PRACTICAL HANDBOOK

A Re-industrialization Roadmap for Hong Kong SMEs of the Textile and Fashion Industry

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香港毛織出口廠商會有限公司
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CLOTHING INDUSTRY TRAINING AUTHORITY

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Introduction

This handbook provides 20 different practical "business models" to the SMEs in upgrading their product and production processes. These models show the plans being used in some successful operations of real global and local companies (Hong Kong companies are labelled anonymously in this Handbook). Examples are given to illustrate how the advanced technologies e.g. fibre-recycle technologies could be used to develop new products.

In addition, many large-scale e-commerce platforms, big-brands as well as innovative startups have been extremely active in creating new technologies for online retailing, including virtual modelling, big data application and artificial intelligence. It is perceived that disruptive innovation will soon be dominating the fashion industry and such phenomenon will provide a good opportunity Hong Kong to be *re-industrialized*.

To further understand the upsurge of technology applications in this industry, the business models being applied in the selected global and local models, including three outstanding startup companies, are demonstrated under the three directions as identified in the Study Report as follows:

- Digitalized Manufacturing and Business Models
- Circular Economy and Resource Efficiency
- High Value Added Solutions

1. Digitalized Manufacturing and Business Models

Digitized manufacturing and digitally-enabled new business models have been identified as one potential technology trend for Hong Kong's re-industrialization of the fashion industry. The explosion in big data and new computing capabilities with advances in artificial intelligence, automation and robotics, and human-machine interaction will disrupt manufacturing. It is believed that digitalization will change the whole manufacturing value chain, from the supply chain and production processes to marketing and sales. Digitalization is connecting designers, workers, suppliers, buyers, consumer and physical industrial assets, and enables new value and landscape of manufacturing. In terms of digitized manufacturing and new digitally-enabled business models, different models are introduced to explore the potential development route.

1.1Digitalized manufacturing

Digitization is the automation of the traditional manual and paper-based processes, from analogue to digital form[1-2]. In today's fashion industry, digitized manufacturing has already been employed in some factories, and more and more companies have started paying attention to digitalization. In this section, some local models will be presented.

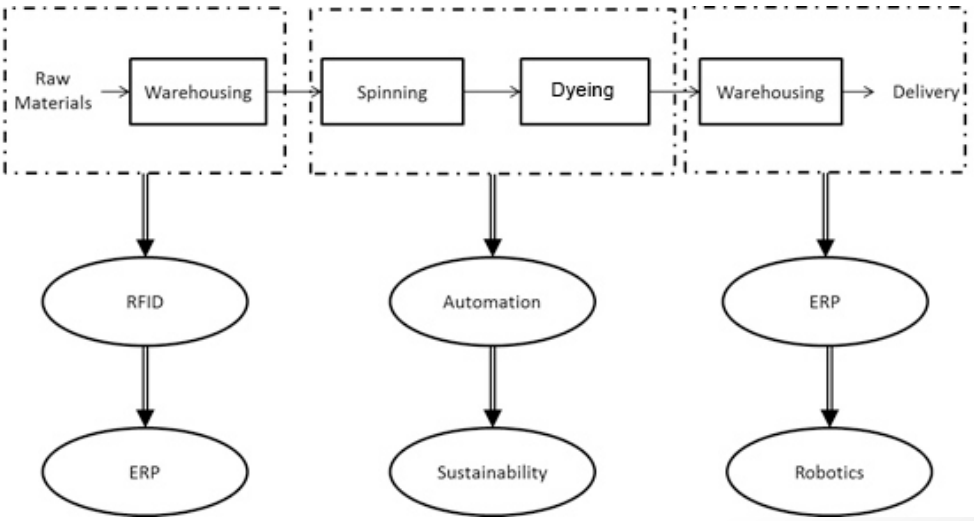
[1] https://www.i-scoop.eu/digitization-digitalization-digital-transformation-disruption/ [13-09-2018]

[2] https://www.gartner.com/it-glossary/?s=digitization [13-09-2018]

1.1.1 Company A

Company A is a Hong Kong based yarn spinning and dyeing producer with main factories in Mainland China. With technology and innovation investment in the past decade, it has become an innovative manufacturer highly relied on automation instead of intensive labor.

To increase the efficiency of production and reduce labor cost, the company has introduced automatic machinery for spinning, which replaced more than 2/3 of its workforce compared to traditional spinners. To better manage the inventory and enhance information visibility in the supply chain, it deployed RFID-based information system to tag ID number and storage location of spools of yarn. The RFID system helps the company reduce time and manpower resources for managing stock in the warehouse, and enables it to make appropriate decisions on sale and purchase. Besides, it has deployed smart warehouse technology, including robots and robotic arms for picking and moving yarns to replace intensive manpower, while shortening the time and increasing accuracy for shipment. To integrate different information across the whole production and sale chain, enterprise resource planning (ERP) has also been applied with customized features. The improvement of the production process is illustrated as follows.

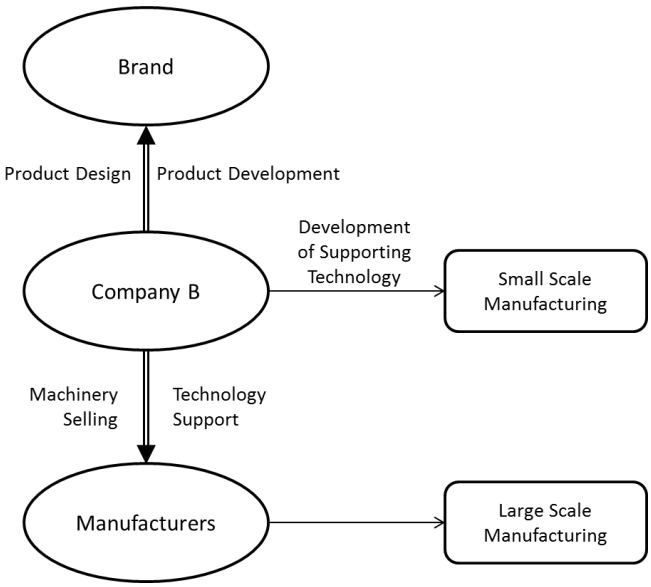


The company has been highly successful in adopting such technologies and demonstrates the importance of automation for traditional textile manufacturing. In recent years, many developed countries such as USA have started revival revolutions in the textile industry through automation and new technologies. With the application of digital technologies, the manufacturing sector of the fashion industry will become more intelligent and automatic, which will be the main trend for the production of fashion products in the future.

1.1.2 Company B

Company B has been a sales agent of textile machinery for several decades. It offers the world leading textile machinery in different brands to Mainland China and Hong Kong markets. With a deep understanding of updated textile technology, this company started to expand its business to product development, digitized manufacturing and technology support.

Manufacturers bought new textile machines to upgrade their manufacturing lines or to develop new products. However, workers sometimes just learnt some basic techniques to operate the machines, and which led many manufacturers facing the dilemma for production due to different raw material characteristics or special processing methods. With the strength of its in-depth textile technology and advanced machinery knowledge, the company collaborates with a number of brands to design and develop new products with innovative fabrications or materials as well as digitalized manufacturing methods. It takes responsibility for small-scale manufacturing and develops corresponding software and computing system to make the production process automated. Providing the whole set of machinery and supporting technologies, it resigns the manufacturers for large-scale manufacturing. The business model is illustrated as follows.



The development of the company has performed an important role in introducing automation and digitization to the traditional textile manufacturing industry. Taking advantage of knowledge and techniques of new textile machinery, it participates in the digitized manufacturing in small scale and provides practical and efficient technical support for mass manufacturing in large factories, through which it has urged the change of production process of new products and facilitated the new machinery application for the manufacturers.

1.1.3 Company C

Company C is a Hong Kong based manufacturer for denim products with factories in mainland China and Southeast Asia. Like many traditional Hong Kong manufacturers, it focuses on high-quality production and social responsibility and is good at global sourcing and supply chain management at the same time. Facing the changing industry and dynamic market, the company has taken some effective actions to adjust its business model.

First of all, it adapted itself to the new market demand as a co-creation manufacturer and has heavily invested in technologies from fabric development, fashion trends, washing technique development, embellishment of new innovations in design, manufacturing and management. For example, it has adopted smart technologies for denim 3D whiskers, with automated arms and programs to replace the traditional manual whiskering process and reduce usage of a chemical catalyst. On the other hand, it has applied RFID to track from raw materials to final products, which enabled the digitization of manufacturing. It also has introduced AI-controlled automation system to enhance the production efficiency in Southeast Asian factories, as well as 3D simulation design software and cloud database to shorten the lead time from design, prototype making to manufacturing. As introduced by the manager, the company has set Hong Kong as design and product development center, Mainland China as a production center for high quality and complicated process, and Southeast Asian as an automated mass production center. Nowadays, it has become practical to take advantages of different resources in different locations and manage various centers with new technologies in data management and automation. Besides, the company has launched its e-commerce business through various channels. For example, thanks to its high quality and fashionable products, it won the opportunities to cooperate with some famous online subscription service or personalization clothing box providers. It is also trying to build up a brand in main e-commerce platforms, like Amazon, T-Mall and other fashion buyer websites.

1.2 New digitally-enabled business models

Digitalization and digitization are two conceptual terms but often used interchangeably in a broad range. Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing

opportunities[3], in which data is at the center. With advanced digital technologies, traditional fashion companies start to change business operations, business models and even revenue streams. To embrace new business opportunities, many digital oriented startups appear and have achieved a varying degree of success.

In 2017, the number of brick-and-mortar stores collapsing into bankruptcy hit a new all-time high. More than 6,985 stores closed across the US by December[4], and according to Fung Global Retail & Technology, this is even worse than the estimated record during the 2008 financial crisis.

