How Internal IT Capability Affects Open Innovation Performance: From Dynamic Capability Perspective

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Abstract
Information technology (IT) and open innovation has been one of hot topic in existing research respectively. However, there are lack empirical research on inner mechanism of internal IT capability affecting open innovation performance. According to dynamic capability theory, this paper puts internal IT capability, internal knowledge integration, firm social capital, and open innovation performance into a theoretical model. Through 232 surveys, the results indicate that internal knowledge integration plays a mediator role in the effect of internal IT capability on open innovation performance. Meanwhile, the relationship between internal IT capability and internal knowledge integration can be positively moderated by firm social capital. This study extends the research on open innovation and IT business value, and provides theoretical direction for practice.

Keywords
internal IT capability, internal knowledge integration, firm social capital, open innovation performance

Introduction
It is widely known that our daily life is impacted by digital economy (Chen, 2020), such as AI, internet, big data, cloud computer. Scholars and managers also pay increasing attention on the high potential of digital economy. Although there are many different definitions of digital economy (Li et al., 2020), all of them emphasize the importance of information technology (IT). Meanwhile, digital economy creates many chances for promoting the level of innovation (Teece, 2018). Different from closed innovation, open innovation emphasizes that “projects can be launched from either internal or external technology sources, and new technology can enter into the process at various stages” (Chesbrough, 2006). However, how firms use IT improving open innovation performance to complete transformation and upgrading objectives is an important topic (Urbinati et al., 2020). Thus, it is imperative to explain the inner relationship between IT and open innovation.

Prior research considers the important role of IT from resource perspective in open innovation (Dong & Netten, 2017). With the development of IT, researchers point out that recent research claims that IT is not a resources but a capability (Bharadwaj, 2000). Especially, in digit economy, IT is updated more quickly. Recent research pays attention on the role of IT capability in open innovation (Cui et al., 2018). For example, Wu and Ding (2019) claim that external IT capability can help firms to acquire external knowledge to improve open innovation. Some researchers claim that firms not only obtain external knowledge, but also management acquired external knowledge and existing knowledge in open innovation process (Lichtenthaler & Lichtenthaler, 2009; Scuotto et al., 2017). However, previous research mainly considers that IT capability can help firms to acquire external knowledge to improve open innovation, ignoring the role of IT managing internal knowledge in the open innovation process. In other words, empirical research pays few attentions on the role of IT which manages and exploits internal knowledge in open innovation process.

To make up the gaps above, the main goal of this paper mainly explains the following two questions: How internal IT capability has an effect on open innovation performance? Which background factor can strengthen the relationship between internal IT capability and internal knowledge integration? Based on it, from dynamic capability perspective, this paper constructs a theoretical model including internal IT capability, internal knowledge integration, firm social capital, and open innovation performance.
IT capability, internal knowledge integration, firm social capital, and open innovation performance. More specially, this paper tests the inner mechanism of internal IT capability affecting open innovation; firm social capital moderates the relationship between internal IT capability and internal knowledge integration. Finally, the theoretical hypotheses are tested empirically.

This paper mainly has contributions from the following aspects. First, compared to existing research which pays attention to the role of IT to acquire external knowledge in the open innovation process, this paper considers the role of internal IT capability in the open innovation process. Because internal IT capability can help firms to manage- ment or exploit internal knowledge including acquired knowledge and existing knowledge to improve open innovation performance.

Second, some research emphasizes that firms should integrate their knowledge in the open innovation process. However, few empirical research pays attention to the important effect of knowledge integration on open innovation. Therefore, this paper considers internal knowledge integration as inner mechanism.

Third, extant research pays more attention to external environment factor as moderators (such as environment dynamic) to examine the IT business value. However, few empirical research discusses internal environment factor as a moderator in improving IT business value. Therefore, this paper considers firm social capital (internal environment factor) as a moderator in the open innovation process.

The rest sections of this paper are organized as the following: Literature review is presented in section 2; Section 3 constructs theoretical background and research hypotheses; Research methodology is described in Section 4; Data analysis is developed in Section 5; Conclusions of the paper is in Section 6, including theoretical and practical implications and limitations.

