

## **B2B E-COMMERCE TECHNOLOGY FACTORS WITH MEDIATING EFFECT PERCEIVED USEFULNESS IN JORDANIAN MANUFACTURING SMES**

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### **Abstract**

The adoption of electronic commerce (e-commerce) for the business to business model category in business operations is currently no longer a privilege merely to large organizations; the Small and Medium Enterprises (SMEs) can also benefit from the adoption. Although the SMEs are considered to play a major role in the economic growth of most nations, they are generally moving slower towards adopting B2B e-commerce compared to larger organizations. It is important to determine the factors influencing intention to continue using B2B e-commerce by the SMEs so that they can effectively use it without wasting their limited resources. This study aims to examine the factors that affect the intention to continue using B2B e-commerce among the manufacturing SMEs in Jordan using the Technological, Organizational and Environmental Model (TOE) that has been developed by Tornatzky and Fleischer. The quantitative method has been applied in this study where data collection has been done using a self-administrated questionnaire distributed to the SMEs in the manufacturing sector in Jordan. The total number of valid questionnaires is 168. Data analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM) technique indicates that relative advantage, top management support and information intensity have a significant indirect effect on intention to continue using B2B e-commerce, through Perceived Usefulness (PU). Perceived usefulness, from the Technology Acceptance Model (TAM), mediates the relationship of each of the two factors: relative advantage and information intensity with the intention to continue using B2B e-commerce.

Keywords: B2B E-commerce technology, Intention to continue use, Perceived usefulness, Small-medium enterprises.

## 1. Introduction

B2B e-commerce can be defined as “internet-enabled technologies that allow an organization to buy and sell products and services electronically, business transactions by means of telecommunications networks and share value chain” [1]. Many studies have predicted that B2B e-commerce will dominate the world economy where B2B e-commerce is considered to be a significant determinant of future growth of the economy [2]. Developed countries have aggressively implemented B2B e-commerce and in fact, B2B e-commerce has become an essential part of business activities in these countries [3].

The B2B e-commerce market is generally more profitable than the B2C e-commerce market because its volume is almost ten times that of the B2C e-commerce market [4]. In the Republic of Korea, for example, B2B e-commerce accounted for 91% of e-commerce value [5]. Projections for the future of B2B e-commerce in emerging economies such as India and China are also positive [1, 4].

The Jordanian industrial sector consists mainly of the mining and quarrying sector and the manufacturing sector. This industrial sector stands as one of the main pillars of the Jordanian economy, contributing directly to about a quarter of the national economy in terms of Gross Domestic Product (GDP) [6]. According to Amman Chamber of Industry, the manufacturing sector in Jordan consist of (Therapeutic and Medical, Chemical and Cosmetics industries, Plastic and rubber products, Engineering and electronic industries, Furniture, Kitchens and doors, Paper, Stationeries and offices supplies, Food and supply, Leather and Garments and construction). The government in Jordan sees the future of Jordan as an industrialized country and this means that the focus of Jordanian economy would be in industry rather than in services [7].

B2B e-commerce expansion in the country can be considered as low, some organizations may have even discontinued using B2B e-commerce for their business. The consequences from Jordanian SMEs not continuing to use B2B e-commerce include:

- Loss of the amount of potential future growth to the individual SMEs.
- Wastage of the earlier effort in convincing the SMEs to adopt B2B e-commerce.
- Loss of the amount of potential future growth of Jordan’s economy from B2B e-commerce adoption.
- Stagnation of the achievement of the goal of the Kingdom of Jordan to be one of the leading countries in B2B e-commerce adoption.

## 2. Literature Review

Different variables are used to determine B2B e-commerce in previous studies; some of these variables are important in certain studies but they can have no effect in other studies. One consideration for this issue is depending on country of study, where these variables used can be different from one country to another. For example, relative advantage is an important variable for different levels of B2B e-commerce adoption in Ghana [8], while this variable has no effect in Iran [4]. Top management support is an important factor towards B2B e-commerce adoption in Jordan [3] and in developing countries [4]. Also, most of these studies focus either to explain the influence of these variables on B2B e-commerce adoption, or to

determine the level of B2B e-commerce adoption without considering other variables as a mediator to strengthen the model.

In the context of Jordan, there are limited studies in Jordan that has looked into the usage of B2B e-commerce technology by organizations or SMEs. For example, internal and external factors that affected B2B e-commerce adoption by small and medium organizations has been explored where it was discovered that the adoption of B2B e-commerce is influenced by organizational factors, particularly readiness, strategy, managers' perceptions and external pressure by trading partners [9]. Readiness and external pressure are most important for achieving maximum benefit from B2B e-commerce adoption. The next sections will mention the important factors affecting intention to continue using B2B e-commerce by Jordanian Manufacturing SMEs.

### **2.1. B2B e-commerce technological factor**

Most of the research studies stress they need to explain how organizations perceive the technology. According to previous studies, the most important factors they used to determine B2B e-commerce technology is a relative advantage.