1.2.1 Company D

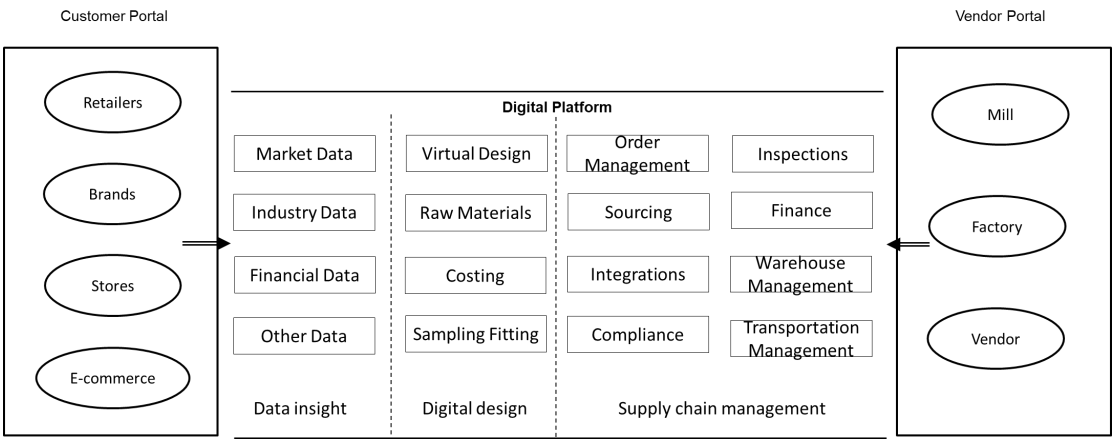
Company D is an international supply chain management company with actions and detailed plans for digitalization. It has invested in new technologies for years and is building a digitalized platform for global supply chain from raw materials at a mill to consumer behaviors, providing seamless data and information for customer needs.

As introduced by the technology director of the company, the fashion industry has fundamentally changed due to various technologies such as the Internet of Things, cloud computing, social media, mobile devices, data analytics as well as the changing consumer behaviors of millennials. More and more consumers heavily rely on smartphones and apps for life, from shipping, travelling, work and almost everything. The fashion supply chain should be digitalized to meet the new market

[3] https://www.gartner.com/it-glossary/?s=digitalization [13-09-2018]
[4]https://www.cnbc.com/2017/12/26/store-closures-rocked-retail-in-2017-and-more-should-come-next-year.html [05-30-2018]

demands and change the relationships and interconnections between material providers, designers, manufacturers, brands, retailers and end consumers.

The company aims to create a fully digital platform to connect stakeholders and every process together with data insights. It believes the future supply chain will be a multidimensional system where suppliers and vendors can connect to each other with transparency and data analytics. The system is illustrated as follows.



To realize this digital platform, some technologies have been addressed as the most important ones to develop and improve in the near future. First of all, data insight and market intelligence is the key factor for future supply chain management. For the fashion industry, many new problems emerge, like how to deliver the right product at the right time at the right price and to the right consumer in the right access with the right logistics, for which big data analytics can help. For example, the company is collecting customer data through in-store, mobile, e-commerce and customer service, and developing statistical modeling to forecast models for sales, inventory, risk analysis and shipment for logistics business. Different data will be shared with analytics to serve its customers including brands, retailers, suppliers and vendors on its digital platform. Secondly,

virtual design technology is essential for the future fashion supply chain bringing speed, innovation and digitalization. A virtual sample can be created in a much shorter time than traditional physical samples and has multiple iterations in colors and patterns for different user accounts. With virtual simulation, the sample can be virtualized how it looks, fits and moves on a real person. The technology makes the entire process from design to production faster and more efficient, and provides opportunity for global working and communication simultaneously. Besides, other technologies, such as 3D printing allowing personalized fashion come true, automation and robotics in warehouse and last mile delivery, and the Internet of Things connect billions of devices with big data analytics will facilitate the entire supply chain process to become digital in near future.

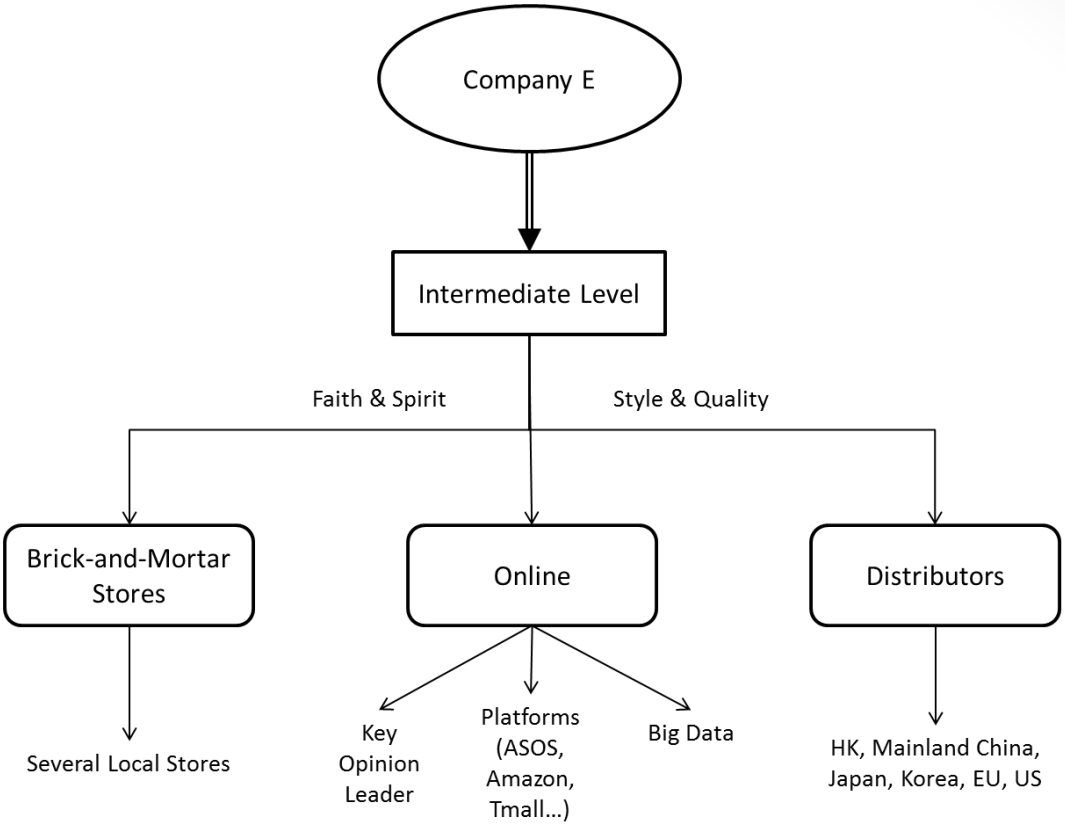
Company D is a pioneer in digital fashion supply chain management, and its business model has changed disruptively by using new technologies. It shows a possible framework of fashion supply chain in the near future and indicates the urgency of digitalization across different industry sectors for each fashion participant. From its experience, big data and analytics would become the core competitiveness of the industry in the very near future.

1.2.2 Company E

Company E is a local fashion brand. Enlightened by spirit and faith, the company founders created this brand around 10 years ago. The brand and its founders have high hope to deliver positive information to customers through fashion creations. In the past ten years, this brand faced with many critical problems, such as fierce competitions from fast fashion big brands and other niche brands in Europe and the US, the high rental cost in Hong Kong and the rise of e-commerce business.

Taking advantage of digitalization, they manage the brand well and successfully endure for a positive future.

The company has set their brand as intermediate level fashion in the route of spirit and faith for ladies aged around 25 to 35. Only several brick-and-mortar stores are in operation locally and with more than half of their supply completed by different distributors. Their target market includes Hong Kong, Mainland China, Japan, Korea and the US. On the other hand, the brand has invested to develop their e-commerce business. They invite a professional consultant to build an online store and launch fashion collections more agile than physical stores. Further engaged with the social media, they develop marketing strategies of *Key Opinion Leader* and big data analysis for website traffic etc. Besides, they also adopt alternative marketing methods such as stage shows to connect with customers through artistic activities. Without investment on brand spokesman, this local brand already attracted some stars for free promotions. Representing a unique model of small fashion branding, this company's business model is illustrated as follows.



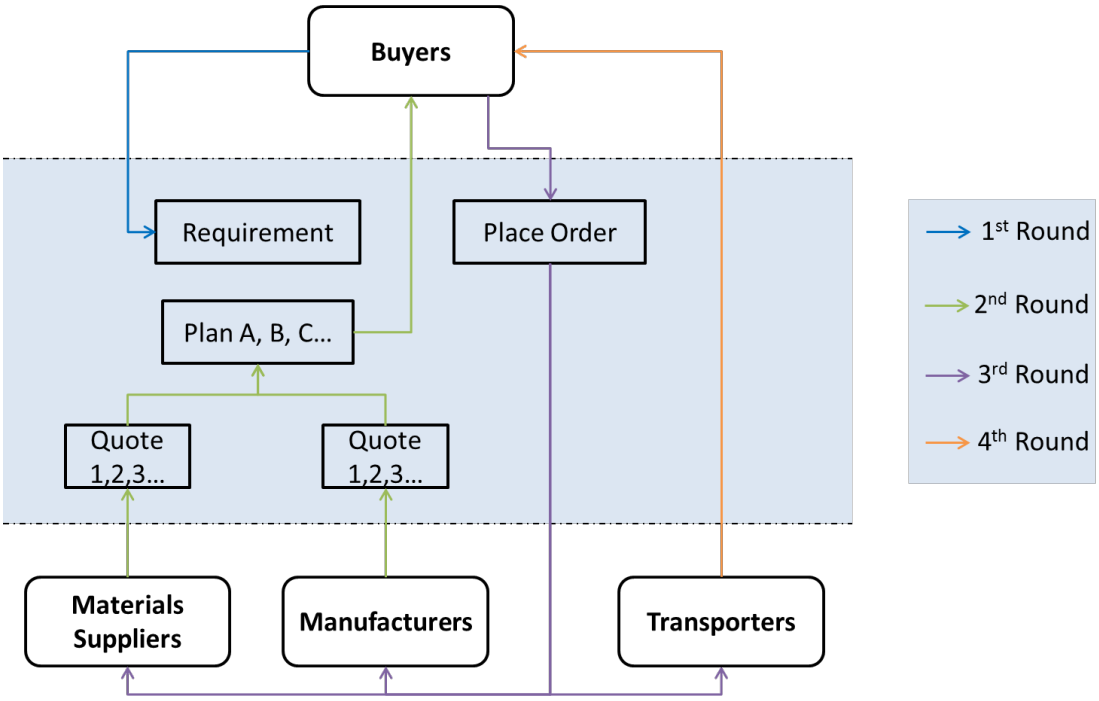
The company is a typical digitalized fashion brand with popular retail technologies that are generated by e-commerce and social media. It provides some feasible methods for fashion retail at the moment, but as introduced by the company founder, it also faces some inevitable difficulties that include product return policy and cost, shipping cost and rapidly increasing cost on website traffic and big data analysis. As new technology develops rather slowly in the fashion industry, its retailing sector is still in the progress of digitalization.

