REFLECTIVE OR FORMATIVE MEASUREMENT MODEL OF SUSTAINABILITY FACTOR? A THREE INDUSTRY COMPARISON

Eijaz Ahmed Khan*, Mohammed Naim A. Dewan**, Md. Maruf Hossan Chowdhury***

* Business Administration Discipline, Khulna University, Khulna, Bangladesh
** School of Marketing, Curtin University, Perth, Australia
*** School of Information Systems, Curtin University, Perth, Australia

Abstract

The sustainability concept is commonly used in many domains. However, the assessment of reflective and formative measurement has been ignored largely. As a result, sustainability factor scales are specified wrongly and this might lead to reduced scale validity. The aim of the study is find out the nature of sustainability factors either reflective or formative by investigating three distinct industrial settings in Bangladesh. A quantitative research design is used and the data is analysed through Partial Least Square (PLS) analysis. PLS analysis validates the indicators and factors. Sustainability factors in context of microbusiness and supply chain found reflective in nature whereas in e-business it was formative. The study suggests that sustainability factor is a context specific phenomena and it can be treated either reflective or formative.

Keywords: Sustainability, Reflective, Formative, Partial Least Square

1. INTRODUCTION

The concept of sustainability is a common theme that can be applied in many domains i.e., micro business, supply chain and e-business. To date, this concept discusses under three main thoughts specifically, economic, social and environmental sustainability (Elkington, 2007). However, so far, no study has attempted to assess and to specify sustainability factor scales with respect to either reflective or formative measurement model (Chowdhury, Khan, & Dewan, 2014; Dewan, Chowdhury, & Khan, 2014; Khan, Chowdhury, & Dewan, 2014). Subsequently, it may be assumed that many scales are specified incorrectly in terms of the measurement model. That is because, a precise specification of a model depends on how the scholars conceptualized it (Baxter, 2009), what are the procedures considered to measure it (MacKenzie, Podsakoff, & Podsakoff, 2011), and it may also context specific (Chowdhury et al., 2014; Dewan et al., 2014; Khan et al., 2014). The misspecification of reflective vs formative measures may result in wrong abstraction of theory building from epistemological concern as well as inappropriate choice of organizational strategy settings (Diamantopoulos and Siguaw 2006). Specification of sustainability measurement factor is therefore, crucial both from epistemological and practical ground. In this context, this paper focuses the issues of selecting a proper mode of measurement model specification and validating the measures of sustainability factors by considering three industrial settings: microenterprise (informal sector), supply chain (manufacturing sector) and e-business (service sector).

This study assumes that conceptualization of sustainability factors and the causal relationship between manifest indicators and corresponding latent indicators might be either reflective or formative, since no empirical study has done yet to validate the construct indicators measurement model. In describing this conceptualization and causal relationship, the existing literature is silent. This study also realizes that one domain is not sufficient to unearth evidence on the nature of sustainability factors. Because the conceptualization of the sustainability factors depends on the context and thereby need to formulate and examine measurement scales by applying different industrial settings. In terms of context, microenterprise (informal sector) has been the subject of scientific investigation but in this study both the sector focus and the origin of the firms are new (Khan et al., 2014). On the other hand, supply chain (manufacturing sector) and e-business (service sector) are applied in this research have a fair background in the literature (Chowdhury et al., 2014; Dewan et al., 2014). Therefore, considering these three distinct domains, this paper makes an attempt to discuss the concept and define the nature of sustainability factors either reflective or formative.

2. THE REFLECTIVE VERSUS FORMATIVE MODEL

Measurement model specifies the relationships between the measures and the underlying latent variables (Götz, Liehr-Gobbers, & Krafft, 2010). Literature addresses, reflective or formative, two distinct levels of models specification. The nature of the constructs in the conceptual model generates the need for using either formative or reflective

items. The rationale is to develop items that can properly measure each individual construct. For the selecting reflective or formative measurement of a particular construct, theoretical deliberations are integral (Coltman, Devinney, Midgley, & Venaik, 2008; Jarvis, MacKenzie, & Podsakoff, 2003). While, Diamantopoulos (2006) and Coltman et al. (2008) claim the importance of both theoretical and empirical considerations for designing and validating appropriate measurement models. Coltman et al. (2008) argue that empirical evaluations build an important ground for content validity, especially to identify errors and misspecifications or wrongly conceived theories. Misspecification of measurement models have significant impact on research outcome and may even mislead organizational policy setting. Therefore, researchers must pay careful consideration in identifying and designing appropriate measurement model. In some cases, this choice is simple because the causal priority between the construct and the indicators is very clear. However, in some cases, choosing correct measurement model i.e. reflective vs. formative measures can be difficult (Diamantopoulos & Siguaw, 2006; Hulland, 1999). In this regard, the four criteria suggested by Jarvis et al. (2003) are worthwhile: (1) direction of causality from construct to indicators, (2) interchangeability of indicators, (3) covariation among indicators, and (4) nomological net of construct indicators. In the similar tone, the study of Coltman et al. (2008) addresses some valuable insights for determining formative and reflective measurement model. They pin point theoretical and empirical considerations for specifying appropriate measurement model. In terms of theoretical considerations, like Jarvis et al. (2003), they consider nature of constructs, direction of causality and characteristics of items. Whereas, in terms of empirical considerations, Coltman et al. (2008) suggest the significance of evaluating item correlations, item relationships with construct, antecedents and consequences as well as measurement error and collinearity. This study uses the criteria suggested by Jarvis et al. (2003) and Coltman et al. (2008) to identify formative and reflective measurement model for sustainability factors based on three industrial settings (see Tab. 1).

