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# Creating a global vision for sustainable fashion

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## **Creating a global vision for sustainable fashion**

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### **Abstract**

Textiles, the fastest growing sector in household waste, have created an exponential rise in the export of second hand clothes (SHC) to overseas markets such as Kenya and Tanzania. Despite the few advantages for the destination markets (for example, enterprise opportunities), this has exasperated a difficult situation for domestic production. Increased cheap imports from Asia have also led to decline in SHC markets, resulting in increased land filling and the associated environmental impacts. Our research proposes remanufacturing fashion from the unwanted SHC, embellishing using local (destination market) craft/design. From literature review conducted, reuse and remanufacture of clothing causes the least impact on energy use and appears to be the most environmentally and socially friendly approach to sustainability efforts. Remanufacture of clothing is currently practiced at niche market levels, for it to have a broader impact; it needs to gain entry into the mass-market retail arena. In the mass market arena, the apparel value chain is organized around several parts with a marketing network at the retail level. Lead firms predominantly construct these value chains, are predominantly located in developed countries, and may be large retailers and brand-name firms, playing a significant role in specifying what is to be produced, how, and by whom. Our goal is to understand how designers, manufacturers and retailers may work together in a remanufacturing process. We present findings from interviews with Tanzanian second hand clothes retailers and artisans, UK fashion remanufacturers and retailers. We discuss the implications on the fashion design process and propose a new product development method for sustainable consumption of fashion. We conclude by reflecting on potential mechanisms of the supply chain integration and how the large multinationals may become engaged.

*Key words: remanufacturing, design process, supply chain, second hand clothes*

## **1. Post-consumer textile waste**

Post-consumer textile waste is defined as any type of garment or household textile no longer needed and discarded (Hawley, 2006). Textile waste, identified as the fastest growing stream in the household waste (Defra, 2007), causes significant damage to the environment at land fill sites. Defra (2009) reports that annual textile waste within UK is 2.3 million tonnes, of which only 24% is recovered for reuse and around one million tonne of textile waste ends up in landfill every year.

National and international waste policies, along with environmental concerns, have been drivers behind corporate social responsibility policies and waste management programs. The new EU Waste Framework Directive 2008/98/EC, published in the Official Journal of the European Union in November 2008, needs to be transposed into UK Law by 12 December 2010 (Defra, 2008) with a number of issues pertinent to textiles. Article 29 of the directive discusses 'waste *prevention programmes*' which directs member states to have established by no later than 12 December 2013. Moreover, this should work with Article 28 (waste *management programmes*) to analyse current waste management programmes' situations in member states. It recommends that measures should be devised to improve reuse, recycling, recovery and disposal of waste.

Regarding the impact on the environment, Woolridge et al (2006) conducted research to quantify the energy used by reuse/recycling and whether this resulted in a net energy benefit when compared with using virgin cotton. The energy footprint was quantified using a streamlined life cycle assessment and they found that 'for every kilogram of virgin cotton displaced by second hand clothing approximately 65 kWh is saved, and for every kilogram of polyester around 90 kWh is saved, (Woolridge et al 2006, p.94). The conclusion was, therefore that the reuse and recycling of clothing results in a reduction in the environmental burden when compared to purchasing new clothing made from virgin materials.

### **1.1 Secondary textile industry**

Textile recycling, an ancient practice dating back to Ancient Egypt, has always been market driven, and can recover between 93-98% of the textile waste collected (Brill 1997, Hawley 2004, Defra 2006). Oakdene Hollins report (Defra, 2006) refers to the textile recycling industry as 'secondary textiles industry' and, from the literature reviewed, provides the first diagrammatic representation of the flow of materials through the secondary textile industry which it notes sorts and distributes used textiles into some 140 different grades, with four main categories:

- Re-use and reselling: either transported to markets (often to the African continent but also to Europe and Asia), often referred to as the second hand markets, or may be resold in the UK through retail shops (considered the 'cream' of used textiles), referred to as 'vintage'. The clothing is also sometimes reused and redesigned into new items of clothing.
- Wiper Grade - material suitable for use as rags and wipers with little or no further processing and generally sold in the market or to industrial cleaning businesses.
- Recycling Grade - material suitable for pulling (knitted items) or shredding into fibres (woven items) for use in new end products. Shoddy may be used in a range of other industries for their fire retardant properties, such as automotive, aircraft or

bedding upholstery, yarns for knitting are used for reprocessing as knitted garments.

- Waste - material that cannot be resold or recycled which is disposed to the waste stream. Textiles that end up in landfill are usually soiled or unusable because they are not the right type of fibre mix or are torn and unsellable.