1.2.3 Company F

Company F is a local company positively exploring the adaptation of blockchain technology for the fashion industry. Blockchain technologies enable systematic cooperation in an entirely distributed and decentralized manner, capable of

managing social interactions on a large scale and dismissing traditional central authorities[5]. Using blockchain, this company would like to achieve the following results: (1) Auditability – a full audit trail of data, creating an everlasting means of record keeping along a supply chain; (2) Immutability – timestamped and tamper-proof transactions, providing a single source of data integrity; (3) Smart contracts – continuous real-time tracking of data by using smart contracts across the supply chain; (4) Disintermediation – peer-to-peer interactions with digital signatures.

With the development of the fashion industry and new technology, the company has changed its business model from OEM, ODM to supply chain risk management. It starts building a system with transparent information, quality standards, and inspections and so on, and bears the risks during the business processes. The entire process of an order through its system is simply presented as follows:



[5] https://en.wikipedia.org/wiki/Blockchain [05-10-2018]

Through the company platform, buyers make requirements; materials suppliers and manufacturers propose different quotes accordingly. Based on the quotes, different plans are automatically formed and sent to buyers. The buyers can choose appropriate plan and place order directly, and involved parties including materials suppliers, manufacturers and transporters can complete relevant tasks. The platform makes the entire process of pricing and service providing transparent.

Company F is exploring a novel digital business model with blockchain and setting an example of how to use a new technology to solve the problems in the traditional fashion supply chain. Will this become "Uber" in the fashion industry?

2. Circular Economy and Resource Efficiency

Based on the global industry development and the local situations, circular economy and resource efficiency have been identified as a key technology trend for the Hong Kong fashion industry. The Hong Kong stock exchange has taken the lead and made ESG (Environmental, Social and Governance) disclosure mandatory for listed companies based on measurable key performance indicators such as targets and achievements[6]. Sustainability is gradually becoming a policy-guided aspect of investment. In terms of the fashion industry, sustainability has already attracted much attention globally, and Hong Kong starts playing a positive role. For example, Fashion Summit (Hong Kong)[7] – a sustainable fashion event has been holding annually since 2017, brings together leading academics, key players from the fashion industry, NGOs, media, decision-makers and leaders to achieve

[6]https://www.hkex.com.hk/Listing/Rules-and-Guidance/Other-Resources/Listed-Issuers/Environmental-Social-and-Governance?sc_lang=en [19-09-2018]
[7]http://www.fashionsummit.hk/index.php/en/ [19-09-2018]

sustainable fashion in Asia. Although Hong Kong is no longer a manufacturing base, many local originated manufacturers are still active in the global fashion industry because of high-quality production, good reputation and infrastructure support. With the technology trend of circular economy and resource efficiency, the Hong Kong manufacturers may form the regional niche in sustainability. Global and local models as introduced below are focused on two aspects – process technologies for resource efficiency and recycling for circularity.

2.1 Process technologies to save water, energy and chemicals

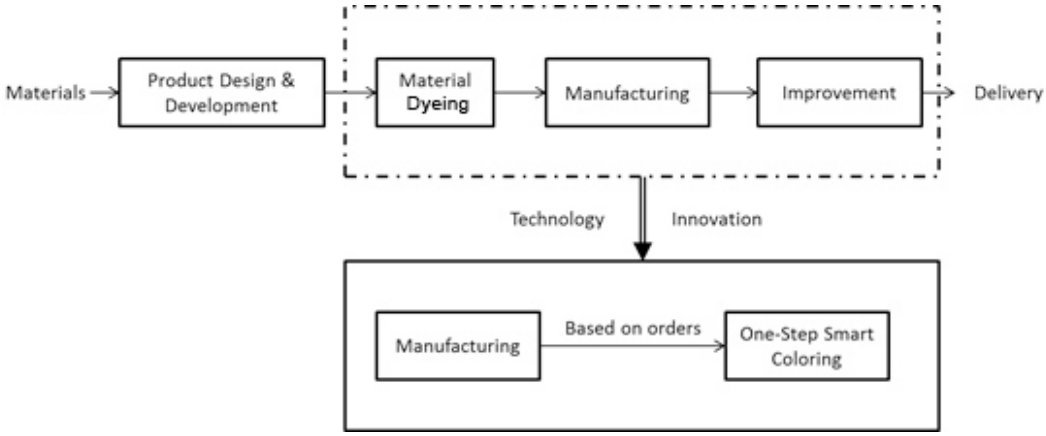
For energy efficiency, the fashion industry not only upgrades traditional technology or process, such as deployment of computing-based monitoring systems, energy-saving or recovery installations, resource re-use systems, and production waste treatments, but also develops new technology to replace conventional polluted processes, such as waterless dyeing, digital printing, seamless manufacturing, 3D production etc. Three local models will be presented in this section.

2.1.1 Company G

Company G is a local intimate apparel manufacturer with factories in Mainland China and Southeast Asia. As the main supplier for big brands of intimate apparel, the company keeps its research, product design and product development centers in Hong Kong, instead of moving outside like many other manufacturers in the industry. It values professional talents, especially with expertise in intimate apparel fitting, product development and technology innovation. It has established a mature tutor system for long-term technician training and also awards scholarships to outstanding students in related areas of leading

universities so as to cultivate potential young talents. One difficulty to operate product development center in Hong Kong is to hire qualified sewing workers. To adapt to the requirements for fast and large quantity supply, the company has used SAP to manage the operation from raw material, product design and development to manufacturing and product delivery.

To improve the processing for its production, it has invested funds and talents on technology innovation. Its research team has created equipment for undergarments' one-step smart coloring, saving close to 90% of water, chemicals, energy and time. With this new equipment, the company can realize the flexibility to color intimate apparels without minimum order quantity in a sustainable way. This new concept of colouration also improves the dyeing process for the whole industry. The production process flowchart is illustrated as follows:



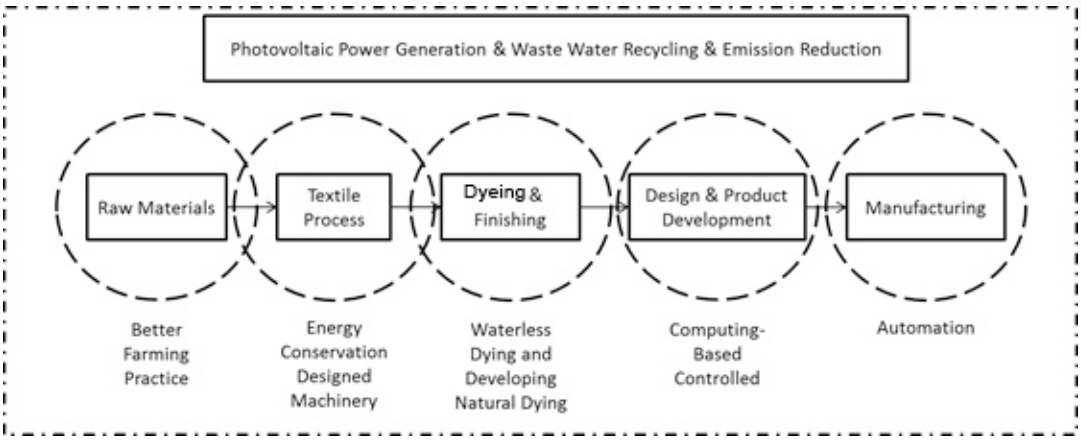
Usually, in the production process of the bra, material dyeing includes pads, metals, plastics, and elastic, different materials may have problems in color shading, size and function after manufacturing, so some improvements should be done before final product delivery. With this innovative equipment, all the intimate apparels can be *garment-dyed* as a final product, and that would allow

more agile product supply, more flexible product coloring and more sustainable manufacturing.

Company G shows a successful model for technology innovation in traditional textile and clothing manufacturing, which not only improves production efficiency and flexibility but also upgrades the traditional polluting process to meet stringent environmental policy.

2.1.2 Company H

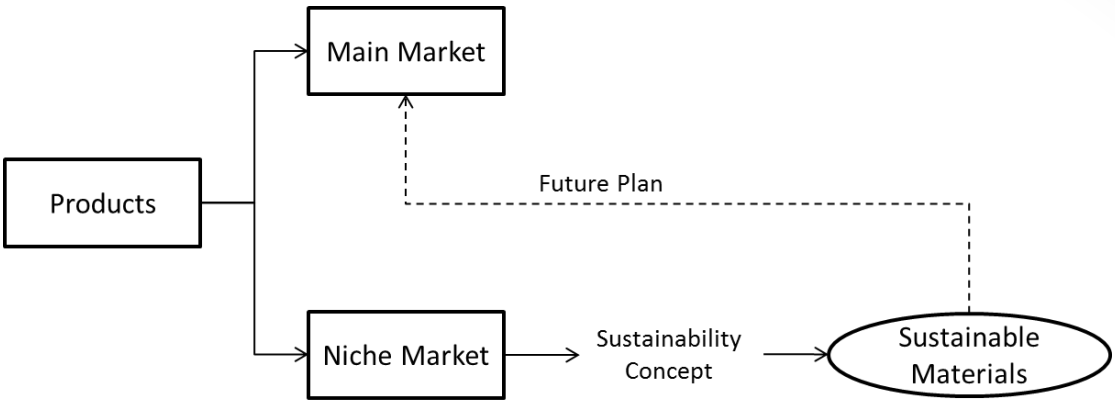
Company H is a Hong Kong based apparel manufacturer with factories in Mainland China. Facing the stringent policy for environmental protection, the company has taken different actions to establish a resource-efficient business model. For energy conservation, it has implemented photovoltaic power generation for clean electricity, introduced a recycle project for dyeing wastewater and use recycled water for dying for the second time, and developed new machinery for eco-washing. In processing from raw materials to final production, the company has also improved traditional methods and gained eco-friendly certificates; for example, better farming and crop practice, using eco-friendly dyes and waterless dyeing, and computing-controlled cut and made to reduce textile wastes etc. The process flow is illustrated as follows:



Company H has upgraded its factories from each sector within the entire manufacturing supply chain, they have been rewarded handsomely of saved costs in energy, water and textile waste etc. It has developed a blueprint for resource-efficient production for the fashion industry.