#### **Relative advantage**

Hassan et al. [10] reported that the relative advantage could be defined as the advantage adopting B2B e-commerce technology to an organization in comparison to not adopting B2B e-commerce in terms of the advantage of improving communications and the image of the organization, in increasing the sales, revenues and competitive advantage of the organization and in lowering its inventory cost. B2B e-commerce adoption is very important for the organization to reduce administrative cost in sales and marketing as well as improves the relationships between business partners. The adoption also leads to stock level reduction and higher internal efficiency thereby widening access to new customers and increasing sales [11]. The relative advantages of B2B e-commerce technology is one of the considerations for the manufacturing companies in Iran [4]. If an organization believes that the relative advantage from website business activities will enhance their business efficiency and effectiveness, then it would be more inclined to retain its website. Thus, a great perception of the benefits of having an online business website should lead to the greater possibility of website continuance intention [12].

### **2.2. B2B e-commerce organizational factor**

Organizational variables are important in predicting organizational technology adoption that produces changes in products and services. Many studies on technology adoption theoretically explained the relationship between organizational factors and technology adoption [4, 12]. However, based on previous studies, the most frequent factor influencing B2B e-commerce adoption and different technologies adoption is top management support.

#### **Top management support**

Top management support is the means that can provide encouragement to the team and help them overcome problems and solve them in a timely manner. Similarly, top management support is important in getting a new technology being implemented in an organization [13]. In the context of cloud, computing adoption management

support play a crucial role because the usage of cloud computing would possibly involve the integration of resources, activities and therefore the re-engineering of bound processes [14].

There are two general concepts about how top management support affects the technology adoption. According to Hassan et al. [10] and Lutfi et al. [15], the first concept refers to the level of commitment and support in terms of providing financial and human resources, vision, support and a commitment to form a positive environment for innovation. The second concept refers to the adoption decision's dependency on the different job position such as CEO, owner/manager of the organization who makes the decision to adopt the technology [16]. This study adopts the first concept of top management support, where the support refers to the commitment in first having a vision towards B2B e-commerce technology followed by the provision of the required support to create an encouraging environment for the continuance.

### **2.3. B2B e-commerce environmental factors**

The environment factors have a critical role in encouraging organizations to adopt technologies such as B2B e-commerce [4]. Researchers have suggested that environment context provide opportunities such as information intensity and security. The important factors that are related to B2B e-commerce adoption are discussed in following sub-sections.

#### **2.3.1. Information intensity**

Information or data intensity is defined as the degree of data that is presents the product or service of a business, which reflects the amount or quality of information intensity of that product or service [17, 18]. Information intensity refers to the information about products and services, thus the more complex the products or the service are; the more information is required to describe them. Information intensity is considered very important for motivating as well as demotivating e-commerce adoption [19]. Many organizations are unable to adopt e-commerce because their products or services require lengthy explanations, which are difficult to describe causing the difficulty to adopt e-commerce by the organization. Complicated information may lead to many difficulties that prevent also the adoption of B2B e-commerce. Therefore, the result of higher data intensity in an organization of perceiving innovation that may be a competitive tool and this encourages the level of innovation that is adopted [18].

#### **2.3.2. Security**

Garg and Choeu [20] study is based on the concept of security used is defined as the trust or confidence of the organization in using B2B e-commerce in terms of the issues of privacy, data confidentiality and security of transactions, security of payment system and the reluctance of partners to make an online payment. The important thing desires of information security are to protect the confidentiality, integrity and availability of data regardless the shape of data accepted [21]. In Jordan, security threats are crucial in e-commerce environments and may limit the growth of the technology [22]. It has been pointed out that online payment in Jordan is only a few percents of overall e-commerce in the region [23]. This is because Jordanian users and companies are still cash oriented and prefer cash on delivery.

There are two different concepts of security where both concepts are related to each other and complement one another. The first concept of security refers to privacy concerns, which relate to the protection of client details and transaction from each external and internal fraud and criminal attacks. The second concept of security refers to the lack of confidence, which relates to hackers and viruses when using the internet and B2B e-commerce to pay online.

#### **2.4. Perceived usefulness**

PU is defined as "the degree, to which organization owner/managers believe that employing a specific system would enhance the organization job performance" [24]. PU is a factor that directly affects the intention to adopt a system [25]. PU comes from the term "usefulness" of the system for B2B e-commerce adoption by SMEs and the assessment of PU can be made by observing the influences of B2B e-commerce on job performance with respect to performance measures including speed and productivity [26].

#### **2.5. Intention to continue using B2B E-commerce**

In accordance with the discussion of Venkatesh et al. [27] in this study, we define behavioural intention as the willingness of the organization to continue using B2B e-commerce technology. Different researchers point out different factors that affect the behavioural intention and these factors differ depending on the context of the technology [28]. Intention to continue using e-commerce would lead to the maintaining or the increase of current usage and frequency. Studying intention to continue using e-commerce serves to determine why organizations are continuing or not continuing to use this technology [29].

