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Integration between radical innovation and incremental innovation to expedite supply chain performance through collaboration and open-innovation: A case study of Indonesian logistic companies

Erna^{a*}, Surachman^a, Sunaryo^a and Atim Djajuli^a

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^aPost Graduate Doctoral Program in Management Science Economics and Business Faculty, Brawijaya University, Indonesia

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ABSTRACT

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During the past few decades, logistic industry has grown rapidly worldwide, however, the performance of Indonesian logistic industry is decreasing due to various supply chain issues. Logistic companies are suffering with low performance which has negative consequence on gross domestic product (GDP). To address this issue, the primary objective of the current study is to investigate the role of innovation in supply chain management. By using the cross-sectional research design, 300 questionnaires were distributed among the employees of logistic companies. 21 The questionnaires were distributed by using area cluster sampling. PLS-SEM was preferred to achieve the objectives of the current study. Findings of the study have revealed that collaboration with supplier, customers and external partners had significant positive relationship with radical and incremental innovation. Moreover, radical and incremental innovation maintained significant positive relationship with open-innovation performance. An increase in open-innovation increases the supply chain performance among Indonesian logistic companies. Therefore, logistic companies must focus on innovation to boost their performance. This study contributed in 4 to the body of literature by examining the important role of radical and incremental innovation in supply chain performance.

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1. Introduction

During the past few decades, logistic industry has grown rapidly worldwide (Hameed et al., 2018). This industry has significant effect on the economic development of every country (Lan & Zhong, 2018). An increase or decrease in logistic industry performance plays major role in gross-domestic product (GDP). Therefore, to boost economy, logistic and supply chain industry has important contribution. However, the performance of Indonesia logistics industry is decreasing day by day. According to the report of World Bank in 2016, the Indonesian logistic industry decreased ranking up to 63 as compared to 13 the Malaysia, Thailand and Singapore. Indonesian logistic industry has low performance as compared to Malaysia, Thailand and Singapore. Decreases in performance has negative effect on gross-domestic product (GDP) which shows negative effect on overall economy of Indonesia.

* Corresponding author

E-mail: rma_rian@yahoo.com (Erna)

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Logistic performance index released by World Bank in 2016, shown in Fig. 1, demonstrates that Singapore is at top in transport related logistic infrastructure following by the South Africa, Malaysia, China, Thailand, Brazil, Mexico, India, Philippines and Vietnam. However, Indonesian transport related logistic infrastructure facing worse condition as compared to all these countries. The present worse conditions of Indonesian logistics are based on various issues such as supply chain issue. Moreover, Fig. 2 indicates tax revenue percentage of gross-domestic product (GDP) from logistics. It is evident that in tax revenues, Indonesian logistic is also facing issues due to which it has vulnerable conditions as compared with the other countries. Therefore, logistic sector must insure better supply chain practices.



Fig. 1. Logistic Performance Index (Quality of trade and transport related infrastructure) Source: World Bank, World Development Indicators (2016)

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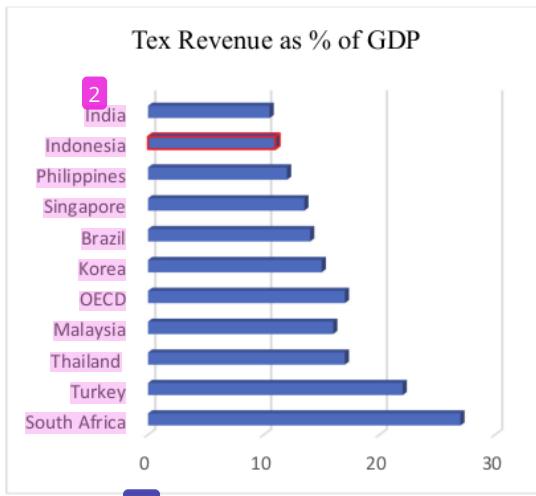


