



Research Article

Evaluating the relationship of customer and supplier involvement relating to product characteristics on new product development by using structural equation modeling

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ABSTRACT

In the present era the changes in needs of customers are increasing along with the tremendous business competition in the prevailing market scenario. Therefore the expansion of economic progress as reflected by the manufacturing sector has focused on the development of new products. The basic purpose of this study is to determine the association between product characteristics, supplier, customer involvement, and the development of new products in the furniture market of Punjab Pakistan. For this study, the data of 180 respondents is collected through a survey questionnaire by using convenience sampling. The gathered data is examined by the structural equation modeling (SEM) through partial least square (PLS). Findings of the study indicate that product characteristics such as product differentiation and modularity have a significant relationship with supplier and customer involvement whereas findings concluded an insignificant relationship between product innovativeness with supplier involvement and product variety with customer involvement. Furthermore, results declared a significant relationship between customer and supplier involvement with new product development. This study will assist the manufacturer of the new product development to provide better marketing services.

Keywords: *Product Characteristics; Supplier Involvement; Customer Involvement; New Product Development*

1. INTRODUCTION

The main purpose of any organizations is to create the value and their existence depends on their ability of value creation. Therefore, main occurrence of organization management is complex and vital progressively. The most valuable point is consistency and integration of management's techniques along well-adjusted and constant value creation for the efficient management of any organization (Khanshir et al., 2012). Nowadays, due to early growth of products and higher market competition there is an increasingly need of services and products. Variety of needs and increase in population is the key factors inspiring organizations to accomplish goods and new products. In life cycle of product, the profit is maximized in maturity period of product presentation. Actually, the organizations are persuaded to keep their efficiency in stage of maturity. In this situation the simple solution is the new product development for stability in the economical market and company's survival (Kmetovicz, 1998).

The performance of any company is mainly affected due to involvement of customers and suppliers. So any company will be able to work well if it involves customers and suppliers in formation and development of new product (Lin et al., 2010). According to opinion of some researchers new product development plays a key role in creation of economic wealth. Innovative markets, new products and growing opportunities can be generating through advance and development of new products. Increasingly, corporations understand that customer fulfillment is important tool for progress (Shepherd & Ahmed, 2000). Corporation mostly receives information and resources from the involvement of customers and suppliers (Lau et al., 2010). For enhancing performance of

any corporation and market effectiveness the integration of suppliers and customers is valuable for deciding which modern technologies should be used (Crocitto & Youssef, 2003).

The progress and economic development of a firm is mainly dependent on its capacity to introduce new products in the market. Product characteristics like product innovation, product quality, product differentiation and product modularity influence on the development of various products that are new in the market. The involvement of supplier and consumers in the development of new creation phases is very important due to which information and ideas from various suppliers and customers can result in great benefits for the development of new product and it will ultimately enhance the overall functioning of the firm (Petersen et al., 2005). Therefore, firms are continuously trying to develop certain best practices, strategies and methods so that they can satisfy needs and wants of customers which are very valuable for the progress of the firm. The role of customers and suppliers and product characteristics plays a key role while developing a new product.

Relationships regarding characteristic of product, customer and supplier involvement are not completely stated in some studies (Parker et al., 2008; Chen et al., 2010). Von Hippel & Schreier (2006) has stressed and focus on the value of firm with clients for the purpose of the development of new ideas due to which new product development is supported. Various studies have determined that customer involvement has a positive effect on the development of new products e.g. Von Hippel & Katz (2002) because when products are made according to the needs and demands of the customers there are a great chance of their success. On the other hand there are some studies that show negative relationships on involvement of suppliers and the involvement of customers (Christensen & Bower, 1996; Lagrosen, 2005) on the results of new product development of the corporation. These results are generating because vast research has not clearly notable between different phases of new product development because each phase include certain activities and each phase brings specific implication for results. Most of studies are narrow in developing countries like Pakistan. In this research we determine the association between certain characteristics of product, supplier and customer involvement and development of the product. Also, investigate the impact of customer involvement and suppliers on development of new products.