### **3. Underlying Theories**

The Technological, Organizational and Environmental (TOE) framework can be combined with Diffusion of Innovation (DOI) theory such that the five factors of DOI theory (relative advantage, compatibility, complexity, trialability, observability) are used in the technological context to describe that the adoption depends on the technologies inside and outside the organizations. In addition, the TOE framework emphasizes the internal and external characteristics of the organization. Internal characteristics refer to the organizational context in the TOE framework, whereas the external characteristics of the organization refer to the environmental context within the TOE framework. The TOE framework has been suggested as a useful starting point in studying B2B e-commerce adoption [4]. TOE is suitable to explain the adoption of innovation because it contains three contexts of organization: technological context, organizational context and environmental context that may influence the process of organization adoption of technological innovation. However, it does not take into consideration the behavioural aspect such as the perceived usefulness of technology. It has been suggested that integrating TAM into TOE would be beneficial [30].

### **4. Conceptual Research Framework**

Based on the variables described in Sections 2.1 to 2.5, the conceptual research framework was developed as in Fig. 1. The framework has the characteristics of relative advantage, top management support, information intensity and security

(IVs). The PU is Mediating Variable (MV) and intention to continue using B2B e-commerce is a Dependent Variable (DV). The framework is used to study the direct effects of the relationships between independent variables constructs on the intention to continue using B2B e-commerce. Furthermore, it determines the indirect effects of PU on the relationship between independent variables constructs, PU and intention to continue using B2B e-commerce. This study considers PU from TAM as the mediating variable in determining the effect of TOE factors and the intention to continue using B2B e-commerce as is shown in Fig. 1.

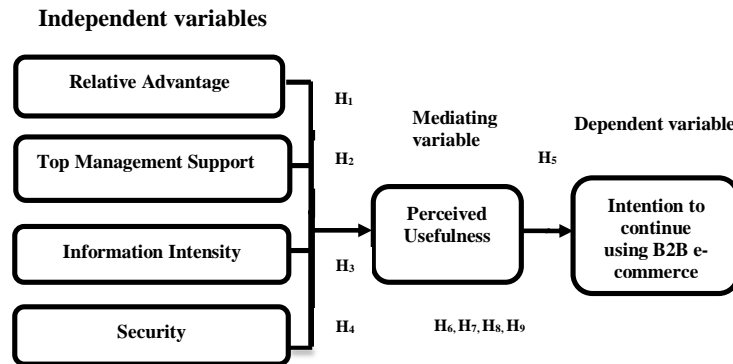


Fig. 1. Conceptual research framework with hypothesized relationships.

## 5. Hypotheses Development

### 5.1. Relationship between relative advantage and perceived usefulness

Previous researchers have comprehensively investigated the impact of relative advantage on organizations technological adoption [1, 2, 10]. They discovered that once businesses understand the relative advantage of an innovation, then the chance of adoption may increase [14]. Other researchers checked the effect of relative advantage on PU and found that has a significant effect, as an important predictor on PU for RFID adoption in Malaysia's Healthcare [31]. Moreover, Ramayah et al. [12] examined that if organizations believe that website business activities will enhance their business efficiency and effectiveness, they might still retain their web presence. Therefore, it is considered that is an indirect positive effect of relative advantage on intention to continue using B2B e-commerce by SMEs in Jordan through PU. Thus, in this present study, the following hypothesis is formulated:

**H1:** Relative advantage has a positive impact on the PU.

### 5.2. Relationship between top management support and perceived usefulness

Top management support is another important factor that affects the adoption of B2B e-commerce as well as different technologies [4]. Top management support positively affects PU of cloud computing by organizations in India [32]. Top management support is also critical in order to make a good climate and give satisfactory assets in the organization's B2B e-commerce technologies. In Jordanian manufacturing SMEs, this study assumes that top management support

to be very important for the use of B2B e-commerce technology in their organizations. Thus, top management support has an indirect effect on intention to continue using B2B e-commerce by the SMEs in Jordan through PU. The following hypothesis is formulated:

**H2:** Top management support has a positive impact on the PU.

### **5.3. Relationship between information intensity and perceived usefulness**

Several studies revealed that information intensity encourages innovation adoption, including B2B e-commerce [33]. Information intensity has a significant effect on the health sector in Kenya [34]. This indicates that higher adoption of Information and Communication Technology (ICT) with promotes higher intensity of information. Among rural based SMEs in Malaysia, it has also been found that there is a significant relationship between information intensity and ICT adoption. This implies that the more specialized the ICT applications, the more likely the SMEs are to adopt those applications [35]. For this study, since Jordanian manufacturing SMEs in different sectors have completely different information processing needs, hence those information-intensive sectors are more likely to appreciate the usefulness of B2B e-commerce. Therefore, it is considered that information intensity has a positive indirect effect on the intention to continue using B2B e-commerce by Jordanian SMEs through PU. This results in the following hypothesis:

**H3:** Information intensity has a positive impact on the PU.

### **5.4. Relationship between security and perceived usefulness**

Security challenge is an important factor towards the intention to continue using B2B e-commerce because of the lack of security equipment to deal with the theft of credit card information as well as data transaction between organizations. Security, which includes privacy concerns, has a significant and direct effect on intention to adopt RFID by hospitals in Malaysia [31]. Information security is crucial considers for Malaysian health care. Similarly, security is also a significant factor in ERP adoption by SMEs in Nigeria [36]. Thus, this study considers that security has an effect on the intention to continue using B2B e-commerce by the Jordanian SMEs through PU. This results in the following hypothesis:

**H4:** Security has a positive impact on the PU.

### **5.5. Perceived usefulness and Intention to continue using B2B E-commerce**

In TAM framework, PU is hypothesized to be the direct predictor of Behavioral Intention (BI) to fully different technologies adoption [25]. In fact, perceived usefulness has been found to the foremost vital consider acceptance of technology within the workplace, even a lot of necessary than ease of use [31]. Therefore, for this study:

**H5:** PU has a positive impact on the Intention to continue using B2B e-commerce.

### **5.6. Perceived usefulness as mediator**

PU was one of the most influential drivers identified in the study of predicting the intention to use different technologies [37]. Since PU is a mediator in TAM, then

integrating the mediator variable PU into the TOE framework would provide a better understanding of intention to continue using B2B e-commerce by the manufacturing SMEs in Jordan. PU is also expected to have an impact on the intention to continue using B2B e-commerce. Therefore, this study envisages that PU has a mediating effect between TOE factors and intention to continue using B2B e-commerce by Jordanian SMEs. The following hypotheses are formulated:

- H6:** PU mediates between relative advantage and intention to continue using B2B e-commerce.
- H7:** PU mediates between top management support and intention to continue using B2B e-commerce.
- H8:** PU mediates between information intensity and intention to continue using B2B e-commerce.
- H9:** PU mediates between security and intention to continue using B2B e-commerce.

## 6. Research Methodology

Based on an extensive literature review, this study considers multiple items. All items of each construct were reviewed and adapted with some modification to match the study environment. A set of 27 questions was compiled to represent the constructs. Relative advantage is adapted from Hassan et al. [10], top management support is adapted from Hassan et al. [10], information intensity is adapted from Ghobakhloo et al. [2], security is adapted from Garg and Choeu [20], PU is adapted from Davis [25] and intention to continue using is adapted from Venkatesh et al. [27]. When necessary, the wording was modified to suit the study environment. Seven points Likert scale were employed for the study and it ranged from strongly disagree to strongly agree.

The unit of analysis of this study is the organization of Jordanian manufacturing SMEs. The sample frame is the manufacturing SMEs in the Amman Chamber of Industry (the association of manufacturing SMEs in the Hashemite Kingdom of Jordan). This study uses, the simple random method, in which, every possible sample of the same size has an equal chance of being chosen. The advantages of the random sampling method include: it is easy to implement and it requires a little knowledge of the population in advance. Thus, the type of this population (list of manufacturing SMEs) makes the simple random method the most appropriate option in this study [38]. Sample size can be determined through the proposed first rule of thumb that for “10” items, such as for a study with 4 independent variables, 1 mediator and 1 dependent variable, the minimum of sample size is 6 times 10 (which is 60) [39]. The “rule of 10” may yield sample size with inadequate statistical power. Researchers have also asserted that sample size larger than 30 and less 500 is appropriate for most research [40]. The larger the sample, the more reliable the PLS estimates. Thus, we increase the sample size to obtain more reliable PLS values. A total of 200 self-administered questionnaires were distributed to the Jordanian manufacturing SMEs by hand to collect the required sample. Although self-administered and collection is more expensive in data collection than the postal delivery, it has many advantages such as time-saving and increased response rate [38]. The researcher conducted face-to-face questionnaire administration at the business location of the Jordan manufacturing SMEs. The use of self-administered questionnaires enables the researchers to gather a large of information. Moreover, it is more convenient for respondents to give the



description of their attitudes and beliefs toward the desired subject under study (B2B e-commerce technology). The total numbers of 168 useful questionnaires were obtained from SMEs that have email or a simple website and who intend to continue to advance the level of B2B e-commerce technology.