Table 1. Theoretical and empirical consideration of reflective vs formative model

Consideration	*Reflective model*	*Formative model*
	Theoretical consideration	
1. Direction of causality between items and latent construct	Direction of causality is from construct to items Changes in the construct do cause changes in the indicators while changes in the indicator should not cause changes in the construct	Direction of causality is from items to construct Changes in the construct do not cause changes in the indicators while changes in the indicators should cause changes in the construct
2.Nature of constructs and indicators	Indicators are manifestations of the construct	Indicators are defining characteristics of the construct
3. Characteristics of items used to measure constructs	Indicators should be interchangeable Indicators should have the same or similar content Indicators should share a common theme Dropping an indicator should not alter the conceptual domain of the construct	Indicators need not be interchangeable Indicators need not have the same or similar content Indicators need not share a common theme Dropping an indicator may alter the conceptual domain of the construct
	Empirical consideration	
1.Covariation among the indicators	Indicators are expected to covary with each other	Not necessary for indicators to covary with each other
2. Nomological net of the construct indicators	Nomological net for the indicators should not differ	Nomological net for the indicators may differ
3. Item relationships with construct antecedents and consequences.	Indicators are required to have the same antecedents and consequences	Indicators are not required to have the same antecedents and consequences
4. Measurement error and collinearity	Identifying and extracting measurement error by common factor analysis	Using vanishing Ttetrad test to determine if the formative items behave as predicted

Source: Jarvis et al. (2003) and Coltman et al. (2008)

The relationship between latent construct and the indicators, i.e. whether the latent construct is replicated by its (observable) indicators or the indicators are defining characteristics of the construct, as well as the direction of causality can be visualized by Fig. 1a and 1b.

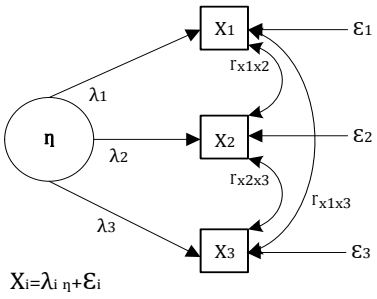

Figure 1a Reflective measurement model η: latent variable; λ: loading; x: reflective indicator; ε: measurement error on level of indicators; r: correlation between indicators

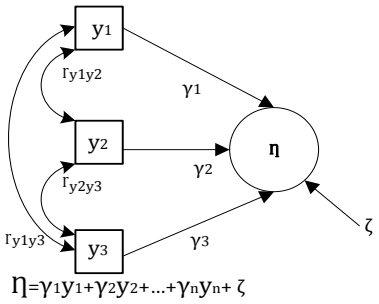

Figure 1b Formative measurement model η: latent variable; γ: weight; y: formative indicator; ζ: measurement error on level of the latent variable; r: correlation between indicators

The above discussion illustrates several conceptual and empirical issues for designing and specifying models as either reflective or formative. By considering these issues, this paper makes an attempt to conduct a quantitative study in context of three distinct industrial domains to specify and to validate the reflective and formative measurement of sustainability factors. Before discussing the materials and methods and results of the study, the illustration of ideas with sustainability factor, the next section provides a discussion of the formative or reflective in context of three selected industrial settings.

3. SUSTAINABILITY FACTOR: REFLECTIVE OR FORMATIVE

In the field of micro business, the definition and core assumptions in terms of sustainability factors still remain obscure (Khan, Rowe, & Quaddus, 2012; Shepherd & Patzelt, 2011). There is no consensus on suitable measures for sustainability constructs in micro firms. The majority of studies have dealt with the economic factors of the firm rather than the social and environmental factors. Some researchers have shown economic factors along with non-economic factors (e.g., Carr, Cole, Ring, & Blettner, 2011; Irava & Moores, 2010; Kickul, Liao, Gundry, & Iakovleva, 2010; Lumpkin & Dess, 1996). Basically, they highlight non-economic factors with regard to mental satisfaction and how it relates to economic factors. Their study reflects the absence of discussion about measurement issues and two major components of firm sustainability factors, namely social and environmental. Brüderl and Preisendörfer (1998) argue, survival could be seen as the minimum criterion for firm sustainability factors. They emphasize the minimum economic and social gain of the firm. Further, Khan et al. (2012) states, micro firms' activities cannot be treated as sustainable without measures for environmental factors in addition to the economic and social factors. Khan et al. (2012) pioneer paper conceptualizes three sustainability factors economic, social and environmental as either reflective or formative by considering a series of indicators for each factor. Their study labels four indicators with economic factor i.e., employment, sales growth, income stability and profitability; includes five indicators in social factor i.e., basic needs, social recognition, empowerment, freedom and control and child labor, and clusters five indicators with environmental factor i.e., water and energy use, waste and emission, waste management, space management and hygiene factor. These indicators are so far used in other studies (e.g., Batjargal, 2007; Khan, Rowe, Quaddus, & Nuruzzaman, 2013; Parris & Kates, 2003; Revell & Blackburn, 2007; Venkataraman, 2002). Although, Khan et al. (2012) study contributes in understanding the sustainability concept in context of micro business, lack of discussion in measurement issues and empirical test limits the validity of sustainability factors. Khan et al. (2014) current paper on validation of sustainability factor tries to overcome these limits by conducting an exploratory factor analysis (EFA). Throughout the process of their EFA, three indicators i.e., profitability, child labor and space management has been deleted due to low loadings. EFA with varimax rotation yields three distinct factors which are reliable with high Cronbach's alpha values. Their study conceptualizes and validates these three distinct sustainability factors in terms of reflective measure, and suggests to test a confirmatory factor analysis (CFA) and other properties of structural equation modeling (SEM) for further investigation.

