

## FIRMS' CO-CREATION AND INNOVATION BY TOOLKITS USAGE: THE MEDIATING ROLE OF RELATIONSHIP QUALITY

*Dr Ripan Kumar Saha<sup>1</sup>, Dr Sharan Kaur Garib Singh<sup>2</sup>, Dr Azni Zarina Taha<sup>1</sup>, Dr Tey Lian Seng<sup>1</sup>*

<sup>1</sup> Department of Business Policy & Strategy, Faculty of Business & Accountancy,  
University of Malaya, Malaysia

<sup>2</sup> School of Business, Whitireia Community Polytechnic, Auckland, New Zealand

**Abstract:** In the modern business world, firms gain enormous success in innovation by involving customers in the innovation process. This approach ostensibly reduces firms' cost by decreasing reliance on internal research and development. Organizations often use knowledge from customers via toolkits usage to fulfill customer's need. Fulfilling customer needs through customer involvement in product innovation process via toolkits usage has seen favorable outcomes for the organizations. Therefore, the purpose of this research is to examine the impact of toolkits usage on co-creation and innovation, respectively. Additionally, this study aims investigate the mediating role of relationship quality between predictor and criterion variables. This study includes a survey of 393 manufacturing firms in Malaysia. Results confirm that toolkits usage is positively associated with innovation and relationship quality. Further, the results provide evidence that relationship quality plays a mediating role on the relationship between toolkits usage and criterion variables. The results assert important implications for practitioners wanting to reap benefits from individualized products through toolkits usage. In sum, manufacturers can garner value from toolkits usage within the context of an emerging economy, like Malaysia.

**Key words:** *Innovation, Co-creation, Toolkits Usage, Relationship Quality, and Malaysia*

### INTRODUCTION

The rapid growth of information technology and Web 2.0 based communication systems such as social media have revolutionized opportunities for organizations to interact with customers for ideas which may use to enhance their innovative and creative capabilities. In the same way, this has enhanced firms' innovative and creative capabilities to develop new or improve existing products [1-3]. To sustain and succeed in a competitive business environment, organizations are induced to produce products according to consumer needs [4]. Therefore, many firms in various industries are trying to understand user needs by engaging customers in product co-creation and innovation processes. One popular form of customer engagement for product co-creation and innovation is toolkits usage for innovation [5] or customer co-design [6].

Toolkits usage first emerged in the 1980s for designing and manufacturing customized integrated circuits (IC), which was a huge success. As a result, many firms started offering toolkits usage that allow customers to design their products. For instance, Nike has a system where customers can tailor their sneakers, and Dell offers an online selection process where users can configure their personal computers. The phenomenon underlying toolkits usage is it allows customers to take part in the product development process which used to be strictly within the domain of organizations [5];[7-8].

Although several studies [5-7] pointed out the significant advantages of the toolkit usage process, its' limitations have been advocated by other authors as well [9]. Authors argue that customers might get limited value from the product that they developed by toolkits usage, as the cost for actively developing or co-creating products might exceed the benefits they are receiving. However, there have been several significant successful toolkits usage applications.

Although there are challenges, however studying toolkits usage is pertinent for emerging economies like Malaysia. Toolkits usage research in Malaysia has been centered mostly around user acceptance, user satisfaction, compatibility with other devices, and toolkits' impact on purchase intent [10-14]. However, only one study examined the outcome of customers' customization using a toolkit [15]. Hence, to the best knowledge of the researchers, this research is the first in Malaysia to examine the influence of toolkits usage for product co-creation and innovation, respectively.

Given the above indicated gap in understanding of toolkits usage for co-creation and innovation, this study addresses the question that this study objectives to answer. Therefore, to what extent does the toolkits usage impact on co-creation and innovation for firms is the research question guiding this study. Hence, the purpose of this research is to examine the impacts of toolkits usage on co-creation and innovation. The succeeding section covers literature review followed by methodology and results. Discussion and conclusion are the final sections of this paper.

