight can support OI in dealing with some constraints to implementing OI. Similarly, OI necessitates a more entrepreneurial mindset, a broader opportunity-seeking behavior, and a solid strategic alignment with innovation (Mantas & Soderquist, 2010). The basic idea behind OI is to open the innovation process (Huizingh, 2011). It indicates that IT firms that want to improve their technology may and should use internal and external knowledge (Arvaniti et al., 2022). OI transforms a company into an entity that participates in creative activities open to the public. OI should ensure the accomplishment and continuous replication of high levels of innovation and, hence, the long-term and stable development of firms that respond to environmental concerns feasibly and flexibly (Panwar, Ober, & Pinkse, 2022). EA dimensions like opportunity foresight and systemic insight require management to think outside the box (Spaniol et al., 2019) and to visualize technology-enabled business opportunities outside its own business models (Karimi & Walter, 2021). Moreover, because firms' survival and growth depend primarily on their ability to adapt to the dynamic changes in the business environment, and OI involves opening the innovation box to incorporate inside and outside ideas and technologies, the more agile a firm is, the more likely that it will adopt OI (Wang & Kim, 2017). This alignment between EA and OI is supported by the idea that agile firms are more likely to embrace open innovation practices, which facilitate incorporating novel ideas and technologies from inside and outside the organization. Thus, we hypothesize that:

H2: Entrepreneurial agility (EA) is positively related to open innovation (OI).

Open innovation (OI) and organizational performance (OP)

OI represents a firm's efforts to develop new resources, ideas, and applications outside its borders (Edelbroek, Peters, & Blomme, 2019; Ireland et al., 2003). The primary principle of OI is to open the innovation process (Cheng & Huizingh, 2014). The most comprehensive definition of open innovation is using information inflow and outflow to review innovation internally and market expansion for the invention's external use (Chesbrough, 2003). It also suggests that enterprises that want to boost their technology may and should use internal and external ideas (Arvaniti et al., 2022; Kafetzopoulos et al., 2023). Bogers et al. (2019) argued that the DC framework clusters might assist firms in reaping the full advantages of OI (Bogers et al., 2019; Cirjevskis, 2022). There are several perspectives and definitions of organizational performance (OP). OP is often characterized as the capacity to accomplish administrative duties via effectively and efficiently managing resources (Uljanati et al., 2021; Wanasida et al., 2021). When archival financial data is available, an OP may often be evaluated through Return on Equity (ROE), Return on Investment (ROI), and Return on Assets (ROA) (Dibrell, Craig, & Neubaum, 2014). Some studies have examined how OI affects IT organizational performance, although the results are mixed. For example, in their meta-analysis, Oduro et al. (2021) revealed that OI is positively related to firms' financial and non-financial performance. Also, Wang et al. (2021) found that inbound and outbound OI improves OP. Kang and Kang's (2010) finding revealed that informal network knowledge transmission and technology adoption positively link technological innovation performance. Harif, Nawaz, and Hameed (2022) state that OI combines ICT and innovation and boosts OP by raising ROI, ROA, and ROE. However, Davoudi et al. (2018) found no significant association between OI and intellectual property rights. Despite the conflicting findings, we draw on the DCT to theorize that OI can boost a firm's performance dynamics of IT firms by incorporating ideas and technologies from outside the company. Therefore, we suggest the following hypothesis:

H3: Open innovation (OI) is positively related to the organizational performance (OP) of IT firms.

