

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM TO GUIDE SUSTAINABLE BUSINESS PRACTICES OF FUTURE MANAGERS IN THE BANGLADESH TEXTILE INDUSTRY

Part of the German-Bangladesh Higher Education
Network for Sustainable Textiles



Final Report, 2020

Authors

Dr. Jonathan Morris
My Hanh Doan
Isabella Georgiou

Contributors and Wider Project Team

Prof. Edeltraud Guenther
Dr. Lisa Koep
Dr. Frederik Plewnia
Dr. Remmer Sassen
Christina Froemder
Sonja Buchholz-Postert
Linda Heinze

Publication Date

September 2020

Publisher

Chair for Sustainability Management and Environmental Accounting, TU Dresden, 2020

For citation and reprints, please contact the Chair for Sustainability Management and Environmental Accounting.

Copyright © 2020 Technische Universität Dresden, Faculty of Business and Economics

All rights reserved. No part of this report may be reproduced, adapted, stored in a retrieval system or transmitted by any means, including photocopying, recording, or other electronic or mechanical methods without the prior written permission of the publisher.

For permission request, please contact:

Professor Edeltraud Guenther,
Chair of Sustainability Management and Environmental Accounting
Faculty of Business and Economics, TU Dresden
ema@mailbox.tu-dresden.de

Acknowledgements

This work has been undertaken by the Technische Universität Dresden as a part of the German-Bangladesh Higher Education Network for Sustainable Textiles (HEST). The HEST project was commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), administered by the German Organisation for International Co-operation and Development (GIZ). The project was funded by DAAD with funds from GIZ on behalf of BMZ. The project was run in cooperation with the Bangladesh University Grants Commission (UGC). The HEST project funded a series of work streams to address the issue of sustainability connected to the textile industry in Bangladesh through strengthening academic curricula. The programme had three overall aims – 1) improve the quality of study programmes, 2) boost applied research and 3) develop the capacity of middle managers. TU Dresden co-ordinated the stream “Introducing Sustainability to the Textile Engineering Curriculum to Guide Sustainable Business Practices of Future Managers in the Bangladesh Textile Industry”. To address the issues, TU Dresden worked in partnership with Ahsanullah University of Science and Technology (AUST) and Notre Dame University Bangladesh (NDUB) to revise, develop and enhance the curricula at these Universities and embed sustainability concepts into the content. We would like to thank the University partners for their efforts and collaboration throughout this project period. Our appreciation also goes to the GIZ, DAAD and UGC for their continued support throughout this research. Lastly we wish to thank all the researchers, teachers, faculty staff, experts and industry partners who have also contributed to this project.

Contents

List of Abbreviations.....	4
Executive Summary	1
Introduction and Overview.....	4
Project Rationale	4
Motivation of the Project	5
Aims and Objectives	6
Methodology	8
Overview of Outcomes and Partnership Function.....	9
Project Relevant Outcomes and Statistics	10
Consolidated contacts	16
Partnership Relations	16
Curriculum: Gap Analysis and Development	18
Ahsanullah University of Science and Technology.....	18
Expert Validation	21
Notre Dame University Bangladesh	21
Final Modules.....	23
Implementation.....	25
Scientific utilization of the Curricula in the Bangladesh Universities	25
Ensuring Successful Implementation of the Developed Contents.....	27
Workshops.....	29
Timeline of Events	29
Dresden Project Workshop, October 2018	31
Thailand Winter School, March 2019.....	34
Dresden Workshop II, April 2019.....	36
Dhaka Workshop, August 2019	37
Dhaka Conference.....	39
Research Outputs.....	41
Book Chapters.....	41
Conference Presentations	41
Blog Posts.....	43
Student Projects	44
Sustainability of the Project Partnership	48
Notable Partnerships and Interaction	48
Future Plans and Implementation	49
Chair of Sustainability and Innovation Management	49
Digital Workshop	50
Conclusions and Key Project Statistics.....	53
Overview of Project Indicators	54
References	57

List of Abbreviations

AIT	Asian Institute of Technology
AUST	Ahsanullah University Bangladesh
BBA	Bachelor of Business Administration
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BSc	Bachelor of Science
CSR	Corporate Social Responsibility
DAAD	German Academic Exchange Service
DESD	United Nations Decade of Education of Sustainable Development
DTE	Department of Textile Engineering
ECTS	European Credit Transfer and Accumulation System
EU	European Union
GIZ	German Society for International Cooperation
HEI	Higher Education Institute
HEST	Higher Education Network for Sustainable Textiles
LCA	Life Cycle Assessment
MBA	Master of Business Administration
MoUs	Memorandums of Understanding
NDUB	Notre Dame University Bangladesh
NGOs	Non-Government Organizations
OBE	Outcome Based Education
RMG	Ready Made Garments
SDG(s)	Sustainable Development Goal(s)
TOT	Training of Trainers
TUD/TU Dresden	Technische Universität Dresden
UGC	University Grants Commission (Bangladesh)
UK	United Kingdom
UN	United Nations
UNU-FLORES	United Nations University, Institute for Integrated Management of Material Fluxes and of Resources

Executive Summary

The textile industry accounted for 9.3% of the world's employees and is responsible for several environmental challenges, accounting for 10% of total carbon emissions and 17-20% of industrial water pollution. In addition, social impacts arising from the textile industry are significant, associated with ethical issues such as poor labour conditions in developing countries. A major challenge of the industry is to support the transformation of textile producing countries and regions towards greater sustainability. Recent prominent global scandals in the textile industry have highlighted the problem of poor working conditions and environmental pollution which have gained prominence among actors across the value chain. The ready-made garment sector (RMG) is embedded in a globalized supply chain; unsustainable practices within the supply chain can have consequences for corporations. Secondly, in response to such scandals, companies are increasingly imposing requirements on suppliers. In this digital age, corporate practices and the activities of their suppliers are being placed under increasing pressures. For developing countries, this can lead to increased pressures on managing the trade-offs between creating an investor-friendly environment and the promotion of social and environmental goals. While numerous international producers in the textile industry have committed to sustainability, implementation appears to be lacking in many cases.

The main challenge addressed by this project was to support the transformation process of Bangladesh towards a sustainable economy and responsible textile production in line with the Sustainable Development Goals (SDGs: 5, 8, 9, 12, 17, and specifically SDG 4). These goals are concerned with the development of skills-training by highlighting the importance of integrating sustainability assessment into managerial decision making. Due to the significant importance of the textile industry to the economy of Bangladesh, addressing those demands is crucial to retain Bangladesh's competitiveness in the textile market and sustainable economic development. The project approach was achieved through an north-south international collaboration between the Chair of Sustainability Management and Environmental Accounting at the Technische Universität in Dresden (TU Dresden), Germany and two higher education institutes in Bangladesh (the Department of Business and Economics at Notre Dame University [NDUB] and the Department of Textile Engineering [DTE] at Ahsanullah University of Science and Technology [AUST]) to develop a curriculum that will educate future mid-level managers in Bangladesh and increase their capacities to act and respond to the growing challenges of social, environmental and economic sustainability in the textile sector.

To achieve the aims of the project, partner workshops were held at TU Dresden in Dresden, Germany and the Asian Institute of Technology (AIT) in Bangkok, Thailand and Dhaka, Bangladesh to strengthen the project partnerships, covering topics that encompassed curriculum development, didactic training, and networking activities. The event at AIT took the form of a winter school which brought together international experts in sustainability and textile management, and offered management training workshop for industry partners which helped to broaden the scope of sustainability ideas and developments beyond those offered in the courses of TU Dresden. Through these channels of experts from across Europe, Southern Asia and New Zealand, a collaborative approach was enacted which saw expertise added from various academic disciplines (including management, art and design, textile design, textile engineering, and economics) combined with certification and auditing companies, textile supply chain managers and non-governmental sustainability and circular economy organisations. It was through these channels that cutting-edge research in the field of sustainable textile production could be translated into leading teaching in the Bangladeshi higher education sector.

Ultimately, the project achieved its aims, with the textile engineering curriculum at AUST and the Bachelor of Business Administration (BBA) curriculum at NDUB enriched in relation to social and environmental standards. The exposure to experts from academia in different countries as well as industry representatives ensured that the courses developed were rounded, academically strong and industry-relevant. Further suggestions and recommendations for the future strengthening of the academic programs were offered – meaning that industries and universities in Bangladesh should be operating closer together so that students are offered practical experience relevant to their studies and that careers as managers in the textile industry become more appealing, exciting and valuable to graduates. These developments also ensure that that industry expectations in relation to graduate attributes are met in terms of the content and skills delivered. Modules were modified to include sustainability components in topics such as apparel manufacturing, industrial management, production planning and control. Standalone modules were also developed around themes concerning: Sustainability for Textiles, Communicating Sustainability, Sustainable Supply Chain, Sustainable Organization Management, Resource Management, Total Quality Management, and Sustainability Controlling, which can be offered as further education training for other courses or as parts of managerial training. Ultimately, the shared experiences from participants in this project has

helped to enrich the teaching and learning opportunities in Bangladesh and provide a renewed appreciation of the education and textile industry settings in Bangladesh. The project team is very appreciative of all those who worked on, and assisted with the development of the project outputs and intends to continue the cooperation long after the ending of the project's operational period in order to continue to shape Bangladesh's pathway towards a sustainable textile industry.

Introduction and Overview

This project is part of the program “*German-Bangladesh Higher Education Cooperation in the Textile and Garment Sector*” within the framework of the German-Bangladesh Higher Education Network for Sustainable Textiles (HEST). HEST fosters cooperation between German and Bangladeshi Higher Education Institutions with the aim to improve the understanding of responsible and sustainable management through sound and practice-oriented qualification of future executives. This process is fundamental to support the transformation process of Bangladeshi economy towards a sustainable economy. To achieve the aim of the programme, teaching and research at Bangladesh Universities were targeted for improvement by international cooperation. The project focused mainly on realizing tangible improvement in research and qualification services with respect to the needs of responsible and sustainable management in the textile and clothing sector.

Project Rationale

The textile industry is a major employer in developing countries worldwide and, in certain countries, can be an incredibly dominant actor in their economy and society. The industry’s global sales volume is approximately \$2 trillion and it accounts for almost 10% of the world’s employees. However, it is also associated with substantial sustainability challenges – including 10% of total carbon emissions and up to 20% of industrial waste water worldwide (Luque & Herrero-García, 2019). From a social perspective, the industry is linked to ethical issues such as poor labour conditions in producing countries (often developing countries). Therefore, a major challenge of the industry is to support the transformation of textile producing countries and regions towards greater levels of sustainability, especially from a social and ethical perspective. In Bangladesh, the textile and clothing industry is the prime source of generating revenue and the root of economic growth in the country. The readymade garments (RMG) sector took hold in the country in the late 1970s as a small, non-traditional export sector. Over the past decades, the sector alone contributed to approximately 80% of the country’s total exports (BGMEA, 2018). The European Union (EU) has become the main export market of apparel items and Germany is largest buyer within these countries (Textile Today, 2019). Over the time of the textile export boom, the industry’s expansion can be seen from a situation of less than 400 factories in 1984 to more than 4500 in 2018. The result of this is the number of RMG workers rising to approximately 4 million (BGMEA, 2019). Studies at the turn of the

Millennium by Bhattacharya & Rahman (2000) noted that women comprised of over 90% of the workers in RMG factories, accounting for roughly 70% of the total female employment in the manufacturing sector of Bangladesh.

