

Chapter 11

Sustainable Innovation in the Apparel Supply Chain: Case Study on TAL Apparel Limited

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Abstract Sustainability has become a critical trend for US and European fashion industry, it led the retail brands to pressure manufacturers to operate in a more sustainable and socially responsible manner. However, TAL is a manufacturer that proactively embraced the concept of sustainable production without the pressure of their clients and remains one of the world leaders in sustainable manufacturing movement. TAL established its own detailed internal standards of environmental and social governance, that make sustainability an integral part of all aspects of its business; from environmentally sustainable manufacturing facilities, safe working environment, active employee engagement to supplier management. They further engage in industry wide collaborations that include participation in Sustainable Apparel Coalition and production of recycled cotton clothing collection with Patagonia. In this case study, we attempt to add to the current knowledge of sustainable supply chain management by providing an example of sustainable manufacturing model using the Sustainable Supply Chain Network Innovation Model. Data was collected through the use of secondary data and semi-structured interviews with the executive officers, Dr. Delman Lee, President and CTO and Christelle Esquirol, Vice President of Sustainability of TAL Apparel Group.

Keywords TAL · Sustainable innovation · Apparel supply chain

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11.1 Introduction

Today's consumer can be perceived as rather contradictory, with disposable fashion in high demand while requiring more transparency from retailers as it relates to manufacturing. Contradictory as it may be, with the sustainable movement going from grassroots programs to mainstream news, more fashion brands are interested in taking a strong initiative to improve environmental and social conditions along all sections of the supply chain, including fiber cultivation, garment manufacturing, shipment of finished product, and disposal of garments. Since sustainability has been the key trend in the retailing industry, the continuous improvement in the supply chain has been acknowledged as one of the most reported initiative (Kotzab et al. 2011). Therefore, it is critical for the retailers to be engaged in sustainable supply chain management and actively seek and partner with overseas manufacturers that are innovating the manufacturing process to be environmentally, economically, and socially sustainable. On the supplier side, a more proactive green supply chain practice can be brought upon by the rationalization of the supply base.

According to Van Bommel (2011)'s Sustainable Supply Network Innovation framework, *innovative pressures* (e.g. government policies, customer demands, response to stakeholders, competitive advantage, pressure groups, and reputation loss) and *innovation power* (i.e. innovation characteristics of the "focal" company and cooperative characteristics of the supply network) start the implementation process of *sustainable strategy* (i.e. resign, defensive, or offensive), *activities*, and *performance* in a supply chain. While his framework focuses on buyers and their relationship with the suppliers, this research presents a case study to illustrate the sustainable innovation process at the supplier level, applying the sustainable supply network innovation framework to the production source. The case is developed by collecting data through the use of secondary data and semi-structured interviews with the executive officers, Dr. Delman Lee, President and CTO and Christelle Esquirol, Vice President of Sustainability, of the focal company, TAL Apparel Group. Secondary data was collected through TAL's press release, their website, news reports and TAL Sustainability Report (2014).¹

11.2 Literature Review: Sustainable Supply Chain Innovation

Sustainable supply chain concerns the "management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and

¹List of websites are presented at the end of the article.

stakeholder requirements” (Seuring and Müller 2008, p. 1700). Sustainable Supply Chain Management (SSCM) is defined as “the strategic, transparent integration and achievement of an organization’s social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains” (Carter and Rogers 2008, p. 368). SSCM is characterized by the explicit integration of environmental and social objectives that extend the economic dimension to integrate environmental and social considerations (Tseng 2013).