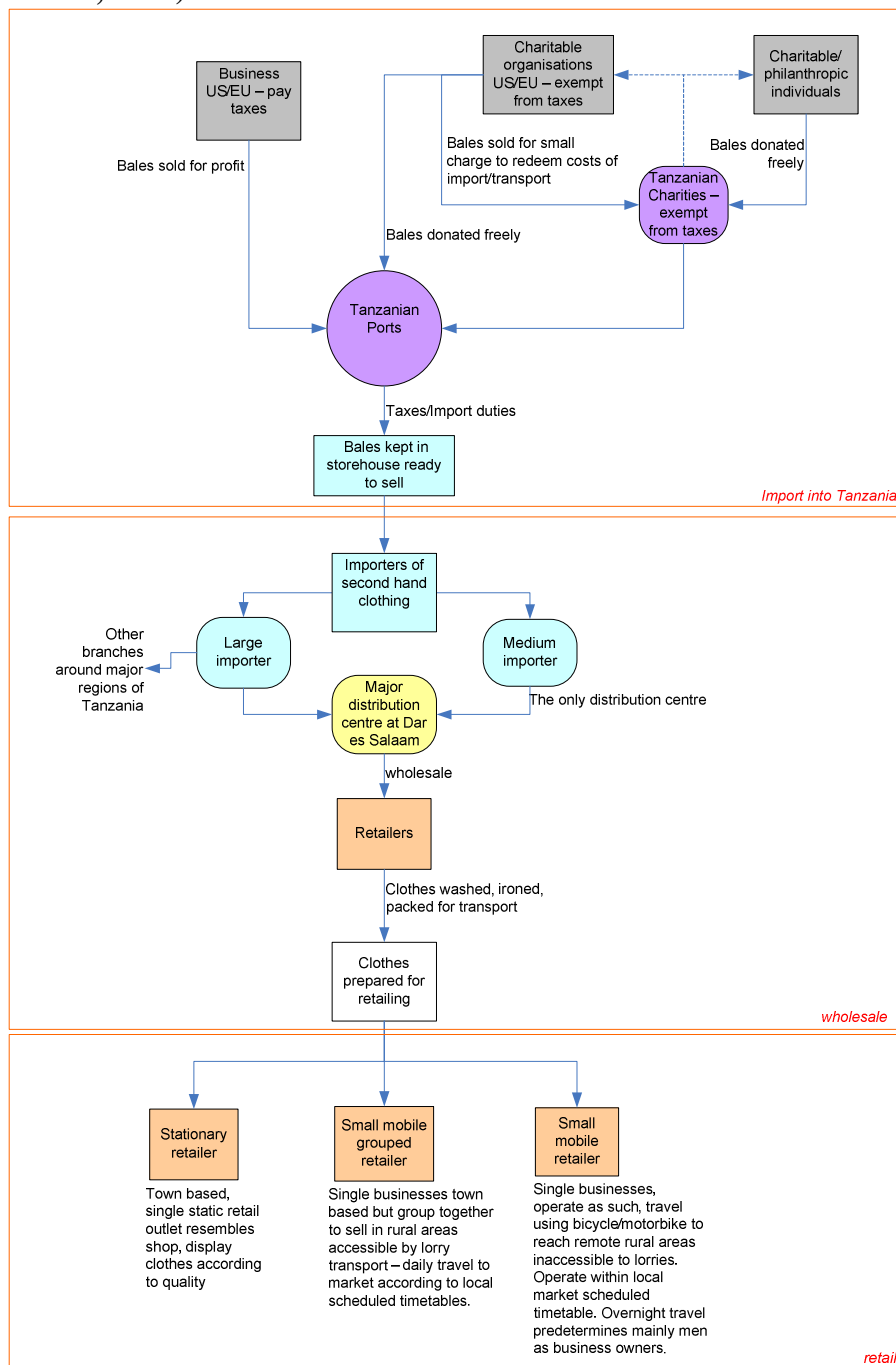
A life cycle analysis of the clothing development process indicates the significant part played by the consumer in textiles waste management (Defra 2006, Tukker et al 2006, University of Cambridge, 2006, Birtwistle and Moore 2007) and the subsequent exponential rise in the export of second hand clothes to overseas markets (Rivoli, 2005, Mhango et al 2005, Hawley 2006, Claudio 2007). Whilst there have undoubtedly been advantages for the destination markets, specially in Kenya and Tanzania – the largest importers of UK and USA second hand clothing respectively (Rivoli 2005, Field and Schmidt 2007), this has exasperated an already difficult situation faced by the domestic manufacturing industries and entrepreneurs (Baden and Barber 2005, Sinha, 2007). Moreover, second hand clothing markets are declining due to increased cheap imports from Asia resulting in increased land filling – legal or illegal- and the associated problems and impacts (United Republic of Tanzania 2003, Mero and Ndongsok 2008). In a reaction to this, 14 countries in Africa, as well as some countries in Latin America and Caribbean, were banning imports of recycled clothing or making it bureaucratically impossible to import (Dupin, 2003). However, the Tanzanian 2009/ 2010 National Budget has reduced the import duty rate for the SHC from 45% - equivalent to 30 US cents per kilogram - to 35% -equivalent to 20 US cents per kilogram (Tanzania Parliament, 2009). This suggests that there will be increased importation of SHC to Tanzania and consequently increased textile waste as there is little provision of textile end of life management systems.

## **1.2 Second hand clothing trade in Tanzania**

According to Kinabo (2004), SHC started to be imported in Tanzania before independence in 1964. SHC is commonly termed as ‘mitumba’ in Tanzania (a Kiswahili word meaning bale or bundle - they arrive and are sold to retailers in bales). Originally, SHC was imported mainly by charitable organizations and Churches, and donated freely to poor/needy people or disaster relief. During the economic crisis of 1980-85 and the decline of the textile industry sector, SHC (mitumba) become very popular with all categories of people in Tanzania; rich, educated, politicians, children, youth, old etc., even being smuggled from neighbour-countries e.g. Rwanda, Burundi, Zambia, and Democratic Republic of Congo (Kinabo, 2004).

While much is documented about the supply of fashion (design, manufacture, production and marketing and second hand) less is known about how the second hand clothing is distributed once it arrives in the destination market. Figure 1 illustrates the process of mitumba entering the Tanzanian market. According to Caritas Tanzania, (Kinabo, 2004), SHC are imported into Tanzania by businessmen/women and charitable organizations from USA and member countries of European Union. Charitable organizations in Tanzania apply for mitumba from charitable organizations and individuals in European Union and USA. They import mitumba for donating and are exempted from taxes as they provide it free of charge to the beneficiaries. The businessmen/women import the second-hand clothing for selling and getting profit. Once cleared at customs, the bales of used clothing are kept in store ready for selling.

**Figure 1: the process of introducing second hand clothing into Tanzania**  
 (Source: Kinabo, 2004)



Business importers may be characterised as large or medium importers. The large importer usually has many branches with one wholesale operation at least at each central town region including the main selling and distribution centre Dar es Salaam; the medium importers normally only wholesale around Dar es Salaam city. Whole selling takes place in terms of 'bales'; purchasers of bales are normally retailers. Many of these businessmen/women come from rural areas and the few within the district centres. Some of the small businessmen/women clean iron and repack the used clothing for selling or transporting to rural market.

Tanzanian rural markets sell not only SHC but also brand new clothes such as jeans, shirts, t-shirts, women's wear, clothes for babies, kanga and vintage and other traditional commodity. Local operations tend to lack management and modern equipments, resulting in non-standardised product quality compared to that imported from Asia and, because they are sold at higher prices, they find it difficult to compete against both SHC and new clothes from Asian countries such as China, Pakistan, India, UAE (Dubai), Taiwan, Hong Kong (territory of China) and so on (McCormick et al, 2002). The mix of locally produced clothing, imported new and SHC raises a number of issues within the marketplace:

- i SHC is affordable by the poor, being sold cheaper than either that newly produced locally or imported.
- ii Many consumers prefer SHC for quality and durability: some regard SHC as more comfortable (breathing and sweat absorption) and yet others regard SHC to be strong even in adverse situations, eg jeans.
- iii SHC has created employment for many people: many youths and adults (women and men) have livelihoods from selling SHC. Additionally, SHC brings in income to the government as there is a charge of 35% import tax and 20% VAT which deters the government from placing an outright ban on their import into Tanzania.

