



Renewing Materials:

3D Printing and Distributed Recycling
Disrupting Samoa's Plastic Waste
Stream.

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Reclaimed ABS material
from old computer key-
boards (photograph by
Lionel Taito-Matamua)

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Abstract

Keywords: 3D printing, distributed recycling, participatory design, fa'a Samoa, plastic waste, upcycling, re-claimiing

This research addresses the serious issue of plastic waste in the Pacific. Using Samoa as a case study, we hypothesise that distributed recycling combined with 3D printing offers an opportunity to repurpose and add new value to this difficult waste stream. It is also an opportunity to engage diverse local communities in Samoa by combining notions of participatory design, makerspaces and 'wikis' of parts with traditional Samoan social concepts such as 'Fa'a Samoa', or 'the Samoan way' and sense of community.

The project seeks to explore creative and innovative solutions to repurposing plastic waste via a range of design research methods. Field work in Samoa has established the scope of the issue through interviews with different stakeholders such as Government, waste management businesses, the arts and crafts community and education. The field work has also helped identify potential product areas and collaborative partners. The different types of plastic in the waste stream have been identified and material

experiments such as plastic shredding and filament extrusion are underway using low cost open source processing equipment to transform plastic waste into useable 3D printing filament. From this filament, potential 3D printed end products are explored through a hands-on researching by making process.

The experiments inform the design of workable, economically viable, socially empowering and sustainable scenarios for repurposing and upcycling plastic waste; printed in the form of useful and culturally meaningful 3D printed objects, artefacts and products. Applications range from creating greater awareness of the issue by way of tourism and the Samoan notion of 'mea alofa' or 'gifting', through to functional utensils and parts. It is an opportunity to expand Samoa's traditional forms of craft into new self-sustaining communities, makerspaces and small scale local industries. The outputs of the initial project are intended to provoke discussion and invite participation in the implementation of these different scenarios of production.

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I dedicate this research to my loving grandparents and to all the people who have passed away whilst I have been on this journey.



Plastic rope tied up to a tree. Photo taken on the water-front in Apia Samoa (photograph by Lionel Taito-Matamua)

Chapter

1

Introduction and Overview

*Q: How can additive manufacturing influence new ways of recycling waste plastic materials in Samoa (and vice versa)?
And what applications can Samoa have for the recycled material?*

Introduction

Marine plastic debris has been considered one of the most serious pollution problems since the Great Pacific Garbage Patch was first predicted and corroborated in the 1980s. (Shomura & Yoshida, 1984) The situation has direct economic implications for pacific nations who rely on healthy marine environments as a source of sustenance and income, as well as reputational capital for tourism. (Penaia, 2014).

While there are many ecological initiatives that aim to collect debris from the marine environment in operation, recent research emphasises that without significant improvements in waste

management the amount of plastic waste entering oceans from land will increase by a significant order of magnitude by 2025. (Jambeck, J.R., Andrady, A., Geyer, R., Narayan, R., Perryman, M., Siegler, T., Wilcox, C., Lavender Law, K., (2015). Plastic waste inputs from land into the ocean, Science, 347)

Given the scale of the problem, it is unlikely that it will be resolved by any single solution. However, the emerging digital technologies associated with 3D printing provide some possibility to disrupt this relentless stream and to raise awareness of the issue. (Manyika, et al., 2013)

Literature Review

The literature used in this thesis project is primarily focused on the effects of plastic waste in the South Pacific as well as research into recycling plastic waste with 3D printing processes. *“Plastic has become an integral part of society as population growth and technological development have resulted in the global production of plastic increasing by 500% over the last 30 years and it expected to continue to grow to 850 million tons per year by 2050 (Lotfi, 2009) (L. C. M. Lebreton, 2012).”* - (M.A. Kreiger, 2013)

Plastic pollution in the Pacific is not only affecting the lives of the local inhabitants, but also affecting wild-life and the tourism industry of the ‘Pacific Paradise’. The image of the Pacific, as described by David N. Zurick, conveys to the world *“images of pristine beauty and romantic, almost timeless”* (Zurick, 1995). Shadowing this beauty is the underlining increase of pollution. This problem is caused by *“the steady increase in imports from overseas (Dahl, 1984)”* which *“has brought with it an accumulation of old car bodies and broken down heavy equipment, appliances, bottles, cans and plastic”*.

The pollution not only affects natural wild-life and ecosystems but can also affect the tourism sector in the Pacific Islands. Much of the Pacific Islands' income relies heavily on tourists from other countries experiencing the beauty and culture of the region (Regina Scheyvens, 2010). Finding a way to reduce the impact of this waste stream is a key aspect of this design thesis. *"There are also tourist perceptions and emotive issues arising from widely published images of seabirds, marine mammals and fish entangled in abandoned or lost netting, furthermore, entanglement and ingestion may lead to death from starvation and debilitation, with a reduced quality of life and lower reproductive performance..."* - (Gregory, 2009)

Many regions in the Pacific struggle with basic material necessities. The advent of low cost 3D printers offers an opportunity to use additive manufacturing *"to make appropriate technologies for energy generation, water distribution, utensils, shoe insoles, parts of medical equipment, parts of water filters, etc. as well as parts and copies"* (Pearce, 2010) of the printer itself.

As the technology of the "next industrial revolution" becomes more affordable and accessible, new scenarios of production are emerging. The advent of a \$750 kitset printer from Makerbot in 2009 signalled the possibility of a *made@home* revolution. Students at Victoria University of Wellington responded

with a *recycled@home* scenario and the resulting Recyclebot was the first example of a closed material loop in the form of small-scale distributed fabrication and recycling. (Fisher, et al., 2012)

This pioneering project has since been complemented by more recent technical and commercial developments such as recycling filament machines like the RecycleBot (M.A. Kreiger, 2013), Filabot (McNaney, 2012), the Lyman Filament Extruder (Lyman, 2012), and the MiniRecycleBot (MiniRecycleBot, 2012).

These developments are further supported by research into the economic implications of recycling plastic waste for the production of printable filament, such as Krieger's journal article about Joshua Pearce's RecycleBot: *"The cost of commercial 3-D filament (ABS or PLA) currently ranges from \$36-\$50/kg, while the RecycleBot produces 1kg of filament from about 20 milk jugs for under 10 US cents..."* - (M.A. Kreiger, 2013)

All these developments form a basis for this study. I hypothesise that digital technologies and distributed recycling combined with the social and cultural context in Samoa offers a unique opportunity to model a workable, economically viable, socially empowering and sustainable scenario for repurposing and upcycling plastic waste, by reinvigorating it in the form of useful and culturally meaningful 3D printed objects and artefacts.

I also propose moving beyond the "prosaic" (Walker, 2014) by revisiting the notion of reduce/recycle/reuse with a new, more poetic strategy of reclaim/remake/reinvigorate by 1) Reclaiming not only materials but also a sense of identity in the onslaught of foreign matter; 2) (Re)Making as a form of social practice, recapturing in virtual space Samoan practices of sociable creation - transforming production from the anonymous activity it has become, to a more personal, communal activity; and 3) Reinvigorating in the sense of giving new life and meaning to matter, rather than attempting to reiterate its previous mass produced purpose.

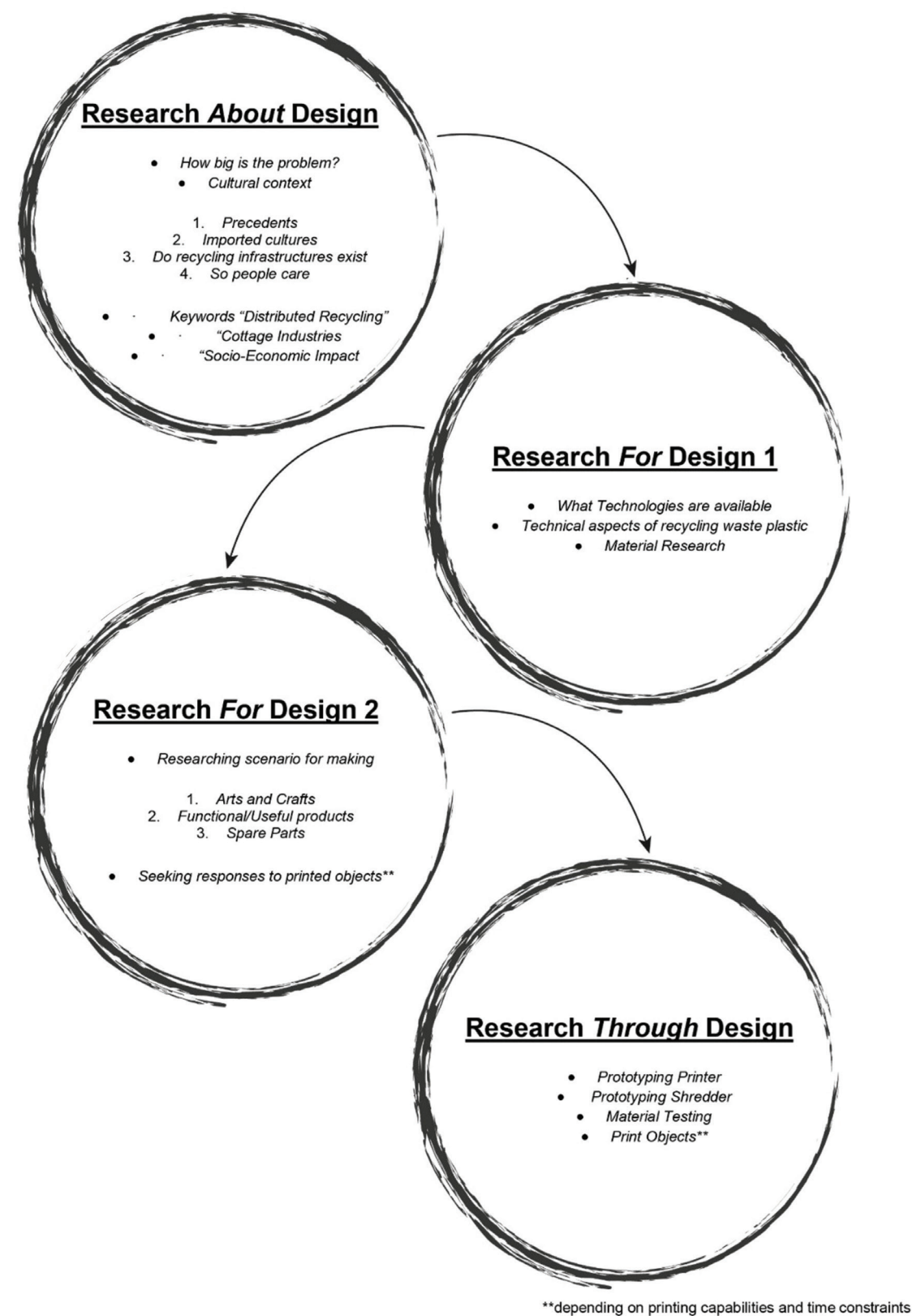
This represents a design response to a much larger issues such as "social inequalities" and "environmental destruction" captured by Stuart Walker in Designing Sustainability. (Walker, 2014) It is also a design response that connects to the concept of designing and making as an empowering activity in Klaus Krippendorff's idea of "cooperative design". (Krippendorff, 2008)

In conclusion, this emerging body of knowledge provides a compelling and timely context for exploring distributed recycling of plastic waste in combination with additive manufacturing as a means of disrupting Samoa's plastic waste stream. pollution.

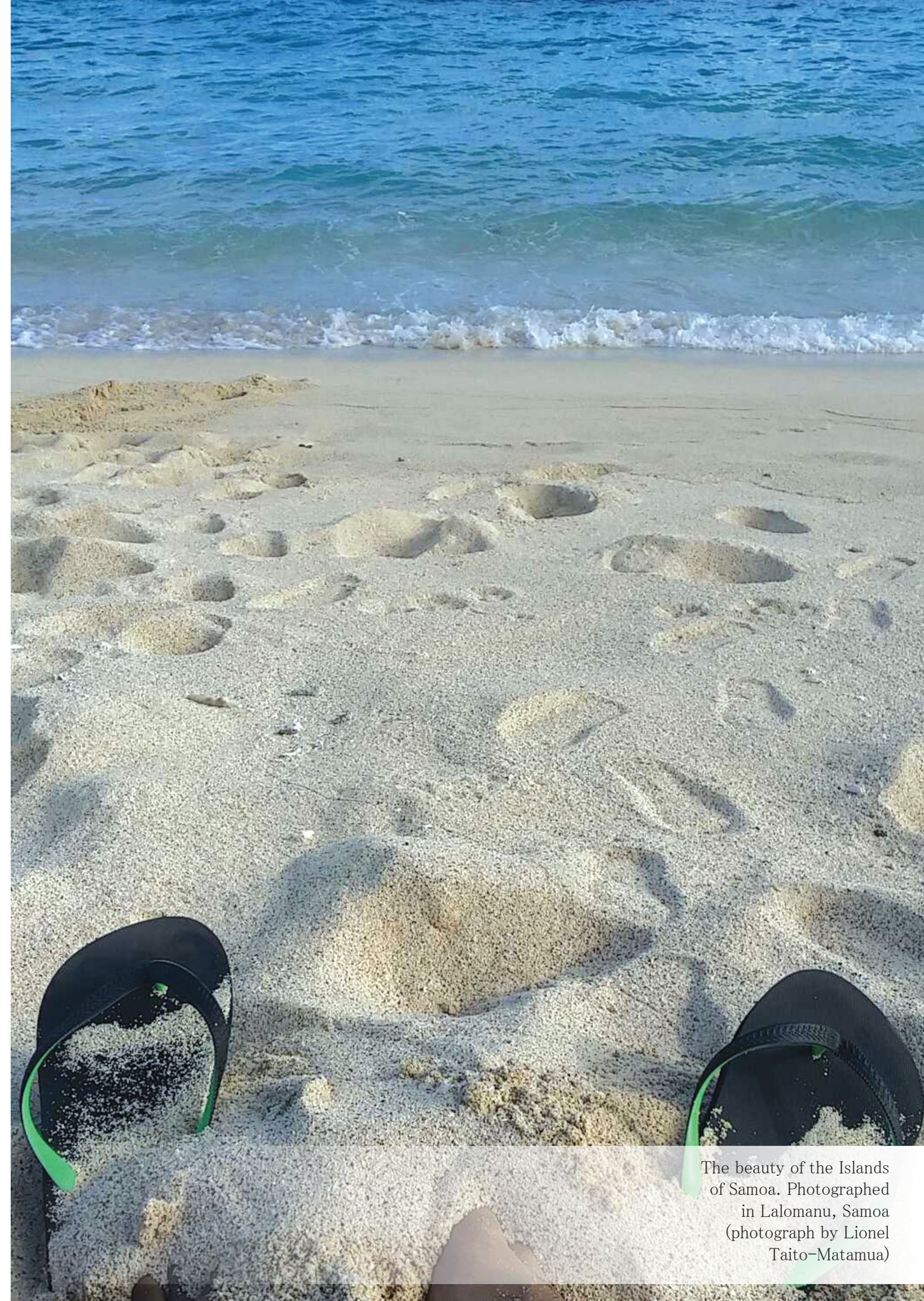
Research Process

This research requires different stages to prove the initial hypothesis. Research must be conducted into the cultural context of this research to assess if the issue is current and valid. Material experimentation is needed to

test the different plastic types. Design explorations are being used in this research to create printable objects which can be 3D printed which benefit the community. These objects must also relate to the cultural context.



—Figure 1 Flow chart of my research process



The beauty of the Islands of Samoa. Photographed in Lalomanu, Samoa (photograph by Lionel Taito-Matamua)

Chapter 2

Contextual Research

Country Information



—Figure 2 The main Islands of Samoa. (From left to right: Savaii, Apolima, Manono. And Upolu.)

Independent State of Samoa is located south of the equator, halfway between Hawaii and New Zealand. Formerly known as Western Samoa, the total land area is 2,934 km² consisting of two larger islands of Upolu and Savaii which account for 99% of the total land area with 8 smaller islets (Environment, 2011).

Samoa's 2011 census showed an estimated population of 187,820 with 36,735 in the urban centres and 151,085 based in the rural areas (Statistics, Population and Housing Census 2011, 2012). There are a large number of Samoans based in and around the main city centre of Apia, the capital of Samoa. In 2014 there were an estimated 130,955 visitors to Samoa ([http://www.samoagovt.](http://www.samoagovt.ws/wp-content/uploads/2015/02/2015-)

[STA-Newsletter-07-120215.pdf](#)), compared to 2006 which saw an estimated 115,882 visitors to Samoa (Statistics, Key Statistics, n.d.).

On December 29, 2011, the international dateline was moved east of the country, aligning its time zone more closely with Australia and New Zealand. This change was to align with trading partners in America and Europe (Tapaleao, 2011). Samoa's temperature on average is relatively high with a heaviest rain-fall between the months of November and April. January is Samoa's wettest month with July being the driest (http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_Region=Australia&ThisCCCode=WSM).

Emailed Contacts

The research investigation started with finding key contacts in Samoa who could assist with the project. Starting with personnel working for the environmental sectors of the Samoan Government, one of the first contacts to reply was Fuatino Leota (Principal Chemicals and Hazardous Waste Management Officer) who also directed me to Setoa Apo (Principal Waste Management Officer). Both work for Ministry of Natural Resources and Environment in Samoa. The conversation can be found in the Appendices (Appendix 1- A1.1).

Fuatino and Setoa explained recent steps Samoa is taking to improve plastic disposal. Samoa had introduced a “Regulation on Plastic bags in 2005 which was approved early 2013”. The introduction of a “Biodegradable Plastic bag regulations which regulates the importation of shopping bags. The importer has to have a license to import

shopping bags in line with the minimum requirement of specially the bags must be 50% starch 50% petroleum based to ensure that they must be naturally degrade within 12 months” (Leo, 2014).

Recycling companies in Samoa are collaborating with the Samoan government to find new ways of reducing the amount of plastic waste being produced. This directed the research into contacting recycling companies in Samoa. A response from West End Co. , Ltd. representative, Marina Keil threw light on some of the current practices (Appendix 1- A1.2). She explained that very little plastic is being reprocessed in Samoa and activity was limited to collecting, compressing and sending the bundled material to other countries such as NZ, Australia and Singapore. However, plastic was not commonly collected as there is little market value in the material (Kiel, 2014).

Samoa Waste Management Strategy

Samoa people have developed their own methods of disposing of waste. This includes feeding it to pigs, open burning, pit burying and disposing garbage at the landfills. Despite collection services being available in Samoa, open burning is most often used as an immediate method. The government has developed a Waste Management Act which prohibits burning of waste in any manner,

including on private property or public land (Environment, 2011). Pit burying is another technique used by locals to dispose of waste such as tins, glass etc. This is a technique used to inhibit mosquito breeding around the house.