2. LITERATURE REVIEW AND RESEARCH HYPOTHESES

2.1 THE RELATIONSHIP BETWEEN PRODUCT CHARACTERISTICS, CUSTOMER AND SUPPLIER INVOLVEMENT

The progress and economic development of a firm is mainly dependent on its capacity to introduce new products in the market. This can be only possible by presenting new innovations, enhancing the modularity and varieties of products, introducing new differentiated product, understanding customer needs and preferences and by the development of new product. Therefore, firms are continuously trying to develop certain best practices, strategies and methods so that they can satisfy needs and wants of customers which are very valuable for the progress of the firm. The role of customers and suppliers plays a key role while developing a new product in an efficient way (Ford et al., 1998; McElroy, 1995). Hanna et al. (1995) have described that product that is developed new in the market with various varieties and innovative are due to involvement of suppliers and customers. Customer consideration is the most important step and is very much essential for the advancement of new products because by carefully understanding customer needs and preferences and making product according to their needs and preferences ultimately brings satisfaction of the customers. Abdolmaleki and Ahmadian (2016) indicated that there was an association between various characteristics of the product like product differentiation, innovation of products and modularity of the product with customer contribution and supplier. BI & Zhang, (2001) defined product modularity as partition of merchandise into various independent parts because of this a business firm or industry can standardize various components of a product and in this way product variety is created. For superior modular products manufacturing, Technical and information relating to marketing is provided by suppliers. Brusoni & Prencipe (2001) and Sabel & Zetlin (2004) defined that growth of modular products entails input of suppliers. Moreover, foreffective and operational design of modular products there is a need to collect and share information with designers of organization regarding customers and market preferences. Thus, the necessary product is transformed, modified or according to of customer abilities and their participation can resolve

problems relating to design and new ideas are formed to deliver enhanced modified products with the increase of customer fulfillment. From the whole discussion, the following proposed hypotheses are as followed:

H₁ Product variety has a significant relation with customer involvement.

H₂ Product variety has a significant relation with supplier involvement.

H₃ Product modularity has a significant relation with customer involvement.

H₄ Product modularity has a significant relation with supplier involvement.

Product differentiation is about bringing a new, unique and different product in the market that is dissimilar with the rivals. Its might include one or more unique attributes, features or benefits so that the value proposition can be offered to the customers. The product differentiation is very much vital for maintaining or developing positioning strategy in the firm. A firm tries its best to provide the best service or product to its customers. In product differentiation the product appeals more to the specific target audience. Due to increased competition prevailing in the market it is very much important to provide different features in the product. It enhances the loyalty of a brand and makes brand equity. Due to this a customer has a reason to buy a specific product of brand and a customer repeat the purchase of a specific brand. The customer recognition of specific product is very much important in differentiation of a product. Due to this a company can compete in specific areas other than price. In product differentiation certain unique features are added in a specific product that makes the customers brand conscious that ultimately makes them loyal to a specific brand. Thus various studies (Semeijn et al., 2004; Lau, 2011) disclosed that differentiated product can be made by the involvement of customer and suppliers.

H₅ Product differentiation has a significant relation with customer involvement.

H₆ Product differentiation has a significant relation with supplier involvement.

Von Hippel (2005) reported that customers and the suppliers are the significant cause of innovative designs for creation new products with different varieties. The innovation of product states as introducing redesigned, something that is new or making some improvements in existing products or services. Its importance is well recognized in both service and manufacturing industries (Grubbstrom & Hinterhuber 2006; Wang & Wolfbeis, 2015). MacCarthy et al., 2003; Pine et al, 1993; Wong and Huang, 2014) stated that many firms are using certain techniques and they are becoming more customer oriented and to satisfy customer some firms use specific techniques such as mass customization. Drucker (1954) argued that the aim of both service and manufacturing industries is to satisfy need of customer therefore the competition in the market is increasing rapidly due to which firms must introduce innovation in various products because customer always

prefer that thing which is according to the modern trends and those products are chose by them that best fulfill their needs. That's why the innovation in product is very much important for the survival and growth of the firm. Sun et al, (2010) explained that for innovation in product there is a requirement for sharing information and high level of participation by both customers and suppliers. So, following hypothesis is established.

H₇ Product innovativeness has a significant relation with customer involvement.

H₈ Product innovativeness has a significant relation with supplier involvement.