Our ultimate research quest is to consider if a strategic alliance may be possible between retailers, recycle firms and entrepreneurs in destination second hand clothing markets to undertake a remanufacturing process.

### **1.3 Closed –loop remanufacturing**

The importance of remanufacturing used products is widely acknowledged in the literature in terms of solid waste recovery and economical benefits. Remanufacturing could offer a sustainable business model with significant reduction of carbon emissions and energy use and diverts materials from landfill sites, reduce solid waste and recovers much of the intrinsic value of the used product. However the process of design for remanufacturing is relatively novel in research terms, still under-studied and therefore poorly understood (Ijomah et al 2007, Gray and Charter 2008).

Remanufacturing is a process of disassembling, cleaning, inspecting, repairing, replacing, and reassembling the components of a part or product in order to restore it to new condition (Narsar and Thurston 2006, Michaud and Llerena, 2006, Majumder and Groenevelt 2001). Remanufacturing differs from recycling or reuse as the remanufactured product is upgraded to the quality standard of a new product (Savaskan et al, 2004) with expected life span of an original product (Fleischmann et al, 1997). In an open-loop system, products are manufactured, consumed and discarded after use. Remanufacturing closes the loop of material flow by converting waste into resources and feeding them back into the manufacturing process (Narsar and Thurston 2006). The recovered products replace the primary sources in forward supply chain and save the energy associated with production of virgin materials. Sudin (2004) proposed a remanufacturing property matrix (RemPro-matrix) for the generic remanufacturing process and preferable product properties, as presented in Table 1. The matrix illustrates which product properties are preferable for each step of the remanufacturing process.

Table 1: The RemPro-matrix showing the relationship between the preferable properties and the generic remanufacturing process steps (Sudin, 2004)

Remanufacturing Step Product Property	Inspection	Cleaning	Disassembly	Storage	Reprocess	Reassembly	Testing
	Ease of Identification	x		x	x		
Ease of Verification	x						
Ease of Access	x	x	x		x		x
Ease of Handling			x	x	x	x	
Ease of Separation			x		x		
Ease of Securing						x	
Ease of Alignment						x	
Ease of Stacking				x			
Wear Resistance		x	x		x	x	

#### 1.4 Fashion design process

Industrial fashion design process comprises a sequence of activities, which occurs in a logical order, from idea generation to the final product. Lawson (1997) argued that the design process is a negotiation between problem and solution through the activities of analysis, synthesis and evaluation. Phases of design process as identified by LaBat and Sokolowski (1999) are the problem definition and research, creative exploration, and implementation. Wickett et al (1999) stated the process as trend analysis, concept development, fabrication selection, palette selection, fabric design, silhouette and style direction, prototype construction and analysis, and line presentation. Based on multiple case studies conducted with UK fashion designers, Sinha (2000a) suggested five key phases of design process to be: research and analysis, synthesis, selection, manufacturing, and distribution. Burns and Bryant (2002) also present a similar process to those described, and provide eight detailed stages as research, design, design development and style selection, marketing and apparel line, preproduction process, sourcing, apparel production, and distribution and retailing. Even though the number of activities defined in the design process varies by author, there are no major conflicting views of general design process and, common thread is that the design process consists of universal identifiable activities which occur in a logical order. The sequence presented by Sinha (2000a) reveal an explanatory analysis of whole design process in five key stages, and any definition of design processes could rather fit into these five phases.

**Research and analysis** -The research phase generally includes market research and fashion research (Burns and Bryant 2002, Rosenau and Wilson 2006). Market research collects information about general market trends, need of the target market consumers and preferred product characteristics. Fashion research focuses on forthcoming trends on colours, fabrics, silhouette, trims and design details (Sinha 2000a, Burns and Bryant 2002, Keiser and Garner 2008).



**Synthesis**-This is the stage of design development where the designer transforms inspiration and mood into designs. Garment sketches and technical drawings are developed manually or by using computer-aided design techniques. The sketches are reviewed, selected for processing to have flat patterns created for them. Prototype samples for each design are made and tried on for fit, appearance, measurement and overall performance (Burns and Bryant 2002, McKelvey and Munslow, 2003). Sometimes, instead of using sketches, some designers use draping technique, where the designer works with the actual fabric on mannequin to create the design and then transfer it into a two dimensional pattern piece (Burns and Bryant, 2002).

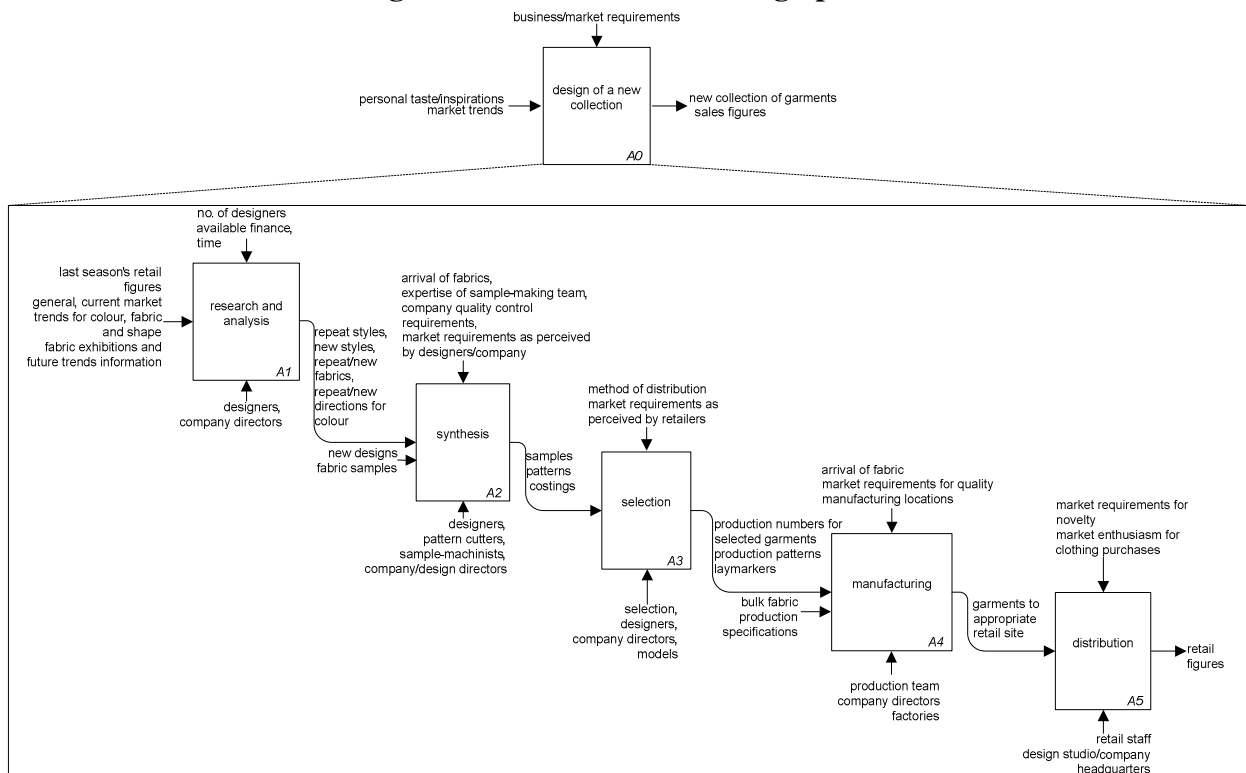
**Selection**-Company prepares a sample range of designs to show to the selection committee in order to select the styles for bulk manufacturing (Sinha, 2000a). The company may produce a fashion show or visual representation of the products to the buyers or the sales representatives (Burns and Bryant 2002).