The Samoan government has established guidelines and regulations through the following legislation;

Existing Legislations and Policies (Environment, 2011, pp. 21-22)

-Waste Management Act 2010.

An ACT to provide for the collection and disposal of solid wastes and the management of all wastes in Samoa, and for related purposes.

-National Waste Management Policy 2001.

The purpose of this policy is to propose guidelines for the minimization, control and management of wastes and pollution.

In terms of recycling, Samoa does not have an organised recycle collection scheme. There are a few recycling companies operating in Samoa. These recycling companies operate on the two main islands of Upolu and Savaii. They are;

- o Pacific Recycle Co., Ltd
- o West End Co., Ltd
- o Singapore Motor
- o Demolition Depot

The Pacific Recycle Co., Ltd operates at Tafaigata next to the Waste Unit Office.

They have assisted the Ministry in various ways as well as beach resort operators and some schools. The responsibility of collecting recyclable waste from schools and resorts falls on Pacific Recycle Co.

The recycling companies in Samoa accept a range of materials including scrap metals, tins, car bodies, plastic bottles and containers and car batteries. Recycling paper and cardboard is difficult as there is no current recycling scheme for these materials. As Samoa is quite isolated and far from major trading partners, recycling companies face many challenges in shipping materials to overseas countries. The return from such operations is not financially sustainable.

In terms of recycling schemes Samoa Breweries Limited is the only company in the country that implements a return for reuse system. This scheme has been operating for decades in both beer and soft drink glass bottles. They refund 20 sene (cents) for 750ml bottles and 10 sene for 450ml bottles (Environment, 2011).

Field Research

The first step in exploring my hypothesis involved field research in Samoa. Information about plastic waste management was collected from interviews with two main stakeholders, PR (Pacific Recyclers Ltd.) and SPREP

(Secretariat of the Pacific Regional Environment Programme). The field work also coincided with the third International Conference on Small Islands Developing States (SIDS Conference 2014) and facilitated meetings with key

organisations and businesses attending the conference. An understanding of Samoan traditions and social practices was gained from participating in the *Teuila* Festival (Leo, 2014), Samoa's largest annual festival and celebration of Polynesian culture. This included discourse with experts and professionals in related areas as well as visits to local residents. The following considerations have specific relevance to the project.

Waste Management in Samoa

Samoa has legislation in place with the Waste Management Act 2010 and the National Waste Management Policy 2001. However, the recycling sector consists of only a few independent operators who focus mainly on scrap metal, without an organized recycle collection scheme. To test the economic viability of plastic recycling in 2010 PR and SPREP exported 7,642 kg of plastic waste to Australia collected between the years of 2007 and 2010 as detailed in Table 1:

Table 1 Details of Accumatled plastic waste in Samoa. (2007–2010)

Description	Quantity (kg)
PET bottles, baled	1,782
PET bottles, ground	155
PVC white, ground	723
PVC tubes yellow, ground	290
Mixed plastic with metal	2,327
Plastic cover black, ground	2,365
Total	7,642

The financial return did not match investment. (Lee, 2014) Both PR and SPREP subsequently confirmed that plastic is one of their most difficult recycling issues due to its lack of monetary value (Haynes, 2014) and PR concluded that on-island processing is the key to managing this growing waste problem in Samoa. (Sio S. , 2014) This observation provided economic background for the thesis project.

Culture and Traditions in Samoa

A number of traditional social and cultural concepts or practices were also identified that could be aligned with and enrich technological context of our hypothesis – to mutual benefit.

“Tree of Life”

Fig 3 shows some applications for different parts of the coconut palm as an example of a comprehensive and sustainable use of a local resource; as building materials for the Fale or traditional Samoan house; for diverse woven and carved implements and artefacts; as food or fuel; and for a wide range of exportable commercial applications. The tradition for using every part of the coconut palm is a key precedent for this study.

–Arts and Crafts

Pacific nations can call on rich and longstanding craft traditions spanning functional structures and implements, through to highly decorative and symbolic artefacts. However, the field study revealed that Samoan craft communities are resourceful and not exclusively locked into traditional materials. For example, local artist Naomi Apelu has moved away from pandanus, coconut palms, and natural flax, and uses recycled plastic bags and palette strapping to create woven place mats, baskets and other traditional Samoan woven ornaments. Her work serves as an important precedent for an adaptable, resilient and innovative culture of craft and making where new materials and processes are integrated into and enhance traditional practice - and vice versa.

–Mea Alofa

Mea alofa is the universal term that Samoans associate with gift giving. (Sio S. W., 2006) Gifts are presented at any large family occasions such as weddings and funerals, including greeting visitors. Traditionally in Samoa, the customary items which were gifted (*sua*) were fine mats or long lengths of *tapa* cloth. However, the old traditions are becoming harder to maintain due to lack of master weavers. The fine mats of today are no longer “fine” and have no function because most are too bulky to wear. (Schoeffel, 1999) This perceived loss of quality represents an opportunity to revisit the link between value and craft – not necessarily in the form of traditional craft but reinvigorated with digital craft.

–Fa’a Samoa

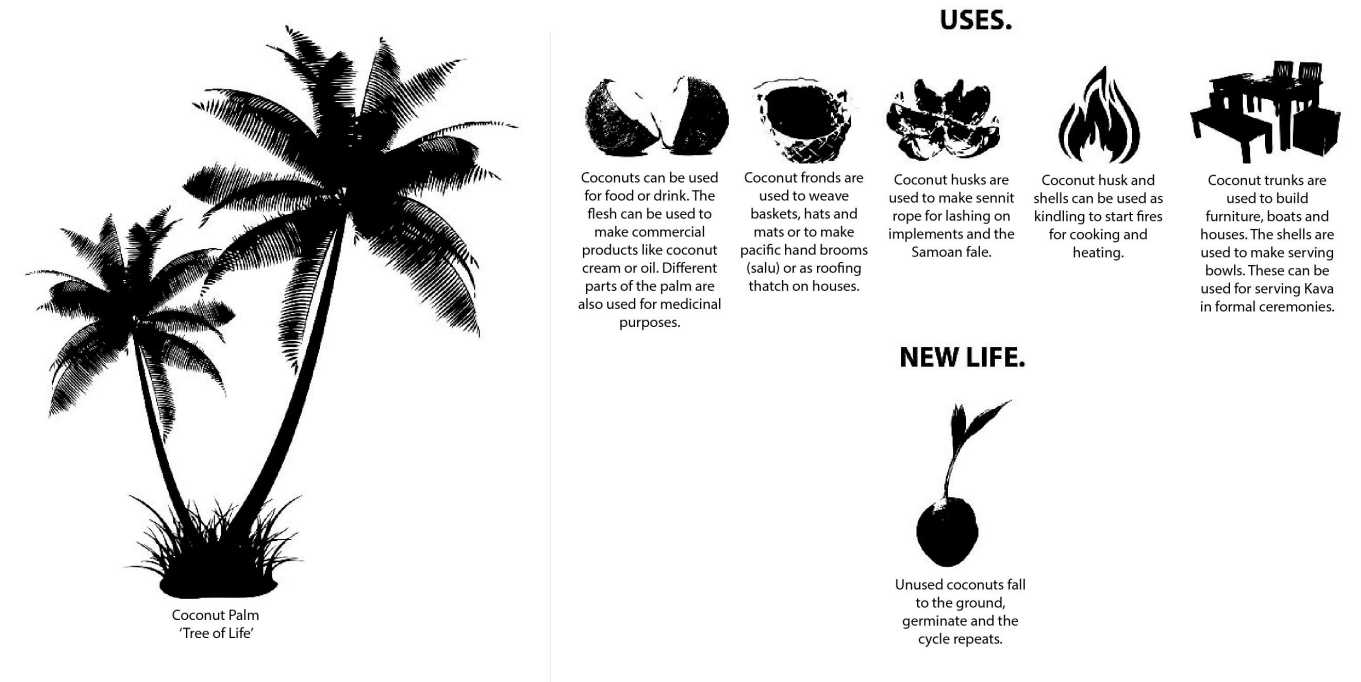
Betham explains ‘the Samoan communal way of life’ as captured in the term “*fa’a Samoa*”: “In Samoan traditional society (...) the matai, village and whole community join in this on-going responsibility of learning and living as the young are instructed, directed and guided in cultural ways and values of respect and good relationships.” (Betham, 2008) Samoa’s communal way of life is most evident during times of traditional events and covers different aspects of the Samoan culture including *aiga* (family), *gagana Samoa* (Samoan language), *Fa’a matai* (chiefly hierarchy) and *fa’alavelave* (ceremonial and family obligations).

–Education

Schools in Samoa are an important link in developing a viable ecosystem of (re)making. While a digitally capable community is necessary to provide content – 3D digital files for artefacts and products, digital fabrication may in turn offer special opportunities for education in Samoa by supporting a cultural disposition towards kinaesthetic and tactile learning. (Faleolo, 2013) This approach to learning has found a new ally in the emergence of the “Maker Movement” where “physical ‘making’

(Fana’afi, 1986) Extended family, friends, and local village neighbours help by sharing their time and expertise with the host family. The idea of coming together as one big family is found throughout Samoa. This concept of community is not dissimilar to online communities where users can share ideas, information and designs, freely available for others to use and modify to suit their purpose - such as thingiverse.com who facilitate CAD (computer-aided design) file sharing between users in a participatory design process. These communities - online communities and *fa’a Samoa* share similar characteristics, which can easily co-exist.

is the new frontier” and brings with it a “making based model of education”, which has far reaching implications for society. The maker movement is not just about making things, “it is about developing agency, starting with the physical world, through the use of platforms and technology that make it easier to connect, learn and collaborate.” (Deloitte Center for the Edge, 2014) In this respect the maker movement is not only aligned with modes of learning in Samoa, it is also connects to the concept of *fa’a Samoa*.



–Figure 3 Different uses for the different parts of the coconut palm. (diagram by Lionel Taito–Matamua)



–Figure 4 Elevated Rubbish baskets located around the islands of Samoa. (photograph by Lionel Taito–Matamua)



–Figure 5 Samoan Artist Naomi Apelu (image courtesy of Tiapapata Art Centre)

–The Tourism Industry

At 20-25% of GDP Samoa's economy is largely driven by tourism (Samoa) and there is clear awareness of tourism's importance to Samoa, including the need to maintain Samoa's environmental heritage as a "green, clean and healthy island." (Leo, 2014) Typically tourism and cultural heritage are often closely linked, therefore the tourism industry could be an important conduit for digitally crafted products and artefacts that create compelling narratives and a greater awareness of the issue.

Importation

Samoa water companies are one of the biggest importers of plastic into Samoa. *Le Vai*, Samoa's biggest purified water suppliers import most of their plastic bottles into Samoa. As they do have a plastic blow

moulding machine, when that machine is inactive, all the different size bottles which they supply to their customers, are imported from New Zealand.

Table 2 Plastic importation data collected from one of Samoa's largest bottled water companies (Le Vai)

Bottle Size	Number of Bottles (per year)	Price (per 1000)
375ml	72,000	\$236.79
500ml	90,000	\$277.85
1L	12,000	\$414.83
4L	4,000	\$713.84
20 gal	1,000	\$9.00 USD*
Total	179,000	Approx. \$58,888.70 per bottle



–Figure 6 Plastic bottles onsite at Pacific Recycles. The only amount of plastic found on the whole site. (photograph by Lionel Taito-Matamua)



–Figure 7 Damaged HDPE plastic crates located in piles behind a local brewery in Samoa (photograph by Lionel Taito-Matamua)



–Figure 8 Old rubber tyres piled at Pacific Recycles. Another growing issue in Samoa is the increase in waste rubber tyres. (photograph by Lionel Taito-Matamua)



–Figure 9 Scrap metal found on the scrap yard at Pacific Recycles Ltd. Samoa. (photograph by Lionel Taito-Matamua)



The main landfill in Samoa. Tiapapata landfill, Samoa (photograph by Lionel Taito-Matamua)

Chapter 3 Design Exploration

Potential product areas

Prior to travelling to Samoa, a list of potential product areas was developed to help the participants understand the range of applications that could benefit from this technology (table 3). The idea of using this technology in this way is unheard of in Samoa. It intrigued all the participants who all responded with positive feedback. Certain applications such as the education sector, using 3D printing as an educational aid resonated immediately with participants.

Another area of interest was the tourism industry where the notion of gifting recycled craft objects and artefacts to visitors as they leave Samoa serves the dual purpose of raising awareness of the issue as well as relocating a small amount of plastic waste to its probable country of origin.

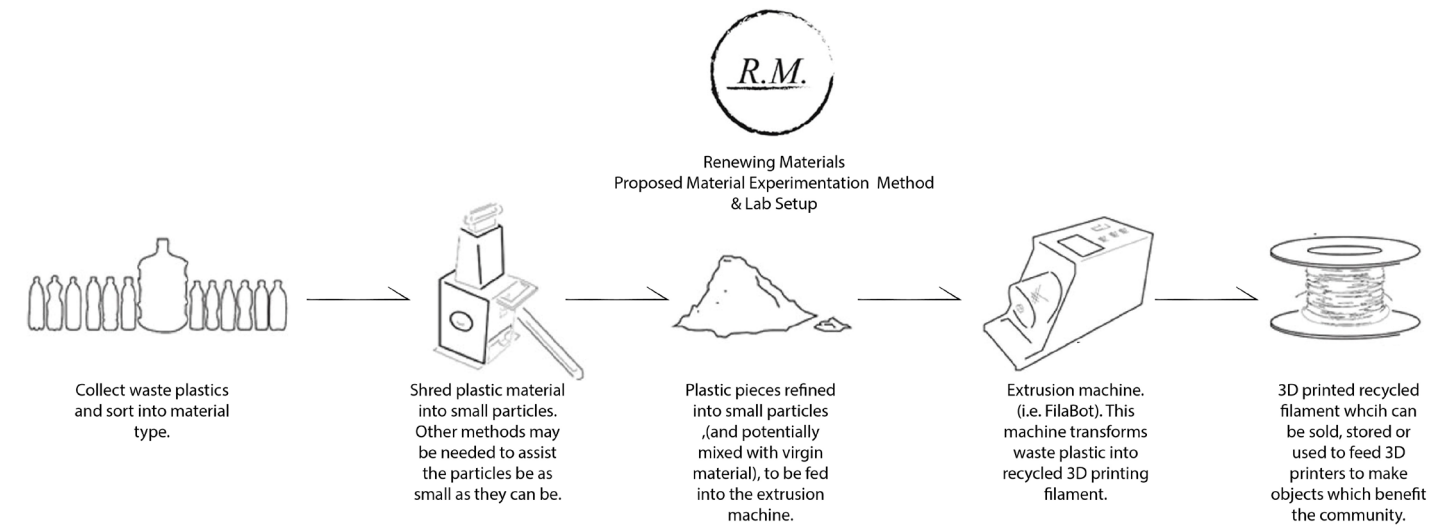
The possibility of 3D printing spare parts was also raised as a means of alleviating the cost of shipping spare parts to Samoa and the associated issues of maintaining inventory. This forms the basis of a manufacturing scenario of spare parts

on demand – customised as required. The range of potential collaborators and applications were collated on a matrix. It includes stakeholders such as tourism and government agencies, educational organisations, art & craft communities, the building industry, or agriculture and fisheries; with applications ranging from functional implements and spare parts, through to souvenirs, craft objects or educational projects.

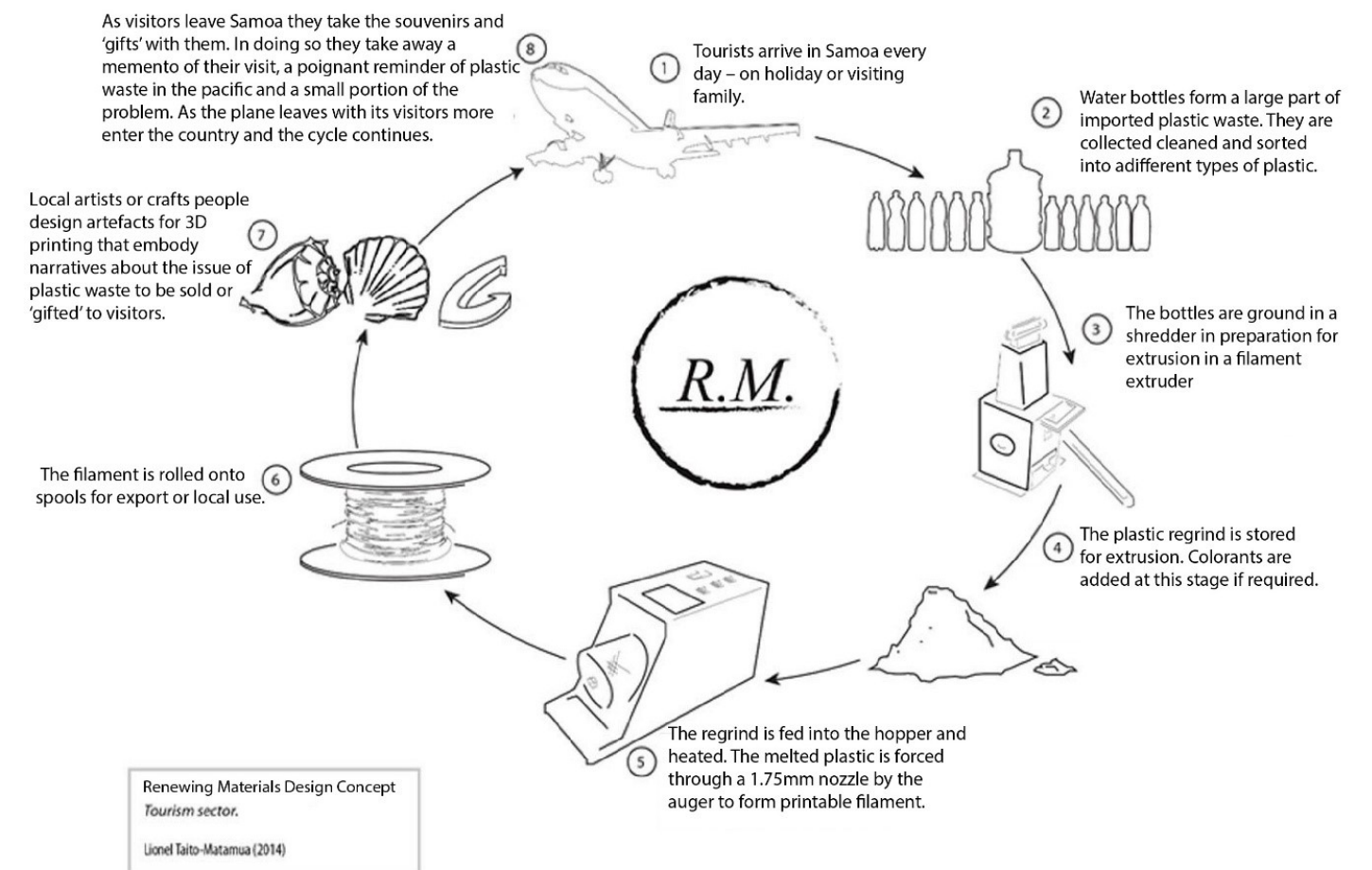
In this respect the field research provided the context for the subsequent design research carried out in New Zealand. The goal of the design research was to give tangible physical form to two speculative case studies; one symbolic and the other more practical. 3D printing spare parts also was mentioned to help companies which have to ship spare parts into Samoa which means having a waiting list and having to pay for import and shipping costs. Having 3D printing available in Samoa could mean new parts made of recycled materials made only in a few minutes' maybe hours.