## **LITERATURE REVIEW**

### **Innovation**

Innovation is a driving force for competitive advantage especially in this day and age when many economies like China accelerate manufacturing innovation that creates tremendous competition [16]. Due to stiff competition spurred by shorter product life cycle, firms are faced with the reality that tapping external knowledge and skills can speed up its innovation. Hence building innovation of the enterprise has created a paradigm shift from Schumpeter's [17] notion of the individual entrepreneur bringing his/her innovation to the market. Therefore, stiff competition has compelled firms to collaborate in innovation [18] and this transition reflects an open concept of innovation, as articulated and extensively researched by Chesbrough [19]. Open innovation thrives on the idea that external parties such as customers or users are sources of knowledge to firms and researchers have found positive outcome with performance [18]; [20-21].

In this research, innovation is regarded as the competence of a firm in developing new products or improving existing products. Building innovation involves a lot of ambiguity in the form of "technical, production, need and market uncertainties" [17]. Thus, different types of information are accessed and transferred to reduce uncertainties. For example, accessing need-related information from users reduces uncertainty hence increases innovation effectiveness. This access includes an intensive comprehension and appreciation about users' prerequisites, activities, and procedures, which are usually transferred from users to manufacturers using market research techniques [17]. An active participation of users in the design or development of products using tools created by the manufacturer is an alternative approach to the conventional market research technique. Users are empowered to take part in the innovation procedure by using toolkits. Based on this and the preceding section, toolkits usage is known as a form of market research technique that can contribute to innovation processes of a firm.

### **Co-creation**

Consumers or users are no longer passive recipients of products or services [22-23]. Due to the Information Technology, and the Internet of Things, customers or users are currently well associated, informed, interacted and empowered like never in the past. Customers or users have learned how to use these tools to be heard and seen by firms and be engaged in the product development or design procedures of the product. Subsequently, firms are taking advantage by getting customers or users actively participating in the firm's innovation procedure [24].

Actively involving users in designing or developing products is a type of co-creation, which is characterized as the users' vigorous involvement in product development and design of a new offering [25-26]. Co-creation is facilitated by the manufacturer when users or customers interact with the manufacturer. Customer-centric management is applied in co-creation with the purpose of leveraging customer or user information and capabilities for the innovation process. Co-creation has the benefit of gaining knowledge about the customer's or user's product needs, applications and solution technologies [17]. There are many methods of co-creation and toolkits usage is one of them [27].

Piller et al. [17] proposed three characteristics that entail co-creation. First, the innovation process stage depicts the time when the new product development phase receives input from the co-creation activities. Customer or user input can be in the form of idea creation and concept enhancement. Second, the degree of collaboration is a reflection of the underlying relationship structure within an open environment scenario. Collaboration can be dyadic, which is the interaction between the firm and one customer or user at a time or collaboration between a network of customers or users only (without the firm). Third, the nature of tasks allocated to customers or users depict degrees of freedom. A few degrees of freedom mean the task is narrow and predefined while many degrees of freedom describe an open and creative task in which case a solution is barely conceivable. Thus, engaging customers or users in the product development or design process via toolkits usage fits in well with co-creation, which is the definition adopted in this study.

### **Toolkits Usage**

Manufacturers desire producing products that customers want, because of the positive impact on competitive advantage. Thus, customer needs drive product developers into investing in tools that can give highly precise and valuable knowledge of future demand. von Hippel's [5] work on toolkits spurred vital contribution in toolkits usage and the value in customized products. Following von Hippel's research, this study adapts his definition of toolkits usage. Thus, this study defines toolkits usage as social media platform that helps customers or users to make modifications to the design of the product and/or allow feedback to be given to the manufacturer [5]. Toolkits usage assist to develop, accelerate, and visualize each innovative route, carried out by designers as well as in multidisciplinary groups in any kind of organization [28].

Literature has shown that market research, ethnography and other types of conventional market research techniques have been used to explore user needs [29]. These methods are meant to transfer user need-related knowledge to manufacturers, however not all information from the user gets transferred. Because of the multifaceted nature of user needs and user atmosphere, some information is difficult to transfer. For example, it is impossible to fully transfer detailed, and subtle interactions to specifications [5]. Thus, giving customers a toolkit to design products relieved manufacturers from the daunting task of fully understanding user needs.

Researchers stipulate empirical evidence of favorable outcome like decreased R&D cost, increased revenue and improved innovation with the use of toolkits usage in helping design and manufacture products [30-31]. However, toolkits usage is not a panacea. Customers may be unable to use the toolkits at the onset. Therefore, manufacturers must be aware of offering users the correct information for the added benefits. Moreover, toolkits usage platform should be user-friendly so that customers can use it immediately without having to spend time learning its functionality and it should be in language familiar to users [5].