Harlam's single factor test was conducted to detect the presence of common method bias (variance due to the measurement method) in this study. The test revealed that the first factor accounted for 16.1% of the variance, which is less than the threshold level of 50% of the total variance explained [41]. A total number of 168 manufacturing organizations participated in this study. Majority of the organizations (18.5%) were from Chemical and Cosmetics industries, followed by Furniture, Kitchens and Doors (15.5%). Around 39.9% of SMEs have been in existence for more than 10 years. A majority of the SMEs (59.5%) have a total of 1-9 employees, 34.5% with 10-49 employees and 6.0% with 50-249 employees. In terms of using emails or website, 42.2% of the organizations use internet and email and 44% use basic website. Most of the respondents (72.2%) were holding positions (manager /Department Manager/Owner). Meanwhile, 38% of the respondents have been working with an existing organization for between 11 and 15 years, while 37% of the respondents had between 1 and 5 years of working experience.

## **7. Data Analysis and Results**

The quantitative data collected have been analysed using Smart Partial Least Square M3 Version 3.2.7 and SPSS version 22. PLS-SEM is a technique to estimate causal relationship among variables. Following a two-stage analytical procedure, measurement model is analysed first to assess the reliability and validity of the instrument and then hypotheses were tested through a structural model. According to Hair et al. [39], the causal modelling technique of PLS seeks to maximize the explained variance of the dependent variables, unlike the other first-generation regression methods. The measurement model displays the relationship between indicators (items) and its construct meanwhile the structural model is used to examine the relationship between constructs [42]. Structural equation modelling using variance based partial least squares is the method used to analyse the data since the question items are subjective measurements in Likert scales (1-7) that are used for different variables in the research framework. The justification for applying the Smart PLS method is to derive predictive inference from a complex framework and to test the relevant hypotheses [43].

### **7.1. Descriptive statistics of the latent constructs**

The mean of all the six latent variables varies from 3.827 to 5.229, whereas the standard deviation varies from 1.397 to 1.618 on a seven-point Likert scale. However, the values of the mean of all the variables were found to be higher than the midpoint 3.50. PU has the highest score with a mean value of 5.229, while information intensity has the lowest mean value at 3.827. The dispersion of values reported through standard deviation indicates that the highest value showed by top management support at 1.618 and lowest value showed by relative advantage at 1.397. Table 1 presents the result obtained from the descriptive analysis.

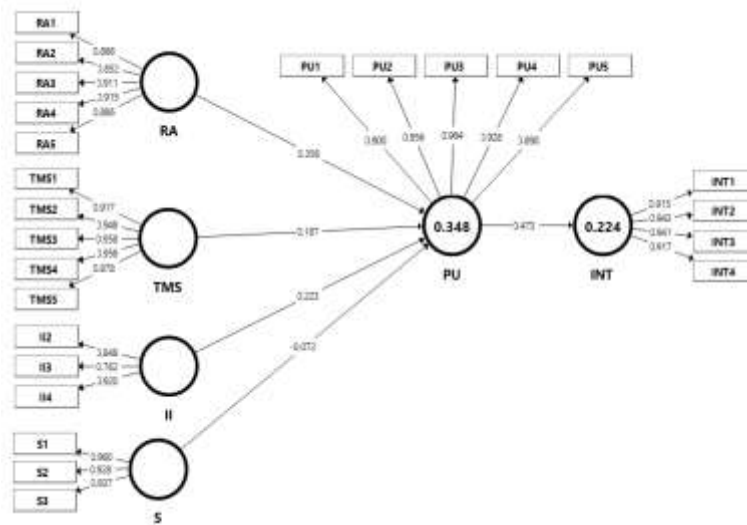
**Table 1. Descriptive statistics (n=168).**

Latent variables	Minimum	Maximum	Mean	Standard deviation
Relative advantage	1.60	7.00	5.044	1.397
Top management support	1.00	7.00	4.858	1.618
Information intensity	1.00	7.00	3.827	1.599
Security	1.20	7.00	4.498	1.445
Perceived usefulness	1.00	7.00	5.229	1.434
Intention to continue using B2B e-commerce	1.25	7.00	5.152	1.467

**7.2. Measurement model**

The main loadings for all the question items explained are more than 0.7 for all the latent variables (model variables present in the framework). The minimum value of the main loading is 0.762 and the maximum value is 0.964. The average Variance Extracted (AVE) to measures the level of variance captured by a construct versus the level due to measurement error, values above 0.7 are considered very good, whereas, the level of 0.5 is acceptable. It is found that all the AVE values are greater than 0.5, which shows that the convergent validity is confirmed. Meanwhile, the Composite Reliability (CR) is a less biased estimate of reliability than Cronbach’s Alpha, the acceptable value of CR is 0.7 and above. The values in Table 2 are shown to be larger than 0.7, which indicates high levels of internal reliability among latent variables. Also, as in Fig. 2, showing the path analysis and beta values.

The discriminant validity is a Fornell-Larcker criterion. It compares the square root of the AVE values with the latent variable correlations. Specifically, the square root of every construct’s AVE should be greater than its highest correlation with any other construct [42, 43], as shown in Table 3.