The relationship between customer and supplier involvement with new product development

Mostly firms have attained huge benefits related supplier and customer participation to enhance the performance of company (Stump et al., 2002). Monczka (2000) investigated the strategies for the integration of supplier in development of product and the analysis shows that the involvement of suppliers helps in reducing costs of production and the defects are reduced that result in high quality and less time is required for the formation of highly standardize products. Vargo & Lusch, (2004) said that customer involvement is an important issue for the development of new product. Customer's plays an active role in creation of value and their desires and needs are achieved better and additionally they get satisfied. A research on development of new product shows that that the input of customer has insignificant result statistically. Studies shows the goods that are made with the involvement of supplier and customers are more highly able to fulfill the needs, wants and desires of customers then before because when the products are made according to customer consideration and demands they will be able to satisfy customers fully and the performance of company will improve and ultimately innovations and

new product will be more successful (Hoyer et al, 2010; Bonner 2010). Mostly studies explained that a significant connection exist between customers contribution and suppliers contribution with performance of new product (Von Hippel, 2005; Abdolmaleki and Ahmadian, 2016). Moreover, involvement of suppliers and customers have shown reduction in the costs of development and standard goods are made with minimum defects in it, the quality of various products is enhanced, and less time is required to market various products thus, the involvement of suppliers and customers played a great part for development of product (Monczka, 2000; Dyer et al., 2000; Lipparini, 1994). Similarly Lau (2011) reported about the involvement of suppliers and customers on the performance of the new product and results of the confirmatory factory analysis had shown a significant impact of the involvement of customers and suppliers on the functioning of new product formation.

H₉ Customer involvement has a significant relation with product development.

H₁₀ Supplier involvement has a significant relation with product development.

2. DATA COLLECTION PROCESS

An exploratory research is directed through utilizing convenience sampling of managers and production teams at furniture industry were made. At end result, a total of 225 questionnaires are collected. Afterward removing questionnaires with missing values or errors 180 effective responses are make use of for analysis of the data. The rate of response is 80%.

In regards of demographics amongst 180 male respondents, in which most of the 66% respondents are single and remaining are married. In case of ages, more than half of the 64% respondents are above 30, Majority of the 41% respondents had a graduation degree, 25.5% of respondents are undergraduate and 62.8 respondents specified that they have monthly income more than 85000.

3.1. MEASURES (DEVELOPMENT OF QUESTIONNAIRE)

Questionnaire format consist of 2 sections. First section of questionnaire includes the questions regarding the background of respondent demographic. This part comprises of six demographic points which comprise gender of participant, marital status, age, family type, education and monthly income correspondingly. Questionnaire second section contains the questions concerning product characteristics (product innovativeness, product modularity, product differentiation, and product variety), customer involvement, supplier involvement and new product development. All questions are measured using five point Likert scale. This scale range from strongly agree to disagree (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Strongly Agree, 5 = Agree). Likert scale offers the data for every single element in the scale so the respondent can know precisely what are they selecting (Boone and Boone, 2012). Entirely questions were adopted from Svendsen et al., (2011), lau (2011) Al□Zubi & Tsinopoulos, (2012) and Abdolmaleki and Ahmadian, (2016).

3. RESULTS AND DATA ANALYSIS

The proposed hypotheses shown in the conceptual model have been supported by utilizing the partial least squares. Results of this research are gained by using Smart PLS-SEM, which is considered as the advanced techniques to explore the data. Many of the preceding studies suggested PLS-SEM as one of the appropriate techniques for data analysis (Hair et al. 2017; Henseler et al. 2016). It is an essential method to explore the primary data. PLS is a variance-based modeling approach to SEM. It is a technique used for estimating reliability of model and path coefficients for hypothesis testing in structural model (Hair et al. 2017). PLS comprised of two major measures, which consist of two model i.e.; assessment of measurement model and structural model.

4.1. MEASUREMENT MODEL

Measurement model main function is checking the data validity and reliability that whether the composed data is reliable for the study conduct or not. First, in PLS the measurement model is calculated for checking of validity and reliability of the indicators. This is measured through outer loadings (CFA), composite reliability (CR), average variance extracted (AVE), Cronbach alpha and Discriminant validity (Hair et al. 2019).

Cronbach's alpha is an internal model consistency measure of all items as one group based on the factor loadings of each item (question) as displayed in Fig. 2.

