What Drives a Firm Innovation Success? Insight from Indonesian Firms Experiences

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Abstract. He current study investigates determinants of innovation success among Indonesian firms by exploiting Indonesia Innovation Survey (IIS) data. Currently, insights on on different factors that influence innovation success of Indonesian firms is relatively few. Therefore, the current study to shed the lights on such research gap. Using logistic regression, the impact of internal R&D, firm openness decision, government financial support, and appropriability condition on innovation decision is assesed. Subsequently, Tobit regression is employed to assess the effect of the independent variables on innovation success/performance. The study results show that only internal R&D that drives innovation success. Further, internal R&D along with the implementation of open innovation strategy and strategic protection positively influence innovation success new to the market. The study emriches innovation literature in developing countries context (Indonesia) on the broad factors that drive innovation success that previously remain unexplored.

Keywords: Influencing factors · innovation success · Indonesian firms · innovation survey

1 Introduction

In the context of Indonesia, insight on factors that drive innovation success using innovation survey data to date remain unexplored. Existing research tend to focus on productivity and business performance as the indicator of firm performance in a specific sector industry. For instances, foreign direct investment as the driver of Indonesian manufacturing firm productivity [1], export and import as determinants of Indonesian manufacturing productivity [2], productivity in Indonesian automotive industry [3], international technology or R&D spill overs as the driver of productivity growth [4, 5], a link between innovation strategy and non-financial performance in oil and gas companies [6], and the impact of cooperation activities on business performance in food processing industry cluster [7].

Although previous researches that exploit Indonesia Innovation Survey (henceforth IIS) have been conducted, the studies do not capture broad factors that drive innovation success. For examples, open innovation implementation and its impact on innovation

performance [8], the impact of innovation barriers on innovation performance [9], innovation barriers and its link to open innovation [10, 11], and innovation value chain [12, 13].

In developed economies empirical context, although different factors that link to innovation performance using innovation survey data have been studied enormously, there is limited research that examine broad innovation success' determinants in a single study. Majority of innovation studies that use innovation survey data mostly derived from community innovation survey or CIS. Using Italian innovation survey data, Berchicci [14] investigates the impact of R&D activities and external knowledge acquisition on innovation performance. Other scholars, exploits CIS data to study the link between knowledge search strategy and innovation performance [15–17]. A large strand of CIS-based open innovation studies as the driver of innovation performance also has been investigated [18–21]. External knowledge and absorptive capacity as the drivers of innovation performance also was conducted [22, 23]. While internal R&D consistently and positively affects innovation success/performance [24–27].

Therefore, the main objective of this study is to narrow such research gap by exploiting the IIS 2014 data that consists of manufacturing and services firms. It is expected that the study' results not only enrich innovation literature in the context of an emerging economy, but also provides managerial insights for practitioners. In this study, potential factors that may drive innovation success consists of R&D activities, open innovation indicators, government funding, and intellectual property right (IPR).

This study investigates influencing factors of innovation success across Indonesian innovative firms using IIS 2014 data that covers 2011–2013 periods of survey. To address the study objective, therefore the following research question is proposed "to what extent broad factors, such as R&D activities, open innovation indicators, government funding, and IPR, drive innovation success of Indonesian firms?"

2 Literature Review and Hypothesis

Indonesian Firms and Their Innovation Success' Drivers
This section discusses earlier studies that used IIS to look at the effects of different variables on innovation success in Indonesian firms. IIS 2011 measured the effect of open innovation practices on innovation and performance by looking at the breadth and depth of searches for outside knowledge [8]. However, the study focused on Indonesian manufacturing firms since the IIS 2011 only covers manufacturing firms. It turned out that both external search breadth and depth significantly and positively affect innovation success. It indicates that Indonesian firms also perform open innovation like many other firms in developed economies.

A recent study, using IIS 2014, explores different types of knowledge searching activities (KSA) performed by Indonesian manufacturing and services firms as well as its impact on innovation success [28]. The study reveals that Indonesian innovative firms perform different types of KSA such as science-, market-, and R&D and cooperation-based KSA. Surprisingly, only market based KSA that significantly and positively affect innovation success. While, a study that investigate different factors that hinder innovation performance shows that different barriers affect innovation success differently [9].

Based on the reviewed studies, it may be concluded that to date there is no consensus on what a wide range of factors that affect the success of innovation perfomed by Indonesian innovative enterprises since such issue to date remain unexplored.

