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The organizational determinants of open innovation: a literature framework and future research directions

Nengzhi(chris) Yao^a, Karena Yan ^b, Christos Tsinopoulos^c and Junhong Bai^a

^aSchool of Business, Nanjing Normal University, Qixia District, Nanjing, Jiangsu, China; ^bInnovation and Technology Management, Durham University Business School, Durham, UK; ^cSchool of Business and Management, Royal Holloway, University of London Egham Hill, Egham Surrey, UK

ABSTRACT

This paper aims to explore the organizational determinants of open innovation (OI). A review of 154 publications taken from management and innovation journals makes us identify four dimensions of 'resource-related' organizational factors that can determine OI: resource investment (what or how many resources are being invested), organizational structure (where resources are being attributed), human capital (who or what individual-level characteristics are) and the attitudes of individuals (how resources are being treated). We also identify core theoretical lenses and propose moderating and mediating mechanisms that can explain the relationship between the dimensions and OI. Based on this, we generate a literature framework and propose that the effects of organizational factors on the implementation of OI can be achieved by influencing firms' dynamic abilities, and that these effects vary across costs-related contingencies. We also suggest several directions for addressing relevant unexplored questions within the framework.

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open innovation; absorptive capacity; organizational structure; centralization; Not-Invented-Here; Not-Shared-Here

Introduction

Open Innovation (OI) was coined by (Chesbrough 2003) and has been defined as 'a distributed innovation process based on purposively managed knowledge flows across organizational boundaries' (Chesbrough and Bogers 2014): 17). It departs from the traditional isolated innovation process, providing diverse perspectives, better access to resources, markets, and increased speed to market. By utilizing external sources of knowledge, firms can reduce innovation costs, reduce long-run volatility, and increase the chances of innovation success, especially in the global market (Barrot, Calderón, and Servén 2018; Fu et al. 2022). This can have beneficial effects on firms, as faster innovation processes lead to increased profitability, while new products and services lead to increased market share and competitiveness. As OI continues to evolve and become more widely practiced, it will no doubt continue to create the potential for economic development and growth on a local and global scale (Menne et al. 2022; Lee, Lee, and Lee

CONTACT Karena Yan  ji.yan@durham.ac.uk  Innovation and Technology Management, Durham University Business School, DH1 3LB, Durham, UK

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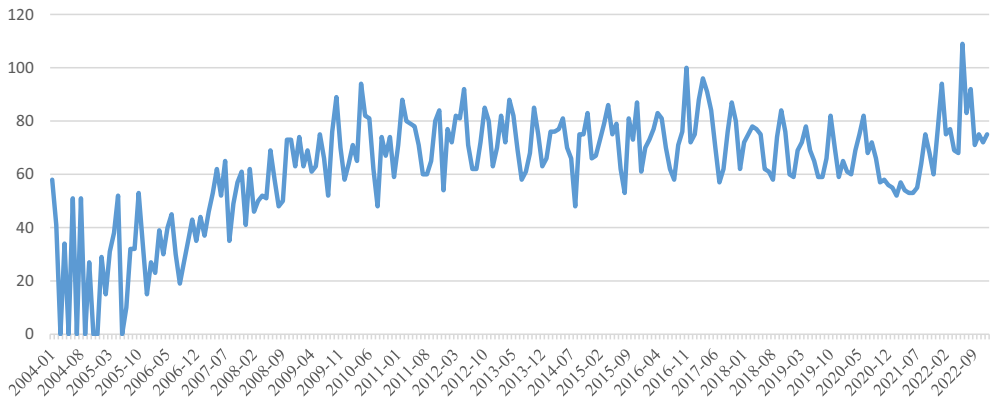


Figure 1. The index of google search trends about open innovation.

2020). Over the past decade, OI has become one of the most popular areas in innovation and economic research, and, as a result, has attracted significant attention (see Figure 1 for Google Search Trend Index (Stanko, Fisher, and Bogers 2017; West and Bogers 2014; Ghasemzadeh, Bortoluzzi, and Yordanova 2022)).

Given that an organization's resources and operational attributes (organizational factors, hereafter) play critical roles in shaping its strategy implementation and performance, researchers have aroused a scholarly interest in exploring organizational factors as determinants of OI (Bogers et al. 2017; West et al. 2014; Chaudhary et al. 2022). The literature has mainly centred around the question: *What and how do organizational factors affect the implementation of OI?*¹ OI implementation reflects OI-related strategy and performance outcomes, such as external search breadth/depth, OI propensity and OI effectiveness. The purpose of this work is to develop a framework to explain the organizational determinants of OI.

In practice, it is difficult to conclude or give practical suggestions for a firm on how to make efforts to embrace OI. Rather, it would be more operable to separate multiple factors into primary dimensions and focus on each one. For example, in response to the challenges of Artificial Intelligence (AI), International Business Machines Corporation (IBM) advanced R&D efforts in terms of seven dimensions, such as more long-term investments, a better sharing environment and a more professional R&D workforce.² The company recognized that compared to a general strategy, detailed designs of an R&D system and specific decisions on which organizational aspects to promote might have more practical implications for developing AI technology in a competitive market. In so doing, IBM guided each organizational aspect and meanwhile adopted a stakeholder-participation approach such that they can launch open initiatives to address AI issues. Giving specific suggestions on each dimensional design is more aligned with the need and requirements of departmental employees due to strategic operability, particularly in the era of the digital economy where data and information flows are regarded as important sources of innovation and people work in an open environment.

In research, while the relationship between organizational factors and OI has attracted significant scholarly attention (see Figure 2), extant literature has shown inconsistencies and discrepancies in the findings. For example, on the one hand, scholars have argued

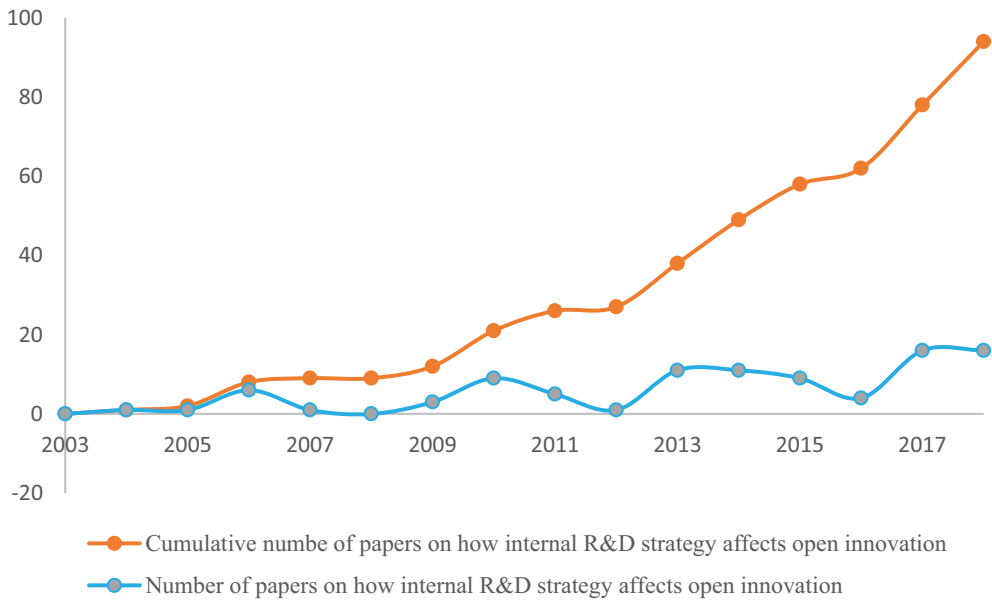


Figure 2. Research exploring the determinants of open innovation during 2003–2018. Note: The term “open innovation” was formally coined in 2003; to show this trend, we excluded the supplemental “external innovation” literature because some of them were published before 2003.

that OI propensity is hindered by a series of factors, such as internal social contexts (Capron and Mitchell 2009), technological overinvestment (Dong and Netten 2017) and fear of capabilities leakage (Pisano 1990). On the other hand, much evidence based on capability development view has suggested that well-endowed technology companies (usually with high resource endowment) have a higher ability to extract external resources (Bogers et al. 2019; Brusoni, Prencipe, and Pavitt 2001; Zhang et al. 2007). These research inconsistencies and fragmentations are partly attributed to the considerations of different dimensions of organizational factors (Pisano 2011).