Open innovation (OI) as a mediator in EA-OP relationships

EA is a managerial cognitive skill that allows individuals to predict, visualize, and take advantage of opportunities for entrepreneurship (Kohtamäki et al., 2020). Teece et al. (2016) contend that OI could improve agility by enhancing and hastening new product development to address emerging market opportunities. By offering access to diverse and complementary knowledge, inbound OI decreases the risks associated with experimenting, stimulates a firm's innovation engine, and offers excellent flexibility when attempting high levels of innovation performance (Bianchi et al., 2016). Furthermore, organizations with outward OI must often examine a larger spectrum of technical breakthroughs for possible internal uses (Hu, McNamara, & McLoughlin, 2015). Much research demonstrates that OI benefits OP indicators (Popa, Soto & Martinez, 2017; Carayannis & Grigoroudis, 2014; Chiang & Hung, 2010). For example, Oduro et al. (2021) found a positive, significant connection between OI and the company's overall performance. In this telling, OI can secure the accomplishment and continuous replication of high levels of innovation and, hence, the long-term and stable development of firms that respond to environmental concerns feasibly and flexibly (Ober, 2022). Thus, in line with the theoretical proposition of the DCT, the more agile a firm is, the more likely it will adopt open innovation (Wang & Kim, 2017). Therefore, it can be reasonably expected that an agile, entrepreneurial orientation will lead to more innovation openness, which, in turn, can enhance OP. Thus, we propose the following hypothesis:

H4: Organizational innovation (OI) positively mediates the relationship between entrepreneurial agility (EA) and organizational performance (OP) of IT firms.

Moderating role of environmental dynamism (ED)

Nowadays, firms compete in a highly dynamic business environment. Rapidly evolving technology, the fast entrance of new rivals, and the growing commoditization of goods and services all contribute to this dynamic (Zupic, 2014; Marek, 2016). Environmental dynamism (ED) is a shift in the competitive environment that affects how organizations compete and react to customer needs. Drnevich and Kriauciunas (2011) argue that since EA is a manager's capacity to predict, visualize,

and execute entrepreneurial opportunities, firms need an agility position in a dynamic business environment without agility. They will need help managing change and fulfilling the ever-changing requirements of their customers. ED may provide a window of opportunity for new technologies and markets, encouraging firms to constantly assess their knowledge and understanding from external information sources and be flexible in accepting the environment to increase OP (Zhang & Zhu, 2021). However, according to Zulganef, Pratminingsih, and Rianawati (2023), ED negatively mediates the relationship between EA and OP. Despite the varied results, we anticipate ED to play an essential moderating role between EA and OP relations. Thus, we suggested the following hypothesis:

H5: Environmental dynamism (ED) positively moderates the relationship between entrepreneurial agility (EA) and organizational performance (OP) of IT firms.

Conceptual framework

Figure 1 demonstrates the conceptual framework of the study. The study predicts a positive, direct relationship between EA (i.e., opportunity foresight, systemic insight, and entrepreneurial mindset) and organizational performance. Moreover, we expect this direct relationship to be positively mediated by open innovation and moderated by environmental dynamism.

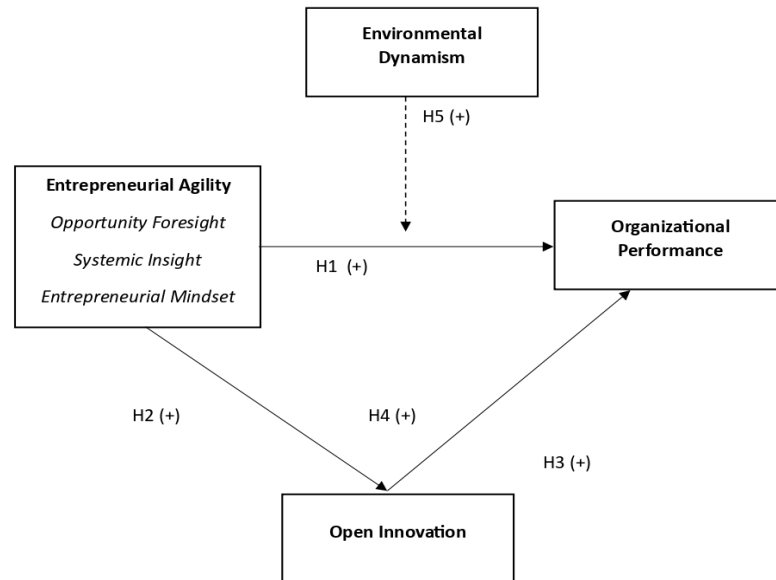


Figure 1. Conceptual framework of hypothesized relationships

METHODOLOGY

Study design

This research examined the effect of EA on the OP of IT firms. Moreover, it analyses the influence of OI as a mediator and environmental dynamism as a moderator between the abovementioned relationships. An online survey was used to gather the data for this research. To minimize the problem of unintended bias in the survey, we prepared the survey with one order of questions in sections, then we made copies of that section of questions so that the same questions exist in the design form more than once, and re-ordered the copied sections of fields so that they appear in different orders. More specifically, through the support of an IT expert, we programmed Section A, Section B, and Section C and then replicated the sections but in diverse orders, like ABC, BCA, or CAB.