2.1.3 Company I

The company I is a Hong Kong based textile and clothing manufacturer with the focus on sustainable materials. Since the US is one of its major markets, it has developed a series of linen clothing made with fibers extracted from the flax plant. Due to the eco-friendly characteristics, the consumers in the US are willing to pay more for this kind of sustainable clothing. Finding a niche for a specific market, especially under the sustainability concept, has become a business strategy in most developed countries like the US, EU countries and even some highly developed regions in developing countries. The company indicates that a small change in business strategy to uncover a niche market can make a success, for which a flowchart is presented below:



2.2 High-tech textile recycling for circular economy concepts

The circular economy has fast become the most popular concept in the fashion industry. This concept aims to make a closed loop for products in the "cradle-to-cradle" design. The issue of waste in the fashion industry is most severe in Hong Kong. According to the city's Environmental Protection Department[8], there are with more than 340 tons of waste dumped each day into the city's overflowing landfills. Besides looking at ways to increase resource efficiency, several Hong Kong fashion companies and research institutes started to focus on recycling technology development. Though key innovations are not yet implemented on large scale, some experimental operations have been launched. On the other hand, a new business model for fashion recycling has also emerged globally. In the section, global and local models will be presented.

2.2.1 Company J

Company J is a local upcycling factory open for fiber recycling. Collaborated with a research institute and an international fashion brand, this mill aims to adopt innovative solutions to recycling blended textiles into new fibers and yarns

[8]https://www.csmonitor.com/World/Asia-Pacific/2018/0918/Inside-Hong-Kong-s-mission-to-curb-clothing-waste [20-09-2018]

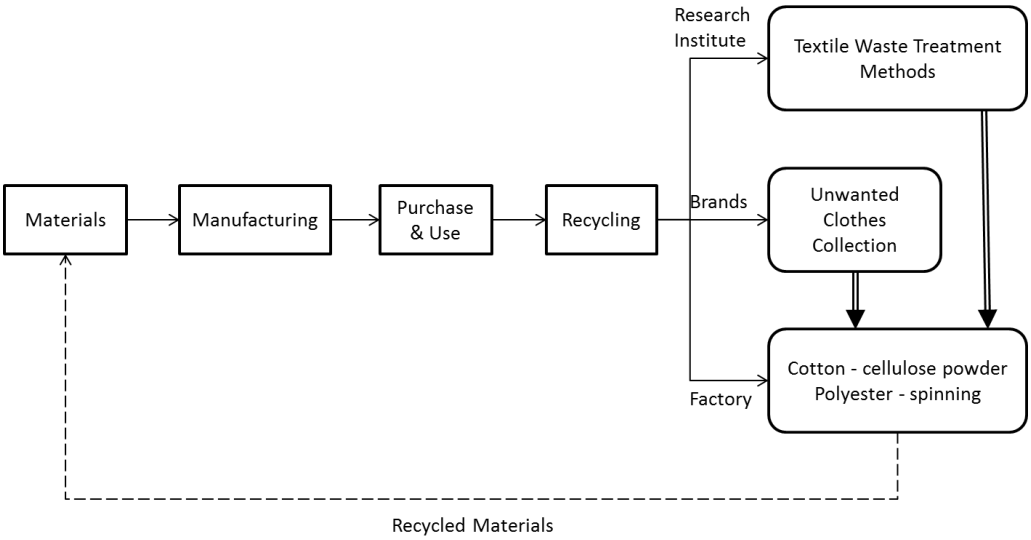
through hydrothermal process and biological method. This action is a breakthrough to realize “cradle-to-cradle” for textiles.

The hydrothermal process uses only heat, water and less than 5% of a biodegradable green chemical, to self-separate cotton and polyester blends. The recovered polyester material can be reused directly, almost without any quality loss. This fiber-to-fiber recycling method is cost-effective, and there is no secondary pollution to the environment, ensuring the life of the recycled material is prolonged in a sustainable way. Biological treatment is also adopted for textile waste recycling. Fermentable glucose and polyester fibers from textile waste will be recovered through bioprocessing. This new approach to textile waste treatment includes the pre-treatment and the enzymatic hydrolysis process. The recovered sugar can be used to produce biodegradable products such as bio-surfactant (as a cleaning agent) and bio-based polymers[9].

The company carries out mechanical recycling, where soiled or damaged fabrics are sanitized, buttons and zippers removed, and sorted and stored. The operation will be categorized in different colors, and the materials are UV-sterilized before being cut into pieces and spun into yarn without water or dying. It has also installed a system to separate cotton and polyester blends using heat, water and small quantities of biodegradable chemicals. The cotton is turned into cellulose powder and the polyester fiber is recycled for spinning. At the moment, the company operates in a small scale and conducts an experiment for industrial-scale production in the future.

[9] http://www.hkrita.com/newsletter/issue45/feature-2-en.html [20-09-2018]

Company J is a successful model for new technology application of textile recycling as well as collaboration model among academic research organization, brand and manufacturer. Research capacity for fashion in Hong Kong is ranked amongst the top in the world, yet relatively few achievements in industrial scale is realized eventually. It is worth considering how to collaborate with local academic organizations to develop feasible and valuable innovation for manufacturers, through which the Hong Kong fashion industry can be revitalized with advanced technologies instead of sole traditional competition.



2.2.2 Company K

Company K is a local joint collaboration for Garment-to-Garment recycling among research institute, brand and manufacturer. It operates in a retail space, where the customer can bring unwanted garment for recycling and get a new garment made with own recycled fibers. The whole process from sterilization, each recycled step to whole garment production can be seen in the retail space.

Through this special experience, public members can participate in the recycling activity, getting a new value-added product and receiving recycling educations[10].

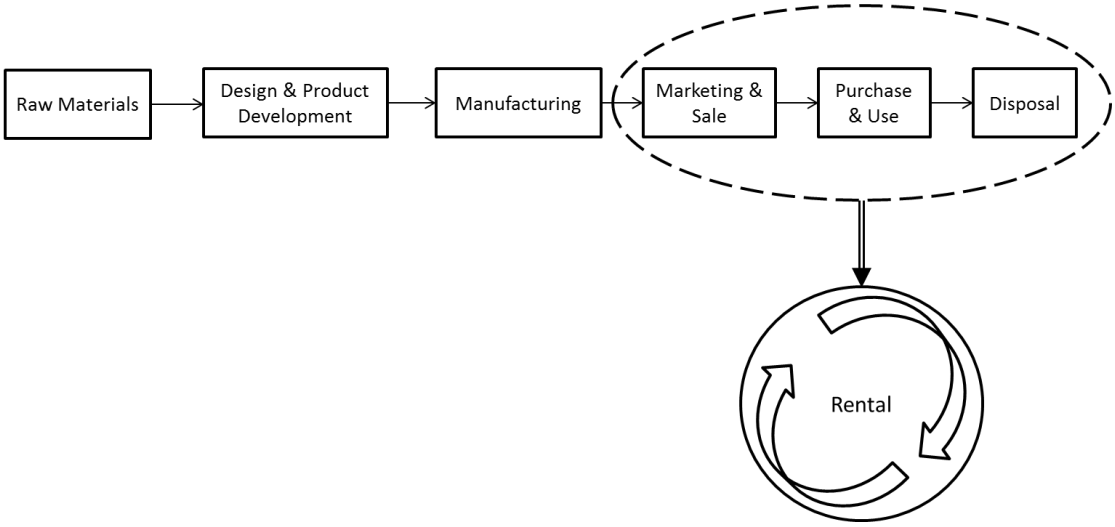
2.2.3 *Rent the Runway*[11]

Based in the US, *Rent the Runway* has been launched since 2009 to provide service that allows women to rent high-end clothes. From a startup for one-off cocktail dresses, it has already developed into a rental service provider for designer clothing for various occasions through subscription models: 1) 89 USD monthly for 4 new pieces per month and 2) 159 USD monthly for an endlessly rotating wardrobe. With the popularity of social media, everyone can get the most updated fashion information from Instagram, Facebook, WeChat and any other social media platforms as fast as celebrities. The procession of the latest fashion items thus become a possibility for more and more people. It is familiar that an expensive fashion item is just worn for some special occasions or even for taking photos to show off through personal social media. Besides, designer clothing is expensive for ordinary consumers and regarded poor long-term investment comparing to luxury brands. With the advantages of mobile shopping and delivery service, the market need for high-end designer clothing rental is expanding.

Instead of using specific recycling technology, this company has adopted a new business model to correspond to the newly emerging market trends as well as meet the needs of the circular economy. The rental service is changing the mindset of clothing consumption, especially among the millennials. Once clothing rental becomes a daily habit for a certain part of consumers, a circular economy can be gradually established as a new fashion mainstream, giving clothes a longer

[10]http://www.hkrita.com/marketing/PressRelease/20180903_HKRITA_Media_event_on_Textile)Recycling_Eng.pdf [19-09-2018]
[11] https://www.businessinsider.com/rent-the-runway-membership-2018-8 [20-09-2018]

lifetime to close the loop while reducing material and resource consumptions. The new supply chain is illustrated as follows:



3. High Value Added Solutions

High added value products for health, sports, work and personal protection have been identified as the third technology development trend for re-industrialization of the Hong Kong fashion industry. The increasing population of ageing people requires new solutions for personal healthcare textile products with special needs. Besides medical applications such as wound care or artificial tissues, today many healthcare textile products have been created with other functions, for example, disease detection, GPS and rehabilitation etc. Another growing part of the global population regularly participates in sport and outdoor activities, so functional textile-based product for different sports and activities have become a rapidly expanding market demand. At the same time, demand for high value added clothes for safe work and personal protection is also expanding due to the awareness of safety in working conditions. Furthermore, personalized fashion or made-to-measure clothes has also gathered momentum thanks to the digitalization of the fashion industry. In this section, global and local models in these areas will be shared.

3.1 High value added functional products

A model of Japanese cluster for high-quality towels and two local models for functional textile-based products are presented.