Fig. 2. Logistic Tax Revenues Source: World Bank, World Development Indicators

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Numerous research studies emphasised on the logistic from various views (Anselmsson, 2006; Hsu, 2006; Maurice, 2013; Martínez & Adame, 2014; Purnama, 2014; Chielotam, 2015; Castorena et al., 2016; Hu et al., 2016; Albasu & Nyameh, 2017; Cichosz et al., 2017; Mowlaei, 2017; Kucukkocaoglu & Bozkurt, 2018; Maldonado-Guzman et al., 2018; Liu et al., 2018), however, in rare cases any research study properly documented the logistic supply chain performance of Indonesian logistic companies. In rare cases any study carried out a note of various threatening issues as well as performance of Indonesian logistic industry. Therefore, this research study is one of the attempts to fill this research gap by investigating the supply chain performance in Indonesia. This research study provided the research framework to enhance supply chain performance and to increase the contribution of Indonesian logistic companies in gross-domestic product (GDP).

Therefore, these issues can be resolved through various innovative strategies. Innovation as the expansion and implementation of various creative ideas for advancing as well as evolving the mission of an organization (Khan et al., 2018; Santhi & Gurunathan, 2014; Anyanwu, et al., 2016; Mosbah et al., 2017; Maroofi et al., 2017; Jones & Mwakipsile, 2017; Malarvizhi et al., 2018, Le et.al. 2018; Rubin & Abramson, 2018). Innervational activities enhance the performance by taking competitive advantage. Through innovation activities, logistic companies can develop new strategies for supply chain management after collaborating with customers, suppliers and partners.

Innovations are in various types, however, in the current study two major innovation types, namely; radical innovation and incremental innovation are selected. Both radical and incremental innovation have major role in logistic company's performance. Radical innovation is based on new technology in product, process or services which has not been used previously, however, incremental innovation is

based on improvement in existing technology such as reduction in cost and increase the effectiveness (Sen & Ghandforoush, 2011). Radical innovation is heavily based on new technology development rather than improvement in old technology and however, incremental innovation is based on small improvement in products, processes and services.

In cases of logistic firms, both radical and incremental innovation are important. Because to improve the supply chain process, new technology and improvement in existing are required to increase the performance. As improvement in supply chain services influences on customer satisfaction which is important to enhance performance (Heikkilä, 2002). However, both incremental and radical innovation require collaboration with customers, suppliers and external partners. According to Chesbrough (2006), external and internal knowledge are the important for innovation. According to Hameed et al. (2018) knowledge from supplier, customers and external partners is essential for international activities which causes to develop open-innovation with the help of internal innovations. Open-innovation is the process of inflows and outflows of knowledge from the boundaries of the firm in shape of idea commercialization (Chesbrough, 2006).

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Therefore, the primary objective of the current study is to investigate the role of innovation in supply chain management. Moreover, the sub-objectives are stated below;

1. To examine the role of collaboration to expedite incremental and radical innovation.
2. To examine the role of incremental and radical innovation to expedite open innovation.
3. To examine the role of open-innovation in supply chain management.

Fig. 3 shows the framework of the current study. It shows how collaboration between supplier, customers and external partners facilitates radical and incremental innovation. It also shows that radical and incremental innovation enhance the open-innovation and finally open-innovation enhances the supply chain performance of logistic companies. This is one of the pioneer studies, which investigate the role of radical innovation, incremental innovation and open-innovation to resolve the various supply chain issue of Indonesian logistic companies.

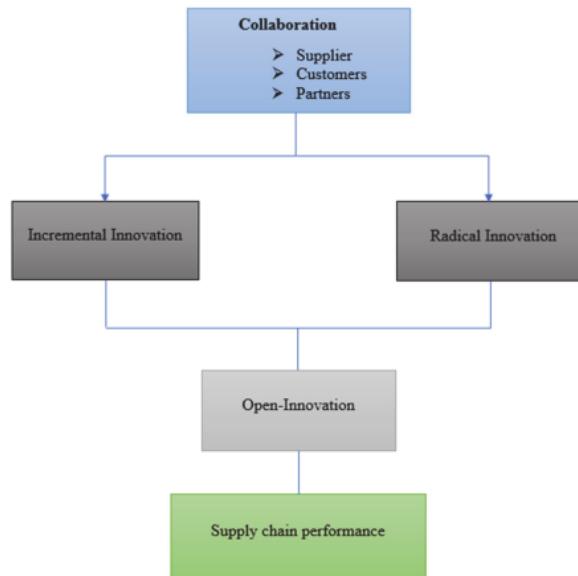


Fig. 3. Theoretical framework of the current study

2. Hypotheses Development

The discussion about radical innovation and incremental innovation has been progressively articulated worldwide (Banerjee & Cole, 2011). As communication enhances and international businesses through

fast development in the IT industry, critical issues identified with radical innovation and adjustment of new technologies should be addressed (Chesbrough, 2006). Particularly it is important that how radical innovation and incremental innovation influence on the performance of the supply chain.

