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## Article

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# **Coopetition-Based Open-Innovation and Innovation Performance: Role of Trust and Dependency Evidence from Malaysian High-Tech SMEs**

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## **Abstract**

In a highly competitive environment, the phenomenon of coopetition is emerging rapidly among various firms as well as markets which is significant to enhance firm's open innovation performance (FOIP). However, Malaysian High-Tech SMEs are unable to develop a well-managed coopetition mechanism which influence negatively on open innovation (OI) performance. To address this problem, the objective of this study is to investigate the effect of coopetition-based OI on the FOIP. To achieve this objective, a survey was conducted by using cross-sectional research design. Managerial employees of Malaysian high-tech SMEs were selected as the ultimate respondents of this study. While analyzing the data through PLS-SEM, it is revealed that coopetition has major contribution to enhance FOIP. Likewise, it is highlighted that the role of trust and dependency is crucial to develop a good coopetition platform. The study contributed in the body of literature by investigating the mediating role of trust and dependency to enhance the positive effect of coopetition based OI on FOIP, particularly in Malaysian high-tech SMEs. Thus, the current study has major importance for Malaysian high-tech SMEs to look on the vital factors to expedite coopetition and innovation activities.

**Keywords:** coopetition, open innovation, firm performance, trust, dependency, high-tech SMEs.

## **1. Introduction**

In highly competitive environment, the phenomenon of coopetition is emerging rapidly among various firms. This phenomenon is based on collaboration with competitor (Klimas & Czakon, 2018). The notion of coopetition first presented by Ray Noorda, the chief executive officer (CEO) as well as the founder of Novell. After initial announcement, further encouraged by Nalebuff and Brandenburger (1996) and provided a novel explanatory model related to the inter-organizational relationships among firms

(Lechner et al., 2016) which is lonely based on cooperation and coopetition (Mead, 2018).

Coopetition has drawn a substantial consideration as it linked two different or opposite concepts: collaboration and competition. According to Coy (2006), coopetition is better described as “sleeping with the enemy.” It is a significant strategy which insures major benefits (Bengtsson & Kock, 2000) in the field of OI. Now companies have started to use coopetition as one of the tools to enhance open innovation (OI) activities, however, Malaysian High-Tech small and medium-sized enterprises (SMEs) requires further intention, because the OI activities are at initial level in these SMEs. Hence, the current study considered the Malaysian High-Tech SMEs to examine coopetition-based OI.

The engagement in various activities of so-called ‘coopetitive’ environments, basically depends upon communications in which collaboration as well as competition take place simultaneously (Bengtsson & Kock, 2000), generally, can result in various valuable knowledge-related practices among firms (Chin et al., 2008). These knowledge-related activities have key position in the process of OI. As OI is two-way procedure where external knowledge outside the firm enters inside the firm and goes outside in shape of final idea. Lichtenthaler (2008) explained that, OI is the both outside-in and inside-out transference of latest technologies and ideas. OI can be defined as “it 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).” Therefore, coopetition-based OI could improve the firm’s open innovation performance (FOIP).

Various prior studies demonstrate the phenomenon of coopetition and innovation (Barney et al., 2017; Liu & Tan, 2017; McCarthy et al., 2018; Rodríguez et al., 2017), however, most of the studies did not fill the gap of coopetition and OI in High-Tech SMEs, particularly in Malaysia. Hence, the current study filled the literature gap by examine the role of coopetition to enhance the FOIP.

This study is performed to address the problem of low OI in Malaysia High-Tech SMEs. As literature shows that most of the companies are unwilling to open up various innovation strategies (De Wit et al., 2007; Lichtenthaler & Lichtenthaler, 2009) which effect negatively on OI success. That is the reason; the overall performance of Malaysian High-Tech SMEs is low as compared to the High-Tech SMEs related to developed nations like United States (US) and United Kingdom (UK). Example of coopetition include DELL, Sony, HP and Matsushita (Watanabe et al., 2009).

However, coopetition requires trust on competitors and dependency on each other’s. Trust has an imperative character in coopetition phenomenon (Devetag, 2009). Different partners involved in coopetition faces risks and lack of trust that decline performance (Ritala, 2009) and various innovation activities (Nieto & Santamaría, 2007). Dependency is equally important with trust and significant role in trust (Bouncken & Fredrich, 2012). Most of the times, powerful or big firms develop the mechanism of dependency when they have their own resources and become more powerful (Pfeffer, 1981). Therefore, trust and dependency play a mediating role between coopetition and FOIP.

To date, however, it is remained unclear whether that involvement in the process of coopetition accelerates the FOIP, particularly in High-Tech SMEs. Hence, this study has intentions to partially fill this literature gap. Thus, the objective of this study is to

investigate the effect of coopetition-based OI on the FOIP in Malaysian High-Tech SMEs. The other two objectives are as follows;

- To investigate the mediating role of trust between coopetition and FOIP.
- To investigate the mediating role of dependency between coopetition and FOIP.

The current study is one of the pioneer studies which filled the literature gap by introducing the phenomenon of OI and coopetition in Malaysian High-Tech SMEs. Particularly, this study introduced trust and dependency as major element of coopetition-based OI. This study highlighted that trust and dependency are essential to carry out coopetition-based OI phenomenon. This phenomenon is not possible without trust and dependency. Moreover, the current study investigates the vital role of coopetition to promote OI in high-tech SMEs. Furthermore, it investigated the mediating role of trust and dependency between coopetition and FOIP. Therefore, the current study has major significance for Malaysian High-Tech SMEs to look on the vital factors to expediate OI activities through coopetition activities. It provides the valuable insights to increase firm's performance through well managed coopetition-based OI.

