Relationships between Inter-firm collaboration, Intra-firm collaboration, Innovation Capability, and New Product Development: A Complementary Approach (competitive paper)

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ABSTRACT

Inter-firm collaboration (IEC) and intra-firm collaboration (IAC) are highlighted as key antecedents of successful new product development (NPD) in the innovation literature. A review of the literature, however, shows a lack of consensus regarding the relationships between inter-firm and intra-frim collaboration and NPD performance. Moreover, only a few research empirically investigates the complementary effect of IEC and IAC on firms' outcome. To address the gap in the literature, we re-examined the complementary effect of IEC and IAC on NPD performance by introducing innovation capability as an important mediator in the link between inter-firm and intra-firm collaboration and NPD performance using the resource-based view and dynamic capability theory. Survey data from a sample of 147 high and med-tech manufacturing firms in Iran show the positive impact of the interaction between IEC and IAC on firms' innovation capability. Moreover, innovation capability found to positively impact on both financial and non-financial dimensions of NPD performance. The findings provide both managerial and theoretical implications.

keywords: Innovation capability, Inter-firm collaboration, Intra-firm collaboration, Dynamic capability, Resource-based approach.

INTRODUCTION

For firms in rapid technological change and technology-intensive industries, innovation capability offers several substantive benefits, such as competitiveness, manufacturing efficiency (Matanda, Ndubisi&Jie, 2015, p.1). Technology-intensive environments may render existing knowledge and skills obsolete. Based on the resource-based view, certain internal capabilities are the basis on which it further achieves superior performance and strengthens competencies (Teece et al. 1997, p.509). However, more recent evidence (Nieto & Santamaria 2007, p.374) shows that major internal resources are not adequate and the firm efficiency in the absorption of additional resources is vital to the development of innovation capability. The purchasing process is costly and time - consuming for companies, hence the remarkable feature and strategy is collaborative activities to absorb resources. Despite the inter-firm collaboration's widely touted benefits (Kogut 1988, p.329; Kalwani & Narayandas 1995, p.14), an increasing number of studies have found the failure results in NPD collaboration projects (Schleimer & Faems 2016 p.154; Nieto & Santamaria 2007, p.375). Taking advantages of inter-firm collaboration has needed design and management the interior networks called intra-firm collaboration. The question as to whether all firms are equally taking advantage of intra-firm collaboration has been largely unanswered, because of conflicting results (Schleimer & Faems 2016, p.154). While several studies (Faems, Van Looy, & Debackere, 2005, p.238; Gulati & Nickerson 2008, p.703) revealed evidence to affirm the positive role of internal collaboration, (Luzzini et al. 2015, p.21) claimed the intra-firm cooperation linked to financial NPD performance insignificantly, similarly, (Barki & Pinsonnault 2005, p. 176) stated the general conflict between the intense interior collaboration and NPD performance. Via extending the

resource-based theory, the dynamic capability is the firm's ability to integrate, build and reconfigure the internal competencies and the external resources in aiming to respond to changing environment faster (Barreto 2010, p.257; Helfat & Peteraf 2003, p.997). Therefore, the creation of capability to a large extent is dependent on technological, managerial and organizational internal processes, that have essentially resulted intra-firm and inter-firm collaboration activities (Teece 2007, p.1323). Hence in this research, innovation capability is considered as one of the internal and external collaboration outputs. Moreover, while the positive impact of innovation capability on product performance has often been reported in prior research (Bonaccorsi & Lipparini 1994, p.144; Eisenhardt & Tabrizi 1995, p.107), in recent studies the negative relation has been well documented (Belderbos et al. 2004, p.1237). Some studies suggest investigating the NPD performance through using multi-dimensional scale to address inconsistent result. Following to (Najafi-Tavani et al. 2013, p.3389) we focused on two sub-dimensions of NPD performance, namely financial and non-financial aspect. Therefore, we argue that through enhancing inter-firm collaboration and intra-firm cooperation directly linked to two dimensions of NPD performance (i.e. financial and non-financial) and consequently facilitates reinforcing innovation capability. Grounded in the dynamic capability theory of the firm, the main contributions of this study are to first using the complementary approach, to examine whether there may exist an interaction between intra-firm and inter-firm collaboration and if this interactive relationship enhances innovation capability performance, and secondly, to investigate the forming of innovation capability as a mediator between intra-firm and inter-firm collaboration and NPD performance by considering dynamic capability theory, finally, analyze the NPD performance in a multi-dimensional sub construct in financial and non-financial performance scales.