Radical innovation speaks to functionality or technology which has not been used previously. It recommends a change in outlook, similar to the innovation of the wheel, transistor, microprocessor, etc. It is accomplished by utilizing a mix of existing technologies to create another one that has not been seen used previously. The second sort of innovation is called incremental. This kind of innovation enhances the existing functionalities by decreasing cost, enhancing effectiveness, etc. (Sen & Ghandforoush, 2011). Radical innovation is an invention that replaces the current business framework. Unlike incremental innovation⁹, radical innovation blows up the present system and replaces it with something entirely new. A radical product innovations bring extraordinary customer benefits, substantial strategies of cost reductions, or the capability to create new businesses methods, any of which lead to superior performance (Slater et al., 2014).

Radical innovation is shown in Fig. 4. This innovation type has significant effect on performance (Baker et al., 2014) by adopting various innovative strategies in supply chain. Radical innovation gives some breakthrough by providing the solution of existing problems. It has the ability to transform the market and society. Therefore, it works like a strategic tool to enhance the performance of logistic companies by implementing better strategies of supply chain.

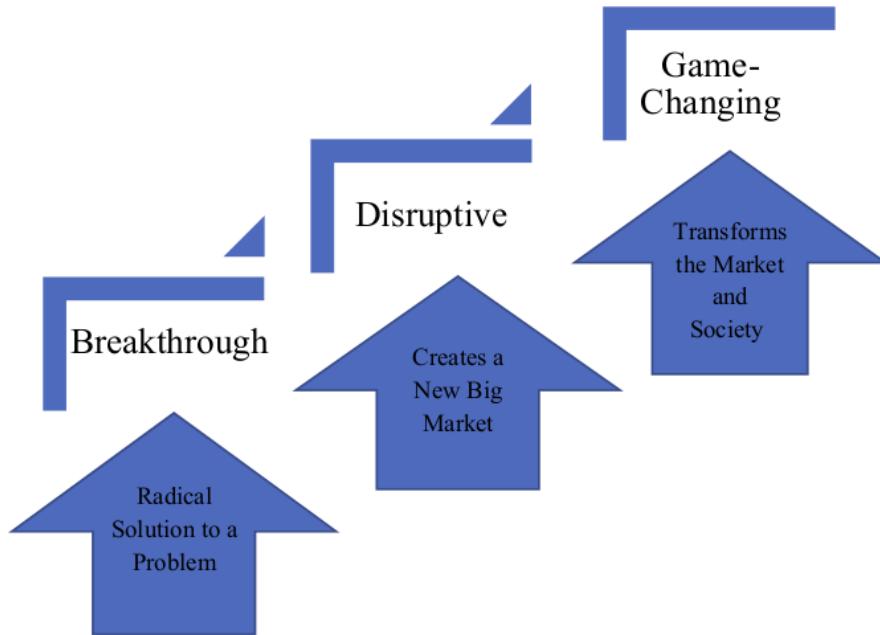


Fig. 4. Radical innovation

Incremental innovation is one of the common form of innovation. It employs the current technology and increases value to the customer particularly in logistic companies. Incremental innovation remains an significant instrument for preserving as well as growing radiology activities within a dynamic marketplace (Rubin & Abramson, 2018). Incremental innovation is most important to make changes in the current supply chain activities which enhances the overall performance by decreasing the supply chain issue, particularly in Indonesian logistic companies. However, enterprise risk management (Hameed et al., 2017), fluctuates due to political influence on industry (Maqbool et al., 2018) and investors' decision making in supply chain activities cannot be neglected. Incremental innovation is shown in Fig. 5 which indicates a small improvement

rather than a huge technological shift. These small improvements can be the base of big technological development. With the help of effective knowledge management, incremental innovation performance can be increased (Rupietta & Backes-Gellner, 2017) which contribute significantly towards the performance of supply chain (Para-González et al., 2018). It is evident that radical innovation is rare but having big change, on the other hand, incremental innovation is more but small improvements in technology, product and process which may bring huge change.