Table 3 Potential product areas which this research can help benefit in Samoa.

Area	Contributors (Co-design)	Category	Objects
Government	• Tourism	• Gifts	• Shells • Endangered species • Animals • Nature • Jewellery • Indigenous objects
	• Water	• Filter	• Bottles • Lids/caps • Tap heads
	• Education	• Fa'a Samoa (Practical teaching)	• Teaching Guides • Physical Examples • Miniature models
		• Science	• Atomic Structures • Biological structures • Models (i.e. organs)
Arts and Crafts	• Culture	• Fa'a Samoa	• Traditional craft • Traditional models • Traditional artefacts • Cultural artefacts
		• Future	• Abstract cultural models • Artefacts
Functioning Objects	• Hunting and Fishing	• Spare parts	• Cutlery • Tools • Utensils
	• Home and Living	• Kitchen	• Cups • Cutlery • Plates • Bottles • Sponge holders
		• Bathroom	• Soap/sponge holders • Organisers • Hooks
		• Outdoors	• Tools • Fittings • Housing
Building Industry	• Hardware	• Spare parts	• Nuts/bolts • Fittings • Scale models • Joinery • Spacers • Tools

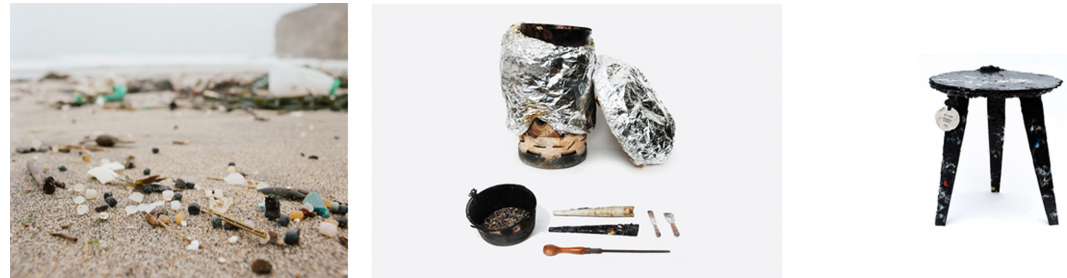


–Figure 10 Renewing Materials Proposed Material Experimentation Methods=. (image by Lionel Taito–Matamua)



–Figure 11 Renewing Materials Tourism idea proposal. (image by Lionel Taito–Matamua)

Precedents



–Figure 12 Images of the Sea Chair project by Studio SWINE. (images retrieve from <http://www.studioswine.com/sea-chair/>)

In addition to the field research a number of relevant design precedents were identified. The first precedent is the ‘Sea Chair’. This design study involves collecting pieces of plastic waste either floating in the ocean or swept up on shore. Following collection, the plastic is not sorted but is heated sufficiently

until it is soft enough to compress as a colourful conglomerate. It is placed into molds to form the legs or pressed flat and filed to shape to create the circular seat. Each chair created is tagged with co-ordinates which coincide with the location where the material was collected.



–Figure 13 Images of the ‘Everything You Buy Is Rubbish’ project. (images retrieved from <http://everythingisrubbish.co.uk/>)

The process provides parallels with my intentions, that is, collecting plastic waste and melting it (in my case transforming it into filament), then placing it in molds and compressing it (in my case reconfiguring it through the 3D printer) to create functional or decorative objects.

The second precedent is the recycled plastic shoe called ‘Everything You Buy is Rubbish’, made and designed by a group in the United Kingdom. The use of recycled plastic is a prominent consideration in this design. In a similar process to the Sea Chair, the sneakers

are made from plastic waste washed up on UK’s shoreline or from everyday household plastic waste. The visual quality of the shoe is supported by the advertising statement of ‘You Did It’. It engenders a sense of responsibility for the problem in the first instance combined with a sense of achievement and ownership in the outcome. The simple design and powerful messages constitute a significant step in terms of creating awareness, not only about the impact of plastic waste but also the impact of design in the sustainable world.

Concept Product Ideas

The field research and design precedents provided the context for the subsequent design research carried out in New Zealand. The design research addresses the second question of this thesis project “What applications can Samoa have for the recycled material?” with a creative response. Initial design

experiments investigate what could be made with the recycled plastic material. The concepts are explored on Solidworks and seek to integrate the technical opportunities offered by 3D printing with indigenous knowledge – by design. A number of speculative design concepts are documented here.

-Abstract Coconut



-Figure 14 Abstract coconut concept made in Solidworks (CAD software) (image by Lionel Taito-Matamua)

The idea behind this concept is taking a symbol which is affiliated with Samoa and recreating it in a new form. I chose the coconut as it represents not only an essential part of the Samoan culture but it is also a recognisable symbol of the Pacific Islands. I also decided to use the coconut as it symbolises the different ways the coconut tree can be used. An idea which I want to emphasise as I try to find new ways of using the recycled plastic in a useful way.

The outer structure represents the

coconut husk as a cage or container for the coconut itself - represented in turn as a sphere within its protective cage. The concept captures an opportunity only possible through 3D printing; the ability to print a print within a print. The dynamic nature of this configuration invites playful interaction with the abstract coconut.

The symbolic references and the tactile qualities of the object give new meaning to what was once waste material, inviting visitors to take it with them a souvenir and memento of their visit.



-Figure 15 Different layers of the coconut. (image retrieved from <http://oivietnam.com/wp-content/uploads/2013/07/is-coconut-water-healthy-2.jpg>)



-Figure 16 Coconuts as they grow in the trees (image retrieved from <http://www.celkau.in/Crops/Plantation%20Crops/Coconut/images/coconut.jpg>)



-Figure 17 Abstracted Coconut model. 3D printed in ASB and coloured with a brown dye. Lashed with waxed cord and attached to a metal chain (photograph by Lionel Taito-Matamua)

-Siapo Flower



-Figure 18 Lily concept render designed on Solidworks, (image by Lionel Taito-Matamua)

This concept is influenced from the Samoan siapo. The *Siapo* is a Samoan *tapa* cloth which holds significant value to the Samoan people. Often used for tradition celebrations such as funerals and weddings, the siapo is a traditional gift which not only symbolises family value but also family wealth. The patterns drawn on the siapo are traditional motifs also used in the Samoan *tatau* (tattoo).

This design takes the 2D motif and recreates it in a 3D form. The idea for this concept is a decorative artefact which transforms the *siapo* into a 3D abstract form. This contemporary reinterpretation of the siapo, made possible by 3D printing, is an example of the sort of artistic exploration that could be expected from the art and craft community in Samoa.



-Figure 19 Samoan tapacloth (image retrieved from <http://langis.co.nz/collections/frontpage/products/samoan-tapa-cloth-flower-patterns>)

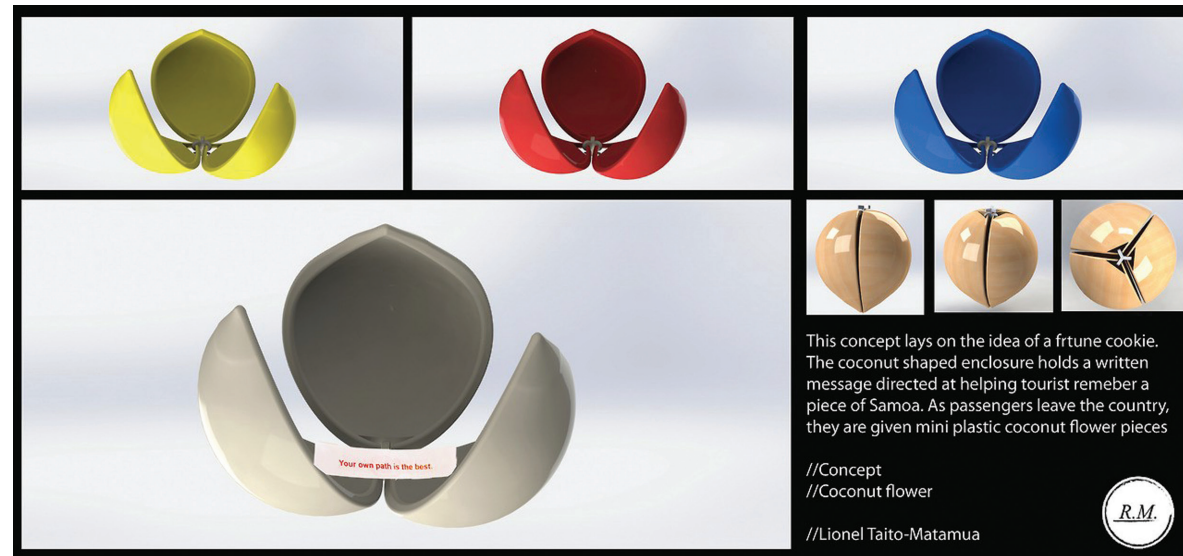


-Figure 20 Samoan Siapo (tapacloth) (image retrieved from <http://www.tapapacifica.com/samoan-siapo-tapa-cloths.html>)



-Figure 21 Lily 3D printed in ABS and finished with brown dye, (photograph by Lionel Taito-Matamua)

-Hidden Message



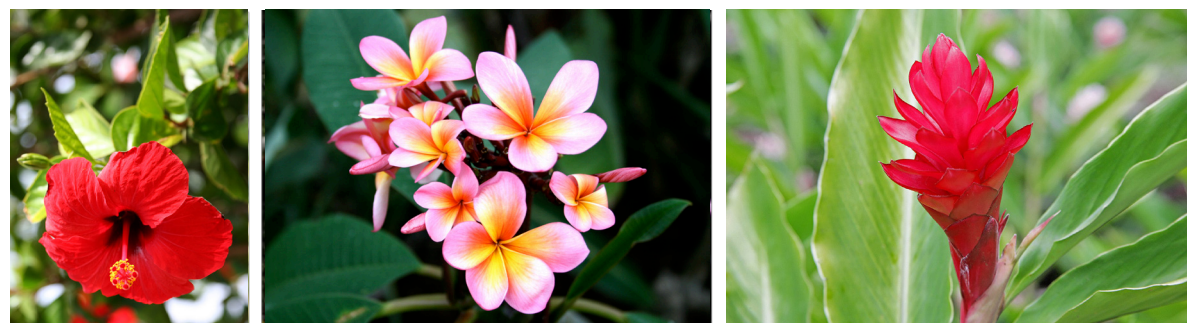
-Figure 22 Fortune Cookie inspired Coconut Flower designed on Solidworks (image by Lionel Taito-Matamua)

The idea behind this concept comes from the Chinese fortune cookies. But in this case the cookie is a 3D printed model which acts as an enclosure for a hidden message written in Samoan, helping visitors to remember some of the language as they leave the country.

Once again the design is based on the coconut. I decided to use this form to capture the idea of planting a seed - that from something small, something big,

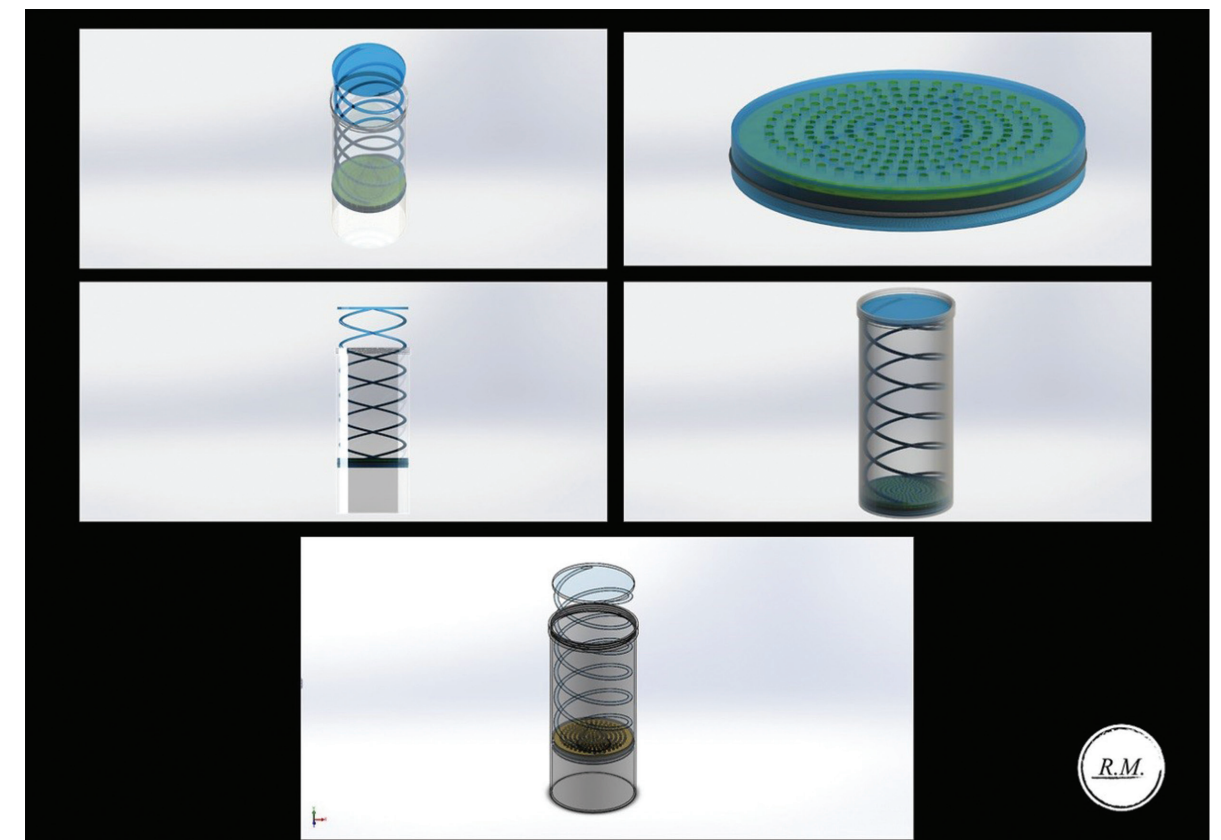
strong and useful can grow. Like the coconut germinating and transforming into a coconut palm. The message inside the enclosure will serve as a reminder and grow into a memory of the visit to Samoa.

The object itself opens up to form a 3 petaled flower which represents the beauty of Samoa, also known for its vibrant colourful flowers like the Teuila and the hibiscus flower.



-Figure 23 Native flowers of Samoa.
(images (L) retrieved from http://en.wikipedia.org/wiki/Hibiscus_rosa-sinensis (M) <http://howto-garden.com.au/selecting-plants/frangipani-trees/> (R) <http://www.eurecaplants.com/productportfolio-item/red-ginger/>)

- Filtration Bottle



-Figure 24 Filtration bottle concept designed on Solidworks (image by Lionel Taito-Matamua)

This bottle is based off the design of the coffee plunger. Using a spring tension loaded filter which pushes the unwanted contaminants to the bottom of the bottle. The inner core of the bottle is 3D printed with the potential of the outer shell to be 3D printed (potentially in PET). The design shown above does not show the mouth piece that would direct the flow of water. Inside the filter disk is a layer of filtration cloth and potentially a pressed flavour disk which can be

changed to suit the consumer's taste.

The design is inspired by the poor quality of water found in Samoa. The poor water quality has caused an influx in bottled water and with plastic water bottles being one of the biggest contributors to Samoa's plastic waste dilemma. The possibility of recycling old water bottles in new forms would be a valuable solution to this problem.

Two further speculative design concepts were selected for further development as case studies; one symbolic and the other more practical.

– 3D Printed Turtle Skull gift (note: refer to Chapter 5)

The turtle occupies a special place in Samoan culture reflected in its name *I'a sa* (sacred fish), but its habitat is severely threatened by ocean borne plastic waste (Teuten, Rowland, Galloway, & Thompson, 2007). “Swimming with Turtles” is a conservation pool and one of Samoa’s successful tourist attractions where visitors interact with them in their natural habitat. In the spirit of *mea alofa* a 3D printed skull would be gifted to visitors as a reminder, not only of the experience but also of the plight of these animals.

– Handgrip for a taro peeler (*asi*) (note: refer to Chapter 5)

The *asi* is a household tool used to scrape the outer skin off the taro root. Originally made from coconut shells, the traditional version has been discarded in favour of a more convenient alternative – the end of a tin can – most commonly mackerel cans. The concept of “parts on demand” could offer more comfort and safety to this otherwise improvised implement.



–Figure 25 My 3D scanning setup at the Museum of New Zealand– Te Papa Tongarewa Archives. Digitally scanning Turtle skulls (image by Lionel Taito–Matamua)



3D digital scanning
setup at the Museum of
New Zealand Te Papa
(photograph by Lionel
Taito-Matamua)

Chapter

4

Material Experimentation

Laboratory



—Figure 26 Filament extrusion lab. FilaBot Original® and FilaBot Reclaimer®. Setup in the School of Design Workshop, VUW (image by Lionel Taito-Matamua)

A low cost laboratory was set up to test recycling waste material and to transform it into 3D printable filament. A Filabot Reclaimer®, comprising of a chainsaw chain linked to a manual crank, was used to grind plastic materials into small particles (about 1 cm x 1 cm), which were then fed into a Filabot Original® extruder to produce filament for 3D printing. The laboratory facilitated an iterative and creative process of making, analysing and remaking in response to technical constraints and opportunities as well as the cultural context.

Materials

HDPE (high-density polyethylene) and PET (polyethylene terephthalate) were selected as our main materials for experimentation as they represent the largest constituent in the waste stream, based on the statistics gathered from PR. Additionally, ABS (acrylonitrile-butadiene-styrene) and PVA (polyvinyl alcohol; water soluble polymer) were trialled using new resins. Combined, they are the most common plastic materials in terms of both production and disposal in the world. (PlasticsEurope, 2015) White milk bottles (HDPE) and clear to translucent beverage bottles (PET) were locally collected, washed

and dried. An ABS resin and a modified PVA resin (from Adept) in pellet form were used without further treatment. A blend of HDPE and ABS colour masterbatches (CMB from BASF) was also tested as proactive simulation of

likely real-world situations such as use of multiple resins in a single instrument without sufficient purging. This also included a wood filled polymer filament used to simulate a potential filament made with filler from the coconut palm.