This study is also one of the attempts to present valuable idea to boost SMEs performance. Selection of SMEs is based on various reasons. Because it is evident from the literature that SMEs has noteworthy contribution in the Malaysian economy (Aris, 2006; Saleh & Ndubisi, 2006). SMEs has significant contribution to the economic development of Malaysia (Abdullah, 2002). However, these SMEs are struggling to develop effective OI mechanism, the lower OI distressing their overall performance as well as competitiveness in local and international markets (Hameed, Basheer, Iqbal, Anwar, & Ahmad, 2018). In contrast to the large corporations, SMEs have more issues to adopt OI due to lack of resources and small scale. Therefore, it is easy for large corporations to get success in OI as compared to SMEs. SMEs needed the collaboration with their competitors to get significant success in OI. That is the reason this study introduced coopetition-based OI in SMEs.

## 2. Review of Literature

Relationships of cooperation among various competitors characterized by simultaneous cooperative as well as competitive ties are generally defined as *coopetition*, a mixture or combination of two key words *cooperation* and *competition* as mentioned by Nalebuff and Brandenburger (1996). This is also supported by Bengtsson and Kock (2014), generally in the various fields such as management as well as business. This coopetition-based innovation has great importance for various competitors, particularly in high competition markets where the survival is challenge for companies. However, less attention has been paid to High-Tech SMEs. Most of the High-Tech SMEs are facing problems related to OI in Malaysia. SMEs are unable to carryout OI practices solely in a competitive environment. Therefore, these High-Tech SMEs need coopetition-based OI in which the role of trust and dependency is vital. As the OI has considerable importance in SMEs (Chesbrough, 2006).

### 2.1 Game Theory and Resource Dependency Theory

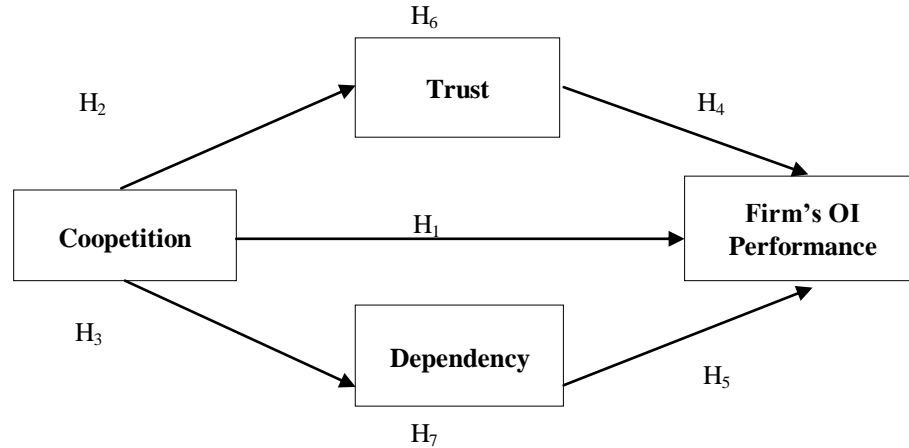
Nalebuff and Brandenburger (1996) used game theory as one of the bases that will "make it easier to explain the reasoning behind a proposed strategy." They use the term coopetition, which is generally constant with their message that cooperation is suitable in

different situations, however, competition is suitable in others (Armstrong & Clark, 1997).

Coopetition conceptualizes valuable relationships comprising of two conflicting elements, namely; cooperation as well as competition. Based on game theory arguments, Nalebuff and Brandenburger (1996) suggested that the coopetition powerfully improves the firm performance. The reason of performance improvement is that firms execute various activities in a good value net of different stakeholders like clients, suppliers and competitors (Bouncken & Fredrich, 2012). All firms in this valuable network play numerous roles in business games. In coopetition, firms collaborate with their enemies which enhance the OI performance through new ideas. Consequently, they can utilize collaborative as well as competitive relationships in the pursuit of success within the field of OI.

Cooperation is quite similar with game theory in which various competitors play games of business by trusting on each other's and get success. It is not only guiding to play a business game but also guides to think that how to play the game and how to change various rules by involving their competitors (Bouncken & Fredrich, 2012). It leads managers to play a game like coopetition between competitors. However, in this situation, one competitor needed to depend on other with trust. Thus, dependency and trust are major factor in smooth coopetition as shown in Figure 1. Deficiency in any one element will lead towards collapse.

Applying different ideas from resource dependency theory to coopetition, suggests that most of the organizations requires various types of resources from other competing organizations (van den Broek et al., 2018). It demonstrates the degree to which coopetition creativities draw on joint resources between competing firms (Stentoft et al., 2018). Thus, dependency in competition is essential to collaborate, exchange resource and OI performance. Consequently, resource dependency theory is in line with the role of dependency in competitors on each other. To handle resource dependency: this indicates that various cooperative firms can share their knowledge as well as exchange access to different resources (Ghanbari et al., 2017).



**Figure 1: Research Framework**

### 2.2 Hypothesis Development

Coopetition refers to the “strategic and dynamic process in which economic actors jointly create value through cooperative interaction, while they simultaneously compete to capture part of that value” (Bouncken et al., 2015). This coopetition strategy is most important for global competition (Luo, 2007). A vital predecessor is external knowledge as it promotes innovation activities and implementation of innovation process (Pittaway & Rose, 2006). It also plays a key part in achievement in firm’s innovativeness (Parra- Requena et al., 2015) which is the base of OI. External knowledge expedite internal innovation activities which has direct effect on overall OI system (Chesbrough, 2006). It has various forms like relationships with different external partners consists of suppliers, competitors, customers etc. (Covin & Slevin, 1988). These external partners have major importance for OI.

