Stakeholders' influence towards sustainability transition in textile industries

Chapter 17
Stakeholders' Influence Towards Sustainability Transition in Textile Industries

Arpita Chari, Mélanie Despeisse, Ilaria Barletta, Björn Johansson, and Ernst Siewers

Abstract With the rise of global challenges associated with linear models of production, transitioning to more sustainable models has become increasingly important and urgent. However, this transition is not done systematically due to a general lack of organizational knowledge and motivation to apply existing models, metrics and frameworks for sustainability. The current sustainable value proposition in organizations also shows that management rarely has a clear implementation strategy and underestimates what is required for a successful sustainability transition to take place. In addition, few empirical studies exist to corroborate these observations. This research focuses on analyzing the organizational barriers to the long-term sustainable transformation process, by considering the interests of all stakeholders, including the planet. The objective of the paper is to provide guidelines in the form of a decision support framework to textile industries to adopt and implement green technologies in their sustainability transition process.

Keywords Sustainability transition · Stakeholder · Multi-level perspective · Barriers · Textile industry

17.1 Introduction

Among industries that have a large global climate impact, the textile industry has had a significant contribution to climate change, causing severe depletion of the planet's resources. In 2016, the textile industry contributed to 6.5% of global greenhouse gas emissions (GHG), equivalent to about 3.3 billion tons of CO_2 equivalent (Quantis 2008). Additionally, the overall life-cycle of textiles is plagued by several unsustainable issues some of which are: high amounts of water utilization (almost 100 kg to

A. Chari (✉) · M. Despeisse · I. Barletta · B. Johansson
Department of Industrial and Materials Science, Chalmers University of Technology, Göteborg, Sweden
e-mail: arpitac@chalmers.se

E. Siewers
DyeCoo Textile Systems B.V, Weesp, The Netherlands

Y. Kishita et al. (eds.), *EcoDesign and Sustainability I*, Sustainable Production, Life Cycle Engineering and Management, https://doi.org/10.1007/978-981-15-6779-7_17

dye a kg of fabric), dyestuff and other effluents contained in the waste water (Cid et al. 2005; Luo et al. 2018), large transportation related fuel emissions in the supply chain and high energy consumption (Choudhury 2014). These negative effects of the textile industry along with their predominantly linear ("take-make-dispose") model, threaten the limited resources available in our natural ecosystem with a tremendous impact on environmental and societal levels (Ellen MacArthur Foundation 2016). Hence, there is an urgent need for these industries to decouple economic growth from resource utilization and find a balance between the social, economic and environmental dimensions of sustainability through radical innovations.

Sustainable development is a normative and contested concept (Hedenus et al. 2015; Stubbs and Cocklin 2008), one that takes place with varying vested interests and values of the encompassing actors within a defined system. Sustainability transition typically involves this broad network of actors who are dynamically interacting between the different sub-systems.

Research in this field has gained increased traction over the past decade with a number of studies analysing socio-technical transformations into a sustainable economy (Van Den Bergh et al. 2011) from a systems perspective. Various frameworks have also been conceptualized in order to understand these sustainability transitions (Turnheim 2019), namely: the multi-level perspective (Geels 2017; Rip and René 1997; Geels 2002), transition management approach (Loorbach 2010), innovation systems approach (Hekkert et al. 2007; Franco 2002), dialectic issue lifecycle model (Penna and Geels 2012), strategic niche management (Rip and René 1997) among many others. However, many of these models have been criticized for not paying enough attention to the underlying interests of the various stakeholders involved in the transformation process. Farla et al. (2012) in their special issue paper addressed dynamic actor interactions from a systems perspective. They focused on capabilities and strategies that organizations and individuals need to inherently possess in order for successful sustainability transitions to take place. Several studies have analysed that the complexities arising from stakeholder involvement and management commitment have been barriers to the sustainability agenda in domains such as green building and construction (Mok et al. 2018; Hongyang et al. 2019; Pham et al. 2019; Williams and Dair 2007), urban freight transport (Van Duin et al. 2017), facilities management (Elmualim et al. 2010), manufacturing (Moldavska 2016; Orji 2019), circular economy (Houston et al. 2018) and environmental management (Geels 2017; Reed 2008) to name a few.

Epstein and Buhovac (2010) explain that although some organizations address sustainability as part of their business agenda in addition to gains in financial performance, the long-term advantages and opportunities of creating sustainable value for the organization have still been heavily underestimated. Along with developing the Corporate Sustainability Model to measure the drivers of sustainability, they identified the following key challenges of implementing sustainability in organizations:

(a) Setting clear and measurable goals;
(b) Financial incentive pressures;

(c) Stakeholder involvement and reaction to sustainability measures.