Material Exploration and Experimentation

Material exploration is a significant part of this research and it investigates different aspects of making print quality filament, such as:

- Suitable temperature for the different types of plastic being shredded and the extruded
- Which types of plastic work
- Whether the recycled material has to be mixed with virgin material (e.g.

ABS pellets, HDPE pellets)

- The amount of filament made from certain amounts of shredded plastic material
- How long the material takes to fully extrude
- Once the filament is made, how it behaves in the 3D printer in terms of final material quality and extruding quality

Testing

The testing process was broken down into two sections - the filament extrusion testing and 3D printing testing. The extrusion testing explored how different types of plastic reacted to being extruded. The plastic material was and sorted into its plastic type and ground in the reclaimer. The plastic type was determined by the recycling grade stamp at the bottom of each bottle. The first few tests determined what temperature suited the type of plastic. I started by researching

melting and softening temperatures of HDPE (High-density Polyethylene) by extruding small amounts of particles, monitoring the thickness of the filament, the rate of extrusion, the flexibility and strength of the filament. The same test was done using other plastic particles and pellets such as PET (Polyethylene Terephthalate), PVA (Polyvinyl Alcohol) and ABS (Acrylonitrile butadiene styrene). The results of the extrusion process are recorded in the charts provided.

Extrusion Results

The extrusion tests established that three of the five plastic types were able to be extruded. This included both HDPE and HDPE mixed with colorants. The mixture with colorants had to be extruded at a different temperature to the pure HDPE due to the inclusion of the colorant pellets. The average speed of the extrusion process for the recycled HDPE averaged at 250mm per minute and HDPE and colorants at 340mm per minute (both measured whilst the filament was winding itself into a coil on the floor). ABS was easily extruded as the Filabot

Original came with a complimentary bag of white ABS pellets. Materials such as PET were quite difficult to extrude due to the temperature logged into the Filabot. The PET extruded inconsistently and in small blobs. It solidified quickly causing the material to bubble and become very weak. PVA was an extra material which I experimented with due to its water soluble characteristics. This was not able to be extruded and also caused blockages within the Filabot Original. Extrusion temperatures are logged in the table below-

Table 4 Extrusion temperatures for the different materials which were tested.

Material	Extruding Temperature (Approx.)	Able to Extrude
HDPE (Milk Bottles)	135°c - 185°c	Yes
HDPE + ABS (Colorants pellets)	170°c - 192°c	Yes
PET (Water/Soda Bottles)	200°c -260°c	No
PVA (Pellets)	200°c	No
ABS (Pellet)	170°c - 190°c	Yes

Some issues which I found in this stage of the experimentation was-

1. The recycled filament did not have a consistent diameter.
2. Sections of the recycled filament were quite rigid
3. Some particles that went through the reclaimer were not small enough to be extruded

4. Purging must be done following an extrusion to clean out the heating barrel
5. Only add the plastic into the hopper once the heating barrel has heated up, not doing this can cause the plastic to melt on the auger inhibiting feeding and causing blockages

Extrusion Experimentation #1

Three of the five materials, including HDPE and HDPE + ABS CMB, were extruded successfully (Table 2). The ABS moiety required extrusion at a higher temperature, however, it improved the average extrusion rate of the blend which measured 340 mm per minute, compared to 290 mmpm for HDPE only. On the contrary, PET was difficult to extrude, and the melt formed isolated blobs rather than a uniform strand. It is thought that the PET resins used for bottle production were for injection moulding and did not provide properties needed for extrusion, melt viscosity in particular. PVA was almost impossible to extrude and caused clogging in the extruder because of its excessively low melt viscosity.

Table 5 Extrusion of various materials

Material	Extruding Temperature (°c)	Overall Quality
HDPE (Milk Bottles)	135°c - 185°c	Good
HDPE + ABS (Colorants pellets)	170°c - 192°c	Good
PET (Water/Soda Bottles)	200°c -260°c	Poor
PVA (Pellets)	200°c	Very Good
ABS (Pellet)	170°c - 190°c	Very Good

3D Printer Experimentation #1

Second stage of testing sought to establish how the recycled filament behaves in a 3D printer. To start this stage, I took a piece of the material and fed it straight into the extruder head of the 3D printer. This established whether the filament was able to be extruded, and to also whether the rate and quality of the extruded material compared to common 3D printed material. Multiple tests were conducted for this purpose and some issues found in the filament making process effected the quality of the 3D printer extrusion. One significant issue was the inconsistent diameter of the filament. If the filament was too thin the feed mechanism was unable to feed it to the print nozzle. This would cause the filament to melt too early in the feed chamber where it would blob and clog the extrusion hole. The inconsistent diameter of filament also meant the extruder could not extrude at a steady rate and at a slow speed, this would cause the 3D printer to skip areas as it moved around the 3D printer bed. As a result of this experimentation, new strategies had to be implemented in order to complete the research.

The modifications listed below were made to fulfil these requirements:

Table 6 Changes made for the up and coming stages.

Changes	
Filabot Extrusion	3D Printer Extrusion
Allow Filament to self-coil on the floor beneath the FilaBot	Feeder modification is needed to help stop blobbing and clogging
Proportions of recycled material and colorants to be measured out	Modify 3D printer extrusion temperatures
Size of particles to be similar to colorant sizes	Modify 3D print CAD files to suit material prints
Minimize temperature scales	Wrap filament onto a spool for easy filament feeding
Potential to incorporate other technology (i.e. twin screw extruder)	Modify bed height and assess filament flow rate

Extrusion Experimentation #2

Due to the results found in the preliminary extrusion tests in both the FilaBot and the 3D printer, other types of plastic, and methods of experimentation were tested to try and gain a higher quality of recycled filament. Old computer keyboards were gathered to test how a recycled ABS filament would extrude through the FilaBot and also 3D printer. As computers are becoming increasingly common in Samoa's growing economy, and as technology develops old computers made of ABS will need a new disposal processes. Reflecting on the issues that arose during the first tests, another piece of equipment was included into the laboratory setup. The Thermo Process-11 parallel twin screw extruder and pelletizer was purchased by Victoria University of Wellington to help develop research into material combinations and experimentations through additive manufacturing. Starting by grinding the old computer keyboards in the FilaBot Reclaimer®, the particles of plastic were not small enough to flow consistently through the hopper of the twin screw extruder. As some of the particles were too large to extrude, other methods of grinding were utilised. Tests using a blender and a coffee grinder were performed to help decrease the size of the waste material. The coffee grinder performed much better than the blender, therefore it was used to grind the reclaimed ABS from the keyboards. As a result the particles were smaller and

easier to extrude. To assist with material quality and also extrusion, virgin ABS pellets were blended with the recycled particles in the twin screw extruder. The extruded filament was fed straight into the pelletiser which transformed the recycled ABS twin screw filament into uniform size shaped pellets. The decision to transform the twin screw filament into pellets for use in the FilaBot® was made to maintain the concept of low cost recycling and also to

compare the quality of filament produced by the FilaBot® with different types of plastic. Following the same process as in the initial tests, the pellets were poured into the FilaBot® resulting in a grey coloured filament. The colour was the result of the black keyboard combined with additional virgin ABS pellets being added to the FilaBot® extrusion to add extra strength. The overall thickness of the material was quite uniform in size.

3D Printer Experimentation #2

Using the newly made recycled ABS filament, tests were performed to monitor the quality of the filament whilst being extruded in a 3D printer. Using an unmodified 3D Printer, the material was still difficult to print. Issues included a slow extrusion rate from the heated nozzle and the feed mechanism not being able to feed the filament into the nozzle. Multiple tests were done with the unmodified printer by altering the different settings in the maintenance options of the software and also changing the temperature of extrusion by changing the material option from ABS to PLA. These tests were unsuccessful and it was not possible to print the required CAD files.

Following these tests, a modified 3D printer (same model as the first 3D printer tests) was used to see if these modifications made any difference.

A nozzle with a larger diameter was installed and also a temperature controller chip. With the settings set at the default ABS temperature settings, the recycled filament was extruded at a faster rate than the unmodified 3D printer. The extruder was able to extrude the recycled filament. A pacific influenced fish hook CAD file was uploaded to test the printing qualities and the printer was successful in printing the model.

With this successful print, our research fulfilled one of our major tasks and goals. 3D printing a good quality model using recycled materials. With this success, the focus returned to developing the two selected design concepts – the 3D printed turtle skull gift and the handgrip for a taro peeler (asi) - in greater detail as case studies.



–Figure 27 HDPE Milk bottles collected from local Wellington Cafes (image by Lionel Taito–Matamua)



–Figure 28 Reclaimed HDPE particles placed into the hopper (image by Lionel Taito–Matamua)



–Figure 29 Recycled HDPE filament being extruded. (image by Lionel Taito–Matamua)



–Figure 30 Recycled Filament made using the extrusion lab. Colours were added using ABS colourants. (image by Lionel Taito–Matamua)



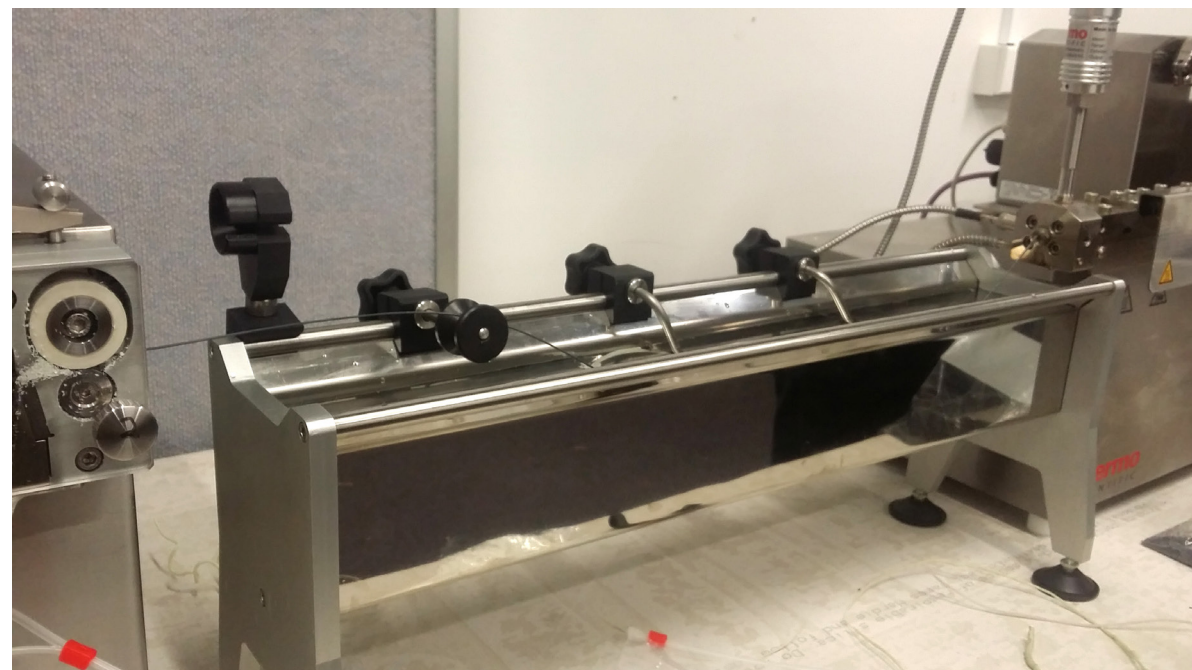
-Figure 31 ABS Keyboard, shredded using the reclaimer. (image by Lionel Taito-Matamua)



-Figure 32 ABS pieces ground in a coffee grinder to make particles smaller (image by Lionel Taito-Matamua)



-Figure 33 Grounded ABS keyboards. (image by Lionel Taito-Matamua)



-Figure 34 The Twin-screw extruder and pelletizer which was used to make recycled plastic pellets. (image by Lionel Taito-Matamua)



-Figure 35 3D printed Pacific inspired hooks made out of recycled ABS filament. Finished with lashed leather. (image by Lionel Taito-Matamua)



-Figure 36 3D printed Pacific inspired hook and partial printed Turtle skulls made out of recycled ABS filament. Finished with lashed leather. (image by Lionel Taito-Matamua)

Chapter 5 Results and Discussion

Production

Turtle skulls held in the collections at Te Papa, the National Museum of New Zealand, were scanned using an Artec® 3D scanner to form a 3D digital mesh. Solidworks® and a parametric modelling application were used to process the mesh and convert it to STL (stereolithography) file format for 3D printing. An UP Mini® 3D printer with added temperature controls and modified nozzles was used to create physical models with improved quality. We expect that the techniques and equipment stated here may be substituted with more user-

friendly methods such as smartphone-based apps and open source tools.

The resulting prints were treated to post production processes such as sanding and colouring using dyes, inks and stains. Traditional crafts such as *tapa* cloth printing provided inspiration for these post production processes and raised the possibility of combining traditional inks with 3D prints – either as a surface treatment post production or introduced as a colourant during the extrusion of filament.

Contextual Interpretations

The turtle skull, digitally scanned and replicated in reclaimed plastic, embodies a narrative; that this replica is made from the very material that is putting the turtle at risk. The vessel that holds the printed skull references the fale. It lends a ceremonial character to the gift and a sacred quality to its contents. The gift serves a symbolic and tangible reminder of the issue. In accepting it, the visitor becomes entwined in *fa'a Samoa* and comes to play a personal part in disrupting the flow of plastic waste.

The handgrip for the asi is printed from wood-filled polymer – raising the possibility of combining two materials readily at hand, waste from the coconut palm and recycled plastic – in a “tree of life” mentality. The small stand serves as a platform for scraping the taro or a plinth

for storing the handgrip. It references the formal qualities of traditional utensils such as adzes, food pounders and *kava* bowls and elevates the status of the handgrip beyond disposability to that of an implement that will be kept and valued, and possibly even worthy of *mea alofa*.

Both case studies demonstrate that, far from being a constraint, the low resolution of the UP printer can result in a surface qualities not unlike the irregularities found in traditional craft such as carving. Similarly, the configuration of the support material inherent in the printing process is at times reminiscent of the patterns and structures that are also found in traditional weaving. This suggests the real possibility of maintaining an aesthetic integrity or continuity between traditional craft and digital craft.



-Figure 37 Digitally scanned turtle skull and shell. Presented on a 3D printed container.
(image by Lionel Taito-Matamua)



—Figure 38 Asi handgrip design iterations and form experiments. (image by Faitasi Talamaivao)



—Figure 39 Asi handgrip and stands made with different finishes. (L) Sanded and clear varnished, (M) Wood stained, (R) Clear ABS Plastic dyed. All finished with a waxed cord lashing. (image by Lionel Taito-Matamua)



-Figure 40 CAD designed handgrip which holds the Asi (used to peel taros). (image (L) by Lionel Taito-Matamua (R) by Ali'inu'u Jansen)

Chapter 6 Conclusion

These case studies represent only two scenarios of making in response to our design proposition. However, it can be expected that many more will follow, particularly when the concept is opened up to a wider audience. To achieve this we envision a constellation of localised but interconnected cottage industries, craft communities, school groups and small scale manufacturers utilising waste plastic as a newfound resource and adding value in the form of skill, knowledge and cultural content via online databases and exchange networks that are consistent with *Fa'a Samoa* and open-source sharing. Initial responses to this proposition from stakeholders in Samoa* were very encouraging and warrant further research and publication (ongoing) with a view to implementation.

Sustainability has become a growing topic in different areas. With plastic waste and ocean borne plastics a major contemporary issue, this research encourages not only designers, but everyone to rethink how they dispose of plastics. This research also opens up an opportunity for 3D printing to be exposed to new communities who can benefit from its capabilities. As this research has found, isolated areas such as Samoa, and potentially other pacific nations, can integrate their indigenous cultures and values with new technologies, design innovation and creation. Giving such communities the opportunity to design and make objects specific to their needs allows them to be more inventive about what plastic objects they buy, use and

throw away. Having the opportunity to make products and objects on demand through 3D printing, allows communities to be more creative. The availability of 3D printers and a recycling lab in rural areas in Samoa, will raise the opportunity for local communities to find new ways of recycling waste plastics, minimise sea and river dumping, and give them the opportunity to create basic necessities through 3D printing and customisation.

With the ongoing development of 3D printers and materials research, comes new opportunity for evolving the technology. The research has revealed a need for more variable and versatile 3D printing systems which could eliminate the issues exposed by the experiments. The issues which arose during this research also opened opportunities in other areas such as material exploration into the use of indigenous materials (coconut palm particles etc), research into post processes using indigenous materials and knowledge (pandanus seeds, natural dyes etc), opportunities for 3D scanning to be introduced to the pacific, objects which can be made which benefit the community and also further research into the creation of recyclable filament and the development of recycled filament system laboratories.

This research represents a personal success as it allows me to give back to my community through my passion for design. The opportunity to find a new way of recycling waste material and making meaningful objects out of that material

has given my work greater complexity and depth. From here I would like to develop my research into a pilot program which encourages students from local low decile schools to interact with 3D printing and the chance to be creative in what they make. After starting here in New Zealand,

the longer term plan for this research is to introduce it to Samoa where they can learn about CAD software and digital making, giving them the opportunity to gain a basic feel for design thinking and development as an empowering activity.



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Appendices'

Appendix 1 – Email Conversations

A1.1 Emails between myself and Fuatino Leota (Principal Chemicals and Hazardous Waste Management Officer) and Setoa Apo (Principal Waste Management Officer)

From: Setoa Apo
Sent: Wednesday, May 07, 2014 10:27 AM
To: Lionel Taito
Cc: Setoa Apo; 'Fuatino Matatumua-Leota'; 'Fuatino Leota'
Subject: RE: Victoria University Postgraduate Student
Talofa Lionel,
The recent Waste Audit we did was in 2011 and I've attached herewith our report which might assist you regarding your queries. We do have a Biodegradable Plastic bag regulations which regulates the importation of shopping bags. The importer has to have a license to import shopping bags inline with the minimum requirement of specially the bags must be 50% starch 50% petroleum based to ensure that they must be naturally degrade within 12 months. We are also trying to educate people in using reusable bags for shopping amongst other things like reuse plastic containers for storage. Our recycling companies (private) are collecting and exporting plastics but subject to market value. Hope this might assist.
Faafetai,
Setoa.