Fortunately, since it is possible to discern the fundamental elements of organizational factors, classifying these factors into different dimensions can achieve explanatory primacy in explaining their different implications on OI. Doing this is also consistent with the practical method adopted by companies like IBM that design its R&D system as a combination of several aspects of specific plans. Theoretically, resource-based perspectives are believed to dig further than other perspectives and have shifted the analytical focus from complex phenomena to the resources that firms control (Foss 2011). Given that resource is placed at a fundamental level than firm strategy and it has achieved explanatory primacy in strategic management (Barney, Ketchen, and Wright 2021; Foss 2011), we focus on resource-related dimensions, i.e. *what, where, who and how*, to classify organizational factors and explore their effects on OI. Transferring attention from a general organization design (which involves multiple aspects) to resource-related *what, where, who and how* allows us to identify, classify the dimensions of organizational factors and analyze fundamental mechanisms from extant work. We selected papers based on a rigorous review process of articles published in 25 highly cited management

journals, searching articles with the term 'open innovation' on Scopus, and supplementing the sample with a list of papers from Google Scholar investigating 'external innovation'. Each article was then reviewed in detail with the process of iterative refinement to ensure they only targeted OI implementation and classified into resource-related factors. We finally had 154 papers. As our analysis and coding of the 154 articles suggest, four 'resource-related' dimensions were identified to capture the determinants of OI: resource investment (*what* or *how many* resources are being invested), organizational structure (where resources are being attributed), human capital (*who* or *what* individual-level characteristics are) and the attitudes of individuals (*how* resources are being treated).

Moreover, the fragmentation of prior research exploring the determinants of OI is also due to the disciplinary theoretical lenses examined in the literature. Scholars have drawn on a variety of theoretical perspectives to frame their work (see (Vanhaverbeke and Cloodt 2014) for a discussion), such as the resource-based view in management, and the transaction-cost logic in economics. However, existing reviews have not integrated these theoretical perspectives or highlighted synergies of different theories regarding the relationship between organizational factors and OI. Echoing the call for integrating mainstream theories with OI issues (e.g (Bogers et al. 2019; Vanhaverbeke and Cloodt 2014; West et al. 2014)), we synthesize predominant theories used to explain the relationship between organizational factors and OI in terms of the four dimensions. We also propose a moderating mechanism (namely, a series of moderators), and a mediating mechanism (with firm capability as a mediator) underlying the relationship. Combining the relationship with moderating and mediation mechanisms, we generate a literature framework that helps us to achieve a comprehensive understanding of *what* (i.e. what are the effects of organizational factors on OI?), *when* (i.e. when do organizational factors affect OI more?) and *how* (i.e. how do organizational factors affect OI?) questions.

Our review contributes to extant literature in several ways. First, our work responds to the agenda of 'internal factors of OI success' in OI scholarship (Bogers et al. 2017), an important topic characterized by inconsistency and divergence. Extant literature reviews regarding OI have mainly focused on the consequences of different OI practices (e.g (Ehls, Polier, and Herstatt 2020; Obradović, Vlačić, and Dabić 2021)). Yet, exploring organizational determinants of OI is essential, because they not only cover diversified drivers of OI activities (Spithoven and Teirlinck 2015), but they also reflect main challenges of firms' OI practices (Chaudhary et al. 2022). As a large body of empirical and theoretical literature has suggested, an effective organizational design is key to OI's success (Berchicci 2013; Chaudhary et al. 2022). In this sense, we add to OI literature by adding a review on the success factors of OI. Second, our work outlines a clear overview of the determinants of OI and identifies relevant questions being explored and unexplored. It thus can provide ample opportunities for future research. Third, we develop a literature framework that explains the relationship between organizational factors and OI. To make the relationship explainable, we synthesize the findings of the literature and the predominantly used theories. With the identification of a series of moderators and mediators, we further propose the influential mechanisms and boundary conditions that can reinforce or weaken the relationship and thereby make the research framework more comprehensive. For the academy, our work will open avenues for future research, and guide scholars in the formation of a structured view on key OI questions within this research stream. For firms facing OI

challenges, it also has great practical implications relating to the design of an effective organization to embrace OI. It can be particularly beneficial for firms in developing countries as OI allows them to tap into new sources of knowledge, resources, and technology and results in cost-savings and faster innovation cycles so that they can catch up their competitors in more developed nations.

Method

Classifying organizational factors into four dimensions

Existing research has demonstrated the inconsistency and discrepancy with regard to the research on exploring the determinants of OI. For example, scholars have shown the negative effects of technological overinvestment (Dong and Netten 2017) or fear of capability leakage (Pisano 1990) on OI, whereas more research rooted resource-based view or capability development perspective suggests that positive drivers can arise from in-house resource endowments and effective system designs (e.g. (Sikimic et al. 2016; Zhang et al. 2007)). Still, several scholars (e.g. (Brunswick and Vanhaverbeke 2015; Mol 2005)), have reported that there is no constant relationship between technological development and the propensity for OI adoptions. The inconsistency and fragmentation partly derive from the multi-dimensionality of organizational factors (e.g. (Berchicci 2013; Chaudhary et al. 2022)). That is, when exploring determinants of OI, some scholars might consider which or how many resources are invested, whereas others weigh other aspects more, such as how these resources are allocated or treated.

The literature fragmentation motivates us to classify factors into four dimensions for outlining a clear overview of this topic. 'From the perspective of reductionism, the advent of RBT [Resource-based Theory] was a distinct advance because it literally dug deeper than rival perspectives by placing the primary explanatory burden on the resources controlled by a firm' (Foss 2011): 1417–1418) (Barney, Ketchen, and Wright 2021) also regard the resource-based perspective as the foundation of managing firm strategies. Consistent with their logic, we relate organizational determinants of OI to the level involving resources that a firm can control and propose that the determinants can be classified into resource-related *what, where, who* and *how*. This consideration is also well inspired by (Pisano 2011) who considered an organization's R&D design as a combination of resource portfolio (what), organization architecture (where), people characteristics (who) and coordination process (how). Pisano argues that an effective organization for innovation is like an organic system that results from the interaction of decisions and choices in terms of factors within the organization. These organizational factors should be designed to simplify a firm's strategic intentions – how to win. Similarly, we consider an effective organization for OI to be *a pattern of in-house decisions in the dimensions of resource investment, organizational structure, human capital and individual attitudes for achieving OI goals*. Since constructs based on resource can represent the microfoundation of organizational design (Teece 2007), these four resource-based dimensions can capture primary factors within an organization. Specifically, resource investment reflects *what* or *how many* resources firms invest; organizational structure reflects *where* or *how* resources are organized or attributed among R&D units; human capital is a type of strategic

resources that reflect “*who*” matters or individual-level characteristics; attitudes reflect *how* resources are being treated or *what* attitudes that are held in relation to resources.

Scope of the literature review

In this section, we provide details of the process of composing the literature regarding the determinants of OI. We modeled the journal selection process on the related work of (West and Bogers 2014) a highly cited literature review paper published in the *Journal of Product Innovation Management*. Firstly, we included all 25 most frequently cited management journals that publish technology and innovation management studies and that were identified by (Linton and Thongpapanl 2004).³ The journals’ importance was determined based on citation analysis. Within the list, we searched for articles published between 2003 and 2018 with the term ‘open innovation’ appearing in the title, abstract, or keywords.⁴ We used Scopus, the largest database of peer-reviewed literature, and found 368 relevant articles. This paper aims to review the research exploring the effect of organizational factors on OI implementation (as dependent variables), rather than those on other performance outcomes. To ensure the selected articles are specifically targeting OI implementation, we reviewed each in detail and excluded those that investigate other performances, such as innovation performance and financial performance. A process of iterative refinement was used to narrow down the list and at the same time to identify OI research themes. Through our review, we found two main streams of research that explore OI topics: how organizational factors affect OI (i.e. the antecedents of OI) and how OI affects innovation performance outcomes (i.e. the consequences of OI). Extant reviews have largely focused on the OI outcomes, whereas we aim to work on its antecedents. Organizational factors refer to factors typically in relation to resources, processes, or operational attributes within an organization, as we discussed earlier, which can be classified into resource-related factors including valuable resources, resource distributions, human capital, and individual attitudes toward resources. Based on this classification, we re-examined each article and manually coded the basic information (i.e. name of the authors and publication year) as well as the inductively formalized thematic information, including dimensional constructs, theoretical lenses, OI constructs, predicting directions and key questions. This work finally allowed us to precisely identify the four dimensions that are in relation to the determinants of OI (N1 = 94): resource investment, organizational structure, human capital, and individual attitudes. Figure 2 presents the trend of research on these dimensional factors as determinants of OI between 2003 and 2018.