This research focuses on the third aspect of sustainability implementation: stakeholder interactions. The aim is to recognize the barriers to sustainability transition at the multi-stakeholder level in the textile industry domain. Several underlying sustainability issues in textile industries are triggered not only by technological advances, linear consumption and production, but also by the surrounding and internal social structures (Farla et al. 2012), namely, the actors. The inclusion of multi-level interactions among different stakeholders in the value chain is critical in realizing the common goal of sustainable development, instead of interests vested with a single industrial organization. With this background and the urgent need for sustainable transition in textile industries, the research aims to address the following questions:

RQ1 How do actors play a role in sustainability transition in textile industries and what barriers hinder this process?

RQ2 What conditions and strategies need to be created in order to realize sustainability transition?

The RQs are addressed through a case study that has successfully adopted and implemented a clean dyeing technology. Results are presented in the form of a decision framework to provide guidance for radical innovation implementation.

In the following section, a literature review on sustainability transitions, innovation implementation and the important role actors play in the organizational change for sustainability have been outlined. Section 3 describes the research methodology adopted in the paper. In Sect. 4, the results of the study along with implementation tactics using a decision framework that can support sustainability transitions have been summarized. The paper ends with discussions in Sect. 5 and conclusions along with future work highlighted in Sect. 6.

17.2 Literature Review

17.2.1 Multi-level Perspective for Sustainability Transitions

Of the several frameworks that have been formulated to understand the multi-dimensional complexities of sustainability transitions, the multi-level perspective (MLP) approach (Geels 2017; Rip and René 1997; Geels 2002) has been explored in this research in order to understand the role of the different players in the textile industry and the barriers hence derived towards sustainability transition. MLP argues that transitions are non-linear and take place due to dynamic interactions among three levels, namely: (a) Niches, which are spaces in which radical innovations or changes in activities take place; (b) Regimes, where rules and practices are already well defined or established and where incremental reformism occurs; (c) Landscape, where if developments occur that put enough pressure on the regime, then it creates opportunities for the niche innovations to emerge. These are represented by levels of

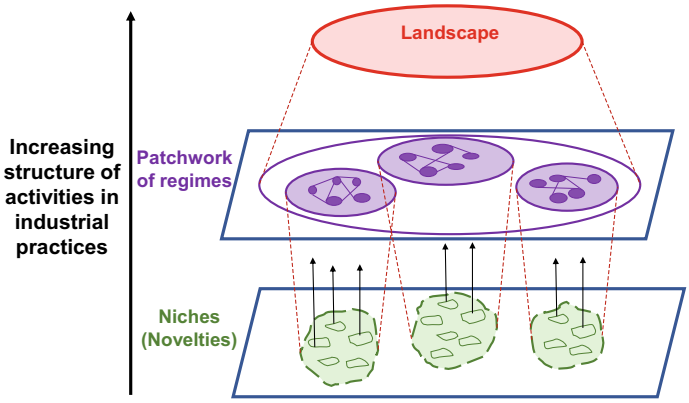

Fig. 17.1 Nested levels of multi-level socio-technical systems (adapted from Geels 2002)

increasing hierarchy where regimes are nested within an exogenous landscape and niches are in turn part of regimes (Geels 2012) (Fig. 17.1)

MLP addresses dynamic stability and radical change, a framework whose development was influenced by neo-institutional theory (where actors are restricted by regulations and shared values), sociology aspect of technology (where innovations are social constructs, developed through the complex interactions of various actors) and evolutionary economics (regimes, niches) (Geels 2002). The interactions between the different levels are enacted by various actors as they progress towards the sustainability transition process. In order for systemic changes (technological advances for example) that occur within niche spaces to be accepted by the highly structured and 'locked-in' regimes, it is important to recognize the role that the actors play within these levels. Although it is important to focus on the impact that these different stakeholders have on the transition process, it is particularly important to adopt a holistic view of the system and the interrelated sub-systems; i.e., if actors want to change one part of the system they may have to comply with rules governing other parts of the system (Farla et al. 2012). The reason of using the MLP framework in this study is to understand how actors at the different levels are affected by sustainability issues and how successful actors can lead the way to sustainability transitions in established domains such as the textile industry.

17.2.2 The Importance of Stakeholder Value

Sustainability transition is a multi-actor process, that includes a range of actors with varying capabilities (Turnheim 2019). Stakeholders or actors are people or groups that have the power to directly affect an organization's future (Ackermann and Eden 2011). Hart and Milstein (2003) in their paper on creating sustainable

value in organizations, elaborated that the value embedded in the interconnectedness of stakeholders positively drives sustainable development.