The EU is the main destination of garments manufactured in Bangladesh, with Germany being the largest single market. This is reflective of the overall the industry, which is characterized by ‘buyer-driven’ supply chains with brands searching for ever-lower production costs. This places further downward pressures on social sustainability. As brands attempt to squeeze lower costs from their suppliers, these suppliers in turn are driven to lower their own costs and, as a result, conditions such as low wages, long hours and unsafe working conditions have become accepted by business managers (Perry & Towers, 2013; Pedersen & Gwozdz, 2014). Addressing this managerial conceptualisation of sustainability and its importance has become a dominant challenge. These interventions to business organisation and structure are parts of attempts to shift institutional beliefs and manage the tensions that exist between the desire to create “business-friendly” conditions to attract economic activities on the one hand, and the potential environmental and societal damage which can occur in order to facilitate this competitive advantage on the other hand (Boström & Micheletti, 2016; Oelze, 2017). Due to the significant importance of the textile industry to the economy of Bangladesh, addressing those demands is crucial to retain Bangladesh’s competitiveness in the textile market and sustainable economic development. The sustainability of textile countries such as Bangladesh will require fundamentally shifting the expectations of key stakeholders in the country. This includes representatives of business management, industry and policy makers which are often pulling in different directions (Hahn et al., 2015).

Motivation of the Project

Despite the significant economic contribution of the industry to Bangladesh, the expansion of the industry has brought with it a range of environmental, economic and social issues as mentioned above. Through this project, these issues were addressed on an educational level through the development and reformation of the curricula in two universities in Bangladesh. The intention was to facilitate a cultural-institutional shift through curricula modification and development. The importance in education in this type of setting is highlighted by the United Nations Decade of Education of Sustainable Development (DESD). The DESD ran from 2005-2014, aiming to drive transformative education around the world. This is supported by previous

empirical studies which have shown how the inclusion of sustainability in higher education institutions (HEIs) can result in positive changes in the perceptions, awareness and interest of sustainability (Richardson et al., 2016; Felgendreher & Löfgren, 2018; Tang, 2018). HEIs, in particular Universities, are important agents of sustainability promotion as they can drive medium to long-term research agendas and create graduates who orient themselves to shape a sustainable future (MacDonald & Shriberg, 2016). This is evidenced in the work of Soundararajan and Brammer (2018), which found that managers should take a greater role in understanding and utilizing indicators and measurement systems to guide sustainability decision-making. These skills should be supported by increased awareness and research driven by HEIs (Krupka & Weber, 2013). Despite the potential for the success of the DESD, one criticism is that it did not have a strong impact on developing countries with large textile industries such as India (Banga Chhokar, 2010), and left to industry to promote sustainability practices in its workforce. Therefore, there is a need for partnerships to understand the market and the role of sustainability knowledge to improve employment prospects of graduates. This is a critical step for graduates to have holistic, comprehensive and applicable skills related to the complexities of sustainability (Greenhalgh et al., 2016). In this project, the knowledge exchange and partnership set up was intended to help ensure that the conditions required to develop sustainability knowledge could be realised.

Aims and Objectives

The overall aim of this project was to support the transformation process of Bangladesh towards a sustainable economy and responsible textile production in line with the Sustainable Development Goals (SDGs), specifically SDG 4 (Quality Education); the secondary aim was to contribute to the achievement of SDG 5 (Gender Equality), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation and Infrastructure), 12 (Responsible Consumption and Production) and 17 (Partnership for the Goals). This was achieved through a programme of cross-cultural education exchange and development of skill-training which highlighted the importance of integrating sustainability assessment into managerial decision making through revisions of Higher Education curricula in Bangladesh Universities.

The focus on introducing the theme of sustainability into the curriculum of University-level Textile and Business Administration courses in Bangladesh enabled the possibilities for the mobility of teaching staff in Bangladesh to collaborate with academic partners in Germany and

gain exposure and experience of sustainability concepts. These concepts were then applied into the relevant course components (in the form of module components and entirely new courses). The long-term sustainability of this approach aims to influence the knowledge, understanding and capabilities regarding sustainability management in future managers in the Bangladesh textile industry (i.e., those graduates who study the sustainability-enriched curricula). Through a series of modified modules that included the sustainability component in topics such as apparel manufacturing, industrial management, production planning and control, knowledge gained by future students is expected to challenge the existing knowledge within the Bangladesh textile industry and facilitate a pathway towards more sustainable industrial best practices.

By extending the cooperation to involve industry, non-government organizations (NGOs) and academic experts across a wide-range of backgrounds related to the textile and clothing sector, it was ensured that industry expectations in relation to graduate attributes are met. In order to realise this, the co-operation had the stated aim of completing a number of final year theses, research dissemination workshops in conjunction with industry partners, and seeking collaboration with industry partners to maintain and support the long-term functioning of the collaboration and increase the extent to which sustainable textiles is embedded in Higher Education. The textile engineering curriculum at AUST and the Bachelor of Business Administration curriculum at NDUB are enriched in relation to social and environmental standards and can serve as exemplars for other Universities to follow. The follow-up tasks moving forward should focus on implementation and ensuring student satisfaction for the courses prepared.

Methodology

In order to tackle the challenge of lack of social sustainability in the textile industry in Bangladesh, the curricula in HEIs were to be revised to incorporate greater levels of sustainability on the basis that this will provide new knowledge, skills and attitudes for future mid-level managers in Bangladesh. This will be achieved through the implementation phase after the end of the project, when the existing networks of expertise developed are able to provide ongoing and long-term practical assistance to help enlighten issues of social sustainability to students. As graduates, these individuals will be expected to contribute to the future development of the Bangladesh economy, and will hopefully take this knowledge and understanding of social sustainability issues with them.

In order to realise the project aims and set the groundwork for the long-term institutional shifts towards sustainability, the project partners surveyed key stakeholders of the curricula (i.e., students taking the courses and the industries that will ultimately benefit from the training). These results were then built on, and shaped through a series of partner workshops that encompassed curriculum development, didactic training and facilitation of academic/industry partnerships. Through these interactions, the teaching staff in the Bangladesh Universities were exposed to cutting edge research in the field of sustainable textile production and sustainability management which will ultimately lead to sustainable concepts becoming embedded into the teaching in the Bangladesh higher education sector.

Modules were modified and developed to include a sustainability component in topics such as apparel manufacturing, industrial management, production planning and control. Lecturers and teaching staff from AUST and NDUB participated in training workshops to facilitate knowledge transfers and skill advancement for curriculum development. Standalone modules around these themes were developed around the themes of: sustainable organization management, value chain management, resource management, social responsibility management and sustainability controlling, which can be offered as further education training for other courses or as parts of managerial training.

Whilst there were inevitably a number of challenges with international academic collaborations relating to distance, work environments and academic cultures, collaborative workshops had

the potential to bridge the gap between the perspectives of textile industry sustainability as quality management and productive efficiency with the theoretical perspectives of sustainability that are more common in German and wider Westernised settings.

Overview of Outcomes and Partnership Function

The general outcome of this project was the development and refinement of modules forming a sustainability-driven curriculum at both partner universities in Bangladesh (AUST and NDUB). Specifically, the objectives were achieved through the following measures:

- Workshops and trainings were held across four countries, enabling the project to enhance the quality of practice-oriented teaching on selected Bangladesh study courses with relevance to responsible management in the textile and clothing sector. The Bachelor of Science (BSc) in Textile Engineering curriculum at AUST was revised with sustainability criteria integrated into eight existing courses; a new course “Sustainability for Textiles” was developed which brought together multiple concepts of sustainability. At NDUB, six new courses were created to form a Major concentration within the Bachelor of Business Administration course. Drafts have been prepared for submission to the Universities’ respective academic councils and, ultimately, the University Grants Commission of Bangladesh (UGC).
- In both of these cases, the objectives of the project were exceeded. Originally, it was intended that AUST would modify its existing courses; however, the work done in refining the courses exceeded expectations and provided enough material to develop the Sustainability for Textiles stand-alone module. In addition, NDUB generated enough material to move from a minor to a major concentration, developing 6 courses compared to the original plan of 4 modules for a minor concentration. Each module is equivalent to 5 European Credit Transfer and Accumulation System (ECTS).
- To achieve the adaptation of the curriculum in accordance to industrial expectations and enhance the applicability of the knowledge of the graduates, the curriculum was revised in cooperation with companies in the textile and clothing sector. Specifically, 5 companies participated in the 2019 Winter School; an additional 2 companies participated in the final conference in Dhaka. A textile and a sustainability auditing firm participated in a panel session as part of the Dhaka conference.
- Sustainability issues in the textile/RMG sector were explored along the entire value chain to highlight barriers and opportunities for successfully implementing steps to move towards

sustainable development and to promote relevance for a wide range of stakeholders including academics and business professionals. As an outcome, two student research projects were undertaken, which considered at least 3 different perspectives. 10 conference papers were presented at academic conferences with manuscripts in development for publication in highly-ranked textile, business and sustainability journals. The paper “Promoting sustainable and responsible business practice through education: a case study of the Bangladesh textile industry” was invited for a full contribution at the International Journal of Sustainability in Higher Education. Combined insights and findings from the Winter School and Dresden workshops were disseminated via the Sheffield Political Economy Research Institute (SPERI) to draw a wider audience to the project and its outcomes. Lastly, two book chapters which draw on the practical industrial implications for sustainability in the textile industry were accepted for publication in the book "Sustainable Textile and Fashion Value Chains".

- A follow-up project involving AUST, GIZ and TU Dresden through a new partnership with the United Nations University (UNU) in Dresden has been secured with focus on capacity building and implementation of sustainability curricula at AUST.

Overall, our team’s reflection on the hosting of such collaborative events were positive, and we intend to build on this spirit of cooperation and motivation to continue to work collaboratively to tackle global issues of sustainability challenges in global textile production networks. An additional outcome of the project is the development of a network of researchers and teachers willing to work together in the future, past the end of the project.

Project Relevant Outcomes and Statistics

Table 1 documents the proposed project outcomes and the realisation of activities over the duration of the working period compared to the initial funding bid. Table 2 presents the outcomes in the curriculum development of the two partner universities in Bangladesh.

Table 1: Project Outcomes

Project goal (outcome)	Target indicator	Actual performance of the indicator
The quality of practice oriented teaching on selected study course with relevance to responsible management in the	Revised curricula for 5 modules have been submitted to the UGC	9 revised courses at AUST and one new course are finalised for submission to academic council

textile and clothing sector is improved		
The needs-based research carried out by AUST, NDUB and TUD is intensified	4 final year theses have been completed as part of this project in conjunction with industry partners 3 research dissemination workshops have been held in conjunction with industry (winter school in Thailand, workshop at TUD and middle manager training at AUST) by September 2019 1 third party funded project has been obtained in conjunction with industry in Germany by December 2019	Students at TU Dresden are recruited for research projects Skill gaps analysis is carried out with industry partners Two student projects completed at AUST and one at NDUB Student project dissemination took place among 16 experts and scholars Project workshop took place in Dhaka in August 2019, where 5 expert partners provided feedback The 2020 Workshop in Dresden, Germany was cancelled due to COVID-19 travel and health restrictions and will take place online Cooperation with United Nations University (UNU-FLORES) in Dresden, who coordinates the Chair of Sustainability and Innovation Management project funded by GIZ, and involves AUST as the employer for the participant trained in the project. Preparation of a collaborative online workshop with UNU-FLORES in the framework of the Chair of Sustainability and Innovation Management project
Project outcomes are disseminated	4 manuscripts have been prepared for international conferences	1 third-party funded project with Engelbert Strass and AUST Conference attendance and presentation of results in Germany, United Kingdom (UK), Indonesia and Maldives
Development relevant professional networks for responsible corporate management are established	A cooperation project between at least 3 partners who met via the network has been agreed	Invites to industry representatives from the Textilbünds, H&M, Lidl,