Literature Review

Open innovation emphasizes the important role of external knowledge (Chesbrough, 2006; West & Bogers, 2014). Based on it, some researchers from different perspectives considers the relationship between firm capability (Lichtenthaler & Lichtenthaler, 2009), knowledge management (Santoro et al., 2018; Secundo et al., 2019; Spaeth et al., 2010), and open innovation. With the development of research on open innovation, researcher considers the role of information technology affecting open innovation (Cui et al., 2015; Trantopoulos et al., 2017; Wu et al., 2019). For example, Dong and Netten (2017) suggest that information technology can have an important effect on external search.

In digit economy, firms tend to pay more attention on IT. Previous research from resources perspective consider the effect of IT on firm performance (Havakhbor et al., 2019), innovation (Chatterjee et al., 2020; Hensen & Dong, 2020; Karhade & Dong, 2021; Vendrell-Herrero et al., 2021). With the development of IT, some research claims that IT as resources cannot create value, firms should view IT as capability. Then increasing researchers pay attention on firm performance (Aydiner et al., 2019; Chae et al., 2018; Rehman et al., 2020), innovation (Soto-Acosta et al., 2018; Wu et al., 2019). More importantly, recent research considers the effect of IT capability on open innovation. For example, Wu and Ding (2020) claim that external IT capability can help firms to acquire external knowledge, then improve open innovation.

Furthermore, we can know that open innovation not only pay attention on external knowledge but also internal knowledge. IT can help firms to management and exploit internal knowledge (Wu et al., 2019). However, previous research mainly considers the critical role of information technology to acquire external knowledge in the open innovation process. Few empirical research considers the effect of internal IT capability on open innovation performance. Therefore, this paper considers how internal IT capability effect on open innovation and background factor.

Theoretical Framework and Research Hypotheses

Theoretical Framework

The resourced-based view explains that a firm accumulates valuable resources to acquire competitive advantage (Barney, 1991). However, in changing environment, it is not insufficient to accumulate resources to maintain competitive advantage (Chien & Tsai, 2012). Dynamic capability theory extends the resource-based view (Chien & Tsai, 2012), and it is one of theoretical framework used in previous studies to conceptualize and explore firm performance (Lin & Wu, 2014). Dynamic capability is defined as the ability to integrate, build and reconfigure internal and external capability to response rapidly changing environment (Teece et al., 1997). Meanwhile, it referring to two key aspects, namely dynamic and capability, will help firms to get new forms of competitive advantage (Teece et al., 1997). Dynamic means the ability to renew capability to get congruence with the changing business environment. Capability emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment (Teece et al., 1997).

Dynamic capability is divided into three continuous but sequential activities, namely sensing, seizing, and transforming opportunities (Teece, 2007, 2012). Sense means that firms identify and assess opportunities; seize means that firms mobilize resources to address opportunities and capture value; transform means that firms can continue renewal resources (Teece, 2012). Internal IT capability means the
IT-related resources and capabilities to support activities within the boundaries of firms to help them offer reliable products and services and minimize overhead costs (Dale Stoel & Muhanna, 2009; Wade & Hulland, 2004). We suggest that internal IT capability will help firms to sense and seize knowledge. Meanwhile, knowledge integration means that firms integrate acquired knowledge and existing knowledge (Grant, 1996). In this paper, we suggest that internal IT capability can help firms to transform knowledge. Therefore, we can know that internal IT capability can have an important effect on open innovation performance through internal knowledge integration. We suggest that internal knowledge integration will help firms to transform knowledge.

Dynamic capability also claims that firms should notice the complementary resources (Teece et al., 1997). Moreover, dynamic capability suggests that to acquire competitive advantage, firms should combine a capability with other capabilities or assets (Teece, 1986; Teece et al., 1997). Such indicates that internal IT capability as an organization capability is contingent on some conditions (Dale Stoel & Muhanna, 2009). Previous research mainly considers external environment factors as contingency factor (Havakhor et al., 2019) in IT business value. With the development of research, some research suggests that internal environment factors, such as innovation strategy (Cui et al., 2015), resource commitment (Mao et al., 2016), social media capability (Benitez et al., 2018), will enhance effectiveness of business value of IT. Firm social capital which has an important influence on firm performance emphasizes internal network of organization (Yli-Renko et al., 2001). Firm social capital emphasizes the inner network (Tsai, 2000), but previous studies ignore the moderating role of firm social capital to improve IT business value. Therefore, to supplement the previous research on the contingency factor of internal IT capability, this research puts firm social capital (internal environment factor) in theoretical framework (see in Figure 1).