Supply Chain Innovation (SCI) is defined as “an integrated change from incremental to radical changes in product, process, marketing, technology, resource and/or organization, which are associated with all related parties, covering all related functions in supply chain and creating value for all stakeholders” (Gao et al. 2017, p. 1530). When the supply chain innovation results in balanced performance of economic, social and environmental dimensions, where all three dimensions have positive innovation performance, Sustainable Supply Chain Innovation (SSCI) is achieved (Gao et al. 2017). Innovation is one of the main drivers in the strategic orientation of a company (Paraschiv et al. 2012). Therefore, when sustainable development is given consideration in the process of integrating innovation into corporate strategy, the process becomes a path toward socio-ecological co-creation that is also highly consistent with the corporate’s desired business outcome (Brown 2008). As innovations in terms of corporate sustainability “present the opportunity for firms [...] to reposition their internal competencies around more sustainable technologies”, it remains as a critical element in establishing strategic advantage for the firm (Hart and Milstein 2003, p. 62). Therefore, companies must be able to drive innovation in terms of both corporate sustainability and their core strategy (Milton de Sousa Filho et al. 2010) in order to achieve strategic advantage. In addition, Baumgartner (2014) states that innovations and continuous improvement are necessary for corporate sustainability as part of strategic management. The linkage between the innovative firm and its supply chain is even more important when one considers that a sustainable supply chain is one of the few remaining ways for a company to achieve a sustainable competitive advantage (Damanpour 1991); hence, sustainable innovations need to extend beyond one individual firm to a connected supply chain of firms.

In introducing Sustainable Supply Network Innovation framework, Van Bommel (2011) maintains that supply chains should be regarded as complex network of participating organization with many linkages among and between the actors, rather than a linear chain. As a result, the relations between the different actors have become extremely complex and diverse. According to Van Bommel (2011)’s framework, the first element focuses on the *innovation characteristics* of the “focal” company. The second element includes the *cooperative characteristics* of the supply network. Together these two elements can be seen as the *innovation power* of the focal company and its supply network, and represent the capability of the focal company to react to the *innovation pressure* (Omta 2002, 2004). Examples of factors used to characterize the innovation power of the focal company include; external orientation and transparency, interdisciplinary and cross-functional

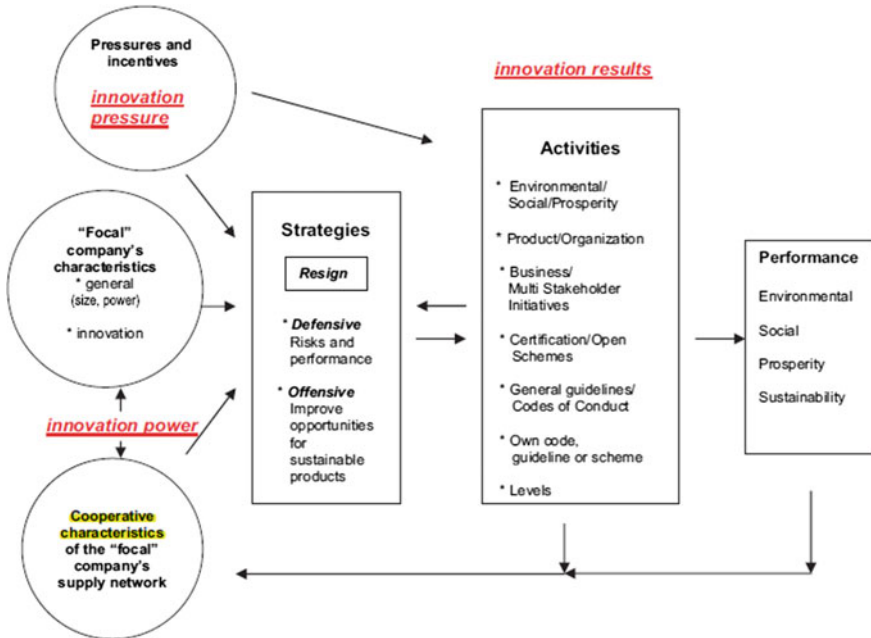


Fig. 11.1 The implementation of sustainability in supply networks from an innovation perspective (Van Bommel 2011)

cooperation between the departments, capacity of an organization to learn about the business-natural environment and to manage this knowledge, leadership, autonomy and possibility for experimenting, and the capability of the focal company to react (Van Bommel 2011). See Fig. 11.1 for the Sustainable Supply Network Innovation framework proposed by Van Bommel.