Next, we supplemented the sample with a list of papers from *Google Scholar* investigating ‘external innovation’. This was done in order to address the concern that OI might overlap with external innovation-related concepts. As such, some scholars did not state them as OI, especially before the term OI was coined by (Chesbrough 2003). The supplemented list of research (N2 = 60) mainly includes highly cited articles (with over 200 citations) and several recent articles (generally after 2017) on related fields such as co-creation, R&D alliances, joint ventures, university-enterprise collaboration, technology acquisitions, or user innovation

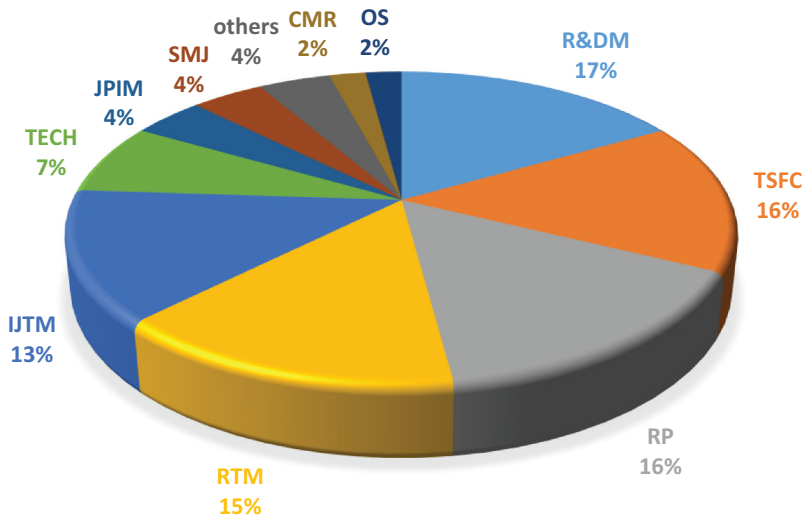


Figure 3. Research on the organizational determinants of OI in different journals. Notes: R&DM=R&D Management; RP=Research Policy; TSFC=Technological Forecasting and Social Change; RTM=Research Technology Management; IJTM= International Journal of Technology Management; TECH=Technovation; JPIM=Journal of Product Innovation Management; SMJ=Strategic Management Journal; OS=Organization Science; CMR=California Management Review.

Table 1. Paper description concerning the determinants of OI in the category of each dimension during 2003–2018.

Period	Organizational factors					Paper types			
	Resource investment	Organizational structure	Human capital	Individual attitudes	Multi-dimension	Empirical			Total
						Quantitative	Qualitative	Conceptual	
2003–2008	13	5	4	5	7	19	8	7	34
2009–2013	8	9	12	10	10	21	21	7	49
2014–2018	18	6	20	12	15	39	24	8	71
Total	39	20	36	27	32	79	53	22	154

Notes: Open innovation was coined by (Chesbrough 2003) which is regarded as the starting point of OI research; among the supplemented articles, those published before 2003 (11 articles) were categorized into the period 2003–2008; multi-dimension means more than one dimension in one paper.

(appearing as keywords in their abstracts). They also belong within the scope of OI (Chesbrough 2017). A similar process was used to code the information of each article. Finally, we obtained a list of (N1+N2=) 154 articles. Figure 3 presents the distribution of these articles across journals. We further classified the articles into three periods of six, five, and five years respectively (2003–2008, 2009–2013, and 2014–2018) to illustrate the research trend. As shown in Table 1, the topic has seen a general increase in both quantitative and qualitative papers, whereas the number of conceptual papers remains relatively stable. There has also been a proliferation of papers for each dimension of organizational factors. These increases may be attributed to the fact that more and more OI modes have been adopted in practice, thus attracting scholarly interest.

Table 2. Four dimensions of organizational factors and OI.

Organizational factors	OI-related outcomes						Total
	External search strategy	OI mode choice	OI propensity	OI effectiveness	OI practices	Multi-variable	
Resource investment	8	7	9	5	5	5	39
Organizational structure	0	2	7	3	3	5	20
Human capital	7	3	9	7	9	1	36
Individual attitudes	2	2	10	4	7	2	27
Multi-dimension	1	3	12	6	8	2	32
Total	18	17	47	25	32	15	154

Notes: External search strategy includes search breadth (usually measured through types of outsourcing activities), and depth (usually measured through the strength or repetitive times of one outsourcing activity). Some scholars conceptualized both breadth and depth as openness, while others define openness as the choice between openness modes, including closed-open choice, make-buy-ally choice and choice between OI modes; propensity usually refers to the likelihood, strength, or frequency to which OI mode is adopted; effectiveness refers to the returns or values obtained from OI; OI practices refer to types of general practices, their conditions, or related outcome performance, which are usually qualitative or practice-oriented research; multi-variable means more than one OI implementation variables; multi-dimension means more than one dimension of organizational factors.

Analysis of the literature

Our review suggests that scholars have mainly considered five types of dependent variables in relation to OI implementation: external search strategy (i.e. breadth or depth of external search), mode choice (i.e. make-buy-ally choice or OI modes choice), OI propensity (i.e. the frequency with which OI mode is adopted), OI effectiveness (i.e. value or returns created by OI), and OI practices (i.e. general OI practices mainly discussed in qualitative papers). Table 2 classifies the literature by matching four dimensions of organizational factors with each OI-related variable. Among the 154 papers, 47 investigate OI propensity, which makes up the biggest proportion (30.5%).

Table 3 presents the theory applications concerning organizational factors as the determinants of OI. There are seven predominant theories that were adopted from management and economics: resource-based view (RBV), structural contingency theory (SCT), upper-echelon theory (UET), asset specificity theory (AST), absorptive capacity view (ACAP view), knowledge-based view (KBV) and transaction-cost economics (TCE). In addition, we noted that 22 of 154 papers did not draw on the above theories but followed the OI-mode logic described by (Chesbrough 2003). That is, innovation performance

Table 3. Theories applied to explain the relationship between organizational factors and OI.

Organizational factors	ACAP view/ Others										Total
	RBV	SCT	UET	AST	KBV	TCE	Multi-theory	OIL	Others	Null	
Resource investment	4	1	0	0	11	6	2	3	7	5	39
Organizational structure	0	7	0	0	1	1	3	2	2	4	20
Human capital	1	0	5	3	4	2	1	5	10	5	36
Individual attitudes	0	0	0	0	2	0	2	6	2	15	27
Multi-dimension	2	1	0	1	4	0	9	6	1	8	32
Total	7	9	5	4	22	9	17	22	22	37	154

Note: RBV=Resource-Based View, SCT= (Structural) Contingency Theory, UET=Upper-Echelon Theory, AST=Asset Specificity Theory, ACAP view=Absorptive Capacity/Dynamic Capability Theory, KBV=Knowledge-Based View, TCE=Transaction-Cost Economics, Multi-theory=more than one aforementioned theory, OIL=Open Innovation Logic; Null means that there is no clear theory used; since papers drawing on KBV usually make arguments on the absorption of knowledge (absorptive capacity is regarded as a type of learning ability), we put ACAP and KBV into one category.

benefits from opening up innovation processes through which valuable knowledge has flowed into the organization. We also identified 37 papers without clear theory lenses. These papers mainly started from a practical OI practice and conducted qualitative research to explore the organizational challenges of OI practices. For each dimension, both differences and commonalities existed in theory applications (see Table 3). It is worth noting that among the 73 papers that applied the theories (i.e. RBV, SCT, UET, AST, ACAP view, KBV, TCE, and multi-theory), 17 were based on a multi-theory perspective. This suggests that in some cases, it might be difficult to explain OI issues by means of a single theory. These statistics thus initially suggest that classifying different dimensions will help to explain the relationship between organizational factors and OI.