**Research Hypotheses**

**Internal IT capability and internal knowledge integration.** Internal knowledge integration means that “the capacity for extensive coordination between different specialized subunits within an organization, and explicitly targets the implementation of a given project concept” (Iansiti & Clark, 1994). There are two mechanisms to integrate knowledge, namely directions and organizational routines. From this perspective, this paper suggests constructs the relationship between internal IT capability and internal knowledge integration from the following two aspects.

First, directions which involve codifying tacit knowledge into explicit knowledge can integrate knowledge (Grant, 1996) through transferring knowledge among individuals (Mitchell, 2006). Internal IT capability can codify knowledge (Cohendet & Edward Steinmueller, 2000). Then codified knowledge can effectively be transferred (Huber, 2001). In other words, codified knowledge makes people to more easily access and acquire them, such will make knowledge to be transferred in organization (Ding et al., 2013). Furthermore, knowledge integration captures on knowledge transfer (Mitchell, 2006). Thus, we suggest that internal IT capability can make knowledge to be transferred, then integrate knowledge (Mitchell, 2006).

Second, organizational routines which involve social interactions among individuals (Grant, 1996) can integrate knowledge through sharing knowledge (Zhang et al., 2008). Internal IT capability makes people communication (Olesen & Myers, 1999) and social interaction (Shklovski et al., 2006), which will make people trust each other (Wu et al., 2009). With trust, people can share knowledge with others. In contrast, without trust, people may tend to be not willing to share knowledge with each other (Huber, 2001). In a word, trust makes people in organization to share knowledge (Inkpen & Tsang, 2005). For example, when trust exists in organization over time, people tend to be more willing to share knowledge with each other (Inkpen & Tsang, 2005). Sharing knowledge is the foundation of knowledge integration (Zhang et al., 2008). Based on theory above, we propose the following:
**H1.** Internal IT capability has a positive effect on internal knowledge integration

**Internal knowledge integration and open innovation performance.** Increasing researchers pay attention on the internal organizational activities in the open innovation process (Brunswicker & Vanhaverbeke, 2015; Lichtenthaler & Lichtenthaler, 2009). Internal knowledge integration as an organizational capability (Grant, 1996) can makes sure that knowledge including acquired knowledge and existing knowledge can be shared and transferred among people. Based on this, we construct the relationship between internal knowledge integration and open innovation performance from the following aspects.

First, if a firm wants to get better open innovation performance through acquiring external knowledge, it is imperative to consider the knowledge base in organization (Díaz-Díaz & de Saá Pérez, 2014). Internal knowledge integration will make firms to effectively integrate knowledge including acquired knowledge and existing knowledge. Such will make firms to have a deep knowledge base (Zhou & Li, 2012), which helps firms to know what firms need knowledge, acquiring more valuable knowledge, improving open innovation performance.

Second, internal knowledge integration will make firms to share and transfer knowledge among people to create more new knowledge (Smith et al., 2005), improving open innovation performance.

**H2.** Internal knowledge integration has a positive effect on open innovation performance

**The mediating role of internal knowledge integration.** According to H1 and H2, we can know that internal IT capability has a positive effect on internal knowledge integration; internal knowledge integration has a positive effect on open innovation performance.

**H3.** Internal knowledge integration plays a mediator role in the relationship between internal IT capability and open innovation performance

**The moderating role of firm social capital.** Firm social capital "refers to the extent and quality of relationships between individuals and units within a given firm" (Yli-Renko et al., 2002). It has three dimensions, namely structural dimension, relational dimension, and cognitive dimension. Structural dimension means that individual or unite can acquire knowledge through social interaction (Nahapiet & Ghoshal, 1998); relational dimension relates to a capital which represents relationships among people or unit, such as trust (Tsai & Ghoshal, 1998); cognitive dimension is embedded in organization like a shared code which facilitates a common understanding of collective goals (Tsai & Ghoshal, 1998).