External knowledge from competitors through coopetition accelerate the FOIP. Because OI need both internal and external knowledge (Chesbrough, 2006). As Pollok, Lüttgens, and Piller (2018) investigated that external knowledge through crowdsourcing is significant to promote OI. But knowledge attributes could align efficiently with specific OI mechanism (Zhou, Yao, & Chen, 2018). However, coopetition is not possible without trust and dependency on each other by different competitors. In coopetition, competitors are always requiring high level of trust and dependency to get success in their operations.

Specifically, cooperation between competitors looks to play a positive contribution in progressing firm’s technological development as well as to enhance the innovation capabilities (Gnyawali & Park, 2011) among competing firms. Due to the high uncertainty in markets, competitors must put on more flexible activities of collaboration to expedite innovation (Bengtsson & Kock, 1999) which ultimately boost the OI performance.

However, based on misconduct of any partner in coopetition activities directly leads towards decline in these collaborations and it has strong negative effect on OI. In this condition’s firms do not trust on each other’s and collaboration comes to an end in no time. As it is the matter of trust and dependency on each other’s. Moreover, coopetition

can also be significant to develop new product (Bouncken et al., 2018) as well as numerous product lines (Quintana-Garcia & Benavides-Velasco, 2004).

Prior researchers have stressed the significant positive relationship among coopetition and innovation activities among various firms (Ritala et al., 2013). All these previous studies favor the positive contribution of coopetition in innovation practices (Ritala, 2012) which is ultimately beneficial to expedite OI activities. It helps to open up their strategies by licensing their ideas.

More specifically, coopetition has significant positive association with incremental as well as radical innovation practices as mentioned by different researchers (Bouncken & Fredrich, 2012; Le Roy & Czakon, 2016; Ritala et al., 2013). This strategy of coopetition is important for both early as well as late stages of various activities related to incremental innovation (Bouncken et al., 2018). However, again it requires high level of trust and dependency. This is more important in High-Tech SMEs, because these SMEs requires more OI activities to enhance their performance in highly competitive environment.

Those SMEs having employees less than 250 (European Commission, 2005), are limited in coopetition activities due to small in size (Akdoğan & Cingöz, 2012), which is major constraint in innovation performance (Camisón-Zornoza et al., 2004). Thus, these SMEs have fewer resources to get success in OI. Hence, to promote OI performance for High-Tech SMEs is more important than small scale SMEs. Sometimes coopetition becomes mandatory activity to survive in a competitive environment through OI. Therefore, these firms must trust and depend on other competitors.

Mention (2011) carried out a research on OI and coopetition, the study provides the results that coopetition has significant role to encourage OI practices. Furthermore, a research performed by Estrada et al. (2016), provides valuable insights that coopetition increases the innovation related to the new product development. Moreover, it is proved that coopetition has significant role to increase firm performance (Raza-Ullah et al., 2018), as it has significant association with market performance (Ritala, 2018) and shows positive outcomes for SMEs (Kraus et al., 2019).

Above literature demonstrates that coopetition has positive relationship on FOIP. Coopetition provides external knowledge which is most important in OI. Moreover, various SMEs do not have sufficient ability due to small size that is why OI is a crucial challenge. This challenge could be handled through coopetition. Hence, it is hypothesized that;

- **H<sub>1</sub>:** There is a positive relationship between coopetition and FOIP

Coopetition is one of the most important elements of business (Bengtsson & Kock, 2000) which is fundamentally developed through different logics of interaction in which one of the factor include that various individuals performance to exploit their interest related to business activities (Luo et al., 2006). It is a phenomenon in which firms take on information leakage as well as exploit power over various partners (Bouncken & Fredrich, 2012). Collaboration is second factor, in which individuals play their role to promote mutual interest. In fair collaboration practices, firms exchange knowledge with each other's and built a strong relationship through trust and dependency (Diekola, 2016).

Trust is the most significant part of every coopetition activity (Castaldo & Dagnino, 2009; Kraus et al., 2019). It is considered as building block of relationship activities (Bradach & Eccles, 1989). Since coopetition is not only developed on different types of competition, but also on various activities of alliance (Devetag, 2009). Therefore, trust has significant relationship with coopetition which effect the performance of firms, particularly FOIP.

According to Ireland and Webb (2007), social force like trust interrelate with various economic forces by effecting significantly on firm performance. As the OI is based on the use of internal as well as external resources (Chesbrough, 2006) and coopetition is also one of the ways to utilize external resources. Moreover, dependency is also equally important with trust. Dependency has crucial role in coopetition success (Bouncken & Fredrich, 2012).

It is described by resource dependency theory, firm exchange their resources like knowledge and depend on each other's (van den Broek et al., 2018). In line with resource dependence theory, sometimes influential companies make dependency situation when they take the control of concerned resources and hold power over other firm's (Pfeffer & Villeneuve, 1994) which effect on OI activities. Therefore, dependency in coopetition is most crucial element in OI activities.

Furthermore, dependency affects the relationship between the alliance activities of High-Tech SMEs and coopetition (Bouncken & Fredrich, 2012). In the process of coopetition, various competitive firms depend on each other's to accelerate the process of OI. It is one of the important elements in coopetition success. Hence, in line with trust, dependency has also key importance for coopetition success. Castaldo and Dagnino (2009) revealed valuable findings by examining the relationship between strategic role of trust in cooperative dynamics and found a significant positive association. Literature proved that trust is one of the most crucial part of OI which is based on coopetition.

Thus, High-Tech SMEs requires a certain level of trust and dependency among competitors. On the basis of trust and dependency, coopetition works smoothly. As in coopetition, one competitor trust on their competitor and allow to run operations smoothly. A high level of trust and dependency requires for better communication and to run operations without disturbing each other's. Hence, from above discussion, it is hypothesized that;

- **H<sub>2</sub>:** There is a relationship between coopetition and trust.
- **H<sub>3</sub>:** There is a relationship between coopetition and dependency.