Measurement of supply chain sustainability factors integrating economic, social and environmental is rare (Chowdhury et al., 2014). Few studies are available pertaining to measurement of supply chain sustainability factor (e.g., Craig R Carter & Jennings, 2004; Zhu, Sarkis, & Lai, 2008). But these studies focus either environmental or social factors. Perhaps the only few studies that consider both social and environmental factors (e.g., Craig R Carter, 2004; Chowdhury, Dewan, & Quaddus, 2012; de Brito, Carbone, & Blanquart, 2008; Hutchins & Sutherland, 2008). However, these studies fall short of integrating all wings of sustainability in supply chain, for example, the study of de Brito et al. (2008) analyses sustainability only from logistical point of view and lacks indication regarding influence of manufacturing operation. Similarly, Hutchins and Sutherland (2008) highlights on social perspective and Craig R Carter (2004) focuses on social and environmental perspectives. In the field of supply chain sustainability management (SSCM), the study of C. R. Carter and Rogers (2008) is significant as they introduce a theoretical framework

by covering three aspects of sustinablity. Though informative and widely covered, the study is still conceptual and has lack of indication about measurement aspects of sustinability issues. In the midst of existing void of lacking integrated empirical work on economic, social and environmental sustainability in supply chain, Chowdhury et al. (2014) conducts a study to develop and validate a sustainability scale for measuring supply chain sustainability. In their study, at first, based on the findings from content analysis and theoretical justification, they conceptualize the factors of sustainability in context of supply chain management. Their study yields and confirms number of indicators underling three main sustainability factors. Economic factor corresponds with sales volume, cost of sales, profit margin and sales growth. Some other variables, such as fair wages, benefits, facilities, hazard and safety, health and sanitation, force, supplier social performance, and employee satisfaction categorizes under social factor. Environmental factor labels with water pollution, air pollution, soil pollution, waste recycling, hazardous material, certification and audit, legislation, and supplier environmental performance. Next, to refine these selected items, they run an EFA. The EFA validates all the variables except child labor, employee satisfaction, and legislation and supplier environmental performance. Their study also confirms the high Cronbach's alpha values corresponding to each factor. Chowdhury et al. (2014) study considers three sustainability factors as reflective in context of supply chain sustainability and proposes to conduct a CFA and SEM for future research.

The current level of knowledge acknowledging e-business sustainability factors is limited. A few number of studies include some aspects of the sustainability (e.g., Dao, Langella, & Carbo, 2011; Elliot, 2011; Melville, 2010; Watson, Boudreau, & Chen, 2010), but empirically tested measurement of e-business sustainability in terms of economic, social and environmental issues is very rare. Most studies in this research area mainly focuses on environmental sustainability (e.g., Elliot, 2007; Elliot & Binney, 2008; Erek, 2011; Houghton, 2010; Waage, Shah, & Girshick, 2003; Watson et al., 2010) and ignores main two sustainability factors i.e., economic and social. Piotrowicz and Cuthbertson (2009) stress, these three factors are equally important. To date, no empirical study has been undertaken to measure and validate three important sustainability factors in this domain. However, an empirical study by Mohammed Dewan, Biswas, Chowdhury, and Quaddus (2013) identifies three sustainability factors for sustainable e-business in the context of bank service industry, but lacks the attempt of measuring sustainability factors. Another study by Dewan et al. (2014) conducts an empirical test by applying a EFA. In their study, they explore 20 indicators through literature analysis and field study. Then, they omit four items such as additional customer requirements, environmental policy and management, risk and crisis management, investment management via an EFA process. Remaining items labels as follows: economic performance, efficiency of processes, quality of the services, risk and crisis management, process costs, investment management, potential value added services are identified as economic factors; employment and labour practice, products and services responsibility, privacy of information, legislations and code of conducts compliance, additional customer requirements, contribution for local and national development are observed as social factors; and energy resources, air pollution, usages of materials, environmental legislations compliance, environmental policy and management, commitment for future generations are recognized as environmental factors. In the context of e-business sustainability, three distinct sustainability factors: economic, social, and environmental have been suggested as formative. Dewan et al. (2014) also advise to undertake an advance level study by considering CFA and SEM tools.

The concept of sustainability is wide and context dependent (De Giovanni & Esposito Vinzi, 2012). Since there is no single concept of sustainability, probably, there is no universally accepted way of measuring it. Browsing literature on three distinct industrial contexts it is revealed that sustainability measurement differs substantially in three distinctive contexts. Review of literature also identifies several gaps in common irrespective of the context such as empirical measurement incorporating economic, social and environmental sustainability factors is quite rare; specification of either reflective or formative measurement of the sustainability concepts is not reported vividly. Recent studies of Khan et al. (2014), Chowdhury et al. (2014) and Dewan et al. (2014) proposed that sustainability can be considered as either reflective or formative construct however, confirmatory studies are needed to validate the findings. Some relevant studies can also be referred from conceptual and logical stances as evidences to both formative and reflective measurement of sustainability concept. For instance, Sage (1999), based on conceptual stand inferred that sustainability factors are interrelated and therefore should not be considered independently. On the other hand, Bansal (2005), measured corporate sustainability as a dependent variable while items that influence the sustainability are considered as independent variable from which based on the causality effect, it can be deduced logically that sustainability can be modelled as formative measurement.

4. RESEARCH METHOD

4.1 .Research setting

The sustainability concept can be described through several frameworks. Among these frameworks, the Global Reporting Initiative (GRI), the Human Development Index (HDI), Sustainable Consumption Indicators (SCI), IChemE and Sustainable Industrial Performance (SIP) are widely accepted and applied in many business fields without considering reflective or formative measurement issues. Therefore, understanding the nature of three sustainability factors in terms of reflective or formative in context of different business field is very important. With respect to this concern, the sample is chosen from three distinct domains: microenterprise (informal sector), supply chain (manufacturing sector) and e-business (service sector).

4.2. Sample and data collection procedure

The target population establishes the boundary line between respondents and non-respondent, therefor it is important to determine the specific target population during the sampling design process. Similarly, the target population represents the sample elements that have the relevant information and about which inferences are drawn. In case of microenterprise (informal sector), a total of 438 survey questionnaires were completed. For supply chain (manufacturing sector), 296 supply chain decision makers were surveyed and in e-business field, 219 bank managers (service sector) were participated. The sampling approach was based on a convenience sampling.

The data gathering strategy under the survey method is generally predicated on the nature of survey interaction and the mode of questionnaire administration. In data collection procedures, this study used face-to-face survey because these methods allow maximum response rates in comparison with other methods (Malhotra 2008). This method also provides the most flexibility in the data collection process. In addition, a wide variety of questions can be asked in a face-to-face interview because the respondents can see the questionnaire and an interviewer is present to clarify ambiguities. Even though this technique was time-consuming, it was expected to increase the sample numbers of those willing to respond. The survey instrument together with a covering letter explaining the purpose and instruction of the survey were provided to the participants.