From: Fuatino Leota
Sent: Tuesday, May 06, 2014 9:41 AM
To: Lionel Taito
Cc: 'Setoa Apo'; 'Fuatino Matatumua-Leota'
Subject: RE: Victoria University Postgraduate Student
Talofa Lionel.
Malo le soifua. I also have roots in Manono-Tai at Apai...lol
Yes Viane contacted me re your research on Plastic Bags and we are pleased to assist you with your thesis prep.
My line of work is mainly on Chemicals and Hazardous Waste while my colleague – Setoa Apo (copied in this email) is currently handling the management of Plastic Waste in our country.
We just revised our Regulations on Plastic Bags 2006 and got approved early 2013. Perhaps Setoa can forward you this fyi. In the meantime, we are working collaboratively with our local Recycling companies in collecting, storage and packaging in particular the plastic bottles. The recycling companies will compress in

bulk using their bailers and shipped to overseas markets (NZ, China etc).
Perhaps Setoa will tell you more for your research.
Let us know if you need anything.
All the best.
T

From: Fuatino Matatumua-Leota
Sent: Tuesday, May 06, 2014 7:08 AM
To: Fuatino Leota
Subject: Fwd: Victoria University Postgraduate Student
----- Forwarded message -----
From: "Lionel Taito"
Date: 4 May, 2014 11:34 PM
Subject: Victoria University Postgraduate Student
To: Fuatino Leota
Cc:
Talofa lava Fuatino.

my name is Lionel Taito-Matamua (NZ born but cultural ties to Faleu Manono, and Salelologa, Savaii) and im a postgraduate Masters student here at Victoria University of Wellington. I was referred to you by my uncle Viane Tagiilima. I am a Industrial Design student who is currently working on his thesis. My thesis is currently looing into Plastic waste and recycling, Using Samoan as a model for potential future studies. what im looking to do is find out is-

1. how much plastic waste is produced in Samoa,
2. how is Plastic waste currently being managed
3. what is the people of Samoa's attitude and action towards disposing of plastic
4. what recycling schemes are currently in action in Samoa

These are only a few questions for now and I have read through the 2013 environmental report which is available online.

The reason for this research is to look into how Additive manufacturing (3D printing) can help influence new ways of recycling around the world, but starting of small and looking into Samoa, which holds significant value to me. This would potentially mean taking old plastic waste such as bottles, bags etc and shredding them up to create material which can be used in a 3D printer. the new recycled materials could be use to create new items which could be useful in the community. This research looks into not only benefiting a countries waste and pollution stats, but also gives the opportunity for more available jobs, new technologies introduced, decrease in waste effecting our ocean wildlife and other valuable outcomes which could help develop Samoa as a country and keep it clean.

I was just wondering if you were willing to help me out and if you didnt have the answers if you could direct me in the right direction in terms of contacts in Samoa. Your help will be more that useful.

heres a video which explains what 3D printing is- <https://www.youtube.com/watch?v=X5AZzOw7FwA>

and a video which influenced my thesis- https://www.youtube.com/watch?v=_pRy88R-4BI

you can contact me via this email.

regards-

Lionel Taito-Matamua (BDI)

Master of Design Innovation Student 2014

Victoria University of Wellington

A1.2 Emails between myself and Marina Keil (West End Apia - recycling company in Samoa)

Hi Lionel, all the recycling companys here in samoa, are pretty much the same we are only called recycling companys but recycling is not actually done here because of the lack of technology, we only collect, segregate compress and load in container ship it overseas country such as nz aust,singapore and korea. because plastic is not so famous compared to other recyclable goods, due to its value, not much companys do collect it, but if govt does ever step in and probably give incentive maybe export of plastic out of samoa will increase. if you have any questions pls let me know.

Kind Regards

Marina Keil

On Tue, May 20, 2014 at 4:51 PM, Lionel Taito wrote:

Talofa Lava, my name is Lionel Taito-Matamua and I am a Masters Thesis candidate at Victoria University of Wellington, NZ.

I am sending this email to see if you can help me with finding information about recycling in Samoa. I found your information on the Samoa Ministry of Foreign Affairs exporters list.

My thesis looks into finding a new way of recycling plastics via additive

manufacturing (i.e. 3D Printing), yet I am finding it hard to find information on the techniques which are used in Samoa to recycle plastics. I have had email talks with Setoa Apo but I want to find information straight from the businesses which work with recycle materials. i know you specialize in scrap metals, I just wanted to know if you deal with plastic waste or if you could direct me to the companies in Samoa whom deal with Plastic waste recycling.

The beauty of Samoa and its wildlife is important to me and I plan to use this masters Thesis to help keep our country clean.

I look forward to hearing from you

regards-

Lionel Taito-Matamua (BDI)

Master of Design Innovation Student 2014

Victoria University of Wellington

Appendix 2- Vanya Taule'alo Interview

Thursday 11 September 2014

0900am

Vanya Taule'alo Art Gallery

Samoa

The recording for this interview started during my presentation to Vanya. So the beginning was cut off but most of the beginning was mainly talking about my own work and showing my samples which I took to Samoa.

From beginning of recording...

Interviewer - Lionel

Interviewee – (Vanya)

(..And I've seen turtles and that around their necks. It's almost like cardboard paper, that kind of thickness. They hold six coke or tins of coke. And they have been very, very disruptive.) The thing about the plastic that is available here in Samoa, and one of the purposes of me coming to Samoa. Was to see what is actually available and looking at the fishing nets used here. Once they are lost in the ocean u know... (They are treacherous.) So once they are floating around out there, there will be

Marine (“yeah”) animals you know getting caught up in those nets.-So like the birds eating plastic just because it’s thinking its food and stuff, it’s basically one of the main inspirations to use the plastic itself. (“yeah”) From that video and from the images I just showed you. So using Samoa as my case study, and looking at Apia as the main CBD area here. The area which I also want to focus on is the rural areas (“yeah”). What do those people out in the Mainland’s deal with this waste management issue? (“Yeah”) It’s easy for people here around the city CBD (“yeah”) just because they have the local dumps which they can go to (“yeah”). There’s only one in Savaii which I know of (“yeah”) and there only one here (Upolu). But the thing is with the ones out here (*Pointing at the rural areas*) is first going into the City (“yeah”) to collect the goods (“yeah”), but then once they are done with it....

Main methods of disposal which my research has found is the burying method (“yeah”), so what they do is bury the materials (“yeah”). Burying mostly because of mosquitoes (“yeah”) and the other one is burning... (Which is absolutely toxic) Carbon emissions the fumes that come from the material (we have trouble with our neighbours, there’s actually a law against it. So for everyone that is burning a non-organic waste, they are breaking the law and every now and again we get Burma and fumes coming through our house, it comes straight through our house.) It’s not only just me finding other ways of recycling this material but sort of me creating that awareness (“yeah”). I’m not the best recycler you know, but I will try educate other people (“yeah”) to sort of you know help out and give back that 5% (“yeah”) which over time will add up (“yeah”).

There are two legislations which the Samoa Government has in terms of collection (“yeah”) – they don’t have a recycling system per say like we do I New Zealand (“yeah”) They don’t have that recycling system where ‘plastics go here’ and there’s no sorting of materials. So what they do at the recycling company is bulk up everything in one little sections (“yeah”). Get all the plastic together, get all the aluminium together and ship it overseas (“yeah”). And they sort it out at the dump). And they sort of make it sound like –“here this is your problem now”. The thing is I want to find a way to keep the plastic on island, not that it’s a good thing, but find new ways of using it. To get money back, through the materials. Also through the processes which I use (3D printing) (“yeah”). So this is the research question which I am looking into. Finding new ways of recycling this material on island but using Samoa as a case study which can potentially be used in other countries. Other countries such as India have jumped on to the bandwagon, in terms of 3D printing, but they are not going past a certain stage. So what they are doing is, these are images from Mexico but it’s sort of the same process in India (“yeah”), so what they are doing is collecting the plastic (“yeah”). I’m not sure if they are actually separating it into (“different types of plastic”) types, Shredding it, other groups are

then bottling the shredded material and putting them into bottles like that (“Oh ok, right”), and then from these bottles, all they do then is just stack it. That is about 8tonnes worth of plastic there. (And what happens then, someone else comes along...) So yeah basically someone else comes along and yeah just takes it. What I’m trying to come up with is sort of a step beyond this (“yeah”). So not keeping it as shavings but using these machines here (*Pointing to Image of Filabot*) this is called a filabot (“yeah”), so what it does is that it creates from the shreds a filament cord or plastic cord which gets fed into the 3D printers that gets used like ink. So basically you’re using waste materials like you used a day before (“yeah”) to create something new. That’s the whole idea behind this project (“yeah”). So what India is doing is coming up with the filament (“yeah”), and they are selling the filament. So they are still getting the money in (“yeah”), from the waste material. They are getting a lot of people from the slums to help out with that as well. (So what sort of things would you be, vast amount of...) that’s another aspect which I wanted to talk to you about (“yeah”). Getting that arts and crafts aspect of it and sort of an artist aspect – this is also what I said to Steven as well (“yeah”) - getting ideas for what artists could use it for, other than using this materials that isn’t normally used in terms of art per say, other than woven mats that a female artist made using plastic bags, but then when they changed the plastic bags...(she can’t do them because they will disintegrate). And also the colours are lost as well (“yeah”). So it’s more of me letting you know what I’m up to (“yeah”) then letting you have a think over –when I’m gone - how artist can have an input. (Well I think there’s a number of really innovative things you can do, I think it’s quite exciting and if somebodies got a gallery the applications could be endless.) Oh pretty much. This is basically just a quick brainstorm of what could be made. Schools can benefit from it (“yeah”), stationary could easily be 3D printed (“yeah”), examples that teachers could use (“yeah”). Spare parts is another thing that could help out here, tools, fixings as well and I know after I had a walk around the city and I know there is a lot of plastic being imported from Asia (“yeah”), and all their products always come in plastic. (And they’re crap) yeah exactly so once they break...they are just landfill, (I just look at them as just landfill)- exactly the quality of the stuff from Asia, isn’t that great – (No, it’s not) – they are just brought in because it’s cheap you know (“yeah”). Also what happened on Monday, just after leaving Stevens house, So just as we left the drive way (“yeah”), we looked just across the road and there was a plastic chair sort of similar to those garden ones (“yeah”) just inside those little rubbish container things out side. So plastic chairs could easily be fixed using 3D printing (“yeah”) Like if there’s a piece missing from the bottom, you could easily print a piece which just slips on to it. SO basically yeah, so the applications are endless with 3D printing (“yeah”). It’s still a young sort of technology, as time progresses it will become cheaper and cheaper (“yeah”) and also, what they are doing now,

is moving away from plastics, they are also printing...what scientist are doing is that they are looking into cellular structures to ("yeah") 3D print organs ("yeah"), they are still trying to develop that technology to print organs. So what a mate of mine done who was in the news last week just before I came, he's a class mate of mine, He helped this man whom has no nose. So what he did was he 3D printed a little scaffolding piece ("yeah") which because of the prosthetic nose he was given by the doctors ("yeah") or by the hospital, is when he moves the nose moves and could easily fall off –it's not a good look. So it's got a realist look to it the thing is it has a lot of movement ("yeah") on to it so people can see the little gaps inside ("yeah"). So what my mate did, he came up with a little scaffolding made of 3D printed rubber with a bit of plastic in there. You can start mixing materials now ("yeah"). That's where the higher grade printing is going now ("yeah"). So what he done is made a scaffolding for when the face moves, the noses moves with it sort of like suspensions on a car ("yeah"). So that's where the technology is going at the moment. It was first developed, from what I know, for out of space ("yes"). So if they lose a piece out there or they need something, they can just make it with a 3D printer. (I didn't know, like you've seen ads on TV there was either a Swedish or Norwegian group of women who were just drawing and making things happen, and Oh My Gosh, amazing to know the applications that you have got).It's sort of an aspect where I know Samoa can tap into easy ("yeah"), also other isolated countries which you know don't sort of have the advantages as we do back in NZ ("yeah") and in America and stuff. So using 3D printing the amount of plastic coming in could cut down, also the plastic that is in the country can be reused ("yeah") instead of getting shipped away to other countries ("yeah"), and money can be made from this ("yeah"). That is another thing, I will be meeting up with the guy from Pacific Recycles ("yeah"). But these are some concept ideas which I came up with, so this one is sort of an abstract for of a Coconut. The idea behind this was, for tourist whom come to Samoa to take something back with them ("yeah"). And the idea ("oh that's beautiful") which is shown at the bottom is an abstract shell ("yeah"), and the nut in the middle so that is one idea which I came up with for the Tourism industry ("yeah"). These can potentially be made with the plastic bottles they use. Save the amount of bottles you use, collect it ("yeah") give it to potentially the people whom will make these ("yeah"), and in return you will get a piece which sort of reminds you of ("yeah") this is the plastic that I used and it gives that sense of worth back in to ("yes it does, and it looks beautiful too") that material which is normally discarded.

Another one was influenced by the Siapo ("oh yes"), this is more of my take of the Siapo is 2-Dimensional, why not make it 3-Dimensional ("yeah") using 3D printing ("yeah"). So this is more of an Exhibition piece more than something which can be sold to general public ("they are lovely aren't they"). So all of these here are

made by myself using a software which we use at the school of design ("yeah"). Solidworks, so what it is, is taking the pattern which is at the bottom of the page ("yeah"), making 3-Dimensional and maybe potentially getting a whole series of different patterns or different motifs, aligning then in a certain way and creating a 3-Dimensional Siapo pattern (("gorgeous"). So you have actually made that),No haven't made it yet, but these are all just concepts ("they are concept designs, I love them"). The next one was influence by the Asian influence here in Samoa ("yeah"). Taking the idea of the Fortune cookie ("yeah"), and making a little coconut shell which opens up in to a small flower ("oh cool") which holds a small message inside which the tourist –this is another tourist idea- which the tourist can take away with them ("yeah") with maybe a little message inside in Samoan and then they can learn it or something or ("yeah")...you know just a little something to take back, a little souvenir piece ("yeah") which they can take back with them ("cool"). So the idea behind these is that, the plastic is getting recycled in the country ("yeah") but as it gets taken away by them that plastic being taken out of the country ("yeah") but hopefully people won't throw them away because of the significance and value put into it ("No, exactly"). It sort of the whole psychological ("yeah") aspect to it. Playing with people's ideas of what's significant and what is... ("yeah")

So the last one was a quick idea that I came up with, is taken from the idea of a coffee plunger ("yeah"), the pieces inside will be 3D printed ("yeah") still a work in progress ("yeah"), but the thing is because the water quality here isn't that great ("yeah") hence why there is a lot of bottled water being bought ("yeah"). S simple push down like a coffee plunger and a little filter which is built in to this part here ("yeah") sort of cleans the water for them, maybe also adding flavour to it if they want like a little capsule. There's an example at the bottom.

(You should patent these ideas, go into that programme where you....what's that programme where you)...Like an inventors programme...haha ("yeah") like I said these are still basic ideas concepts ("its amazing") just to sort of people that im talking to an idea of what im sort of looking at ("yeah"). A big focus for me is the tourism Industry ("yeah") just because of the amount of people that come to Samoa to visit ("yeah"), holiday, get away from where they are from. And also thinking about how much plastic they use. As I am here as well I'm documenting how much plastic I use ("yeah"). I will be taking plastic samples back to NZ with me ("yeah"), hopefully get through customs which I don't see why they wouldn't ("yeah") but yeah sort of looking into how I can use this technology to help benefit ("yeah") the country which can then be used as a case study for other countries ("yeah"). The outcome may not be good, there maybe people opposed to what I am doing, but so far the feedback I've had is great you know.

(Discussion about potential interviewees. Names disclosed)

Like I said it's about educating and creating awareness. The issue plays a part

in everyday lifestyle. (It's impacting in everything we do). If they are focusing on Agriculture itself. Plastic is harming it.
(I mean it boils down to very simple things like when I go to Christchurch which is where I was originally from. I mean over the years peoples practices have changed. And so now people will have 3 bins and that kind of recycling from a domestic situation onwards, that's absolutely something that we need. I mean some years ago when Leti, that's my husband, was in MNRE we were trying to get these wheelie bins from a firm in NZ who were going to give them to us so we could sell them. But I mean it fell through because people didn't want to pay a small tax for collecting of rubbish and so forth. That kind of thing is what we need happening here. So that the sorting and dumping of stuff out at the dump there can be much more specific so that's where the plastic goes, that's where the aluminium goes and so on and so forth.)
It's also...unemployment is a big thing here in Samoa ("yeah"), it creates Jobs. That's another key factor of this research ("yeah") I'm doing is the whole idea of cottage industry ("yeah") something small which can later then expand ("yeah"), which helps communities as well. Yeah like I said its more the education aspect and also creating that awareness ("yeah") that there is technology out there, like looking at the art pieces inside you can tell that there are artist out there that can come up with work ("yeah") from this recycled material which adds value ("yeah") to it and the value off that material they started off with easily can double ("yeah") or even triple ("yeah"). That's why I came up with the whole exhibition piece, which was influenced by the artist. Something which can just stay there as an art piece ("yeah") which can potentially be, I would want it to sell ("yeah") but it's more of a piece which shows where the country could head into. And then there's also the other aspect of adding 3-dimensionality ("yeah") to the 2D Siapo ("yeah") it gorgeous. Those kind of items will be lovely in a gallery to sell...)
So like I said....This was also influenced by the amount of flowers used in churches ("yeah"). I know a lot of churches here in Samoa use the real flowers ("yeah") out in NZ they tend to be lazy and use the artificial ones ("yeah"). So why not make something which is artificial and potentially add a LED light to it ("yeah") which lights up at night time ("yeah"). So yeah that's what my research is. (Oh it's very exciting.) I've got the support of the school ("yeah") and my supervisors ("yeah") and they are pretty keen to just jump on board and try get ideas and awareness out there in the country as well. Which is why I wanted to meet up with a lot of different people from different areas ("yeah"). SO from the arts and crafts area, you and Steven, might go back and see him again next week. (That's quite fascinating to be honest) The ideas that the biggest landfill in the world is the Ocean. Tafaigata its not, the one in Stoke valley in in Wellington ("yeah") is not. We went for a drive around the island on Sunday and one of the things I remember specifically and

clearly is just in front of Faletolu Primary. There was this little boy who just ran across the road and I see just this whole lot of rubbish get thrown into the water. I was like WOW.(The really sad thing is that a lot of Samoans dump into the river, and you don't understand why they do it. We would have a gorgeous really clean front of the house, and at the back if you have a river they will just dump into it... Like how the hell)....And all those rivers lead back to the ocean...(of course they do).The sort of ideology or idea we came up with back in NZ is why they do that is that the whole idea of they cook using leaves ("yeah"), they use organic materials o cook with, eat with, they eat on whatever matts ("yeah") and then they are used to just throwing that out ("yeah"). The idea of getting plastic and not getting educated on what that material does ("yeah") and how it acts. All they are doing is just biffing it ("yeah").
(Well if you see the country side after Fa'alavelaves, just ruined with the polystyrene food containers)
Those can easily be replaced even with cardboard (Yeah like I remember once there was a funeral of the old lady next door, and after that funeral a whole laneway of polystyrene. A you people going to come and clean this road way and they said it's not our problem. And I said "well whose problem is it? It was your faalavelave. It's your responsibility to actually pick it all up and get rid of it). It that relaxed Lifestyle that they are just used to eating using the banana leaves and then just throwing that away, because those are easily decomposable.(Well you know the funny thing is to that by enlarged people sweep up their leaves and grass and burn it, so they are not even composting it. Which is one of my absolute pet issues is burning of both organic and toxic waste). I've seen one ad, only one ad so far while I've been here which talks about the dumping in rivers or into the ocean. (Because they cleaned up beautifully)...And I'm sure it was all cause by the whole SIDS conference.
(There was a huge clean up before SIDS, like before that our rubbish was not collect for the whole 2 weeks and the end of our lane way here. And some of those rubbish stands, Dogs get into them and they are awful. There is a huge problem here with how people deal with waste).There was another issue with the research coming over here was that ("yeah"), because of the conference, a lot of people will clean up their houses ("yeah"). It's not the REAL Samoa that's the everyday lifestyle ("yeah"). Like you will be driving down the road ("yeah") and there will be rubbish just scattered in the gutters, rivers so it's kind of ("yeah")....I was hoping that potentially maybe next week it will go back to normal ("yeah"). Then I can get proper images of what the real lifestyle is ("yeah"). At this rate we will see how it goes. Like last week it was pretty clean ("yeah") because of the conference.
(And you can see rubbish tins all around. The complex here, where they are all around the complex and around the drains, because I walk my dogs down there,

and for a long time those drains were absolutely appalling. Quite shocking walking around those, usually I go. Because there's a cricket field, and touch field, if you go down the road up here. And there were old chairs and old seating, people just going over there and leaving stuff. Now you go around to where the swimming pool is and yeah now your think is how long will they last?)

