Apparel professionals' perception of sustainability-related technology: a structural equation modeling approach

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Abstract:

Purpose This study aims to examine the effects of the characteristics of apparel professionals on their attitude toward sustainability-related technology in the context of a developing country, Bangladesh.

Design/methodology/approach A quantitative approach was used to investigate the apparel professionals' perception of sustainability-related technology. A survey was conducted, and 204 valid responses were used in data analysis. The structural equation modeling technique was used to analyze the data.

Findings The findings demonstrate that apparel professionals' personal innovativeness positively impacts their knowledge of apparel technology. Knowledge of apparel technology and environmental issues in apparel manufacturing both significantly and positively impact their level of awareness of sustainability-related technology in apparel manufacturing. The findings also suggest that managers' level of awareness of sustainability-related technology has a significant positive impact on their attitude toward sustainability-related technology.

Originality/value Fishbein's attitude theory was applied to examine how the various characteristics of apparel professionals (i.e. personal innovativeness in technology, knowledge of apparel technology, knowledge of environmental issues of apparel manufacturing) affect their awareness of and attitude toward sustainability-related technology. This study expands our understanding of the causal flow among cognitive variables of apparel professionals, including their innovativeness, knowledge, awareness and attitudes. The findings of the study can be helpful to the apparel industry to improve apparel professionals' adoption of sustainable technology.

Keywords: apparel industry | technology adoption | sustainable technology | sustainability | Bangladesh

Article:

Introduction

The global apparel industry has become one of the focal industries that consider sustainability as a core element to protect the environment. For many developing countries, the apparel manufacturing sector is a major contributing industry to their countries' economic development; however, this industry significantly impacts the environment through water and air pollution (Shen et al., 2017). It is regarded as one of the most polluting industries globally (Shen et al., 2017). On the one hand, apparel manufacturing consumes a massive amount of natural resources throughout its life cycle; on the other hand, this industry emits a substantial amount of greenhouse gases (Niinimaki et al., 2020) and produces millions of tons of waste (Connell and Kozar, 2017; Islam et al., 2021).

Many apparel supplying countries, along with some large global brands, initiated and imposed policies, guidelines and regulations for conserving energy and natural resources and lessening the emissions of greenhouse gases. International apparel brands such as VF, H&M, Louis Vuitton and Patagonia have propelled several sustainable initiatives along their supply chains to conform to legal and environmental regulations (Rahman and Gong, 2016; Shen et al., 2017). United Nations Framework Convention on Climate Change established the "Fashion Industry Charter for Climate Action (FICCA)" that aspires to achieve net-zero emissions from this industry by the year 2050 (UNFCCC, 2021). Bangladesh has become the second-largest apparel exporter in the world (WTO, 2022) and one of the signatories of the FICCA (UNFCCC, 2021). Being a signatory of FICCA and supplying a large portion of apparel products to Western brands, the apparel industry of Bangladesh needs to adopt sustainable practices (Rahman and Gong, 2016; Koksal et al., 2017) and technologies (Hoque et al., 2022) that are helpful to achieve sustainability-related goals.

When a firm experiences regulation regarding sustainability, it can adopt sustainability-related technologies to significantly transform its manufacturing activities (Díaz-Chao et al., 2021). Previous literature argues that the interaction between sustainability and technology adoption reinforces a firm's ability to meet environmental, economic and social sustainability-related goals and influences the firm to achieve a win-win situation (Porter and van der Linde, 1995; Adams et al., 2016). Particularly, it is evident from the literature that the adoption of technologies to increase a firm's efficiency might enable the firms to better manage their sustainability efforts and would gain a synergy effect to increase the firm performance (Ghisetti and Rennings, 2014; Ozusaglam et al., 2018). Therefore, adopting sustainability-related technology plays a critical role in industries where environmental, social and economic sustainability issues are considered important.

The use of sustainability-related technologies can be considered a realistic attempt for apparel firms to improve their economic and sustainability performance (Asadi et al., 2021). Recently, apparel firms have been engaged in using technologies that are not only fulfilling multiple operational purposes but also providing some environmental advantages due to the resulting technological benefits. Those technological benefits include economic usage of energy and space, flexible workforce, improved lead-time, decreased production cost, reduced environmental influence such as carbon emission, improved system performance with enhanced communication and collaboration within the supply chain and so on (Bollinger, 2015; Bortamuly and Goswami, 2015; Chaudhary et al., 2020; Fu et al., 2018; Hoque et al., 2021, 2022; Sharma et al., 2021; Ştefan et al., 2015). Despite the benefits of implementing sustainable technologies in the apparel industry, there is little published research on sustainability-related technology adoption in

the context of Bangladesh, particularly in the apparel industry which is a major contributor of Bangladesh's economic development.