Drivers of Innovation Success

Conducted CIS-based innovation studies have measured a wide range of factors that influence firms' innovation success. However, it is relatively few a single study that captures broad factors that drive innovation success. Previous studies that employ data derived from innovation survey consistently show positive link between internal R&D and innovation success (Ganotakis & Love, 2012). This seems natural since many firms in developed economies are R&D-based innovative firms. This differentiates firms in developing compared to their counterparts in developed economies [29].

In terms of open innovation practices, a large strand of studies in both developing countries e.g. [30] and developed countries [18, 19, 31, 32] show positive relationship between open innovation and innovation success with different degree of variations of relationship because of the differences on external search breadth and depth. To differentiate with previous open innovation studies, in this study, broader open innovation measurement such as R&D acquisition (external R&D); acquisition of machinery, equipment and software; acquisition of other external knowledge; and cooperation activities are employed.

In relation to the link between government support on funding and innovation success, surprisingly, there is no positive correlation on such linkage [25, 33]. Hence, it may indicate that different factors lead to different innovation success. Apart from discussion on the broad factors that drive innovation success, the link between such factors and innovation decision are also discussed. Based on the literature review, hence, a proposition can be derived:

Broad factors, such as R&D activities, open innovation indicators, government funding, and IPR, drive innovation success (that is measured by sales of product innovation new to the market and to the firms) differently.

3   Methodology

Data and Sample

To date, Indonesia has only three waves of innovation survey: 2008, 2011, and 2014. Unfortunately, there is no update innovation surveys conducted by Indonesian government. Data was generated from the last wave of innovation survey conducted in 2014. In terms of sampling method, the survey used multi-stage random sampling. Usable questionnaires that were successfully collected was 927. The surveyed firms are categorized using the International Standard Industrial Classification (ISIC) Rev. 3.1 in the survey. To guide the data collection and interpretation, the survey used the Oslo Manual (OECD/Eurostat, 2005). Since this study focuses on innovative firms, only innovative firms are included as the sample. The innovative firms refer to any firms that not only produced any types of innovation such as product, process, organisational and marketing, but also allocated expenditure to perform innovation activities during 2011–2013

period. Of the collected 927 firms, it turns out nearly 58% (535) can be classified as innovative manufacturing and services firms.

Independent Variables
Independent variables consist of internal R&D, open innovation imlpementation, government financial support, and appropriability condition. Open innovation indicators consist of breadth and depth of external searching; acquisition of R&D (external R&D); acquisition of machinery, equipment, and software; acquisition of other external knowledge; and cooperation activities. The last independent variable is appropriability condition. It consists of formal protection and strategic protection. Formal protection is a dummy variable which takes the value 1 if the enterprise used design patent, trademarks, or copyright to protect inventions or innovations during 2011–2013. Strategic protection is a dummy variable which takes the value 1 if the enterprise used complexity of design, secrecy, or lead-time advantage on competitors to protect inventions or innovations during 2011–2013.

Borrowing from a study conducted by Laursen and Salter [18, p. 140], the external search breadth in this study refers to the total number of sources of external knowledge used, which ranges from 0 when no external information is implemented to 9 when all external information is employed. Laursen & Salter [18, p. 140] argue that "firms that use higher numbers of sources are more open, with respect to search breadth than firms that are not". As a result, the firm will be more open if they have a more significant number of breadth indicators. First, each external knowledge source is coded as a dummy variable, with 0 for not using any knowledge source and 1 for using the given knowledge source. Then, the nine sources of knowledge are accumulated so that the firm's score is 0 when no external knowledge sources are used and 9 when all external knowledge sources are used. In relation to the depth of external knowledge searching measure, first, each of the 9 sources are coded with 1 when the firm uses the source to a high degree and 0 in the case of not used, low, or medium use of the given source. Subsequently, the 9 sources are accummulated so that each firm gets the value of 9 when all knowledge sources are used to a high degree, while each firm gets 0 when no knowledge sources are used to a high degree. While the rest of independent variables are dummy variables.

Dependent Variables
Dependent variables are divided into two i.e., innovation decision and innovation success. Innovation decision variable consists of four types of innovation such as product, process, organisational, and marketing innovation. Each type of innovation is dummy variable that is coded 1 if a firm performs a type of innovation during 2011–2013, while 0 otherwise. Following the study conducted by Pippe [34] l, technological and non-technological innovations are the two types of innovation. Product and process innovation are generally classified as technological innovation, while organizational and marketing innovation are commonly grouped as non-technological innovation [34]. Manufacturing predominates in technological innovation, ignoring non-technological innovations frequently used in the services sector (like corporate and marketing). However, there are links between and frequent co-occurrences of technological and non-technological innovations [34].