In high level of firm social capital, internal IT capability is an important, valuable and scarce resource. In other words, the interaction of internal IT capability and firm social capital will have a more important effect on internal knowledge integration. We establish the moderating role of firm social capital in the relationship between internal IT capability and internal knowledge integration from the following two aspects. First, when the high level of firm social capital, there is high level of trust among people. In such background, individuals or units interact with each other (Tsai & Ghoshal, 1998) to make them to easily communicate and become familiar. By contrary, when the low level of firm social capital, there is low level of trust among people, and individual has less communication with each other. Therefore, in high level of firm social capital, internal IT capability can more effectively make individuals to communicate with each other to make knowledge to be shared among people. Second, when the high level of firm social capital, shared vision makes a firm to have a common understanding of collective goals (Tsai & Ghoshal, 1998) and lets individuals to have a collectivity. On the contrary, when the low level of firm social capital, individuals tend to be individualist. Therefore, in high level of firm social capital, internal IT capability can make people more effectively interact to achieve common goal, promoting knowledge to be transferred among people.

Based on the analysis above, we can know when firm social capital has a high level, internal IT capability tends to be more important effect on internal knowledge integration. Conversely, when firm social capital has a low level, internal IT capability tends to have less important influence on internal knowledge integration.

**H4.** Firm social capital moderates the relationship between internal IT capability and internal knowledge integration

**Research Methodology**

**Data Collection**

This research empirically tests the theoretical model using survey data. Variables referred in this study were measured as following to guarantee the validity. First, we reviewed the relevant literature and generated a pool of items to tap the domain of each construct. The questionnaire was prepared in English, and our team translated these variables into Chinese. Next, the Chinese-version of the questionnaire was back-translated into English by a third party to check for consistency. Second, we in-depth communicated with other teams of professors and doctoral students to revise the phrasing of the scales of our questionnaires. Lastly, in order to design the content of the questionnaire to be more accurate and understandable for respondents, we carried out a preliminary investigation by...
distributing to 20 questionnaires to MBA students at Huazhong University of Science and Technology. They were asked to review the questionnaire for structure, readability, ambiguity, and completeness. Then, we further revised the questionnaire according to their feedback. Subsequently, the phrasing of items was further enhanced by the authors and peers, a process that produced a final version of questionnaire. The formal study informants were the managers of firms located in Wuhan, Shanghai and Beijing.

This study empirically tests the theoretical model using survey data. The questionnaire was mainly collected in the following ways. First, EMBA and MBA students at Huazhong University of Science and Technology and Wuhan University filled out the questionnaires. Second, the questionnaires were completed online in the form of scrolling through social relationships. Third, we directly contacted the firms’ managers to complete the questionnaire. In the end, a total of 570 questionnaires were sent out, after eliminating those that were not answered or contained obvious errors, and 232 effective questionnaires were received, constituting a 40.70% response rate. Information on firms is shown in Table 1.

To examine nonresponse bias, in this research, T-tests indicated that there were no differences between respondents and nonrespondents. Meanwhile, the result which examined early and late respondents for demographic characteristics and model variables did not reveal any significant difference ($p < .05$). therefore, we suggest that there was not a problem of nonresponse bias in this paper.

### Measure of Constructs

In this paper, we adopted the five-point Likert scale to measuring all variables (1—“strongly disagree” . . . 5—“strongly agree”).

**Independent variable.** Internal IT capability as independent variable included five items which were referred from Bharadwaj (2000), Dale Stoel and Muhanna (2009), and Wade and Hulland (2004): Information technology promotes information (knowledge) sharing among units; Information technology can provide good products and services for firms; Information technology promotes information (knowledge) sharing among people; Information technology promotes firms to reduce operating costs; Employees in information technology departments have a wealth of knowledge on information technology.

**Mediator variable.** Internal knowledge integration as mediator variable including four items referred from Ian-siti and Clark (1994) and Mehta et al. (2006). Firms can make acquired knowledge to rapidly flow; Firms can make acquired knowledge to combine with existing knowledge; Firms always solve operating problems through using acquired knowledge; Firms’ employs would like to accept acquired knowledge.

**Moderator variable.** Firm social capital as moderator variable were adapted from Nahapiet and Ghoshal (1998), Tsai and Ghoshal (1998), including the following five items: Different units always communicate with each other; Firms’ employees always discuss problems on operating; Firms’ employees always share ideas and emotional communication; Firms’ employees in different units establish deep feelings; Firms’ employees worried about damaging other interests.

**Dependent variable.** Open innovation performance as dependent variable included four items which were developed and adapted from Chesbrough et al. (2006), Hung and Chou (2013), Johannessen et al. (1999), and Sisodiya et al. (2013). Partners (clients, consumers, research institutions, etc.) play a critical role in the innovation process; Partners play a critical role in raising innovation benefits; Partners play an important role in increasing R&D investment; Partners play an important role in increasing number of new production.