Prior literature indicates that examining the characteristics of individuals is essential to understanding their personal propensity toward technology adoption (Parasuraman, 2000). As apparel professionals play a vital role in maintaining the industry's competitiveness in the global market, it is crucial to understand their characteristics (Agarwal and Prasad, 1998a), such as their personal innovativeness in technology (Lu et al., 2005), knowledge about the apparel technology (Dickson, 2000) and knowledge about the environmental impact (Kang et al., 2013) of apparel production. As the second largest apparel exporter, Bangladesh has proved its importance as an influential stakeholder in the global apparel industry. Therefore, apparel professionals in Bangladesh have a great role to take part in accomplishing sustainability-related goals. However, previous studies have not addressed how the characteristics of Bangladesh's apparel professionals impact their perceptions of sustainability-related technology. Therefore, this study aims to fill this gap by examining the research question – How do the characteristics of apparel professionals in Bangladesh impact their attitudes toward apparel sustainability-related technologies? The theoretical foundation of this study was built on Fishbein's attitude theory (Fishbein, 1963; Fishbein and Ajzen, 1975). Specifically, Fishbein's attitude theory is applied to examine how the various characteristics of apparel professionals (i.e. personal innovativeness in technology, knowledge of apparel technology, knowledge of environmental issues of apparel manufacturing) affect their awareness of and attitude toward sustainability-related technology.

This research makes a valuable contribution to the existing body of literature by investigating the influence of personal innovativeness and knowledge on individuals' awareness of and attitudes toward sustainability-related technology in the context of Bangladesh's apparel manufacturing sector. The findings of the study can be helpful to the industry practitioners attempting to understand apparel professionals' awareness of and attitude toward sustainable technology acceptance. Therefore, the research contributes not only to the field of textile and apparel but also to the existing body of literature on sustainable technology adoption. Adopting sustainable technology is imperative to Bangladesh, as the country will be able to meet the United Nations' Sustainable Development Goals (SDGs) if most of its apparel firms use sustainable technologies, especially for goals 12 (Responsible Production and Consumption) and 13 (Climate Action) (SDGS, 2022).

Literature review

Related work and rationale for research

Existing literature suggests that technology adoption varies across countries as well as industries (Kumar and Siddharthan, 1994). Historically, according to Islam and Adnan (2016), most apparel manufacturers in Bangladesh were dispassionate about upgrading and differentiating themselves through the adoption of technology. In Bangladesh, apparel manufacturing has been considered a labor-intensive business, although it is a major industry in Bangladesh supporting the country's economic development. The benefits of technologies have not been widely recognized by apparel industry professionals. During the past decade, several apparel firms in Bangladesh have adopted different types of informational and operational technologies. The typical technologies that are adopted by apparel firms include high-speed sewing machines, computer-aided design (CAD), automatic inspection systems, automatic material handling devices, numeric control machines,

advanced fusing and pressing machines, business management software, computer-based production control and inventory management, robots in the production operation, robots in logistics, ERP software and information technology (Park-Poaps et al., 2020). In the existing literature on the general technology adoption-related research in the Bangladesh apparel industry, only one study conducted by Park-Poaps et al. (2020) was found. Following the modified framework of Wiarda (1987), Park-Poaps et al. (2020) replicated the study of Varukolu and Park-Poaps (2009) in Bangladesh to investigate the technology adoption status among apparel firms. Their study examined the influences of contextual factors on technology adoption of clothing manufacturing firms. They found that information technology and related software were the most common technologies adopted, and automation-related technologies were the least common.

It should be noted that apart from general technology adoption, the adoption of technologies that help apparel firms to achieve sustainability-related goals is particularly critical for the Bangladeshi apparel industry to maintain their competitiveness in the global apparel market and their long-term backbone status in the country. The study of Iqbal and Su (2021) attempted a qualitative approach to understanding the technology adoption-related factors perceived by top apparel industry professionals in Bangladesh. One important factor of technology adoption identified in their study is sustainability consideration. Sustainable technology adoption is becoming an emerging driving force in enhancing Bangladesh's apparel industry. However, the only study that focused on sustainable technology adoption in the Bangladesh's apparel industry was conducted by Hoque et al. (2022). Their study adopted stakeholder theory and inspected the role of different stakeholders in facilitating sustainable technology adoption and improving firm performances and competitive advantages (Hoque et al., 2022).

The adoption of technology for the sake of sustainability has become an effective approach in different industries. Recent literature is getting enriched by research works related to sustainability and individual behavior toward technology. The study of Adnan and Nordin (2018) investigated factors affecting sustainable agricultural technology adoption by farmers in Malaysia. Their findings argued that knowledge and awareness have an impact on the farmers' adoption intention toward sustainable practices in agriculture. The study of Ojo et al. (2019) investigated the relationship among knowledge, belief, attitude and behavioral change of IT professionals toward adopting green information technology. They found that knowledge and belief significantly impact IT professionals' attitudes toward green information technology. Asadi et al. (2021) found that an individual's intention to adopt sustainable information technology is significantly impacted by their awareness of consequences. In addition, several previous studies investigated the effects of individuals' personal characteristics on their overall attitudes toward a specific technology (Sun, 2016; Rojas-Méndez et al., 2017; Purnomo et al., 2021), including knowledge (Purnomo et al., 2021), education (Alsultanny and AlZuhair, 2019) and experience (Blut and Wang, 2020).