3.1.1 *Imabari* Towel Japan[12]

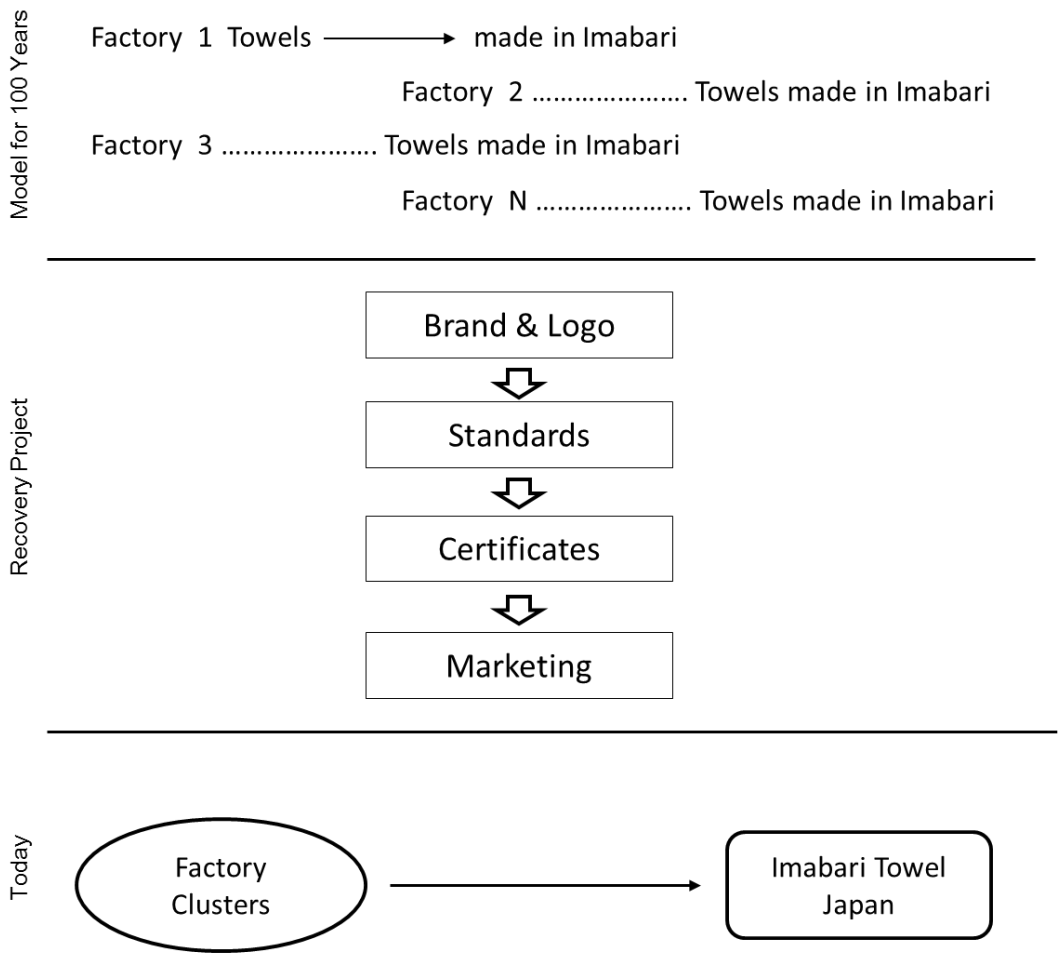
Imabari has led the Japanese towel industry in high quality for 120 years with good reputation in softness and water absorbency. With a temperate climate for cotton, Imabari was named "Manchester of Japan" in the 1920s, and the underground water of Sojagawa River is gentle with few impurities most suited to produce delicate, soft and bright color fabrics. In its heyday, it took more than half of the towels sold in the domestic market. However, Imabari faced with a dramatic decline due to cheap towel imports around 12 years ago. Towel production plunged and hundreds of factories closed, and the industry in Imabari on Shikoku seemed to disappear in no time.

The local towel producers fought back and eventually succeeded with a new business strategy, which has become a successful model in Japanese revitalization. They assigned Kashiwa Sato, one of the leading creative directors in Japan, to build a high-end brand for *Imabari* Towel to compete with other brands on quality. In 2006, the *Imabari* towel recovery project launched. The new strategy and actions included 1) created a meaningful brand logo; 2) set white towels as key product; 3) established new product quality standards such as "five-second rule"; 4) introduced a certification system for "Towel Sommelier" to teach the world about towel quality; 5) the Shikoku Towel Industrial Association devised its

[12] http://imabaritoweljapan.com/ [20-08-2018]

original standards to certify whether the products can use the trademark and logo; 6) promoted the action as a model of regional revitalization through media.

Today, *Imabari* Towel becomes a symbol of the high quality towel in Japan and Europe. Its high-end towel even prices over 1,000 HKD. It has been taken as a luxury product for high-quality lifestyle. The creative director Sato's business strategy did revitalize the traditional industry. A flowchart for the business model is illustrated as follows.

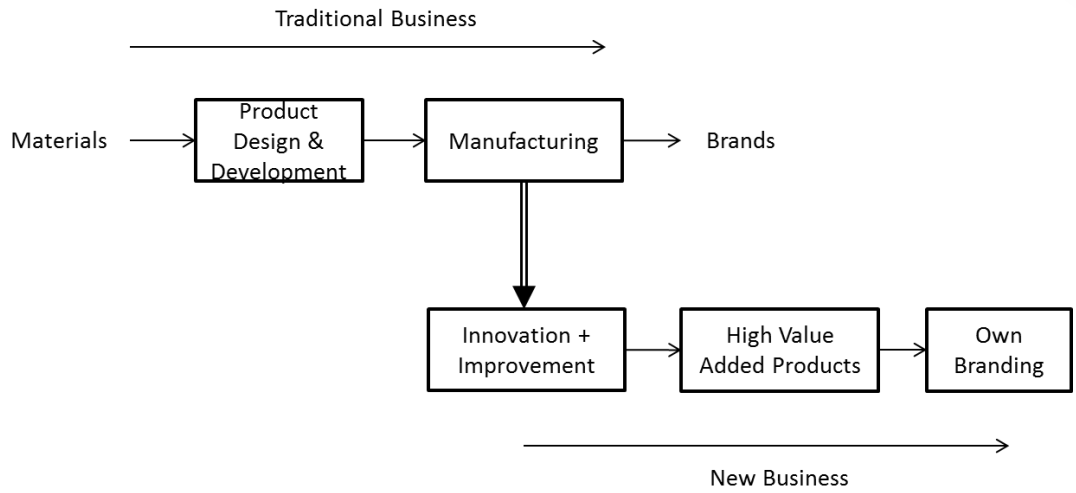


The *Imabari* Towel model is a classic model to realize regional industry revitalization. The important step is to build standards and form a flexible but well-managed cluster, and branding is a plus. High added value products with appropriate business strategy and model are still competitive, especially for traditional manufacturers.

3.1.2 Company N

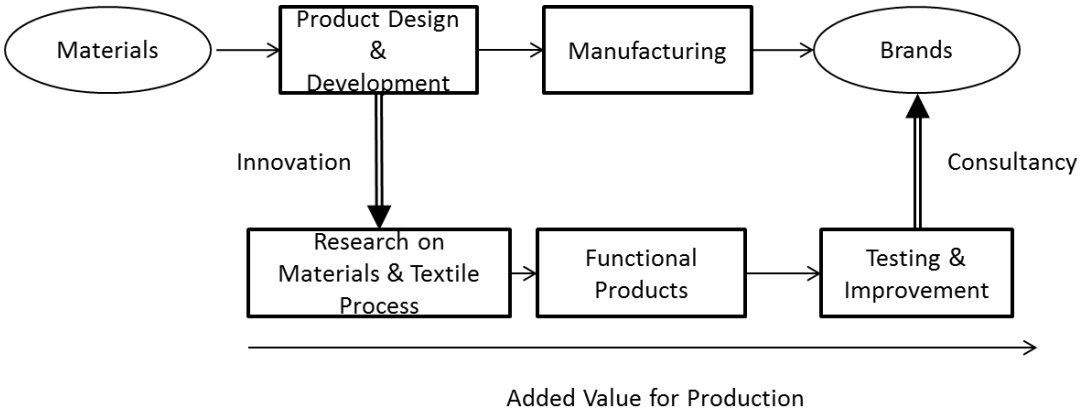
Company N is a local traditional knitting manufacturer, with attempts to develop new product lines for high value added products. Targeted at thermal functions, it obtains a patent from a research institute and forms a research team to develop different thermal products. With the speciality in knitting, it develops heating knit panel through 3D knitting technology using conductive yarn and natural fibers. The yarn heats up within 30 seconds by the portable 5V/2A power. A series of knit products have been created, including an eye mask, knee sleeve, wrist wrap, calf sleeve etc.

As a traditional manufacturer, the company uses its strength in knitting and invested in the development of high value added products, through which a new business branch has been established based on the traditional model. It is practical to realize the first step of re-industrialization in Hong Kong from an innovative product line. The development flowchart is illustrated as follows.



3.1.3 Company O

Company O is a Hong Kong based traditional textile manufacturer. Taking the advantages of textile skills, the company attempts to develop new functional materials and clothes at the experimental level. For example, it has developed a graphene jacket for thermal function with the characteristics of lightweight, high strength, and good breathability. The functionality of the product is still under testing and wear trial. The company predicts that a certain group of consumers will be interested in this kind of high value added product. The flowchart of its added value for production is illustrated as follows.



Many Hong Kong based manufacturers have good resources in fashion professionals with long-term practice in manufacturing. It is crucial to make good use of this unique strength. Any innovation in product development or manufacturing process achieved by our professionals will make great contributions to the re-industrialization progress of the Hong Kong fashion industry.