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM: FINAL REPORT

between the participating universities and the private sector	1 industry contact has been developed into an industry funded research project to tackle either a social or environmental issue by June 2019 (to be carried out after the project timeframe of June 2019) Amount of research funding obtained by university partner after DAAD project has ended	Primark, BASF and Engelbert Strauss were sent Management Training Workshop at AUST in September with 8 industry experts Winter School took place in Thailand in March with 6 project partners and 22 invitees invited Dr. Jon Morris and Dr. Lisa Koep attended the HEST conference in Dhaka in February 2019 AUST initiates a networking event for HEST Bangladesh universities Memorandums of understanding (MoUs) signed between AUST, NDUB and the Bangladesh textile manufacturer DBL
The textile engineering curriculum at AUST and NDUB is enriched in relation to social and environmental standards in the textile and clothing sector	The BSc in Textile Engineering curriculum at AUST and at least 3 modules of the BBA curriculum at NDUB are amended to include sustainability challenges and revised drafts have been submitted to the UGC	Teaching materials from TU Dresden have been explored for incorporation into these modules leading to 7 new courses and 8 revised courses submitted to UGC
The curriculum is revised in cooperation with companies in the textile and clothing sector to ensure industry expectations in relation to graduate attributes are met	At least 12 textile companies (4 small companies/subcontractors, 4 medium and 4 large companies) are invited to provide feedback in 2019	5 companies participated in the 2019 Winter School 2 companies participated in the final conference in Dhaka
Further, standalone modules on sustainability are developed for NDUB, which can be offered as further education trainings for other courses or managerial trainings	5 draft 5-ECTS module on textile sustainability have been created for NDUB to allow minor concentration for business students on textile issues	6 potential modules have been developed by NDUB 1 standalone module has been developed by AUST Teaching materials from TU Dresden have been explored for incorporation into these modules
Sustainability issues in the textile/RMG sector are explored along the entire value chain to highlight barriers and opportunities for successful implementing	2 student research projects At least 3 different perspectives considered in the research	Paper presented at the Business and Society Seminar 2018 in Mannheim, Germany Paper presented at the EGOS

steps to move towards sustainable development	2 publications in high ranking journals 2 workshops held to disseminate findings 2 conference papers presented at academic conferences	conference 2018 in Talinn, Estonia Paper presented at the EGOS conference 2019 in Edinburgh, UK Paper presented at 10th ICTEL conference in Bali, Indonesia Paper presented at the 2020 International Conference on Arts, Education and Business (ICAEB-20), Male, Maldives Paper presented at the 2020 EUROMA Sustainability Forum in Nottingham, UK 5 academic experts and 4 industry representatives participated in panel discussions in 2019 project conference in Dhaka 2 book chapters submitted by Dr. Lisa Koep and Dr. Jon Morris
---	--	---

Table 2: Development of Curricula

Type	Title/ topic	Newly developed or revised	Level	Status	Involvement of actors from outside university	Number of partner institutions involved	Reference to SDGs
Curriculum	BSc Textile Engineering	Revised	Bachelor's	Internally approved on the level of the university	Science/ research Economy/ private sector	2	4, 6, 12,13
Teaching module	Sustainability for Textiles	Newly developed	Bachelor's	Internally approved on the level of the university	Science/ research Economy/ private sector	2	4, 6, 12,13
Teaching module	Communicating Sustainability	Newly developed	Bachelor's	Internally approved on the level of the university	Economy/ private sector Science/ research	2	4, 6, 12, 13
Teaching module	Sustainable Supply Chain Management	Newly developed	Bachelor's	Internally approved on the level of the university	Economy/ private sector Science/ research	2	4, 6, 12, 13
Teaching module	Sustainable Organization Management	Newly developed		Internally approved on the level of the university	Science/ research Economy/ private sector	2	4, 6, 12, 13
Teaching Module	Sustainable Resource Management	Newly developed	Bachelor's	Internally approved on the level of the University	Science/ research Economy/ private sector	2	4, 6, 12, 13

Teaching module	Sustainability Management Controlling	Newly developed	Bachelor's	Internally approved on the level of the university	Economy/ private sector Science/ research	2	4, 6, 12, 13
Teaching module	Total Quality Management	Newly developed	Bachelor's	Internally approved on the level of the university	Economy/ private sector Science/ research	2,	4, 6, 12, 13

Consolidated contacts

Table 3 below provides an overview of the number of consolidated and new contacts made since the beginning of the project.

Table 3: Consolidated Contacts

	Consolidated contacts	New Contacts
Science/research	16	32
Economy/private sector	10	25
Civil society	0	1
Politics/public sector	0	14
Other	0	0

These contacts have been important for the development of project activities. For example, memorandums of understanding (MoUs) have been signed between AUST, NDUB and the Bangladesh textile manufacturer DBL, as well as with the Asian Higher Education Institutes such as the Asian Institute of Technology (AIT) in Thailand and Christina University in Indonesia. These MoUs will facilitate internships and guest lectures for students at the Bangladesh Universities. AUST have consolidated their relationship with the AIT with a view to future cooperation between the two institutes.

Partnership Relations

The partnership experienced a number of practical working difficulties throughout the project. The biggest challenges were concerned with difficulties in working virtually across different time zones and different experiences regarding working styles and institutional priorities. To address these challenges, the project team developed new project progress, monitoring strategies, and alternative methods for virtual communication through a combination of regular emails, conference calls and shared documents. Differences in time-zones and working weeks between the two countries added to the complexity of running the project. Due to the distances involved and the nature of academic work, setting dates and confirming flights was a significant challenge. The administration component of the project proved to be at times a complicated procedure. Challenging logistics, re-arranging meetings and adjusting time scales on short notice were difficult. The requirements for visas, particularly single-entry visas for project

partners entering Germany, were difficult to co-ordinate and brought up new, unexpected challenges. Despite these issues, the events held were successful and the administrative processes of the project improved as time progressed. Overall, the project developed a strong network of closely working academics and achieved the aims that it set out. We have been pleased with the overall interest in the project in both Germany and Bangladesh and are now looking to the future and generating tangible outcomes (funding bids, journal articles) relating to the project's activities. The biggest risk for the sustainability of the partnership is the ability to implement the revised curricula. An additional workshop was planned for March 2020 where partners would be given the opportunity to present "inaugural" lectures to academic audiences in Germany. This event was structured to encourage feedback from professors, university teachers and students in order to help the project partners in Bangladesh implement the changes to the curriculum even after the support of the project was withdrawn. However, due to the COVID-19 pandemic, the workshop was cancelled. Priority, therefore, was placed on the implementation phase in the future stages of the project. The project team appreciates the challenges of continuing to encourage and develop sustainable working relationships following the conclusion of the project.

Curriculum: Gap Analysis and Development

Both Universities engaged in gap analysis and key stakeholder engagement to ensure that the proposed curricula addressed specific needs in the industry and student body. The results are documented in the following sections.

Ahsanullah University of Science and Technology

Prior to the start of the HEST project, the textile engineering curriculum at AUST had only limited content on economic, environmental, or social sustainability. Therefore, there is existed a great potential to enrich the current curriculum by including modules on sustainable resource management, sustainable organization management, stakeholder management, global citizenship & Corporate Social Responsibility (CSR), sustainability assessment and business ethics. In addition, the textile education system in Bangladesh is primarily built on old British undergraduate curricula, which have not been majorly revitalized over the past decades. Consequently, the activity of learning is viewed as passive: education is instruction based and focused on teaching rather than learning. As such, this is often oriented towards delivering outcomes that enable students to prioritise achieving good grades (Mohan Baral et al., 2012), contrasting with the emergence of more active methods of learning, where the student is engaged and encouraged to actively participate. In the redesign of the curricula, modern didactic methods aimed at active learning are prioritized. Examples of these include flipped classroom techniques and peer to peer learning, which will be targeted at developing the social competencies of the students.

To ensure acceptance of the newly qualified graduates as middle managers in the textile industry, it is important that the graduates have qualified sustainability knowledge, in conjunction with fulfilling the employers' expectations in relation to required graduate attributes. Relationships with industry partners was sought to identify the needs of the sector to transition towards sustainability. Facilitating this will enable the development of effective strategies to achieve quality improvements in textile education thereby making it relevant and useful (Textile Today, 2012). Due to the rapid industrialization in Bangladesh, textile engineering education has been booming and the discipline is in high demand by students but to continue to ensure the high quality graduates in industry, quality assurance of textile education provided by AUST was a key priority for AUST in this project (Baral et al., 2016). For AUST, the project's aims for development of the textile curriculum can act as a foundation upon which to develop a quality standard for textile education. The specification of curriculum development was to combine technical expertise with sustainable management techniques. This will ensure graduates have managerial skills which take into

consideration the triple bottom line approach to sustainability and provide them with skills that are attractive to employers.

This in turn will ensure future middle managers in Bangladesh's textile industry are equipped to address the sustainability issue. As a focus on sustainability in textile related teaching is currently absent in Bangladesh, the research of this project has the potential to act as a blueprint for other third level institutes in Bangladesh offering textile education. Further, the modules developed throughout the project period can be amended and adjusted to cater for certificate, diploma of managerial workshops after the project funding has ceased, or to develop postgraduate teaching around this topic. There is also potential to use the developed course materials as a basis to creating short online courses, which can be easily accessed by students or managerial workers in the textile industry.

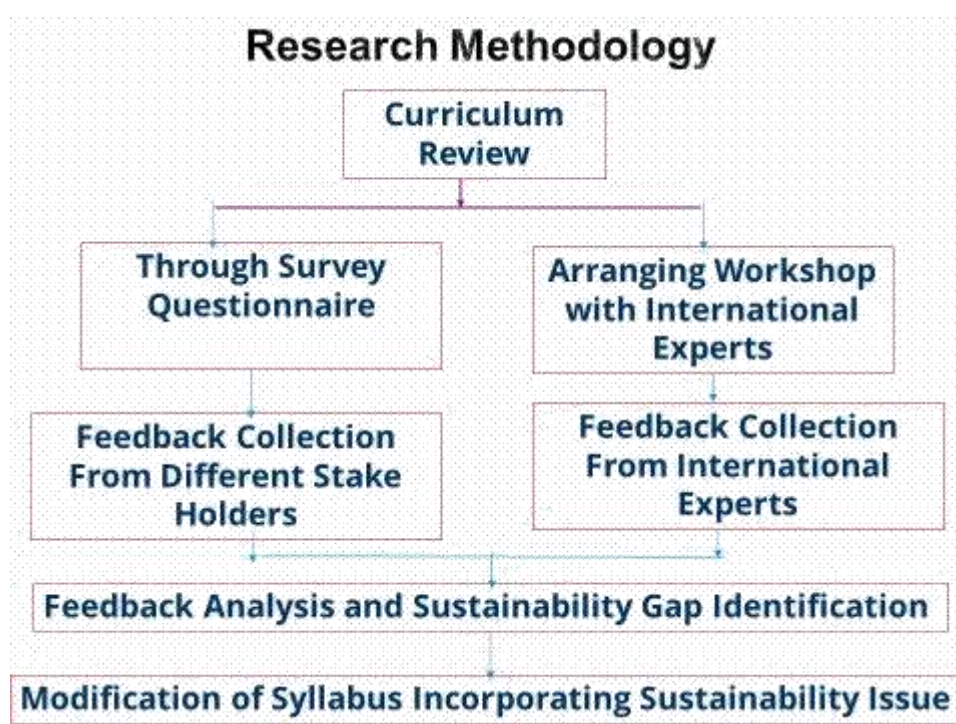


Figure 1 Methodology of the Needs Analysis in AUST

The Research conducted within the scope of this project included the review of the existing curriculum of textile engineering education of AUST through consulting with different stakeholders to identify the sustainability gaps that exist at present. This has been done through conducting a survey from different local stake holders from Bangladesh and collecting international expert's opinions through arranging meetings and workshops. Finally, the sustainability issues have been incorporated into the existing syllabus to minimize the gaps that

has been identified from the research results. The overview of research methodology has been depicted in Figure 1.