Sustainability-related technology

Sustainability-related technologies can be classified into four kinds: carbon dioxide and other greenhouse gas emission reduction technology, substitute technology of natural material and fuel, energy-efficient technology and recycling technology (UNEP – UN Environment Programme, 2022). According to Frondel et al. (2007), sustainable and clean technology decreases air and water pollution and reduces energy and material consumption, whereas energy-efficient technology is focused on energy saving. According to Kondratenko et al. (2017), sustainable technology requires

less amount of materials and energy and as a result, minimizes the detrimental impact on the environment.

The manufacturing and information technologies that are used in apparel manufacturing and help apparel firms' efforts in improving their economic, environmental and social performance are considered sustainability-related technology in this study (Fu et al., 2018; Hoque et al., 2022). Technologies such as CAD, high-speed sewing machines, technology for dyeing and finishing apparel products with a reduced amount of energy, water and chemicals, automation, information technology used in the sustainable production process can be termed sustainability-related technologies, which have been adopted in the apparel industry to improve the environment, the well-being of employees and the economic performance of firms (Papahristou and Bilalis, 2017; Díaz-Chao et al., 2021). The environmentally sound and socially responsible technologies play a substantial role in upgrading the global apparel industry and addressing the "triple bottom line" of people, planet and profit (Connell and Kozar, 2017).

Hypotheses development

The theoretical foundation of this study is built on Fishbein's attitude theory (Fishbein, 1963; Fishbein and Ajzen, 1975). The fundamental theoretical proposition of this theory is that it propositioned a causal flow among cognitive variables, including beliefs and attitudes. The attitude theory of Fishbein states that the attitude of a person is a function of his or her salient beliefs, and those beliefs are shaped by knowledge. Fishbein's attitude theory is a classical theory in social psychology that provides a useful framework for understanding and predicting individuals' attitudes toward adopting sustainability measures (Li et al., 2020). It has been commonly used in research examining sustainable behavior at the personal level (Paul et al., 2016; Su et al., 2019). It also provides a suitable theoretical ground to examine the factors affecting attitude and has been applied in analyzing technology adoption (Rehman et al., 2007; Mishra et al., 2014). In this study, the theory is applied to examine how the factors (personal innovativeness in technology, knowledge of apparel technology and knowledge of environmental issues of apparel manufacturing) affect individual apparel professionals' awareness of and attitude toward sustainability-related technology.

Effect of apparel professional's personal. The word "innovativeness" can be referred to the desire of an individual to find out something new and different (Hirschman, 1980). So, an individual's innovativeness or novelty-seeking tendencies is the degree to which that individual is open to experiencing or trying something new. Although Agarwal and Prasad (1998b, p. 206) suggested that the term innovativeness can be particularly associated with the information technology domain by defining it as "the willingness of an individual to try out any new information technology." personal innovativeness has acquired convincing empirical literature support as a critical predictor of individuals' technology adoption in different disciplines (Agarwal and Prasad, 1998b; Hirschman, 1980; Karjaluoto et al., 2019).

According to the study by Patil et al. (2020), individuals with higher levels of personal innovativeness are expected to develop more positive beliefs about new technologies. In general technology adoption research, it is acknowledged that highly innovative persons are active information explorers of novel ideas. Innovative individuals are able to handle higher levels of uncertainty and are able to develop a more positive attitude toward technology (Rogers, 1995). The study by Agarwal and Prasad (1998a) contended that by synthesizing information from different media, people develop beliefs about new technologies. With the same level of exposure

to different media, individuals with greater personal innovativeness are expected to develop more knowledge about the target technology (Lu et al., 2005). Individuals who are more innovative in nature are also more dynamic when consistently looking for information on the new ideas, innovations and technologies they adopt earlier than others (Rogers, 1995; Liébana-Cabanillas et al., 2018). Thus, those individuals become technically more knowledgeable and competent than others (Liébana-Cabanillas et al., 2018). Apparel professionals who are highly innovative tend to be active information seekers about new apparel technology. Individual apparel professionals with higher level of personal innovativeness are more likely to have more knowledge of apparel technology. In this study, it is hypothesized as follows

H1. Apparel professionals' personal innovativeness has a positive and significant effect on their knowledge of apparel technology.

Effect of apparel professional's knowledge of environmental issues in apparel manufacturing on their level of awareness of sustainability-related technology. Knowledge about environmental issues influences environmental behavior and makes individuals more aware of the adverse impact of manufacturing on the environment. Amel et al. (2009) found that individuals who are more knowledgeable about environmental issues tend to show more sustainable behavior. Therefore, individuals with more environmental knowledge are more likely to concentrate on improving their behaviors' environmental effects (Jenkin et al., 2011). Simmons and Widmar (1990) advocated that a lack of knowledge about the impact of waste on the environment can act as an obstacle to the environmental awareness of an individual, and this may happen even among people who feel responsible for the environmental impact.