We try to push the whole clean and tidy and we can have systems easily implemented into Samoa Like rubbish collections.

(See what they need to do because the problem behind it all, there are rubbish collections and there rubbish collections at least once a week in the rural areas. Have the ability, if they use their heads to put stuff out. None of that however is recycled. Still doesn't stop people from being lazy and not being bothered to take rubbish to the stand. So it becomes a problem, so what happens up this road here and that road to the dump, is that people a driving out to the dump, they don't want to pay their 2 Tala or 5 Tala or whatever it is to go into the dump. So they are dumping on the side of the road. So you can often find from here on quite a trail of litter. The Dump used to be really well managed and when the Japanese were funding it, it was really compacted and being bulldozed with drainages it was not smelly) I've seen the drawings and the design for it and there's a little flow underneath for all the liquids to go. (I know that is largely fallen to pieces with lack of funding to keep it going. We used to, the guy who used to run it Fa'afetai, he was working for MNRE, now he's working for SPREP. I don't know his surname but I can get his name for you. Perhaps talk to him when you go to SPREP as well. In terms of what I think for the art area value I can see the value...if I wanted to design a piece of Jewellery. At the moment I have to go over to Bali of somewhere, I've been over there once and I have to get it made say out of silver or these resin ones or whatever. As someone who is interested in Design myself about making your own stuff that can really actually be quite satisfying.) How much does it cost to make something out in Bali say out of metal or...? (I haven't tried the metal but the silver was quite prohibitive). How much was the Silver? (They have it in Rupee which is like in the thousands, hundreds.)

With 3D printing, there's companies out there like Shapewaves where you can make the digital file, send it to them...I think they are over in the Netherlands ("yeah"). And what they do is print it for you and you can pick what material it's made of. I've made rings out of stainless steel. You can get cheap gold ("yeah"), silver you can print in, there's other materials such as carbon fibre you can print in, I think about a year or 2 ago they started printing in ceramics ("Seriously"). There's a lot of...Email me that link.

Yeah I'll send it to you, all you got to do is basically is come up with the design on the computer, and send it... This is where this technologies going. This is what I'm sort of ("yeah"), not really advertising but getting it out there that- I'm not working

with anyone, I'm just with the University, someone who's trying to get his research done but its letting people know that there is stuff out there. So people are making stuff that you could never think of like Ball joints are easy to make ("yeah"), using 3D printing now. You can also come up with the angles that you want the ball joint to move.

So through the University we have spent just under 2000NZD on equipment which just arrived before I left. Which is a small amount of money ("yeah"). Because we are with a government funded scheme and working with other universities called the product accelerator. So what it is, is we are trying to get NZ to jump on to the whole 3D printing ("yeah") bandwagon as a whole. 3D printing in to Universities and getting universities to play around with the technology ("yeah"). See what they can do with it. Jump on to the digital scanning using technology ("yeah") like Xbox Kinect scanning, so at our university we have the Industrial designers ("yeah"), which is where I am in. the media designers which is more games, the digital CGI stuff and coming up with code, so we sort with them to come up with code ("yeah") and stuff and see how they run. And then we have got another section which is called culture and context. Which is more theory based design ("yeah"). More like the curator's design ("yeah"). Looking into the meaning behind the design and letting people know about them (So yours sorts of jumps into every)... So mine just jumps into every aspect, the good thing about being an industrial designer. Name a company and we can help them out ("yeah"). This is what I reckon, we can jump into any industry, it could be graphic based("yeah"), physical based or even come up with concept and ideas ("yeah"). So without industry it's basically endless. It's sort of an industry where I want more pacific Islanders to tap into because of the creative nature ("yeah").

Back in NZ I have noticed, and it's something I've talked about all the years I've been at Uni is that, parents push kids to go be lawyers, doctors, accountants, and pushing them to be something which they don't want to be sort of pushes their natural creativity to the side

(Absolutely, I've been saying this for years here in Samoa.)

So the whole time I've been at Uni this is what I've been pushing. There's no Pacific Design,

(No Exactly.)

Just pacific arts and crafts.

(Well I was at the university for many, many years here and I finally got so sick of it in 2008 that I left in the middle of the year. But I've been trying for 4 years, with the creative arts, and with that a whole school of design. I've been saying that we need it, with the limited technology that we have available for us in Samoa. Not only is it jobs for kids. There are new Career pathways opening up all the time in all areas of design and that was product design. All and every avenue of design. I wanted, I

think I was too early.)

Samoans I've noticed don't like change.

(I mean when I was....it took 4 years to get passed by senate. It got approved at the senate, really good and then 4 years every year when they have council which is like twice a year they would ask me to get my booklet together and my PowerPoint presentation and every year it just got passed off. I mean looking at what you're doing this is absolutely essential even in Samoa which is so technically you know compared to where you dealing with absolutely vital. So then people can know what this is all about, and then they can start using it for themselves. You know you're not only got the artistic thing, you've got the craft thing you got woven who do weaving, women who do all sorts of things can to come up with contemporary ways to create things. Those weaving bags, I don't know if you do them but those weaving bags which I get from Manukau, I don't know where they get that stuff from. But that's all recycled stuff.)

So yeah with Design in general, there's no end point ("yeah") to what we do. For a lot of my work I try to incorporate a little pacific influence ("yeah") into it and with those hand prints, I didn't use a digital scanner ("yeah"), what I did was I used photographs. I kept the palm out open and just took photos from all over the place ("yeah"). And the idea behind that was like the weaving. It takes the different images ("yeah") and weaves them together ("yeah") to create that 3D digital mesh and from there edit it on the computer and you know then add a little thickness to it and then 3D print it ("yeah").

So a lot can be put back into you work sort ("yeah") of like these little plinths I made tattoo telling the stories and passing down of stories ("yeah") and telling the stories of each individual which I want to tell. (They are gorgeous, I mean they have an application too for people who like containers and want to create. Or sell as little containers.)

Discussion about other designer's works and other application. **Off the Record**
There's more than just what you can buy in the stores.

Off the Record Discussion

END OF INTERVIEW

Appendix 3- Agafili Shem Leo Interview

Monday 15th September 2014
0900am
Level 5, Government Building
Samoa

The recording for this interview started during the video explaining 'the Great Pacific Garbage Patch'. Did not record during presentation slides about me and my work.

From beginning of recording...

Interviewer - Lionel
Interviewee – (Agafili)

....So yeah this is one of the videos that helped influence my research.

(*Watching Pacific Garbage Patch video*)

Oh so it is a dumping site? It's not much of a dumping site. It's more, the oceans a dumping site. So scientifically the ocean is the largest dumping site in the world. So the thing that happens on the island is that, no one lives there other than a few people who are researchers and people who help clean up the island. The thing with this island is that all the rubbish has swept up from the ocean. None of it was bought over but all swept up which is sort of an influence on why I wanted to do this research.

So this is more of an over exaggerated image of what the ocean may look like in the future. Just a whole lot of plastic. The thing with plastic is it doesn't go away. All it does is it breaks down into little pieces and marine creatures will start eating it thinking its food.

These images may be a bit graphic but its me trying to get the awareness out there. So marine life, I know that turtles are quite special to Samoa, and also the wild life, the marine animals like the fish and all the other creatures. So the reason why I chose Samoa is because how connected my roots are. And with the things that I'm trying to look into is sort of is, the main centres are here in Apia the CBD, but how do the people out in the rural areas, in the villagers deal with this plastic. There's a big tourism sector here in Samoa as well. And also thinking about how much plastic is used or brought over to Samoa and what happens afterwards. So the amount of water being drank.

From what I know these are two of the waste management policies and legislations that you have. (We also have a regulation passed last year 2013. The use of

plastic papers,) Is that the plastic bags with the 50% starch in it. (Yeah, that's the one). Yeah I was talking to Setoa at the beginning of the year and he was telling me about it. But at this stage there is no recycling system is there. (NO, not with plastics). Yeah cos I've talked to a few recycling companies like Westend and...(they are focusing on metals)...yeah that's the thing, there's not much money coming back from the plastics That's the whole idea of using plastic is, keeping it in the country, which isn't a good thing but from keeping it in the country using the manufacturing process (3D printing) to create stuff which benefit people here in Samoa.

This is my thesis question which I am looking into. Where I am looking into how I can use 3D printing, to use the recycled material to make things that can benefit Samoa. One it can help slow down the importation of plastics, because all you're doing is reusing the same plastics over and over again. And so one of the main influences for this research was the coconut tree. Every part of the coconut tree is being used. The leaves, baskets, the t=nuts themselves are being used for food. And then the nuts as they ferment, they grow into another tree. So it's a life cycle, but as for plastic there's a dead end. Once you're finished with the product. Basically it is just left there to stand. What I'm trying to do is go the extra step and make something out of it.

In terms of Socio-economic growth. More jobs can be made from it that's if this research develops the way that I want it too. So more jobs more income from families who have no jobs, this is an example of what's happening in Mexico. So this is a little community in Mexico, and that is about 6-8 tonnes worth of plastic just there, so what they are doing is just shredding it into little particles, Then another group bottles it up into water bottles, So just like these ones here. So all they are doing is bottling it up...

...and then they are just stacking it. So that's about 8 tonnes worth of plastic just in that little area there. I think that accumulated in just 4 months. (So what do they do with it after?) That's the thing I'm not too sure what happens after that but what my research does is go the next step.

So what I want to do is take the particles or little pieces of plastic and we got a machine which we call a FilaBot what it does is makes the ink for the 3D printing machine. So the 3D printing machine uses like a wire sort of the wire you use for the moa vao (weed eater). Oh yeah ok...So it melts the plastic and as it prints layer upon layer to make the model or whatever. Another thing this is other countries such as India are benefiting from 3D printing as well. In terms of 3D printing material in NZ if we import it from the US is about \$120 roughly NZD if you are buying from America. There has been research done looking in to recycled filament and they found that plastic milk jugs which we have is about 30cents US just the bottle. Melt down about 20 of them and you can have about 1kg worth of filament. So people in India are making that recycled material then sending it out to other countries. So its all recycled material and they are benefitting from it. That's the machine there and that's being supplied

by the University as well. Oh ok.. that's the good part I've got the support of the university and the support of the head of school. So now its just me coming over here to Samoa letting people know, its not only just my research trying to get information, but its ore me making people aware about the issues that plastic has. As im here im documenting the amount of plastic im using as well, like Fagu vais (water bottles) that im using. The stuff that I bought over as wellm documenting all of that. And just seeing as a tourist, how much plastic is being generated because after, you know what tourist do, is just bin it. And it's the countries problem you know. Yeah just going that extra step. So here are some examples which I done on the computer. Of what I can make of it. But yeah just yell out if I'm going over time. Because I've had a talk to the likes of Vanya Taulea'lo and Steven Percival to get the arts and crafts perspective of what I'm looking into.

So this one here, is influenced by the coconut it's an abstract Coconut. The nut in the middle and then the outer shell. So the benefits of 3D printing is that you can 3D print pieces with-in pieces. Unlike other materials where you have to go through many different steps to put pieces with-in each other, 3D printing is easily done. So this one here is a tourist based piece. Where tourist can take it as a souvenir. It's all made from the recycled plastic they would have used here. So what could happen is companies could collect the plastic, sell it off to another company who are recycling it making it into 3D print material. Then creating pieces which people can take back with them home or other countries. So it takes the idea of the rubbish and putting value into it. So they have another way to remember their trip to Samoa.

This is another idea which I had, which looks into the arts and crafts area. Looking into the designs of the Siapo. SO the idea behind this is the Siapo is 2D, its flat. What I wanted to do with this is to create an exhibition piece which you could put in a gallery which is 3Dimensional, something that gives another look into the ideas where the Siapo patterns came from and may look like in terms of physical looks.

This is another tourist based idea which is influenced by the Asian influence here in Samoa. You know those fortune cookies they have in Asia where they break it up and there's a little note inside. This is sort of the same idea but starts off as a coconut shape but opens up into a little flower with a little message inside it. It could be a little something in Samoan that they could take back with them. But as I said before it's all made of recycled plastic. And they take that plastic back with them. So it's only a little portion but looking at the tourism industry in Samoa it's quite big. So think about all the small amounts being taken out of the country but we earn money from it.

And then this one here is looking into water quality here in Samoa. The tap water quality isn't that great from what I know hence why there is a lot of bottled water being used. So this is just a quick idea looking into a sort of a coffee plunger style, so you push down and all the little unwanted stuff in the water gets all

stuck at the bottom. In terms of all these ideas I've got. They are all concepts they are all just the beginning stage. (Understandable). So the idea behind all...(I think it will be good if we can get a recycled bottle from these recycled materials. Because as you rightly pointed out, we have just finished the SIDS conference. And there's up to ten- actually 15 water companies also actually bottling the water. And you can imagine the piles of imported plastic bottles to bottle this water. And then you can look at – It will be interesting if you could get the actual number of imported bottles from the water companies. But also after you drink it and it becomes someone else's responsibility, have you ever thought of creating an actual bottle which is, you know a huge in terms of using this recycled bottle for our local companies here. And the cause that you have, is not only economical but very environmentally safe). So yeah that's the idea of me coming to Samoa is not only experiencing how much plastic is being used but also getting ideas from the people who actually live here of what they think. So the idea that you have there is a perfect example of getting feedback from back from the locals can help out my research as well. Instead of me making stuff that isn't necessary but stuff locals know they need and can be easily implemented

(Because if you go to like big games, like the All Blacks a coming next year. At the Apia park, no one is allowed, everyone is forbidden to take the glass bottles inside because you know, te'i togi sesi le ulu a lesi (in case someone throws it at someone else) like things like that. But that really is an example of how the glass bottle is slowly fading because of protection and in case someone throws it amidst a fight, it comes back to the idea of being able to recycle bottles for future purposes and to know that o le mea lae fai tua (what people are doing out back) they just you know eli lalo le pu ae tanu (dig a hole and bury) because that's what they do ahh) that's what my research has found...

That heat I've found out in the research I've done so far, they either burn it or they bury it. All because of the mosquitoes growth. Especially with the whole mosquito sickness that is going around right now, it scares a lot of people and so they are more aware now so they are just burying it. We went for a drive around the island with Uncle Lino on Sunday, we went for a drive around and one of the things that I noticed in front of Faletolu Primary as we drove around the island ok there was a little boy who just ran across the road and all I saw – there's only about a 430-40 metre walk to the ocean but there's this little section of stream that's there and what I noticed with him was that he was holding something and all I see is him throw it into the water. It sort of another example of how I'm coming here to sort of educate people as well. Not just me getting information but creating that awareness and I think education is one of the big switches that can help Samoa as well. Just letting people know this is how the material works, it doesn't just disappear like that. What happens is that it stays in the ocean and lingers in the ocean breaking apart slowly and animals start eating it especially when we are trying to live off the ocean?

(Yes, that is a very important part, and if you think of the tourism sector as you

rightly pointed out. Which is the largest contributor to our GDP every year. And you go to the villages where the idea of keeping it very simple but effect and economical. If you go to the beach fale in the villages is very evident in most of the villages and it doesn't take away the fact that bottled water is very high in the tourism, beach fale and hotels and things like that. And the question is where they are actually dumping it). EXACTLY

That's more the area where I want to look into, like what are they doing with that plastic. Because there isn't much of a recycle system because I went over to Tafaigata landfill and had a look there and it's all mixed up with all this other material. And they are just slowly sorting it out but looking at it. The amount of time they are taking to sort it out compared to the amount of rubbish coming in. There is a big difference.

But this is sort of a little brainstorm of areas which technology can help. So in terms of education Teachers can actually make physical models of what they are talking about which gives the kids an idea of what they are actually talking about. Stationary, ruler's pens are another contributor to plastic waste. Because once they are broken they are thrown in the rubbish. Say a piece of your tray there broke you could easily replace it with a 3D printer. This is one of the good things about 3D printing is that it adapts to a lot of different areas. So say you broke a piece of your plastic chair. You can just 3D print a piece which just slides back on and the chair is reusable again. And that's the sort of recycling area that I'm talking about. It doesn't just stop from once its broken you throw it away you either break that material up for something else, or you can print something to fix it.