Stakeholder involvement in sustainability transitions is an important stage, one that analyses in which way the stakeholder either influences or is affected when sustainable practices are adopted on a wide, market scale (Welp et al. 2006). Knowing this information is pivotal to ultimately give recommendations to key decision makers in the textile industry: investors on novel production technologies, investors within the apparel and furniture industry, top managements leading those companies as well as influencing conscious demand by consumers. By involving external and internal stakeholders, industries have the opportunity to enhance transparency and trust in their activities, thus increasing their reputation and overall sustainability performance. In order to drive sustainability performance, incorporating and enforcing a sustainability strategy within organizations is important. Epstein et al. (Epstein and Buhovac 2010) elaborated that companies need to integrate both formal systems (e.g. performance measurement metrics and tools) that support the sustainability agenda within their Business-As-Usual activities, as well as informal systems (e.g. leadership, cultural mindset of employees and stakeholder involvement) in the organizational structure as critical drivers of performance, which could lead to more harm than good with a lack of consideration thereof. In the context of this research, individual and collective actors whose roles were stable (Wittmayer et al. 2017) i.e., with fixed responsibilities, were incorporated in the sustainability transition process.

17.2.3 Innovation Implementation

Implementation has been defined by Voss (1988) as "*the user process that leads to the successful adoption of an innovation of new technology*". Sustainable development requires new innovations (Ritzén and Sandström 2017) to develop in the niche area and then adopted and implemented into the fixed business models of organizations within regimes. A concept that is widely addressed in innovation management literature (Van De Ven 1986; Nagji and Tuff 2012), is how novel innovations or solutions could help mitigate the challenges arising from unsustainable activities of industries. This can further be understood from Fig. 17.2 which has been adapted from the innovation ambition matrix published by Harvard Business Review (Nagji and Tuff 2012) based on Igor Ansoff's growth matrix (Ansoff and McDonnell 1986).

The model explains that the extent to which organizations are willing to integrate change and initiatives within their business models along with a good understanding of market potential, will ultimately determine success. In particular, breakthrough innovations that cater to unestablished markets and new customer requirements will create value for the organisation. The case study with DyeCoo illustrates the breakthrough of the innovative dyeing technology in the textile industry domain (their success level has been depicted in Fig. 17.2). Other applications for the technology exist in the fields of extraction (Lang and Wai 2001), impregnation (Üzer et al. 2006)

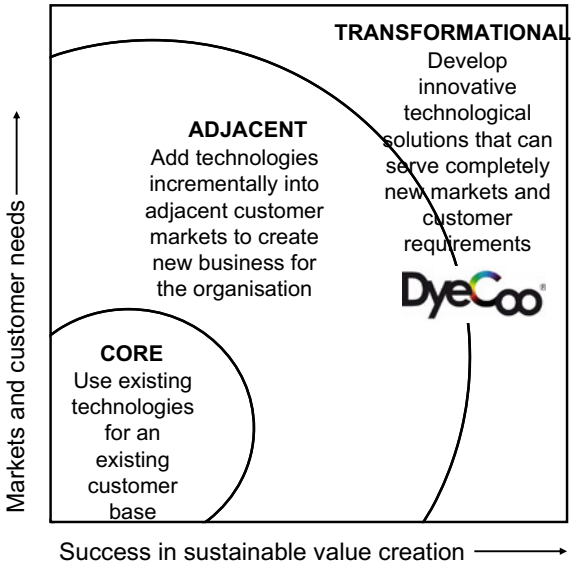

Fig. 17.2 Types of innovations under different market conditions (Nagji and Tuff 2012)

and particle generation (Fages 2018) among others, giving this technology immense potential to make transformational changes in various markets.

A wide field of literature exists that has examined the efforts required to incorporate change at all levels in an organization within the area of organizational development and change (Armenakis 1999; Judson 1991; Klein and Sorra 1996; Kotter 1995; Kotter and Schlesinger 2009) in the past few decades. For instance, Epstein and Buhovac (2010) suggested that the effectiveness of an organization's innovation implementation strategy is based on the organization's strength to adopt the innovation as well as stakeholders' commitment and values to utilize the innovation. Damschroder et al. (2009) in their consolidated framework for implementation model also relate implementation to individual characteristics and responsibilities, priorities, culture and leadership in an organization as well as the needs of stakeholders who are affected by the implementation process. Stål and Corvellec (2018) in their research with Swedish apparel companies explored the extent to which adoption and implementation of sustainable strategies in business models are successful, through organizational institutionalism. To sum up, stakeholders' and organizations' perceptions (Epstein and Buhovac 2010) at multiple levels in the sustainability transition process are therefore extremely important to consider while implementing innovative technologies and go beyond the usual constructs of involving just external experts or scientists.