Alongside the curriculum gap analysis and identifying the sustainability topics for incorporation, two research projects have been conducted by the final year students with the supervision of faculty members of DTE, AUST in order to gather knowledge through feedback both from blue collar workers and managers and owners about barrier and success factors that are involved in implementing sustainability in the Bangladeshi textile industries. To collect the feedback from local stakeholders, a survey was conducted with a sample size of 150 from different organizations through supplying semi structured questionnaires for quantitative feedback and also by offering open ended questions for qualitative feedback, which were prepared focusing on three basic dimensions of sustainability i.e. social, economic and environmental.

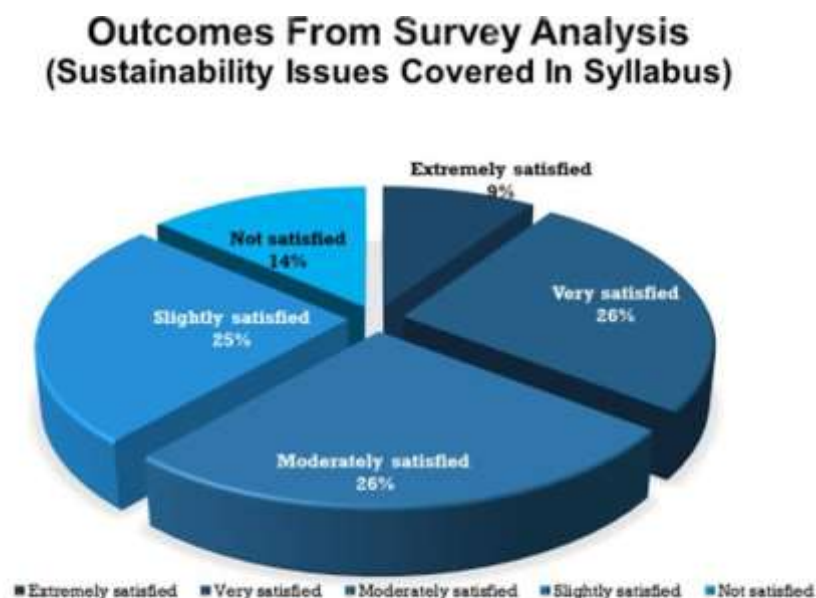


Figure 2 Sustainability Issues Covered in Existing Syllabus of AUST

A model, developed at the University of Michigan (Rodriguez, Roman, Sturhahn & Terry, 2002), has been considered while developing the conceptual framework and questionnaire preparation. The feedback was collected both in the five-Likert scale format and written suggestions from different stakeholders such as academics, curriculum experts, university alumni, employers and employees in the textile industries of Bangladesh. Finally, the collected data was analysed both quantitatively and qualitatively by using Statistical Package for the Social Sciences (SPSS) software in order to identify the sustainability gaps. After summarizing the survey feedback, the following results have been achieved as shown in Figure 2. The results of this study highlight

that significant sustainability gaps exist in the present syllabus of textile engineering education of AUST.

Expert Validation

Experts from academia and industry were also consulted to further enhance the curricula and to recommend additional topics of interest, including sustainability assessment tools, compliance and CSR issues, sustainable accounting and cost control, industrial ecology, sustainable textile products and green chemistry. The valuable insights of these experts add value and enhance the quality of textile engineering curriculum through minimizing the gaps identified from the curriculum review and survey. Based on the above research results and knowledge, it was unveiled that the incorporation of sustainability topics is very much important in the existing courses of curriculum.

Notre Dame University Bangladesh

The project team at NDUB reported the gap analysis for their curriculum development through several steps. The first step was to identify the gaps of the existing curriculum with regards to sustainability management content and skills that equip graduates of Business Administration. This enabled a draft outline of the required courses to be drawn for further development within the project activities.

The initial gap analysis was conducted with four stakeholder groups:

- Academic Staff
- Industry Representatives (Managers & Employees)
- NGOs and Auditor Experts
- Undergraduate Students

For academics, industry representatives and experts, data was collected using three structured questionnaires and analysed using qualitative and quantitative analysis (including but not limited to descriptive statistics, multiple regression analysis, correlation, one-way analysis of variance [ANOVA]).

The engagement with students was achieved through running small focus groups with student representatives to gain knowledge of the student perspectives of sustainability management in Business Administration courses, bringing together the findings from the survey and focus groups highlighted gaps in the current curricula offering at NDUB. In attending the Dresden and Thailand

workshops, assistance and inspiration were received, which helped NDUB to further delve into these gaps and develop a deeper understanding of the steps and the knowledge required to address them. Following the workshops, especially the period following the second Dresden workshop, the project team was able to develop and build on course outlines and content with objective-based learning criteria.

The main research gaps revealed from the study were:

- Sustainable Organization Management
- Sustainable Supply Chain Management
- Negotiation Skill Development
- Social and Environmental Compliances

Over the course of the project, the research team at NDUB adjusted their aims away from a concentration of four courses for a minor concentration, towards developing six courses for a major concentration in sustainability. The end result was six proposed courses to minimise the gaps in sustainability knowledge. These courses included (in-depth information on the content of the courses can be found in the Appendix):

- ✓ Communicating Sustainability
- ✓ Sustainable Supply Chain Management
- ✓ Sustainable Organization Management
- ✓ Sustainable Resource Management
- ✓ Total Quality Management
- ✓ Sustainability Controlling

The following diagram provides clarification on how the different courses will address the identified gaps shown in Figure 3:

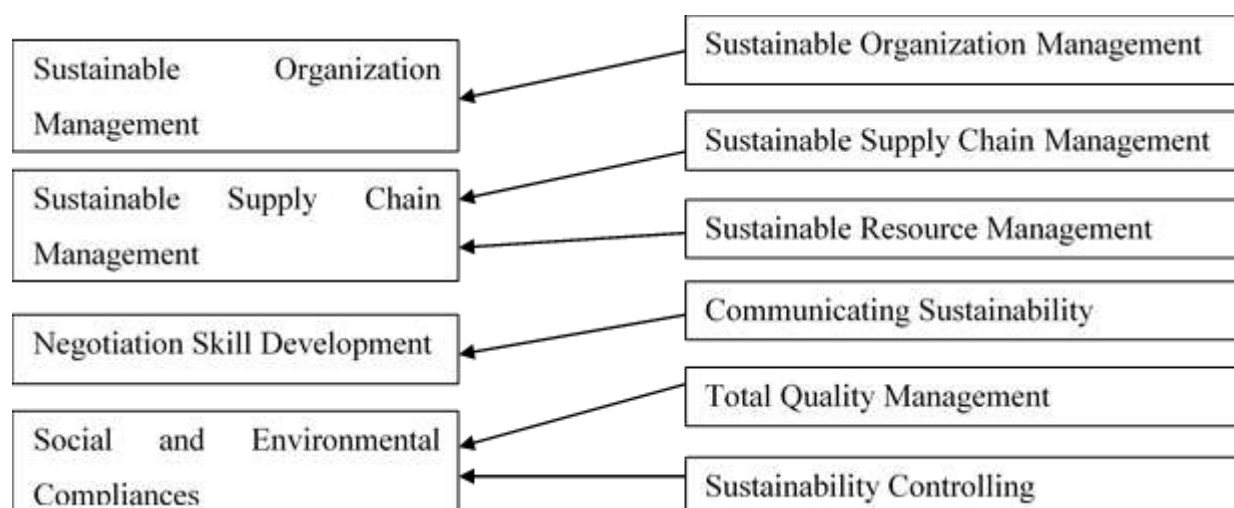


Figure 3 Contribution of courses in identified gaps

As the faculty members were directly involved in the background research and participated in the proposed curriculum development process via the HEST project, it is anticipated that they already possess the necessary skills to deliver the content and support the student learning process. They would also be able to share the perspectives that they have developed throughout the project to ensure students learn about the different academic, industry and expert perspectives for sustainability. The teaching methods initially proposed are:

- Class lecture
- Group discussion
- Case study
- Workshops, seminars
- Industry visit
- Thesis paper development
- Supervision of students' internship at industries
- Periodic evaluation of curriculum and upgradation

These teaching styles will be updated as the faculty staff progress their own careers and continue to improve, develop, and enhance their own teaching skills.

Final Modules

The final modules are listed here for the two Bangladesh Universities. Alongside the new courses developed at NDUB, an additional new course entitled **Sustainability in Textiles** has been created and another 9 courses from existing syllabus were modified with incorporation of sustainability

topics in the curriculum of Bachelor of Science in Textile Engineering offering by the DTE, AUST. The newly developed and modified courses are as shown in Table 4:

Table 4 Courses developed and revised during the HEST project

University	Study Programme	Name of the module/course	Type of Module	Finalized
AUST	BSc. Textile Engineering	Sustainability in Textiles	New	Yes
AUST	BSc. Textile Engineering	Textile Raw Materials I	Revised	Yes
AUST	BSc. Textile Engineering	Textile Raw Materials II	Revised	Yes
AUST	BSc. Textile Engineering	English Language	Revised	Yes
AUST	BSc. Textile Engineering	Chemistry I	Revised	Yes
AUST	BSc. Textile Engineering	Management and Maintenance of Textile Machinery	Revised	Yes
AUST	BSc. Textile Engineering	Yarn Manufacturing III	Revised	Yes
AUST	BSc. Textile Engineering	Apparel Manufacturing III	Revised	Yes
AUST	BSc. Textile Engineering	Sociology and Industrial Organizational Psychology	Revised	Yes
AUST	BSc. Textile Engineering	Textile Testing and Quality Control-III	Revised	Yes
NDUB	Bachelor of Business Administration (BBA)	Communicating Sustainability	New	Yes
NDUB	Bachelor of Business Administration (BBA)	Sustainable Supply Chain Management	New	Yes
NDUB	Bachelor of Business Administration (BBA)	Sustainable Organization Management	New	Yes
NDUB	Bachelor of Business Administration (BBA)	Sustainable Resource Management	New	Yes
NDUB	Bachelor of Business Administration (BBA)	Total Quality Management	New	Yes
NDUB	Bachelor of Business Administration (BBA)	Sustainability Controlling	New	Yes

Details of all above mentioned courses are attached in the OBE (Outcome Based Education) format as Annex 1.

Implementation

Moving forward, the development of these courses is linked to national level initiatives within Bangladesh. The government of Bangladesh is integrating “sustainability” in its core national policies such as the National Sustainable Development Strategy, the Perspective Plan of Bangladesh: 2010-2021, the 7th Five-Year Plan. Moreover, Bangladesh already adopted Sustainable Development Goals declared by the United Nations (UN). Sustainability has not only social or environmental aspects but also economical aspects. The Bangladesh government has taken initiatives to ensure improved working condition, waste management, resource efficiency, recycling, usage of renewable energy, etc. For example, the Effluent Treatment Plant must be installed by textile manufacturers. Moreover, many financial stimuluses, such as tax exemption for green factories, are offered to encourage sustainability practices. In this curriculum gap analysis project, a rigorous background research had been conducted before proposing the courses. These courses will help to develop more sensible and responsible business graduates with knowledge of different aspects of sustainability who will eventually lead Bangladesh to a more sustainable economy. Moreover, findings of background research can be helpful for academics, industry people, experts, the government and public.