THEORETICAL BACKGROUND AND RESEARCH HYPOTHESIS

Inter-firm collaboration and new product development

On one hand, inter-firm collaboration have been receiving much positive attention due to its effects on NPD performance (Barrat 2004, p.38; Sánchez & Perez 2003, p.57; Griffith & Lee 2016, p.16;). On the other hand, there is a considerable amount of the literature which has been found the inter-firm partnering as a negative and partly insignificant effective factor on NPD performance (Jean, Sinkovics & Cavusgil, 2010, p.1223; Audy et al. 2012, p.653; Faems et al. 2008, p.1073). A challenging area in the field of relationship between inter-firm collaboration and NPD performance has been created due to applying a one-dimensional analysis. In some studies, the effects examined via non-economic factors (Kogut 1988, p.328; Park, Mezias & Song, 2004, p.16) and in other researches financial variables were used to analysis (Kalwani & Narayandas 1995, p.8). Therefore, in this study by applying two dimensions financial and non-financial performance in line with the (Najafi-Tavani et al. 2013, p.3389) we proposed the intra-firm collaboration directly linked to NPD performance.

H1 $_{a, b.}$ *Inter-firm collaboration has a positive effect on a) financial b) non-financial firm's NPD performance.*

Intra-firm collaboration and new product development

Intensive intra-firm collaboration has not a positive and significant effect on NPD project performance generally (Barki & Pinsonneault 2005, p.175; McEvily, Perrone & Zaheer, 2003), and according to resource-based perspective mainly on financial performance (Luzzini 2015, p.26). Furthermore, firms who are keen to compete in an uncertain environment through their innovative products, reinforcing internal collaboration networks among employees

improves the firm's ability to absorb external technologies that are unknown for firms, leads higher NPD performance via reducing the time for absorption (Moreira, Markus & Laursen, 2018, p.2517). All these inconsistent results reinforce the need to investigate the relation between intra-firm collaboration and NPD performance. In line with (Najafi-Tavani et al. 2018, p.3389) we take two-dimensional sub-constructs to measure NPD performance financial and non-financial performance. It is therefore hypothesized:

H2 $_{a, b.}$ *Intra-firm collaboration has a positive effect on a) financial b) non-financial firm's NPD performance.*

Inter-firm collaboration and innovation capability

Collaborative activities among firms enhance innovation capability of the firm through increased accessibility to a vast amount of information (Amara & Landry 2005, p.245; Kim, Chiou & Calantone, 2018, p.838) that helps firms identify and develop innovation opportunities which lead to better market performance. Several authors have recognized significant performance in the result of cooperative activities with a different partner. Studies that reported cooperation with type of partner like suppliers (Bonaccorsi & Lipparini 1994, p.142; Eisenhardt & Tabrizi 1995, p.89), customers (Faems, Van Looy & Debackere, 2005, p.247; Freel 2005, p.130) , competitors (Nieto & Santamaria 2007, p.375) enhances innovation performance are well documented (Belderbos et al. 2004, p.1256; Zeng, Xie & Tam, 2010, p.181), it is also well acknowledged that the collaboration with universities has had negative or insignificant effects on innovation capability (Lööf & Heshmati 2002, p.61; Tether 2002, p.947). Although there are many studies, the research in the effect of inter-firm collaboration on innovation capability remains limited and less consistent. Therefore:

H3. *Inter-firm collaboration has a positive effect on innovation capability.*

Intra-firm collaboration and innovation capability

Coordination and cooperation among NPD projects team members and personnel in other departments within a firm is part of a firm's strategic capabilities named intra-firm collaboration (Lorenzoni & Lipparini 1999, p.318). As far as we know intra-firm cooperation achievements has investigated in the literature, however, recognition of internal firm characteristics determines cooperation among units that leads to innovation. Under which conditions may innovation occur as a result of collaboration, briefly was addressed in the literature (Colombo et al. 2011, p.537). Empirical results have been mixed, while some researchers determined a positive association between intra-firm collaboration and innovation capability outcomes (Kogut & Zander 1992, p.389), others have failed to find a positive relationship (Laursen & Salter 2014, p.876), leading to the conclusion that external cooperation among firms does not automatically lead to innovation success in organizations. Additional studies to understand more completely the key tenets of technical and managerial internal processes that lead to innovative collaboration activities are required. Therefore, we proposed:

H4. *Intra-firm collaboration has a positive effect on innovation capability.*

innovation capability and New product development

Studies of the relation between innovation capability and inter-firm collaboration are well documented (Nieto & Santamaria 2007, p.368; Huggins 2010, p.335), it is also little acknowledged that intra-firm cooperation is effective to innovation achievement (Gulati 2007, p.130). Performance of New product development has been increased through creating innovate- ion capability within firms (Adams 2004; Balachandra & Friar 1997, p.285), while some studies have claimed the moderation effect decreases NPD performance (Griffin &

Mahon 1997, p.5; Calantone, Harmancioglue & Dorge, 2010, p.1065). There are some potentially open questions about the reason of failure or success of the NPD project in the market despite having innovation ability. The analysis in the related literature has not met with general acceptance and causes this inconsistency. Our steps proceed in considering two-dimensions sub construct NPD performance (i.e. financial and non-financial measurement) very much in the same way as (Najafi-Tavani et al. 2018, p.197). This paper addresses intra-firm and inter-firm collaboration effects concurrently, so far lacking in the NPD performance literature.

H5 $_{a, b.}$ *Innovation capability has a positive effect on a) financial b) non-financial firm's NPD performance.*

The interaction effect of intra-firm and inter-firm collaboration on innovation capability

What we know about inter-firm collaboration benefits is largely based upon empirical studies that investigate how the NPD performance is enhanced through better information sharing, yet a question has been raised about the interaction effect of external collaboration with cooperation within the firm on innovation capability performance. In spite of recent evidence (Schleimer & Faems 2016, p.162; Hillebrand & Biemans 2004, p.115; Schleimer & Shulman 2011, p.869), the controversy findings signal the need for additional studies to better understanding of the relationship between intra-firm and inter-firm collaboration requires emphasizing the importance of interaction effect of them on innovation capability creation. In order to investigate the supplementary effects of collaborations, we took the resource-base and complementary theories from a contingency perspective.

H6. *The interaction effect of intra-firm and inter-firm collaboration on innovation capability is positive.*

RESEARCH METHODOLOGY

sample selection, data collection, and common method bias

The data used were collected through the utilization of a questionnaire-based survey in March 2018. This research is set in the medium-to-high technology manufacturing sector in Iran. Initially, the English draft of the survey instrument refined through a discussion process including academics and research peers. Professional translators then translate the English version into Farsi and back-translated in order to reduce concerns regarding the conceptual equivalence (Najafi-Tavani et al. 2018, p.197). 450 firms were randomly sampled and contacted for their participation from the list of 1500 members. In total, we collected 155 companies' information with a response rate of 34.4 %. We have conducted various preventive procedures to mitigate CMB concerns in research design following a recommendation by Podsakoff, Mackenzie, and Lee (2003). The CFA was carried out to estimate CMB likelihood analysis for two models, the simple model loaded all variables except the interaction variable. The second model loaded the interaction variable either. In the first model, all items were loaded on to one confirmatory factor resulting in χ^2=314.692 and df=191. The second model with χ^2=334.667 and df=208. Since the comparison between the two models showed a different result ($\Delta\chi^2$ of 19.975 with Δdf=17, $p < 0.001$), we concluded that CMB was not a significant concern in this study.