Previous studies also indicated that knowledge about unfavorable consequences has a significant impact on environmentally friendly measures (Mayer et al., 2015; Dalvi-Esfahani et al., 2017). Individuals' environmental knowledge is associated with their understanding of the outcomes or consequences of the desirable influence that their behaviors may have on the environment or on other individuals (De Groot and Steg, 2009). The knowledge of environmental issues can establish the belief that the existing conditions of the environment may be threatening to individuals' valuable things, which can encourage them to increase their level of awareness of environmentally friendly tools and technologies (Mishra et al., 2014; Asadi et al., 2021). Individuals who have more knowledge of the undesirable outcomes of a manufacturing operation will be more aware of the technologies that can reduce the undesirable outcomes (Eriksson et al., 2006; Kang et al., 2013). In the case of sustainable technology adoption, it is proposed that apparel professionals' higher knowledge of environmental issues will increase their level of awareness of sustainability-related technology in apparel manufacturing. Thus, it is hypothesized as follows:

H2. Apparel professionals' knowledge of environmental issues in apparel manufacturing has a positive and significant effect on their level of awareness of sustainability-related technology in apparel manufacturing.

Effect of apparel professional's knowledge of apparel technology on their level of awareness of sustainability-related technology. Highly knowledgeable human resource positively impacts the adoption of sustainable technology (Blackman and Bannister, 1998; Weng and Lin, 2011; Cainelli et al., 2015). Knowledge of the latest technology helps individuals understand the impact of those technologies on both manufacturing and the environment (Kang et al., 2013). Thus, knowledge

about a current technology may increase the level of awareness of some particular technologies necessary to improve the current technology to meet the firm's sustainable goals. According to some recent studies conducted within the apparel industry context, knowledge about the latest apparel technology can be regarded as one of the critical skills of apparel firm managers (Jacobs and Karpova, 2020; Iqbal et al., 2022). It is expected that the industrial professionals who know more about modern apparel manufacturing technologies, their benefits and impact on the environment, will tend to have a higher level of awareness of the technologies that can help the apparel firms achieve sustainable manufacturing (Koo and Chung, 2014). Therefore, it is hypothesized as follows:

H3. Apparel professionals' knowledge of apparel technology has a positive and significant effect on their level of awareness of sustainability-related technology in apparel manufacturing.

Effect of apparel professionals' level of awareness of sustainability-related technology on their attitude toward sustainability-related technology. Awareness is vastly used in many empirical studies in the field of technology adoption and, especially, in green technology adoption (Mishra et al., 2014). Some studies addressed public awareness of action strategies and willingness to respond to environmental change (Whitmarsh, 2008). They explored awareness and behavior in relation to environmental change. As a matter of fact, awareness is reported to be a factor in preserving and improving the quality of the environment (Fielding et al., 2008). According to the study of Amel et al. (2009), awareness is significantly and positively associated with self-reported sustainable behavior. The findings of the study of Asadi et al. (2021) suggested that managers' awareness significantly and positively affects their intention to adopt sustainable information technology in the context of manufacturing industries. In the apparel industry context, when an apparel professional is well aware of the technologies that could be used in production to reduce waste and pollution generated and improve energy efficiency, he or she would be more likely to have a positive attitude toward sustainable technology. In this study, it is hypothesized as follows:

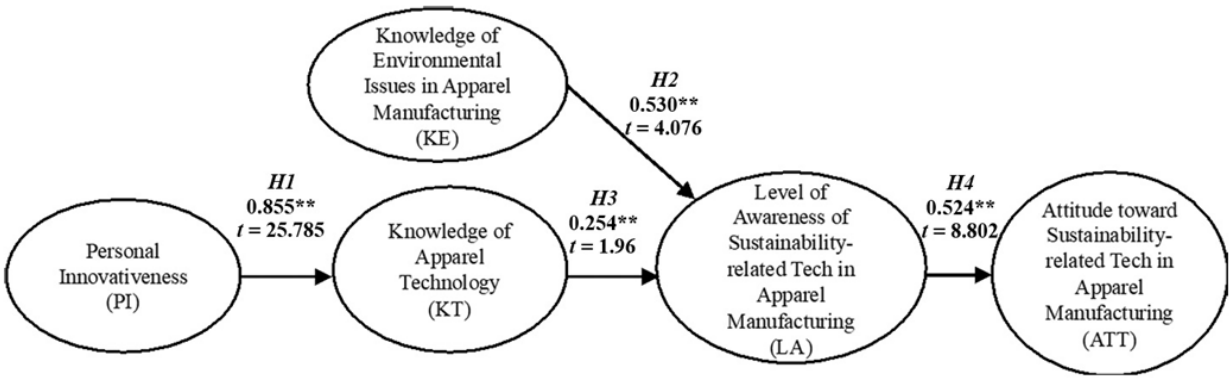
H4. Apparel professionals' level of awareness has a positive and significant effect on their attitude toward sustainability-related technology in apparel manufacturing.