Table 1. Descriptive Statistics

VARIABLES	OBS.	MEAN	SD	MIN	MAX
Innovation Success					
new2market (Radical innovation)	535	19.91	27.06	0	100
new2firms (Incremental innovation)	535	32.13	32.93	0	100
Innovation Decision					
Product Innovation	535	0.78	0.41	0	1
Process Innovation	535	0.62	0.49	0	1
Organizational Innovation	535	0.67	0.47	0	1
Marketing Innovation	535	0.87	0.34	0	1
Independent Variables					
Internal (in-house) R&D	535	0.46	0.50	0	1
External BREADTH	535	5.22	2.61	0	9
External DEPTH	535	1.53	1.48	0	8
External R&D	535	0.17	0.38	0	1
Acquisition (machine, equip., software)	535	0.71	0.45	0	1
External knowledge acquisition	535	0.29	0.45	0	1
Cooperation	535	0.27	0.45	0	1
Local government funding	535	0.03	0.18	0	1
Central government funding	535	0.02	0.15	0	1
Formal protection	535	0.45	0.50	0	1
Strategic protection	535	0.76	0.43	0	1
Control Variables					
Small firms	535	0.55	0.50	0	1
Medium firms	535	0.33	0.47	0	1
Large firms	535	0.12	0.33	0	1
Exporters	535	0.06	0.23	0	1
Sector 1	535	0.05	0.23	0	1
Sector 2	535	0.11	0.31	0	1
Sector 3	535	0.04	0.21	0	1
Sector 4	535	0.07	0.25	0	1
Sector 5	535	0.47	0.50	0	1
Sector 6	535	0.09	0.29	0	1
Sector 7	535	0.16	0.37	0	1

Source: The author

Table 2. Correlation Outputs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.NEW2MARKET	1.00																
2.NEW2FIRMS	−0.12	1.00															
3.PRODINN	0.39	0.52	1.00														
4.PROCINN	0.16	−0.09	−0.03	1.00													
5.ORGINN	0.07	−0.03	0.04	0.17	1.00												
6.MKTGINN	0.14	−0.01	0.08	0.04	0.11	1.00											
7.INTERNAL R&D	0.19	−0.01	0.15	0.14	0.20	0.13	1.00										
8.BREADTH	0.12	0.00	0.03	0.09	0.16	0.06	0.20	1.00									
9.DEPTH	0.14	0.01	0.06	0.05	0.11	0.08	0.10	0.38	1.00								
10.EXTERNAL R&D	0.05	0.03	0.07	0.08	0.13	−0.02	0.24	0.21	0.08	1.00							
11.ACQUISITION	0.07	−0.10	−0.01	0.15	0.16	−0.01	0.13	0.10	0.07	0.17	1.00						
12.EXTERNAL KNOW	0.05	−0.05	0.03	0.13	0.15	0.08	0.22	0.15	0.12	0.24	0.17	1.00					
13.COOPERATION	0.07	0.05	0.16	0.14	0.16	0.04	0.13	0.06	0.13	0.24	0.14	0.24	1.00				
14.LOCAL_GOV	−0.02	0.12	0.04	−0.03	0.02	−0.02	0.03	−0.04	−0.05	0.12	−0.02	0.03	0.20	1.00			
15.CENTRAL_GOV	0.09	−0.05	−0.01	0.12	0.03	0.02	0.06	0.09	−0.01	0.17	0.07	0.13	0.19	0.33	1.00		
16.FORMAL_PROTECT	0.06	0.02	0.09	0.06	0.13	0.08	0.17	0.23	0.05	0.15	0.12	0.14	0.06	−0.06	0.02	1.00	
17.STRATEGIC_PROTECT	0.09	−0.01	0.00	0.18	0.23	0.00	0.08	0.13	0.09	−0.02	0.11	0.12	0.09	−0.07	−0.03	0.12	1.00

Source: The Author

Finally, the percentage of sales for newly introduced products and companies is the dependent variable of innovation success.