MEASURES

Dependent, independent and control variables

Constructs description as follows: *"Inter-firm collaboration",* to estimate the extent of collaboration between units from different firms in accordance with the Schleimer and Faems (2016), p.158, 7-point Likert scale (i.e. 1=never;7=always) were used. *"Intra-firm collaboration"* measure was adopted from the Schleimer and Faems (2016), p.158. either. Using a 7-point Likert scale (i.e. 1=never – 7=always) respondents were asked the extent of collaboration between units within a firm. Following the approach of Ngeo and O'Cass (2012), the scale *"Innovation capability"* measures four types of innovation in the business unit in relative to its major competitors. Using a 7-point Likert scale (i.e. 1=much worse than competitors -7= much better than competitors), the respondents rated them. *"NPD performance"* was measured based on the study of Langerak, Hultink, and Robben (2004, p.85) in two financial and non-financial dimension. Six items were developed for NPD financial performance, which evaluates the performance of the selected new product. All items anchored on 1=very poor and 7=very good. Similar to financial performance measure, using the 7-point Likert scales (1=very poor and 7=very good) the other four items were generated to assess non-financial performance. Firm age and firm size which may have influences on NPD performance are the main control variables that were considered in this survey.

ANALYSIS

Reliability, validity, and descriptive statistics

CFA analysis was performed via AMOS 23.0. It was also employed to assess the dimensionality, validity, and reliability of scales by analyzing the CFA model output data (Najafi-Tavani et al. 2013, p.3390). The analysis of measurement is shown in Table I which contains the loadings of each item, means, standard deviations, average variances extracted (AVEs), composite reliabilities (CRs). The final measurement model fitted the data well, with $\chi 2=269$(d.f.=160); (IFI) =0.924; (TLI)=0.9; (CFI)=0.921 and (RMSEA)=0.068. All item loadings are highly significant (P<0.001), and fall into the range of >0.6 (Hair et al. 2010). Furthermore, the composite reliabilities(CRs) of all construct are greater than 0.7 demonstrating internal reliability and average variances extracted (AVEs) measure ranged from 0.542 to 0.721, all exceeding the 0.5 thresholds (Bagozzi & Yi 1988). In support of discriminant validity, as Fornell and Larcker (1981, p.47) suggest we compared The square root of the AVEs of each latent construct with its correlation with other constructs. The estimates found that no associated correlations of the construct exceeded the square root of the AVEs for all construct, therefore, all constructs meet the Fornell-Larcker criterion of discriminant validity.

RESULTS

We followed structural equation modeling(SEM) technique in AMOS 23.0 to test the proposed hypotheses using the maximum likelihood method. In order to test the main and interaction effect separately, two models were generated. Model 1 contains all variables except interaction one. The interaction term (inter-firm collaboration× intra-firm collaboration) were added to the baseline model to develop interaction Model2. The estimates show that the baseline structural model adequately fitted the data, with $\chi 2=314.692$; d.f.=191; IFI=0.92; TLI=0.9; CFI=0.92; and RMSEA=0.07. Inter-firm collaboration has positive and significant effect on financial NPD performance (SPC=0.211, p<0.05, tvalue=2.293) while has no direct impact on non-financial NPD performance (SPC=0.304, p>0.05, tvalue=0.713) supporting $H1_a$ and no support for $H1_b$. The path from intra-firm collaboration to either financial NPD (SPC=0.045, p<0.05, tvalue=0.482) or non-financial NPD performance (SPC=0.304, p<0.05, tvalue=3.309)

is positive so the findings provide evidence in support of $H2_a$ and $H2_b$ hypotheses. The relationship between inter–firm collaboration and innovation capability is not significant (SPC=0.096, p>0.05, tvalue=1.05) not supporting H3. The results further show intra-firm collaboration and innovation capability significantly and positively related(SPC=0.187, p<0.05, tvalue=1.989), hence supporting H4 as well. All independent Variables were mean-centered before the interaction terms being into the analysis. The path from IEC×IAC to Innovation capability is positive and significant (SPC=0.295, p<0.05, tvalue=3.027) in support H6 that predicts interaction effect on innovation capability is positive. We find strong support for the hypotheses $H2_{a,b}$ asserting that innovation capability affects non-financial NPD performance (SPC=0.363, p<0.01, t value=3.633) as well as financial NPD (SPC=0.245, p<0.05, t value =2.522) positively. Adding the interaction term (IEC×IAC) to the baseline model (Model1) rises R^2 value related to the variance in innovation capability to 17% while the Model1 explained 10% of the variance in innovation capability, 17% of the variance in financial NPD performance, and 0.17% of the variance in non-financial NPD performance. This incremental change in total variance explained the (ΔR^2=0.7%) in innovation capability.