According to Gao et al. (2017), the development of sustainable supply chain innovation in the literature present partial or fractional views when evaluated from the perspective of the various actors within the supply chain. In previous literature, the role of the focal company is usually given to Western brands or retailers who are towards the end of the channel (Lambert and Cooper 2000). Most studies have mainly focused on buyers as focal companies and how they interact with suppliers (e.g., Vale 2004; Wong et al. 2013; Wuttke et al. 2013). Further, some studies give limited perspective regarding the three dimensions of sustainable development (Gao et al. 2017), mainly arguing the environmental dimension of sustainability known as green innovation or eco-innovation (e.g., Chiou et al. 2011; Seman et al. 2012; Wu 2013; Zhu et al. 2012). However, different actors within the supply chain with various responsible functions may have different insights on sustainable innovation depending on how it is perceived to affect their business (Hassini et al. (2012).

In order to better illustrate the social and environmental innovation within the supply chain, collaboration among the different players with the supply network

should be noted as key element to success (Gao et al. 2012). Collaborative relationship among the upstream and downstream parties in the supply chain is critical in achieving significant change and conquering the barriers in innovation process such as high-cost pressure, a shortened project cycle and increased competition (Gao et al. 2012). Lee (2010) presents a successful case of supply chain collaboration where companies such as Hewlett Packard, Electrolux, Sony and Braun reduced the recycling and disposal cost by 35% by developing a common European Recycling Platform. Further, collaborative planning, forecasting and replenishment systems help organizations to easily overcome financial barriers, which lead to the successful achievement of sustainability initiatives in supply chain (Attaran and Attaran, 2007). Grekova et al. (2016) suggest that supplier collaboration can enhance the buying firm's performance both directly (Zhu et al. 2007; De Giovanni 2012) and indirectly (Dyer and Singh 1998) by stimulating the firm to invest in and implement more sustainable processes that influence the firm's performance. While the importance of cooperative characteristics is well studied with the literature, the role of focal company is mainly given to the buyer where sustainable action is initiated by the Western brands and retailers rather than suppliers. Therefore, current study aims to extend the Sustainable Supply Network Innovation framework to focus on the source of production, the manufacturers, and present a case of collaborative relationship within the supply network in achieving successful SSCI strategy with balanced approach in all three dimensions of sustainability.

11.3 Innovation Strategy: TAL the Innovative Manufacturer

TAL Apparel was founded in Hong Kong in 1947 and has profited off of a strong reputation of manufacturing shirts, blouse, trousers, men's suits, and outerwear. It manufactures in 10 factories located in 5 different countries, producing over 50 million garments a year. TAL produces roughly one out of every six men's shirts that is currently being sold in the USA as well as selling a wide range of clothing around in Europe and Asia. The company's customers include Brooks Brothers, Calvin Klein, Hugo Boss, JC Penney, Liz Claiborne, Nautica, Ralph Lauren, Talbots, Banana Republic, and Tommy Hilfiger, to name a few.

TAL views itself as an innovator in apparel manufacturing. TAL has focused a lot of efforts on Research & Development and these have resulted in a range of patented products including non-iron, non-wrinkle shirts as well as Deodorant technology that protect fabrics against bacteria and fungi. TAL's R&D team has between 15 and 20 staff, and collaborates from time to time with the Institute of Textiles & Clothing at the Hong Kong Polytechnic University. So far, the collaboration has brought forth a number of significant innovations in the development of textiles. TAL's most well-known innovations include their wrinkle-free technology, *SoftAL*[®] Process, which allows for production of a 100% cotton shirt that does not need ironing.

There's also the *SoftAL[®]Wool*, the world's first garment wet processed machine-washable, tumble-dryable 100%, wool trousers and *EZCOOL[®]*, which allows a garment to dry twice as fast as a normal cotton product. The *DriXpert[®]* fabric provides moisture management to keep the skin cool and dry regardless of exertion. While TAL has long been established and known for its technology, recently they've garnered attention for a new form of innovation: sustainable manufacturing.