Thus, we used an explanatory research design. According to Grembowski (1985), the survey technique can help researchers collect data in a minimal period. The items of every construct used in the questionnaire were adapted from

prior studies (i.e., Karimi & Walter, 2021; Van de et al., 2009; Horton, Macve, & Struyven, 2004). The final questionnaire was developed online to gather the data quickly. The adopted research methodology best fits the proximity, cost, and time constraints during the study. A detailed overview of the research methodology is shown in the subheadings given below.

Measures and measurements

The instrument developed in the study was adapted from prior studies. In addition, everything was examined on a five-point Likert scale, i.e., “1 (strongly disagree) to 5 (strongly agree). The study has adopted a 10-item scale of EA from Karimi and Walter (2021). The open innovation instrument was established on 10 items adopted from (Fu, Liu, & Zhou, 2019). The OP variable was measured using the five items adapted from Lin and Chen (2007). The ED was measured with a four-item scale adopted by Li and Liu (2014).

Sampling and data collection

The target population of the study was Italian IT firms. There are about 59,160 IT firms in Italy (Bold Data, 2021), and collecting data from every firm is impossible. Therefore, the convenience sampling technique was used, which identifies respondents who are available and easily accessible. Italy was explicitly targeted due to its status as a population experiencing a higher degree of emerging IT industry as entrepreneurial ventures. To accomplish the study’s main objective, the authors conducted a primary survey during the second and third quarters (May–July) of 2022. The first step in this process involved preparing the questionnaire on Google Forms, which allows for the digital collection of data. A cover letter was included alongside the study to provide the necessary context and information for the participants to make informed decisions regarding their participation. The survey also featured a cover page emphasizing the potential for participant contribution as voluntary and anonymous. The online questionnaire was sent to 502 managers of IT firms out of which 411 were returned. Upon data collection completion, 411 comprehensive responses were obtained via the survey and subsequently utilized for further analysis.

Analytical strategy

While descriptive statistics provide a summary of collected data, inferential statistical analysis aids researchers in making informed conclusions about a studied population based on the study sample. The objective is to understand the research topic in the context of measured outcomes. To evaluate both our measurement and structural models, we utilized structural equation modeling techniques, employing software packages such as SPSS Statistics® (version 26.0) and SPSS AMOS® (version 24.0), as previously recommended within the scholarly literature (Dai & Adel, 2020). The normality of the collected data was assessed using the correlation coefficient approach.

RESULTS

Sample characteristics

The sample characteristics of the firms are shown in Table 1. The majority of respondents (managers) (71.19%) were men. Most respondents (55.69%) were university graduates, and 42.37% of firms had operated for more than 11 years. 63.75% were service-based firms, and 43.37% were firms limited by share. The data also showed that the majority of the firms were large firms (50.12%).

Data normality

As suggested by Kline (2015), Skewness and Kurtosis statistics were used to determine data normality. Table 2 presents the data normality results. According to Kline (2015), Kurtosis values should be less than 10 for data normality, and Skewness values must be less than 3. The data results indicated that all Skewness values ranged between -1.128 to 0.631, while the range of Kurtosis values was between -0.526 to 1.027, confirming data normality. Furthermore, mean values are also shown in Table 1, which reveals that all mean values are above 3 on a five-point Likert scale, indicating respondents’ trend towards the agreement side.