Literature framework about the effect of organizational factors on open innovation

Based on above literature analysis, we generate the literature framework (see Figure 4) that explains the determinants of OI and synthesizes the predominant theories that were used in terms of each dimension. As an improvement, this work takes a further step to identify a series of moderating and mediating mechanisms, thereby improving the framework. Next, we analyze how theories are used to explain the effect of each dimensional factor on OI, and discuss the mediating and moderating variables, respectively.

The effect of organizational factors on OI

Resource investment

Resource investment reflects organizational resource inputs, which include both financial and nonfinancial resources investment within organizations. It is often measured through R&D expenditure, R&D spending, resource, or knowledge investment in innovation

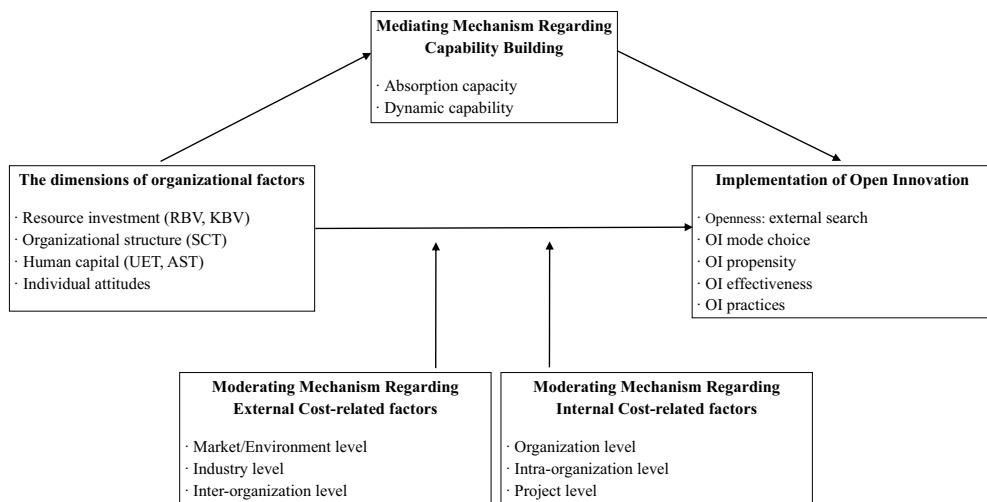


Figure 4. An integrative literature framework concerning the relationship between organizational factors and open innovation.

activities. As the core source of a firm's knowledge base and product innovation, resource investment plays a key role in determining OI.

RBV (Barney 1991) has been the theory most commonly used to argue for the positive role of resource investment in shaping OI. It stresses that accumulated resources that are valuable, rare, imperfectly imitable and not substitutable can allow firms to achieve a state of sustainable competitive advantage. In their review of research that addressed outsourcing issues from RBV (Espino-rod ríguez and Padr n-robaina 2006), found that the success of outsourcing activities can be attributed to two aspects of resources' characteristics: the heterogeneity of resources and the persistence of that heterogeneity. In OI context, research has mainly suggested the role of the first characteristic of resources. For example, research has found that firms in possession of valuable resources can grasp more technological opportunities to expand innovative activities (Villalonga and McGahan 2005) and increase their value (Sikimic et al. 2016).

RBV mainly points out the positive effect of resource investment on OI, whereas the article 'The two faces of R&D' (Cohen and Levinthal 1989) provides a comprehensive view of the dual role of internal R&D. It holds that internal R&D efforts do not only generate new knowledge or processes within organizations but also enable firms to externally exploit or explore potential knowledge. This view of R&D in the innovation field has received much attention. There are two main mechanisms that we can identify from the extant literature to explain this. One important avenue of research was opened up by (Cohen and Levinthal 1989, 1990) who emphasized the importance of in-house resource investments in building capabilities (i.e. ACAP) for promoting firm growth. The second stream examined the role of firm boundaries' expansion in relation to transaction-cost economics (TCE) (Pisano 1990).

In the first stream, capability-building holders maintained that learning is a path-dependent process of knowledge development and of experience accumulation (Cohen and Levinthal 1990). A firm's ability (labeled 'ACAP') is rooted in the accumulation of knowledge and processes but has extended implications. Research that is drawing on the ACAP view tends to combine KBV with the logic of knowledge-absorbing. There are at least two benefits to accumulating knowledge. First, knowledge broadness enables firms to integrate dispersed knowledge and build-up extensive collaborations with diversified partners (Zhang and Baden-fuller 2010). Second, long-term accumulated knowledge is usually architecturally structured. It prevents data and knowledge from unwanted disclosure or leakage when connecting with others (Brusoni, Prencipe, and Pavitt 2001). Much empirical research has confirmed these benefits. For example, scholars found that resource investment enhances firms' ability, allowing them to learn from other organizations (Chaudhary et al. 2022) and simultaneously curb partners' opportunistic behaviors (Kale, Singh, and Perlmutter 2000); to facilitate out-licensing (Sikimic et al. 2016); to assimilate and utilize external afflatus (Ehls, Polier, and Herstatt 2020) and to conduct exploration and exploitation more deeply and broadly (Enkel et al. 2017). From a capability-building perspective, high-ability firms are more likely to implement OI and do much better. This view is consistent with the logic of (Cohen and Levinthal 1990) who show that increased ACAP benefits firms' external innovations.

The second stream of resource-investment research has drawn on a transaction-cost perspective. Holders of this perspective admitted that the accumulation of technological resources is a critical source of firms' ability development. However, they added that

besides building capabilities through self-development, 'firms can tap the R&D capabilities of competitors, suppliers, and other organizations through such contractual arrangements as licenses, R&D agreements, and joint ventures.' (Pisano 1990): 153). They considered the cost arising from the asset specificity of organizational resources, i.e. the transaction cost (Williamson 1985). Since internal R&D efforts (i.e. specific investments) tend to have specific needs, these efforts seem to work less effectively if the firm is to conduct other activities like external innovation. Using internally developed abilities to conduct OI is of high cost. Ironically, according to (Chen, Lu, and Zhu 2017) firms usually outsource in order to save costs. Therefore, when costs are so low that they can be compensated through returns from partnering, firms' willingness to be more open will increase. By contrast, under high costs, firms may resort to internal development which strengthens property protection and the appropriability regime, rather than promoting the likelihood of being open. For example (Ahuja 2000), suggested that firms with abundant expertise or core resources might have fewer incentives to share key information and establish external linkages, since they are afraid of the outflow of key resources or skills. Following transaction-cost logic, OI is regarded as a transaction that depends on the balance of ongoing transaction costs and potential consequent returns. As inconsistent findings have appeared, research on the relationship between resource investment and OI has suggested it to be negative (e.g. Barge-Gil 2010)), positive (e.g. Sikimic et al. 2016)), or insignificant (e.g. Mol 2005)).

Organizational structure

How can resources be organized and attributed among organizational units in order to promote innovation? This relates to the design of the organizational structure, the second dimension. It refers to the organization's architecture, in which the units interact with the technology center according to a certain hierarchy. While organizational structure may involve complex hierarchical arrangements (e.g. formal/informal, vertical/horizontal, mechanistic/organic), our review suggests that empirical work in OI research field mainly looks at whether resources or power are concentrated into one header quarter, or are dispersed among R&D units or departments, i.e. centralization or decentralization (or a hybrid of the two). This may be due to difficulties in identifying forms of organizational structure. To identify the structure, scholars need to penetrate into an organization's skeleton and inspect it thoroughly with analytical precision. As such, some scholars have tried to use other measurements for organizational structure, such as the allocation of patents to affiliates of the parent firm (e.g. Arora, Belenzon, and Rios 2014)).

A small range of literature has directly explored how organizational structure relates to OI activities. Based on a research institute's survey of 71 diversified corporations' R&D executives (Argyres and Silverman 2004), coded organizational structure by analyzing laboratory and staff information, and measured decentralization and centralization according to the ratio of corporate to divisional researchers. They found that compared to a decentralized structure, firms with a centralized configuration are more likely to pursue innovative activities that have broader effects on technological evolution and are more likely to source from external organizations. Explanations behind these hypotheses mainly touch on the functional nuances of different structures in terms of communications, coordination, linkage, or resource configuration. Similar explanations were also

mentioned in the following works (e.g. (Arora, Belenzon, and Rios 2014; Zhang, Baden-Fuller, and Mangematin 2007)). For example (Zhang, Baden-Fuller, and Mangematin 2007) suggested that in centralized firms, communication within laboratories and between researchers can be better controlled to prevent knowledge spillovers, and facilitate effective knowledge exchange with partners. A centralized structure is always accompanied by more efficient use of technological resources and more concentrated project portfolios with the result of increase of firms' ACAP. Due to these structural features, firms with a centralized structure are more likely to build new alliances.