Scientific utilization of the Curricula in the Bangladesh Universities

The modified course contents can also form parts of the Executive Master of Business Administration (MBA) program at NDUB. This is the programme where mid-level managers can enrol. The project team at NDUB has already considered sustainability content such as Corporate Social Responsibility and Business Ethics, Sustainable Supply Chain Management, Sustainability Resource Management as potential components for the MBA. In addition, NDUB is committed to value-based and student-centred education and is seeking opportunities to contribute further to Mid-Level Management training. At AUST, the teaching staff who will deliver the newly developed module and modified courses will be given training to enable them to implement these concepts into their teaching. Both Universities were able to send faculty members to workshops held in Bangladesh, Germany and Thailand to enhance the knowledge regarding sustainability and its relevance for the textile industry and helped to build and strengthen relationships between the two universities.

Under this project an exclusive training session was arranged for the mid-level managers of different textile industries. Eight topics were selected for this training program and eight experts were nominated from different organizations all over Bangladesh as trainers for this program. The topics covered in the training are stated below:

- 1) Future and Sustainable Human Resources for Textile Industry
- 2) Sustainable wet Processing and Chemical Management for Textile Industry
- 3) Sustainability for Social Compliance
- 4) Sustainability in Supply Chain Management for Textile Industry
- 5) Need for Sustainability Practices in Textile Industry
- 6) Sustainability and Challenges of Yarn Manufacturing
- 7) Auditing and Sustainability Certification for Textile Industry
- 8) Sustainability for Textile Industry 4.0

The program was continued two days (8th-9th September 2019). Around 37 mid-level managers from different renowned textile industries of Bangladesh participated in the training program. After completion of the training program they received the certificates. The participants of the training program expressed that this training program was really very resourceful and it will help them to practice sustainability in their organizations effectively. Some of them also added that it is the first time in Bangladesh that they received training on eight topics within two days from eight experts which is not possible in the regular time.

Project contribution for the Training of Trainers

Another Training of Trainers (TOT) was completed on 22nd August 2019 under this project at AUST where all the participants were faculty members from DTE, AUST and NDUB. The following topics were covered in the training session:

- i) Methods of Teaching and Learning
- ii) Didactic Training - Outcome Based Engineering Education

Two experts were nominated from two renowned academic institutions as trainers of this program. It was indeed a nice communicative and participatory session for the teachers. The participants think this training will accelerate them to add the modern methods of teaching and OBE in their existing way of teaching.

The above two programs were held at the seminar room of AUST and were coordinated by the DTE from AUST side. It was a new experience for DTE as well as for AUST. For this arrangement the relation between DTE, AUST and textile industries has been enhanced.

Ensuring Successful Implementation of the Developed Contents

The project undertook several events to ease the implementation process at the two Universities. One event, a training programme of the trainers entitled “Objective Based Education” was conducted for the lecturers of NDUB and AUST in Dhaka. A further two workshops were conducted by experts from industrial partners (DBL Group, Renaissance Group and BGMEA) with participation of students and faculties involved in NDUB under the HEST project. All these

events had significant importance in the skill development of faculties. Hence, the following innovative steps were taken for the successful implementation of the results:

- The share and use of background research's findings while teaching the courses.
- The initiation of more collaboration with different industries so that teachers and students can get better idea about practical implementation of sustainability through industry visits, research and internships.
- More TOT for the faculties might be essential in order to teach courses more effectively and efficiently.
- Tutorial materials development such as books, articles, etc. for new modules can help to implement among the learners effectively.
- Certificate courses, diploma courses, Training on Sustainability for Mid-level managers, etc. will help enhance the capacity building for achieving the goal of sustainability.
- The bridge between faculties and industry experts would create avenue for students to access real life experience and develop required skills.

At AUST, the instructors who will conduct the newly developed course and modified courses will be trained properly. Some of our faculty members of DTE, AUST attended the workshops held in Bangladesh, Germany and Thailand under the project so that they acquired knowledge regarding sustainability and its impact in textile sector. Besides that, they also require further training on the teaching regarding Sustainability in Textile and it would be better if they will get the opportunity to participate the training program from TUD and other Universities of Germany. In addition, it will also be necessary to arrange different textbooks, reference books and journals for further proceed with the implementation of the project's outcomes.

Workshops

Workshops took place throughout the course of the project for two primary purposes:

1. Facilitate face-to-face communication between the partner institutions and understand the local working contexts of the Bangladesh partners, and
2. Provide “focusing” events to bring together sustainability experts from academia, industry and non-governmental institutes.

While the first purpose was important for strengthening the relationship between the project partners and provide working groups for inspiration and feedback in the curriculum development, the second aim of the workshops enabled the sharing of additional external know-how and insights in order to establish a curriculum that will enable graduates to tackle challenges in the sector. Furthermore, teaching methodologies as well as studying material for students were updated and adjusted to create higher output in terms of knowledge transfer and applicability of study, which was achieved through training of training activities.

Timeline of Events

Throughout the course of the project, workshops, conferences, trainings and other events took place. Tables 4-6 list the events in chronological order. These events are referred to throughout the description of activities in this report.

Table 5: Workshops

Event	Place	Start Date	Duration (days)
Dresden Project Workshop and Expert Plenum	Dresden Germany	04.10.2018	10
Thailand Winter School	AIT, Thailand	26.03.2019	4
Project Workshop	Dresden, Germany	24.04.2019	5
Conference and closing workshop in Dhaka	Dhaka, Bangladesh	19.08.2019	10

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM: FINAL REPORT

Table 6: Conferences / Dissemination events

Event	Place	Start Date	Duration (days)
DAAD networking Event	Bonn, Germany	03.03.2018	4
Bangladesh Partner Visit to Dresden	Dresden, Germany	07.03.2018	2
Attendance at PDW at 2018 EGOS conference	Tallinn, Estonia	02.07.2018	4
Sustainable Textiles Conference	Chemnitz, Germany	11.09.2018	2
Attendance at 2019 EGOS Colloquium	Edinburgh, UK	03.07.2019	3
Attendance at 2019 ICTEL Conference in Bali	Bali, Indonesia	08.07.2019	3
Project development meeting with Engelbert Strauss	Biebergemünd, Germany	05.08.2019	1
Conference and closing workshop in Dhaka	Dhaka, Bangladesh	19.08.2019	10

Table 7: Training events

Event	Place	Start Date	Duration (days)
Management Training Workshop in AUST	Dhaka, Bangladesh	08.09.2019	2

Dresden Project Workshop, October 2018

As part of the workshop, the project partners from Bangladesh were offered insights into the sustainability teaching offered at the Chair of Sustainability Management and Environmental Accounting, drawing on topics from general introduction to sustainability principles and resource management, practical tools for measuring, monitoring and assessing sustainability (drawing on techniques from the Chair's teaching portfolio), through to more theoretical approaches to sustainability such as corporate social responsibility and strategic management. Here, the Bangladesh partners were not only given the opportunity to participate in lectures and practical sessions to test their own understanding of the content, but were also asked to contribute by drawing links from the lecture content with their own teaching course offerings. Feedback from this exercise saw synergies between the Chair's teaching on resource efficiency and sustainability management and controlling with the Industrial Management course offered by AUST; there was a desire to integrate components into the syllabus here. Practical tools such as Life Cycle Assessment (LCA) and Material Flow Cost Accounting (MFCA) were also indicated as useful tools which could be adapted to fit the Wet Processing and Production Planning and Control modules at AUST by drawing on specific examples relating to textile engineering. For NDUB, the aim was to develop new courses, building on the existing expertise in topics such as Strategic Management but by putting further emphasis on sustainability management and social responsibility.

To further strengthen the North-South co-operation, an expert plenum drawing on research expertise from European Universities was arranged to showcase the research being carried out in textile value chains. This brought together researchers focused on issues such as modern slavery, gender equality, trust and legitimacy in supply chain networks and responsible business practices. This event brought together eight invited experts with our Bangladesh project partners to develop networks with European researchers and gain an overview of contemporary research carried out in European Higher Education institutes. The running of the events was a great success, developing a spirit of cooperation and motivation to continue to work collaboratively to tackle global issues of sustainability challenges in global textile production networks. Whilst there are inevitably a

number of challenges with international academic collaborations relating to distance, work environments, academic cultures, this event and the subsequent planned events throughout the remaining project duration have the potential to bridge the gap between the sustainability perspectives of the textile industry and the more common theoretical perspectives in Westernised settings.

The general remarks on the workshop was the realization that a significant number of employees of the textile sector work in mid-level management; therefore, a purely technical focus is not sufficient to integrate sustainable practices throughout the industry. Thus, there is a critical benefit for integrating sustainability minor courses into the Business Administration courses that deal with buying practices and negotiation.

One area of the project which was highlighted for future progress was on the expertise of teaching and learning, specifically on the effectiveness and efficiency of content delivery. While the workshop sessions touched upon teaching skills and exercises which could be integrated into the existing and new courses, concern was raised over the classroom performance. A suggestion for future projects and collaboration stems from the training of teachers for the specific purpose of effective sustainability teaching. During this point of the project, a number of ideas for new curricula were proposed. For NDUB, the Business Administration minor courses to be introduced include:

- Sustainable Organization Management (BBA) – this draws on industrial relations and sustainability controlling concepts. The full content for the course was refined and developed in the Thailand winter school and the 2nd Dresden workshop;
- Sustainable Supply Chain Management in the Textile Industry (BBA) – this concerns with horizontal networks and the relationship between CSR and procurement department;
- Resource Management in the textile industry (BBA) – this component covers resource efficiency, non-renewable and renewable resources and lifecycle analysis;
- Socially Responsible Management in the textile industry (BBA) – this covers topics which deal with environmental and social compliance, being made up of three main parts: 1) CSR: ideas of communication theory, definitions of CSR, strategies of communication, activities

and trends; 2) Gender equality, human rights, international governance and modern slavery;
3) Foot printing and indicators;

- Negotiation Skills/Sustainability Management Controlling – this draws on developing negotiation skills with an internship program of 3 to 6 months to gain practical knowledge from the industry and will be accompanied by a report.

For AUST, the process for implementing sustainability into the existing curricula began with the following modules:

- Industrial Management – Sustainable development, sustainability indicators, resource efficiency measurement, CSR, Strategic Management tools, LCA;
- Production Planning and Control – MFCA, CSR;
- Courses containing cost analysis for individual streams – CSR, LCA;
- Project Work – CSR;
- Special Wet Processing – CSR, Industrial Ecology, Water Footprint, Carbon Footprint, Ecological Footprint, Greenhouse Gas Emissions;
- Sociology and Industrial/Organisational (I/O) Psychology – CSR, codes of conduct, human rights;
- Apparel Manufacturing-III – CSR, sustainable fashion and design;
- Apparel Manufacturing-IV – CSR, sustainable fashion and design;
- Production Planning and Control – CSR, LCA.

The partners expressed the need to discuss the results with the wider faculty team and add the proposed modifications to the existing syllabus. The surveys being conducted at both institutions were seen as being critical for understanding the content required for meaningful changes to the courses within the Bangladesh context. Feedback from the Management Education Workshop in Bangladesh can be utilized to survey the thoughts of textile companies and what they feel about the revised elements. Partners should document their guest lectures given by practitioners at AUST and NDUB, recording where they took place, who gave it and what the subject matter was. Training

and evaluation of teaching staff was also found important to demonstrate that the teaching quality has improved. To date, 16 lecturers and teachers from AUST and NDUB participated in training and these experiences were supplemented by teaching evaluations from colleagues and students.

Thailand Winter School, March 2019

The workshop and the expert talks gave strong recommendations and suggestions for curriculum development and research suggestions. The key take-away from the event was the need for case studies to be embedded into the teaching content in order to aid students to develop the practical knowledge required to function in the industry. In addition, students should be encouraged to think creatively and critically to develop new solutions to sustainability challenges; part of this is to progress beyond a ‘text book study’. It is here where the industry-university collaboration can play an important role in increasing the effectiveness of the knowledge learning process and aid in facilitating two-way knowledge transfers between industry and practice. However, the workshop and the guests from an educational perspective in Bangladesh highlighted the importance of demonstrating the value of sustainability as a teaching subject and justify the effort to ‘squeeze’ the concept into core courses.