DISCUSSION AND CONCLUSION

Inter-firm and Intra-firm collaboration and innovation capability

The results fail to support the positive relationship between inter-firm collaboration and innovation capability. A possible explanation of our findings and the inconsistency of the literature result is nonpaying attention to contingency factors related to the link between inter-firm collaboration and innovation capability. This study finding provides empirical support for the argument that intra-firm collaboration has a significant role in the success of the NPD project which allows the firm to be more innovative and perform better. While Iran has faced international sanctions, the import of the vital equipment's into Iranian industry section is prohibited, hence firms by relying on their limited technical information have tried to strengthen functional unit skills and knowledge to design and develop these products to tackle the sanctions.

Interaction of inter-firm and intra-firm collaboration and innovation capability

This study empirically illustrated the positive relation of interaction between intra-firm and inter-firm collaboration an innovation capability. Due to our literature review, our study is probably one of the first to empirically investigate the effect of interaction, despite the fact that a few numbers of researches have examined intra-firm and inter-firm collaboration in a study separately (Colombo 2001, p.17; Schleimer & Shulman 2011, p.869). Therefore, this result suggests firms with a high level of cooperations among units and sufficient knowledge to exploit any resources as inter-firm collaboration outputs.

Innovation capability and NPD performance (i.e. financial and non-financial)

The findings of this paper provide empirical evidence that innovation capability improves financial and non-financial NPD performance as the two key dimensions of performance assessment. Firms have considered innovation as a key factor in their success in the fast change competitive environment (Najafi-Tavani et al. 2018, p.193; Balachandra & Friar 1997, p.285). "Innovation outsourcing has become a megatrend has helped many companies such as IBM, Hewlett Packard, and Dell reduce their R&D budgets while relying on their external contracting suppliers to take more responsibility for the design and product development" (Kim, Chiou & Calantone, 2018, p.838). However, some other studies (Griffin & Mahon 1997,

p.5; Calantone, Harmancioglue & Dorge, 2010, p.1065) have reported a negative effect on this relationship by considering some criteria in evaluating.

Inter-firm and Intra-firm collaboration and NPD performance

The research findings show the inter-firm collaboration linked positively to financial NPD performance, while the results indicate the insignificant relationship between inter-firm collaboration and non-financial NPD performance. Regarding contingency theory, the paradox results (Griffith & Lee 2016, p.18; Tsai 2009, p.767; Freel 2005, p.129), may be caused by existence contingent factors in the collaboration environment with uncertainty and complexity. RBV theory asserts that engaging in cooperation, affected performance through generating new capabilities, accordingly, investigating the relation indirectly is recommended (Tsai 2009, p.775). Intra-firm collaboration may significantly enhance financial and non-financial NPD performance. In line with studies arguing that attention to intra-firm collaboration is essential in achieving higher levels of performance, our studies results indicate the cooperation capabilities within a firm related positively to NPD performance (Calantone, Cavusgil & Zhao, 2002 ,p.522; Clercq, Thongpapanl & Dimov,2011). As a result of cooperation in the product supply chain, innovative technology can increase NPD performance and ultimately improve financial indicators.

Managerial implications

For managers, the first implication is that priority would be given not only to the collaboration in the supply chain with external partners but also to their complementarity capability caused by intra-firm collaboration. Due to our study result, intra-firm collaboration reinforces innovation capability. Firms who have a well-informed organization that absorbs information from external resources and exchange the knowledge between functional units are more capable to be innovative. Managers should be noticed cooperation with other partners although is significantly improve the financial performance of NPD but may not affect the non-financial performance of NPD project.

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