However, some scholars may suggest an opposite conclusion when using other variable constructs. For example, (Arora, Belenzon, and Rios 2014) used the extent of patents assigned to affiliates to construct a centralization proxy. They found that centralized firms have a lower propensity to acquire patents, whereas decentralization is correlated with a greater number, and a higher patent level, of acquisitions. While these findings cannot be interpreted to be causality relationships, they can be attributed to the fact that innovation activities in centralized structures undergo deeper integration than activities conducted independently among discrete entities. According to (Arora, Belenzon, and Rios 2014) a centralized organizational design seems to make firms focus on exploiting existing resources rather than exploring outsiders'.

As discussed above, existing research has reached no consensus on which organizational structure (centralized or decentralized) is better for OI. This accords with the central proposition of structural contingency theory (Drazin and Van de Ven 1985), which stresses the importance of 'fit' between an organization's strategies or context with its structure, in shaping firm performance. Firms' structures should be flexible enough to match the strategy they have adopted. For example, holding a dynamic view (Boumgarden, Nickerson, and Zenger 2012) analyzed the structural changes of two companies: Hewlett-Packard (over 25 years) and U.S.A Today Online (over 15 years). They found that these firms tended to strategically change their structures, because both centralization and decentralization have operational issues (e.g. inertia and bureaucratism) when continually being adopted over the long term. Firms need to flexibly adjust their structures to avoid these structural inertia issues. Taking a contingency perspective, scholars (e.g. (Aoki and Wilhelm 2017; Islam, Miller, and Park 2017)) have more recently suggested that structural flexibility is adopted so that firms can achieve a balance between exploration and exploitation, in order to create sustainable value.

Human capital

The third dimension of success factors of OI is human capital. Human-side factors have deep implications for strategic decisions regarding resource utilization. This has recently ignited research interest in the OI area (e.g. (Ahn, Minshall, and Mortara 2017, 2018)). Extant research on exploring the effect of human capital on OI can be categorized into two types: firm leader and employee.

Leader

Upper-echelon theory states that organizational outcomes can be partly explained by the background characteristics of top management teams (Hambrick 2007). In the OI area, our review suggests that such characteristics mainly arise from top managers' psychological

qualities (e.g. innovation awareness and risk-taking propensity) and demographical factors (e.g. education and work experience). (Ahn, Minshall, and Mortara 2017) comprehensively investigated the effects of CEO characteristics on the choices of OI modes in the context of manufacturing SMEs. Generally, they found CEOs with good qualities (e.g. positive attitudes and entrepreneurial innovativeness) usually have a higher tendency to adopt outbound OI. For demographic characteristics, they found that education in engineering and prior experience working within a technological discipline leads to more interfirm collaborations and Mergers & Acquisitions. For CEO's characteristics, a positive relationship between leaders' abilities and OI effectiveness has been implied by other scholars (e.g. Naqshbandi and Tabche, 2018 (Chiaroni, Chiesa, and Frattini 2011)); and a consensus seems to have been achieved in recent literature (e.g. (Ahn, Minshall, and Mortara 2018)). Where the particular experience of CEOs is concerned, the conclusion might be different. For example, (Shi, Hoskisson, and Zhang 2017) found that CEOs who experienced an independent director's death will have less motivation for post-acquisitions.

Employee

Top-level management cannot completely reflect the whole composition of human capital in innovative activities. Employees, as front-line participators in innovation activities, play an important role in OI success. For example, (Chatenier et al. 2010) were the first to identify the main tasks and challenges that R&D staff is likely to face in OI activities. They and subsequent scholars (Salter, Criscuolo, and Ter Wal 2014) have provided a practice-oriented profile that highlights a series of abilities that OI professionals should have, such as being capable of brokering solutions and developing partnerships. More recently, Vanhaverbeke, Cheng, and (Chesbrough 2017) explored OI managers' characteristics through their LinkedIn profiles. Based on this, content analysis work was conducted by (Dąbrowska and Podmetina 2018) who identified key requirements and associated techniques (e.g. excellent communication and leadership) that candidates must have when competing for OI specialists' jobs.

In addition to the qualitative research mentioned above, a few quantitative studies have appeared, and the majority of them have bridged Human Resource Management (HRM) and OI. HRM is concerned with how to plan recruitment, how to choose staff, how to appraise staff, how to compensate staff, and how to train and develop staff. For example, (Teirlinck and Spithoven 2013) found that firms recruiting more highly qualified employees (e.g. with Ph.D. degrees) have a higher propensity to engage in research cooperation. Incompetent employees need professional training or a superior's guidance to develop required skills. (Podmetina et al. 2013) comprehensively confirmed the positive role of HRM practices (i.e. motivation, learning, training, and appreciation) in supporting different OI modes (i.e. external partnering, technology sourcing, and acquisition). These empirical investigations suggest that HRM is important for OI.

Asset Specificity Theory (Williamson 1983) can be applied to explain the role of HRM practices in influencing OI. HRM practices improve the specificity of leaders and employees in implementing OI (Fleming and Waguespack 2007). This type of asset specificity has a higher value for OI occupations than for other purposes. Moreover, better HRM practices have been found to increase asset diversity (decrease asset specificity) and thus benefit OI. Firstly, firms that have access to diverse human capital (e.g. recruiting experts from

different domains) can exploit new markets more efficiently (Enkel et al. 2017). Secondly, diverse expertise and all-around skills might allow employees to be adaptable to different circumstances (Bogers, Foss, and Lyngsie 2018). This is particularly important for the success of OI when considering different collaboration partners.

Individual attitudes

Bringing new resources into an organization where norms have been formed is not straightforward. It is determined by individual attitudes, which is the fourth dimension. In our context, attitudes refer to individual evaluations of an object of thought in relation to innovation activities (Antons and Piller 2015). Since knowledge is actually utilized and put into practice on an individual level, employees' attitudes will determine the effectiveness of OI. Existing research has mainly suggested that employees always embrace negative attitudes to external resources and outsourcing activities (e.g. (Remneland Wikhamn and Styhre 2019))) because of the fear of capabilities leakage (Pisano 1990). In the OI context, the literature focused on individual attitudes in particular has rarely moved beyond highlighting two attitudes: 'Not-Invented-Here' (NIH) and 'Not-Shared-Here' (NSH).

The NIH concept was introduced earlier in knowledge exploration (Katz and Allen 1982) after which followers like (Chesbrough 2003) emphasized the complementary concept: NSH. In the external exploration process, NIH syndrome refers to a negative attitude that employees hold toward external knowledge. In terms of the knowledge-exploitation process, (Remneland Wikhamn and Styhre 2019) described NSH as a situation in which employees hold a negative attitude to exploiting knowledge beyond the boundary of the firm. According to this work, both NIH and NSH imply adverse consequences for OI.

Our review indicates that research on the negative connotations of NIH and NSH can be classified into three categories according to the degree to which NIH/NSH hurts OI: (1) A biased or wrong evaluation of external technology (e.g. (Agrawal, Cockburn, and Rosell 2010; Menon and Pfeffer 2003)); (2) Suboptimal utilization of inbound OI (e.g. (de Araújo Burcharth, Knudsen, and Søndergaard 2014)), or stickiness of outbound OI (e.g. (de Araújo Burcharth, Knudsen, and Søndergaard 2014)); (3) The ultimate failure of an OI practice (e.g. (Chaudhary et al. 2022; Remneland Wikhamn and Styhre 2019)). For example, (de Araújo Burcharth, Knudsen, and Søndergaard 2014) confirmed two hypotheses: NIH and NSH syndrome would decrease the frequency of both inbound and outbound OI practices. Inbound OI refers to activities of sourcing knowledge from other companies, such as buying patents, whereas outbound OI means that internal inventions should be taken outside the company, such as spin-offs. For innovation failure, it is also possible that some OI projects failed because of NIH/NSH. However, this causality has not been empirically tested in innovation research, not least in OI contexts. We obtained insights from the following industrial cases. Eastman Kodak Company existed as a successful technology company excelling in imaging and cameras. It occupied 90% of the U.S. film market share, but eventually it went bankrupt. This is partly due to the firm's failure to adapt during the digital photography revolution. Kodak had a very strong centralization tendency and a relatively closed organizational norm. The bureaucratic culture allowed employees to form a type of rigid mindset that hinders managers from quickly responding to emerging

disruptive technologies. Similar patterns can also be found in the case of German piloting companies, whose internal cognitive barriers lead to the failure of crowdsourcing initiatives. Another example is the widely known mobile phone firm, Nokia. To some extent, Nokia's insistence on a relatively closed Symbian operating system, and their resistance to the Android system, meant that they lost out to competitors like Samsung.