**Manufacturing**- Bulk manufacturing takes place for the selected styles. Production numbers, quality level, and size ranges are planned according to the buyer requirements. Sourcing decisions on whether the production will be domestic or offshore is determined by the factors such as manufacturing capacities, cost, quality control standards, expected turnaround time etc (Sinha 2000a, Burns and Bryant 2002).

**Distribution**-Manufactured orders are delivered to the retail outlets for selling to the public and the distribution decision is based on the type of marketing channel the company belongs (Burns and Bryant, 2002).

Figure 2 represents an IDEF0 model of generalised fashion design process as practiced by industry (Sinha, 2000b).

**Figure 2: General fashion design process**



## **2. Methodology**

We conducted on site visits and in-depth interviews with several companies both in UK and Tanzania to examine their approaches to utilising SHC. The interviews were conducted to determine the business process models for each operation, identify associated issues and how clothing destined for the landfill may be utilised in the remanufacturing process of clothing. Each interview was recorded, photographed (where possible), transcribed and analysed using flow charts, or IDEF<sub>0</sub> modelling principle where each process is labelled as an activity with inputs, outputs, constraints and drivers the process (Jayaraman, 1990).

This paper presents the results of the interviews and process charts from the following:

- 1) Handcraft/Fashion design producers- Art and cultural products company P, and couture and batik promotion investment company Q.
- 2) Second hand clothing businesses - Tanzanian second hand clothing middleman X and retailer Y.
- 3) Fashion remanufacturing process – UK fashion remanufacturers A and B.

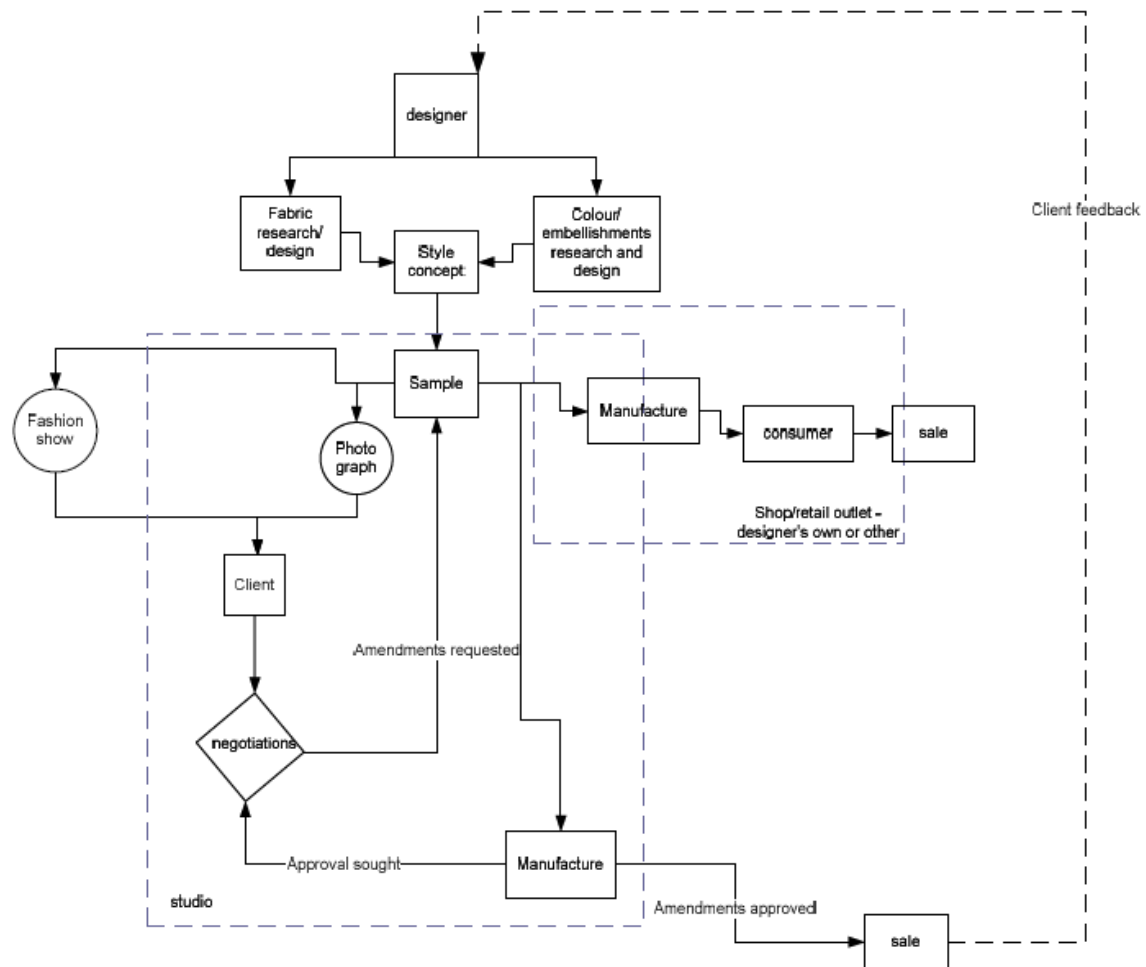
## **3. Results**

### **3.1 Handcraft/fashion design procedures**

The Designers/ handcraft sectors is characterised by ease of entry as the capital required is little and in job training (informal) is widely available. It is also characterised by relatively low operational costs, as the customers sometimes supply the raw material and some designers are producing their own raw materials. The main sources of raw materials are wholesalers and retailers, although some of them obtain it from factories and customers. The dominant distribution channel is one in which garment manufacturers sell directly to individuals.