Table 1. Sample characteristics

<i>Gender</i>		
Male	82	71.19
Female	31	26.17
Other	03	2.64
<i>Education</i>		
College (3 years)	29	18.12
Elementary school (8 grades)	-	-
High school (4 grades)	31	26.19
University (4 years or more)	63	55.69
<i>Number of years in operation</i>		
2-5 years	46	35.81
6-10 years	27	15.69
Above 11 years	51	42.38
Less than 1 year	11	6.12
<i>Sector</i>		
Agriculture and Fisheries	21	10.39
Manufacturing	36	25.86
Services	72	63.75
<i>Legal status of firms</i>		
Limited by guarantee	23	13.31
Limited by shares	41	43.37
Partnership	14	6.82
Sole Proprietorship	47	36.0
<i>Firm size</i>		
Large	205	49.47
Small/medium	206	50.12

Table 2. Descriptive statistics and data normality test

	N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
1-Entrepreneurial Agility	411	1.00	5.00	3.5226	0.91997	-0.807	-0.178
2-Open Innovation	411	1.20	4.90	3.7270	0.74972	-0.668	-0.205
3-Environmental Dynamism	411	1.25	5.00	3.0255	0.86194	0.631	-0.526
4-Organizational Performance	411	1.00	5.00	3.8681	0.79892	-1.128	1.027

Sampling adequacy

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used to test the sampling adequacy of the current study. Hair et al. (1998) recommended that the value of the KMO index should be 0.80 or higher for excellent sampling adequacy. KMO results shown in Table 3 indicated that the value of the KMO index of 0.848 is higher than the recommended sampling adequacy criteria by Hair et al. (1998). In addition, significant results of Bartlett's Test of Sphericity ($X^2=7359.193$; $df = 0.171$; $P<0.000$) confirm the sampling analysis' suitability (Henseler & Sarstedt, 2015).

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.848
Bartlett's Test of Sphericity	Approx. Chi-Square	7359.193
	Df	171
	Sig.	0.000

Measurement model

Confirmatory factor analysis (CFA)

CFA was used to test the reliability and validity of the measurement model using AMOS-24. Table 4 shows the CFA results. CR (composite reliability) values were used to measure the reliability. Nunnally and Bernstein's criteria (1994, pp. 186-193) were followed in the current study. CR values above 0.70 confirm construct reliability (Nunnally & Bernstein, 1994, pp. 186-193). The data results of the present study show that all CR values are higher than the recommended threshold of 0.70. Moreover, Hair et al. (2010) recommended testing both convergent and discriminant validities for construct validity. Bagozzi and Yi (1988) suggested that for convergent validity, the values of Average Variance Extracted (AVE) should be greater than 0.50, and the current study AVE, values of all constructs, are well above the recommended criteria of 0.50, which confirms convergent validity (see Table 4). Moreover, for discriminant validity, Fornell and Larcker (1981) suggested that the square root of AVE values should be higher than the constructs' correlation values. Furthermore, Henseler et al. (2015) recommended that Heterotrait-Monotrait Ratio (HTMT) values (Table 5) should be less than 0.90 for discriminant validity. The current study results shown in Table 4 and Table 5 confirm convergent and discriminant validities. Moreover, when all items were loaded in a single factor, the total variance by extracting the sum of the square of loadings was 34.977, which is less than 50%, as Podsakoff et al. (2003) suggested for common method bias.

Table 4. Confirmatory Factor Analysis

	CR	AVE	MSV	1	2	3	4
1-Entrepreneurial Agility	0.93	0.56	0.29	0.747			
2-Open Innovation	0.92	0.54	0.24	0.491***	0.737		
3-Environmental Dynamism	0.88	0.66	0.02	-0.084	0.053	0.810	
4-Organizational Performance	0.84	0.55	0.29	0.534***	0.304***	0.124**	0.738

Table 5. HTMT analysis

Variables	1	2	3	4
1-Entrepreneurial Agility	-			
2-Open Innovation	0.778	-		
3-Environmental Dynamism	0.675	0.786	-	
4-Organizational Performance	0.644	0.656	0.879	-

Note: N=411.