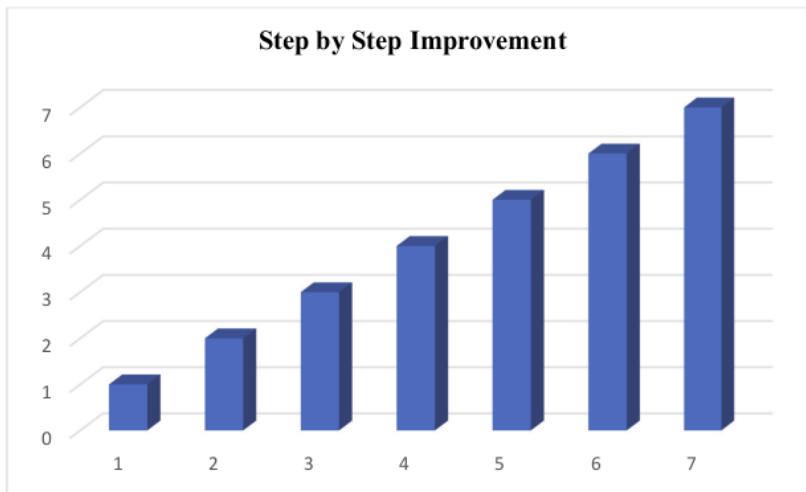


Fig. 5. Incremental Innovation

Collaboration with customers, supplier and external partners has significant role in incremental and radical innovation. According to the Chesbrough (2004), both external and internal knowledge from suppliers and customers are important to bring open-innovation. Gradually, firms balance their internal innovation competences with solutions, ideas, as well as technologies from external partners such as suppliers (Chesbrough, 2008). Suppliers are supposed to improve or even drive innovation by giving valuable knowledge (Faems et al., 2005) in products, process and services, as well as in the context of service in which suppliers innovate to advance the daily supply chain operations 15 formed for the buyer. We expand on contracting literature to characterize innovation as all supplier-initiated, proactive endeavour that outcome in new (i.e., radical) or enhanced (i.e., incremental) methods for conveying administrations (Johnson & Medcof, 2007). In the administration outsourcing setting, these innovations focus on the tangible parts of the administration framework (Gallouj & Weinstein, 1997). A key element is that the company takes advantage of the supplier's entrepreneurial knowledge and thoughts (Shimizu, 2012). Acquisition of entrepreneurial knowledge and thoughts can bring new ideas when the company use this knowledge in effective manner. These ideas from external partners and customers help to bring open-innovation. Therefore, radical and incremental innovation further enhance the open innovation practices among logistic firms. These open-innovation practices enhance the supply chain activities.

"Open-innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, 2006). Fig. 6 shows the mechanism of open-innovation. It 13 the both outside-in and inside-out transfer of technologies and ideas (Lichtenthaler, 2008). It is the process in which companies use external knowledge to expedite internal innovations and bring new ideas to the market and commercialize these ideas. It has significant contribution in supply chain performance.