There are mainly two parts which reported mostly in measurement model are item loadings and AVE. In Fig. 2 and table 2 items of each latent variable are separately loaded. According to empirical rule, loading of factor values should be higher than 0.40 (Hair et al. 2011). In current study we realize that all items of loaded such as customer involvement (CI), supplier involvement (SI), product innovativeness (PI), product modularity(PM), product differentiation (PD), product variety (PV) and new product development (NPD) are acceptable. All the value of indicators loadings was higher than 0.60 which exceeds 0.40 (Hair et al. 2019). More over table 3 exhibit the outcome for outer values of Variance Inflation Factor (VIF) of all indicators which shows that values of VIF are less than 5 and these values represents that no collinearity issues is present among the indicators. Table 3 displayed that all construct item loadings are greater than the suggested value of 0.5 (Hair et al., 2011). Cronbach alpha and composite reliability (CR) and value of rho_A are larger than 0.709 which specifies the satisfactory internal reliability of all the variables (Ringle & Sarstedt, 2016). However, the value of average variance extracted (AVE) for each latent variable is bigger than 0.5.

Discriminant validity is displayed in Table 4 by the heterotrait–monotrait and Fornell and Larcker criterion. The AVE square root (italic diagonal features), as presented in Table 5, are greater than the correlations of inter construct. Heterotrait -Monotrait correlations (HTMT) value should be less than 0.90 (Fornell & Larcker, 1981). It displays that 0.84 is the greatest HTMT correlation ratio which forms an adequate level of discriminant validity which reveals an acceptable level of measurement model.

4.2. STRUCTURAL MODEL

PLS-SEM second measure is to run the structural model by bootstrapping after the measure of measurement model by path algorithm. Basic function of structural model is to check the recommended hypotheses of the study which are established from the detail review of the literature. The conclusions of research are usually founded on the assessment of structural model and it also provides the value of overall model fit by r square and SRMS value. This model is also known as advanced level regression since it provides better result than the simple linear regression (Henseler et al. 2009). If examiner wants to check the significance levels of the variables through PLS-SEM then option of bootstrapping should be selected. For significant result t-values should be overhead 1.96 which significant at the 0.05 level (p-value) (Hair et al. 2011). Structural model of the current study is demonstrated in Fig. 2 which explains that all independent and dependent variable has a positive and significant relationship among them. Table 5 indicates the association among product variety with customer involvement ($b = 0.227$, $t = 2.384$, $p = 0.017$), product variety with supplier ($b = 0.041$, $t = 0.472$, $p = 0.637$), product modularity with customer ($b = 0.212$, $t = 3.242$, $p = 0.001$), between product modularity and supplier ($b = 0.121$, $t = 3.032$, $p = 0.043$), product differentiation with customer ($b = 0.212$, $t = 3.242$, $p = 0.001$), between product differentiation and supplier ($b = 0.121$, $t = 3.032$, $p = 0.043$), product innovativeness with customer ($b = 0.212$, $t = 3.242$, $p = 0.001$), between product innovativeness and supplier ($b = 0.121$, $t = 3.032$, $p = 0.043$), customer involvement with product development ($b = 0.212$, $t = 3.242$, $p = 0.001$) and supplier involvement with the product development ($b = 0.121$, $t = 3.032$, $p = 0.043$). all value of t are more than 1.9 and all p-value are less than 0.01 and 0.05 expect product innovativeness with customer involvement and product variety with supplier involvement which exhibit that only two developed hypothesis are not accepted otherwise other hypothesis were accepted and supported. Hence, H1, H3, H4, H5, H6, H8, H9 and H10 were accepted while H2 and H7 were rejected.

4.3. COEFFICIENT OF DETERMINATION (R-SQUARE)

Values of R² are measured differently such as 0.75 measured as a substantial whereas 0.50 measured as moderate and 0.25 measured as weak relationship among the dependent and independents variable (Henseler et al. 2016; Hair et al. 2011). In table 6 and in Fig. 2 adjusted R square values was 0.481, 0.543 and 0.584 which designates that there is a strong association and a moderate effect between variables.