Hypotheses testing

We used the structural equation modeling (SEM) technique to test the study's hypotheses since it allows comprehensive analysis by showing both direct and indirect effects. In addition, we employed a slope test through the Hayes process macro to test the moderation effect. We assessed the structural model by examining the beta, t-values, effect sizes, and confidence intervals (Sarstedt et al., 2022). For the mediating effect, we used Preacher and Hayes (2008) methods with subsamples of 5,000 bootstrapping procedures to evaluate t-values and confidence intervals for the mediating hypothesis.

Direct effect

Table 6 presents the direct effect results, which showed a significant impact of EA on OP ($\beta=0.573$; $P<0.001$). Moreover, EA significantly affects OI ($\beta=0.436$; $P<0.001$). OI also significantly and positively impacts OP ($\beta=0.344$; $P<0.001$). Hypotheses H1, H2, and H3 are accepted based on these significant results.

Table 6. Test of hypotheses (direct effect)

Relationships	Estimate	T	P
H1: Entrepreneurial Agility → Organizational Performance	0.573	14.15	***
H2: Entrepreneurial Agility → Open Innovation	0.436	9.79	***
H3: Open Innovation → Organizational Performance	0.463	10.53	***

Note: ***P<.001; N=411.

Indirect effect

The mediating effect of OI on the relationship between EA and OP is tested, and the results are shown in Table 7. The results revealed that OI has a *complementary, partial* mediation effect on the EA—OP relationship ($\beta=0.105$; LLCI=0.050; ULCI=0.151) since the direct relationship between EA and OP was still significant after introducing the mediator variable into the model. Hence, hypothesis H4 is also accepted.

Table 7. Test of hypotheses (indirect effect)

Relationship	Total effect		Direct effect		Relationship	Indirect effect		95% Confidence Interval	
	β -value	S.E	β -value	S.E		Beta	S.E	LLCI	ULCI
EA → OI	0.37***	0.035	0.28***	0.044	H ₄ -EA → OI → OP	0.105	0.025	0.050	0.151

Note: N=411;EA= Entrepreneurial Agility; OI=Open Innovation; OP=Organizational Performance LLCI= Lower Limit Confidence Interval; ULCI= Upper Level Confidence Interval.

Moderation effect

The current study tested environmental dynamism as a potential moderator in the relationship between EA and OP and found that in the presence of high environmental dynamism, the relationship between EA and OP gets stronger compared to low environmental dynamism. The conditional effect of EA on OP in the presence of environmental dynamism is shown in Table 8. In addition, the slope of the relationship is shown in the moderation graph in Figure 2.

Table 8. Conditional effects of the focal predictor (Entrepreneurial Agility) at values of the moderator (Environmental Dynamism)

DV: Organizational Performance				
Test(s) of highest order unconditional interaction: (X*W)				
R ² -change = 0.091***				
F Statistics = 51.01				
Moderator: Environmental Dynamism	β	P	95% CI	
-1 SD	0.121	0.13	-0.054	0.431
Mean	0.344	<.001	0.142	0.552
+1 SD	0.674	<.001	0.418	0.930

Note: *** p<0.001; CI= confidence interval.

The results indicate a significant moderation effect with a significant R² (0.091) change and significant F statistics (51.01; P<0.05). Moreover, the slope of the relationship, as presented in the mod graph, indicates that in the presence of high environmental dynamism, even with low EA, OP is high. On the other hand, in the presence of high environmental dynamism and high OP, OP will be the highest, as the study hypothesized in H5. As a result, hypothesis H5 is also accepted.