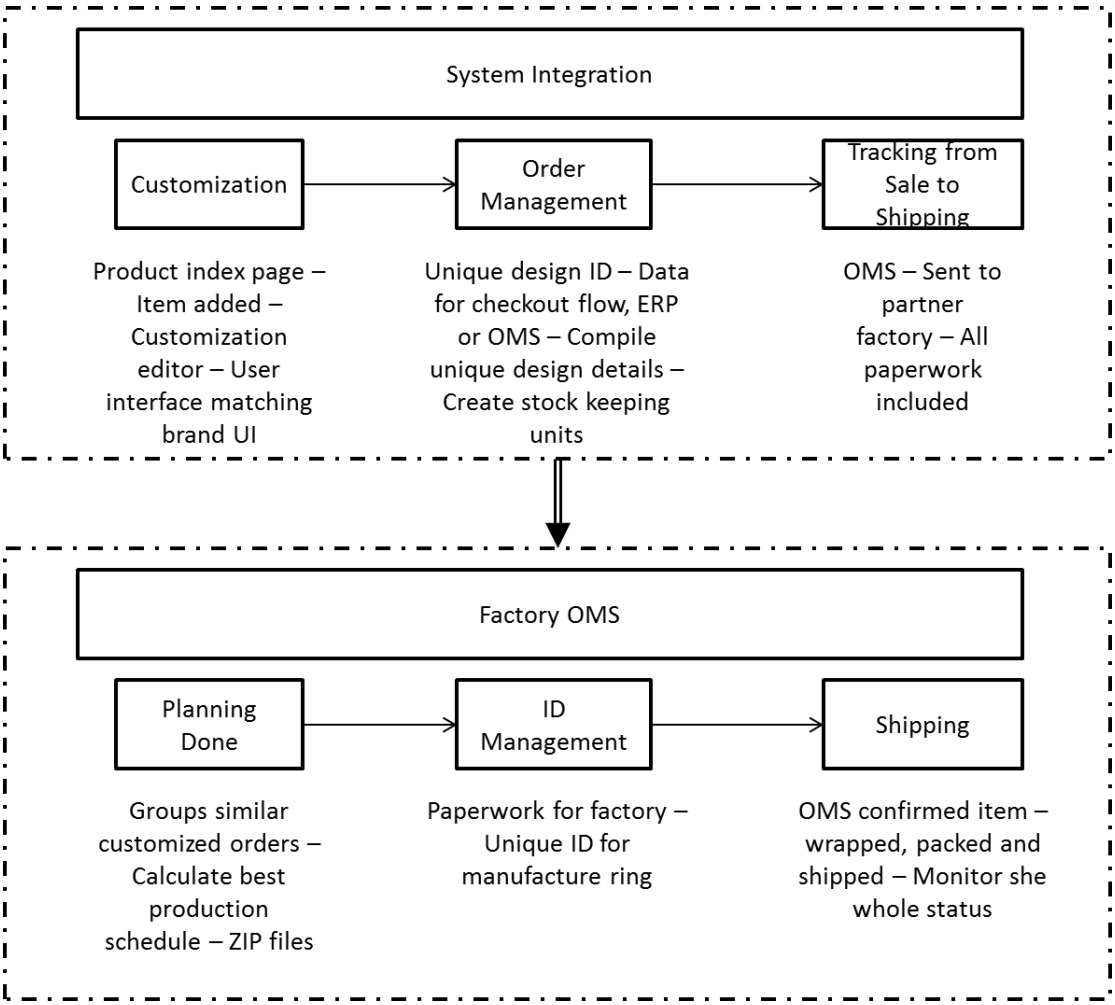
3.2 High value added personalized fashion

With the development of digitalization, personalized fashion becomes possible, and many companies have launched a corresponding business. A UK model and a Hong Kong based manufacturer model will be presented in this sub-section.

3.2.1 *Unmade*[13]

Unmade is a London based technology company, providing fashion brands with a solution for mass-customization from e-commerce to manufacturing. This company works together with the brands to create different parameters that consumers can design their individual orders within, through which consumer feels involved and engaged in the experience while the brands have control. E-commerce orders can be sent directly to the assigned factory for automated manufacturing and delivered straight to the consumer. Their technology can seamlessly integrate individual and short-run orders into existing production and make the personalized products manufactured at the same cost and speed as mass-produced items. The working flow is illustrated.

[13] https://www.unmade.com/ [22-09-2018]



The company provides fashion brands with the ability to offer customized products and manufacture the results. Though it only enables the personalization of motif and colors for knitting products, the technology provides an easy operating platform embedded in brands' pages and connects the customer, brand and brand's factories with the accurate data flow. As manufacturer partners for brands, technology upgrade has become an inevitable trend in the near future; at the same time, it is possible for manufacturers to consider a new business model Manufacturer-to-Customer with the help of new technology.

3.2.2 Company Q

Company Q is a Hong Kong based apparel manufacturer. This company has entered the made-to-measure business for several years, producing customized shirts and trousers for the US market. The consumer simply chooses the fitting, fabric and style of garment they require, either at the store or through the Internet. The order is sent to one of its factories in Asia, where the garment can be made based on specific requirements and delivered directly to the customer in the US within three weeks.

To deal with the increasing trend of personalization fashion, it has developed "one-piece-flow" manufacturing method and corresponding supply and inventory management system. With the help of digitalization, it takes less than half an hour to produce one piece of shirt with specifications. The improvement for small-scale production with new technology is making personalization fashion practical and attractive.

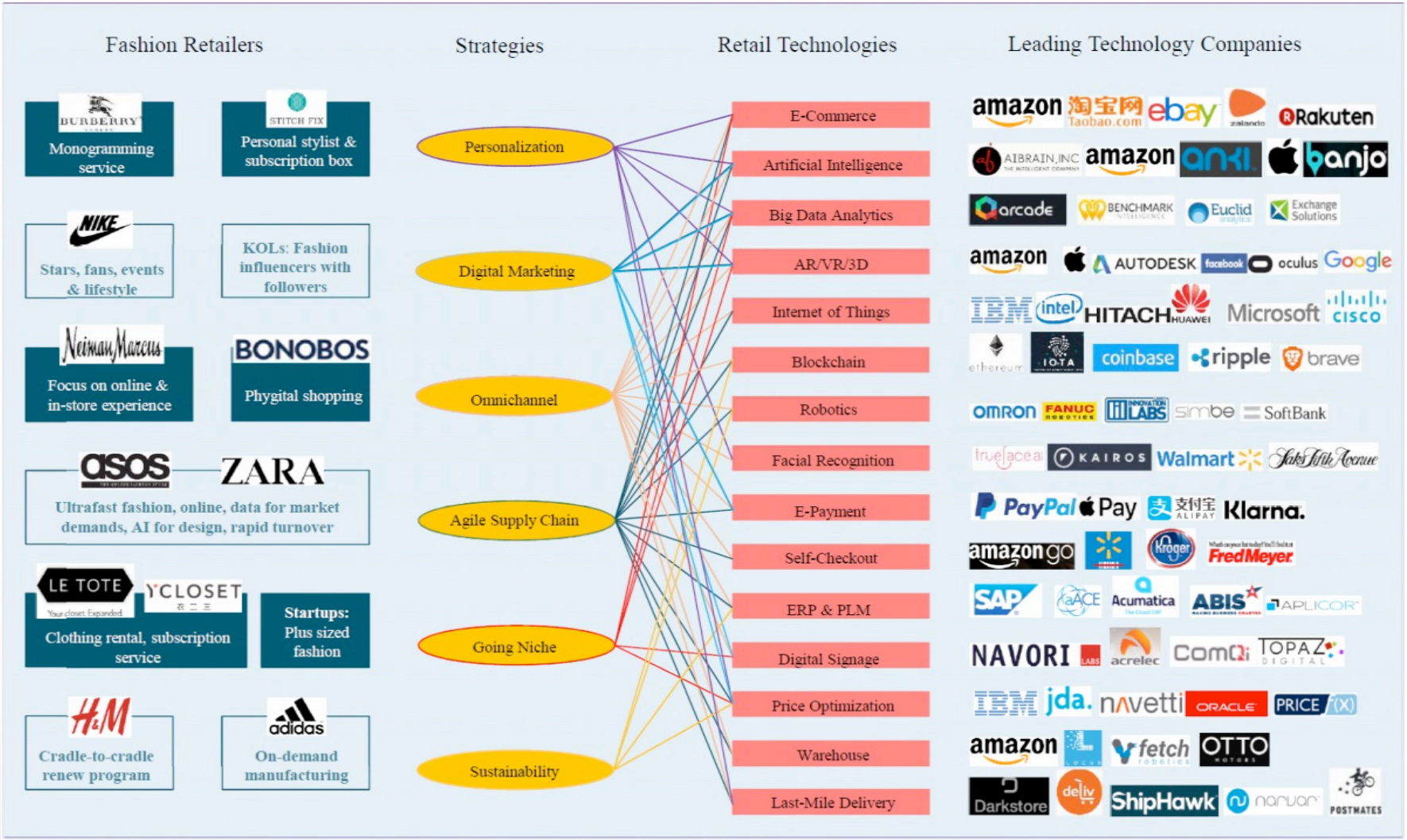
In the previous century, made-to-measure used to be a traditional culture in the Hong Kong fashion market; however, this market shrank rapidly due to the maturity of garment production and high-speed societal development. After decades, customers are now transforming their consumption behavior to focus on personalization, sustainability and innovation. The traditional made-to-measure market has been upgraded into personalization fashion to realize better fitting as well as customized choices from materials, patterns to accessories and personal styles. Using the latest technologies, it is possible to get personal body measurement data through body scanners or even mobile apps, design a personalized product within minutes online and delivery the product to almost all over the world. As a traditional sourcing hub, Hong Kong can play a unique role in

this market with the strength in agile supply chain and rich product development/design and manufacturing experience, and new digitalization technology application is indispensable.

3.3 E-retailing

For the global fashion industry, many retailers are reacting to the customers' changing choices and the increasingly volatile market by closing physical locations. A majority of fashion retailers, from luxury to fast fashion, from big brands to startups, gradually recognized that new technology will be the key to win market shares, especially when the millennials are becoming the main consumer group. However, comparing to other industries, fashion has been relatively slow to embrace new technologies.

This section outlines the emerging strategies of fashion retailers and summarizes a list of new retail technologies with leading technology companies. A map integrating strategies and retail technologies has been developed, as a potential opportunity for HK fashion industry for future development.


Fashion Retailers
Strategies
Retail Technologies
Leading Technology Companies
Monogramming service
Personal stylist & subscription box
Stars, fans, events & lifestyle
KOLs: Fashion influencers with followers
Focus on online & in-store experience
Phygital shopping
Ultrafast fashion, online, data for market demands, AI for design, rapid turnover
Clothing rental, subscription service
Startups: Plus sized fashion
Cradle-to-cradle renew program
On-demand manufacturing
Personalization
Digital Marketing
Omnichannel
Agile Supply Chain
Going Niche
Sustainability
E-Commerce
Artificial Intelligence
Big Data Analytics
AR/VR/3D
Internet of Things
Blockchain
Robotics
Facial Recognition
E-Payment
Self-Checkout
ERP & PLM
Digital Signage
Price Optimization
Warehouse
Last-Mile Delivery

4. New startups

Technology is opening up new doors for fashion startups. Advances in technologies like artificial intelligence, augmented reality, visual search, digital merchandising and many others have allowed innovative startups to spring up and fill in the gaps of creative business models in the fashion industry. Three startups founded by Hong Kong based researchers are to be introduced in this section.