4.3. Instrument selection

The measurement of instrument for the sustainability factor is rarely found in previous studies. However, the current studies by Khan et al. (2014), Chowdhury et al. (2014) and Dewan et al. (2014) was developed instruments for sustainability factors. In their study, they followed procedures suggested by MacKenzie et al. (2011). At first, their studies established a conceptual definition of sustainability factors and indicators via literature review. Then, they used a field study approach to generate any new items and confirm existing items in literature review which represents the content validity of sustainability factors. Next, they run an EFA to refine and purify the items. Since their studies followed a sound step in developing instrument, the current study adapts their proposed instruments for future study. In context of microenterprise (informal sector), the questionnaire developed by Khan et al. (2014) consisted 12 items to measure the economic factor (4 items), social factor (4 items) and environmental factor (4 items) (see Tab. 2). Chowdhury et al. (2014) study comprised 16 items for supply chain sustainability (manufacturing sector) to measure the economic factor (4 items), social factor (6 items) and environmental factor (6 items) (see Tab. 2). In context of e-business (service sector), Dewan et al. (2014) questionnaire contained 16 items to measure the economic factor (5 items), social factor (6 items) and environmental factor (5 items) (see Tab. 2).

A Likert scale was used to measure in their studies. J. Hair, Money, and Samouel (2007) suggested that there are two choices; odd or even numbers in selecting scale categories. Many studies have used a seven-point Likert scale, having a central 'neutral' point. Based on the experience or judgment of the researcher, the central point is used when it is perceived that some portion of the respondents is likely to feel neutral about the issue being examined. However, Matell and Jacoby (1971) advised either not to use or to use the neutral point when the scale consisted of many points. Furthermore, avoiding the central tendency error of respondents was another reason to use a six-point scale. The central tendency error is observed when respondents answer a middle choice 'neutral' or 'neither agree or disagree' without really meaning that. Therefore, it is worthwhile to use a six-point Likert scale.

4.4. Data analysis technique

The quantitative data analysis was conducted using the SEM technique. This technique allows the simultaneous modelling of associations among multiple independent and dependent variables (Chin, 2010). Coupling the econometric perspective of prediction and the psychometric perspective of construct validity, it enables the measurement of unobservable (latent) variables using observable measures (or manifest variables, items or indicators) by explicitly modelling measurement error (Chin, 1998). It is widely used for its inherent flexibility in testing a theoretical model with multiple predictors and criterion variables against empirical data. The data of the questionnaire survey was analysed through Partial Least Square approach (PLS). PLS path modelling is based on an algorithm that, firstly, estimates the best weights of each block of the measurement model and then estimates the path coefficients in the structural model (Chin & Newsted, 1999). Thus, the latent variable component scores or weight estimates depend on how well the measurement model and structural model are specified. PLS is more appropriate when the measurement items are not well established and are used within a new measurement context (Barclay, Higgins, & Thompson, 1995). Moreover, the capability of handling formative as well as reflective indicators and constructs was one of the greatest incentives to adopt PLS.

For analysing the measurement properties of the sustainability factors, we conducted a CFA. For the result of CFA, we assess the convergent validity and discriminant validity of the scales for reflective measurement model. Convergent validity measures the correlations of items in a single construct. The goal is to ensure that items are correlated and measure the same underlying dimensions. The reflective items were tested for convergent validity by determining item reliability, composite reliability (CR) and average variance extracted (AVE).

Table 2. Specifying and assessing a reflective or formative measure for sustainability factors

Factor	*Item*	*Description*
		Microenterprise (informal sector)
Economic	EC1	We see our micro-firm is providing employment to us and others
	EC2	Our micro-firm's economic performance is at an acceptable level in terms of sales growth
	EC3	Our micro-firm's economic performance is at an acceptable level in terms of income stability
	EC4	Our micro-firm's economic performance is at an acceptable level in terms of return on investment
Social	SO1	Our micro-firm ensures basic needs for our family
	SO2	Our micro-firm enhances our social recognition in society
	SO3	Our micro-firm improves our empowerment in society
	SO4	Our micro-firm provides freedom and control over the course of our own lifestyle
Environmental	EN1	Our micro-firm uses utilities (e.g., energy and water) in an environmental friendly manner
	EN2	Our micro-firm produces few wastes and emissions
	EN3	Our micro-firm is concerned about waste management
	EN4	Our micro-firm is concerned about hygienic factors
Adopted from Khan et al. (2014)		
		Supply chain (manufacturing sector)
Economic	EC1	Our sales volume is high
	EC2	Our cost of production is low
	EC3	Our profit is high
	EC4	Our sales growth is high
Social	SO1	Our company provides fair wages and overtime payments
	SO2	Our company provides benefits to the employees (e.g., medical benefit, child care facility, transportation)
	SO3	We take precaution for hazard and safety of the employees
	SO4	We take measures for health and sanitation of the employees in comparison to the competitors
	SO5	We do not force to work and do not harass our workers
	SO6	Monitoring to social compliance factors of our suppliers is adequate
Environmental	EN1	We take measures to control water pollution (e.g., effluent treatment plant-ETP)
	EN2	We take measures to control air pollution in comparison to competitors
	EC3	We take measures to control soil pollution
	EC4	We recycle or utilize all types of wastes (e.g., selling wastes to recyclers)
	EC5	We control the use of hazardous materials and chemical in products
	EC6	Environmental audit (either by buyers or government or other organizations) take place in our plant
Adopted from Chowdhury et al. (2014)		
		e-business (service sector)
Economic	EC1	The bank has the ability to redesign its products to reduce the service cost
	EC2	The bank is doing enough to maintain competitive quality of the services
	EC3	The bank has the best software and hardware to ensure full security of the services
	EC4	The bank is maintaining desired productivity level of the processes
	EC5	The bank investing enough on potential value added services
Social	SO1	The bank is maintaining desired standard in employment and labour practice
	SO2	The bank is maintaining full accountability of products and services for the customers
	SO3	The bank is able to ensure socially responsible action throughout the organisation
	SO4	The bank has enough vigilance on complying legislations and code of conducts
	SO5	The bank is contributing enough to local community
	SO6	The bank is increasing contribution for national development
Environmental	EN1	The bank is using energy resources effectively
	EN2	The bank is doing its best to minimise air pollution
	EC3	The bank is doing its best to minimise usages of materials
	EC4	The bank is fully complying with environmental legislations
	EC5	The bank is maintaining its environmental commitment for future generations
Adopted from Dewan et al. (2014)		