Topics such as design for sustainability, circular business models, automation, digital transformation, compliance, lean management, and financial skills were proposed to be incorporated in the curriculum by industrial representatives. It is anticipated that the modifications made to the textile education curricula in Bangladesh will foster the skills in graduates (and ultimately the professionals that they become) to address the key identified challenges in the Bangladeshi textile industry, most notably the lack of institutional definition of sustainability.



Figure 4: The participants of the workshop

Furthermore, it was highlighted that the need to consider a circular economy approach towards sustainability in the textile industry as well as demonstrating compliance through auditing and certification is important. This gave impetus for further development of content in these fields which could be integrated into the textile sustainability curriculum. Throughout the workshop, there were many useful ideas and insights into contemporary research which can guide the future development of what “sustainability” contexts should be included into the Bangladesh curriculum. These include:

- Design for sustainability
- Water usage
- Waste/circularity (reparability, durability)
- Collaboration & co-creation
- Overproduction / shifts from fast to slow fashion
- Automation and its impact on workforce in Bangladesh
- Digital transformation in supply chains skills
- Transparency

- Compliance: certifications, audits and standards
- Lean Management/Six Sigma
- Finance & Human Resources for non-finance managers

In addition, our discussions highlighted the techniques and methods required to successfully implement our curriculum ideas, and enlighten the learning outcomes for students. These include increasing the uptake of:

- Didactic methods
- Continuous assessment
- Problem based learning
- Focused learning outcomes which are then matched with relevant assessment methods
- Industry placements
- Study visits

From the learning outcomes from the winter school, it is important to identify how themes of digital platforms, certification, codes of conduct and circular thinking can fit into the proposed themes. The Universities will be organised into working groups with support from staff at TU Dresden to work on the details of their module adaptations and development and this will ensure that the module outlines are ready for submission to the Bangladesh University Grants Commission, the crucial first step of formally altering the curriculum content.

Dresden Workshop II, April 2019

Coming less than one month after the Winter School, our second workshop in Dresden brought the ideas and guidance from the winter school into developing further the curriculum content and activities required for successful implementation of the project goals. These were integrated into the existing proposals for curriculum development within AUST and NDUB.

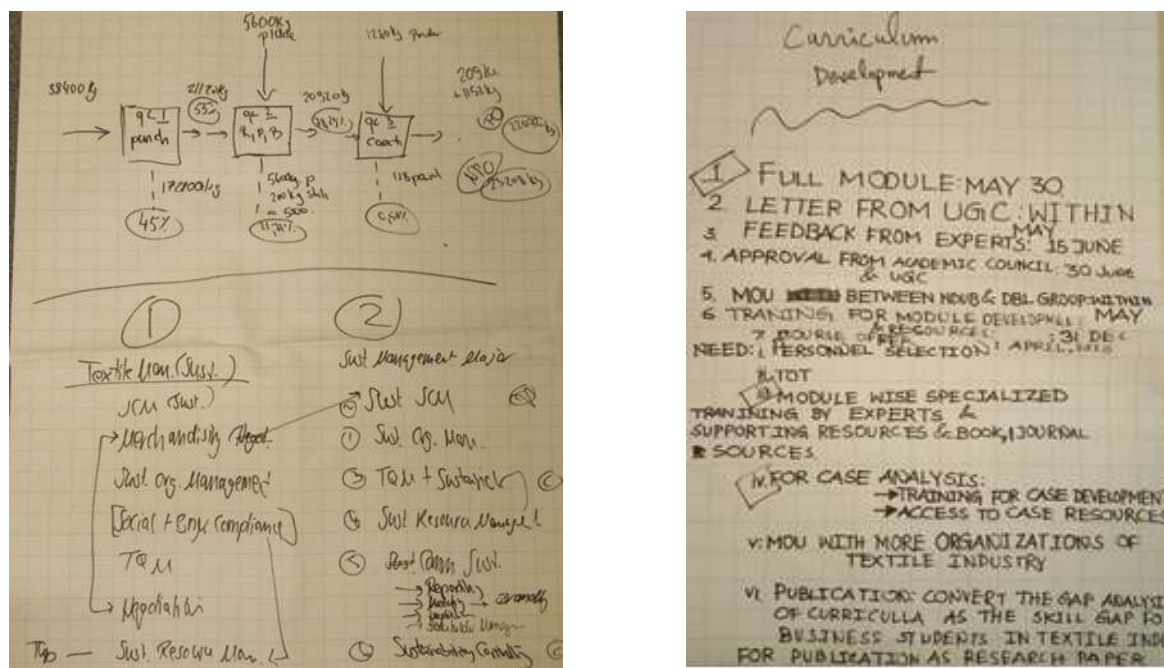


Figure 5: Sample of notes on outputs during the workshop

The discussions with the partners set up the processes for the finalisation of the curricula and the timelines and processes required for the two Universities to gain approval and to implement their curricula.

Dhaka Workshop, August 2019

The partners from Bangladesh were invited to give their feedback on the functioning of the project, the achievements made and the way in which the implementation phase can be supported and organized in order to ensure the revised curricula reach the class rooms and influence graduates. The opening sessions of each of the workshops were dedicated to the project partners to provide feedback on their developed curricula. Here, partners were able to engage with experts with regards to the curriculum development and request ideas for the implementation phase of the course development. Throughout the events organized, specific focus was placed on understanding the

needs, deficiencies in expertise and knowledge for the Bangladesh Universities to translate the proposed curricula into engaging, high level classes and courses for student development.

Experts from TU Dresden as well as further education and practice experts were invited to attend these events to share their specific experiences in textile design and sustainability contexts. Additionally, academic experts were able to provide guidance and advice for the implementation phase, whilst practitioners guided refinement of the content and delivery methods to ensure that graduates would be equipped to deal with the practical realities in the textile industry.



Figure 6: Round of discussion during the workshop

A topic that was elaborated was the knowledge and skills required for graduates to ensure they are able to progress into careers in the textile industry and specifically to implement sustainability in professional context. It was concluded that communication skills from graduates are often missing and that the ability to show initiative and willingness to learn is essential. Furthermore, sustainability was seen as a complex subject which covers many topics and deals with many complex interactions that require systems thinking. The working group at NDUB discussed the further modification of the modules. The main outcomes of the discussion were the following:

- Schematic design of all modules on sustainability, and

- Visual illustrations of course topics for each module.

The working group at AUST discussed about further steps and hurdles in implementing the changed curriculum. After an overview of each module was presented, it was decided that the following modules will be further integrating a sustainability component:

- Chemistry I – Green Chemistry.
- Management and Maintenance of Textile Machinery – resource efficiency, occupational health, safety.
- Yarn Manufacturing III – developing sustainable working environment.
- Sociology and Industrial Organizational Psychology – introduction to sociology; population, the environment and sustainable development; global inequality, gender inequality and modern slavery, work and economic life; and
- Apparel Manufacturing III – social, environmental, and economic aspects in the textile industry,

Furthermore, a new course was agreed to be created: Sustainability for Textiles (Tex 321), which will be offered in the 3rd year and will contain a number of sustainability related themes including sustainability, Compliance and CSR, Sustainable Accounting and Cost Control, Industrial Ecology and Sustainable Textile Products.

Dhaka Conference

The Dhaka conference was organized to give equal weighting to the academic and practitioner perspectives. Two panel sessions took place which brought together experts from these positions as well as being balanced between Bangladesh and European backgrounds. Within the conference, a research session was held to highlight the relationship between research and teaching, and to give opportunities to students in the Bangladesh Universities to present their findings and draw the

linkages between their own research and future topics which can be used to update the curricula taught at their Universities.



Figure 7: Panel of experts during the conference

During this event, the need for integrating case studies in the curriculum was further highlighted. It was pointed out that this could be done by letting students analyse sustainability actions and marketing of companies in Bangladesh and propose improvements or include companies in the presentation of results. Furthermore, the creation of a “resource list” rather than a “book list”, including articles, websites and reports as a reading list for students could further enhance the learning procedure and provide to the students a broader source of information. In this source of information, relevant materials from invited experts will be collected and provided to the partner universities in Bangladesh. Lastly, experts from industry invited as guest lecturers was seen as a way to help further develop the modules. In the case of AUST, this was seen as beneficial, especially in the new module where expertise may initially require additional help for development.

Research Outputs

Several research outputs were developed throughout the course of the project, aiming at disseminating the project outputs and gaining expertise input from conference participants and reviewers. These outputs are listed as follows:

Book Chapters

Koep, L, Morris, J, Dembski, N, Guenther, E. (2020). Procurement practices in the fashion Sector: past, present and future. In André Matthes et al. (Eds): *Sustainable Textile and Fashion Value Chains*. Springer.

Morris, J, Koep, L and Damert, M. (2020). Labels in the textile and RMG sector: communicating sustainability to effect more sustainable consumption. In André Matthes et al. (Eds): *Sustainable Textile and Fashion Value Chains*. Springer.

Conference Presentations

Koep, L, Morris, J & Guenther, E. (2018). Transforming the Textile Industry in Bangladesh: Adopting a Value Chain Approach to Tackle Sustainability Tensions. Presentation at the Business and Society Seminar: The Transformation towards Sustainable Business: Empowering Stakeholders for Sustainable Innovation, Production, and Consumption. Mannheim, Germany.

Koep, L, Morris, J & Guenther, E. (2018). Can Bangladesh's textile sector be sustainable? Adopting a paradox perspective to deconstruct sustainability tensions of textile production and consumption. Presentation at the European Group for Organisation Studies. Talinn, Estonia.

Gomes, K., Birjis, A. & Masud, A. A. (2019). Impacts of the Level of Women Empowerment on Ready Made Garments Industry in Bangladesh. Presentation at the International Scientific Conference: Sustainability of Global Garment Industry (ICSG2i 2019). Dhaka, Bangladesh.

Gomes, K & Mustafa, S. (2019). Exploration of Barriers and Success Factors of Sustainability of Bangladeshi Textile Industry at Various Stakeholders' Level from Social, Environmental and Economical Concern. Presentation at the International Conference on Teaching, Education and Learning (ICTEL). Bali, Indonesia.

Koep, L & Morris, J (2019). Organizing for social supply chain management in the textile industry - a longitudinal exploration. Presentation at the European Group for Organisation Studies. Edinburgh, UK

Mohan Baral, L & Rahman, F. (2019). Exploration of Sustainability Gaps in the Textile Engineering Curriculum of Bangladesh. Presentation at the International Conference on Teaching, Education and Learning (ICTEL). Bali, Indonesia.

Mohan Baral, L. (2019). "Sustainability in Textile Engineering Education for Sustainable Textile Industry of Bangladesh" Proceeding of the International Conference on Textile Engineering (TextileEngg-2019), 21-22 October' 2019, Bangkok, Thailand.

Mustafa, S & Gomes, K. (2020). Exploration of barriers and success factors of sustainability of Bangladeshi textile industry at various stakeholders' level from Social, Environmental and Economical concern". Presentation at the International Conference on Arts, Education, and Business (ICAEB-20), Male, Maldives.

Mohan Baral, L & Akhter, N. (2020). Exploration of Sustainability Barriers and Success Factors in the Textile and Ready-Made Garments Producer Level- Bangladesh Perspectives. Presentation at the International Conference on Arts, Education, and Business (ICAEB-20), Male, Maldives.