(And one thing that I think you can, well taking from what you just said and the skills that you have and the training and background that you have. You're looking at creating stuff out of it, and I foresee, like if you look at the wood, some of the most expensive souvenirs that's being taken out of the country and produced In Samoa are carved from the wood. For tourist obviously. So if we could come up with these design and souvenirs made from this recycled plastic, I mean that's a brilliant idea for us to be able to produce those things from rubbish, plastics)

So these are just examples of work that I've done and work that can be made out of plastic. (*looking at my physical work samples*) Feel free to touch it, but that's the sort of machine quality of the 3D printer which I am using. (So you make this from plastic?) Yep that's made of plastic but it's not recycled plastic that's just the material we are used to using. But these are just examples that I bought over to look at, to show the sort of machine qualities you can get...(you can use it as you know light fittings)...Yeah you can use it for light fittings. (You can enlarge it and it becomes a nice light fitting). Yeah, basically anything you make on the computer, all of those were made on the computer can be...(So this is what the 3D printer can do?)...Yeah and these are some more examples. So that's more the low grade. For us we call them concept models before we make the final. But these are other examples of what I've made, these were from a project that I did at the beginning of the year, which incorporates culture with 3D printing. This was the first time I started

looking into it. (What material did you use for)...that's plastic, ABS plastic those are different qualities because of the different techniques I used on the computer. But with that project they are all digital scans of...(Well can I ask about the safety of the chemical mixture of this)...like I said its basic ABS plastic but with bottles there's like PET, the HDPE which is the ones they use for the Talone (Bottles) which they use for the petrol that is the HDPE. Things like polystyrene is still early stages and I know polystyrene is a big thing here in Samoa with Fa'alavelaves and all those other stuff. But at this stage the actual printing of it. There's being research being put into it, and each 3D printer has been designed to get rid of the fumes as well but it's still in sort of a young sort of process, technology. Is sort of like the printers that you use to print your paper work. It will develop to become cheap and affordable for households just like the Ink printers. So that was looking into incorporating a new interpretation of genealogy. I was looking at Hands and all that there are digital scans of my family's hands. These ones here? Yeah so they are all little sections of the hands. But this one here is one of my prized possessions. It's more of a higher quality of 3D print using resin. With this one here takes the idea of- say this was a scan of your grandfather, who is sick and just about to pass away. Take a scan of his hand and it makes a piece of jewellery which can be passed down. So this is your grandfather's hand and it sits in yours and you still have that connection with him. The lines like this I made to resemble the art of tattooing of Samoa. (What's that thing depict?) It is another hand scan, it fits into the hand like that. This is my little brother's scan. But I wanted to make it in a way that sort of looks fashionable. Like this it is still a concept...(Obviously you can have a big market in design, fashion and design). There isn't really a domain which is called Pacific design, its just pacific Arts and Crafts. So that also means there's no such thing as Samoan design which is what I'm sort of trying to look into and develop. There are a few Maori designs incorporating their culture into their design. So not only am I trying to pick the brains of people to jump on to the bandwagon of design but us designers we can adapt if it goes into graphic design making posters and leaflets, furniture design, design furniture such as these, and also looking into product design There's sort of different areas where I'm coming over here and talking to people about which I want to advertise as well, it's not just always being a lawyer or doctor which I know a lot of people back home do because, you know how a lot of Samoans go to NZ tell their kids go be a doctor or go be a lawyer or engineer, there's also other jobs. Us pacific people you know we are good with the creative side of things sort of using that idea to sort of advertise our culture into a new domain. IL show these real quick... (*Showing them physical models of my work*) ... (this is like what I said in the email, to have a very young Samoa who is actually interested in Design and looking into the idea of recycling for the best interest of this country. To have, you know not educated or bought up in Samoa, you still have the heart to come back and give something back.) Yeah exactly its something I'm proud about, mums from Faleu...(yeah I know a lot about your

background from your uncles, but is this your first time here in Samoa). NO I've been here a few times the last time I was here was in 09 when my grandmother passed away. When that happened it was the first week before Uni started for me. SO it happened...(so you haven't been working? You've been in school?) Yeah I've been in school, so this is my 5th year in school now I'm working on my thesis but in terms of Design work, I have done bits and pieces for other people. For exhibition pieces but this is where I want to go. I want to see where this this takes me in terms of the whole recycling domain because you know, there's not many Pacific Island designers/ Samoans designer...(you know and with the interest of plastic. Because I have been to Tuvalu and to the cooks and most of them work with either the wood of the bone, not in plastic. That's why with your research I think the prime Minister will be very interested about your findings when your research is concluded, are you planning on coming to Samoa to serve a bit or?). We'll see what happens with this research because my research is handed in net February, so this is more the field work research I'm doing now. IV done the bits and pieces of the background checks before I came over so I know a bit. The machines have been imported to NZ so now we do have them so once I get back it will be all material experimentations. (What about the exercise of the idea in NZ, has there been solid activities in terms of using recycled plastics?) It's something that is starting to build up now. Because us designers we are starting to work with Scientist to see, well looking for new chemical bonds. Overseas in the US and Europe. There has been research looking into recycling plastics. But the idea behind my research is sort of using what's already been done incorporating what I'm doing for isolated areas in the Pacific. Because there's not much money being made...(Have you been to Tuvalu?) No I haven't. (Well I went to Tuvalu, if you want to know really about what climate change can do to a country. You go to Tuvalu. Because I visited Tuvalu for Government business in June and you drive, because it only takes a few minutes about 15 mins to go to the other side, this is what the ocean can do in terms of carrying these plastics. They are dumped on the side where the Mangroves are. The magnitude of having plastics in the islands for a country like to Tuvalu who a struggling in terms of Climate change and a lot of other issues. Plastic is huge in terms of unresolved issues for the future. And even in Samoa for a very small country, two of the largest landfills are the sea or the land)...exactly like I said before education is the key, bringing the awareness to others through this research and then yeah, especially trying to get the whole idea out making sure that it doesn't just stop here for me. Once this research is developed I'm going to try and work into recycling other stuff. Because people tend to, once they finish their thesis...(especially when you become an academic. Because you only teach in the rooms. And like when people ask. 'What's it like to become an academic?' like most of the teaching and learning is done in the classroom, so it's different from design. You do your research and then you apply it.) Exactly (and you know this country needs people like you to come back and visit. Not only in schools also the practical side of it maybe if you have a chance you can talk to Penehuru, one of the artist in Samoa, Lino will know him. In terms of using that knowledge and applying

it in a very artist way as you're doing. But in terms of the government and the planning. The government is actually looking into developing our water front it's a huge project developing our water front, you go to Wellington it all the same. I saw in the newspaper last week in Auckland, that they are doing this as well but this is the future of it in order to do away with these plastics we need to, you know I'm thinking about my son, who is experimenting with materials. It's easy for kids to grasp what you are trying to tell them if you use the 3D material. So yeah plastic could be used as teaching materials in schools. Well that's something I have in mind. You know through the years and I'm sure you will be progressing along from your masters and maybe looking at a PHD thesis, how to actually recycle it into a bottle). This project is more of a driver for what other countries and communities can use. It's not only just for Samoa. I'm just using Samoa as a little example because its...(a you looking at another country to do a comparative)...no at this stage not really just because its more...the whole Idea is more me coming here see what the life styles like see how the plastics being managed and then doesn't just stop there looks into how can this plastic be adapted and used to give back to communities. What products can be made from this? What do people of Samoa actually need? You know? It more one of those projects which doesn't just stop at one point but develops as technology progresses. This is why I decided to come to Samoa because of my cultural connection to this and the passion that my parents have and how they came to NZ for my education, why not give back to the community. This is the whole idea behind this research. (And that's fine). That's basically where I'm at, at this stage if you have any question or more ideas feel free to email me show me or give me ideas yeah the whole idea coming to meet with you was to get the whole legislation side and policy side and the whole government stand point of where it is. (Sure I'm sure the Prime Minister will be happy to meet, for myself we are looking at polies from the whole government perspective. This is a milestone achievement to use your findings and especially how to deal with this mounting difficulty of dealing with plastic because it doesn't go away like you said. So unless we have a recycling plants to ensure these plastics are being recycled it's just going to keep on piling up. You can do away with papers like for this division, we handle a lot of paper work with cabinet. And with that, papers can be burnt but for plastics not only is it environmentally hazardous to burn them but if we dump it into the sea its going wash over to)...its one of those things that it becomes someone else's problems. We want to keep it isolated keep it in the country which isn't a good thing but it coming up with a system which gives an economic response to it. SO we get money from it. (This is the difference, like I help formulating polices which is a big responsibility for the cabinet. So cabinet formulate policies but it's the practitioners who are actually doing it every day a causes the challenge. For example Government makes a law to make sure that recycling over say for example we have a scenario which.... like the 50% biodegradable plastic act that was passes last year. So if cabinet decided say for example to have a regulation in place to ensure that plastics are being recycled, but there is in the absence of management to ensure that that

happens. SO in the absence of having a plant for these plastics that policy cannot be implemented so we have to have policy side to it and also something that has to be implemented).

That's the idea behind coming to see you to get that sort of ideology there was an article in the Samoa observer about 2 or 3 weeks ago. Silafau Ioane Sio from Pacific Recycles and how he reckons there's money to be made from the tyres as well and also plastic bottles. So I'll be meeting with him on Wednesday to get his stand point and his sort of view. I could easily ask him check how much, if they have statistic, how much is actually being collected vs. what is still out there. Because that is one thing that is hard for people out Tua, it's hard for them to get things...(not only that you are looking at transportation issues. You pay for a load to go to Tafaigata dumping site. I mean it could be easy for people living around town in the facility of Apia but when you talk about someone back in the village trying to get transport to come over to Tafaigata. It's hard. Because Government one, I think its driven by Ministry of Natural Resources and Environment, where the trucks go out to the villages to collect the rubbish it still doesn't take away the problem. The problem still remains there. And how much plastic is being collected vs those who are not being collected and dumping in the sea or otherwise. That's data you could get from you know)...I was pretty happy that I got here as the SIDS conference was wrapping up. You know it's a topic which is relevant, its happening worldwide as well but it would be good if Samoa jumped onto the design bandwagon or the whole 3D printing and technology Bandwagon and... (the other thing that makes it very interesting is the practical side that you will be doing. That makes it very different from someone who is doing things in polices. Who's doing things like reviewing the law? Because you know with Design that's an A+ thesis because we are looking at thing in terms of the GDP of our, but you know one will need to stop and think about you know the implications with so many people coming into Samoa. And continuing to use plastic bottles and you know things...its how we look at the future and anticipating what is going to happen if the sector really is improving. I think we are looking at 1000+ people coming in ever 12months and if one person takes two drinks a day, then that's a lot of plastic bottles). What I just remembered is coming through customs in Auckland going through the whole scanning process, I had a water bottle in my bag, the thing that surprised me is that they told me that I could finish the water and take the bottle with me and it will be alright to come into the country. Which is sort of interesting in the sense that, why are they allowing the plastic to come into the country when they are trying to yon sort of get rid of it. Which is a point that I will always remember coming because it was the first instance that I found that plastic....NZ is allowing it go but they are making it a bigger problem for the smaller countries. Because you know I was surprised...wouldn't it be easier if I left it with you. I bought it from you guys, you guys have it. But man I was surprised. (Because if you keep on telling people, like that's very good news because we could actually use that to encourage our travelling passengers you know, you can take your empty bottle and dump it somewhere else when the plane stops) That's another area which I want to look

into is the amount of plastic that builds up on the plane itself, (on the plane itself lately just the preparation leading up to the SIDS, we found out there's no proper incinerator for rubbish for the planes, that's been like that for years. So with our border management, she found out there was no proper incinerator or proper place for these rubbish from the planes. And that would become a big problem with pest's transfers and things like that.) That's one of the biggest notes I made because I'm keeping a diary as I'm here. Its one of the big notes that the rubbish that is or amount of plastic or whatever material that is being used on the plane the country where we land in, it becomes their problem. And that becomes the responsibility of the host country. Exactly its well spurring its sort of an issue which part of every different area in the country...(its HUGE especially if you have about six 777 flights coming in you look at about 300 people drinking water bottles at least one or two. That's the whole rubbish that's being dumped in Samoa). Exactly, bringing it here and leaving it here. And the plane just leaves with a whole new cargo. Yeah. It's easy for NZ to deal with it easy for Australia band other countries but when we are here in Samoa, talking to those recycling companies there's not much money made from them so it's hard for people here to deal with that material sure all of it is collecting at Tafaigata and that's it. Well that's sort of the areas where it just bring out the whole perspective of how there's a whole of stuff happening around this world that people don't really noticed. So that's one of the first things I noticed when I was on the plane. (I'm not sure Lionel whether you have been given a copy of these regulations but it may be useful if I give you a copy of this one. This was approved by cabinet last year so maybe you can refer to, others are available online but I don't think this is available online. Oh ok, cool. Do you need the Samoan translation?) No il be good. Haha. That will help heaps...but yeah this is just a consent form.....

(*Off the record discussion*)

END OF INTERVIEW

Appendix 4- SPREP Interview

Tuesday 16th September 2014
0800am
SPREP, Cross Island road
Samoa

The recording for this interview started from the beginning of the meeting with 4 people from SPREP

From beginning of recording...

Interviewer - Lionel
Interviewee – (SPREP)

Yeah so Like I Said I am currently working on my Thesis, which is looking into finding new ways of recycling plastic waste. Using my background in Design, with additive manufacturing which is 3D printing. To help find new ways of recycling plastic in isolated areas. I'm using Samoa as an example as it is close to home for me, my roots are here in Samoa, even though I am New Zealand bred and born. So I'm only 22, graduated last year. My family is from Faleu, Manono and my dad is from Salelologa, Savaii. SO the whole Fautasi race last week was sort of hectic for our family. Just rival boats. And just real quick some of my work. So this is sort of examples of additive manufacturing, 3D printing. Do you guys know much about additive manufacturing first? (Not much apart from what I have seen on the news). I've got a quick video if you guys want to watch but these are the material qualities of 3D printing which you can get. This is more of the low quality sort of stuff you can get but feel free to have a nosey. (Technical difficulty with video) So the way that 3D printing works is that it's a process where you create a model on the computer...(Video starts playing)...but this video will tell you. (*participants watch video*) So yeah 3D printing is still a relatively new process all because the patents are just starting to expire so people are taking ideas from designs which were made quite a while ago. But these are examples of small 3D prints which I made back at Uni. We have a few 3D printers onsite at Uni which we use to rapid prototype where we can make quick sketch models of our products. So other work which I have done include pieces using Photography, looking into Graffiti is one of the project which I did which sort of related back to tattooing. Artist leaving stories behind for other people to view some people might see it as vandalism but other people see it as art. I was trying to capture that artistic side to it. So looking down back alleys and

also looking at pieces which have been paid for by companies.

I have also used other technology such as CNC Milling as well to create this table which also takes influence from the Pacific, where I decided to use the sennit to lash together the table pieces. The only glue used there is for the actual plywood itself. It gets rid of all the nails and all the extra stuff which isn't needed. It looks into using indigenous knowledge and influencing it into my design. I've made a turtle shell lamp a few years ago using another technology which also made those business cards which is laser cutting. Using a really thin veneer and it etches little patterns into the outer shell and as light comes through it, it passes through those little etch lines. This is another version of 3D printing. Which is more Hi-Res which uses a resin. So these machines are quite expensive but like I said it's still quite a relatively new process and as time goes by it will get cheaper. But back to my project, my project is called *Renewing Materials*. In terms of renewing Plastic waste and giving value to it through 3D printing. This image here is an image which helped kick start my project for me. I'm guessing you guys know about the Great Pacific Garbage Patch and sort of the harm it's doing to the environment and the marine life. Midway atoll is one of the biggest influences for my research as I saw a video which showed not too many people living there, a lot of albatross but a whole lot of plastic waste which swept up from the ocean. So the ocean is the biggest landfill in terms of plastic waste in the world.

These are just some more examples of the harm it's doing to marine life. So all these images and also the video that I have which I won't show you as you guys probably know more than I do about this sort of influenced this project from me. The idea of isolated areas such as the Pacific which don't have the resources to eliminate or find new ways to process this material sort of an area which I want to focus on. Just having links to Samoa makes me want to keep that beauty and the whole paradise idea of Samoa.

So I decided to use Samoa because of the Tourism industry because of the large consumption of water bottles by tourist due to the water quality as well. Also the whole idea of Apia being over here and how does the outer areas out here –rural areas– deal with this plastic dilemma.

So far I have talked to one person in Government who's working in the legislation area. I've also had interviews with two arts and crafts people but in terms of legislations I have just got a copy of new legislation which government are working on as well, I just got it yesterday. But so far there isn't much of a recycling system implemented here like we have in New Zealand. Talking to some of the recycling companies here in Samoa, all they do is collect it and ship it to make it someone else is problem. But in return they are not getting much money in return. Which is one of the key areas which I want to focus on is keeping it in the country, which isn't a good thing. But finding a new way to process it and create something out of it which benefits Samoa and potentially earn money from it. It could create jobs for locals as well. This is my thesis question which I have been basically repeating over and over again. Looking into finding new

ways of recycling plastic waste using additive manufacturing.

And a key example of a process was the coconut for me. Every part of the coconut tree gets used. It's more of the life cycle of the coconut like the nuts fall down they ferment and create another tree. But as for plastic it's made –plastic water bottle for example– bottled, the consumer uses it but then it is just thrown away. There is no next process for it. Other than crushing it up, piling it up and shipping it somewhere else. I want to take it that next step finding a new way to use that material.

So for an example which I found over in Mexico, there's a little community which is shredding up their plastic waste so they collect the plastic, shred it up using a 40blade shredder. Then another group bottles it up, in to another set of plastic bottles. SO these are all the little shreds being collected into these plastic bottles. And then all they have done is just stack them. SO this is about 8 tonnes worth of plastic just stacked up there. In terms of the next stage, I'm not sure what they do but I'm guessing they just collect it and just give it away to someone else to deal with. What I want to do is take the idea of shredding the material. Firstly organising it into the different types. The PET the HDPE type materials, Shred it up and then take it to the next step to make 3D printing material. Other countries such as India have jumped on to the bandwagon of additive manufacturing. What they have done is, they have collected the material as well and they have turned it into 3D printing Filament. Which is similar to the weed eater wires which is just fed into the 3D printer. And what it does is it melts it to a consistency to where it can solidify quickly and as it layers on top of each other sticks on to each other. That's the idea behind what I'm trying to do.

In terms of the equipment I am using. We have just recently received a Filabot, which is a machine which turns shreds of plastic into 3D print Filament, the ink for it. So what it does is we put it into the hopper and it goes into a heater barrel, sort of like injection moulding which pushes the material with an auger. And what it does is just shoots out a long strand of material depending on how much you put into the hopper/feeder. Other than that machine there we are also using a shredder just to shred up the plastic and the 3D printer itself. In terms of the compatibility of the plastic when you're producing your final product. How compatible are the different grades of plastic, can have to mix them or can you keep them separate?

You can mix them, a lot of companies are selling filament which are HDPE, but they are mixed with ABS, just to add the qualities of ABS into HDPE or in to PET as well. (And when it's been injected from the machine in terms of filament. I'm assuming, what's the temperature of that?)

I'm not too sure that's one of the stages for when I get back to NZ is starting the material experimentation just because the machines took a long time to get delivered. So we...(the reason is I was just wondering what influence it has on volatilisation on any components within the plastic, you see one of the things we are going to deal with potentially is use pesticide containers as an example. The concept is still we ----- so it's relatively clean but there's still going to be some residual attached. The plastic I was just wondering, and one of the concepts is yes to reuse the plastic for something, but if we went down this track, just wondering

what the implications are for volatilisation)...