**Fig 2. PLS-path analysis of beta value (n = 168).**

**Table 2. Measurement model of PLS (n=168).**

Latent variable	Question items	Main loading	AVE	Composite reliability	Cronbach's alpha
Information intensity	II2	0.848	0.716	0.882	0.833
	II3	0.762			
	II4	0.920			
Relative advantage	RA1	0.868	0.779	0.946	0.929
	RA2	0.852			
	RA3	0.911			
	RA4	0.915			
	RA5	0.866			
Top management support	TMS1	0.917	0.869	0.971	0.962
	TMS2	0.948			
	TMS3	0.958			
	TMS4	0.958			
	TMS5	0.878			
Security	S1	0.960	0.887	0.959	0.937
	S2	0.928			
	S3	0.937			
Perceived usefulness	PU1	0.900	0.861	0.969	0.960
	PU2	0.956			
	PU3	0.964			
	PU4	0.928			
	PU5	0.890			
Intention to continue using B2B e-commerce	INT1	0.915	0.863	0.962	0.947
	INT2	0.943			
	INT3	0.941			
	INT4	0.917			

Note: (II1, S4) were deleted due to main loadings; AVE.

Table 3. Discriminant validity.

	II	INT	PU	RA	S	TMS
Information intensity	<b>0.846</b>					
Intention to continue use B2B e-commerce	0.182	<b>0.929</b>				
Perceived usefulness	0.302	0.473	<b>0.928</b>			
Relative advantage	0.112	0.604	0.508	<b>0.883</b>		
Security	0.187	-0.137	-0.149	-0.220	<b>0.942</b>	
Top management support	0.282	0.470	0.477	0.595	-0.213	<b>0.932</b>

Note: Diagonals (in bold) represent the squared root of the AVE while the other entries represent the correlations.

The Heterotrait-Monotrait ratio of correlations (HTMT) is a new method for assessing discriminant validity in PLS-SEM, the use of simulation studies to demonstrate that lack of discriminant validity [44]. HTMT ratio is “the average of the Heterotrait-Heteromethod correlations relative to the average of the Monotrait-Heteromethod correlations”.

A Heterotrait-Hetero method correlation refers to the correlations of indicators across construct measuring different phenomena, whereas Monotrait-Hetero method correlations refer to the correlations of indicators among the same construct [44]. Using the HTMT as a criterion involves comparing it to a predefined threshold. If the value of the HTMT is higher than this threshold, one can conclude that there is a lack of discriminant validity. Studies have suggested a threshold value of 0.85 [44, 45] and 0.90 [46]. Both threshold values of 0.85 and 0.90 have also been used to distinguish between these two absolute thresholds for the HTMT, as shown in Table 4.

**Table 4. Heterotrait-Monotrait ratio (HTMT).**

	II	INT	PU	RA	S	TMS
<b>Information intensity</b>						
<b>Intention to continue use B2B e-commerce</b>	0.158					
<b>Perceived usefulness</b>	0.276	0.492				
<b>Relative advantage</b>	0.113	0.641	0.535			
<b>Security</b>	0.295	0.146	0.150	0.237		
<b>Top management support</b>	0.253	0.493	0.495	0.630	0.229	

### 7.3. Assessment of structural model

The structural model consists of path coefficients and explained variances. Bootstrapping is a procedure where many sub-samples were taken from the original sample with replacement to give bootstrap standard errors for sharpening the regression coefficient (beta) values. In bootstrapping, subsamples are created with randomly drawn observations from the original set of data. The subsample is then used to estimate the PLS path model. This process is repeated until a large number of random subsamples have been created, typically about 5000 [47]. Hair et al. [42] stated that the bootstrap samples must be at least larger than the number of valid observations in the original data set but recommended 5000. Ranging from 500 to 5000 had little effect on either bootstrap standard error or confidence interval.

The standard error values obtained through bootstrapping determine whether the coefficient is significant or not. Table 5 and Fig. 3 show that the paths II → PU, RA → PU, TMS → PU and PU → INT are statistically and positively significant. On the contrary, the path S → PU is insignificant.

Cohen [48] recommended some guidelines for the assessment of effect size values in the exogenous latent constructs in the prediction of the endogenous constructs. The values of 0.02, 0.15 and 0.35 signify small, medium and large effect sizes, respectively. Moreover, the fit of the model can be determined through the examination of the effect size of the path linking every predictor variable to the dependent variable.

Hence, the effect size would also indicate the power of the impact of each independent construct on the dependent construct [49]. The greatest effect of PU on intention to continue using B2B e-commerce (INT) ( $f^2= 0.288$ ) and Relative Advantage (RA) on Perceived Usefulness (PU) ( $f^2= 0.123$ ) are categorized as medium-small effect size. Also, information intensity (II) on Perceived Usefulness (PU) ( $f^2= 0.065$ ) and Top Management Support (TMS) on Perceived Usefulness (PU) ( $f^2= 0.031$ ) are supported because they have small effect size, see Table 5.