In addition to leading the technological improvement in textiles industry, TAL has put tremendous focus on sustainability. Sustainability has become a critical trend for major US and European fashion brands and retailers, who pressure their manufacturers to operate in a more sustainable and socially responsible manner. However, TAL is a manufacturer that proactively embraced the concept of sustainable production without the pressure of their clients and remains one of the leaders in sustainable manufacturing movement. Through series of interviews, it was found that the sustainable innovation pressure from stakeholders and clients (i.e. retail brands) is not as significant as in the case of retail brands. Rather, the impact of the company's innovative characteristics and organizational culture played a larger role in sustainable innovation. Dr. Lee comments that "it has always been in (founder's) motto to be sustainable. Even before it became a trend, he believed in conserving water, using less paper, and saving energy in our operation." Further, Esquirol adds that while factory audit is required by the clients, "companies will always find cheaper countries to produce and will move on regardless of what (TAL) is doing in terms of sustainability." As a result, the strategies were more offensive than defensive. They believe it is important to conduct audits from within and make sustainability an integral part of every aspect of its manufacturing activities in order to differentiate themselves through process innovation; from environmentally sustainable manufacturing facilities, safe working environment, and active employee engagement to supplier management.

11.4 Leveraging Network of Support and Co-creation

Through analyzing the case of TAL, this study proposes *innovation support* from internal and external stakeholders to be a critical force for manufacturer's innovation power. In addition, TAL has initiated a model of *innovation co-creation* through the partnership with and support from the stakeholders within their supply network. While the current model gives more focus to the activities and performance measured from the perspective of the focal company, innovation co-creation enables the model to view sustainable activities and performance as an outcome of the entire supply network that consists of multiple organizations. Further, several innovation co-creation effort initiated by the supplier/manufacturer provides new insight to the framework previously focused on buyers. Dr. Delman Lee, TAL's president and Chief Technology Officer who is guiding the company's sustainable approach in the entire business process, says that their participation in sustainable

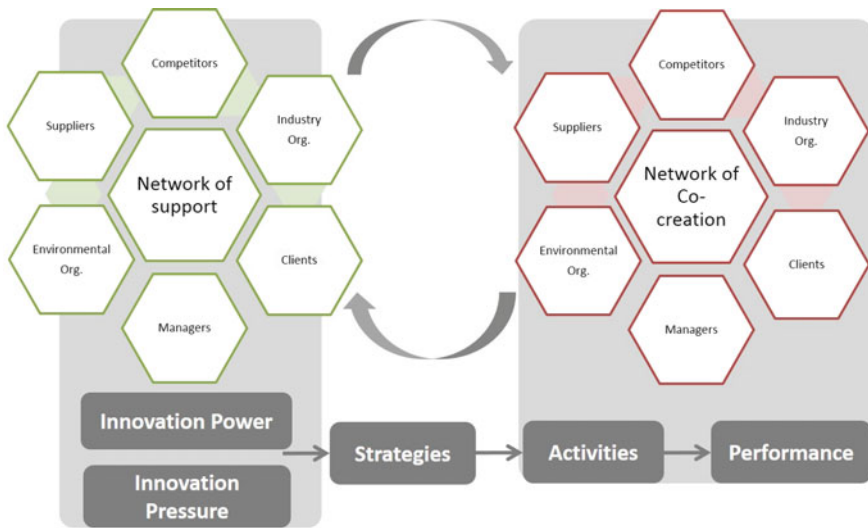


Fig. 11.2 Proposed Model of Sustainable Supply Network Innovation with an Emphasis on Network of support and Co-creation

innovation co-creation allows them the opportunity to interject in the conversation of creating processes for sustainable fashion production with manufacturer’s perspective. TAL does see their sustainable operation as a competitive advantage, as they believe consumers purchasing their shirts from their clients put value on supplier’s sustainability. In order to achieve this, TAL garnered network of support from various stakeholders (e.g., industry organizations, clients, suppliers, employees) and implemented sustainable innovation throughout its supply network which led to co-creation of innovation (Fig. 11.2). In the proposed framework, the importance of network of support is emphasized beyond the cooperative characteristics presented in the original framework, especially as the supplier is placed as a focal company. Network of support include various stakeholders and their networks that support and actively play a critical role in framing focal company’s innovation power. Further, network of co-creation presents that, when supplier is placed as an initiator of innovative practices, the outcome often is co-created with various stakeholders within the supply network. The following sections will address TAL’s strategic efforts and initiatives for garnering network of support to achieve innovation co-creation.