Control Variables
Control variables consist of firm size, exporters, and firm sectors. A firm size indicator is based on the number of employees: small firms consist of 5–19 employees, medium firms contists of 20–99 employees, and large firms consist of more than 100 employees. Of the 535 innovative firms, small firms outnumbered both medium and large firms (55.33%), then followed by medium (32.52%) and large (12.15%) firms. Firm sectors consist of mining and quarrying sector (ISIC code: 10–14); manufacturing sector (ISIC code: 15–37); electricity, gas and water supply sector (ISIC code: 40–43); construction sector (ISIC code: 45); trading, hotel and restaurants sector (ISIC code: 50–55); transport, storage and communication sector (ISIC code: 60–64); and financial intermediation sector (ISIC code 65–67 and 71–74). Exporter variable is dummy variable that is coded 1 if a firm did export activities during 2011–2013, while 0 otherwise.

Statistical Analysis
Logistic regression is used to examine the impact of the independent variables (internal R&D, firm openness decisions, government financial support, and appropriability conditions) on innovation decisions. The effect of the independent variables on the percentage of new products sold to consumers and businesses, which serves as a gauge of innovation success, is also examined using Tobit regression.

4   Findings and Discussion

Descriptive Statistics
Table 1 presents descriptive statistics outputs. It shows that on average around 32% Indonesian innovative firms produce product innovation new to the market (radical innovation) and nearly 20% the firms produce product innovation new to the firms (incremental innovation). Among different types of innovation, marketing innovation is the highest proportion produced by the firms i.e., around 87%. While, around 46% of the firms perform internal R&D. Firm openness indicators show that the firms tend to source information from 5 to 6 external sources (breadth). On average, the firms source information from 1 to 2 external sources intensively (depth). On average, around 71% the firms do acquisition machinery, equipment and software. In terms of external knowledge acquisition, on average, the proportion of the firms that do such acquisition is 29%. The firms that perform cooperation activities with any external networks is accounted for 27%. Surprisingly, very small proportion of the firms that receive funding from local and central government i.e., 3% and 2% respectively. Lastly, the firms tend to adopt strategic protection to protect their intellectual property rights (IPR) i.e., 76%. Table 2 presents the output of correlation analysis of the studied variables. The table shows that in general, there is no very high correlation coefficients that may indicate multicollinearity among the variables.

Undertaking logistics regression, this study shows that internal R&D is the only independent variable that consistently, positively and influence any type of innovation (see

Table 3. Logistics Regressions Outputs

	PRODINNOV	PROCINNOV	ORGINNOV	MKTGINNOV
Internal R&D	**0.110***(0.037)**	**0.090**(0.043)**	**0.099**(0.039)**	**0.079**(0.032)**
BREADTH	−0.005(0.007)	0.003(0.009)	0.010(0.008)	0.002(0.006)
DEPTH	0.011(0.013)	−0.006(0.015)	0.014(0.014)	0.016(0.011)
External R&D	0.059(0.056)	−0.003(0.062)	0.013(0.061)	−0.036(0.041)
ACQUISITION	−0.034(0.039)	**0.094**(0.045)**	**0.071*(0.040)**	−0.014(0.031)
EXT_KNOWLEDGE	−0.033(0.041)	0.044(0.049)	0.045(0.046)	0.037(0.036)
COOPERATION	**0.179***(0.050)**	**0.105**(0.051)**	0.065(0.049)	0.034(0.036)
LOCAL_GOV	0.093(0.132)	**−0.274*(0.144)**	0.013(0.124)	−0.021(0.078)
CENTRAL_GOV	−0.196(0.125)	–	−0.151(0.165)	0.072(0.125)
FORMAL_PROTECT	0.054(0.037)	−0.001(0.043)	0.026(0.040)	0.044(0.031)
STRATEGIC_PROTECT	−0.005(0.041)	**0.140***(0.046)**	**0.184***(0.040)**	−0.025(0.033)
SMALL_FIRM	−0.010(0.065)	−0.085(0.078)	**−0.263***(0.088)**	−0.009(0.049)
MEDIUM_FIRM	−0.043(0.064)	−0.068(0.078)	**−0.214**(0.090)**	−0.008(0.048)
LARGE_FIRM	–	–	–	–
EXPORTER	−0.027(0.081)	0.006(0.109)	0.092(0.106)	0.020(0.074)
Sector 1	**−0.210***(0.074)**	**0.197*(0.104)**	−0.017(0.103)	**−0.187***(0.052)**
Sector 2	0.052(0.066)	**0.254***(0.085)**	**−0.211***(0.073)**	0.063(0.063)
Sector 3	0.040(0.099)	0.131(0.118)	0.130(0.136)	**−0.149**(0.060)**
Sector 4	0.027(0.074)	0.041(0.091)	−0.018(0.089)	**−0.120**(0.051)**
Sector 5	**0.086*(0.049)**	**0.135**(0.057)**	−0.073(0.057)	0.035(0.041)
Sector 6	0.075(0.073)	−0.060(0.083)	0.044(0.084)	0.071(0.069)
Sector 7	–	–	–	–
Observations	535	523	535	535
LR chi2(20)	52.45	60.73	99.67	60.01
Prob > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.093	0.087	0.146	0.145
Log likelihood	−254.783	−319.849	−291.163	−177.567