This study claimed that trust shows a significant role in various coopetition type relationships (Devetag, 2009) and FOIP. Trust is one of the social lubricants which can enhance the collaboration between various partners (Brolos, 2009) and increases the OI performance through exchange of knowledge. Apart from trust, dependency is also important for OI. Study assumes that dependency is an additional significant factor which has significant impact on firm's OI activities.

Both elements, trust and dependency effect positively on coopetition's which effect on OI success. Trust as well as dependency always effect the relationship between coopetition and different innovation activities (Bouncken & Fredrich, 2012). OI is based on new ideas which facilitates internal innovation (Chesbrough, 2006) and coopetition based on



trust and dependency brings new ideas from competitors. It positively influences the OI performance, particularly in High-Tech SMEs.

Nalebuff and Brandenburger (1996) suggested with the help of game theory that coopetition powerfully improve firm performance. With the help of trust and dependency on each other's, firms collaborate with their competitors and enhance the OI activity by introducing external knowledge in shape of new ideas. Thus, they can utilize collaborative as well as competitive relationships to get success in the field of OI.

However, various partners in coopetition activities face risk characteristic to opportunism as well as lack of trust on each other which weaken the rate of achievement (Ritala, 2009) and different innovation activities (Nieto & Santamaria, 2007). Nestle et al. (2018) found that trust has significant relationship with OI. Another study by Brockman et al. (2018) also found that trust has direct relationship with OI performance in various organizations. Therefore, generally the coopetition phenomenon has two different faces: it can foster the FOIP but need to compete with opportunism risk and misinterpretation, thereby dipping the FOIP. Thus, trust and dependency have a relationship with FOIP. However, this relationship may discourage the OI performance. Therefore, it is hypothesized that;

- **H<sub>4</sub>:** There is a relationship between trust and FOIP.
- **H<sub>5</sub>:** There is a relationship between dependency and FOIP

Additionally, above discussed literature demonstrates that, there is a significant relationship between coopetition and FOIP. It is also clear that there is a significant relationship between coopetition and trust, trust and FOIP, coopetition and dependency, dependency and FOIP. Therefore, by following the concept of Baron and Kenny (1986), it could be concluded that trust and dependency could be used as mediating variables between coopetition and FOIP. Hence;

- **H<sub>6</sub>:** Trust mediates the relationship between coopetition and FOIP
- **H<sub>7</sub>:** Dependency mediates the relationship between coopetition and FOIP

### 3. Research Methodology

The study took place in Malaysia and covered all the states of Malaysia. This study is grounded on cross-sectional research design and quantitative research approach. All the High-Tech SMEs from Malaysia were selected for this study. Unit of analysis was individual and managerial employees who were directly involved in coopetition and innovation activities were selected as the respondents.

The survey was carried out to the High-Tech SMEs via email. The email provided a link to the survey. First, respondents were informed regarding the objective of the current study. It was asked to confirm that the respondents are manager having direct involvement in coopetition-based innovation activities. Second, respondents were asked about their permission for participation. Employees not being involved in coopetition and innovation were not allowed to fill the survey questionnaire.

Sample size is selected based on Comrey and Lee (1992) suggestions. "Sample having less than 50 participants will observed to be a weaker sample; sample of 100 size will be weak; 200 will be adequate; sample of 300 will be considered as good; 500 very good, whereas 1000 will be excellent." Consequently, 200 sample size was preferred. All answers were collected on 5-point Likert-type scales. Two hundred (200) questionnaires

were distributed in High-Tech SMEs in Malaysia. Only Seventy-two (72) employees of the High-Tech SMEs were participated in present study. Therefore, the rate of response was only 36%. However, 30% rate of response is adequate in case of email survey (Sekaran, 2003).

### *3.1 Measures*

Coopetition is measured based on three items. These measures are adapted from Bouncken and Fredrich (2012). Measures include; “(a) close competition with alliance partners, (b) collaborating with competitors to achieve a common goal, and (c) important to have an active competition with collaborators.” Scale of coopetition is given in Table 1. This scale is developed by Bouncken and Fredrich (2012) and reached 0.706 value of Cronbach’s alpha.

Moreover, a mediating variable, namely; trust is measured through three items. All the measures for trust are adapted from Zaheer et al. (1998). The trust is measured in two directions, firstly, inter-organizational and secondly, interpersonal trust. These measures are included; “(a) impartiality in negotiations, (b) trustworthiness, and (c) keeping of promises.” Second mediating variable, namely; dependency is measured by three measures adapted from Paladino (2008). These measures are; “(a) relative bargaining position, (b) partners’ unique contributions within collaborations (c) the responding firm needs to comply with its partners’ demands.” All the items of trust and dependency are given in Table 1.