Morris, J. (2020). Promoting sustainable and responsible business practice through education: a case study of the Bangladesh textile industry. Presentation at the EUROMA Sustainability Forum. Nottingham, UK.

Rahman, F, Zulfikar Hasan, Md & Fuad, F. (2020). Identification of Barriers and Success Factors of Sustainability at Worker Level of Bangladesh RMG (Readymade Garments) Sector. Presentation at the International Conference on Arts, Education, and Business (ICAEB-20), Male, Maldives.

Blog Posts

Morris, J. (2019). Using education to promote sustainability in the textile industry. Sheffield Political Economy Research Institute.

Student Projects

Within the project framework, student projects were conducted in Bangladesh which provided the possibility for project partners to develop research capacities and to engage with future potential academic researchers within Bangladesh. Two projects were carried out at AUST and one was at NDUB. The first two research projects have been conducted by final year students of AUST with the supervision of faculty members of DTE, AUST. The final project was carried out at NDUB. The selected project titles are listed in Table 8.

Table 8 Student Projects in Bangladesh

	Research Work Package	Carried out by
#1	Exploration of barriers and success factors of sustainability at the worker level. In-depth interviews with blue collar workers in the Bangladeshi textile industry	Students and Faculty member of DTE, AUST
#2	Exploration of barriers and success factors of sustainability at the producer level. In-depth interviews with managers and owners in the Bangladeshi textile industry	Students and Faculty member of DTE, AUST
#3	Exploration of Barriers and Success Factors of Sustainability of Bangladeshi Textile Industry at Various Stakeholders' Level from Social, Environmental and Economical Concern	Students and Faculty members of NDUB

Methodology used for Project #1 (Exploration of barriers and success factors of sustainability at the worker level. In-depth interviews with blue collar workers in the Bangladeshi textile industry)

In this study, the significance as well as the barriers related to each sustainability aspects were assessed by conducting a survey by using a questionnaire (semi structured: open-ended and close ended) based on sustainability related topics. The data were collected from the target group who were the blue collar workers of Bangladeshi garments industries. The factories from which the data were collected were Creative Collection Ltd., A-One Polar Ltd, NAZ Bangladesh Ltd., Opex & Sinha Group, A4 Apparels, Talisman Ltd. The target population of the survey was 100. The data were collected based on the five-point Likert scale for clear, deeper and appropriate response. Finally, quantitative analysis was done on the basis of close-ended questions by using the Statistical Package for Social Science (SPSS) software and alternative analysis was done on the basis of open-ended questions to explore the significance level and barriers of the sustainability aspects respectively.

Methodology used for Project #2 (Exploration of barriers and success factors of sustainability at the producer level. In-depth interviews with managers and owners in the Bangladeshi textile industry)

In this study, an investigation has been done on the barriers and the success factors of sustainability, in-respect of Bangladeshi textile industries. The barriers and success factors of sustainability at the producer level were assessed by conducting a survey through a questionnaire in 5-point likert scale and (semi- structured: open-ended & close-ended) based on three basic aspects of sustainability like social, economic and environmental. The data were collected from the target group who were the white-collar workers in the Bangladeshi textile industry and the target population of the survey were 28 (Number of factory = 7, Number of peoples per factory = 4). Finally, the statistical analysis (Reliability Test, Multiple Regression Analysis, Analysis of Variance [ANOVA], Coefficients, Regression Equation Development and Pearson Correlation) of the collected data were done by the SPSS software and the data were also used to find out the barriers related to each aspect.

Methodology used for Project #3 (Exploration of Barriers and Success Factors of Sustainability of Bangladeshi Textile Industry at Various Stakeholders' Level from Social, Environmental and Economical Concern).

The data collected for this study followed both qualitative and quantitative data collection methods and the questionnaire used to collect the necessary data is semi-structured. Sample size of the data used in this study is 100. The sources of data used in the study are primary and secondary. Primary sources involved the mid-level managers of textile related companies, officials of the regulatory bodies of textile in Bangladesh and government officials. Almost 40 textile related organizations were interviewed. Secondary sources involved the study of scholar websites, journals, articles and research papers. The measurement of data has been detailed for qualitative part, however for the quantitative segment, empirical statistical analysis and descriptive analysis has been conducted using the SPSS software. The research addressed the following research questions:

1. What are the barriers have you found in textile industry of Bangladesh in the perspective of social/environmental /economical concern?
2. Which concerns of social/environmental /economical compliances have you found most vulnerable for the textile industries of Bangladesh? Why? (Probe to share specific cases or experiences)
3. Do you think our managers are aware about the areas of social/environmental /economical compliances? If not, Why?
4. Do you think our managers practice social/environmental /economical compliances properly? If not, Why?

Questions involving five-point Likert scale were also included. Social concern is further divided into six sub concerns: health, safety, equality, empowering women, legal practice, ethical practice. Findings of this study has suggested the improvisation of different concerns (social, environmental and economic) will ensure the long-term sustainability of this industry as well as making the industry more profitable after some conditions from the stakeholders are fulfilled as well. Most of the managers, including the respondent from the International Labour Organization (ILO) has valued the importance of increasing awareness of helping to maintain each and every concern of social, environmental and economic, from both buyers and sellers to ensure the profit margin of the industry overall and reach the target of \$50 billion of Bangladesh by 2021 in the textile industry through maintenance of every stakeholders' share, and make the textile industry more sustainable

for the betterment of Bangladeshi economy in the long run. It will serve to meet the relevant SDGs by 2030. Full details of these outputs can be found in the Appendix of this report.

Sustainability of the Project Partnership

A cooperation between GIZ and the German textile company Engelbert Strauss have reached out to TU Dresden and AUST, following the work completed as part of the HEST project. The project will fund a new Chair, the Chair for Sustainability and Textile Innovation at AUST, initially employing and training two people: one as an Associate Professor and a Lecturer. TU Dresden, along with United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES) in Dresden, will cooperate on this project to provide training and educational services to the new employees of AUST. Additional focus lies on course module development for Engelbert Strauss's Training Centre in Chittagong, where AUST staff will work in close collaboration with the company. The partnership of the DAAD-funded project is able to sustain itself beyond the end of the project funding through the involvement of a GIZ-funded partnership in cooperation with Engelbert Strauss. The partnership brings together Prof. Lal Mohan Baral of AUST with new recruits in Bangladesh, TU Dresden as an associate partner and UNU-FLORES as coordinator of the new project. The DAAD project showed the successful development of several courses and modules, where the new project gives the opportunity to further develop and implement the sustainability-enriched curricula in the University setting. The strengthened network developed over the course of the HEST project creates an important base for future steps and a sustained cooperation and delivers high-quality education to students to improve sustainability in the textile industry in Bangladesh.

Notable Partnerships and Interaction

- Prof. Kay Politowicz delivered a guest lecture for the course Value Chain Management at TU Dresden in the 2019 Summer Semester.
- AUST and NDUB signed a Memorandum of Understanding with DBL.
- TU Dresden, AUST and NDUB signed Memorandum of Agreements with the Asian Institute of Technology to strengthen research partnerships between institutes in Germany, Bangladesh and Thailand.
- TU Dresden and UNU-FLORES will co-supervise Kamol Gomes as a PhD student funded by the Katholischer Akademischer Ausländer-Dienst (KAAD) from 2020 –

2023, whereby the research is focusing on water management in the textile industry and runs in close collaboration with the new GIZ project.

Future Plans and Implementation

The official end of the project was 31.07.2020; however, many steps have been taken to ensure the sustainability of the project organisation group beyond the funding period. The results achieved through the project will help to ensure the sustainability of both the Textile Engineering course and the Bachelor of Business Administration. This fits with the aims of the Government of Bangladesh's aim to develop and implement sustainable curricula for different levels of textile engineering education through the knowledge developed from this project. As the textile graduates serve the textile industry mostly, a sustainable curriculum for textile engineering education could be effective for the sustainability of textile industry of Bangladesh. The work completed as part of the gap analysis for modifying the BSc Textile Engineering and BBA courses provided experience to faculty teaching staff directly involved in the project.

To continue to address the sustainability gaps in the BBA and Textile Engineering courses, there are plans to continue the development of sustainability specialisations in the Bangladeshi Universities. For example, AUST are planning to develop a new stream in their Textile Engineering Department which will specialise on Textile Sustainability. Further future plans include introducing a new Master's Program and short-term training courses (online and offline) in Textile Sustainability, all building on the knowledge gathered in this project. NDUB will continue the progress made in developing their new modules to enact the Major course in Sustainability.

Chair of Sustainability and Innovation Management

These are covered through activities such as the Chair of Sustainability and Innovation Management. As part of their sustainability activities in Bangladesh, Engelbert Strauss would like to promote the quality of higher education in the country. Their goal is to improve the capacities of future university graduates entering the labour market. Through a further

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM: FINAL REPORT

cooperation and knowledge exchange between AUST, TU Dresden and UNU-FLORES, curricula, teaching methods and materials and the quality of research will be improved.

The project will train university teachers, refine existing curricula based on the previous HEST project and develop new curricula with a focus on sustainability and innovation in the textile sector. This is followed by the implementation of all study modules and enhanced teaching techniques at AUST, including face-to-face lectures and add-on online modules from experts at TU Dresden, UNU-FLORES and other partners. The objective of the project is that AUST, with support from GIZ, UNU-FLORES and TUD, establishes a new Chair for Sustainability and Textile Innovation at the Department of Textile Engineering at AUST. This new Chair will then be in a position to deliver high-quality education to students and people from industry. Through the improved qualification of future specialists and managers in the areas of social responsibility, environmental protection and innovation in the textile and clothing industry, Engelbert Strauss contributes to the improvement of the working conditions of workers in Bangladesh's production plants and to the sustainable future development of the textile sector as such.

Digital Workshop

In March 2020, the Chair for Sustainability Management and Environmental Accounting of TU Dresden, in partnership with AUST and NDUB, planned to host a symposium to share the findings and reflections of their 2-year international co-operation. This was cancelled due to the ongoing pandemic COVID-19. Now that the new project to establish a Chair of Sustainability and Innovation Management has started, the organizer of the new project, together with the partner of the DAAD project, plans to organise another digital workshop where partners involved in both projects can exchange their experience and gathered knowledge.

The workshop will give the opportunity to showcase the newly developed modules as parts of their textile engineering and business administration courses by faculty staff from both AUST and NDUB and create the base for further curricula refinement and implementation of the courses at the university to be ready to teach in 2021 by current and new members of staff. So,

the event shall form the concluding workshop of the DAAD project and the kick-off workshop for the new project at the same time, strengthening the network between all partners for a sustained cooperation.

UNU-FLORES will take the lead in organising the workshop in autumn 2020, using Zoom as digital workshop platform. A mock-up session on Zoom and the specific workshop format will precede as training (one week in advance) to reduce technical-related issues as much as possible throughout the event. Two half-days are planned due to the time difference between Germany and Bangladesh. The first day is filled with pre-recorded lectures and the summary/outcome reports of the DAAD project, while the second day focuses on the evaluation and the next steps for future work with a focus on the implementation of the new project. The halved-workshop format gives participants the possibility to work through the content before the interactive discussion round on the second day. A draft of the workshop schedule is given in Table 9.