### Reliability and Validity

To make sure the reliability, all the scales were tested through Cronbach alpha. All of the scales indicated satisfactory alphas, as showing Table 2. From the Table 2, we knew that all alphas were larger than the acceptable threshold of .6.
To test convergent validity, we conducted confirmatory factor analysis (CFA) and got a significant model. For the model, the indices of internal IT capability suggested a satisfactory model fit, chi square/degree of freedom = 4.1218, RMR = .046, NFI = .960, IFI = .969, CFI = .969, GFI = .966. The indices of internal knowledge integration suggested a satisfactory model fit, chi square/degree of freedom = 4.619, RMR = .023, NFI = .974, IFI = .979, CFI = .979, GFI = .980. The indices of firm social capital suggested a satisfactory model fit, chi square/degree of freedom = 6.487, RMR = .046, NFI = .927, IFI = .937, CFI = .936, GFI = .943. The indices of open innovation performance suggested a satisfactory model fit, chi square/degree of freedom = 1.262, RMR = .013, NFI = .994, IFI = .999, CFI = .999, GFI = .995. Thus, the convergent validity was achieved. To test discriminant validity, chi-square difference tests were conducted. In other words, correlations of any two variables were estimated freely, then constrained to one. A significantly lower chi-square in the no-constrained model was obtained. Therefore, the discriminant validity also is achieved.

Harman’s one-factor was performed to test common method bias. If a single factor could have been extracted to explain a majority of the variance of the data, common method variance concern had been high. From the Table 2, KMO (.871) and Bartlett (Sig = .000) meant that factor analysis was appropriate for the data. And the results of factor analysis did not a single-factor structure. Therefore, there is not a concern of the common method variance.

Data Analysis

Correlation Analysis

The descriptive statistics and correlations of all variables are presented in the following Table 3.

The Mediator Test

The results of the hierarchical regression analyses for internal IT capability, internal knowledge integration, firm social capital, and open innovation performance were presented in Table 4. To test the mediating and moderating role, this paper constructed the regression model including internal IT capability, internal knowledge integration, firm social capital, and open innovation performance. This paper established six models to examine the research hypotheses through regression analysis (Table 4).

The baseline model 1 is the influence of control variables (firm size, firm age) on internal knowledge integration. Model 2 introduces independent variables (internal IT capability). Model 4 introduces moderator variables (firm social capital). Model 4 introduces the interaction of independent

| Table 2. Factor Analysis. |
|---------------------------|
| Constructs/items | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---------------------|----------|----------|----------|----------|
| Internal IT capability (Cronbach’s alpha = .854) | | | | |
| Item 1 | .799 | | | |
| Item 2 | .820 | | | |
| Item 3 | .822 | | | |
| Item 4 | .770 | | | |
| Item 5 | .615 | | | |
| Internal knowledge integration (Cronbach’s alpha = .825) | | | | |
| Item 1 | | .681 | | |
| Item 2 | | .812 | | |
| Item 3 | | .765 | | |
| Item 4 | | | | |
| Item 5 | | | | |
| Firm social capital (Cronbach’s alpha = .847) | | | | |
| Item 1 | | | .740 | |
| Item 2 | | | .840 | |
| Item 3 | | | .767 | |
| Item 4 | | | .643 | |
| Item 5 | | | .652 | |
| Open innovation performance (Cronbach’s alpha = .870) | | | | |
| Item 1 | | | | .764 |
| Item 2 | | | .820 | |
| Item 3 | | | .837 | |
| Item 4 | | | .847 | |
| Eigen-value | 6.653 | 2.179 | 2.005 | 1.152 |
| Percentage of variance explained | 18.379 | 17.477 | 16.369 | 14.385 |
| Cumulative percentage of variance explained | 18.379 | 35.856 | 52.224 | 66.609 |
variable and moderator variable (internal IT capability × firm social capital). The baseline model 5 is the influence of control variables (firm size, firm age) on open innovation performance. Model 6 introduces the independent variable (internal IT capability). Model 7 introduces the mediator (internal knowledge integration).