Discriminant validity analysis was used in this study to test statistically the degree of variance shared among items and constructs in the model. To establish discriminant validity, the square root of the AVE is compared to the inter-construct correlations. In the final analysis for discriminant validity, cross-loadings for each item were explored and compared across all constructs and have been presented in the form of a cross-loading matrix.. In addition, nomological validity also calculated. The formative items are not correlated; therefore, convergent validity and discriminant validity could not be applied. Formative model is assessed by the item level loadings\weights and their t-value, and multicollinearity statistics. Multicollinearity was tested by calculating the variance inflation factor (VIF). This was to ensure that each indicator had a distinct influence on the intended latent variable.

5. RESULT

To ensure the convergent validity of reflective measurement indicators we investigate the item reliability, CR and AVE. Referring to Tab. 3, it is portrayed that loading for all items is more than minimum threshold level of 0.7 with reference to Hair, Ringle, and Sarstedt (2011). Moreover, the t-value, obtained from bootstrapping showed that all loadings are significant at the 0.05 level (Hair et al., 2011). Therefore, we retain all items in case of microenterprise (informal sector) and supply chain (manufacturing sector). Further, to examine the convergent validity of reflective measurement models we calculated AVE and CR. Tab. 3 reports that the CR values of all constructs exceed the cut off level 0.70 as suggested by Fornell and Larcker (1981). It is also evident that the AVE for all construct is more than 0.7 which far more than the minimum cut off value of 0.5 recommended by Fornell and Larcker (1981). With a view to affirm the discriminant validity, in Tab. 4a and 4b, we calculated the square root of AVE which exceeds the intercorrelations of the reflective construct with the other constructs in the model (Chin, 2010; Fornell & Larcker, 1981). We also evaluate the cross loading of the items under each constructs to corroborate the

discriminant validity. The results indicated that all items demonstrated higher loadings in their respective constructs in comparison to their cross-loadings in other constructs (see Tab. 4a and 4b). Further, we consider the nomological validity to support the relationships between indicators and constructs. Fig. 2 shows that t-values between indicators and constructs are significant at the 0.05 level. Based on the outcomes shown in Tab. 3, 4a and 4b and Fig. 2, the overall results for the reflective measurement model have provided satisfactory empirical support for reliability, and convergent validity, discriminant validity and nomological validity of the sustainability factors in context of microenterprise (informal sector) and supply chain (manufacturing sector).

Table 3. Psychometric properties

		Microenterprise (informal sector) Reflective measurement				Supply chain (manufacturing sector) Reflective measurement				e-business (service sector) Formative measurement				
Factors/items		L	L *t*-v	AVE	CR	L	L *t*-v	AVE	CR	L	L *t*-v	W	W *t*-v	VIF
EO	EC1	0.915	113.043	0.820	0.948	0.911	107.698	0.754	0.924	0.310	3.605	0.172	2.400	1.408
	EC2	0.909	103.828			0.745	23.337			0.479	5.098	0.240	2.912	1.489
	EC3	0.871	55.848			0.881	62.199			0.634	8.301	0.303	3.054	1.465
	EC4	0.926	127.463			0.924	106.735			0.816	15.674	0.480	5.812	1.725
	EC5									0.646	7.308	0.341	3.220	1.877
SO	SO1	0.819	43.787	0.799	0.941	0.884	73.762	0.752	0.948	0.278	2.847	0.182	2.198	1.025
	SO2	0.901	74.864			0.894	81.109			0.243	2.511	0.058	0.794	1.120
	SO3	0.929	143.574			0.853	52.182			0.289	2.699	0.062	0.786	1.150
	SO4	0.922	115.558			0.920	96.922			0.548	5.405	0.363	4.106	1.071
	SO5					0.791	34.256			0.754	11.815	0.557	7.079	1.126
	SO6									0.692	9.316	0.432	5.309	1.159
EN	EN1	0.910	124.161	0.793	0.939	0.855	80.806	0.727	0.941	0.380	3.817	0.195	2.295	1.178
	EN2	0.906	89.695			0.887	70.655			0.631	8.040	0.257	2.885	1.369
	EN3	0.875	54.961			0.886	52.789			0.781	14.468	0.479	6.008	1.371
	EN4	0.869	63.122			0.893	69.162			0.470	5.073	0.236	3.362	1.149
	EN5					0.787	30.358			0.714	9.466	0.378	4.066	1.284
	EN6					0.812	44.559							

Abbreviations: EO-Economic, SO-Social, EN-Environmental, L-Loadings, W-Weights, L t-v-Loadings t-value, W t-v- Weights t-value, AVE-Average Variance Extracted, CR-Composite Reliability, VIF-Variance Inflation Factors

Table 4a. Discriminant validity

		Microenterprise (informal sector)					
		Cross loading			AVE Sqrt root		
Factors/Items		EC	SO	EN	EC	SO	EN
EC	EC1	**0.915**	0.544	0.403	**0.906**		
	EC2	**0.909**	0.488	0.319			
	EC3	**0.871**	0.571	0.375			
	EC4	**0.926**	0.511	0.339			
SO	SO1	0.627	**0.819**	0.546	0.585	**0.894**	
	SO2	0.455	**0.901**	0.629			
	SO3	0.464	**0.929**	0.679			
	SO4	0.545	**0.922**	0.656			
EN	EN1	0.422	0.664	**0.910**	0.398	0.703	**0.890**
	EN2	0.401	0.749	**0.906**			
	EN3	0.291	0.561	**0.875**			
	EN5	0.281	0.499	**0.869**			