4. DISCUSSION

The main aim to conduct the study is to inspect the relationship among product characteristics, supplier involvement, customer involvement and new product development. The existing study is conducted in a major city of Punjab Pakistan, Pakistan in which furniture industries are growing rapidly. A sampling technique of convenience is used to collected data from the respondent's. A structural equation modeling by partial least square is utilized to determine the relationship among variables. Through PLS-SEM positive and significance of the hypotheses are observed. The study empirically examined the interdependency among the latent variables, each latent variable and its measuring construct are examined through the confirmatory analysis and after that the structural model equation is utilized to check the structural relationship of the model. Analysis of PLS model indicates that the suggested model can strongly predict the association among product characteristic and customer involvement, product characteristics and supplies involvement and finally customer and supplier relationship among new product development. The subsequent findings are made from PLS-SEM analysis in the study. To verify the internal consistency of the model CR and Cronbach's is used. The results specify a consistency among each individual item of the constructs and the participants and also show that survey results have satisfactory reliability. According to findings of measurement model it was determined that the model have discriminant and convergent validity. The previous studies of Baldiven and Hanel (2003), Nambisan & Nambisan (2008), Svendsen et al., (2011), lau (2011) and Abdolmaleki and Ahmadian, (2016) supported these hypotheses.

Recommendations and Limitations Integration with customers and key suppliers is very much crucial for the progress of development of new product. This will reduce the time required for development and reduce the risk of failure. For that purpose, certain strategies should be made for effective communication with customers and suppliers. This will ultimately enhance the productivity of development process. The characteristics of product such as product quality, product differentiation, product modularity and the variety of products also influence on the development of new product. Providing value to the customers is the main reason for the purpose of the new product development that's why knowledge and views regarding their wants and demand should be taken in the initial stage so that the customers wants can be satisfied and value can be provided to customers which will increase the chances of growth of development of new product. For the effective integration with suppliers the design should be flexible that leads to attain certain benefits from the contribution of suppliers to make products better. The more strong partnership with suppliers will be possible when they will see their contribution in the process of development of new product. So, The characteristics of product should be defined, Customers should be involved in early stage of development of new product and their views and opinions should be given much importance, Effective integration with suppliers is very much essential so their contribution in the process of new product development plays great role, Certain strategies should be made for effective communication with customers and suppliers.

In this research, only "Punjab Pakistan" city was chosen to conduct the study which was limited. The study was established only on 4 product characteristics to investigate. There are as yet various other factors that could be taken for future studies, for example, product quality, and technology. This study comprised of 180 participants which were very slightly small. PLS-SEM was used to analyze the data however others techniques can also be used in future research. Convenience approach sampling was utilized in the existing study however other sampling techniques can also be used. A huge sample size might continue varied suggestions and outcomes. So the broaden and enormous sample can express increasingly distant reaching results.