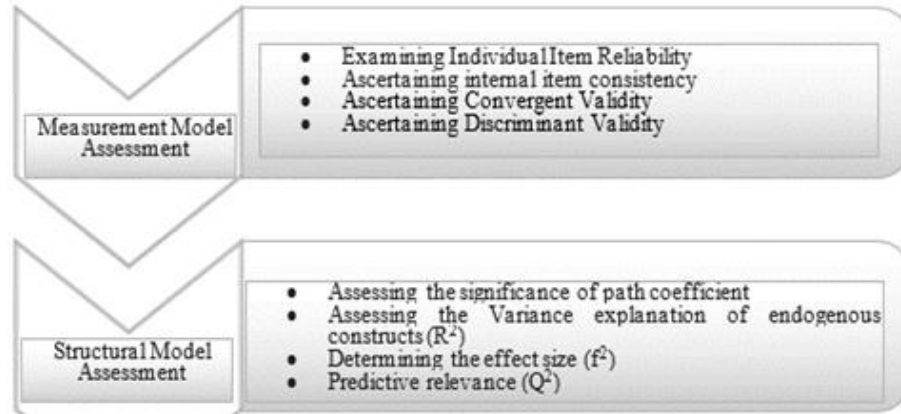
Nevertheless, the current study used five items from Hameed et al. (2018) to measure FOIP. These measures include; (a) new idea to expediate OI (b) communication between both external and internal partners (c) degree of knowledge to enhance openness (d) awareness about the required knowledge for OI (e) partners (e.g., competitors) willingness to learn from experience. In sum, new ideas through competitors, communication, shared knowledge, awareness about OI and intension (willingness) are the key drivers of any FOIP.

### *3.2 Statistical Tool*

SmartPLS 3 (SEM) has been utilized to examine the data. Selection of SmartPLS is grounded on the small sample size. In this study, sample size is too small, as only seventy-two (72) responses were analyzed. The complexity of a structural model does not requires big sample because “PLS algorithm does not compute all the relationships at the same time (J. Hair, Hollingsworth, Randolph, & Chong, 2017).” Many previous researchers have systematically assessed PLS-SEM with very sample (W. W. Chin & Newsted, 1999; Hui & Wold, 1982) which is supported by, Reinartz et al. (2009).

## **4. Data Analysis and Results**

This study examined the collected data through Partial Least Square (PLS)-Structural Equation Modeling (SEM) technique. This is most reliable technique to get results from primary data (Hair Jr, Hult, Ringle, & Sarstedt, 2016). PLS-SEM is based on two major steps. Each step has further steps which are shown in Figure 2. All these steps are performed in this study to achieve the quality results.



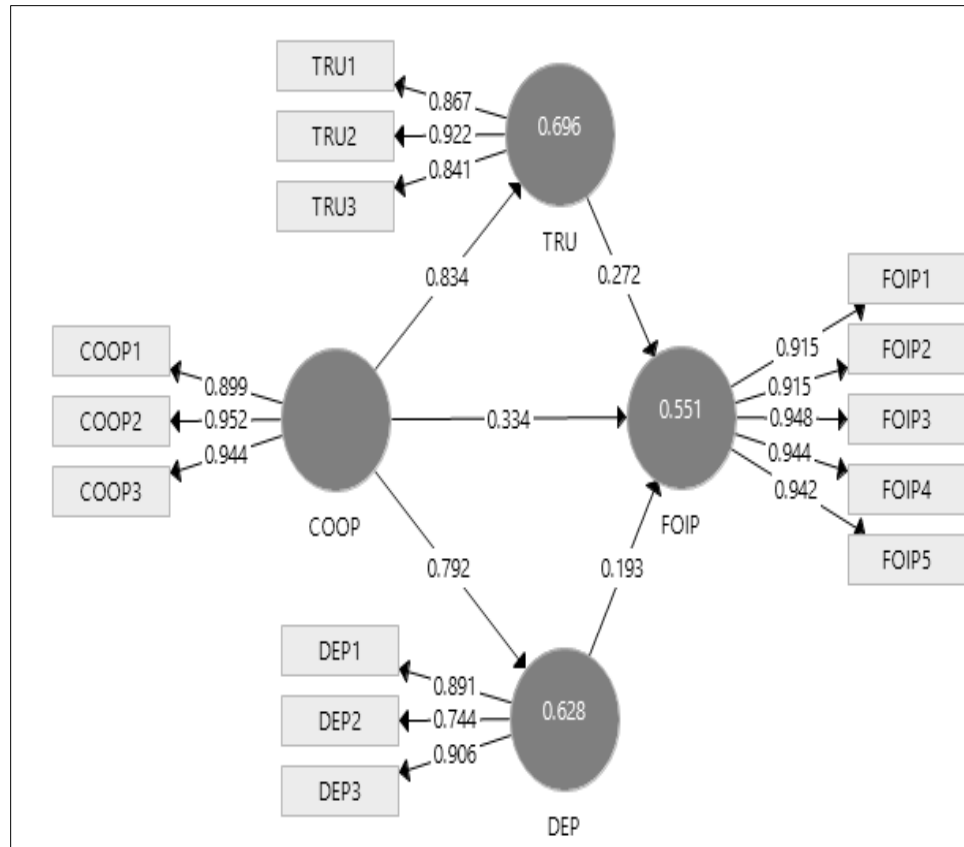
**Figure 2: Two Step PLS (SEM)** Source: Henseler et al. (2009)

#### 4.1 Assessment of the Measurement Model

Before going to assess the measurement model, assumptions of multivariate analysis instructions regarding screening of the missing data and outliers has been examined. For instance, regarding missing data, it has been revealed that, data has four missing values and a mean substitution is used to provide the replacement values for missing data. However, both the multivariate outlier's and the uni-variate has found in the data-set and since the variables of the current study was measured on the basis of 5-point Likert scale, and even though not a single observation seems to be on extreme. Therefore, the data considered for the current study has been kept for analysis. Furthermore, for theory validation, the PLS-SEM procedure has been used. However, in assessing the model, the measurement or outer model has commenced to confirm the reliability and validity. Smart PLS SEM was utilized to assess measurement model (Ringle et al., 2015). Figure 3 demonstrates process of measurement model and based on this, the Table 1 has been explained.

The study examined the factor loadings of all given items of this study. Hair et al. (2010) described that the convergent validity is achieved in case if the factor loadings of items is greater than the value of 0.5. Concerning this current study, loadings are higher than 0.5 as shown Table 1. Moreover, Table 1 clarifies composite reliability (CR), average variance extracted (AVE) and Cronbach's alpha values for each construct.