Figure 1 illustrates the theoretical model and the four relevant hypotheses explained above.

Methodology

An online survey was conducted through a structured questionnaire which was developed based on the extensive literature review on relevant constructs and the study context. The online platform Qualtrics was used to design and distribute the survey to collect the data. Surveys are the common and popular methods (Krosnick, 1999; Lavrakas, 2008) used in technology adoption research. Surveys can provide valid responses (Groves and Peytcheva, 2009; Blair et al., 2013) that can be generalized to other similar populations (Fowler, 2013); furthermore, surveys can offer impartial ways of comparing responses over different times, groups and spaces (Newsted et al., 1998; Lavrakas, 2008; Fowler, 2013). Measures for the constructs were adapted from previously published research – personal innovativeness from Lu et al. (2005) and Agarwal and Prasad (1998b), knowledge about environmental issues from Dickson (2000) and Kang et al. (2013),

knowledge about apparel technologies from Dickson (2000) and Koo and Chung (2014), the level of awareness from Mishra et al. (2014) and attitude from Kamble et al. (2019) and Upadhyay et al. (2022). The constructs were measured using a five-point Likert scale (1 = strongly disagree, 2 = inclined to disagree, 3 = neither agree nor disagree, 4 = inclined to agree, 5 = strongly agree) for each item.



Notes: The path coefficients in the figure are standardized parameter estimates; *$p < 0.05$; **$p < 0.001$
Source: Authors' own work

After getting the Institutional Review Board approval, pilot sample data of 30 apparel managers were collected from Bangladesh. From the results of the pilot data, some question items were rephrased to improve the questionnaire's clarity. A convenience sample was used for this study, with the target group being the managers of Bangladeshi apparel companies with an export focus. The apparel industry in Bangladesh has emerged as the single dominant industry in the country's export arena, accounting for more than 80% of the country's export revenue (Bangladesh Bank, 2022). Addresses, contacts and e-mails were compiled from the members' directory of Bangladesh Garment Manufacturers and Exporters Association. In the data collection stage, individual apparel managers were the target respondents for the survey, as the unit of analysis in this study was at the individual manager level. A recruitment letter briefly describing the purpose of the study and requesting participation in the study was prepared. The finalized questionnaire in English was sent to the targeted respondents through email and other social media platforms, including Facebook and WhatsApp. There are some Facebook Messenger and WhatsApp groups of apparel professionals in Bangladesh, of which one of the authors is a member. Especially the alumni platforms of Bangladesh University of Textiles are a common gathering of the leading apparel professionals in the industry. Authors have used that alumni network for effective data collection. The first email invitation, along with the cover letter/recruitment invitation letter, consent form and the Qualtrics survey link, was sent to the survey recipients. If a participant felt he/she was not the right person to answer the survey, he/she was instructed to forward the survey to an appropriate person. After one week of the initial email invitation, a reminder email was sent. After a week from the reminder email, follow-up calls were made until the minimum target number of responses was achieved. The calling process was repeated for those who could not be reached for the first time.

The survey was sent to 2,900 manager-level apparel employees in Bangladesh, and 239 responses were received. After data screening, 204 valid responses were used in data analysis. Considering the challenges of conducting survey among industry professionals and their busy working schedule, the response rate in this study can be regarded as adequate (Huo et al., 2019).

Around 77% of the apparel professionals who responded to the survey worked in the areas of production, supply chain and merchandizing departments. About 62% of the respondents had job experience of 3 to 9 years, and around 8% had more than 15 years of experience. About 88% of the respondents were males and 12% were females. Table 1 shows the demographic profile of the respondents.

Results

Evaluation of the measurement model

A two-step technique of structural equation modeling (SEM) was used for data analysis. Initially, the measurement model was evaluated by using confirmatory factor analysis to examine the relationships between the indicator variables and their respective underlying factors. To examine the fit of the measurement model, multiple fit indexes were used

Table 1. Demographic information of the sample

Demographic information	%
Gender	
Male	88.0
Female	12.0
Experience (years)	
Less than 3	20.1
3-5	28.6
6-9	33.7
10-14	9.4
15 or more	8.1
Work area of the manager	
Production and merchandising	66.2
Supply chain	10.7
Administration	1.7
Commercial and related operation	1.3
Others	20.1
Level of manager	
Executive	35.0
Assistant Manager	21.8
Deputy Manager	5.6
Manager	11.5
Senior Manager	1.3
Assistant General Manager	1.3
Deputy General Manager	1.3
General Manager	1.3
Director	0.8
Managing Director	0.8
Other	19.2

Source: Authors' own work

including the root mean squared error of approximation (RMSEA), the standardized root mean squared residual (SRMR), the comparative fit index (CFI) and the Tucker–Lewis index (TLI). The measurement model shows a satisfactory fit and an adequate level of measurement reliability and validity (Tables 2 and 3). Convergent validity and reliability were analyzed using the average variance extracted (AVE) and composite reliability (CR) coefficient for the constructs in the model. The discriminant validity was evaluated on the basis of the criteria of Fornell and Larcker (1981) by comparing the square root of the AVE value of each construct with the inter-construct correlations of that construct with all other constructs in the model.