The majority of the businesses in Tanzania are the small to medium sized enterprises or even micro enterprises (TGT, 2007) and may be regarded as the handcraft sector, local designers and the second hand clothing. The local designers/ artisan not only design and make but also retail their fashions. Being small company size, the benefits are quick decision making for procurement and production of raw materials, building close relations with consumers; in many cases, products being made to order to the customer's requirements. The main problem is that the production is slow and as a small company, finances only stretch to buying raw materials for few customers without enough capital to produce more items. Raw materials (such as Tanzanian manufactured fabrics) tend not to be of comparable quality as the imported goods and priced very highly leading to expensive garments which prove to be uncompetitive against the cheap, good quality second hand clothing so readily available. The processes for all of the firms were very client/customer focused, designers would design ahead of meeting clients but negotiate with them to arrive at a design that the client was satisfied with before production began. The general model of handicraft/designer business process is presented in Figure 3.

**Figure 3: A general model of the handicraft/ designer business process**



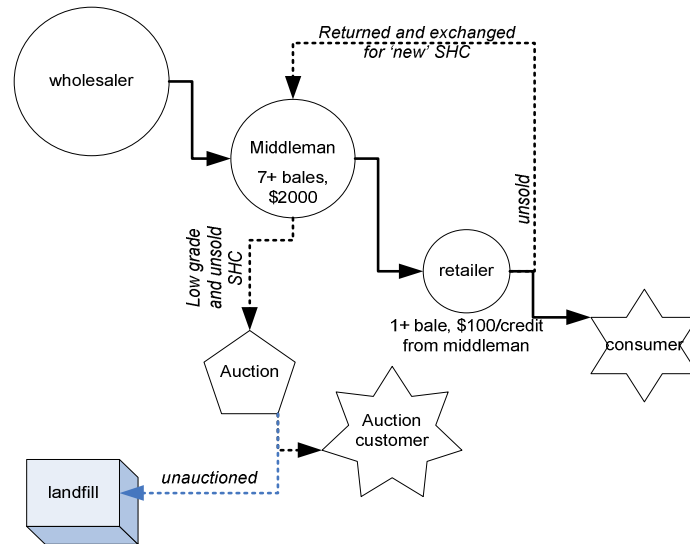
### 3.2 The process of distributing SHC

The second hand stall holder, known popularly as ‘middlemen’, buys bales of used clothing to be resold to retailers in the market areas. Each bale may contain between 200-1000 pieces of clothing (depending on what type of clothing –the thicker and bulkier the item, the fewer the numbers of clothing). A bale of clothing is a block of clothes wrapped with vinyl sheeting and iron bands classified by clothing type such as shirts, jackets, dresses etc.

The main concern of this business is to import the used clothing from abroad, sort them according to their respective grades and sell them to retailers. Middleman purchases SHC bales from wholesalers and sell them item by item to retailers mostly in Dar es Salaam and rarely upcountry regions like Mwanza. Middlemen purchase an average of 7 bales, twice a week, with an average capital of US\$2,000. The smallest middlemen, however, need only US\$100 to buy one bale per week. Currently most retailers don’t have capital, so quite often he gives credit to retailers in the form of clothing which they sell and come back to pay later and also in clothing that has not been sold (exchanging with the new stock). Sometimes they get bales with mixed clothing and some of very low grades. This makes it quite difficult for selling, they are then put into auction for a very cheap pricing and if still

not sold, are finally left to go to the landfill. A process diagram of business activities is represented below in figure 4.

**Figure 4: The process for distributing SHC**



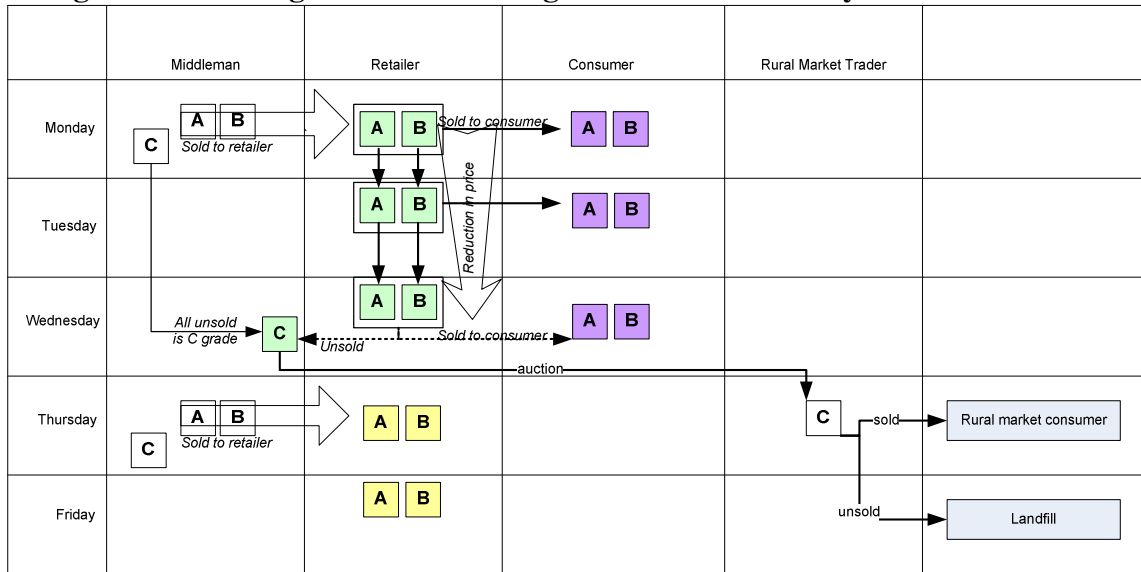
### 3.3 The process of retailing SHC

Retailers are defined as those who purchase second-hand clothes from middlemen and sell them to consumers. Retailers can be sub-classified into stall-keepers, small-street traders, hawkers, and rural market traders. The company Z brings in an annual income is not more than 20M TSh. From buying a single bale of used clothing from stall holders, the company is now buying up to 10 bales within four years of doing this business. This business is much lucrative bringing in profit margins of between 150%-200%, eg, single bale of children clothing for Tsh 120,000 will fetch between Tsh 180,000 to Tsh 200,000.