Overall, the review above suggests that prior research has addressed a number of questions regarding the determinants of OI along with several theoretical lenses. Table 4 summarizes these key questions and the predominant theories we discussed above. Table 5 presents the main information and key findings of representative studies on organizational antecedents of OI.

Moderating variables: transaction cost logic

Transaction-cost logic explains firms' choice to either expand or contract R&D boundaries, as well as the choice between different OI modes. While firms can take advantage of searching for external knowledge, doing so may be costly due to transaction costs. Whether firms resort to self-development or adopt OI modes depends on factors that bring transaction costs.

Our review suggests that factors related to transaction costs can be classified into internal (factors within the boundary of the focal firm) and external (factors that spread beyond the boundary of the focal firm). (Villalonga and McGahan 2005) comprehensively investigated a series of transaction factors in the context of their influence on boundary expansion and contraction, including relatedness, governance specification and recency of experience. In their research, theories such as RBV and TCE were combined to explore the effects of both internal and external factors on the boundary of R&D activities. Furthermore, internal factors can be derived from different levels, including factors at the organization level, such as ACAP, factors within organizations, such as internal training (de Araújo Burcharth, Knudsen, and Søndergaard 2014), and factors at the level of the innovation project. Likewise, external factors reside at multiple levels, including environment-level factors, such as environmental dynamism (Popa, Soto-Acosta, and Martinez-Conesa 2017), industry-level factors (e.g. Michelino et al., 2015), and inter-organization-level factors, such as partners' willingness to cooperate (Schenk, Guittard, and Pénin 2019). This research follows a similar logic. That is, the factors either enhance a firm's costs to acquire knowledge from external environment or strengthen a firm's propensity to outsource because they decrease environmental uncertainties and searching costs. When transaction costs increase to a level that is higher than potential benefits, the effect of organizational factors on OI implementation weakens.

Mediating variables: dynamic capability logic (absorptive capacity view)

Dynamic capability theory (DCT) or the ACAP view⁵ can explain the mechanism with regard to the effects of organizational factors on OI. For resource investment and including human capital, scholars have found that in-house efforts (such as more investment in training employees and educating the workforce) as the basis of ACAP, would facilitate innovation cooperation and performance (Bogers et al. 2019). For organizational structure (Islam, Miller, and Park 2017), have emphasized the key role of the reconfiguration of

Table 4. Predominant theoretical perspectives and questions regarding the relationship between organizational factors and OI.

Mechanisms	Predominant explainable theories	Core assumptions related to OI	Main explored research questions	Selected Examples
Direct effects				
Resource investment	Resource-based view	Organizational resources are regarded as the source of achieving sustainable competitive advantage. These resources are valuable, rare, imperfectly imitable and not substitutable in promoting OI.	What is the effect of organizational resources on OI?	(Villalonga and McGahan 2005; Zhang et al. 2007; Brunswicker and Vanhaverbeke 2015)
Organizational structure	Structural contingency theory	Organizational effectiveness is not depending on one level of structure, but depending on its fit or misfit with organizational context or strategy.	What are the different characteristics of OI between firms with different structures? How do firms adopt different structures to match their external strategies?	(Bercovitz and Feldman 2007; Boumgarden, Nickerson, and Zenger 2012; Arora, Belenzon, and Rios 2014)
Human capital	Upper-echelon theory	Organizational innovation performance can partly be determined by the characteristics of TMT.	What are the effects of CEO characteristics (psychological and demographical) on OI?	(Ahn, Minshall, and Mortara 2017; Shi, Hoskisson, and Zhang 2017; Ahn, Minshall, and Mortara 2018)
	Asset specificity theory	Because of asset specificity, when one certain asset invested to support one transaction has the largest value, its value will decline when being transferred to other purposes.	What are the professional abilities, and skills required for OI managers? What are the effects of employees' characteristics on OI?	Vicente-Lorente (Vicente-Lorente 2001; Teirlinck and Spithoven 2013; Bogers, Foss, and Lyngsie 2018)
Individual attitudes	Null	Null	What are the effects of NIH/NSH on OI?	(de Araújo Burcharth, Knudsen, and Søndergaard 2014; Antons and Piller 2015)
Moderating and mediating mechanism				
Moderating mechanism	Transaction-cost theory	Whether firms decide to acquire assets is depending on the transaction cost. When firms adopt market governance at a lower cost, their operation is more effective.	How is the relationship between organizational factors and OI contingent on transaction cost-related factors?	(Villalonga and McGahan 2005; Laursen and Salter 2014)
Mediating mechanism	Dynamic capability theory (absorptive capacity view)	In dynamic environments, firms can build capability through internal accumulation and external sourcing to address challenges. Firms with high ability have competitive advantages in utilizing external resources.	How does a firm make R&D efforts to enhance the dynamic capability for implementing OI? What is the effect of firm absorptive capacity on OI?	(Capron and Mitchell 2009; Sikimic et al. 2016; Bogers et al. 2019)

Table 5. Representative studies on organizational determinants of OI.

Paper	Journal	Organizational factors	Sample	Time frame	Findings
(Van de Vrande et al. 2009)	Technovation	Culture	605 SMEs	a 3-week period in December 2005	A key challenge that SMEs face is the necessity of dealing with increased external contacts, which relates to organizational and cultural difficulties.
(Montara and Minshall 2011)	Technovation	Culture	43 cross-sector firms	2007–2008	The path that firms take when transitioning from closed to OI is dependent on their organizational culture, with the impetus for adoption and the coordination of implementation both playing a role.
(Wu, Lin, and Chen 2013)	IEEE Transactions on Engineering Management Technovation	Capability and culture	393 firms	2007.7	Firms' ability to innovate and succeed in the market is associated with internal openness strategies.
(de Araujo Burcharth, Knudsen, and Søndergaard 2014)	Strategic Management Journal	NIH and NSH	331 firms	2010.8–2010.11	OI practices are affected by employees' attitudes to knowledge, particularly the NIH and NSH syndromes. Managers can use certain training programs to reduce the associated negative impact.
(Belenzon and Schankerman 2015)	R&D Management	Human capital	103,712 external source code contributions	1999–2010	Developers are strongly influenced by the openness of project licensing and are driven by intrinsic motivation, reputation and labor market signaling, rather than reciprocity.
(Kim, Kim, and Lee 2015)	R&D Management	Various factors	303 firms	2006.6–2008.6	Team size, learning distance, technology uncertainty, strategic importance, and task-relatedness to a company's main business all have significant relationships with inbound and outbound open activity.
(Michelino et al. 2015)	International Journal of Technology Management	Resource and firm types	271 world-top technology firms	2010–2012	Bio-pharmaceutical companies are more open to external innovation, with a preference for collaboration, while technology hardware and equipment firms opt for incorporation of other companies through spin-ins.
(Sikimic et al. 2016)	Journal of Product Innovation Management	In-licensing investment	837 firms	1998–2007	Investing more in in-licensing and having more experience with in-licensing will result in increased volumes of technology out-licensing.
(Enkel et al. 2017)	Research Policy	Individual efforts and attitudes	104 individuals	2014.7–2015.2	Individual assimilation efforts and attitudes are important for developing exploratory innovation, but not exploitative innovation.
(Islam, Miller, and Park 2017)	Research Policy	Decentralization version control system	10,381 open-source software projects	2007–2011	By eliminating the private costs associated with an OSS project, decentralized version control systems can encourage more people to join the project, however, this also leads to a decrease in the average level of contribution from each participant.
(Remmeland Wikhamn and Styhre 2019)	R&D Management	Not-invented-elsewhere syndrome	54 individuals	2013–2017	AstraZeneca's spinout initiative aims to transfer internal projects to startups funded by external venture capital, but faces three managerial challenges: internal decision-making, NIE syndrome, and communication of projects to external investors.