17.3 Research Design

A case study method as described by Yin (2009) was utilized in this research to identify the barriers to sustainability transition in a real-world environment and explore solutions to deal with those issues. To understand the complexity of multi-actor interaction at the different levels of sustainability transition, several organisations within the textile industry domain were identified as participants for the study and fitted within the MLP framework. Leading researchers in sustainable systems and textiles along with stakeholders such as managers, CTOs and other decision makers in the chosen organisations were selected for the data collection process as they have considerable mandate in strategizing and making decisions regarding sustainability issues in the organizations (Lahtinen and Yrjölä 2019). Among stakeholders within the value chain of an organization, managers in particular perceive sustainable development to be a cost and liability of doing operations (Hart and Milstein 2003), a condition that has existed for the last two decades and one that continues to grow (Oxborrow et al. 2017; Revell and Blackburn 2007). It was for this reason that strategic decision makers were chosen in this study. To ensure that top level management did not face managerial isolation issues (Teece 2007), the organisations confirmed that transparency in communication was maintained within all levels of operations.

17.3.1 Case Description

The aforementioned negative impacts of the textile industry on the environment and society, in particular fresh water consumption and pollution, as well as greenhouse gas (GHG) emissions, have paved the way for new technological development opportunities to reduce the industry's footprint.

Between the fall of 2017 and 2018, we collaborated on a project with DyeCoo, a Dutch company that has successfully commercialized a novel water-free dyeing technique, to estimate the climate implications of the textile dyeing process. The patented and commercially available technology uses reclaimed CO_2 (carbon dioxide) as a solvent instead of water for dyeing polyester fibres and textiles. At a temperature and pressure above the critical point, CO_2 becomes supercritical ($scCO_2$), a state with liquid like density and gas like viscosity. $scCO_2$ is a green solvent with high solvability and permeability which allows dyes to dissolve easily in it. The dyes are then easily absorbed by the fibres. 95% of the CO_2 is recycled in a closed loop system. The process uses no water, no chemicals and produces no waste. Short batch cycles and efficient dye use, without a requirement for water evaporation or waste water treatment all contribute to significantly reduced environmental impact in comparison to traditional water-based dyeing technologies (DyeCoo 2012).

It is known that incumbent actors within regimes have their own innovation agenda (Farla et al. 2012) and strategies for improving performance. The purpose of using the

empirical study for this research was to evaluate whether a business case existed for the technology and in turn assess how successful firms such as these (who operate within niches) can influence other industries to break the lock-ins of established technologies and gain momentum towards adopting newer, cleaner technologies. Such radical technologies also have the potential to make industries in the textile industry domain to gradually phase out from being material- and energy-dependent (Stubbs and Cocklin 2008; Hart and Milstein 2003).

17.3.2 Data Collection

To deliver the results from the case study of the project, the paper adopted a qualitative research approach as shown in Fig. 17.3.

Primary data was derived by conducting in-depth semi-structured interviews, a workshop, using questionnaires as well as an onsite visit to DyeCoo's operational facilities. Secondary data was derived from peer-reviewed studies and reports on sustainability in the textile industry issued by established institutions and agencies (Quantis 2008; Houston et al. 2018; EMF 2017). Specifically, data collection was carried out in two phases of the project. During phase 1, a workshop was conducted at DyeCoo's company headquarters, where key experts in the textile industry domain took part in a focus group: DyeCoo, a professor from the University of Borås, Sweden (expert on resource efficient processes for textile dyeing and functionalisation), and a professor from Chalmers University of Technology, Sweden (expert on sustainable energy systems). During the concept mapping, they were asked questions like- 'what is your influence and responsibility on/from the adoption of sustainable practices/new clean technologies?'. Additional actors in the textile industry who have