After opening the bale, the clothes are first sorted for quality; clothing with higher quality are displayed in special frames and have a higher selling price, the rest are grouped together on top of a table or even on the ground waiting for buyer. Sometimes the used clothing have to be auctioned, especially when products are low grade and cheaper and may soon required to go to landfill. In short, a bale of second-hand clothes is sold according to the following cycle: Most middlemen purchase the bales on Mondays and Thursdays. From Monday to Wednesday, middlemen mobilize all retailers of grade A and B to sell as many clothes as possible by decreasing the basic price of each item. Usually, middlemen can obtain enough profit to purchase new bales on Thursday. On Wednesday middlemen mix the unsold items of grade A and B with clothes of grade C, which were set aside on Monday. All the unsold clothes become grade C on Wednesday. As middlemen have already covered the cost of purchasing bales by the sale of grade A and B, grade C becomes their net profit. On Thursday, grade C are sent to some rural markets. The rural market traders go into the business with the goal of selling everything. They will sell grade C by auction sale to the rural small-scale traders.

Figure 5 illustrates this process and examines how the second hand clothing becomes destined for landfill.

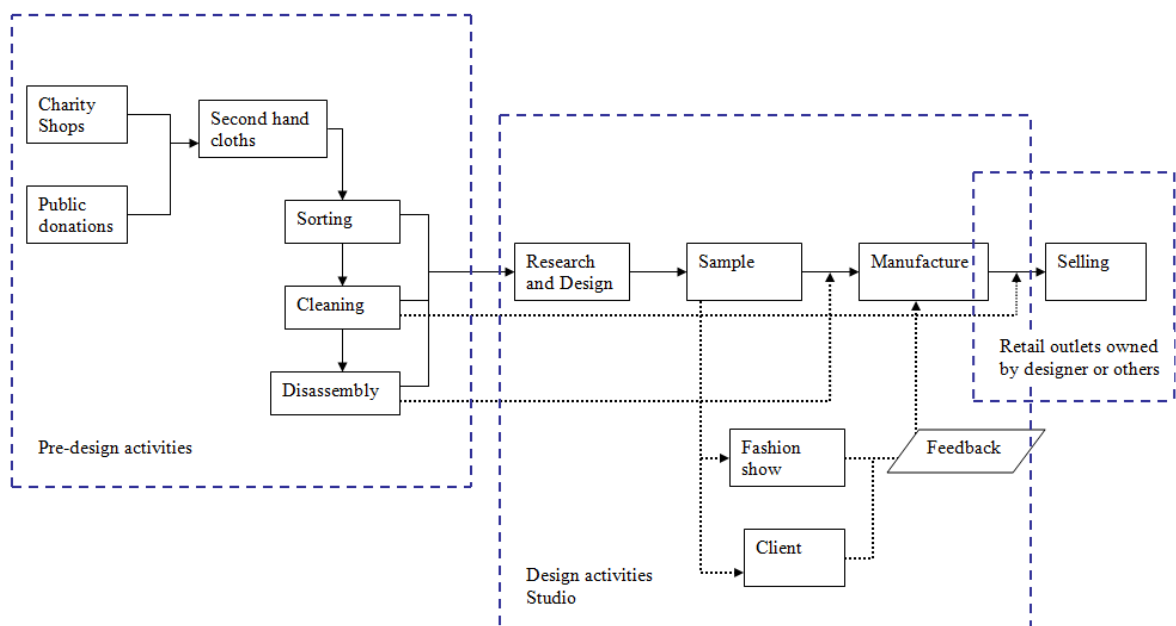
**Figure 5: Flow of graded SHC through the markets till they reach the landfill**



### 3.4 The process of fashion remanufacturing

Remanufacturing is the process of deconstructing SHC and transforming them into unique, timeless fashions. A process diagram of remanufacturing activities is represented in Figure 6. Pre-design activities of the remanufacturing process are categorised into four steps; collection of SHC, sorting, cleaning and disassembly. SHC are collected from charity shops or public donations. Collected garments are sorted either by design, colours or the type of fabric and stored in the design studio accordingly. All the garments that company A receives are dry-cleaned before reuse. Company B does not clean the pre-stock, however the remanufactured garments will be thoroughly cleaned before sending them off for selling. Disassembling of SHC takes place either fully or partially according to the design idea that the designer has in his/her mind.

**Figure 6: The process of remanufacturing**



The design process for remanufacturing was analysed according to the five steps presented in standard design process (Sinha, 2000b) and illustrated in figure 7.

#### *Research and analysis phase*

Research does not focus on trends as the whole idea is to promote non-seasonal, timeless fashions. The collection is always derived from what the designers' feel and what they want to do under the umbrella of sustainability. Design ideas largely depend upon the original type and shape of SHC. The analysis is focused on the investigation of material types and availability, shapes of SHC, and exploring re-designing possibilities.

#### *Synthesis phase*

In company A, design ideas are mainly generated thorough draping and trial and error method. Designer follows a creative approach to discover new designs with less disassembly, by experimenting a trouser or coat on the mannequin upside down, draping a shirt on the mannequin to form a skirt etc. Designer in company B also uses draping, yet mostly works with flat fabrics obtained from fully disassembled SHC. Low quality SHC is used to experiment with sample designs.

#### *Selection*

Sample range of designs is produced to present in a fashion show under the themes of recycling, sustainable or ethical fashions. Sample garments are produced with a theme of colours and with a limited size range.