(Continued)

Table 5. (Continued).

Paper	Journal	Organizational factors	Sample	Time frame	Findings
(Bogers, Foss, and Lyngsie 2018)	Research Policy	Employees' diverse work and educational background	Two sources: (1) 654 Danish firms (2) 480 Danish firms	(1) 2009.11–2009.12 (2) 2009	Knowledge diversity of firms' employees, through their educational and work history diversity, is associated with firms' use of external knowledge in their pursuits of innovation, as firms with higher levels of educational diversity have greater openness to external knowledge.
(Hofstetter, Zhang, and Herrmann 2018)	Journal of Product Innovation Management	Rewards	Study 1: 301 individuals Study 2: 6101 individuals	Study 1: 2013.6 Study 2: 2008.9.17–2013.6.4	Rewards provide positive competence feedback that can increase intrinsic motivation, participation, and creative effort in OI contests, leading to higher-quality outcomes. Offering more rewards can help firms maintain a larger and more motivated crowd of contestants
Naqshbandi and Tabche 2018	Technological Forecasting and Social Change	Empowering leadership and learning culture	155 usable responses	2017.1–2017.4	Empowering leadership and organizational learning culture have a positive impact on OI outcomes. However, there is no significant relationship between organizational culture and absorptive capacity and OI outcomes.

assets and control systems in enhancing dynamic capability. Concerning individual attitudes, a supportive culture such as employee learning orientation would benefit firm performance, since it is usually embedded in the process of building dynamic capability (Bogers et al. 2019). Therefore, firm capability is an intermediary through which organizational factors affect OI.

Although some scholars did not test these mediating effects directly, their theoretical arguments followed a mediating logic. In other words, they emphasize the importance of resource accumulation or adaption in developing the mindset and skills regarding how to employ resources to better implement OI (e.g. (Bercovitz and Feldman 2007; Sikimic et al. 2016)). More directly, some scholars constructed firm ACAP in light of knowledge accumulation and measured it directly by using (accumulated) R&D spending (e.g. (Lin et al. 2012)). This approach to measurement, based on the 'accumulation' perspective, also provides evidence for supporting the mediating role of firm capability. In Table 4, we list key questions within these two mechanisms that have been explored within the extant literature.

Suggestions for future research

As discussed above, research on the organizational determinants of OI is still prevalent. The identification of theoretical lenses and relevant questions that were explored for each dimension also highlight future opportunities.

For example, our review suggests that extant research on how resource investment affects OI mainly works from a static perspective. However, the evolution of organizational resources is a key component in the technology lifecycle, which means that the static RBV is less able to explain changes in competitive advantages or disadvantages over time. Firms may face barriers during different stages of OI implementation (Phillips, Alexander, and Lee 2019) As such, a critical but uninvestigated question is *how does resource investment affect OI over time?* In terms of structure, our review of SCT has suggested that firms will intentionally adjust their structure to fit with their OI strategy. But in practice, multiple structures might exist at the same time. This academy-industry discrepancy also needs further attention. In terms of human-side factors, CEOs have the most administrative power, whereas CTO is responsible for technology and innovation. How their relationship or conflict affects OI would be an interesting topic for further research.

Moreover, the logic of asset complementarity motivates us to investigate the joint effects of dimensions of organizational factors on OI. Complementary (or substitutable) assets are defined as resources for which an increase in any one of them raises (or decreases) the marginal return of the other(s). We believe resource investment, organizational structure, human capital, and attitudes are not mutually independent but closely interrelated. For example, a risk-taking CEO might change employees' attitudes and behaviors toward external innovation. A small range of research on this subject has appeared, such as the investigation into the interaction effects between knowledge base and structure conducted by (Zhang, Baden-Fuller, and Mangematin 2007) and work on NIH/NSH and employee training (de Araújo Burcharth, Knudsen, and Søndergaard 2014). In general, interactions have not been explored sufficiently. Studying two or more dimensions in combination would yield unique insights into *what* the joint effect of dimensions on OI is or *when* the effect is stronger. Potential

findings may be more valuable for firms' practice. For example, a complementary conclusion might guide firms to increase the pertinence of resource searching or selective revealing. A substitution conclusion will benefit firms that are short of certain resources, because in such conditions they can shift to other asset configurations. Given these potential implications, firms' behavior with regard to selective revealing and purposive absorbing also needs further attention. We believe future research should draw on this theoretical perspective to contribute to this research agenda. [Table 6](#) summarizes the key questions discussed above that need to be addressed in the future.

In addition to the direct effects of the four resource-based organizational factors and their joint effects on OI, future research may also want to enrich the literature on the contingent view of the organizational factor–OI relationship. Since previous studies have mainly focused on market environmental factors as moderators (as we discussed earlier and outlined in [Figure 4](#)), largely ignored was how institutional forces influence the effects of organizational factors on firm OI. Answering this research question is important, given the rise of emerging markets like China and India where institutions have not been well established and the markets generally lack the support of institutional intermediaries (Yao, Guo, and Tsinopoulos 2022). Institutional theory has long contended that a country's institutions affect the costs and benefits of firm behaviors, which determines the effects of its strategy on performance (North 1990). (Scott 2013) further proposed three basic institutional 'pillars' that can influence organizational behavior: regulatory forces (i.e. rules, controls, and sanctions exerted by governmental bodies), normative forces (i.e. standards and senses of what is appropriate) and cognitive forces (i.e. cultural elements). Whether and how these factors influence the effect of organizational factors on OI are questions worth further investigation. Moreover, China and other emerging markets are undergoing economic and market reform, and the government plays a crucial role in

Table 6. Future research questions on organizational factors as determinants of OI.

Organizational factors	Theories	Future research questions
Resource investment	Resource-based view	How does resource investment affect OI over time? How does resource dependence affect the implementation of OI?
	Absorptive capacity view	How does external knowledge interact, renew or replace existing knowledge? How does knowledge structure affect the absorption of external knowledge?
	Knowledge-based view	What are the different effects of tacit and explicit knowledge on OI? What is the process of internal knowledge assimilating external knowledge?
Organizational structure	Structural contingency theory	What is the effect of the co-existence of different structures (e.g. centralized and decentralized) on OI? How do firms change their structures to address internal inertia and meanwhile fit with the external environment?
Human capital	Upper echelon theory	What is the effect of leaders' relationship/conflict (e.g. CEO and CTO) on OI? What is the effect of TMT's external relationships (e.g. managerial ties) on OI?
	Asset specificity theory	What is the effect of asset (employee) mobility on OI? What are the different effects of generalists and specialists on OI?
Individual attitudes	Null	How do firms cope with NIH or NSH attitudes to better implement OI? How do employees' attitudes change in different stages of OI implementation?
Combination	Asset Complementary Logic	What is the interaction effect of dimensions of organizational factors (i.e. resource investment, organizational structure, human capital and individual attitudes) on OI?

controlling key resources (Chesbrough, Heaton, and Mei 2021). How institutional changes, for example in the form of governmental innovation strategies, affect firm OI may generate interesting findings and contribute greatly to the stream of OI research.

Implications and conclusion

This work seeks to provide a comprehensive review explaining the determinants of OI, namely how organizational factors affect the implementation of OI. We first classify these factors into four resource-related dimensions and then analyze theories used to explain each dimension's effects. We then develop a theoretical framework that explains the relationship between organizational factors and OI by proposing its moderating mechanism and mediating mechanisms. It should be noted that the four dimensions are by no means completely exhaustive. However, this work has outlined a clear framework based on the current literature that provides the theoretical lenses for explaining OI that is influenced by primary organizational factors, as well as some practical insights for firms on how to make efforts for embracing OI.