Table 2 includes the fit indexes which indicate an acceptable fit of the measurement model: chi-square value/degree of freedom = 3.20; RMSEA = 0.10; SRMR = 0.15; CFI = 0.80; TLI = 0.78. The fit indices were close to or less than the commonly suggested cutoff values according to the strict conventional criteria (chi-square value/degree of freedom ≤ 5; RMSEA and SRMR ≤ 0.10; CFI and TLI ≥ 0.90). However, Hair et al. (2019) argued that "more complex models with smaller samples may require somewhat less strict criteria for evaluation with the multiple fit indices" (p. 642). Furthermore, McNeish and Wolf (2023) suggested dynamic fit index cutoffs for confirmatory factor analysis, arguing that "the meaning of fit indices varies based on a complex interaction of model characteristics like factor reliability, number of items, and number of factors" (p. 61). Considering the sample size and the number of indicator variables in this study and the practical advice provided by Hair et al. (2019), it is understandable from the fit statistics that the measurement model overall exhibits an acceptable and adequate level of fit.

Table 2 also details a summary of the standardized factor loadings, t-values, Cronbach's alphas and analysis results of composite reliability and convergent validity of the measurement model. All the standardized factor loadings are greater than 0.6. The t-values indicate that all the path coefficients are statistically significant at $p < 0.001$, demonstrating that the items are adequate for measuring the study constructs (Hair et al., 2011).

To ensure that the multiple-item scales were reliable, reliability analysis using composite reliability (CR) was carried out for each of the constructs. The CR coefficients of the constructs varied from 0.70 to 0.91, indicating that the items in the scales exhibited high internal consistency (acceptable if greater than 0.7) in estimating the underlying latent constructs (Kline, 2016). AVE value was computed as the mean variance extracted for the items loading on a construct and can be considered the summary indicator of convergence (Hair et al., 2019). The AVE value greater than or equal to 0.5 is suggested by Hair et al. (2019). In this study, the AVE values range from 0.44 to 0.67, which explains an adequate convergent validity (Fornell and Larcker, 1981). The square root of the AVE values of the constructs and the correlations between the constructs are presented in Table 3, which shows an acceptable discriminant validity. Thus, the overall evaluation of the measurement model suggests that the model is adequate to proceed with structural model testing.

Table 2. Results of the evaluation of the measurement model

Indicator variables and their underlying factors	Standardized factor loading	*t*-value	R-square	Composite reliability	AVE
Level of awareness (LA) (Cronbach's alpha = 0.90)				0.91	0.67
LA1	0.80	26.63	0.63		
LA2	0.86	36.43	0.73		
LA3	0.87	39.36	0.75		
LA4	0.80	28.22	0.65		
LA5	0.75	22.05	0.57		
Personal innovativeness (PI) (Cronbach's alpha = 0.69)				0.70	0.44
PI1	0.72	13.02	0.53		
PI2	0.61	10.02	0.38		
PI3	0.63	10.96	0.40		
Attitude (ATT) (Cronbach's alpha = 0.87)				0.87	0.57
ATT1	0.76	19.50	0.57		
ATT2	0.86	29.52	0.74		
ATT3	0.76	19.80	0.57		
ATT4	0.74	19.32	0.55		
ATT5	0.66	13.90	0.43		
Knowledge about environmental issues (KE) (Cronbach's alpha = 0.88)				0.88	0.60
KE1	0.67	15.79	0.45		
KE2	0.78	24.81	0.61		
KE3	0.74	21.02	0.55		
KE4	0.84	32.65	0.70		
KE5	0.82	30.56	0.68		
Knowledge about apparel technology (KT) (Cronbach's alpha = 0.84)				0.85	0.54
KT1	0.75	20.55	0.55		
KT2	0.75	20.66	0.56		
KT3	0.70	17.29	0.49		
KT4	0.62	13.14	0.39		
KT5	0.84	31.10	0.71		
Fit Indices					Values
Chi-square value/df					3.20
RMSEA					0.10
SRMR					0.15
CFI					0.80
TLI					0.78

Source: Authors' own work

Table 3. Discriminant validity of the measurement model

	LA	PI	ATT	KE	KT
LA	*0.82*				
PI	0.47	*0.66*			
ATT	0.49	0.43	*0.75*		
KE	0.73	0.49	0.56	*0.77*	
KT	0.69	0.63	0.48	0.86	*0.73*

Notes: 1. LA = Level of awareness; PI = Personal innovativeness; ATT = Attitude; KE = Knowledge about environmental issues; KT = Knowledge about apparel technology; 2. The elements on the diagonal (italic) are the square root of the values of AVE; 3. The elements below the diagonal are the inter-factor correlation estimates

Source: Authors' own work

Evaluation of the structural model and hypothesis testing

In the next step, the structural relationships of the model were investigated using SEM. The results of the data analysis show that all four hypotheses are supported (Figure 1 includes standardized factor loadings and t-values). For H1 (personal innovativeness – knowledge of apparel technology), the standardized path coefficient ($\gamma = 0.855$) is statistically significant and positive ($t = 25.785$, $p < 0.001$), which means, the data supports a positive relationship between personal innovativeness and apparel technology knowledge. That is, when apparel professionals are more innovative, they tend to have a higher level of apparel technology knowledge.