Regarding the influences of internal IT capability on internal knowledge integration (Table 4), model 2 shows that internal IT capability has a positive effect on internal knowledge integration (b = 0.449, p = .000 < .001). Hypothesis 1 is supported. From model 6, we can know that internal knowledge integration has an important role in improving open innovation performance (b = 0.302, p = .000 < .001). Thus, internal knowledge integration plays a mediating role in the theoretical model.

The Moderator Test

The results of the hierarchical regression analyses for internal IT capability, internal knowledge integration, firm social capital, and open innovation performance were presented in Table 4. To test the theoretical model, we created the interaction terms, namely internal IT capability × firm social capital. Before such activities, this paper means centered independent variable and moderator variable to reduce multicollinearity. Furthermore, to test multicollinearity, this research calculated variance inflation factors (VIF) for each of regression equations. The maximum VIF within the models was 1.287, which was well below the rule-of-thumb cut-off of 10.

To make the results robustness, this paper tests the mediating variable by Mplus. The result shows that internal IT capability has an effect on internal knowledge integration (p = .000), internal knowledge integration affects open innovation performance (p = .000). Thus, internal knowledge integration plays a mediating role in the theoretical model.

Table 3. Descriptive Statistics and Correlations.

| Varies                      | Mean value | Standard deviation | 1  | 2  | 3  | 4  | 5  | 6  |
|-----------------------------|------------|--------------------|----|----|----|----|----|----|
| Firm size 1                 | 2.28       | 0.809              | 1  |    |    |    |    |    |
| Firm age 2                  | 3.33       | 0.992              | .461** | 1  |    |    |    |    |
| Internal IT capability 3    | 3.8181     | 0.79076            | .074 | .072 | 1  |    |    |    |
| Internal knowledge integration 4 | 3.584     | 0.7341             | .063 | .016 | .449** | 1  |    |    |
| Firm social capital 5       | 3.4009     | 0.77905            | .024 | −.009 | .359** | .602** | 1  |    |
| Open innovation performance 6 | 3.3211    | 0.85774            | .073 | −.063 | .315** | .387** | .381** | 1  |

**Correlation is significant at the .01 level (two-tailed).

Table 4. The Empirical Results of the Theoretical Model.

| Control variables          | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|----------------------------|---------|---------|---------|---------|---------|---------|---------|
| Firm size                  | .037    | .013    | .035 (.534) | .035 | −.056 | −.073 | −.059 |
| Firm time                  | −.001   | −.023   | −.015 (−.265) | −.026 | −.037 | −.053 | −.048 |
| Independent variables      |         |         |         |         |         |         |         |
| Internal IT capability     | .449*** | .265 (.000) | .290*** | .325*** | .215** |         |         |
| Mediator                   |         |         |         |         |         |         |         |
| Internal knowledge integration | .508 (0.000) | .502*** |         |         |         |         |         |
| Moderator                  |         |         |         |         |         |         |         |
| Firm social capital        |         |         |         |         |         |         | .302*** |
| Interaction                |         |         |         |         |         |         |         |
| Internal IT capability × firm social capital | .097* |         |         |         |         |         |         |
| R²                         | .001    | .202    | .426    | .435    | .006    | .111    | .190    |
| ΔR²                        | −.007   | .191    | .416    | .422    | −.002   | .099    | .176    |
| F                          | 0.150   | 19.191*** | 42.089*** | 34.753*** | 0.478   | 9.487*** | 13.320*** |

***Correlation is significant at the .01 level. **Correlation is significant at the .05 level. *Correlation is significant at the .1 level.
moderating role of firm social capital in the relationship between internal IT capability and internal knowledge integration in the theoretical model. This paper examines the research hypotheses through regression analysis (Table 4).

The baseline model 1 is the influence of control variables (firm size, firm age) on internal knowledge integration. Model 2 introduces independent variables (internal IT capability). Model 3 introduces moderator variable (firm social capital). Model 4 introduces the interaction of independent variable and moderator variable (internal IT capability × firm social capital). Regarding the moderating influence of firm social capital, model 4 shows that the interaction of internal IT capability and firm social capital has a positive and significant effect on internal knowledge integration ($b = 0.097$, $p = .061 < .1$). Hypothesis 4 gets supported.