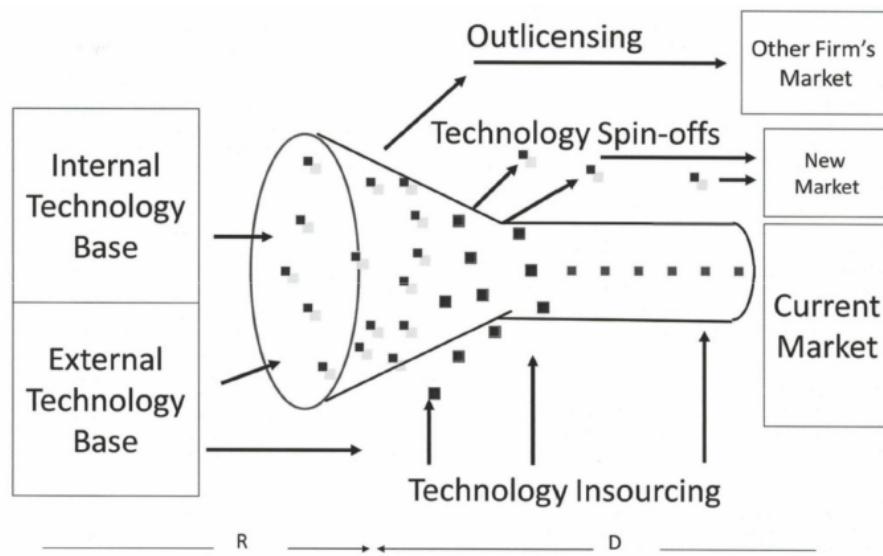


Fig. 6. Open-Innovation
Source: (Chesbrough, 2012).

In this process of collaboration both parties, supplier and company take benefit from the innovation (e.g., better administration for the buyer as well as more proficient administration conveyance for the supplier), which happens within the setting of a particular buyer-supplier relationship, particularly in the activities that a supplier conducts and as a team with a particular buyer. As a component of their day by day activities, suppliers may incrementally enhance or radically change the day by day benefit conveyance towards the buyer, with the point of all the productively as well as adequately accomplishing execution of targets, for example, quality furthermore, conveyance time (Sumo et al., 2016). While this is the most important part to incorporate (incremental) process innovations, suppliers may likewise roll out more radical improvements, for instance to the unmistakable parts of the exchange (such as another technology), which may result in significantly more noteworthy client benefits in respect to existing products and administrations (Chandy & Tellis, 1998). These innovations bring supply chain innovativeness and increases the performance.

Finally, by sum up the discussion, it is evident from literature, collaboration with supplier, customers and external partners is the most crucial to bring innovation. Collaboration with supplier, customers and external partners facilitates radical and incremental innovation. Radical and incremental innovation further enhances the open-innovation activities which finally increases the performance of logistic companies. Therefore, by following the discussion, below hypotheses are concluded;

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H1: There is a significant positive relationship between collaboration and incremental innovation.

H2: There is a significant positive relationship between collaboration and radical innovation.

H3: There is a significant positive relationship between incremental innovation and open-innovation.

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H4: There is a significant positive relationship between radical innovation and open-innovation.

H5: There is a significant positive relationship between open-innovation and supply chain performance.

3.2 Research Methodology

While considering the objectives as well as extent of research in mind along with the nature of population and the design of sampling, it is observed that the quantitative method is suitable technique

used to measure the objective⁵ (Burns & Grove, 1993). The current study examined the effect of radical and incremental innovation on supply chain performance. Therefore, by examining the objectives, research problem and nature of the study, cross-sectional research design was elected (Ul-Hameed et al., 2018). Moreover, according to Brink and Wood (1998), quantitative data "can be transposed into numbers, in a formal, objective, systematic process to obtain information and describe variables and their relationships". Therefore, quantitative research technique is best to reject or accept the hypotheses.

4

Data were collected from the employees of logistic companies in Indonesia. Only those employees were selected who had direct relationship with innovation activities. All the questionnaires were distributed through area cluster sampling technique. Actually, the sampling frame was not available, that is the reason area cluster sampling was employed. As it is one of the suitable techniques when sampling frame is not available (Sekaran, 2003). Furthermore, by following the instructions of Comrey and Lee (1992), 300 sample size was selected. From 300 distributed questionnaires, only 212 were returned. From 212 questionnaires, 6 questionnaires were incomplete. Therefore, 206 questionnaires were used to analyse the data. Finally, Smart PLS-SEM was used to test the hypotheses.

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4. Data Analysis and Results

4.1 Reliability and Validity Analysis

PLS-SEM is one of the prominent techniques to analyse the data. It is one of the suitable techniques to handle complex models. In the current study, the recommendations of Henseler et al. (2009) are followed. According to Henseler et al. (2009), PLS-SEM majorly contains two major sections. One is measurement model assessment and second is structural model assessment. First of all, the measurement model was assessed to check the reliability as well as validity. Table 1 shows the results which indicates that all the factor loading were above 0.5 as recommended by Hair et al. (2010). Moreover, average variance extracted (AVE) was greater than 0.5 and composite reliability was greater than 0.7. Factor loading is shown in Fig. 7. Moreover, Table 2 shows the cross-loadings for discriminant validity. Convergent validity was achieved through AVE.