Although there are challenges in implementing toolkits usage platform for transferring need-related information, the benefits outweigh the costs. Firms have reported increased brand loyalty, enhanced new product development, increased price per product, and potential to obtain needs-related information from user toolkits [32].

In the Malaysian context, there have been several studies examining toolkits usage. However, none of these studies investigated product design toolkits usage by customers and its influence on co-creation and innovation, respectively. Therefore, this research intends to fulfill the void in the Malaysian setting involving manufacturers. Nevertheless, only one study showed the reaction of customers after using of toolkits for customization. In a study that tested the influence of cultural background on the usage and satisfaction of an Internet configuration tool. Khalid and Helander [15] found Malaysian users showed more enthusiasm for idea customization compared to their Hong Kong counterparts. Another study was investigated the influence of website design and usability of online configurators, and result found that users were more willing to purchase products from the website with the most navigation flexibility [33]. Other studies examined the compatibility of a medical toolkit with other devices and its connectivity in remote locations [13]. User feedback on a knowledge management toolkit [12]; various methodologies for monitoring bicycle performance [11]; user acceptance of an emergency expert toolkit [34]; and communication patterns of online users [10]. Two studies investigated library toolkits usage where one examined users' awareness, and understanding [14], while the other explored its usability and effectiveness [35]. Hence against this backdrop, we hypothesize that:

- H1. Toolkits Usage has significant and positive impact on Innovation.
- H2. Toolkits Usage has significant and positive impact on Co-creation.
- H3. Toolkits Usage has significant and positive impact on Relationship Quality.

### **Relationship Quality**

Relationship quality spotlights on the level of suitability of a relationship to satisfy the necessities of the consumer associated with the relationship. Subsequently, relationship quality catches the positive/negative nature of a relationship, which thus gives positive advantages to the customer. For instance, relationship quality has been appeared to improve operational execution and developing new products [36-37]. Wagner and Sutter [38] demonstrated that excellent customer relationships improve supplier-customer joint innovation execution. Relationship Quality is the quality of the relationship that depicts the degree to which the desires of parties engaged in the relationship are met [36].

Torkildsen [39] noticed that quality relationships satisfy customers. To establish a superb relationship, organizations are urged by partners and customers to live up to their needs and desires organizations that can effectively address these issues get by rivalry. Relationship quality is the psychological component of social capital which reflects basic qualities, social network, and relationship competitive advantage [40]. Past investigations accentuated that increments in quality of relationship with community individuals contribute more than some other illustrative variable to improve organizations' innovation [41]. Chiu et al. [42] expressed that a trusted relationship leads to sharing and trading great quality learning for new improvement of the product. The quality of a relationship between an organization and its vital customer is reflected in the degree to which the two

parties create common objectives, standards, and proportional assumptions about the exchange [43]. In the investigation of service quality and customer dedication Giovanis et al. [44] found that relationship quality completely intercedes the service quality and customer loyalty relationship, while Keating et al. [45] found that relationship quality partially mediates the relationship between service quality and customer loyalty interaction. In fact, several investigations have loaned support to this statement [46];[36]. Kim and Cha [47] found that relationship quality influences the customer-employee relationship where a higher relationship quality between the employee and customer significantly influences service innovation. Base on the above literature review, the following hypotheses are developed:

Hypothesis 4: Relationship Quality has a significant and positive impact on Innovation.

Hypothesis 5: Relationship Quality has a significant and positive impact on Co-creation.

Hypothesis 6: Relationship Quality has the mediating role in the relationship between Toolkits Usage and Innovation.

Hypothesis 7: Relationship Quality has the mediating role in the relationship between Toolkits Usage and Co-creation.