4.1 Startup R

Funded by a technology entrepreneurship, an AI-powered startup for suit tailoring service has been set up in Shenzhen in 2017 by a Ph.D. student graduated from Hong Kong. The key innovation is that a user simply takes one image of the full body from the front and another one from the side and the software reconstructs the customized 3D model with accurate measurements of chest, waist, hip, thigh, knee, calf, neck, arm length and shoulder slope within 1-2cm discrepancies depending on tight or loose fitting clothing in the images.

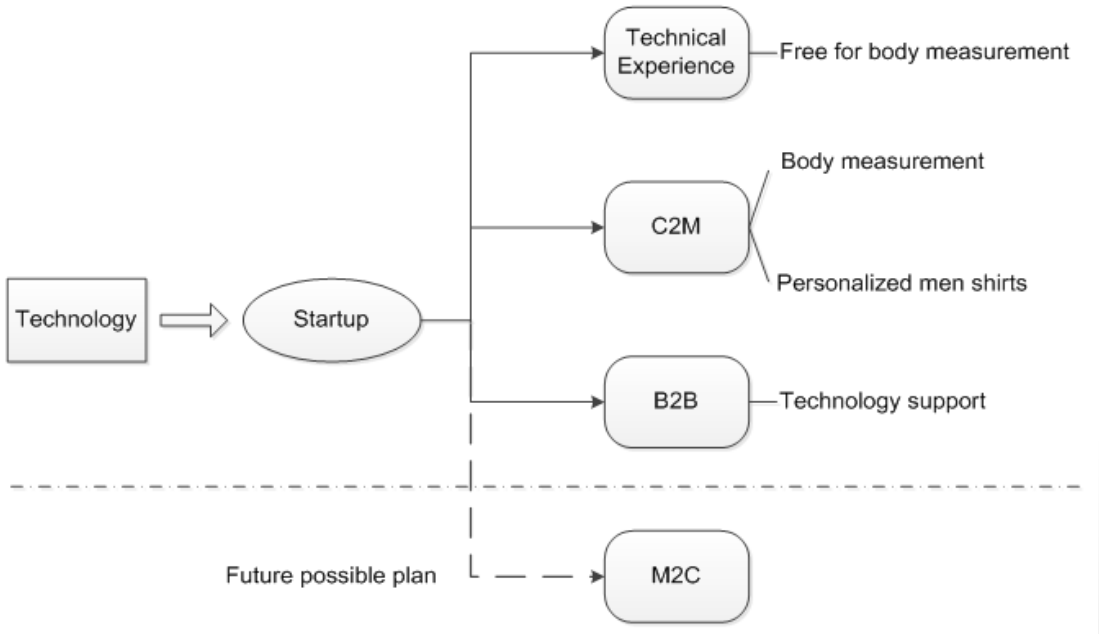
Enabled by big data analytics, a large dataset with over 10,000 human scan models and another dataset of fabric knowledge were used to train its AI to create precise 3D renders of users' bodies from 2D images taken by a mobile phone. The main steps developed to realize automatic shape modelling are as follows:

1) Detect body parts from front-view and side-view 2D images and construct them into 3D models;
2) Predict under-the-clothes body profiles based on the two images;
3) Use cutting-edge deep learning technology for the body image to improve the robustness, efficiency and accuracy of shape modelling; and
4) Apply the above modelling methods to develop a client-server system in the

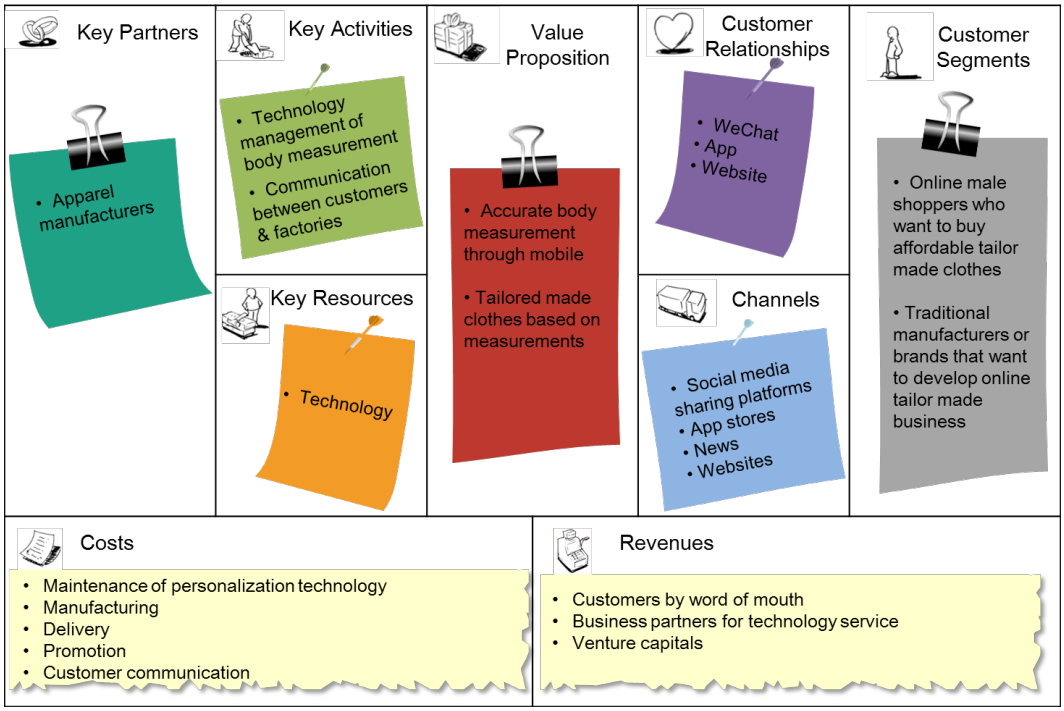
mobile application.

Based on this 3D human modelling technology, the startup company has collaborated with factories that produce garments for globally famous brands and provided customer-to-manufacturer (C2M) service. Through mini-program of WeChat or its App, customers can order tailored-made garments from a range of fabrics, collars, pockets, cuffs, front plackets etc. As promised, the order will be delivered to the customer by courier within 10 working days, and free alteration will be offered within 30 days. At the moment, male business shirts, casual shirts and jeans are on sale, and other categories will soon hit the shelves according to its App announcement.

Introduced by the founder of this startup, the ongoing plan is to provide technology platform and service regarding 3D body measurements to fashion companies, and the future plan might follow a manufacturer-to-customer (M2C) model and invest its own factories for manufacturing. The brief framework is illustrated below.



While the supply chain of fashion industry changes very slowly, the latest influx of new technology often develop quickly and integrate with the industry effectively thanks to its rich resources and solid foundation. The new business model practised by this startup company has been well received and adopted by global technology companies in the era of digital commerce. Its business model canvas is summarized below:



4.2 Startup S

A footwear data service startup was founded in Shenzhen in 2014, by a Ph.D. student graduated from Hong Kong and another two partners from the field of supply chain management. This startup has received Angel Capital[14] in 2015 and Pre-A round of financing in 2016. The notion that initially drove this startup is a low-cost and high-accuracy 3D foot scanner technology. This handy scanner is capable to digitize 3D foot models with a measuring time of about 10 seconds and

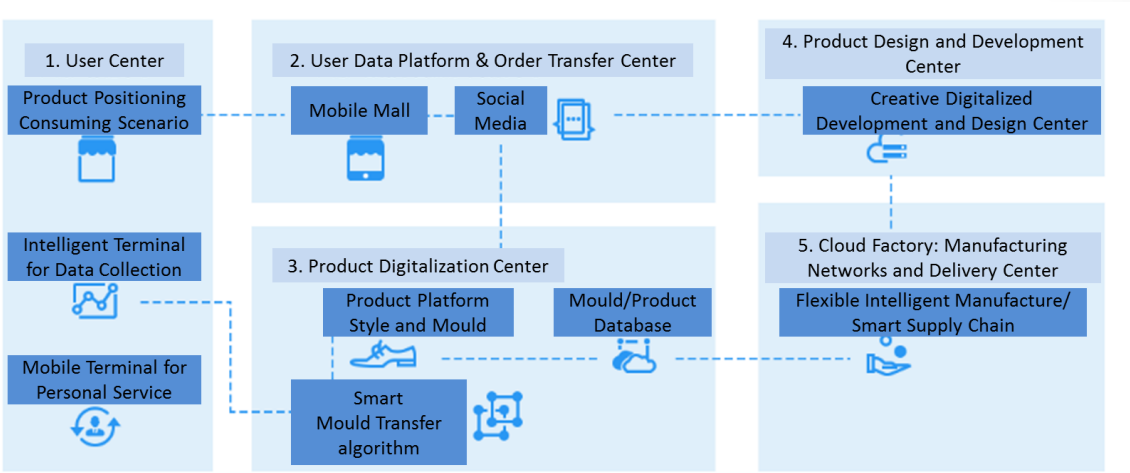
[14] http://www.cloudolp.com/about.html [20-07-2018]

data processing time of about 12 seconds. The mean modeling error is around 1.5mm.