AVE should be at least 0.50 and the CR must be accepted at 0.70 and higher (Fornell & Larcker, 1981). It is given in Table 2 all the variables reliability and AVE is above 0.50. The current study calculated the Cronbach's-Alpha to find out, "internal consistency" of the data. Furthermore, George and Mallery (2003) provided the rule of determining the value "alpha; " $\alpha > 0.9$ - Excellent,  $\alpha < 0.8$ - Good,  $\alpha < 0.7$ - Acceptable". However, according to the results of this study as stated in Table 1 that all variables have "Cronbach's Alpha" value more than 0.8. Thus, this discloses that, all study constructs have good consistency. All the items have factor loadings above 0.7 (Hair et al., 2017).



**Figure 3: Measurement Model Assessment**

**Table 1: Results of Measurement Model**

Construct	Indicators	Loadings	$\alpha$	CR	AVE
Coopetition (COOP)	1. We are in close competition with our partners.	.899	.925	.952	.869
	2. We collaborate with competitors to achieve a common goal.	.952			
	3. An active competition with our collaborators is important to us.	.944			
Trust (TRU)	4. Our cooperation partner has always been evenhanded in its negotiations with us.	.867	.850	.909	.770
	5. Our cooperation partner is trustworthy.	.922			
	6. Our partners related to cooperation keeps up with their promises.	.841			
Dependency (DEP)	7. Our partners related to cooperation has solid comparative negotiating position with us.	.891	.814	.886	.823
	8. Our partners related to cooperation observe minor difference among our products as well as those of our competitors.	.744			
	9. We must obey with various demands of our partners, even if they seem unsuitable.	.906			
Firm's Open Innovation Performance (FOIP)	10. New ideas are always welcomed in our alliance.	.915	.963	.971	.871
	11. Communication between internal and external partners occurs without problems which increase OI.	.915			
	12. The degree of knowledge shared is sufficient to enhance openness.	.948			
	13. All the partners know exactly which knowledge is needed for OI.	.944			
	14. All partners are willing to learn from the experiences in this alliance.	.942			

Nonetheless, external consistency of model was examined through discriminant validity, based on correlation among the concerned latent variables, however, square root of

AVE's was considered and compared with value of each variable. Lastly, as described in Table 2, AVE square root is higher than all the correlations. Moreover, discriminant validity through Heterotrait-Monotrait (HTMT) Ratio criteria is also given in Table 3. Henseler, Ringle, and Sarstedt (2015) suggested different threshold of 0.90 and 0.85 for HTMT to establish discriminant validity. This study used HTMT0.90 criterion and discriminant validity are established as HTMT ratio is below than critical value of 0.90.

Therefore, the current study achieved the first step of PLS-SEM through measurement model assessment. The results of measurement model are shown in Table 1, Table 2 and Table 3. Table 1 indicates the internal item consistency or internal item reliability which is achieved by the study. It also confirms the convergent validity with the help of external consistency by examining AVE. Table 2 and Table 3 confirms the discriminant validity by using two methods recommended by various studies.

**Table 2: Discriminant Validity (Fornell-Larcker Criterion)**

	<b>EK</b>	<b>FOIP</b>	<b>II</b>	<b>R &amp; D</b>
COOP	<b>0.932</b>			
DEP	0.792	<b>0.850</b>		
FOIP	0.714	0.651	<b>0.933</b>	
TRU	0.834	0.711	0.688	<b>0.877</b>

**Table 3: Discriminant Validity (Heterotrait-Monotrait Ratio)**

	<b>COOP</b>	<b>DEP</b>	<b>FOIP</b>	<b>TRU</b>
COOP	1.0			
DEP	0.864			
FOIP	0.751	0.696		
TRU	0.838	0.831	0.76	1.0

#### 4.2 Assessment of the Structural Model

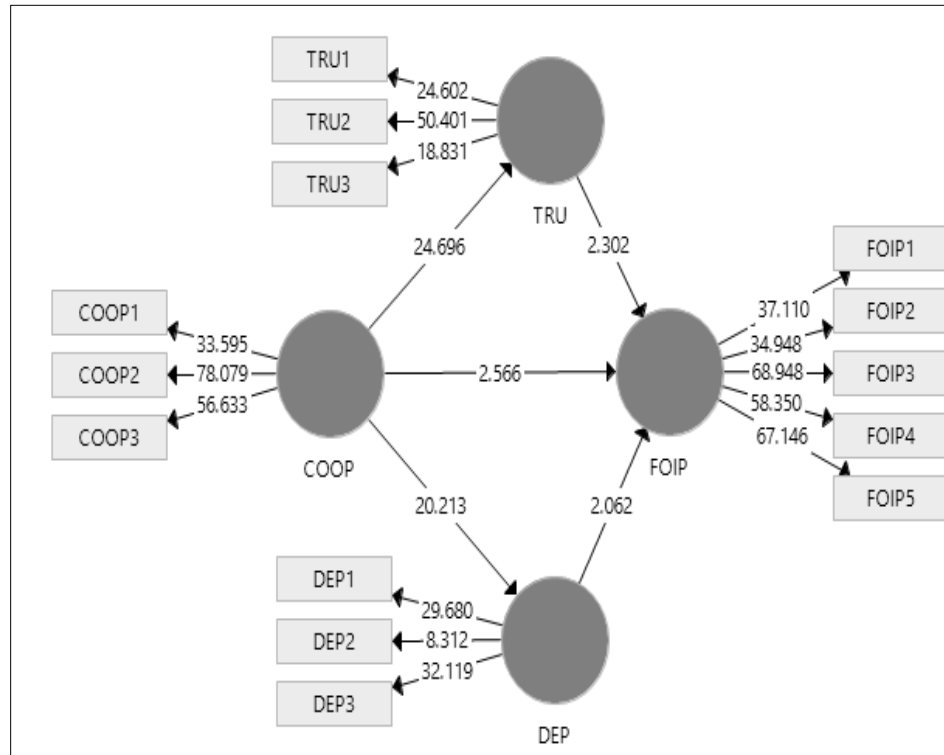
After valuation of outer model, the inner or structural model was evaluated by utilizing SmartPLS 3.0. To achieve this part of analysis, different steps was followed including; "hypothesis testing with path coefficient and T-value, effect size and predictive relevance of the model were examined".