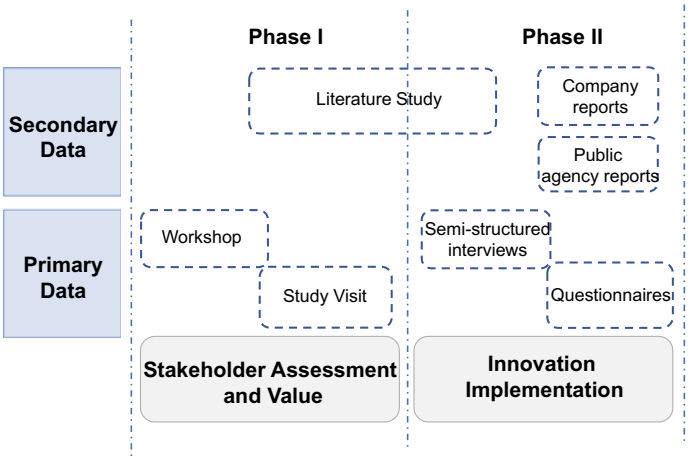

Fig. 17.3 Research methodology followed in the study

implemented/that are interested in the technology implementation were identified during Phase 2 of the project. Semi-structured interviews of about 30–45 min each were conducted with these actors. The questions were developed keeping in mind the primary objective of the project, i.e. to understand the barriers that textile industries face with regards to green technology adoption. When some players did not have sufficient time for an in-depth interview, questionnaires with a similar format were used to gather information. The questionnaire also contained survey-type questions which interviewees were asked to rate on a scale of 1–5, for instance, 'To what extent does your organization/do your customers value: quality, durability ('technology' in the case of DyeCoo), functionality, environmentally friendly (production or recyclability)' on which analysis was performed to understand current priorities and identify the challenges to implement cleaner technologies and methods of production (reflected in Fig. 17.4).

17.4 Key Findings

17.4.1 Barriers to Implementation

Several challenges to technology implementation at different levels of the transition process were identified from the empirical data and previous literature. These barriers have been categorized under different themes and represented in a model based on a PEST (Political, Economic, Social and Technological) analysis framework (Sammut-Bonnici and Galea 2015). PEST analysis tools are generally used to monitor risks involved or factors that can have an impact on an organization. Using such a framework greatly enhanced the understanding of the interesting patterns that emerged whilst studying the challenges in sustainability transitions and categorise these challenges in order to formulate corrective tactics. The technology implementation challenges identified within the PEST framework have further been depicted within a nested view model of the Triple Bottom Line approach (Elkington 1998) in Fig. 17.4.

Here, the 'environmental' factors have been considered to be part of the 'external' influences on an organization. This goes beyond the usual constructs of defining the environment in terms of raw material consumption or environmental impacts. Instead, it has been depicted by 'nature', an important stakeholder in the analysis (Stubbs and Cocklin 2008; Bocken et al. 2013) whose needs have to be met ['eco-centric' low substitutability view of strong sustainable development (Hedenus et al. 2015)].

On a landscape level, these 'environmental' factors along with public policies and regulations under the 'political' factors, put pressure on the already existing internal technical, economic and organizational pressures within regimes, causing changes in their production processes. The industry is still dominant with personal profit margin interests and protection of individual business models. Large players continue to have considerable influence on the end consumer, and this determines the market at the

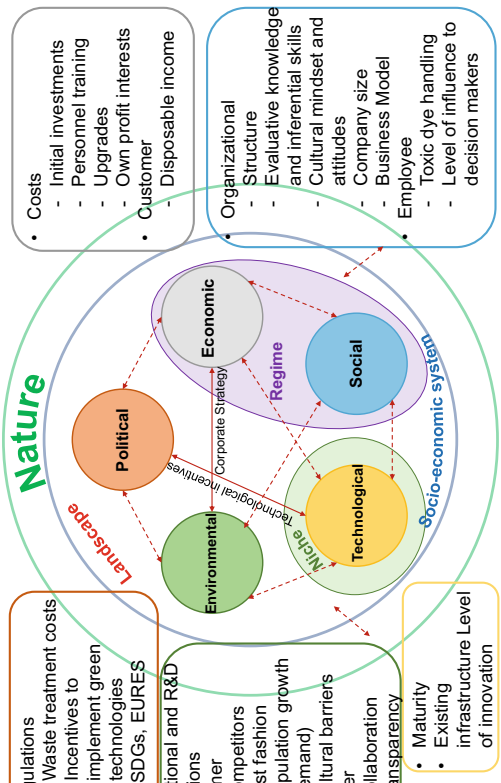

Fig. 17.4 Critical challenges to technological implementation (adapted and modified from (Stubbs and Cocklin 2008; Sammut-Bonnici and Galea 2015; Frambach and Schillewaert 1999; Deradjat and Minshall 2017)

end. As long as these companies are not willing to change their production processes and business models and influence their suppliers and customers in a positive manner, their resistance will continue to be one of the biggest barriers to green technology adoption and sustainability transition.

17.4.2 Architecture of the Decision Framework

Based on the challenges identified from the empirical study, a step-wise decision framework was formulated (Fig. 17.5). It incorporates elements in response to challenges identified within the categorizations of the PEST model. The framework recognises the impact of clean technology adoption in sustainability transitions, so that organisations can 'sense' challenges, 'adopt' better practices and 'transform' their processes, thus creating long-term sustainable value. It acts as a guide for industries to follow the path of sustainability transition. The step-wise processes described in the framework should by no means considered to be linear, but one that should continuously evolve in order to bring about long-term benefits.