### Research framework

Figure 1

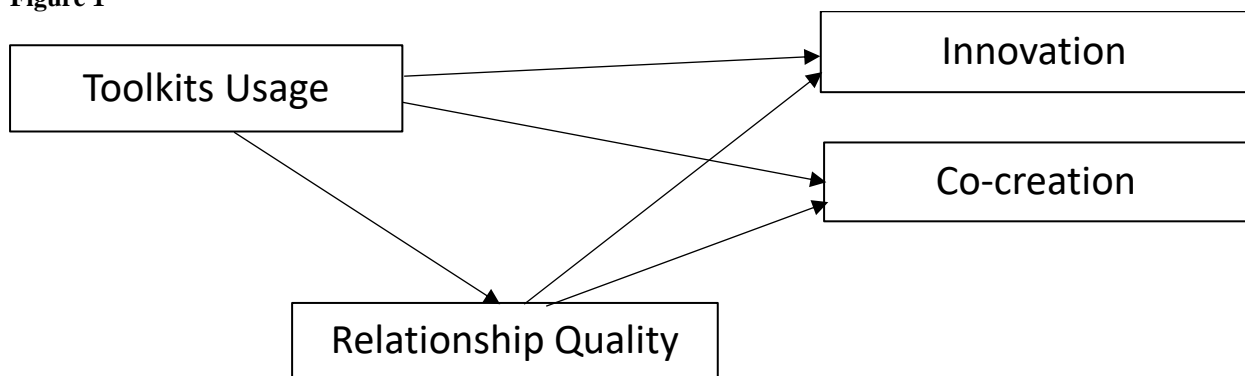


Figure 1. Research framework

## METHODOLOGY

### Sample

The survey data for this research were collected over a period of seven months, from Malaysian manufacturing companies. Manufacturing companies were selected because of their huge contribution to Malaysia's economy and the prevalence and implementation of co-creation and innovation were projected to be stronger in the manufacturing industry [48]. The population of this research included employees (at least manager, managing team and owners) who were mostly engaged in the product operations, product development procedures, and R&D department. The unit of analysis was the manufacturing firms. Each respondent represented one manufacturing firm.

We selected manufacturing firms from the 2016 Federation of Malaysian Manufactures (FMM) directory. However, the population frame underlying the survey may incorporate units that no longer exist, or no longer belong to the target population. Simultaneously, it may not contain units that in fact do belong to the target population [49]. Given this, the manufacturing firms short-recorded, through randomly, were reached by phone and after a preliminary investigation, appointments were made for questionnaire distribution; and justification was given wherever required.

In total, 536 manufacturing companies were selected for the face-to-face, email (Google link), and WhatsApp (Google link) distribution of the questionnaires. However, a total of 405 questionnaires were retrieved from the various industries. According to Hair et al., [50], the questionnaires that have more than 10 percent missing values should be removed from the data analysis, hence 12 incomplete questionnaires were discarded. In total there were 393 acceptable responses, from 393 firms, were considered "clean" and used for data analysis. The response rate is 68.23%.

### Measurement of variables and data analysis Techniques

The measurement of toolkits usage was adapted from Franke et al. [30], which is the incorporation of customer suggestions into the self-design procedure. Innovation was measured by using measurement items which was developed by Grawe et al. [44]. The measurement items for co-creation were adapted from form Ng et al. [52]. Finally, the measurement items for Relationship Quality constructs were adopted from well-established instruments in the previous study conducted by Chu et al. [53] and Singh [54]. All these scales were in a five-

point Likert scale (1 = strongly disagree; 5 = strongly agree, where a rating of 3 = neutral). Respondents were approached to demonstrate their extent of agreement with proclamations regarding the toolkits usage, innovation, co-creation, and relationship quality practices at their organization. The data collected for his study were analysed quantitatively. IBM SPSS® Statistics v.22 and Analysis of Moment Structures (AMOS) v.22 were used to run the relevant statistical tests. Finally, the bootstrapping procedure in AMOS has been utilized to test mediating effect [55]. The next section provides the results attained from analysing the data via hypotheses testing.

## RESULT

### Demographic profile of respondents

Out of 393 respondents majority of the respondents were female (255 or 64.9%), in the age group of 31-40 years old (201 or 51.1%), holding a Bachelor degree (268 or 68.20%), were Senior Managers (182 or 46.30%), and were working in the electronics & electrical industry (132 or 33.6%).

### Exploratory factor analysis (EFA)

Using exploratory factor analysis (EFA), a total of 36 items were used to measure toolkits usage, innovation, co-creation, and relationship quality. These items formed four factors. However, three items for toolkits usage, nine items for co-creation, one items for innovation, and three items for relationship quality were removed because of low factor loadings [50]. The results of the EFA were explained the KMO and Bartlett’s measure of sampling adequacy. In this study, KMO is 0.872 and Bartlett’s Test of Sphericity was significant ( $\chi^2 = 2207.670, p < 0.010$ ). Additionally, the four factors together explained 55.63% of the variance with an eigenvalue of more than 1.