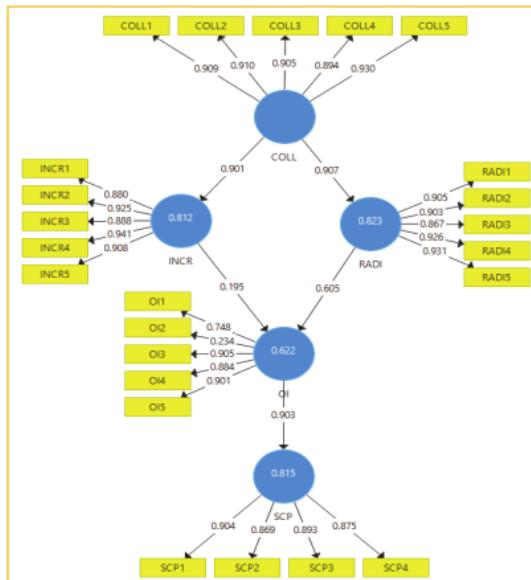


Fig. 7. Factor Analysis

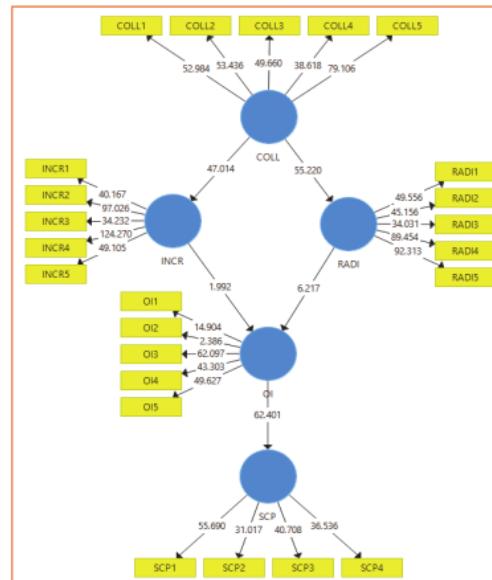


Fig. 8. Measurement Model (Hypotheses Testing)

Table 1

Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
COLL	0.948	0.948	0.96	0.827
INCR	0.947	0.948	0.959	0.826
OI	0.805	0.883	0.872	0.606
RADI	0.946	0.947	0.958	0.822
SCP	0.908	0.909	0.936	0.784

Table 2

Cross-Loadings

	COLL	INCR	OI	RADI	SCP
COLL1	0.909	0.844	0.684	0.826	0.557
COLL2	0.910	0.807	0.708	0.797	0.618
COLL3	0.905	0.810	0.67	0.823	0.566
COLL4	0.894	0.799	0.672	0.801	0.603
COLL5	0.93	0.836	0.745	0.876	0.67
INCR1	0.835	0.880	0.668	0.815	0.582
INCR2	0.831	0.925	0.729	0.866	0.607
INCR3	0.774	0.888	0.626	0.794	0.509
INCR4	0.837	0.941	0.739	0.882	0.634
INCR5	0.813	0.908	0.664	0.851	0.556
OI1	0.807	0.866	0.948	0.841	0.591
OI2	0.187	0.188	0.734	0.225	0.143
OI3	0.622	0.567	0.905	0.601	0.84
OI4	0.601	0.587	0.884	0.632	0.854
OI5	0.606	0.584	0.901	0.623	0.834
RADI1	0.817	0.899	0.718	0.905	0.619
RADI2	0.777	0.811	0.681	0.903	0.616
RADI3	0.802	0.79	0.656	0.867	0.584
RADI4	0.865	0.861	0.759	0.926	0.673
RADI5	0.846	0.839	0.74	0.931	0.67
SCP1	0.63	0.612	0.828	0.656	0.904
SCP2	0.574	0.533	0.753	0.564	0.869
SCP3	0.589	0.577	0.807	0.648	0.893
SCP4	0.553	0.534	0.807	0.603	0.875

4.2 Hypotheses Testing

PLS-SEM bootstrapping is one of the prominent techniques to test the hypotheses (Henseler et al., 2009). Fig. 8 shows the PLS bootstrapping. In Fig. 8 t-value of each relationship is shown. It is evident that t-value is greater than 1.96 which is one of the indicators to accept the hypotheses. All the hypotheses have t-value greater than 1.96. Therefore, all the hypotheses (H1, H2, H3, H4, H5) are accepted.