11.4.1 Shared Value with Suppliers

In order to ensure that the suppliers share the same value in sustainable production, TAL introduced Key Performance Indicators (KPIs) in 2014 through which they

monitor suppliers' performance. Through monthly KPI report, TAL tracks the quantity and quality of self-monitoring audits conducted by the supplier and further provide each supplier with constructive feedback on their performance. Esquirol says that KPI reports enable TAL to better manage their suppliers' performance with data driven approach. TAL's initiative on factory self-monitoring aims to provide the suppliers with knowledge of KPIs, and further promote a proper mindset of sustainability. The goal is not only for suppliers to be compliant with local and international compliance standards but to also develop auditing skills and put in place systems to address social compliance issues.

11.4.2 Employee Engagement

In earning support from their employees, TAL approaches their workers with a long-term relationship in mind. In order to better care of their employees that are spread in multiple regions, TAL developed various strategies to listen to their employees and improve the work environment. Ethics Hotline directly delivers employee grievances to the internal audit team, letting employees to express their concerns anonymously. Big Sister Program launched in 2008 help new workers and provide communication channel for factory employees to share concerns related to worker treatment. Currently, it has evolved to a program that addresses various issues related to acclimating to factory life, community concerns, and overall everyday life matters, utilizing social media and face-to-face exchange.

Foreign migrant workers in factories is another focus area in TAL's social sustainability strategy. Due to the vulnerability of these workers, they are exposed in situation that can seriously harm their quality of living. In Malaysia, TAL has put efforts to enhance the quality of life of the workers, helping them in ways that go beyond the usual practices expected for the employers. Majority of TAL's manufacturing workforce in Malaysia is comprised of foreign migrant workers recruited through third party recruiting agencies. Through interviews with these workers, TAL found that there are unethical practices that exist in the fee payment process as the procedure set by the agencies often times lacked transparency; after foreign migrant workers pay recruitment fees to these agencies, they are not provided with a balance sheet with the exact amount and the interest rates they were charged. In order to address this issue, TAL worked with labor recruiting agencies to set up specific requirements for them to be transparent in their operations and recruitment process. Further, TAL took the initiative to change the recruitment fee payment system where TAL pays the recruitment fees upfront to the recruitment agency and then provides a payment plan where the foreign workers pay back TAL for the fee amount each month. In addition, free accommodation is provided to foreign workers and a checklist in relation to the quality of the housing issued by the

factory team to perform regular audits. Continuous effort is made to ensure the quality living condition of the foreign workers by implementing a housing maintenance system to launch maintenance requests.

TAL also supports continuous training of their employees and has developed various programs to encourage workers in advancing their skillset. For example, Functional Skilled Knowledge (FSK) program focuses on technical skills for critical production roles. Professionals such as garment technicians and supervisory individuals such as quality control inspectors are enrolled in year-long courses to improve production efficiency and quality in relation to sewing techniques and machine maintenance. In 2014, 69 employees from the 2 pilot factories completed the training and by the end of 2014, FSK was launched in all factories with 559 enrolled employees. TAL also began to develop FSK training for non-production roles to build up product knowledge for the sales teams.

Further, TAL introduced 9 Managerial Leadership Competencies (MLCs) in 2010 to educate the employees, especially in supervisory and managerial role. This program encourages employees to learn specific behaviors that enhance their performance and apply the concepts at the workplace. In order to achieve this, TAL implemented strategies to reinforce MLC training through various activities (e.g., a writing competition and an experience sharing session) along with classroom training. Train-the-trainer activities were conducted to create MLCs Advocates who then drive the learning climate for MLCs in different TAL sites.