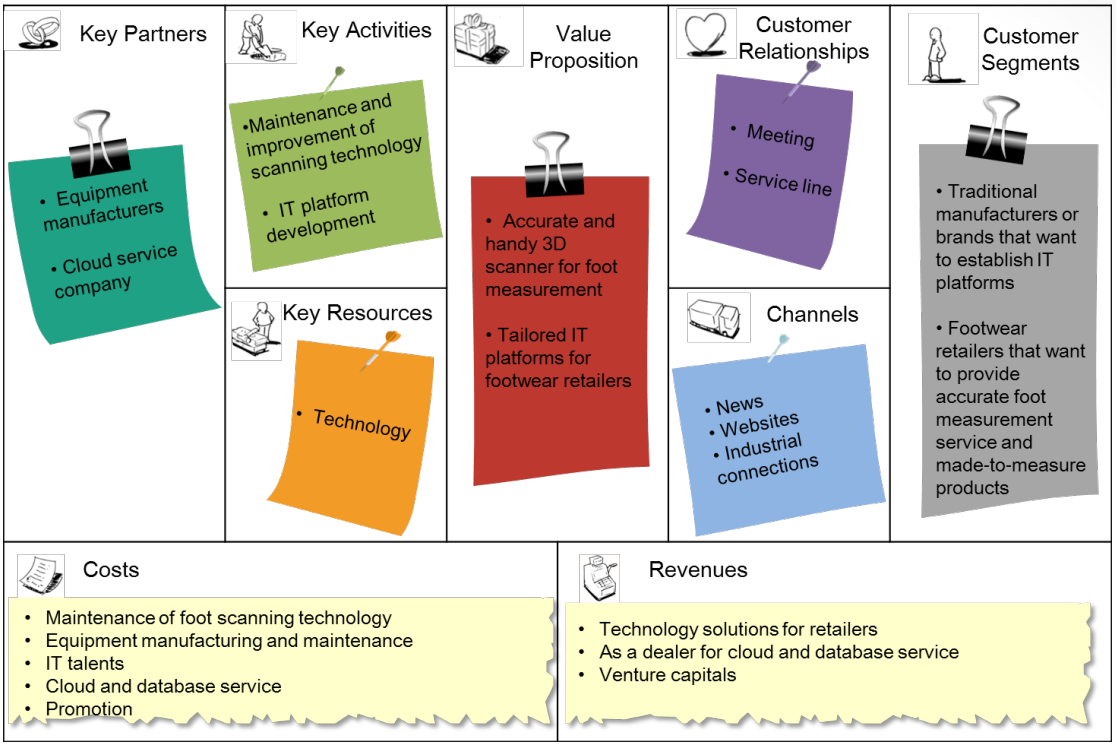
In the first 3 years, the main concern of the startup company team was on product development and improvement to adopt the updated commercial needs from both online and physical stores. At the same time, a database for footwear of different dimensions was also developed. In 2017, this startup has commenced development on intelligent retail and finally developed its third generation 3D foot scanner in a smaller size and with smarter measurement. From 2018, the market positioning has been re-defined as a solution provider for footwear information and technology service. Besides the 3D foot scanner, the startup company has also developed other its own IT products, including *C2M System, Distribution Management System, Ordering System, Online Shop, Huawei Cloud Service and Try-On Management System*. To integrate these products, the company also provides services of smart retail and C2M business.

The service of smart retail includes: 1) customer registration and user data link; 2) physical store digitalization and customer behavior data analysis; 3) user portrait analysis and precision marketing; 4) virtual cloud shop and online to offline; 5) integrated mobile sale terminal and efficient stores; 6) cross-store sale, intelligent transfer and shock shared models; and 7) Real-time big data analysis and strategy support.

The flow of C2M (Customer-to-Maker) service is illustrated as follows.



As the retail business model of the footwear industry is very traditional or even outdated in most areas of Mainland China, it is extremely difficult to introduce a new technology like their 3D scanner to the traditional brands ranging from large, medium to small scale companies. Therefore, this company changed its business strategy and started to provide technology solutions to help footwear companies establishing the whole IT platforms. Only with the necessary IT platform, the new 3D scanning technology can truly prevail in the industry. Its business model canvas is summarized as follows.



4.3 Startup T

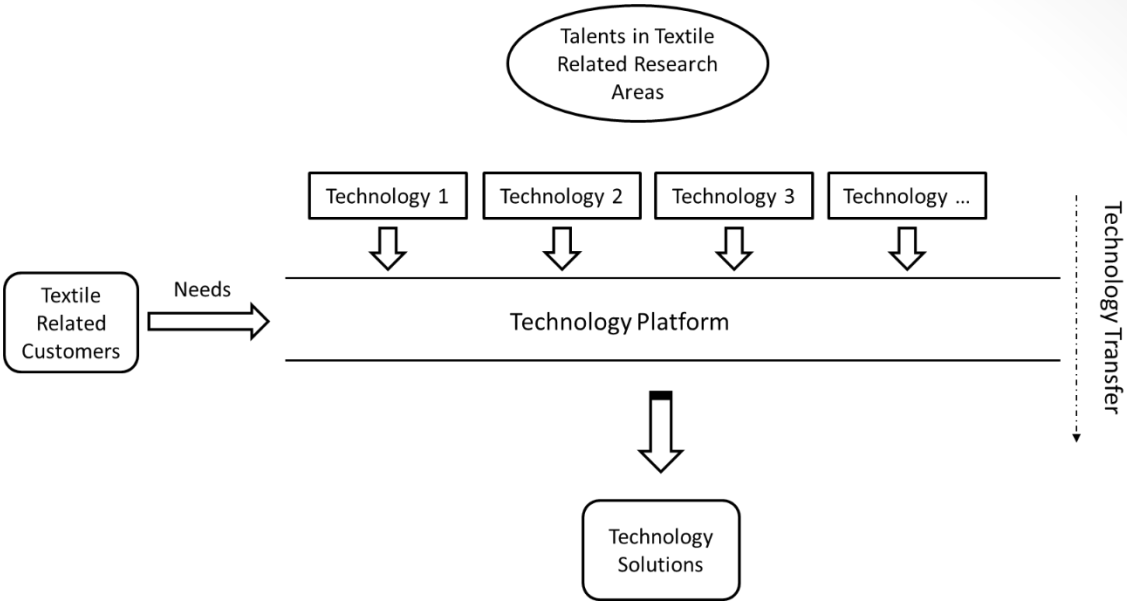
This startup for functional material solutions was established in 2015 by a group of Ph.D. students graduated from Hong Kong. Its aim activity is to provide a *technology platform for advanced textiles. The company founders are expertise in* different research areas, including textile engineering, chemistry, physiology, bio-materials and industrial design. Holding patents in various areas, this company provides technical consultancy and solutions for advanced textile companies or agents.

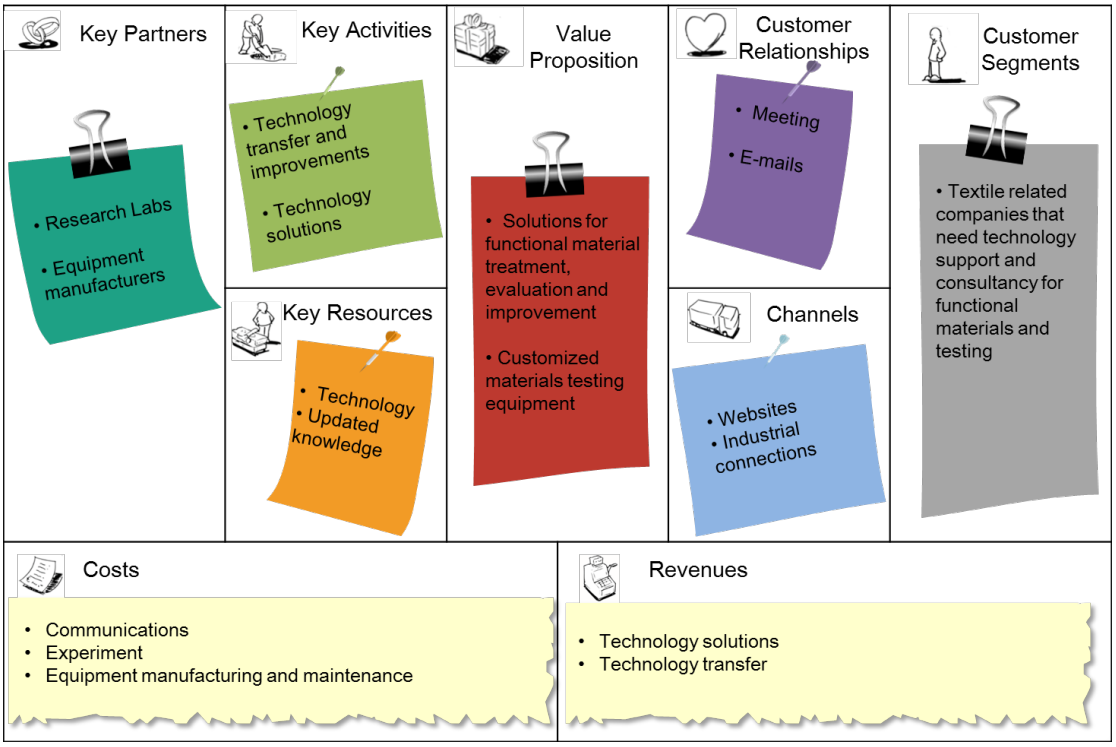
At the beginning since its establishment, the main line of work for this startup was to transfer their research results on functional materials for potential textile and clothing related partners. However, the company soon found out that most textile companies did not well understand their research results and had doubts on

market responses on new material technology. After a period of straggling, the company changed its business model from selling technology to providing technology development solutions. It then transformed to serve as an integrated intelligence platform for companies seeking for material technology consultancy and solutions ranging from functional material treatment, evaluation and improvement to customized material testing equipment design.

After changing its business model, this startup successfully cooperated with several medium to large size companies in different areas. For example, a national clothing retailer consigned this startup to test tens of thousands of provided fabrics and build up an internal fabric database with various parameters and evaluations, so that the retailer can sell appropriate products to target customers. Another example is that an international company consigned this startup to design a functional fabric for new product series, including experiment protocol, laboratory experiment, wear trials, evaluation report and large-scale production plan. Besides, this startup also helped some business partners to develop customized testing mini equipment for various purposes.

The current business model flowchart and canvas are illustrated as follows.


Talents in Textile Related Research Areas
Technology 1
Technology 2
Technology 3
Technology ...
Textile Related Customers
Needs
Technology Platform
Technology Transfer
Technology Solutions


Key Partners
• Research Labs
• Equipment manufacturers
Key Activities
• Technology transfer and improvements
• Technology solutions
Key Resources
• Technology
• Updated knowledge
Value Proposition
• Solutions for functional material treatment, evaluation and improvement
• Customized materials testing equipment
Customer Relationships
• Meeting
• E-mails
Channels
• Websites
• Industrial connections
Customer Segments
• Textile related companies that need technology support and consultancy for functional materials and testing
Costs
• Communications
• Experiment
• Equipment manufacturing and maintenance
Revenues
• Technology solutions
• Technology transfer