#### *Manufacturing*

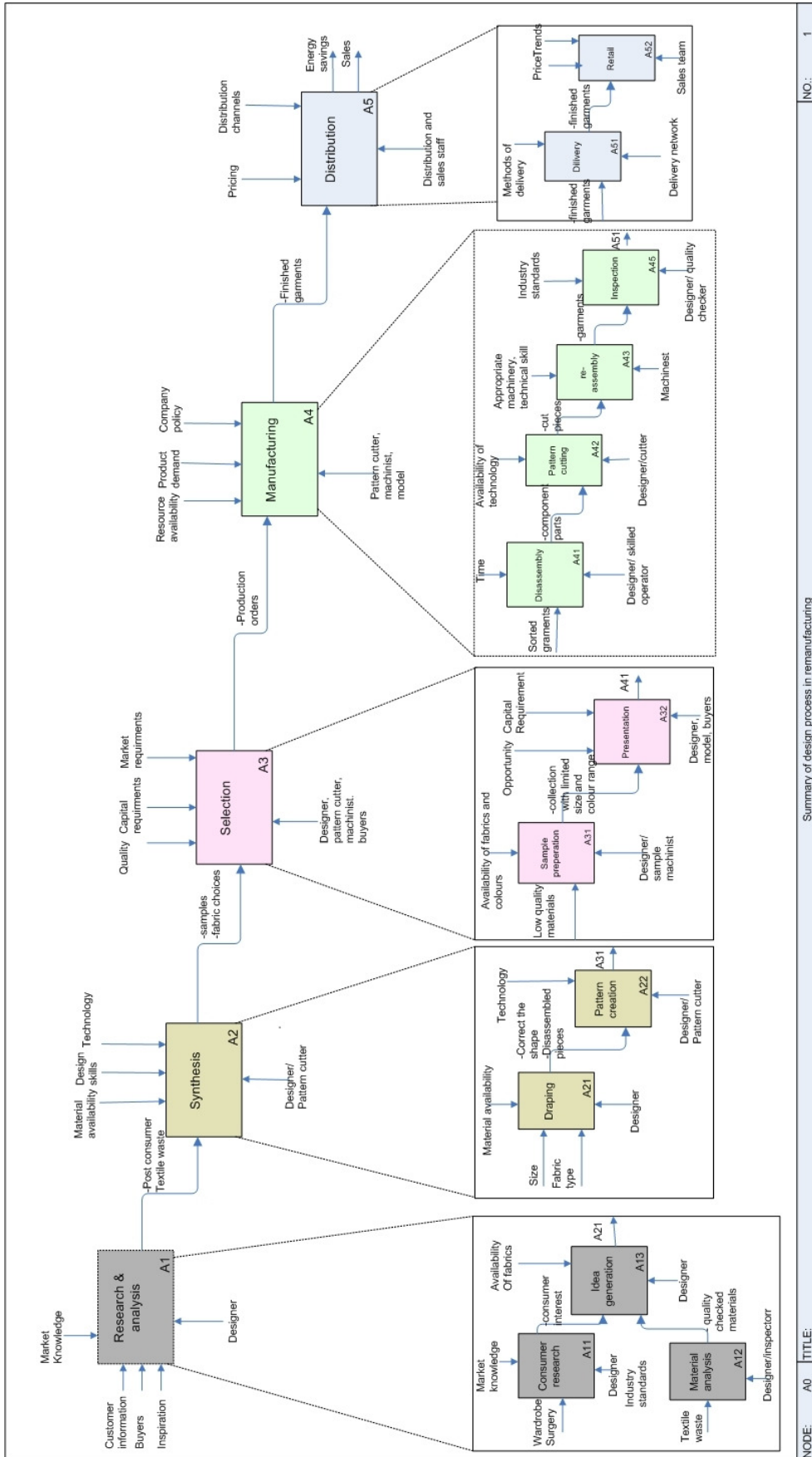
Company A receives very few orders from buyers after presenting sample garments. Majority of the business in both companies continue to be operated by creating one-off pieces to sell in the shops. No two garments are same, even if cut form the same pattern, because the fabric is always different form one garment to the other. Some of the clothes are 'multi way', for example, a top was designed in a way that it could be worn as a dress or skirt as well. Both companies provide a 'wardrobe surgery' service to its customers where the customers can bring their worn out, old garments to the shop to make it to a new, wearable fashion.

#### *Distribution and selling*

Both remanufacturers sell their products through their own shops or distribute products to sell in sustainable and ethical fashion shops. Price of a garment can vary from £10 to £400 depend on the type and quality of the garment.

Figure 8 represents a summary of design process in remanufacturing drawn up according to the IDEFo principles. Each function is represented in a box and the inputs, outputs, controls and mechanisms associated with the function are connected by arrows. Each main activity is decomposed into more detail level of analysis.

Table 2 presents a summary of problems associated with remanufacturing process and possible solutions.



Summary of design process in remanufacturing

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Figure 8: Summary of design process in remanufacturing

**Table 2: Issues in remanufacturing process and possible solutions**

<b>Phases</b>	<b>Issues</b>	<b>Possible solutions</b>
Research and analysis	Research does not focus on trends and produce non-seasonal fashions. There is a less market opportunity for these non-seasonal products.	Use high level of design skills to transfer trend information in to fashions.
Synthesis	Draping is time consuming technique and utilise more fabric than flat pattern cutting using sketches. Designer has to spend significant time on mannequin and also has to take the lead role in both designing and pattern creation processes.	Use of CAD/CAM software tools may help the designer to reduce designing time and utilise the fabric effectively.
Selection	Uncertainty of buyer response as fashions are non-seasonal and also the limited size and colour range produce incoherent fashion stories.	Utilise the retailer's need of being sustainable and market the products as a recycling range in store under the label of sustainable fashions.
Manufacturing	Manual cutting operation is highly a labour intensive and time consuming task. Machine operator needs an extra time to understand each different style and adjust the machine accordingly, which affects the production efficiency.	Component parts of similar shapes need to be cut as a multi layers with small markers to save time and minimise waste. Use of multi skilled operators in a modular production system.
Distribution	It is difficult to market the product without having strong network with well established retailers and distributors. There is a trade-off between price and quality of used fabrics.	Use of marketing strategies to increase the consumer demand for products. Need to be price sensitive to the market.

#### **4. Discussion**

The interviews conducted with SHC wholesalers and retailers outlined how SHC was distributed once it had been sold on from the wholesalers. The interviews also confirmed that SHC are imported by wholesalers and charitable organizations; wholesalers pay all relevant government duties and taxes, charitable organisations (upon application) are exempted. Sometimes the charitable organization sells them to other charitable organizations at a lower price in order to meet the costs of transport and clearing. Problems start when some middlemen take advantage of this by buying the exempted SHC and selling them to the retailers as if imported with extremely high margins. The study confirms the literature review: a) the nature of competition between SHC and domestic manufactured fashion and textiles, individual retailer businesses were able to make almost double that of a designer, when the clothing sold is cheaper than the domestically produced garment/textiles, b) the consumer's interest in second hand clothing as a cheap and good quality source of individually expressive clothing and c) the SHC business offering some sections of the society a living.