Abbreviations: EO-Economic, SO-Social, EN-Environmental

Table 4b. Discriminant validity

		Supply chain (manufacturing sector)					
		Cross loading			AVE Sqrt root		
Factors/Items		EC	SO	EN	EC	SO	EN
EC	EC1	**0.911**	0.775	0.732	**0.868**		
	EC2	**0.745**	0.529	0.509			
	EC3	**0.881**	0.697	0.691			
	EC4	**0.924**	0.778	0.751			
SO	SO1	0.674	**0.884**	0.779	0.809	**0.834**	
	SO2	0.729	**0.894**	0.758			
	SO3	0.661	**0.853**	0.732			
	SO4	0.725	**0.920**	0.721			
	SO5	0.659	**0.791**	0.609			
EN	EN1	0.658	0.778	**0.885**	0.781	0.819	**0.831**
	EN2	0.641	0.735	**0.887**			
	EN3	0.682	0.744	**0.886**			
	EN4	0.570	0.641	**0.893**			
	EN5	0.702	0.773	**0.787**			
	EN6	0.697	0.718	**0.812**			

Abbreviations: EO Economic, SO-Social, EN-Environmental

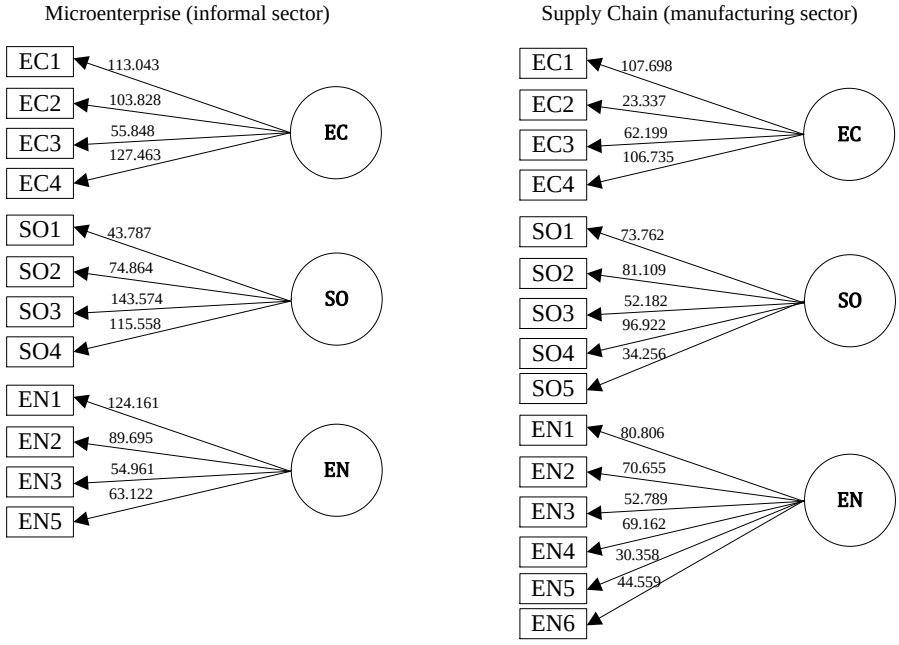

Figure 2. Nomological net *t*-values
Abbreviations: EO-Economic, SO-Social, EN-Environmental

Regarding formative measures we examined indicator weights at first which represent the contribution of each indicator to the respective construct (Chin, 2010). Tab. 3 depicts that *t*-value of all the formative items, except SO1 and SO2 significantly contribute to their respective constructs (Chin, 1998b). However, examination of *t*-values corresponding to the item loadings shows that *t*-values are significant for all items. Therefore, referring to J. F. Hair et al. (2011), all items are retained for measurement of sustainability factors. Test of mulitcollinearity among the formative items showed that variance inflation factor (VIF) of all items ranging between 1.025 to 1.877 which are within the tolerance level of 5 (J. F. Hair et al., 2011). Based on the results illustrated in Tab. 3, the overall outcomes for the formative measurement model have delivered acceptable empirical support for the item level loadings\weights and their *t*-value, and multicollinearity statistics of the sustainability factors in context of e-business (service sector).

6. DISCUSSION

The objective of the study was to develop and validate either reflective or formative scale of sustainability factors in context of three selected sectors. The natures of sustainability concept with its three factors are found concurred with the four features of reflective and formative measure: direction of causality, interchangeability of the measures, correlation among the measures and nomological validity. In context of microenterprise (informal sector) and supply chain (manufacturing sector), item loading and its corresponding *t*-values were significant. Further, AVE and the CR values also meet the criteria and established the convergent validity. Furthermore, AVE Square root and cross loading values also confirmed discriminant validity among the constructs. In case of e-business (service sector), item loading and weight and its corresponding *t*-values were significant. In addition, mulitcollinearity among the formative items showed that VIF of all items were within acceptable level. The current study suggests that a reflective and a formative scale of sustainability factors is a context specific. In addition, the proposed reflective and formative measure of sustainability factors shows reliable and valid results. Nevertheless, it is rather challenging for this study to relate the current findings with the no prior studies due to the fact that reflective and formative measure of sustainability studies was hardly conducted, at least, this study makes an significant contribution to theory, method and practice.

Notably, this study has extended the sustainability studies by specifying and estimating a reflective and formative measure sustainability factors. The findings of this study supports economic, social and environmental tap the conceptualization of sustainability factors based on a three industrial settings in Bangladesh. From a methodological point of view, this study has forwarded a reflective and formative measurement model of sustainability factor using PLS which would offer new understandings for variance based SEM. Apart from that, the implication for this study is highly relevant to the policy decision making in many industrial context. This is because sustainability factors in industrial context is supported having influence on a series of organizational outcomes linked with decision choice. The results enhance the insights of policy makers especially the regulatory authorities the extent to which economic, social and environmental factors influence sustainability in industrial context.