11.4.3 Industry Collaboration Through Sustainable Apparel Coalition

Further, the cooperation characteristics was found not only to be the antecedent of the implementation of sustainable strategies but also a co-created outcome. As TAL implemented a sustainable manufacturing program, their retailer partners started to seek cooperative partnership to develop a sustainable audit program to be used for other suppliers as well. In March of 2011, TAL was invited to become one of the initiating members of a global initiative, the Sustainable Apparel Coalition (SAC) due to the recognition for its work in the research and development of green textiles. Focus of the SAC is on reducing the environmental and social impact of apparel and footwear products using a collaborative approach with the hope of influencing the industry around the world.

One of SAC's goal is to successfully design a pre-competitive, universal index named Higg index to measure and benchmark sustainable practices and products for use by the entire apparel and footwear supply chain. Eventually, SAC hopes to use this index to create a consumer label that can be placed on individual products to inform consumers about the apparel's sustainability rating. Supported by the U.S. environmental Protection Agency as well as academic experts, SAC comprises of leading

apparel and footwear brands, retailers, manufacturers, Non-Governmental Organizations (NGOs). These include major brands such as Adidas, Wal-Mart, H&M, Marks & Spencer, Levi Strauss, Gap, JC Penney, Hong Kong-based brands Esprit and Esquel as well as the Duke University's Center for Sustainability & Commerce. TAL is among SAC's 33 founding enterprises, and among three manufacturers within the group.

Through the inclusion of institutions throughout the supply chain, SAC was able to establish the Equal Partnership concept to be at the center of the SAC agenda. While some manufacturers like TAL already have developed a sustainability strategy, many brands and retailers bring a rather top down approach when they discuss sustainability with their suppliers, demanding suppliers to comply with their own specific list of requirements. This resulted in suppliers needing to deal with multiple audits and overlapping requirements from clients and eventually led to lack of ownership of the sustainability program. Through TAL's effort in communicating equal partnership in SAC, SAC promotes respect and consideration of the supplier's existing sustainability program and further brings acknowledgement of the unequal approach that inhibits suppliers from being included as a proactive member of the sustainable development.

11.4.4 Producing Recycled Cotton Clothing Line with Patagonia

TAL's sustainability program extends to the reduction of fabric waste and production of recycled cotton. For this project, TAL initiated a proposal to several brands with the recycled cotton concept in 2011. Partnering with Patagonia for their recycled cotton clothing collection called "Truth to Material" introduced in 2014, TAL was able to contribute in closing the loop by producing recycled cotton fabric using fabric remnants. In the process, cotton remnants collected from the factories are turned into loose fibers, and spun into new yarn which is then weaved or knitted into recycled fabric used in garment production. TAL's study estimates that leftovers from 16 virgin cotton shirts can generate sufficient remnant for one recycled cotton shirt. Over 2013 and 2014, TAL collected close to 100 tons of cotton scraps and sold over 13,000 garments.

According to Dr. Lee, the challenge still lies in that most of the fashion brands do not embrace the concept of recycled fabric as its color cannot be guaranteed to be within industrial standard tolerance. While white-colored remnants are separated from dominant colors such as red and blue in the sorting process in order to ensure maximum consistency, the recycling process leaves the fibers with a greyish color. The process also restricts the range of color variety of the recycled fabric. Further, recycled yarns are generally of lower quality compared to virgin cotton yarns, as the fiber unraveling process shortens fiber length and the recycled yarns are a blend of fibers of different qualities.

Besides the difficulty in keeping the color and fabric quality consistent, there is also an issue of scaling the production. Recycled cotton fabric is more expensive than conventional cotton as the infrastructure and processes to reclaim and recycle material are not widespread and at scale yet. Production of recycled garments requires participation of various interlinked channels in the supply chain. For example, cotton-recycling companies need manufacturers like TAL to supply cotton remnants but also need retailers like Patagonia to use the fabric in design and manufacturers to be able to produce such garment. Therefore, cooperation and shared value among multiple parties is required in an effort to bring recycled cotton clothing to the market.