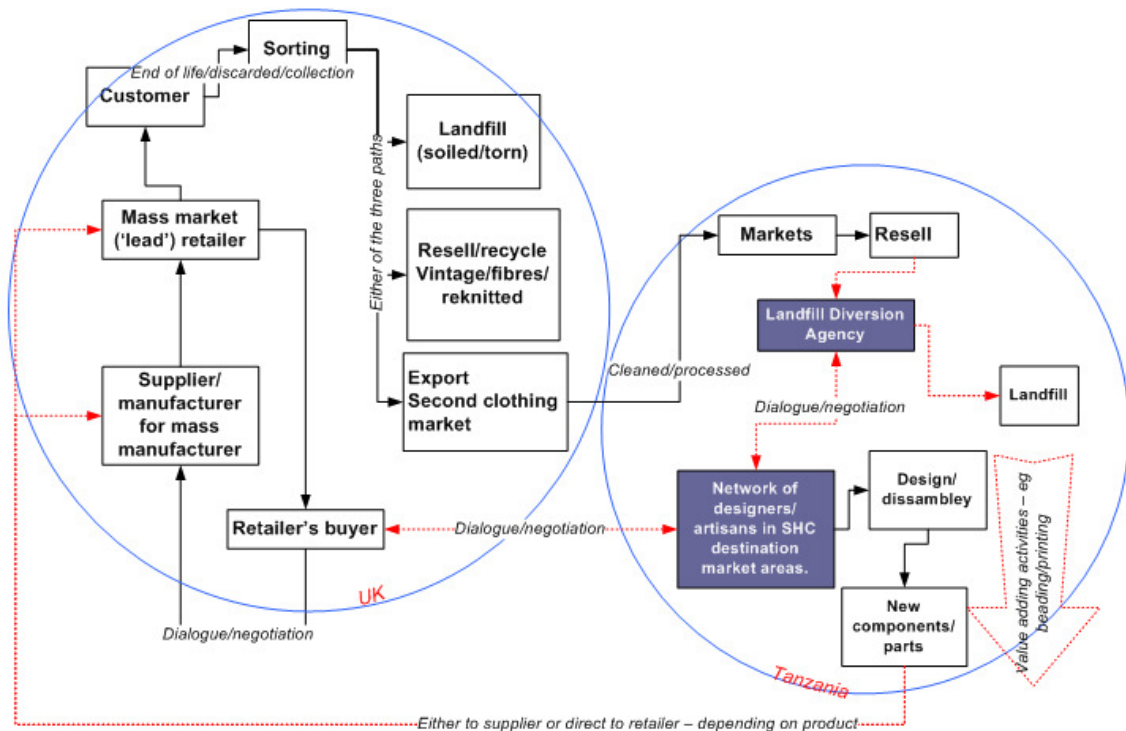
The interviews conducted with remanufacturers outlined the designers' approach to make new fashions from old. The study suggests that the main steps of the design process in remanufacturing are not dissimilar to the industrial design process. Main concerns of the design process are the inefficiency in reverse supply chain, material restrictions, lack of technology applications, and lack of design skills. Maintaining a smooth flow of input material is an issue mainly due to the facts that the remanufacturer does not have entire control over reverse supply chain and a lack of collaboration with textile recyclers to obtain SHC. The remanufacturing process entirely depends upon the general waste stream to collect the material, however the quality and quantity of the recovered waste is an issue. Product design and development skill appears to have a great influence on success of remanufacturing business and there is a requirement of talented designers who could combine high skill and innovation to deal with complexity in re-design process and to recover maximum value from the product.

Developing some form of relationship between the designers/handicraft and the SHC could help to reduce the cost of raw materials for design/remanufacture fashion combining new fabrics perhaps with some carefully selected part of SHC to produce a new fashion. From the interviews and literature reviewed, remanufactured fashion benefits where the consequences of land filling are environmentally more expensive than to reuse – if the garment is capable of being resold without any further energy or expense then it is not suitable for remanufacture. However, if the garment or textile is capable of being reused but is sent to landfill because it is unwanted (for reasons of style or colour) then it would be appropriate to use the fabric for remanufacture. It would therefore be a recommendation of this study that the fashion designer/handicraft make contact with the rural traders, who are the last people in the chain to handle the SHC before it goes to landfill. This therefore requires the designer to create the relationship with the rural traders or opportunities for agencies to be developed that will work with both design/handicrafts businesses and the rural traders to ensure that as much fabric is diverted from the landfill as is possible.

As noted, the second hand clothing market raises complex issues. The clothing supply chain is complex, global, characterised by sub contractors in the developing world and the use of migrant workers. Most fabrics for clothing manufacture are bought on global commodity markets. Retailers can buy clothing from known suppliers, through agents or vendors. Determining origin and sustainability credentials of raw materials and stock are key challenges, affecting transparency and the ability to effectively manage impacts across the supply chain, and requires an understanding of the risks involved in the management of the supply chain (University of Cambridge, 2006). These issues have often been examined by the value chain approach, extensively in the field of development studies, as it examines the mechanisms of developing trade and production through globalisation and the resulting effects (Gereffi et al, 2001).

Our proposition for remanufacturing in fashion is illustrated in Figure 9. The broken lines depict the remanufacturing process network of textile recyclers, technology providers such as Lectra ® (with latest CAD/CAM pattern cutting/management software), local crafts entrepreneurs in destination second hand market areas and factories supplying clothing to the large retailers. Our intention is to pursue this research by interviewing members of this proposed network to understand the issues raised by our proposition with a view to developing an industry based remanufacturing process.

**Figure 9: Proposed remanufacturing model**



## 5. Conclusion

This study provides a useful model for understanding how the remanufacturing process could be practiced in global scale. We argue that there is a potential of incorporating remanufacturing into conventional manufacturing process by linking stakeholders in reverse supply chain (such as craft/design people and recyclers) with the forward supply chain. The development of an agency may create employment opportunities as well as routes into the global supply chain. As noted in the report by TGT (TGT, 2007), buyers from the large international retail chains are reluctant to engage in discussion about local (Tanzanian) production due to the low quality. However, local designers and handcraft tend to negotiate design ideas with clients and buyers, and so buyers may be able to work as they do with their current manufacturers in their centres of low cost production. From a 'corporate social responsibility' approach developing products remanufactured from textiles destined for the landfill using local design skills and cultural heritage may help to address the 'triple top line' issues of ecology -diverting textile waste from landfill, equity - involving the developing economies in the global supply chain and economics - by developing fashion/textiles products that appeal to the growing consumer concern about ethics and the environment (Braungart and McDonough, 2008). Further studies need to be carried out to refine the model presented in figure 9 and improve the understanding of the process of knowledge and information transfer across the value chain. It is vital to identify how and what profits a remanufacturing process can bring to a company and how it can truly be incorporated in the current system.

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