### Confirmatory Factor Analysis (CFA)

The initial model fit index for toolkits usage, innovation, co-creation, and relationship quality with all 36 items showed that the model does not fit (CMIN/DF = 4.66; CFI = .755, which is lesser than .900; GFI = .757, which is lesser than .900; RMSEA = .090 which is more than .080). However, after removed week items found in initial CFA analysis, a re-specified measurement model, as shown in Table 1 shows the model fit index for toolkits usage, innovation, co-creation, and relationship quality. All 21 items indicated acceptable fit as the CMIN/DF value changed to 341.294 and significant (which is lesser than 5.0;  $p < .010$ ). The CFI and GFI values improved (CFI = .945 and GFI = .926), while RMSEA reduced to .047.

**Table 1:**  
Confirmatory Factor Analysis

			Estimate	C.R.	R	P	Model Fit
Toolkits Usage	<->	Relationship Quality	.059	5.43	.449	***	CMIN/DG = 341.29 P = .000 CFI = .945 GFI = .926 RMSEA = .047
Toolkits Usage	<->	Innovation	.055	5.00	.373	***	
Toolkits Usage	<->	Co-creation	.078	6.22	.519	***	
Relationship Quality	<->	Innovation	.064	5.87	.516	***	
Relationship Quality	<->	Co-creation	.052	5.23	.407	***	
Innovation	<->	Co-creation	.048	4.83	.342	***	

### Reliability and Validity

A reliability analysis was performed to assess the items’ internal degree of consistency and reliability in which case, Cronbach’s alpha test was calculated for each of the items of toolkits usage, innovation, co-creation, and relationship quality [55]. The reliability in Table 2 shows that the Cronbach's Alpha value of each variable is more than .700 [50]. We conducted convergent and discriminant validity tests of the constructs. As a result shown in Table 2, Composite Reliability (CR) for all variables is greater than .700, and Average Variance Extraction (AVE) is higher than .500 which indicate the convergent validity of the variables [50]. Also, the correlation result explained that there is a significant and positive relationship between each variable. Therefore, the result provides evidence that all the variables have achieved convergent and discriminant validity [50].

**Table 2**  
Reliability Analysis

Measurements	Number of Items	Cronbach’s Alpha	CR	AVE
User toolkits	6	.814	0.782	0.524
Innovation	4	.834	0.796	0.639
Co-creation	6	.779	0.834	0.503
Relationship Quality	5	.847	0.794	0.562

**Hypotheses testing using Structural Equation Modelling (SEM)**

SEM is a multivariate statistical method which was applied to analyze structural interactions between the measured variables and latent constructs [56].

The research model in Figure 2, is a composite model that was developed based on the hypothesis of this study. In this model toolkits usage is the predictor variable and innovation and co-creation are dependent variables while relationship quality is the mediating variable. The result of the model fit summary in Figure 2 shows the significant value of CMIN/DF of 343.64 ( $p = .000 < .010$ ); while the remaining values supported a model that fitted well (CFI = .945; GFI = .926; RMSEA = .047). Hence, we can conclude that the model fits. Furthermore, Table 3 shows that toolkits usage has significant and positive impact on innovation ( $r = .182, p = 0.007 < .010$ ), co-creation ( $r = .420, p = 0.000 < .010$ ), and on relationship quality ( $r = .449, p = 0.000 < .010$ ), respectively. Table 3 also indicated that relationship quality is significantly and positively related to innovation ( $r = .440, p = 0.000 < 0.010$ ) and co-creation ( $r = .228, p = 0.000 < .010$ ). The results show that five hypotheses (H1, H3, H4, & H5) are supported.