**Table 5. Results of direct effects, *t*-Value and beta coefficients ( $n = 168$ ).**

Path	Beta value	SE	<i>t</i> -value	<i>p</i> -Values	Result	$f^2$
II → PU	0.223	0.081	2.737***	0.003	Supported	0.065
PU → INT	0.473	0.068	6.987***	0.000	Supported	0.288
RA → PU	0.356	0.091	3.908***	0.000	Supported	0.123
S → PU	-0.072	0.078	0.925	0.178	Not supported	0.007
TMS → PU	0.187	0.115	1.623*	0.052	Supported	0.031

Note: \* $p < 0.05$ ,  $t > 1.645$ , \*\* $p < 0.01$ ,  $t > 2.33$ , \*\*\* $p < 0.001$ ,  $t > 3.33$  (one tailed); SE: Standard Error.

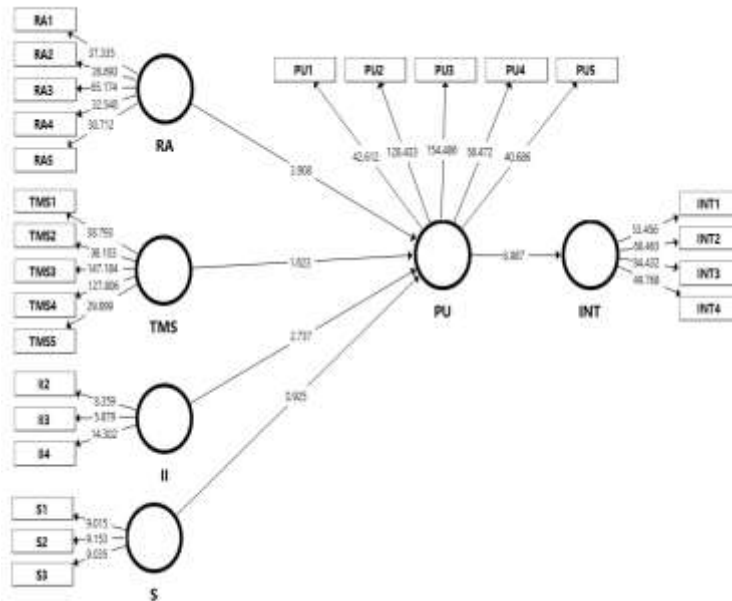


Fig 3. PLS-Path analysis of  $t$ -value ( $n=168$ ).

The significance of the indirect path (mediating effect) in the PLS structural model was examined through bootstrapping 5000 samples and the estimates were computed with path analysis. Table 6 shows the path coefficients and the  $t$ -values for indirect effects of this study. Hayes and Preacher [50] and Hayes [51] explained that mediation is supposed to happen when the indirect relationship between independent and dependent variables is statistically significant. This current study shows that two out of four indirect relationships were found to be statistically significant  $*p < 0.05$  ( $t > 1.96$ );  $**p < 0.01$  ( $t > 2.58$ ) (Two-Tailed). As suggested by Hair et al. [42, 47]. The  $t$ -value significance of the indirect relationship was obtained using bootstrapping ( $n = 5000$ ). The PLS-SEM analysis of significant indirect effect of mediating analysis regarding Perceived Usefulness (PU) on the association between IVs and intention to continue using B2B e-commerce (INT) include,  $II \rightarrow PU \rightarrow INT$  (Beta value = 0.105,  $t$ -value = 2.634\*\*,  $p < 0.01$ ) (H6) and  $RA \rightarrow PU \rightarrow INT$  (Beta value = 0.168,  $t$ -value = 3.044\*\*,  $p < 0.01$ ) (H7), are presented in Table 6.

The demonstration of predictive relevance in PLS-SEM model suggests that the model correctly predicts the data points of the single-item endogenous constructs and the indicators in reflective measurement models of multi-item. In SEM models, the value of  $Q^2$  greater than zero in a reflective endogenous latent variable shows the predictive relevance of the path model for a specific construct. However, when the value of  $Q^2$  is zero or lower, it shows the absence of predictive relevance. Basically, in relative terms, an exogenous construct is considered to have large, medium and small predictive relevance when the  $Q^2$  values are 0.35, 0.15 and 0.02, respectively for a designated endogenous construct.

Stone [52] and Geisser [53] developed predictive relevance as a supplementary criterion for the evaluation of the model's fit. Hence, the procedure symbolizes the

sufficiency of the model to forecast every latent construct's manifest indicator. This present study obtains the  $Q^2$  value through the blindfolding technique for five exclusion distance. The  $Q^2$  value above zero shows the predictive relevance of the exogenous constructs on endogenous construct [54]. For the coefficient of determination ( $R^2$ ) value for direct effect of latent variables (RA, TMS, S and II) on (PU) shows a value of 0.348, which is a substantial fit, while the value for (PU) on (INT) is 0.224, which is a moderate fit [55]. Table 7 displays that in every endogenous construct, the model possesses predictive relevance.