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APPENDIX

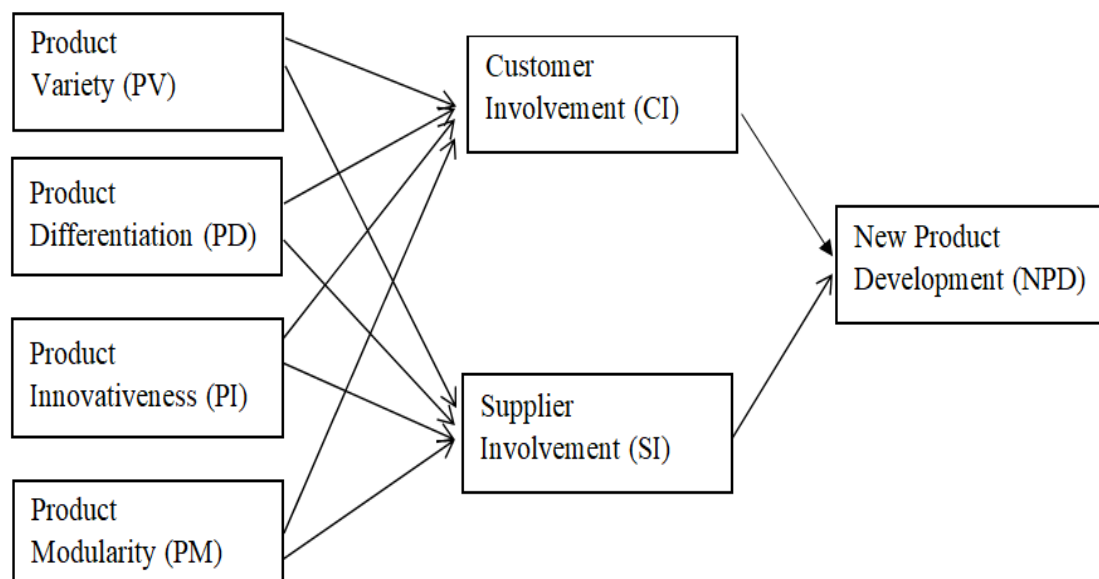


Fig. 1. Theoretical model**Table 1.** Respondents Demographic

Characteristics		Managers and employees (N=180)	
		Frequency	Percentage
Gender	Male	180	100
Marital Status	Single	62	34
	Married	118	66
Age	20-25	18	10
	25-30	46	26
	30 above	116	64
Family Type	Single	112	62
	Joint	68	38
Education of customer	Primary	23	13
	Matric	37	20.5
	Intermediate	46	25.5
	Graduation	74	41
Monthly Income	45000 to 65000	28	15.5
	65000 to 85000	39	21.7
	More than 85000	113	62.8

Table 2. Factor loadings and Variance Inflation Factor (VIF)

	CI	NPD	PD	PI	PM	PV	SI	VIF
CI1	0.779							1.201
CI2	0.772							1.627
CI3	0.762							1.646
CI4	0.638							1.520
NPD1		0.731						1.411
NPD2		0.685						1.353
NPD3		0.737						1.641
NPD4		0.769						1.823
NPD5		0.629						1.442
PD1			0.848					1.932
PD2			0.720					1.383
PD3			0.668					1.187
PD4			0.724					1.561
PI1				0.746				1.367
PI2				0.716				1.312
PI3				0.812				1.186
PM1					0.834			2.893
PM2					0.826			1.614
PM3					0.760			1.443
PM4					0.825			2.862
PV1						0.668		1.128
PV2						0.802		1.429
PV3						0.817		1.437
SI1							0.774	1.810
SI2							0.648	1.394
SI3							0.801	1.703
SI4							0.804	1.416

Table 3. Reliability and validity of the construct

Variables/Items	Cronbach's α	rho_A	CR	AVE
CI	0.746	0.787	0.828	0.548
NPD	0.759	0.768	0.837	0.507
PD	0.726	0.734	0.830	0.552
PI	0.646	0.674	0.803	0.577
PM	0.830	0.844	0.885	0.659
PV	0.641	0.649	0.808	0.586
SI	0.760	0.791	0.844	0.577

Table 4. Discriminant validity

	CI	NPD	PD	PI	PM	PV	SI
<i>Fornell and Larcker's (1981) procedure</i>							
CI	0.740						
NPD	0.615	0.712					
PD	0.654	0.592	0.743				
PI	0.443	0.502	0.574	0.759			
PM	0.571	0.562	0.682	0.535	0.812		
PV	0.523	0.365	0.546	0.460	0.408	0.765	
SI	0.643	0.711	0.666	0.677	0.620	0.410	0.759
<i>Heterotrait-Monotrait Ratio (HTMT)</i>							
CI							
NPD	0.707						
PD	0.766	0.792					
PI	0.558	0.668	0.826				
PM	0.629	0.692	0.853	0.726			
PV	0.655	0.537	0.786	0.732	0.540		
SI	0.791	0.881	0.844	0.892	0.733	0.529	

Table 5. Path Coefficients

Hypothesis	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	Decision Supported
H1: PV -> CI	0.227	0.095	2.384	0.017**	Yes
H2: PV -> SI	-0.041	0.086	0.472	0.637	No
H3: PM -> CI	0.213	0.082	2.609	0.009***	Yes
H4: PM -> SI	0.208	0.071	2.925	0.004***	Yes
H5: PD -> CI	0.385	0.068	5.697	0.000***	Yes
H6: PD -> SI	0.307	0.072	4.250	0.000***	Yes
H7: PI -> CI	0.003	0.071	0.040	0.968	No
H8: PI -> SI	0.405	0.079	5.128	0.000***	Yes
H9: CI -> NPD	0.277	0.075	3.717	0.000***	Yes
H10: SI -> NPD	0.531	0.076	7.007	0.000***	Yes

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6. R-Square value

	R Square	R Square Adjusted
CI	0.492	0.481
NPD	0.548	0.543
SI	0.595	0.585