Table 9: Schedule of the autumn 2020 workshop

Time (CEST)	Day 1	Day 2
8:00 – 8:30	Welcome and Introduction from Germany Dr. Jon Morris, TU Dresden Christina Froemder, UNU-FLORES	Introduction Dr. Jon Morris, TU Dresden Christina Froemder, UNU-FLORES
8:30 – 9:00	Welcome and Perspective from Bangladesh Prof. Lal Mohan Baral, AUST Kamol Gomes, NDUB	State of progress of DAAD project curricula development, knowledge exchange (1): • An overview by the head of AUST, NDUB, TUD
Break	Quick Break	
9:05 – 10:25	Introduction of the new Course Material at NDUB: An overview of the six developed courses, followed by 15-min presentations by the lecturers	State of progress of curricula development, knowledge exchange (2): • Breakout rooms: individual discussion with AUST and NDUB, current status and gap analysis followed by summary all together

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM: FINAL REPORT

10:25 – 10:30	Quick Break	
10:30 – 12:00	Introduction of the new course material at AUST: An overview of the adjusted courses and the new module on “Sustainability for Textiles”, followed by 15-min presentations by the lecturers	Identifying next steps: • Breakout rooms: individual discussion with AUST and NDUB • Summary all together
		Transition to the new project: • Introduction • Research seminar presentation
12:15 – 13:00	Comments, Discussion and Wrap-up	Comments, Discussion and Wrap-up

The workshop will be open to all HEST partners of the DAAD as well as the new project, including academics and representatives from industry, to gather valuable feedback for the success of both projects.

Conclusions and Key Project Statistics

Overall, the project has been successful in realising its aims. Modules were developed at the Bangladesh Universities and partnerships have been strengthened between Germany and Bangladesh, and between academia and the private sector. Over the course of engagement with Bangladeshi participants, there is an interest in sustainability and in implementing them into the curriculum. Education does provide a mechanism for changing the institutionalized perceptions of sustainability across the industry and within the region. Graduates from education courses would have the power and possibilities to reshape approaches towards business operations in the textile industry, though this would need to be accompanied by practical skills, particularly soft-skills, to ensure these demands become parts of the supply chain management practices in textile industries. To achieve this, we identified three key areas where curricula development should focus on: defining and embedding sustainability concepts into teaching modules, relating sustainability impacts to textile production processes through methods such as product lifecycle assessment, and developing soft skills to ensure sustainability criteria are adequately included in business transactions. The improvement in education and knowledge attainment is critical to ensure the long-term viability and sustainability of the textile industry in Bangladesh.

In order to develop stronger collaborative and teaching focused perspectives which draw on academics from Western-contexts, curriculum development should also include industry representation from within the textile industry in Bangladesh and beyond. Future work in this field should focus on co-constructing sustainability in Bangladesh in order to avoid imposing westernized views onto the Bangladesh curricula. To do this, further workshops should be held along with trial runs of lectures with practitioner representatives to ensure the materials developed are applicable in practical situations. There is also a need to ensure that the findings and outcomes are implemented into the core course structure in Bangladesh so that sustainability becomes a key and integral concept across multiple courses. This is important to ensure that it is not only students who already possess some knowledge of sustainability are the ones taking the course, but the exposure of sustainability concepts is felt across students from

INTRODUCING SUSTAINABILITY TO THE TEXTILE ENGINEERING CURRICULUM: FINAL REPORT

a wide range of different subject areas. This should become a major focus for future work in this area.

Overview of Project Indicators

The outcomes of the project compared to the proposed project indicators are documented in Table 10. The project achieved its primary objectives.

Table 10: Project indicators

Activities	Date/month/period of implementation in the reporting year
Virtual kick-off project via Skype to further discuss overall project elements (logistics, personnel, travel arrangements)	05.02.2018
Baseline study with industry members in Bangladesh to determine industry needs in relation to sustainability to ensure responsiveness	Baseline study is completed
Face-to-face meetings in Dresden (4 faculty members of AUST to fly to Germany for 2 weeks). Introduction to the modules, attendance of didactic training sessions, introduction to software based sustainability assessment, mentoring of faculty, networking with academics from ITM TU Dresden, TU Chemnitz and representatives of the textile and clothing sector in Germany)	04.10.2018, 23.04.2019
Regular Skype conferences to discuss details of the suggested module amendments and research work package progress, webinars to provide methodological training	Monthly/Ongoing
Winter School for project staff, TUD (x4) and AUST (x4) staff in Thailand with Bangladeshi (x8) and German academic experts (x8) from environmental sciences, social sciences and textile engineering will be invited to comment the first results of curriculum development	Winter School in Thailand took place in March 2019, with second project workshop in Dresden in April 2019. A further two workshops took place in Dhaka (1 each for NDUB and AUST) in workshop in August 2019

Case studies to be developed by Bangladeshi faculty members, faculty evaluation	Working groups with AUST and NDUB in Bangladesh took place in Dhaka in August 2019
Curriculum and modular elements are submitted to the Bangladesh University Grants Commission for approval	UGC involved in Dhaka workshops August 2019
Management training workshops to take place at AUST based on modules developed as parts of the curriculum development	Conducted in September 2019
Virtual kick-off project via Skype to further discuss overall project elements (logistics, personnel, travel arrangements)	Completed in 2018
Virtual kick-off meeting with students developing detailed research proposal and to discuss project milestones	Mostly conducted by email and in face-to-face project meetings
Regular consultation with project group to discuss progress, webinars and training sessions regarding methodology	Monthly (via Skype, email)
Work with relevant stakeholder group to explore barriers and success factors of sustainability along the textile value chain	Completed in 2018. Ongoing collaborations through networks in 2019
Workshops in both Bangladesh and Germany to disseminate research findings of research work packages, including industry partners	Incorporated into April 2019 TU Dresden workshop and university visit events in Dhaka 2019
Research findings are collated and prepared for publication	Ongoing
Virtual kick-off project via Skype to further discuss overall project elements (logistics, personnel, travel arrangements)	05.02.2018
Invitation of possible industry project partners at TUD, NDUB and AUST	Invitation to private sector representatives sent out during organization for March 2019 Thailand Winter School. 6 organizations attended. Industry representatives attended the closing

INTRODUCING SUSTAINABILITY TO THE TEXTILE
ENGINEERING CURRICULUM: FINAL REPORT

	conference in Dhaka 2019
Regular consultation with industry partners	Dr. Lisa Koep attended the TechTextil exhibition at the Frankfurt Textil Messe in May 2019. Project tour of DBL campus in Dhaka in August 2019
Workshops in both Bangladesh and Germany to disseminate research findings of research work packages, including industry partners	Completed in Dresden (April 2019) and Dhaka (August 2019)
Paper presentations for research dissemination in conferences in UK and Indonesia	Paper presented in EGOS and ICTEL in July 2019
DAAD HEST project meetings	Dr. Lisa Koep and Dr Jon Morris attended in Dresden April 2019; Dr Morris and Mr Plewnia in Dhaka, August 2019
Knowledge enrichment on sustainable supply chains	Dr. Lisa Koep attended the event 5th Zukunftsforum Globalisierung: Nachhaltige Lieferketten in Berlin, February 2019 and ICDD Working Seminar in Kassel in March 2019

References

- Banga Chhokar, K. (2010). Higher education and curriculum innovation for sustainable development in India. *International Journal of Sustainability in Higher Education*, 11(2), 141–152. <https://doi.org/10.1108/14676371011031865>
- BGMEA. (2019). BGMEA issues rejoinder on Just-Style news on Bangladesh garment exports.
- Bhattacharya, D., & Rahman, M. (2000). *Seeking Fair Market Access For Bangladesh Apparels In The Usa: A Strategic View* (No. 11; CPD Working Paper). Centre for Policy Dialogue (CPD). <https://ideas.repec.org/p/pdb/opaper/11.html>
- Boström, M., & Micheletti, M. (2016). Introducing the Sustainability Challenge of Textiles and Clothing. *Journal of Consumer Policy*, 39(4), 367–375. <https://doi.org/10.1007/s10603-016-9336-6>
- Felgendreher, S., & Löfgren, Å. (2018). Higher education for sustainability: Can education affect moral perceptions? *Environmental Education Research*, 24(4), 479–491. <https://doi.org/10.1080/13504622.2017.1307945>
- Greenhalgh, T., Jackson, C., Shaw, S., & Janamian, T. (2016). Achieving Research Impact Through Co-creation in Community-Based Health Services: Literature Review and Case Study. *The Milbank Quarterly*, 94(2), 392–429. <https://doi.org/10.1111/1468-0009.12197>
- Hahn, T., Pinkse, J., Preuss, L., & Figge, F. (2015). Tensions in Corporate Sustainability: Towards an Integrative Framework. *Journal of Business Ethics*, 127(2), 297–316. <https://doi.org/10.1007/s10551-014-2047-5>

INTRODUCING SUSTAINABILITY TO THE TEXTILE
ENGINEERING CURRICULUM: FINAL REPORT

- Hossain, L., Sarker, S. K., & Khan, M. S. (2018). Evaluation of present and future wastewater impacts of textile dyeing industries in Bangladesh. *Environmental Development*, 26, 23–33. <https://doi.org/10.1016/j.envdev.2018.03.005>
- Krupka, E. L., & Weber, R. A. (2013). Identifying Social Norms Using Coordination Games: Why Does Dictator Game Sharing Vary? *Journal of the European Economic Association*, 11(3), 495–524. <https://doi.org/10.1111/jeea.12006>
- Luque, A., & Herrero-García, N. (2019). How corporate social (ir)responsibility in the textile sector is defined, and its impact on ethical sustainability: An analysis of 133 concepts. *Corporate Social Responsibility and Environmental Management*, 26(6), 1285–1306. <https://doi.org/10.1002/csr.1747>
- MacDonald, L., & Shriberg, M. (2016). Sustainability leadership programs in higher education: Alumni outcomes and impacts. *Journal of Environmental Studies and Sciences*, 6(2), 360–370. <https://doi.org/10.1007/s13412-015-0344-7>
- Mohan Baral, L., Kifor, C. V., Bondrea, I., & Oprean, C. (2012). Introducing Problem Based Learning (PBL) in Textile Engineering Education and Assessing its Influence on Six Sigma Project Implementation. *International Journal of Quality Assurance in Engineering and Technology Education (IJQAETE)*, 2(4), 38–48. <https://doi.org/10.4018/ijqaete.2012100104>
- Oelze, N. (2017). Sustainable Supply Chain Management Implementation—Enablers and Barriers in the Textile Industry. *Sustainability*, 9(8), 1435. <https://doi.org/10.3390/su9081435>
- Pedersen, E. R. G., & Gwozdz, W. (2014). From Resistance to Opportunity-Seeking: Strategic Responses to Institutional Pressures for Corporate Social Responsibility in the Nordic

- Fashion Industry. *Journal of Business Ethics*, 119(2), 245–264.
<https://doi.org/10.1007/s10551-013-1630-5>
- Perry, P., & Towers, N. (2013). *Conceptual framework development: CSR implementation in fashion supply chains* [Text]. <https://doi.org/info:doi/10.1108/IJPDLM-03-2012-0107>
- Richardson, J., Heidenreich, T., Álvarez-Nieto, C., Fasseur, F., Grose, J., Huss, N., Huynen, M., López-Medina, I. M., & Schweizer, A. (2016). Including sustainability issues in nurse education: A comparative study of first year student nurses' attitudes in four European countries. *Nurse Education Today*, 37, 15–20.
<https://doi.org/10.1016/j.nedt.2015.11.005>
- Soundararajan, V., & Brammer, S. (2018). Developing country sub-supplier responses to social sustainability requirements of intermediaries: Exploring the influence of framing on fairness perceptions and reciprocity. *Journal of Operations Management*, 58–59, 42–58. <https://doi.org/10.1016/j.jom.2018.04.001>
- Tang, K. H. D. (2018). Correlation between sustainability education and engineering students' attitudes towards sustainability. *International Journal of Sustainability in Higher Education*, 19(3), 459–472. <https://doi.org/10.1108/IJSHE-08-2017-0139>
- Textile Today. (2019). *Bangladesh's apparel export trend of 2018*.
<https://www.textiletoday.com.bd/bangladeshs-apparel-export-trend-2018/>