**Figure 2**

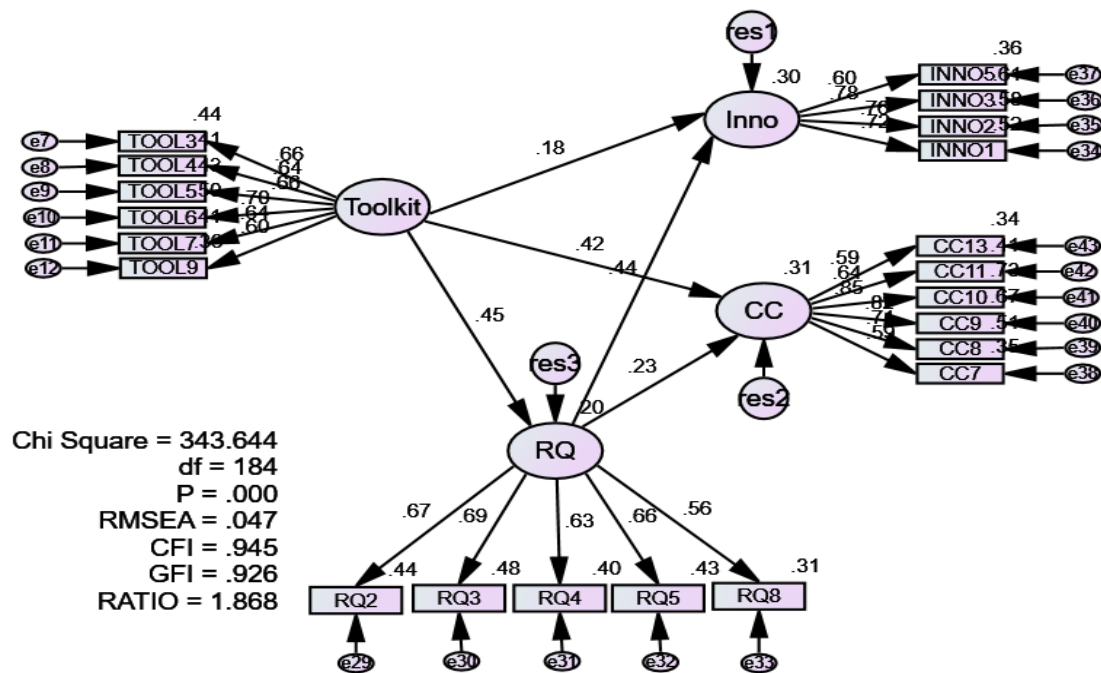


Figure 2. Structural Equation Modelling (SEM)

**Table 3**  
Standardized Regression Weights

Paths	P	Standardized $\beta$
Innovation <--- Toolkits Usage	.007	.182
Co-creation <--- Toolkits Usage	.000	.420
Relationship Quality <--- Toolkits Usage	.000	.449
Innovation <--- Relationship Quality	.000	.440
Co-creation <--- Relationship Quality	.000	.228

**Mediating Effect**

Table 4 displays the output of indirect effect of toolkits usage on innovation and co-creation. The bootstrapping procedure in AMOS was used and performed with, 5,000 resamples. Statistical significance for the indirect effect was determined from 99 percent bias and accelerated confidence intervals [56]. As can be seen, the standardized coefficient for total effect (c) before entering the mediator (relationship quality) was significant with innovation ( $r = .182; p = .009 < 0.010$ ) and co-creation ( $r = .420; p = .000 < 0.010$ ). This means that the toolkits usage does fully influence innovation and co-creation. Furthermore, the result in Table 4 shows that when relationship quality acts as a mediator, the influence of toolkits on co-creation ( $r = .558; p = .000 < 0.010$ ) and innovation ( $r = .482; p = .000 < 0.010$ ) remains significant. On the other side, when relationship quality acts as a mediator, the influence of toolkits usage on innovation and co-creation were significant, but beta/r value reduces for innovation ( $r = .339$ ;

$p = .003 < 0.010$ ) and as well as for co-creation ( $r = .394$ ;  $p = .000 < 0.010$ ). In this result we can conclude that the mediating effect of relationship quality is significantly different from zero at ( $p = .000 < .05$ ) for both interactions. As predicted, the results lend support to a mediation model since the total effect of toolkits usage on innovation and co-creation are significant when controlling relationship quality. Therefore, hypothesis 6 and 7 are supported.