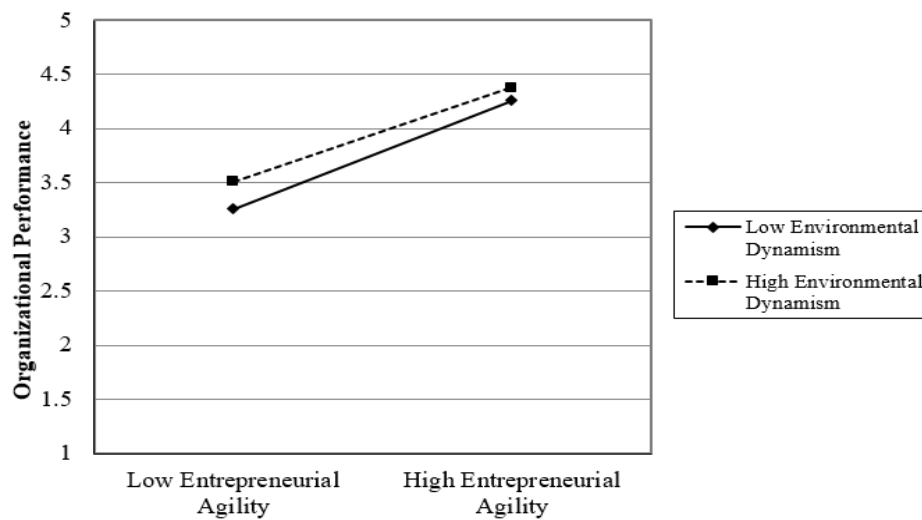


Figure 2. The moderation graph

DISCUSSION AND CONCLUSIONS

The Information and Communication Technologies (ICT) sector is playing an important role in the growth of the European economy (Maryska, Doucek, Kunstova, 2012). However, in Italy, the entrepreneurs of ICTs are facing many challenges, including limited access to finance, governmental policies, and knowledge/ability to explore international markets (Corno et al., 2014). In addition to the external environmental factors, several internal conditions influence the performance of IT firms in Italy. Therefore, this research has focused on factors that can lead to performance. First, this research, building upon the DCT, has examined the role of EA on OP in the IT sector in Italy. Secondly, it highlighted the relationship between EA and OI. In this current digital era, EA can help organizations achieve better performance and competitiveness (Kuratko & Audretsch, 2013). Thirdly, it identified the mediating effect of OI in the EA—OP relationships. Fourthly, the study has revealed the moderation of ED between EA and OP.

The first hypothesis of this research proposed a positive relationship between EA and the OP of IT companies in Italy. Our results confirm this hypothesis, indicating that EA can enhance companies' performance. The results, furthermore, theorize the prior claim that a firm's ability to predict, visualize, and utilize entrepreneurial opportunities (Karimi & Walter, 2021) can positively affect its performance (Chakravarty, Grewal, & Sambamurthy, 2013). Thus, firms that implement EA achieve higher organizational performance. This finding is in line with the DCT. Furthermore, it advances its claims in the IT companies in Italy that entrepreneurial managers who decide to establish solid dynamic capabilities within their firm become better at sensing emerging developments and making more efficient use of their EA, which, in turn, enhances performance (Warner & Wäger, 2019; Teece et al., 2016).

The second hypothesis focused on analyzing the nexus between EA and OI. Supportively, our findings indicate that EA is positively related to OI. Put another way, the more capable a firm is in terms of opportunity foresight, systematic insight, and entrepreneurial mindset, the more efficient and effective it becomes in exploiting internal and external knowledge. Thus, EA can be a strategic tool for firms to leverage the opportunities of OI. Some studies have highlighted the influence of different agility strategies on innovativeness, innovation capabilities, and open innovation. For example, Dabic et al. (2021) mentioned the positive relationship between intellectual agility and innovativeness. Similarly, Zhou, Mavondo, and Saunders (2019) explained that marketing agility positively influences innovation capabilities.

The third hypothesis examines the relationship between OI and OP. The findings supported this hypothesis and revealed that OI could significantly enhance the performance of IT companies. Thus, our result advances the theoretical propositions of the DCT that DC framework clusters (sensing, seizing, and transforming capabilities) might assist firms in reaping the full advantages of OI (Bogers et al., 2019; Cirjevskis, 2022), thereby enhancing firm performance. Previous studies (i.e., Bigliardi et al., 2020; Hung & Chou, 2013; Caputo et al., 2016; Rass et al., 2013) have indicated positive effects of OI on OP. On the other hand, our findings disagree with the studies that found a negative nexus between OI and OP

(i.e., Davoudi et al., 2018). Furthermore, the analysis of the present study reveals that the more open a firm's innovation, the greater its performance. Therefore, more openness leads to superior firm performance.