Niche actors such as DyeCoo, by means of technology co-evolution and collaboration with supporting institutions, have exemplified the process of successfully shifting from just being a 'story' or in the discussion phase to being in the implementation and operational phases. Similarly, organisations would need to use their resources accordingly to carefully 'scan' market segments and conditions (Teece 2007), understand customer needs and in turn influence their demand towards fast fashion and foresee the competitive advantage from adopting cleaner technologies.

The ability to discover opportunities varies among individuals in organisations and will affect the overall decision for niche technology innovation adoption. This search for innovation implementation should extend beyond local organisational boundaries by engaging in a dialogue among other stakeholders in the textile value chain, bringing about a transparent collaboration that would benefit all parties involved. This would also involve aligning sustainable strategies to the business model and acknowledging the continuously changing decision-making capabilities within organisations.

Contrary to deeply ingrained beliefs of resistance within organisations to adopt new technologies, the $scCO_2$ technology from DyeCoo is more reproducible and scientific than other conventional dyeing mechanisms which are more 'art' or 'skill' based. The required 'upgrading' of skills and management of knowledge is thus easily transferable.

It was also seen that actors working at operational levels recognise the direct impact of clean technology on their working environment and act as visionaries who can influence higher management to adopt the innovative technologies. This endorsement of technology adoption in the new regimes may even influence landscape developments (Geels 2004) that could in turn support the long-term strategy of the incumbent firms. Organisations can transform their operations into one that is

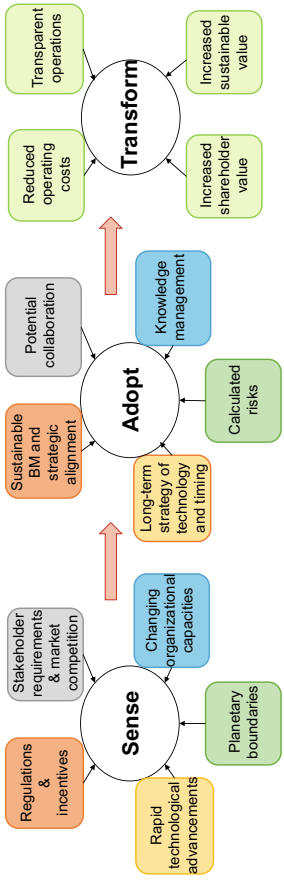

Fig. 17.5 Elements of the decision framework for sustainability transition in textile industries

driven by sustainable value creation if they are able to incorporate long-term changes in their strategic operations and take calculated risks along the transition process.

17.5 Discussion

The MLP has proven to be a useful framework in this empirical research to understand how radical innovations can create windows of opportunities and break through niches to influence the incumbent firms within regimes to adopt them. Although it is a risky proposition to draw on conclusions based on a single case study, different actors who are related to or could benefit from the results were included in the research, giving rise to a rich data set to formulate the results. In the context of the textile industrial domain, the paper has made two contributions to sustainability transitions. The first contribution was to incorporate the complex and dynamic interactions of the different actors to conceptualise successful sustainability transitions. The barriers identified from these different sources resulted in the second contribution: a tactical framework that can enable textile industries to be more sustainable through green innovation implementation. Realistically, the water-free dyeing technology cannot alter the processes of the entire dyeing industry. This is because some applications require dyeing of the fibres at early stages of production (dope dyeing of yarns for example) or applications where volumes of production are very high. However, there is a large potential for this technology in the future. The costs of this radical technology will reduce through economies of scale if products in other areas of application (as mentioned in Sect. 2.3) are produced in large quantities.

The study focused on the textile industry in the EU, but the results could also be applicable in other countries as it is assumed that similar barriers to sustainability transition exist there as well, with different regulations and policies putting pressure on the incumbents.

It is noteworthy to mention that technology cannot be the only enabler to address the negative impacts of textile industries. Sustainability transitions can only be successful if the technological changes are communicated and accepted by the different encompassing stakeholders of this industrial structure who have different values and priorities in their own agendas, by allowing transparent collaborations to bring about mutual benefits.

17.6 Conclusions

The results from this research enabled the formulation of a framework to address the increasing number of sustainability problems such as regulations, costs, technology maturity levels and highly structured organizational processes associated within the regimes of the textile industry domain.