**Table 4:**  
Testing Indirect Effects (Mediation Variables)

Paths	Direct without Mediator (P)	Direct with Mediator (P)	Indirect (BC) P	Findings
Toolkits Usage → Innovation	.182(.007)	.482(.000)	.339(.003)	Partial M
Toolkits Usage → Co-creation	.420(.000)	.558(.000)	.394(.000)	Partial M

*P: Probability, M: Mediation, BC: Bootstrap Confidence (Two Tailed Significance)*

**DISCUSSION AND CONCLUSION**

This study aimed to understand and analyze toolkits usage for value gained in the form of innovation, co-creation, and relationship quality. This research then analysed the effect of relationship quality on innovation. The main purpose of this study was to investigate the mediating role of relationship quality on the relationship among the independent variables and dependent variable. Results confirm the effective use of toolkits usage on innovation, co-creation, and relationship quality in line with past researchers [57-60];[32]. These signal the perceived value appropriated by the Malaysian manufacturers who participated in this research.

It is not surprising that toolkits usage has been regarded positively by the manufacturers of this study. Since innovation is a driving force behind many firms’ competitiveness, involving customers in product design increases the capability of the firm. The notion of building innovation by collaborating and developing ties with external parties like customers mirrors an innovation strategy that is open [61];[18]. Besides when manufacturing firms develop products that enhance the value or utility of the product for the customer, the result is an increase in sales. Toolkits usage enable manufacturers to increase its innovation as well as reduce the uncertainty of customers’ response to next-generation products [17].

The results further suggest that the manufacturers of this study acknowledge customers as active recipients of their products and potential contributors of product design [22];[17]. When companies involve customers to co-create their products, they are in a position to leverage customers’ experiences, knowledge and capabilities to develop new or enhance existing offerings. Additionally, companies learn to better understand user needs and solutions [17]. This method is a very efficient strategy for market testing and new product development thus substantiating toolkits usage.

In our study we hypothesized that relationship quality is positively related with innovation and co-creation. The findings of this investigation support the argument of Wagner and Sutter [38] who demonstrated that high-quality customer connections develop supplier-customer joint innovation execution. Previous scholars like Ngugi et al. [62] had noted that firms relationship quality with customers can influence value co-creation and Innovation. A previous study’s result described that maximizing the trust of corporate relationships tends to increase green service innovation [41]. This result was also supported by previous researches that highlighted the importance of relationship quality for product innovation, particularly with key customers [63]. Thus, relationship quality is the strength of customer relationship which significantly affects product innovation and co-creation. Through high relationship quality, customers tend to take additional responsibilities to participate in the product innovation and co-creation process. In a nutshell, the results of this research provide evidence on the significant effect of relationship quality on innovation and co-creation. Our findings suggest a partial mediating effect of relationship quality on the relationship of toolkits usage and innovation and co-creation [44];[53];[63]. The reason for this could be that there are other factors that have a bigger impact on product innovation and co-creation [64-65].

**Contributions**

There are practical and theoretical contributions from this study. First, this study reinforces the co-creation and open innovation theories through the empirical investigation of toolkits usage. Second, the results confirm important implications for practitioners wanting to reap benefits from individualized products through toolkits usage. Third, this study brings to the fore the types of values garnered from toolkits usage. Moreover, this study empirically confirms the high-value toolkits usage can garner within the Malaysian context. Furthermore, the potential of raising the price of products can be gained from toolkit-based products, which is an avenue for future research. For example, Franke and Piller [8] found that participants were willing to pay twice or more for a self-designed watch.

This research's results add to the literature of toolkits usage, innovation, and co-creation within an emerging market setting. The fact that innovation is no longer a closed activity permeates the findings of this



study. Embracing openness is one of the implicit implications of this study's findings, which is in line with the empirical outcome of another Malaysian study [18]. However, there are risks in opening up the innovation process especially within economies that are still strengthening their appropriability regimes. This risk has national implications for strengthening policies, market-supporting institutions, and the legal systems to support innovation building initiatives by firms [61].

### Limitation and future research

Findings from this study cannot be generalized as a non-probability sampling method was employed. However, there is a chance for future researchers. One impending investigation is to discover other value appropriation variables such as higher prices and innovation costs. It would be interesting to understand and validate empirically if higher prices and lower innovation costs can be reaped from toolkits usage. An Additional opportunity for future study is to test the extent of knowledge spill overs in toolkits usage and the operational mechanics used by firms at the firm and national policy levels to safeguard firms' internal competencies. Finally, co-creation could be tested in future as an intervening variable between toolkits usage and innovation.

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