The fourth hypothesis of this research proposed that OI positively mediates the relationship between EA and OP. The results highlight that OI is a significant mediator that better explains the relationship of EA with OP. EA directly and indirectly (i.e., in the presence of open innovation) influence the OP of IT companies. The result of the study shows that OI partially mediates the association between EA and OP. Partial mediation implies that some effects of predictors pass through mediator variables while others pass directly from independent to dependent variables and have p -values of 0.005. This result demonstrates that EA is a dynamic capability that can be leveraged to enhance OI in a firm, improving firm performance. In other words, OI can secure the accomplishment and continuous replication of high levels of innovation and, hence, the long-term and stable development of firms that respond to environmental concerns feasibly and flexibly (Ober, 2022). Thus, in line with the theoretical proposition of the DCT, the more agile a firm is, the more likely it will adopt OI (Wang & Kim, 2017).

The fifth hypothesis was proposed to investigate the moderation of ED on the relationship between EA and OP. The findings support this hypothesis by claiming that ED is a significant moderator between EA and OP. This finding indicates that ED may provide a window of opportunity for new technologies and markets, encouraging firms to constantly assess their knowledge and understanding from external information sources and be flexible in accepting the environment to increase OP (Zhang & Zhu, 2021). Thus, our findings confirm previous research like Chakravarty et al. (2013), who found that ED significantly moderates the relationship between EA and OP. At the same time, it disagrees with the findings of Zulganef et al. (2023), who observed that environmental dynamism is negatively related to the link between EA and performance. Contrarily, the current research results highlight that high ED and high EA can lead to high OP in Italian IT companies. The implications of these findings from theoretical and managerial perspectives are in order.

Theoretical implications

Agility and dynamic capabilities have remained a hot debate among researchers for the last decade. However, many studies still focus on different approaches/strategies of skill that can influence performance. EA is an emerging domain, and analyses in this area have highlighted several theoretical, practical, and managerial implications. Similarly, this research has shown the implications for practitioners and researchers. Regarding theoretical implications, the study has contributed to the limited literature on EA, OI, ED, and OP. Previously, many studies have focused on different types of agility, including organizational agility (OA) (Chakravarty et al., 2013), supply chain agility (SCA) (DeGroot and Marx, 2013), marketing agility (MA) (Li et al., 2021), and strategic agility (SA) (Ahammad et al., 2021). However, we depart from this line of research by focusing on EA, as there needs to be more literature on EA. Therefore, this research has highlighted the interplay between EA, OI, ED, and OP, using the DCT as a theoretical foundation. It is the first study to examine such interrelationships in the IT sector. In addition, this research provides new insight for researchers focusing on the IT sector.

Managerial implications

Our study findings are of much value to managers and practitioners. EA is vital for enhancing organizational performance. Thus, to respond effectively to ever-changing market conditions, IT firms must continuously update their EA as a DC. Building an innovative culture requires an atmosphere that encourages experimentation and the willingness to take risks. Employees must be given an environment that promotes empowerment, allowing them to generate and test new ideas without fear of negative repercussions. Investing in staff training and development cannot be overstated to foster and sustain this organizational culture. Through the development of EA, IT firms may maintain a competitive advantage and effectively respond to dynamic market situations.

Furthermore, IT firms can cultivate an environment conducive to OI by actively promoting and supporting employee experimentation and the willingness to take risks. It entails providing workers with vital resources, allocated time, and requisite support to explore new ideas and innovations actively. IT firms have the potential to motivate and acknowledge their workers who actively participate in the process of OI, therefore fostering a feeling of ownership and responsibility within the workforce. An innovative culture has the potential to cultivate creativity, enhance employee engagement, and facilitate the development of novel products and services.

The correlation between EA and OP also has significant practical implications for managers within the IT sector. Considering the nature of EA, which incorporates the capacity to adapt to dynamic market circumstances promptly, IT

firms need to prioritize the implementation of agile methodologies and frameworks that enable them to respond quickly to emerging challenges and potential opportunities. Moreover, managers must cultivate a corporate environment that fosters OI and experimentation, motivating staff to embrace risk-taking and go into uncharted territories of thought. Managers can use OI processes to strengthen the connection between EA and OP. These practices include collaborating with external partners and accessing various skills and resources. Through the use of external knowledge and skills, IT firms have the potential to augment their innovative capabilities, hence fostering long-term success.