For H2 (knowledge of environmental issues in apparel manufacturing – level of awareness of sustainability-related technology in apparel manufacturing), the standardized path coefficient ($\gamma = 0.530$) is statistically significant and positive ($t = 4.076$, $p < 0.001$), which means, the data supports a positive relationship between apparel professionals' knowledge of environmental issues in apparel manufacturing and their level of awareness of apparel sustainable technology. That is, when apparel professionals are more knowledgeable about apparel environmental issues, they tend to have a higher awareness of apparel sustainable technology.

For H3 (knowledge of apparel technology – level of awareness of sustainability-related technology in apparel manufacturing), the standardized path coefficient ($\beta = 0.254$) is statistically significant and positive ($t = 1.96$, $p < 0.01$), which means, the data supports a positive relationship between apparel technology knowledge and level of awareness of apparel sustainable technology. That is, when apparel professionals are more knowledgeable about apparel technology, they are more likely to have a higher level of awareness of apparel sustainable technology.

For H4 (level of awareness of sustainability-related technology in apparel manufacturing – attitude toward sustainability-related technology in apparel manufacturing), the standardized path coefficient ($\beta = 0.524$) is statistically significant and positive ($t = 8.802$, $p < 0.001$), which means, the data supports a positive relationship between level of awareness of apparel sustainable technology and attitude toward apparel sustainable technology. That is, when apparel professionals have a higher level of awareness of apparel sustainable technology, they tend to have more favorable attitude toward apparel sustainable technology.

Discussion and implications

Discussion

The findings demonstrate that apparel professionals' personal innovativeness positively impacts their knowledge of apparel technology. Individual managers who hold the personality trait of innovativeness might have a greater motivation to seek more information about apparel technology, which makes them more knowledgeable about newer apparel technologies. It can be inferred from this finding that more innovative apparel professionals will be more interested in searching for information about the latest apparel technologies and become more knowledgeable about those technologies. They will be more interested in finding how newer technologies can be adopted in apparel manufacturing (Lu et al., 2005).

This study measured two types of knowledge of apparel professionals (knowledge of apparel technology and knowledge of environmental issues in apparel manufacturing) and both types of knowledge significantly and positively impact their level of awareness of sustainability-related technology in apparel manufacturing. These findings match with the findings of the study by Kang et al. (2013), suggesting that the knowledge about the latest technology benefits individuals in understanding the influence of those technologies on manufacturing and the impact of manufacturing on the environment (Kang et al., 2013). Knowledge of the technologies used in apparel manufacturing and the environmental impact of apparel manufacturing enables apparel professionals to actively seek new technologies to improve current manufacturing operations to reduce energy use and minimize waste and pollution. Therefore, the apparel professionals' knowledge about apparel technologies and the environmental issues in apparel manufacturing increases their awareness of the specific sustainable technologies essential to meet the apparel industry's sustainability-related goals.

Moreover, compared with the knowledge of apparel technology, apparel professionals' knowledge of environmental issues in apparel manufacturing has a stronger effect on their level of awareness of sustainability-related technology in apparel manufacturing. It is understandable from this finding that the awareness and attitude toward sustainability-related technology adoption are different from the awareness and attitude toward general technology adoption. Because the primary driving force behind the awareness and attitude toward sustainability-related technology adoption is conserving the environment through reducing waste and greenhouse gas and achieving energy efficiency, this study considered knowledge of apparel technology and knowledge of environmental issues in apparel manufacturing as the two important antecedents of the level of awareness of sustainability-related technology in apparel manufacturing.

Finally, the findings suggest that apparel professionals' level of awareness of sustainability-related technology has a significant positive impact on their attitude toward sustainability-related technology in apparel manufacturing, which confirms the findings reported by Mishra et al. (2014). Mishra et al. (2014) found that the level of awareness of the managers significantly and positively impacts their attitude in the context of green information technology adoption. According to Young (2008), the level of awareness is a critical factor influencing an individual's attitude and behavioral intentions. Actually, the level of awareness of the managers is a necessary factor for sustainable technology adoption (Fielding et al., 2008).

Thus, the study results provided an answer to address the research question of the study – how the personal characteristics of apparel professionals impact their awareness of and attitude toward sustainability-related technology in the apparel industry. The findings of the study offered

valuable insights into the role of individuals' personal characteristics in their attitude toward sustainable apparel technology.