##### 4.2.1 Direct Effect

To examine the direct effect between exogenous latent variables and endogenous latent variable, t-value and path coefficient was determined through PLS bootstrapping technique. Henseler et al. (2009) claimed that the path coefficients ( $\beta$ -values) are parallel to regression analysis. Wherever t-values are examined to confirm the significance level of the constructs. Moreover, 1.96 threshold level of t-value was considered. However, by following the instructions of Hair Jr et al. (2014), bootstrapping process was achieved with 5000 sampling iterations using 72 responses to check the  $\beta$ -values and t-values which are the basis of hypotheses acceptance and rejection.

In current study five (05) hypotheses having direct relationships were analyzed, from which all five (05) were resulted supported. Moreover, Figure 4 establishes the direct

effect of each variable on the endogenous latent variable and Table 4 shows the direct effect results.



**Figure 4: Structural Model Assessment**

Table 4 displays that all hypotheses have been supported with t-value greater than 1.96. Additionally, Figure 4 fully clarifies the outcome of all independent variables on the dependent variable (FOIP). Table 4 shows the direct effect results. Additionally, Table 4 shows the effect size ( $r^2$ ). According to the results of the study it is found that coopetition has 0.056 effect size on FOIP. Moreover, trust has 0.049 and dependency has 0.030 effect size on FOIP. According to Cohen (1988), this effect size is small for all three cases.

**Table 4: Direct Effect Results**

	Relationship	( $\beta$ )	(M)	SD	T Statistics	P Values	Decision	( $r^2$ )
H <sub>1</sub>	COOP -> FOIP	0.334	0.338	0.130	2.566	0.011	Accepted	0.056
H <sub>2</sub>	COOP -> TRU	0.834	0.835	0.034	24.696	0.000	Accepted	2.285
H <sub>3</sub>	COOP -> DEP	0.792	0.798	0.039	20.213	0.000	Accepted	1.688
H <sub>4</sub>	TRU -> FOIP	0.272	0.272	0.118	2.302	0.022	Accepted	0.049
H <sub>5</sub>	DEP -> FOIP	0.193	0.194	0.093	2.062	0.040	Accepted	0.030

#### 4.2.2 In-direct Effect

Bootstrapping through PLS is used in the present study to observe the indirect effects of each variable. Similarly, most of the studies show that “bootstrapping is a non-parametric

re-sampling procedure” and receiving more responsiveness because this technique is considered as most potential procedure to test and analyses the effect of mediation (Hayes, 2009; Zhao et al., 2010). Furthermore, by following the references of Hair Jr et al. (2014), PLS SEM by using PLS bootstrapping for mediation was performed as it is best for small sample. However, Hair Jr et al. (2014) suggested that the procedure of Preacher and Hayes (2004, 2008) is best to follow for mediation and the current study was followed this procedure. Therefore, effect of trust and dependency was examined as a mediating variable. Additionally, Table 5 explains the results of mediation through trust and dependency between coopetition and FOIP. It shows that trust and dependency mediating the relationship between coopetition and FOIP as the t-value is above 1.96 for both relationships.

**Table 5: In-Direct Effect Results**

	Relationship	( $\beta$ )	(M)	SD	T Statistics	P Values	Decision
<b>H<sub>6</sub></b>	COOP -> TRU -> FOIP	0.380	0.379	0.087	4.384	0.000	Mediation
<b>H<sub>7</sub></b>	COOP -> DEP -> FOIP	0.259	0.269	0.064	4.083	0.000	Mediation

#### 4.3 Variance Explained ( $R^2$ )

More importantly, the R-square ( $R^2$ ) value has been resultant from the output of PLS which enlightens that by considering all the variables together have the propensity of explaining variance in endogenous latent variable, namely; FOIP by 55.1%, which is moderate (Chin, 1998). As it is shown in Table 6.

**Table 6: R-Square ( $R^2$ )**

Construct	$R^2$
FOIP (FOIP)	55.1%
Trust (TRU)	69.6%
Dependency (DEP)	62.8%

#### 4.4 Construct Cross-Validated Redundancy ( $Q^2$ )

Moreover, predictive relevance ( $Q^2$ ) of the model was examined through blindfolding technique. As explained by Hair Jr et al. (2014) that  $Q^2$ -value is acquired “to assess the parameter estimates” and also assess “how values are built around the model”.  $Q^2$  examined the capacity of framework (model) to forecast the relevance of endogenous variables and clarifies the quality of model. Therefore, Table 7 describes the predictive relevance ( $Q^2$ ). Table 7 also reveals that  $Q^2$  demonstrates the predictive relevance of 0.446 for FOIP, 0.503 for use of trust (TRU) and 0.409 for dependency (DEP) that confirms the model predictive relevance, as  $Q^2$  is greater than zero (Henseler et al., 2009).