The positive relationship between EA and OI also has important practical implications for managers of organizations. Firms prioritizing EA are more likely to possess the DC required to adapt quickly to changing market conditions and respond to new challenges and opportunities. In turn, it enables them to leverage the benefits of OI, which involves collaborating with external partners to access a broader range of knowledge, expertise, and resources. Managers should create a culture encouraging experimentation, risk-taking, and continuous learning to enhance the link between EA and OI. It can be achieved by investing in employee training and development, promoting open communication and collaboration, and fostering an environment that rewards creativity and innovation.

OI involves collaborating with external partners to access broader knowledge, expertise, and resources, enhancing an organization's ability to innovate and create new customer value. To improve the link between OI and OP, managers should prioritize building relationships with external partners, such as customers, suppliers, and academic institutions. By collaborating with external partners, IT firms can leverage their strengths and resources to drive innovation and improve their OP. Moreover, IT firms should regularly evaluate their OI strategies to identify areas for improvement and adjust their approaches accordingly. It can involve assessing the effectiveness of existing partnerships, exploring new collaboration opportunities, and investing in technologies that enable more effective communication and knowledge sharing. Finally, managers should prioritize building a diverse and inclusive workforce that can bring various perspectives and experiences to the innovation process. By promoting diversity and inclusivity, IT firms can enhance their innovation capabilities and create products and services that better meet the needs of their customers.

The finding that OI is a positive mediator in the link between EA and OP of IT firms has significant practical implications for managers. The results indicate that IT firms seeking to enhance their technological capabilities have the opportunity and should consider using both internal and external knowledge sources (Arvaniti et al., 2022). It is recommended that managers prioritize the development of EA and OI capabilities of OP to capitalize on the mediated effect of OI; it is also essential for managers to prioritize developing an organizational culture that nurtures EA. OI encompasses cultivating a conducive atmosphere that fosters ongoing learning. Through this approach, IT firms have the potential to produce an entrepreneurial attitude, enabling them to effectively recognize and capitalize on emerging prospects while also adjusting their strategies to accommodate dynamic market circumstances.

Moreover, it is crucial for managers to consistently assess the effectiveness of their OI methods and make necessary adjustments as deemed appropriate. The process includes:

- identification and resolution of obstacles to collaboration with external partners.
- exploration of novel collaboration prospects; and
- allocation of resources towards technologies that enhance communication and knowledge exchange.

The findings that ED plays a supportive role in the association between EA and OP within IT firms have significant practical implications for managerial decision-making. To optimize OP, managers must prioritize the cultivation of EA while also considering the ever-changing nature of the external environment in which their business operates. To capitalize on the moderating influence of ED, managers need to emphasize establishing a highly adaptable organizational culture sensitive to external fluctuations. The process includes constantly monitoring the surroundings for potential opportunities and challenges and demonstrating adaptability in addressing changes in the marketplace. Furthermore, managers need to develop plans adapted to the unique ED under which their firm functions. In a context characterized by significant volatility, managers should emphasize the cultivation of capabilities that facilitate OI and the ability to effectively respond to changing market dynamics.

Limitations and recommendations

This research has highlighted several implications and focused on the broad context, but it still possesses some limitations that future researchers can consider. First, the research has merely focused on Italy's IT companies; future studies can gather

data from the manufacturing sector. Secondly, the conceptual framework of this study has considered open innovation as a mediator, and future studies can extend the framework by including innovation capabilities as a mediator. Moreover, *future research can replicate our conceptual framework in emerging economies to allow for cross-cultural validation and verification.*

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Authorship contribution statement

Leul Girma Haylemariam: Introduction, Literature Review, Methodology, Analysis, Discussion. **Stephen Oduro**: Literature Review, Introduction, Methodology, Discussion, Editing & Proofreading. **Zewdu Lake Tegegne**: Survey Questionnaire, Data Collection, Data Analysis, References.

Conflicts of interest

The authors declare no conflict of interest.

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