Implications

Implications for researchers. This study investigated apparel professionals' attitude toward sustainability-related technology using their characteristics as the antecedents such as personal innovativeness, knowledge and level of awareness. This study demonstrates the applicability of Fishbein's attitude theory in examining apparel professionals' perceptions of sustainability-related technology in the context of Bangladesh. This study provides empirical evidence on the role of apparel professionals' characteristics on their awareness of and attitude toward sustainable technology. Theoretically, this study expands our understanding of the causal flow among cognitive variables of apparel professionals including innovativeness, knowledge, awareness and attitudes to understand their perceptions of sustainability-related technology. This study contributes to the literature by conducting a survey among apparel professionals at an individual level in the context of a Bangladesh to examine how their personal innovativeness and knowledge impact their awareness of and attitudes towards sustainability-related technology in apparel manufacturing. The literature on technology adoption in Bangladesh is scarce, and there is no previous research on how individual apparel professionals' characteristics impact their attitudes toward sustainable technology adoption in apparel manufacturing. Thus, this study contributes not only to apparel research but also to the literature on sustainable technology adoption.

This study adopted the scales from existing literature and applied them in the context of the Bangladesh's apparel industry to investigate how the characteristics of Bangladesh's apparel professionals impact their awareness of and attitude toward sustainability-related technology. The findings of this study prove the applicability of the scale items in the apparel sustainability context, which is a notable contribution to both apparel sustainability and technology adoption literature.

Implications for practitioners. The findings of the study can be helpful to the industry practitioners attempting to understand apparel professionals' awareness of and attitude toward sustainable technology acceptance. Practically, it is critical to understand how individual managers' personal innovativeness and their knowledge about apparel technology and environmental issues impact their awareness of and attitude toward sustainability-related technology in apparel manufacturing. To achieve the sustainability goals of Bangladesh's apparel industry, understanding the perceptions of apparel managers and their individual characteristics is essential to improve their adoption intention toward and/or competencies in sustainable technology. Human capital is an intangible but valuable asset of a company. The higher executives of the company should recognize the value of innovativeness and knowledge of apparel professionals. Additionally, manufacturers of sustainability-related technology can effectively and proactively provide resources to improve apparel professionals' technological and environmental knowledge for the adoption of sustainable technology. Apparel professionals are important stakeholders in the apparel industry in ensuring sustainability initiatives. As sustainability is an emerging issue in Bangladesh's apparel industry, apparel professionals have been emphasizing sustainability issues in apparel manufacturing. The findings of this study will help them understand that their personal characteristics affect their attitudes toward apparel sustainable technology and will motivate them to learn more about sustainability and have more knowledge about apparel sustainability, ultimately improving their professional careers. The respondents in this study were apparel professionals; some might have a role in decision-making in their companies' sustainability

policies, while others might not. The findings of the study will not only encourage apparel professionals who are at the decision-making positions to adopt sustainable technology in apparel manufacturing but also enable apparel professionals who are not at the decision-making positions to educate their decision-making executives/managers to enhance their executives/managers' knowledge and awareness of sustainable technology. Bangladesh's principal industry is the apparel sector. Bangladesh will find it easier to reach the SDGs when the majority of its apparel manufacturers adopt sustainable technologies, particularly Goals 12 (Responsible Production and Consumption) and 13 (Climate Action) (SDGS, 2022).

Limitations and future research

This study retains some limitations. First, the generalizability of the findings may be inadequate because the study was conducted in the context of a developing country, Bangladesh. Future studies may consider cross-cultural studies and compare the sustainable technology adoption behavior of apparel managers in developed as well as developing countries. Second, this study considered measuring the attitude of apparel professionals towards sustainable technology as a consequent variable and did not measure the actual behavior of the apparel professionals. Future studies can consider measuring the behavioral intention and actual behavior of the apparel managers towards adopting sustainable technology. Third, the findings of the study are explained in light of Fishbein's attitude theory. Future studies are needed to expand the present research by using other theories and including other factors in the model. For example, as the level of education may have an impact on the knowledge level of apparel professionals, future studies can include education level as a factor to investigate sustainable technology adoption behavior. Fourth, this study did not consider the job role (decision-making role)'s impact on managers' perceptions and attitudes. Future studies can capture the impact of managers' decision-making role on their perceptions of sustainability-related technology.

In conclusion, from the sustainability perspective, this study intended to examine the impact of the personal characteristics of apparel professionals on their attitudes toward technologies in a developing country's context through the lens of Fishbein's attitude theory. This empirical research found that apparel professionals' personal innovativeness positively impacts their knowledge of apparel technology. Their knowledge of apparel technology and environmental issues in apparel manufacturing significantly and positively impacts their awareness of sustainability-related technology in apparel manufacturing. The results also indicate that apparel professionals' level of awareness of sustainability-related technology has a significant positive impact on their attitudes toward sustainability-related technology. Future research can investigate the readiness of apparel professionals toward sustainability-related technology. Apart from the individual-level study, future research can also investigate the organizational readiness of apparel companies towards the adoption of sustainability-related technology.

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