**Table 7: Predictive Relevance ( $Q^2$ )**

Total	SSO	SSE	$Q^2 = (1-SSE/SSO)$
Firm's Open Innovation Performance (FOIP)	360.000	199.507	0.446
Trust (TRU)	216.000	107.400	0.503
Dependency (DEP)	216.000	127.701	0.409



## 5. Findings and Discussion

Outcomes of the current study suggests that coopetition is one of the major determinants of FOIP in Malaysian High-Tech SMEs. Statistical analysis revealed that in case of coopetition and FOIP,  $t$ -value is 2.566 ( $t > 1.96$ ) and  $\beta$ -value is 0.334. These results supported  $H_1$ . It indicates that coopetition and FOIP has significant positive relationship with each other's. Increase in coopetition enhances the FOIP. Thus, the against major objective of this study, it is found that coopetition is one of the major contributors towards FOIP. Bouncken and Fredrich (2012) also found that coopetition has significant relationship with innovation. Thus, the current study is consistent with Bouncken and Fredrich (2012). Consistent with these results, Mention (2011) carried out a research on OI and coopetition, the study found that coopetition has positive role to promote OI activities. Another study conducted by Estrada et al. (2016), found that coopetition increases the product innovation.

Moreover, the relationship of coopetition with trust is also significant. As in case of trust and coopetition,  $t$ -value is 24.696 ( $t > 1.96$ ) and  $\beta$ -value is 0.834. In case of coopetition and dependency,  $t$ -value is 20.213 ( $t > 1.96$ ) and  $\beta$ -value is 0.792. These results supported  $H_2$  and  $H_3$ . These results suggested that coopetition has a significant positive relationship with trust and dependency. Increase in the level of trust directly increases the coopetition practices. Moreover, increase in dependency level increases the coopetition among Malaysian High-Tech SMEs. Prior studies, Bouncken and Fredrich (2012), and Wemmer, Emrich, and Koenigstorfer (2016) found a significant relationship between trust and dependency with coopetition. Moreover, Castaldo and Dagnino (2009) performance a study to examine the relationship between strategic role of trust in coopetitive dynamics and found a significant positive association. Therefore, the results of these studies are consistent with the results of the current study.

Nevertheless, it is found that trust and dependency have significant positive effect on FOIP. The relationship of trust and FOIP found  $t$ -value 2.302 ( $t > 1.96$ ) and  $\beta$ -value 0.272. These results are consistent with Brockman et al. (2018). In the relationship of dependency and FOIP,  $t$ -value is 2.062 ( $t > 1.96$ ) and  $\beta$ -value is 0.193. These results supported  $H_4$  and  $H_5$ , respectively. These results demonstrate that trust and dependency have significant positive effect on FOIP. According to the findings of Bouncken and Fredrich (2012), trust and dependency has significant positive influence on the relationship of coopetition and innovation. Thus, these results are consistent with Bouncken and Fredrich (2012). A latest study carried out by Nestle et al. (2018) in South West Germany found the similar results. This study found a significant positive relationship between trust and OI.

Nonetheless, against the first sub-objective, it is found that trust mediates the relationship between coopetition and FOIP. Statistical results supported  $H_6$  as the  $t$ -value is 4.384 ( $t > 1.96$ ) and  $\beta$ -value is 0.380. In case of second sub-objective, the same results were found. It is investigated that dependency mediates the relationship between coopetition and FOIP with  $t$ -value 4.083 ( $t > 1.96$ ) and  $\beta$ -value 0.259. These results supported the  $H_7$ . Thus, trust and dependency significantly mediate the relationship between coopetition and FOIP. It demonstrates that trust and dependency enhance the positive effect of coopetition on FOIP. Hence, trust as well as dependency has major contribution in FOIP through coopetition activities.

## 6. Conclusion

Majorly, the present study grounded on Malaysian High-Tech SMEs. Primarily, the role of coopetition in FOIP was examined. By following the cross-sectional design, survey was conducted to collect the data from various managerial employees of High-Tech SMEs. Valid responses were analyzed by using PLS SEM. Findings of the study revealed that coopetition is a most influencing mechanism towards FOIP. In a competitive environment, coopetition is one of the major elements to enhance OI activities. However, coopetition partners require a high level of trust to get success in coopetition. Moreover, apart from trust, dependency on each other's by competing firms is crucial. Thus, to get success in coopetition, trust and dependency has key importance. Therefore, to expedite OI practices, Malaysian High-Tech SMEs requires success in coopetition activities and to get success in coopetition, these SMEs requires a high level of trust and dependency.

Therefore, it is recommended to the Malaysian High-Tech SMEs, to enhance OI performance, these SMEs should focus on coopetition. However, to enhance overall performance, SMEs are needed to build good relations with their competitors and develop a well-managed coopetition mechanism. Finally, researchers are invited to expand the current model by examining the effect of human capabilities like communication skills to build a reliable coopetition platform with competitors. Therefore, human capabilities could be used as a moderating variable. Secondly, researchers could compare the performance of various firms before and after coopetition, it will provide a better look on the effect of coopetition on OI or simply performance.

### 6.1 Contribution of the Study

This study is one of the first attempt which filled the theoretical gap by introducing the role of coopetition-based OI in Malaysian High-Tech SMEs. This study presented two components; trust and dependency as key elements of coopetition-based OI. Both these factors, trust and dependency are indispensable to perform coopetition-based OI phenomenon. This process of OI is incomplete without trust and dependency. Besides, this study contributed in the field of research by investigating the vital role of coopetition to promote OI in Malaysian High-Tech SMEs. As the Malaysian SMEs are struggling to adopt OI, therefore, this study provided the solution by introducing coopetition-based OI. Additionally, the study investigated the mediating role trust and dependency between coopetition and FOIP. Therefore, the current study has major significance for Malaysian High-Tech SMEs to look on the vital factors to expedite OI activities through coopetition activities.

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