Despite the major findings, this research needs to be considered in view of its limitations. This research was conducted within the specific domain

of the microenterprises (tea-stall business), supply chain (ready-made garment) and e-business (retail banking) and in one country like Bangladesh. But the reality is that sustainability concept is largely varied and complex. Thus, there might be variation in the applicability of the components and consequences. Replication in other contexts would increase confidence in the research model. Data were collected under a cross-sectional design, so the study contains typical limitations associated with this kind of research methodology. For example, the model represents the static nature of sustainability evaluation as the findings are confined to a single point of time. A longitudinal study can overcome this limitation by providing a deeper understanding.

7. CONCLUSION

In general, this study has enriched some knowledge into the epistemic nature of reflective and formative so that scholars can reach an information choice as to the appropriate measurement for their needs. Specifically, this study has explored a new horizon in view of model specification of sustainability factors in organizational level based on three distinct industrial setting. Most importantly, this study has provided empirical evidence that sustainability factor can either be reflective or formative which is not specified by previous studies. Finally, it expects that this study will help the future studies by comparing and contrasting the presented empirical evidence of the reflective and formative measure of sustainability factors.

REFERENCES

1. Bansal, Pratima. (2005). Evolving sustainably: a longitudinal study of corporate sustainable development. *Strategic Management Journal, 26*(3), 197-218.
2. Barclay, Donald, Higgins, Christopher, & Thompson, Ronald. (1995). The partial least squares (PLS) approach to causal modeling: personal computer adoption and use as an illustration. *Technology Studies, 2*(2), 285-309.
3. Batjargal, Bat. (2007). Internet entrepreneurship: social capital, human capital, and performance of internet ventures in China. *Research Policy, 36*(5), 605-618.
4. Baxter, Roger. (2009). Reflective and formative metrics of relationship value: A commentary essay. *Journal of Business Research, 62*(12), 1370-1377.
5. Brüderl, Josef, & Preisendörfer, Peter. (1998). Network support and the success of newly founded business. *Small Business Economics, 10*(3), 213-225.
6. Carr, Jon C, Cole, Michael S, Ring, J Kirk, & Blettner, Daniela P. (2011). A measure of variations in internal social capital among family firms. *Entrepreneurship Theory and Practice, 35*(6), 1207-1227.
7. Carter, C. R., & Rogers, Dale S. (2008). A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution & Logistics Management, 38*(5), 360.
8. Carter, Craig R. (2004). Purchasing and social responsibility: a replication and extension. *Journal of Supply Chain Management, 40*(4), 4-16.
9. Carter, Craig R, & Jennings, Marianne M. (2004). The role of purchasing in corporate social responsibility: a structural equation analysis. *Journal of business Logistics, 25*(1), 145-186.
10. Chin, Wynne W. (1998). Commentary: Issues and opinion on structural equation modeling. *MIS Quarterly, 22*(1), 7-16.
11. Chin, Wynne W. (2010). How to write up and report PLS analyses *Handbook of partial least squares* (pp. 655-690): Springer.
12. Chin, Wynne W, & Newsted, Peter R. (1999). Structural equation modeling analysis with small samples using partial least squares. *Statistical Strategies for Small Sample Research, 1*(1), 307-341.
13. Chowdhury, MMH, Dewan, MNA., & Quaddus, MA. (2012). *Supply chain sustainability through complying buyers' requirements in apparel industry: A fuzzy QFD approach.* Paper presented at the 26th Annual Australian and New Zealand Academy of Management Conference
14. Chowdhury, MMH, Khan, EA, & Dewan, MNA. (2014). *Development and validation of an instrument to measure Supply chain sustainability.* Paper presented at the the 5th Asia-Pacific Business Research Conference, Kuala Lumpur, Malaysia.
15. Coltman, Tim, Devinney, Timothy M, Midgley, David F, & Venaik, Sunil. (2008). Formative versus reflective measurement models: Two applications of formative measurement. *Journal of Business Research, 61*(12), 1250-1262.
16. Dao, Viet, Langella, Ian, & Carbo, Jerry. (2011). From green to sustainability: Information Technology and an integrated sustainability framework. *The Journal of Strategic Information Systems, 20*(1), 63-79.
17. de Brito, Marisa P., Carbone, Valentina, & Blanquart, Corinne Meunier. (2008). Towards a sustainable fashion retail supply chain in Europe: Organisation and performance. *International Journal of Production Economics, 114*(2), 534-553.
18. De Giovanni, Pietro, & Esposito Vinzi, Vincenzo. (2012). Covariance versus component-based estimations of performance in green supply chain management. *International journal of Production Economics, 135*(2), 907-916.
19. Dewan, MNA , Chowdhury, MMC, & Khan, EA. (2014). *Developing and validating instrument for sustainability constructs in the service industry.* Paper presented at the the 5th Asia-Pacific Business Research Conference, Kuala Lumpur, Malaysia.
20. Dewan, Mohammed, Biswas, Nasrin, Chowdhury, Md. Maruf Hossan, & Quaddus, Mohammed. (2013). *Three Dimensional Blended Value Requirements for Sustainable E-Business Modelling: A Study of a Commercial Bank in Bangladesh.* Paper presented at the The 3rd International Forum and Conference on Logistics and Supply Chain Management (LSCM2013), Bali, Indonesia.
21. Diamantopoulos, Adamantios. (2006). The error term in formative measurement models: interpretation and modeling implications. *Journal of Modelling in Management, 1*(1), 7-17.
22. Diamantopoulos, Adamantios, & Siguaw, Judy A. (2006). Formative versus reflective indicators in organizational measure development: a comparison and empirical illustration. *British Journal of Management, 17*(4), 263-282.
23. Elkington, J. (2007). Corporate sustainability. *Visse, W., Mattern, D., Pohl, M. and Tolhurst, N., The A to Z of Corporate Social Responsibility. ICCA Publication & Wiley, West Sussex.*
24. Elliot, Steve. (2007). *Environmentally sustainable ICT: a critical topic for IS research?* Paper presented at the 11th PacificAsia Conference on Information Systems, Auckland, New Zealand.
25. Elliot, Steve. (2011). Transdisciplinary perspectives on environmental sustainability: a resource base