While the collaboration between Patagonia and TAL in 2014 can be noted as a significant move toward sustainable production, the future of recycled cotton production depends on consumer acceptance of the concept. Dr. Lee says, “I believe retailers need to feel confident about the appeal of sustainable products to consumers. For example, it is cool that the garment has some blemishes in it, because it is making a statement about what the wearer believes in. We continue to pitch the concept and I am happy to say that another customer expressed an interest in it recently.”

11.4.5 Collaboration with Environmental Organizations

Multiple strategies are required when building up an environmentally friendly facility, including landscape building, waste water management, green house gas emission control and energy saving. As a supporting member of a World Wildlife Fund program to lower carbon emissions in manufacturing, one of TAL’s factories participated in a test that won the company a Silver Label for its practices in recycling, exhaust emission management and energy-efficient facilities and procedures. TAL was also one of two apparel manufacturers to participate in a worldwide test under a greenhouse gas protocol initiative, which involved reporting its carbon footprint for manufacturing garments on a cradle-to-grave basis. Further, TAL received LEED (Leadership in Energy and Environmental Design) Gold standard in their Vietnam factory and further renovated their Hong Kong headquarters using the LEED Commercial Interiors standard in 2014. LEED features in their office include; LED light panels, low-flow faucets, eco-friendly housekeeping products, and furniture containing regional FSC certified wood, recycled metal and recycled plastic manufactured within the region.

Since TAL established their plan to reduce water consumption in their factories in 2011, they have evolved their program from water reuse to waste water recycling. In one of their facilities located in Dongguan, the company has invested over US \$3.2 million for the environmentally friendly infrastructure. In this specific facility, the water treatment surpasses international standards. With a total area of 1760 m², it has a treatment capacity of 2000 tons per day. After removing harmful substances and pollutants, the water is best recycled to save the use of clean water.

For this reason, the company has built a huge outdoor water storage tank, largest in Guangdong province, made of stainless steel and materials used to build a submarine. With this tank, it is able to effectively recycle water to flower the greenery within the factory area and for toilet flush. About 35% of the total area of the facility is landscaped to contribute to a more comfortable working environment.

TAL's actions for efficient use of energy are to reduce energy consumption, as well as the production's impact on the environment. To monitor electricity consumption, managers had meters installed at various stages of the production line to measure energy consumption and flow and redirect generated heat and steam to areas that can be used. By reusing dissipation heat from steam system to preheat water for domestic use (e.g., showering of staff in the nearby dormitory) via application of heat exchanger system, the company is able to save 200 tons of water and 1200 L diesel each working day. This translates into a reduced cost of up to US \$ 395 per day. In addition, it reduces electricity consumption through even distribution of lighting and the application of light reflectors. Further, an online energy monitoring system is installed in their factory to monitor energy of each machine, allowing them to identify any machine that may be malfunctioning, inefficient or idle. This system eventually led to an estimated energy savings of 5%.

TAL has adopted various emissions control strategies, including installing systems to minimize the energy usage and emission during wet process and placing secondary insulation covers for high temperature machine. Further, TAL is increasing the proportion of light fuel oil and natural gas because their emission factors are lower while decreasing the use of heavy oil.

In order to monitor the environmental impact of the facilities' manufacturing process and prioritize the action plan, TAL has started to perform Environmental Aspect Impact Assessment (EAIA) to identify all environmental impacts at every step of the production process. Incorporating the EAIA methodology, each production activities such as cutting, sewing, ironing, washing and wet process are examined in terms of the type of activities related to environmental aspects, such as transportation, energy, waste production, air emissions, water use or discharge, noise and nuisance and land use. Afterwards, the activities are matched with impacts on air, water, ground and underground water and other natural resources. This analysis is to help TAL develop a robust action plan and to prioritize depending on their risks.