Source: The authors

Table 3). While firm openness indicators have different impact on innovation decision. For instances, acquisition of machinery, equipment and software positively influence process and organisational innovation. Cooperation has positive impact on both product and process innovation. Of appropriability condition, only strategic protection that positively effect process and organisation innovation. Turning to innovation success (see Table 4), independent variables such as internal R&D, external search depth, cooperation, and strategic protection have positive impact on innovation success new to the market. Marginally, central government funding also has positive impact on such innovation success. While acquisition on equipment discourage innovation access new to the firms. Hence the broad proposition stating that broad factors drive innovation success differently is supported.

Table 4. Tobit Regression Output

	NEW2MARKET	NEW2FIRMS
INTERNAL R&D	**20.547***(4.721)**	1.596(4.197)
BREADTH	0.526(0.984)	−0.047(0.868)
DEPTH	**3.888**(1.585)**	1.360(1.431)
EXTERNAL R&D	−0.783(6.477)	7.314(5.805)
ACQUISITION	3.301(5.146)	−9.913**(4.498)
EXT_KNOWLEDGE	−3.767(5.224)	−2.936(4.694)
COOPERATION	**9.985*(5.336)**	6.488(4.779)
LOCAL_GOV	−16.315(14.675)	31.561***(11.933)
CENTRAL_GOV	**26.227*(15.911)**	−23.739(14.681)
FORMAL_PROTECT	2.455(4.700)	3.482(4.187)
STRATEGIC_PROTECT	**9.738*(5.519)**	−0.633(4.733)
SMALL_FIRM	1.185(7.702)	4.165(7.053)
MEDIUM_FIRM	−4.709(7.655)	5.180(6.975)
LARGE_FIRM	−	−
EXPORTERS	1.292(10.115)	−14.649(9.554)
Sector 1	−24.737*(12.915)	−19.495*(10.380)
Sector 2	19.541**(8.688)	−3.143(7.937)
Sector 3	0.487(12.359)	4.183(10.718)
Sector 4	12.676(10.038)	−7.831(9.015)
Sector 5	12.287*(6.546)	−−0.582(5.726)
Sector 6	−0.804(9.545)	12.003(8.131)
Sector 7	−	−
Observations	535	535
LR chi2(20)	67.5	32.85
Prob > chi2	0.000	0.035
Pseudo R2	0.022	0.0079
Log likelihood	−1533.181	−2056.882

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

5   Conclusions

This study investigates the impact of general factors on innovation success of Indonesian innovative firms by exploiting the IIS 2014 data. Based the study findings, it can be concluded that of independent variables, individually, only internal/in-house R&D that has important role (i.e., strong positive impact) on the four types of innovation/innovation decision. Internal R&D that is implemented with open innovation (such as external search

depth and cooperation) and strategic protection positively influence innovation success new to the market.

The study enriches innovation studies literature in the context of an emerging economy (Indonesia) since this study provides new empirical insight on specific factors that affect the success of innovation activities performed by Indonesian innovative firms that previously has not been conducted. This findings support open innovation concept that suggests to be innovative firms cannot rely on internal R&D and combine it with external knowledge [35]. Especially for majority of firms in developing and poor countries that face substantial innovation barriers [36].

In terms of managerial implication, this study suggests that the success of an innovative firm can be realized if the firm combines internal knowledge that is gained from internal R&D and external knowledge generated from inbound open innovation strategy. Additionally, the firm is also suggested to protect their intellectual property right using strategic protection such as complexity of design, secrecy, or lead-time advantage.

Finally, a few study limitations should be discussed, along with the directions they suggest for future research. First, the analysis of the studied variables relied on cross-sectional data. Therefore, the dynamic effects of any factors influencing innovation success could not be evaluated. Therefore, this opens an opportunity for further studies to investigate the long-term effect of innovation success drivers using panel data from innovation surveys. Second, because this study only looked at Indonesian companies, its conclusions may only be broadly applicable to them because different countries may have different conditions that affect the factors that influence the pattern of innovation success. Therefore, in the future, a comparison study across developing countries in the ASEAN region would be interesting to see both differences and similarities in the determinants of innovation success.

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