and framework for IT-enabled business transformation. *MIS Q., 35*(1), 197-236.
26. Elliot, Steve, & Binney, Derek. (2008). *Environmentally sustainable ICT: Developing corporate capabilities and an industry-relevant IS research agenda.* Paper presented at the Pacific Asia Conference on Information Systems, Suzhou, China.
27. Erek, Koray. (2011). *From green IT to sustainable information systems management: Managing and measuring sustainability in IT organisations.* Paper presented at the European, Mediterranean & Middle Eastern Conference on Information Systems, Athens, Greece.
28. Fornell, Claes, & Larcker, David F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, 382-388.
29. Götz, Oliver, Liehr-Gobbers, Kerstin, & Krafft, Manfred. (2010). Evaluation of structural equation models using the partial least squares (PLS) approach *Handbook of partial least squares* (pp. 691-711): Springer.
30. Hair, JF, Money, AH, & Samouel, P. (2007). *Research Methods for Business.* USA: Wiley.
31. Hair, Joe F, Ringle, Christian M, & Sarstedt, Marko. (2011). PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice, 19*(2), 139-152.
32. Houghton, John. (2010). ICT and the Environment in Developing Countries: A Review of Opportunities and Developments What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience. In J. Berleur, M. Hercheui & L. Hilty (Eds.), (Vol. 328, pp. 236-247): Springer Boston.
33. Hulland, John. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic management journal, 20*(2), 195-204.
34. Hutchins, Margot J., & Sutherland, John W. (2008). An exploration of measures of social sustainability and their application to supply chain decisions. *Journal of cleaner production, 16*(15), 1688-1698. doi: 10.1016/j.jclepro.2008.06.001
35. Irava, Wayne, & Moores, Ken. (2010). Resources supporting entrepreneurial orientation in multigenerational family firms. *International Journal of Entrepreneurial Venturing, 2*(3), 222-245.
36. Jarvis, Cheryl Burke, MacKenzie, Scott B, & Podsakoff, Philip M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of consumer research, 30*(2), 199-218.
37. Khan, EA, Chowdhury, MMH, & Dewan, MNA (2014). *Development and validation of a scale for measuring sustainability construct of informal microenterprises* Paper presented at the the 5th Asia-Pacific Business Research Conference, Kuala Lumpur, Malaysia.
38. Khan, EA, Rowe, AL , & Quaddus, M. (2012, 24-26 September). *Exploring sustainable growth of social micro-enterprises in an emerging economy.* Paper presented at the 15th EMAN Conference on Environmental and Sustainability Management, Helsinki, Finland. .
39. Khan, EA, Rowe, AL, Quaddus, M, & Nuruzzaman, M. (2013). The relationship of personality traits of informal micro-enterprise entrepreneurs, role of business environment, and firm sustainable performance - Qualitative evidence from Bangladesh. *Global Business & Economics Anthology 2*(2), 299-310.
40. Kickul, Jill, Liao, Jianwen, Gundry, Lisa, & Iakovleva, Tatiana. (2010). Firm resources, opportunity recognition, entrepreneurial orientation and performance: the case of Russian women-led family businesses. *International Journal of Entrepreneurship and Innovation Management, 12*(1), 52-69.
41. Lumpkin, G Tom, & Dess, Gregory G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, 135-172.
42. MacKenzie, Scott B, Podsakoff, Philip M, & Podsakoff, Nathan P. (2011). Construct measurement and validation procedures in MIS and behavioral research: integrating new and existing techniques. *MIS quarterly, 35*(2), 293-334.
43. Malhotra, Naresh K. 2008. *Marketing Research: An Applied Orientation, 5/E*: Pearson Education India.
44. Matell, Michael S, & Jacoby, Jacob. (1971). Is there an optimal number of alternatives for Likert scale items? Study I: Reliability and validity. *Educational and psychological measurement, 31*(3), 657-674.
45. Melville, Nigel P. (2010). Information systems innovation for environmental sustainability. *MIS Querterly, 34*(1), 1-21.
46. Parris, Thomas M, & Kates, Robert W. (2003). Characterizing and measuring sustainable development. *Annual Review of Environment and Resources, 28*(1), 559-586.
47. Piotrowicz, Wojciech, & Cuthbertson, Richard. (2009). Sustainability–a new dimension in information systems evaluation. *Journal of Enterprise Information Management, 22*(5), 492-503.
48. Revell, Andrea, & Blackburn, Robert. (2007). The business case for sustainability? An examination of small firms in the UK's construction and restaurant sectors. *Business Strategy and the Environment, 16*(6), 404-420.
49. Sage, Andrew P. (1999). Sustainable development: issues in information, knowledge, and systems management. *Information, Knowledge, Systems Management, 1*(3), 185-223.
50. Shepherd, Dean A, & Patzelt, Holger. (2011). The new field of sustainable entrepreneurship: Studying entrepreneurial action linking "what is to be sustained" with "what is to be developed". *Entrepreneurship Theory and Practice, 35*(1), 137-163.
51. Venkataraman, Sankaran. (2002). The distinctive domain of entrepreneurship research. *Edward Elgar Press.*
52. Waage, Sissel, Shah, Rajesh, & Girshick, Sahra. (2003). Information technology and sustainability: enabling the future. *International Journal of Corporate Sustainability, 10*(4), 81-96.
53. Watson, Richard T, Boudreau, Marie-Claude, & Chen, Adela J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. *MIS quarterly, 34*(1), 23-38.
54. Zhu, Qinghua, Sarkis, Joseph, & Lai, Kee-hung. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International journal of production economics, 111*(2), 261-273.