Firstly, our work contributes to the topic of 'internal factors of OI success' (Bogers et al. 2017; Stanko, Fisher, and Bogers 2017). Previous research has uncovered diversities in analyzable perspectives and showed discrepancies in findings. Starting from the idea that resource-related factors construct the foundation of firm strategy, we classify organizational factors into four dimensions (i.e. resource investment, organizational structure, human capital and individual attitudes). We analyze the effects of four dimensions of organizational factors on OI and analyze the predominant theories that have been applied for explaining their effects. This work provides a solid explanation base for scholars aiming to explore the determinants of OI, to see why the discrepancies exist and how the discrepancies can be explained by multiple theories. Such value is more likely to be highlighted given that this topic is, and will continue to be, prevalent within academia (Dahlander, Gann, and Wallin 2021).

Secondly, our work advances the understanding of the relationship between organizational factors and OI by proposing its moderating and mediating mechanisms. The identification of a series of moderators suggests that the effect of organizational factors on OI is unconditionally fixed. It is contingent upon factors related to the transaction cost. These contingent factors can be derived not only from external circumstances, such as market uncertainty, but also from other factors within the organization, such as its ability. These factors account for when organizational factors' effects are stronger, whereas in other situations the effect is weakened. We also point out that future studies can add to the contingent perspectives on the relationship between organizational factors and OI by considering institutional factors as theoretically important moderators. Regarding potential influential mechanisms, our review suggests that organizational factors do not necessarily exert a direct effect on OI, but can do so indirectly by affecting a firm's capability. This mediating mechanism is in line with the logic of dynamic capability and ACAP: resource accumulation can enhance a firm's ability to deploy resources, thus being able to conduct OI more effectively. Moreover, organizational structure (i.e. how resources are being attributed or allocated) may also affect firm capability, as better resource attribution enables firms to perform a higher efficiency of resource utilization and helps firms adjust to cope with external challenges and to build a competitive advantage.

We have also identified previously explored and unexplored questions concerning the relationship between four dimensions and OI. It should be noted that our identification of future research questions is still within the scope of the topic, i.e. four dimensions of organizational factors as the determinants of OI. We consider and classify OI implementation variables (OI-related strategy and performance) according to openness modes or relevant consequences rather than the types of who a firm is open to. About this, a general finding is that extant research has mainly focused on non-competitive contexts (i.e. openness to non-competitors, such as users, suppliers, or research institutes). This notion is consistent with extant reviews on OI (Ghasemzadeh, Bortoluzzi, and Yordanova 2022; Hoffmann et al. 2018; Chaudhary et al. 2022). Thus, scholars may want to enrich our research by considering the determinants and consequences of openness to competitors. Because competitors on the one hand can be a source of valuable knowledge and on the other hand, they compete against each other. Thus, they likely bring both benefits and risks. How firms can be open to competitors to innovate is rarely studied.

Thirdly, our review also offers practical implications regarding how to organize resources to implement OI in terms of at least four aspects. This is especially important, given that OI mode has become a trend in the business world and that modern companies have begun to embrace the digital economy where data and information are recognized as important sources of firm innovation. In practice, it is difficult to conclude or give a general suggestion about how to make efforts for implementing OI better. Notably, our analysis of resource-related dimensions of organizational factors is in accordance with the principle of feasibility and operability. Since the four dimensions are relatively analyzable and operable, and in managerial practice, to a large extent, they reflect the critical determinants of OI success and the main challenges of OI adoption in firms (Chaudhary et al. 2022), our review provides some insights. For example, managers should consider more detailed and specific dimensions of organizational R&D efforts rather than a macro, rough, or single-aspect guide. As the IBM example shows, in response to the challenges of AI technology, IBM made and revised a firm strategy by detailing several micro-level dimensions. These specific dimensional designs gave them more practical and operable insights into how to embrace AI. Moreover, managers who aim to design an effective organization for embracing OI should consider at least four aspects of R&D efforts. It may be not enough for firms that only invest more money or hire talented scientists. They also need to consider how these resources are allocated and treated by employees.

Finally, we should consider extending the implications of our research to the macro level as OI has the potential to significantly benefit economic development (Lee, Lee, and Lee 2020). For example, OI can provide access to the knowledge and technology necessary to create competitive products and services, especially for firms in emerging markets like China and other developing countries. It also allows for cross-border collaboration, as well as increased access to global markets, which could lead to increased foreign direct investments, and greater opportunities for economic growth (Abebe, McMillan, and Serafinelli 2022; Fu et al. 2022).

For firms in China and other developing countries to remain competitive in a global market, they need to adopt OI strategies that leverage the best resources from both domestic and international sources (Li and Ljungwall 2021; Yifu and Wang 2022). Our findings suggest that firms can increase OI through internal R&D arrangements by

providing resources and support to help managers and employees realize their ideas and solutions, optimizing the organizational structure and offering incentives for employees to work on innovative projects and ideas and engage in creative thinking. Additionally, firms should create a culture of collaboration across the organization to ensure ideas are shared and discussed openly. Therefore, firms, especially those in China and other developing countries, should recognize that most promising ideas may come from outsiders in the global market, and ensure that their resources should be properly allocated towards their development. By collaborating with and learning from their partners in developed countries, firms in developing countries can gain access to the newest technologies, ideas, and best practices (Fu et al. 2022). This will help them to accelerate the development process, improve their products, and increase their market share. Using an OI approach, firms in China and emerging markets can stay ahead of their competition and become global leaders (Chesbrough, Heaton, and Mei 2021; Fu et al. 2022; Lee, Lee, and Lee 2021).

In conclusion, our review shows that organizational factors can be primarily classified into four dimensions: resource investment, organizational structure, human capital, and individual attitudes. These dimensional factors exert different effects on OI directly or indirectly by affecting firm capability (absorptive capacity). Moreover, the effects of these factors on OI are also contingent upon both internal and external transaction factors. Our work also suggests a number of future research directions, and an important opportunity to consider is incorporating institutional factors into the OI framework. We hope that our work has presented an understandable view of researching the determinants of OI, and future research can gain valuable insights from it.

Notes

1. When we use the term 'OI' in this paper, it refers to a multi-dimension concept, namely, 'OI implementation' or 'implementation of OI', unless we point out specific dimensions, such as 'OI propensity'.
2. More details related to IBM's strategy for developing AI technology, see <https://www.ibm.com/blogs/policy/ibm-response-to-rfi-on-national-ai-rd-strategic-plan/>.
3. This list includes six general management journals known for scholarship on innovation management (*Academy of Management Journal*, *Academy of Management Review*, *Administrative Science Quarterly*, *Strategic Management Journal*, *Management Science* and *Organization Science*), ten technology and innovation specialty journals (*IEEE Transaction on Engineering Management*, *Industrial and Corporate Change*, *International Journal of Technology Management*, *Journal of Product Innovation Management*, *Long Range Planning*, *R&D Management*, *Research Policy*, *Research-Technology Management*, *Technological Forecasting and Social Change* and *Technovation*), three practice-oriented journals (*California Management Review*, *Harvard Business Review* and *MIT Sloan Management Review*), as well as six journals in other disciplines (*American Economic Review*, *Economic Journal*, *Journal of Marketing*, *Journal of Marketing Research*, *Journal of Political Economy* and *MIS quarterly*).
4. Scholars usually regard Chesbrough's book *Open innovation: The new imperative for creating and profiting from technology* (2003) as the starting point of OI research.
5. Literature concerning dynamic capability and absorptive capability suggests that these two concepts have differences and similarities. However, comparing them is not the purpose of our work. Our argument on firm capability follows (Teece 2007): 1319) definition of dynamic capability, therefore regarding absorptive capacity as one type of dynamic capability, namely, 'the capacity to seize opportunities.'

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Notes on contributors

Nengzhi(Chris) Yao is assistant professor in Nanjing Normal University, School of Business. His research interest is open innovation and institution-based view of firm strategy. His paper has been published in *Research Policy*, *Technovation* and among others.

Professor Karena Ji Yan is Chair in Marketing, Associate Dean of Durham University Business School. Her research focuses on innovation and technology management. She works with international scholars and practitioners to investigate R&D investment and funding problems and apply rigorous methodological techniques to address them.

Professor Christos Tsinopoulos is Executive Dean of School of Business and Management, Royal Holloway University. His research interests include the areas of operations management, innovation management, and sustainability, and he has published a number of academic papers and articles in these fields.

Professor Junhong Bai is Executive Dean of Nanjinr Normal University, School of Business. He has published a lot of papers in both Chinese and English papers.

ORCID

Karena Yan  <http://orcid.org/0000-0002-2353-7279>

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