**Table 6. Significance of indirect effects-path coefficients ( $n=168$ ).**

Path	Beta value	SE	t-value	p values	Result
II → PU → INT	0.105	0.04	2.634**	0.004	Supported
RA → PU → INT	0.168	0.055	3.044**	0.001	Supported
S → PU → INT	-0.034	0.038	0.902	0.183	Not Supported
TMS → PU → INT	0.088	0.056	1.565	0.059	Not Supported

Note: \* $p < 0.05$ ,  $t > 1.96$ , \*\* $p < 0.01$ ,  $t > 2.58$  (two-tailed); SE: Standard Error.

**Table 7. R-square value and Q-square value ( $n=168$ ).**

Endogenous variables	R-square	Q-square	Predictive relevance
Intention to continue using B2B e-commerce	0.224	0.165	Yes
Perceived usefulness	0.348	0.260	Yes

## 8. Results and Discussion

This study found that relative advantage has a direct positive effect on perceived usefulness. This result supports prior studies, which shown that relative advantage has significant positive impacts on the adoption of innovation [3, 12, 32]. Hence, it is relevant to suggest that for the Jordanian manufacturing SMEs, the greater the relative advantage of having B2B e-commerce, the greater the perceived usefulness of this technology to the SMEs. The relative advantage might be measured in economic terms (the new technology is cheaper than the old, or as expensive but more powerful) but it could also be a convenience factor (receiving email is faster than writing letters and going to the post). However, relative advantage is an important factor to guarantee fast diffusion speed and to increase the global market.

Top management needs to constantly support and encourage the adoption of technology innovation as well as provides the resources for the new technology [4]. This implies that top management support will encourage employees to use technology, undergo training and realize the benefits from the use of new technology. Furthermore, this study also found that information intensity has a significant effect on the perceived usefulness of B2B e-commerce among the Jordanian manufacturing SMEs. The possession of high frequency of data exchange, high amount of transactions and a high number of products or services can influence the perception of the usefulness of B2B e-commerce. However, this study found that security has an insignificant effect on the perceived usefulness. For this study, the majority are Jordanian manufacturing SMEs are at the lower levels of B2B e-commerce adoption and are not involved in online transactions; hence, in order for them to retain their current level of B2B e-commerce adoption, security concern may not be the issue to them. According to Hassan et al. [10], for

indirect effect, top management support is insignificant similar to the study of cloud computing adoption.

## **9. Theoretical Contribution and Implications of the Study**

The framework of this study is primarily based on the TOE framework where the existing framework is then extended as the variable perceived usefulness from TAM is added to the TOE framework as a mediator variable. This extension provides facilities to test the mediating effect within the TOE framework. In addition, this research applies new relationship in the TOE framework with factors that affect perceived usefulness, including information intensity as a new relationship between the mediating variable of perceived usefulness and the intention to continue using B2B e-commerce. The findings of this study contribute to research on the adoption of B2B e-commerce in developing countries.

The model could serve as a guide to decision makers in identifying the factors that could affect B2B e-commerce using, as well as help them to draw roadmaps and plan strategies. This would be particularly useful for decision makers who are interested in expanding their business and acquiring more benefits through the using of different levels of B2B e-commerce.

## **10. Limitations of the Study and Recommendations for Future Research**

This study focuses on B2B e-commerce technology by the manufacturing SMEs in Jordan. There are some limitations to this study. First, since data were collected from the manufacturing SMEs in Jordan, this model might not be applicable to the SMEs in other countries. Secondly, this study has put the emphasis that the respondents are the ones who have knowledge of IT as well as of the organization infrastructure, which in turn leads to having respondents from different levels of position in the SMEs. It is indeed ideal to have the respondents from the same level of position in the organizations. Therefore, for future studies, it is better if the respondents are from the same level of working position in the SMEs, preferably the CEO of the company, as long as it can be ascertained that the respondents have the knowledge of IT and of the organizational infrastructure.

This study focuses on the manufacturing sector in Jordan, which is classified under the industrial main sector of the country. Other than the industrial sector, another main sector in Jordan is the service sector, which also consists of a large number of SMEs. Therefore, the current study can be extended for this main sector in Jordan. For example, type of sector could be including determining different sectors.

## **11. Conclusions**

This study has identified the factors and their significant contribution in using TOE framework to examine their association with the intention to continue using B2B e-commerce by the manufacturing SMEs. Thus, the results of this study provided evidence to support the validity and reliability of the TOE framework. The findings of this study serve as a useful tool to provide the necessary directions towards B2B e-commerce technology among manufacturing SMEs in Jordan. This study is useful for decision makers of manufacturing SMEs to evaluate and improve their decision-making process regarding B2B e-commerce technology.

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### Abbreviations

B2B	Business-to-Business
B2C	Business-to-Consumer
ERP	Enterprise Resource Planning
RFID	Radio-Frequency Identification

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