11.5 Challenges and Future Ahead

While sustainability has been acknowledged as a core value across various industries and in different levels of supply chain, one of the biggest challenges is that there are different perspectives and opinions when it comes to measurements and standards. Therefore, manufacturers can end up in difficult situations as apparel

brands often have contradicting values and policies. However, with the development of the standardized measurement and label such as Higg index, “there is much hope in what Asian manufacturers can contribute to environmental sustainability”, Dr. Lee says.

In addition, Dr. Lee admits that these practices were not without some resistance at the factory level. Since they have to meet certain production standards, sustainability program could be perceived as additional burden, Dr. Lee says. However, they are continuing to communicate the importance of sustainable practices, while also linking the program to reduced energy bills, which can also be part of the incentive scheme.

Further, the threat lies in the fundamental issue of the pricing system set in the retailing industry. According to Esquirol, manufacturers like TAL has limited ability to address full spectrum of the issue in sustainable production as the apparel industry pushes manufacturers to work on a very small margin. Esquirol says “Our margins are so small that ... it makes it always more difficult for us to make heavy investment in important hardware essential to our sustainability efforts.” “Retailers claim it is the consumer that keep asking for a lower price. To the defense of the consumers, if they are not explained the price distinction between a manufacturer with or without a Waste Water Treatment Plant (or below or above the minimum wage), I think they will continue to buy things on sale and ask for lower pricing,” she adds. TAL’s sustainable practices would be valued and integrated into the designing process and pricing structure only when consumers demand it. Dr. Lee and Esquirol therefore insist that it is consumers that can make a change in the apparel industry.

In their future endeavor, TAL plans to continue their efforts in contributing to environmental and social sustainability and refine their actions moving forward. For example, while TAL have set their own GHG and water footprint targets before, they have also adopted the Sustainable Apparel Coalition (SAC) Higg Index framework, and set their targets to improve our Higg score in all areas of sustainability.

In order to continue to include suppliers in their effort to streamline the supply chain, TAL plans to improve the Sales and Operations Planning (S&OP) project to better utilize and to increase efficiency of the resources. According to Esquirol, TAL plans to extend the Vendor-Managed Inventory (VMI) concept that enable fabric suppliers to manage fabric stock and anticipate orders. “While some progress has been made in sharing forecast with our suppliers, there remains a lot of opportunities to create a more integrated supply chain. Specifically in enhancing the quality of data shared and ensuring that data is properly utilized to drive actions”, Esquirol says.

Also, TAL is seeking more opportunities in recycled cotton fabric with fashion brands and stays optimistic in finding partners that will share the same value in the project, according to Dr. Lee. He hopes to work with more brands to integrate environmental considerations into their product design and bring recycled fashion into the mainstream. Further, in order to scale the production, he claims that better system and infrastructure should be established in the industry of recycled cotton fabric and more recycling companies should enter into this realm.

11.6 Conclusions

While previous literature on Sustainable Supply Chain Innovation mainly focuses on buyers and its relationship with the suppliers, this research presents a case study to illustrate the sustainable innovation process at the supplier level, applying the Sustainable Supply Network Innovation framework to the production source.

As a manufacturer at the forefront of sustainable innovation, it is found that the sustainable innovation pressure from clients (i.e., retail brands) is not as significant as in the case of retail brands. The movement at TAL mainly comes from internal value systems, company's innovative characteristics (e.g. president's determination on technology and sustainability) and organizational culture. As a result, the strategies were more offensive than defensive. Further, TAL's innovation process proposes a critical element to the success of the model, *innovation network of support* and *innovation network of co-creation*. Cooperation characteristics was found not only to play a key support role for sustainable supply chain innovation but also shape the performance of the focal company in a form of innovation co-creation. TAL's sustainable supply chain innovation was leveraged by seeking innovation support from internal (e.g. employees and managers) and external stakeholders (e.g. suppliers, clients peer sustainability leaders and organizations). This has become a significant force for manufacturer's motivation for sustainable innovation. In addition, TAL implemented a sustainable manufacturing program and their retailer partners started to seek cooperative partnership to develop a sustainable production and audit program to be used for other suppliers as well (e.g., Patagonia).

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