Table 3

Hypotheses Testing Results

	Original Sample (O)	Sample	Standard Deviation	T Statistics	P	Decision
COLL → INCR	0.901	0.900	0.019	47.014	0.000	Supported
COLL → RADI	0.907	0.907	0.016	55.22	0.000	Supported
INCR → OI	0.195	0.189	0.098	1.992	0.047	Supported
OI → SCP	0.903	0.904	0.014	62.401	0.000	Supported
RADI → OI	0.605	0.610	0.097	6.217	0.000	Supported

Moreover, R-square value is shown in Table 4. The R-square value is 0.815 which indicates that all the group of variables, namely; incremental innovation, radical innovation, collaboration and open-

innovation collectively explain 81.5% of variance in supply chain performance. This R-square value is considered as strong (Chin, 1998). Moreover, effect size (f^2) is given in Table 5.

Table 4
Variance Explained (R^2)

	Variance Explained (R^2)
Supply Chain Performance	0.815

Table 5
Effect size (f^2)

Variable	Effect size (f^2)	Strength
Collaboration	0.806	Strong
Incremental Innovation	0.236	Moderate
Radical Innovation	0.136	Moderate
Open-Innovation	0.706	Strong

5 Research Findings

The current study has examined the effect of innovation on supply chain management. It is one of the attempts to address various issues related to the Indonesian logistic companies. As due to various supply chain issue, the performance of Indonesia logistic industry is decreasing. Therefore, the current study has provided a framework to enhance performance for improving supply chain activities. Data were collected from the employees of logistic companies in Indonesia. Moreover, the effects of collaboration with partners and customer were examined on incremental and radical innovation.

It is found that collaboration has significant positive relationship with incremental innovation with t-value 47.014 and p-value 0.000. It indicates a direct relationship between collaboration and incremental innovation. Increases in collaboration with customers, suppliers and external partners enhances the incremental innovation. However, decreases in effective collaboration can decrease the pace of incremental innovation.

Following by the incremental innovation, radical innovation also has same results. It is found that radical innovation and collaboration had significant positive relationship with each other's with t-value 55.22 and p-value 0.000. Therefore, an increase of collaboration with customers, suppliers and external partners will increase the radical innovation.

Nevertheless, it is found that incremental and radical innovation enhance the open-innovation activities. Increases in incremental and radical innovation has effect on open-innovation of Indonesian logistic companies. It is found that incremental and radical innovation had significant positive effect on open-innovation with t-value 1.992, 6.217 and p-value 0.047, 0.000, respectively.

Finally, it is revealed that open-innovation had significant positive relationship with supply chain performance in Indonesian logistic companies. This relationship found t-value 62.401 and p-value 0.000. Therefore, increases in open-innovation increases the supply chain performance. Finally, it is investigated that collaboration with customers, suppliers and external partners enhances the incremental, and radical innovation, additionally, incremental and radical innovation increases the open-innovation which has significant positive effect on supply chain performance.

6. Conclusion

While analysing the data, it was found that innovation had serious role to enhance the supply chain performance of logistic companies. Innovation can be considered as a strategic tool to resolve various issues related to Indonesian logistic companies. It is important to understand how innovation is effective for logistic companies. The current study has found that the role of incremental and radical innovation

was crucial to expedite supply chain. However, to boost incremental and radical innovation, the role of suppliers, customers and external partners was most significant. Collaboration with suppliers, customers and external partners bring new ideas which can be further improved to create innovation. Therefore, collaboration is important to enhance both incremental and radical innovation. Moreover, incremental and radical innovation enhance the open innovation activities. Finally, increases in open innovation can decrease the issues in logistic supply chain and enhance the performance.

Therefore, it is recommended to the Indonesian logistic companies to enhance collaboration with customers, suppliers and external partners. Future research is required to include knowledge management strategic in the model of the current study. As knowledge from customers, suppliers and external partners requires proper knowledge management to innovate something new in supply chain services.

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