The DyeCoo case study is exemplary to showcase how industries who are willing to implement clean technology innovations, can follow a proactive approach for decision making for sustainability. The prescriptive framework suggests that industries should 'sense' customer and planetary requirements among others and go beyond defensive and reactive sustainability performance measures for regulatory compliance. They should 'adopt' proactive long-term sustainability improvements to align with their sustainability strategies in light of rapid technological advancements. The measures taken should not only impact the organization internally, but also those who are outside direct impact, i.e., the entire value chain, thus bringing about transparent collaborations and operations. It will then be possible for incumbent firms in the textile industrial domain to move away from path dependencies and 'transform' into sustainable value-creating organisations by reducing costs along with building a strong multi-level shareholder network. The framework acts as a foundation in improving an organization's priorities and will be further developed in future work to include data quality and availability for multi-criteria decision analysis in sustainability performance measurement.

Acknowledgements The authors would like to thank DyeCoo, The Swedish School of Textiles at Borås, JOIN and TEKO (Sweden's Textile and Fashion Company) for their valuable input in this study. The research was part of the project ClimaDye, financially supported by Climate-KIC and the ongoing project ReWind, funded by the programme Produktion2030 within the Swedish Agency for Innovation Systems (Vinnova).

References

Ackermann F, Eden C (2011) Strategic management of stakeholders: theory and practice. Long Range Plann 44(3):179–196

Ansoff H, McDonnell E (1986) The new corporate strategy. Sidgwick & Jackson

Armenakis A (1999) Organizational change: a review of theory and research in the 1990s. J Manage 25(3):293–315

Bocken N, Short S, Rana P, Evans S (2013) A value mapping tool for sustainable business modelling. Corp Gov 13(5):482–497

Choudhury AKR (2014) Environmental impacts of the textile industry and its assessment through life cycle assessment

Cid MVF, Van Spronsen J, Van Der Kraan M, Veugelers WJT, Woerlee GF (2005) Excellent dye fixation on cotton dyed in supercritical carbon dioxide using fluorotriazine reactive dyes, pp 609–616

Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC (2009) Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci 4(1):1–15

Deradjat D, Minshall T (2017) Implementation of rapid manufacturing for mass customisation. J Manuf Technol Manag 28(1):95–121

DyeCoo (2012) DyeCoo CO_2 dyeing technology

Elkington J (1998) Partnerships from Cannibals with forks: the triple iottom line of 21st Century Business, pp 37–51

Ellen MacArthur Foundation (2016) Intelligent assets: Unlocking the circular economy potential. Ellen MacArthur Found. pp 1–25

Elmualim A, Shockley D, Valle R, Ludlow G, Shah S (2010) Barriers and commitment of facilities management profession to the sustainability agenda. Build Environ 45(1):58–64
EMF (2017) A new textiles economy: redesigning fashion's future. Ellen MacArthur Foundation
Epstein MJ, Buhovac AR (2010) Solving the sustainability implementation challenge. Organ Dyn 39(4):306–315
Fages J et al (2018) Particle generation for pharmaceutical applications using supercritical fluid technology, no. 01668423
Farla J, Markard J, Raven R, Coenen L (2012) Sustainability transitions in the making: a closer look at actors, strategies and resources. Technol Forecast Soc Change 79(6):991–998
Frambach RT, Schillewaert N (1999) Organizational innovation adoption : a multi-level framework of determinants and opportunities for future research 3004(814):163–176
Franco M (2002) Sectoral systems of innovation and production. Res Policy 31(2):247–264
Geels F (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res Policy 31:1257–1274
Geels FW (2004) From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Res Policy 33(6–7):897–920
Geels FW (2012) A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. J Transp Geogr 24:471–482
Geels FW, B, Sovacool BK, Schwanen T, Sorrell S (2017) The socio-technical dynamics of low-carbon transitions. Joule 1(3):463–479
Hart SL, Milstein MB (2003) Creating sustainable value. Acad Manag Exec 17(2):56–67
Hedenus F, Persson M, Sprei F (2015), Sustainable development, nuances and perspectives
Hekkert MP, Suurs RAA, Negro SO, Kuhlmann S, Smits REHM (2007) Functions of innovation systems: a new approach for analysing technological change. Technol Forecast Soc Change 74(4):413–432
Hongyang L, Fang Y, Yan H (2019) A study on the stakeholder influences during green building operation in China. ICCREM 2018:113–117
Houston J, Casazza E, Briguglio M, Spiteri J (2018) Enablers and barriers to a circular economy, no 730378, pp 1–30
Judson AS (1991) Invest in a high-yield strategic plan. J Bus Strategy 12(4):34–39
Klein KJ, Sorra JS (1996) The challenge of innovation implementation. Acad Manag Rev 21(4):1055–1080
Kotter JP (1995) Leading change, Why transformation efforts fail. Harvard Bus Rev (73):59–67
Kotter J, Schlesinger LA (2009) Choosing Strategies for Change—HBR.org, pp 1–8
Lahtinen S, Yrjölä M (2019) Managing sustainability transformations: a managerial framing approach. J Clean Prod 223:815–825
Lang Q, Wai CM (2001) Supercritical fluid extraction in herbal and natural product studies-a practical review. Talanta 53(4):771–782
Loorbach D (2010) Transition management for sustainable development: a prescriptive. Complex-Based Governance Framework 23(1):161–183
Luo X et al (2018) Novel sustainable synthesis of dyes for clean dyeing of wool and cotton fibres in supercritical carbon dioxide. J Clean Prod 199:1–10
Mok KY, Shen GQ, Yang R (2018) Stakeholder complexity in large scale green building projects: a holistic analysis towards a better understanding. Eng Constr Archit Manag 25(11):1454–1474
Moldavska A (2016) Model-based sustainability assessment—an enabler for transition to sustainable manufacturing. Proc CIRP 48(2):413–418
Nagji B, Tuff G (2012) Managing your innovation portfolio, vol 90
Orji IJ (2019) Examining barriers to organizational change for sustainability and drivers of sustainable performance in the metal manufacturing industry. Resour Conserv Recycl 140:102–114
Oxborrow L, Goworek H, Claxton S, Cooper T, Hill H, McLaren A (2017) Managing sustainability in the fashion business exploring challenges in product development for clothing longevity, vol 2017