To make the results robustness, this paper tests the moderating variable by Mplus. The result shows that firm social capital × internal IT capability has a significant and positive effect on internal knowledge integration ($p = .059$). Meanwhile, referred to Aiken and West (1991), Dawson (2014), and Dawson and Richter (2006), this paper divides firm social capital into high and low level. As plotted in Figure 2, in high level of firm social capital, internal IT capability will strengthen internal knowledge integration.

**Figure 2.** The moderating effect of firm social capital.

**Discussion**

**Main Research Results**

(1) Internal IT capability has a positive effect on internal knowledge integration. This result is coordinated with our intuition. The reasons are that internal IT capability can help people to frequently interact and communicate with each other. Such activities will make knowledge to be shared among people, improving internal knowledge integration. Meanwhile, firms can use internal IT capability to codify knowledge, which will easily make knowledge to be transferred, enhancing internal knowledge integration.

(2) Internal knowledge integration has a positive effect on open innovation performance. This result is coordinated with our intuition and agreeable with Lichtenthaler and Lichtenthaler (2009). The reasons are that when firms integrate acquired knowledge and existing knowledge, they may tend to clarify which they really need knowledge. Based this, they can acquire more external valuable knowledge, improving open innovation performance. Furthermore, firms integrate acquired knowledge and existing knowledge, and then they can effectively use knowledge to create more knowledge, enhancing open innovation performance.

(3) Firm social capital positively moderates the relationship between internal IT capability and internal knowledge integration. This result is accordance with our research hypothesis. The reasons are that on the one hand, in high level of firm social capital, a firm has a trust environment. In such environment, a firm’s employees or units can more frequently communicate through internal IT capability, then effectively share knowledge for integrating knowledge. On the other hand, in high level of firm social capital, a firm has a shared vision environment. In such environment, a firm’s employees (units) can keep or establish more close contract and relationship through internal IT capability, then effectively transfer knowledge for improving knowledge integration. Therefore, the efficiency of internal IT capability will be improved. In other words, the combination of firm social capital
with internal IT capability will have a positive effect on internal knowledge integration.

**Theoretical Implications**

(1) This study deepens the research about the effect of internal IT capability on open innovation performance. Previous literature mainly pays attention to IT capability obtaining external knowledge in open innovation process (Trantopoulos et al., 2017; Wu & Ding, 2020), ignoring the critical role of IT capability managing internal knowledge in open innovation process. Based on dynamic capability theory, this study points out how internal IT capability affects open innovation performance. Furthermore, this paper considers the role of internal knowledge integration as a mediator variable in the relationship between internal IT capability and open innovation performance.

(2) This paper enriches the research on the boundary of internal IT capability in the open innovation process. Existing research mainly talks about the important role of external environment factor in the IT business value (Lioukas et al., 2016; Sabherwal et al., 2019), ignoring the critical role of internal environment factor. Thus, based on dynamic capability theory, this study considers the role of internal environment factor in the open innovation process. Specifically, this research tests the moderating effect of firm social capital (internal environment factor) on the relationship between internal IT capability and internal knowledge integration. This empirical research shows that firm social capital can positively moderates the relationship between internal IT capability and internal knowledge integration. Therefore, this paper complements the boundary condition of IT business value.

**Practical Implications**

(1) The results can provide following suggestions for firms. In the open innovation process, firms should stress internal knowledge or focus on internal business activities. Firms should leverage internal IT capability to management and exploit internal knowledge, and then integrate these knowledge (existing knowledge and acquired knowledge) to improve open innovation performance.

(2) This research results indicate that when the level of firm social capital is high, firms should make full use of internal IT capability to improve internal knowledge integration. In other words, if firms form internal IT capability, it should pay attention to the cultivation of firm social capital, in order to enhance the effectiveness of using internal IT capability. More specifically, when firms establish an internal network that employees or unites trust each other, internal IT capability can more effectively share and transfer knowledge among people, which will promote internal knowledge integration.

**Limitations**

This study promotes the existing research, but has some limitations as following:

(1) the paper only considers that internal IT capability has a positive effect on internal knowledge integration, then affects open innovation performance. However, it does not take into account the role of other factors as internal mechanism (such as organization flexibility).

(2) firm social capital is considered as a moderating variable in this paper. But other factors can be considered as moderating variables (such as organization strategy).

(3) IT is not a holistic concept (Aral & Weill, 2007). Research should realize the importance of various types of IT to estimate firm performance (Braojos et al., 2019; Steelman et al., 2019).

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