Penna CCR, Geels FW (2012) Multi-dimensional struggles in the greening of industry: a dialectic issue lifecycle model and case study. Technol Forecast Soc Change 79(6):999–1020
Pham H, Kim SY, Van Luu T (2019) Managerial perceptions on barriers to sustainable construction in developing countries: Vietnam case. Environ Dev Sustain (0123456789)
Quantis (2008) Measuring Fashion 2018: Environmental Impact of the Global Apparel and Footwear Industries Study Full report and methodological considerations
Reed MS (2008) Stakeholder participation for environmental management: a literature review. Biol Conserv 141(10):2417–2431
Revell A, Blackburn R (2007) The business case for sustainability in UK's construction and restaurant sectors. Bus Strateg Environ 16(October):404–420
Rip A, René K (1997) Technological change. Trade Unions Technol Chang 327–399
Ritzén S, Sandström GÖ (2017) Barriers to the circular economy—integration of perspectives and domains. Procedia CIRP 64:7–12
Sammut-Bonnici T, Galea D (2015) PEST analysis
Stål HI, Corvellec H (2018) A decoupling perspective on circular business model implementation: illustrations from Swedish apparel. J Clean Prod 171:630–643
Stubbs C, Cocklin W (2008) Conceptualizing a sustinable business model. Organ Environ 21(2):103–127
Teece DJ (2007) Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg Manag J 28(13):1319–1350
Turnheim B et al (2019) An agenda for sustainability transitions research: state of the art and future directions. Environ Innov Soc Transit 1–66
Üzer S, Akman U, Hortaçsu Ö (2006) Polymer swelling and impregnation using supercritical CO_2: a model-component study towards producing controlled-release drugs. J Supercrit Fluids 38(1):119–128
Van De Ven AH (1986) Central problems in the management of innovation. Manage Sci 32(5):590–607
Van Den Bergh JCJM, Truffer B, Kallis G (2011) Environmental innovation and societal transitions: introduction and overview. Environ Innov Soc Transit 1(1):1–23
Van Duin R, Slabbekoorn M, Tavasszy L, Quak H (2017) Identifying dominant stakeholder perspectives on urban freight policies: a Q-analysis on urban consolidation centres in the Netherlands. Transport 33(4):867–880
Voss CA (1988) Implementation: A key issue in manufacturing technology: the need for a field of study. Res Policy 17(2):55–63
Welp M, Vega-Leinert A, Stoll-Kleemann S, Jaeger CC (2006) Science-based stakeholder dialogues: theories and tools. Glob Environ Chang 16(2):170–181
Williams K, Dair C (2007) What is stopping sustainable building in England? Barriers experienced by stakeholders in delivering sustainable developments. Sust Dev 147:135–147
Wittmayer JM, Avelino F, Van Steenbergen F, Loorbach D (2017) Actor roles in transition: insights from sociological perspectives. Environ Innov Soc Transit 24:45–56
Yin RK (2009) Case study research : design and methods, 4th edn. SAGE