Well there hasn't been much research done looking into that because I wanted focus on the Samoa cultural aspect of what I am trying to do, some areas I haven't sort of looked into properly but the whole idea behind the whole selling of material is, a Filament roll shipped from the US to NZ is about \$120 per filament roll there has been research which has looked into what happens when you recycle plastics. People have recycled milk bottles in the US and are saying that its 30-50cents a bottle and say you use about 20 bottles to make about 1kg worth of filament. Which is quite a lot. Which is quite a large price drop but in terms of material quality, there are some areas where the material isn't as great as the material shipped at a high price but like I said the technology is still quite new and the filament prices will drop as new materials start being produced. So in terms of the stage where 3D printing is now. ABS and PLA are the two main ones we use at VUW just because the PLA is water soluble in terms of other research done overseas. Others are researching into cellular structures 3D printing organs potentially bone structures. Looking into carbon fibre but there are countries over in the Netherlands whom are printing in also stainless steel and other material which is hard to believe they got it working. It's a technology which is always developing and always new stuff coming from it. For me it's one of those technologies where you sort of want to let the whole world know about it just because of the benefits we see from it. And being an industrial designer, our job sorts of jumps into a lot of different categories. So we can do a lot of work helping other industries which can also help benefit the communities. I came up with four real quick examples of some applications, this was a little model I came up with, Little souvenir style model which is only yay big but in terms of the idea behind this, is that it is more directed towards the tourism industry. It takes the shape of a coconut, a nut in the middle and the abstract husk. Some benefits with 3D printing as well it allows you to print within a print. So you can make a ball joint really easy with a 3D printer. So you can basically print layers upon layers of materials and quickly clean it and it will be all able to more. But the idea behind this is a lot of tourist use a lot of bottles, say there was a company which collected them, shredded them and turned it into filament. Then using that Filament to recreate these models which could then be sold back as a souvenir which can be taken away with them. SO the whole idea is that they use the plastic material on the island and they take it back with them. This is one of the ideas behind this concept here. These are all still concepts and they will all slowly be developed throughout this project.

This one here was a play on the idea of the Siapo, the Samoan Tapa cloth. The tapa cloth is 2D why not make it 3D and make it an exhibition piece which adds cultural value to it so this was taken from one of the patterns on the Siapo. Creating into a 3D form in a software which we use call Solidworks. Which a lot of engineering companies use. And then yeah, like what I said adding

personality to it which give a while new experience to people who sort of see it This one here was inspired by the Asian influence here in Samoa. Took the idea of a fortune cookie so breaking something apart and having hidden in the middle or a gift in the middle. SO the idea behind this is also using the coconut again, like I said it was one of my influences, opening it up which makes a 3D flower. So the idea that is holds a message or a little gift which the tourist can take back with them to their countries and can be reused as well. But the idea behind this one was having a little message in Samoan which they can learn and stay with them. So they can take back with them as an experience of their trip to Samoa.

And then the next one is one of my main concepts. This was a real rushed idea which I just wanted to get made which is a water bottle which is similar to a coffee plunger. Taking water from the tap using 3D printed materials on the inside to push down on the water bottle and using a filtration system in the cap to try and get rid of any stuff you don't want to drink. Pushing it to the bottom of the bottle, clean it and reuse it again. This was influenced by the water qualities here in Samoa which I know about just because of the times I have been visiting here.

This was just a quick brain storm of what potential applications in different areas where this technology can help. So for example schools, stationary for kids, 3d printing rulers. There was a time last week where I just finished an interview walked out on to the front yard and at the opposite yard there was a broken patio chair just thrown into the rubbish. And another idea is not throwing away the product but 3D printing a new part that you need. Sort of like that clothes hook. So 3D printing the piece which is broken. So you can just keep using the same material over and over again. I did bring some of my work with me from NZ but not all of it is 3D printed but just an example of what us Industrial designer can do.

(*Showing them physical models of my work*)

So yeah that's basically me really. That basically all I've done yeah Renewing Materials

((Frank Griffin) I saw news clip maybe last year where they use 3D printing to synthesise one of those things for the hip for an old lady. So you have medical applications already. SO what they had done is that the Hip was broken so they had taken that bone out and 3D printed one of these in the shape of the Hip bone). So yeah for the 3D printer which I am using, which uses plastic. It's not one of those machines that you use for a final model but it's more of those machines which you use to give examples of showing your patients this is what we are going to use but it is going to be made of this material. It's one of those things that teachers can use as well. To make examples it's easier to learn from seeing something and touching something then having told verbally where it goes in one ear and out the other. So yeah think of what engineers can come up with, Think of what other people in specialty areas can come up with.

The technology was introduced by NASA as well. If they lose or they break a piece in space. They can 3D print a piece. That was the application of 3D printing initially. Like the ink jet printers that we have these days, when they first came out

they were really expensive and only the high class people could afford it. But now days almost every house hold has one. But now as we look at it, it sort of moving in the same progress the ink jet printers did. It will slowly get cheaper and cheaper as the technology starts to develop and it's exciting to see where it's going.

((David Haynes) I found that really really interesting. I think we've all understood 3D printing based on the news items and things like that. But I've never even thought of the implications for the work we might do out here. We have a big solid waste management team, and recycling is a key focus to try and coordinate regionally with our colleagues in JICAR and plastic is one of our most depressing recycling issues because it has no value.)

((Tsukiji Makato) Actually so I saw a similar, so one person. He also study in New Zealand. Already he promoting the machine. And he actually studying in the Solomon, he collecting the plastic and using this machine he want to promote plastic recycling over there. Yeah so I think it is very interesting, I'm not sure if the machine is the same one, same as this one but actually he tried to promote the machine and the plastic recycling. So anyway plastic is very big issue in pacific Island and so now we try to return all recyclable plastic, metal, aluminium cans but actually plastic is not so valuable. Which makes this a very interesting concept so far. And also if we introduce this machine to community's maybe we can motivate them to so far something for motivating communities and people on the island.)

Yes adding value back into the plastic which is one of the main ideas for this project in terms of value money wise, in terms of income the country can get and also the significant value. Basically the main idea for me coming to Samoa is to experience and have a look around the country how they are dealing with this. I did have a visit to Tafaigata landfill last week. Damn there's a lot of plastic mixed in there. Mixed with all the other materials looking at the people sorting it out vs the amount of stuff coming in...it's going to start piling up. Another idea which came to me was if this is the stuff which is just from Apia area, what is happening to the plastic which is not being collected out in the rural area. Research has looked into other ways. A lot of people are burying their plastic waste or burning it which isn't good because of the fume that comes from burning. So education is a big thing for this project as well. Educating the community, bring awareness to communities. So basically the people I have talked to so far have been informed through my research that plastic isn't the perfect material which the video said before which when you done with it, it just becomes a hassle. An example which I have been using is the Airplanes coming into Samoa. The rubbish which they carry then becomes Samoa's problem. Knowing those companies they wouldn't want to deal with it they will just leave it here. It's the whole education aspect.

((David Haynes) In terms of your work, how long is you masters?) It is a year, it completes next February...(so your basically working right through and we will be very interested in keeping up with what you do from our perspective there could be 2 lines in which we could go...one is the tourism kind of thing would be

very good but equally it would be good to understand what the implications are for routine basic bit of equipment like you talked about the chair before for example. Which are commonly used across the island we probably don't want to encourage plastic knives and forks but the reality is that they are used extensively and if they could be recycled through this process what the cost benefit analysis of this could be. They're the kind of fundamental issues we would really like to understand so we could understand where this could fit in to our integrated waste management system. Because as I said at the moment the stuff is some places are being collected some places it's not. When it is being collected there is very low values and typically has to be subsidised to export it. And it is exported and something else is done with it, it is not used on island. So if you could evaluate it on island yes I can see real benefits for that, but again it all comes down to cost benefit analysis and the best approach to manage this that is the fundamental question here. Everything else you have talked about education and so on, we are well aware of it with all the work that we do.

(Tsukiji Makato) I think it is very good to have an alternative option for plastic recycling. In ----- plastic oil. So just implicate this case. -----) Yeah for sure I'll keep in touch I've got your card there and yeah we can keep in contact.

(*Off the record discussion*)

END OF INTERVIEW

Appendix 5– Pacific Recycles Interview

Wednesday 17th September 2014
01000am
Pacific Recycles Yard, Tafaigata
Samoa

The recording for this interview started during the video explaining ‘the Great Pacific Garbage Patch’. Did not record during presentation slides about me and my work.

From beginning of recording...

So yeah my name is Lionel, I’m from Victoria University I’m only 22 and I’m working on my thesis. My aiga is from Faleu I Manono, ma Salelologa.
So this is some of my own work first just a little bit about me. I’m looking into 3D printing, kei loa le mea ole 3D printing? Leai, I’ll show you a video then. (*Video play back malfunction*) But thanks for meeting with me today, because I had a meeting at 11am and I should have rung first. E pisi tou aso? (E Pisi feololo a.) Sekia le malu o totonu I, but the only reason why I wanted to catch up with Silafau was to get the perspective of how much plastic you guys are actually collecting. See how much plastic you guys are collecting compared to what is still out in the villages and stuff. Sorry man this is taking its time....(ele a faiga.) (*participants watch video on 3D printing*)
So this is the technology that I’m looking at using. But with 3D printing plastic is only a small amount there’s many materials that can be used in 3D printers. Lae iai le rubber, lae iai foi ma ceramics, people are doing ceramics and people are printing in metal as well. So there’s heaps of different materials that are being used but plastic is the one I want to focus on and getting recycled material. So this is one of the reasons why I wanted to talk to you guys about, because I had a look around Tafaigata landfill last week and Ola ma le plastic lae iai sole. But yeah 3D printing is the technology which I am looking into and yeah that is what 3D printing is. It’s sort of like the ink jet printer over there which does 2D, with 3D printing it goes upwards, it uses material to build it. So any idea you can make it with a 3D printer. Like the examples I have here. (*Looking at physical examples I bought to Samoa*) So this is what 3D printed objects look like. These are all made using the 3D printer but other work that I have done...I have done work in photography, taken these photos of graffiti, I have made furniture as well. Using other technology available in NZ, but I like to incorporate my pacific side into it. So that is why I decided to use the Afa. I have also made a lamp using other technology. The same as the card I gave you. Using the laser cutter. It’s sort of like the printer but it shoots a laser which burns into the material. So there’s technology out there that Samoa could adapt to. Compared to this, this is more the high resolution prints. But there’s higher grade

3D printing. There’s also 3D printing which is done in resin, like this one here. This is also 3D printed in resin, this is 3D printed as well feel free to have a look, take photos do whatever you want, its more showing everyone in Samoa what is available. Compared to just throwing the plastic away and then that’s it not knowing from the article that was in the Samoa observer, there’s not much money coming in from the plastic yeah So this sort of a technology where I can see plastic can you know, more money can come into the economy. I have other work here if you want to look at it. This work here was not made using 3D printing but it used the laser cutter and CNC milling machine So the CNC milling machine is a machine which uses a drill bit sort of like a carving machine yeah, which carves out the wood. So these are some examples, these were all made digitally, all on the computer. And then put into the machine. The one work I did on it physically was sanding it. There’s machines out there (e Fai uma machine mea uma IA??) Yeah all those were made with the same machine but it also used the other machine which made the card I gave you. SO I made a box on the computer and added the tattoo patterns onto it. (E tusa a ma le elei lae Maua I gei a? mea oute mafaufau e fai uma le masigi) it takes the labour away and takes the time away you know carving and carving. You just put it into the machine and let the machine do all the work. But yeah back to my actual research, so I was influenced by- have you guys heard of the Great Pacific Garbage patch? (Leai) because I was at SPREP yesterday talking to them. What the garbage patch is, there’s a video of that too, here’s just a little video, this is what influenced my research. (*participants watch video on 3D printing*)
That’s the pacific garbage patch. It’s a spot in the ocean because researchers say they biggest landfill in the world dis the ocean. So theres a lot of...so what is theres an area in the ocean where it’s sort of like a tornado in the middle of the ocean, where the ocean swirls and collects everything into that spot? And once it’s gone through there it moves away because not many people live on that island. All the plastic sweeps up onto their beaches, and all they do is collect it. All that plastic is from the ocean. That is what influenced my research. That’s what made me want to do this and this is just an over exaggerated image of what the ocean may look like full of plastic. So what gets effected are the marine animals, the birds think its plankton or little sea creatures and go into eat it and also the turtles with how special turtles are to Samoa. So I decided to come to Samoa because in Apia and this area here the rubbish collection system is alright you know a’o gei tua, its thinking about how the villages out here are using the plastic. So what my research has found so far is that a lot of people are burying the plastic you know, Eli le Pu, togi totonu le pu you know. And the other idea that they are doing is burning it. Which isn’t a good thing to do with plastic because of the fumes. That come from it. And also because the tourism industry here in Samoa is quite big, so there is a lot of bottled water being used. That’s what my research is looking into. Theres mainly two legislations that I have found that Samoa have in terms of government policy wise. The everyday collection of rubbish from their bins, but there no recycling system. Theres no system just for plastic or just for metal you know? Or glass. It’s just everything mixed together and given away. Which is something which is

more educational. Teaching people of Samoa how to deal with their products. So like I said this is my thesis question is looking into how can I use 3D printing, making of that stuff and using of the machines, use to recycle this material to become an asset for Samoa. Or for isolated countries in isolated areas. One you can get money from it, create jobs, it can limit the amount of plastic being imported in because you are recycling it and because the influence that I have got is....The coconut tree. Every part pf the coconut tree gets used. The coconuts get used for the food, the leaves get used for baskets or for ilis, and then when the coconut seed ferment they grow as another tree. But with the thing with the plastic is, put the water in it, finish using the product, and then just thrown away. Theres no next step. I want to take it to that next step. With this research.

So examples of other countries that doing something with the plastic this is a community in Mexico. So they collect the plastic and they shred it up into little pieces using a 40 blade saw or shredder. Another group puts them into little faguvais. They are put into bottles that look like these. And then all they have do is just stack them. There is no next stage they just stack it. That is about 8 tonne worth of plastic from 4 months in that community. So all they do is stack it there but there is no next step. My process that I am trying to use for this research goes that next step. It uses that shredded material to make the ink mole 3D printer. It melts down all that shredded material makes it into a long piece of filament. That is what we call it. Long piece of wire, pole le wire lae faoga le moa vao, the long string. It's sort of like that. Then it get melted and printed into those kind of object. So the equipment which we are using, which is this one here. It's only a small one but it takes the shredded material through the hole here, and with the heating barrel it melts the material and makes it one long string. Which can then be put into an actual 3D printer that we saw in the video.

So the price of 3D printing material from America to New Zealand is roughly \$80-\$120 NZD. Which is quite expensive for one roll. Which is about 1-1.5kg. What people are starting to find is that if hey recycle the plastic from milk bottles, water bottles, the cost drops a lot. An empty milk bottle cost about 30cents American just for the bottle. If you shred that, melt it you can get a whole lot of material together (bottles) and melt it you can get about 3kg worth of material out of that 30cents a bottle. Theres a lot of money to be saved. What people in India a doing is that they are making the filament out of HDPE and PET plastics. Melting it down and make the roll. And then sell it out over to other countries to buy. SO they are jumping on to the bandwagon as we say. Jumping onto what the technology is doing and selling it and making money from it. So the ideas I'm coming up with fro this project, I've got about four examples this is one.

This is my interpretation of a coconut. It's about this big but it's for the tourism industry. Because the tourist use a lot of plastic water bottles here, and when they use it they leave it for Samoa to deal with. What I come up with for this idea is finish using the bottles, collect the bottles and give it to a company who can do that, like give it to you guys where you guys can shred it up and make the filament out of it. And then what you can do is 3D print these little souvenir pieces which the tourist can buy and take away with them so what they are doing is buying that waste

plastic back and then they are taking that plastic back with them. So think about all the plastic that you could make and that you make here. And they are taking small bits away with them. Theres a lot of people that come and visit Samoa. So think of all those little plastic pieces that are being taken over seas to their own countries. But the thing is you are giving that value back into it through the idea of a souvenir. It's your memories of your visit to Samoa.

Another idea was this one here. This was an example from the Siapo. The Siapo is 2D it's just flat, why not make it 3Dimensional and make it sort of like an exhibition piece which you could put in a gallery or at the entrance of a government building and what it does is that it puts tradition into this material. It gives value to it, cultural value. So yeah making the Siapo pattern 3D.

This one here was an idea from those, you know the Asian Influence in Samoa here now, there's a lot of Japanese and Chinese people her. This was an idea from their fortune cookie. You break the cookie and theres a message in the middle. So this one here was a fortune coconut you could say. So you open up the coconut and it makes a little flower and in the middle of it you could put a little message that they can take back with them to remember Samoa. SO that was another idea.

And the other idea that I came up with was a water bottle system. Because the water quality from the tap isn't that great which is why people tend to buy the water bottles, why not make a water bottle that acts like a coffee plunger which cleans the water for you using the filter which can be 3D printed and used to drink from Every time you are drinking, push it down and its clean. And then just clean it after wards and reuse it. SO it's a reusable bottle but the thing with these is that they are all at the first stage. They are not the final thing. They will all get developed as I go with this project.

And then there are other areas where this technology can be used for. Like the video said before. Teachers can use it for teaching in schools, to print out teaching aids, so they could 3D print out a body or skeleton. Teach their students. Because it's easier to learn if kids touch. If Kids see something in front of them instead of just sitting there and it goes in one ear and out the other. So the education system could benefit from this sort of technology that I am working with. You guys will benefit in terms of plastic doesn't just stay and you ship it overseas and don't get much money from it. The benefit you guys will get is, you guys keep it in their country, which isn't a good thing but the thing is you are keeping it in the country to make something out of it which you can benefit and make money from. Other places like, you know how you guys have trouble getting spare parts, like for example a bike. You break a piece of a bike you guys have to wait for the piece to get shipped from NZ and or Australia. Or all you could do is 3D print that part is that easy. You can just come up with other ideas. Theres a lot of areas which can benefit. Because as this technology develops other areas can benefit. An example in terms of the scientific side. Hospitals are starting to use this technology, using cellular structures to figure out a way to 3D print in bone. So you can 3D print bone and maybe organs for people who may need a new liver of kidney. Using their DNA. So this technology is still developing and theres a lot of new ideas coming in from people to use it

for. It's one of those technologies that I reckon Samoa can benefit from. So the reason why I wanted to come and talk to you guys is if you guys had a clear idea of how much plastic you guys are collecting a year. How much a you guys collecting compared to how much is still out there. That isn't. The ones that are just thrown in the vai and stuff.

So that's my project I'm working on at the moment its my thesis which finishes in February I've talked to two people in the Arts and Crafts, so I've talked to Vanya Taulea'lo and Steven Percival, talked to the people at PREP yesterday, and on Monday I talked to people in government. The Legislation people. Maybe on Friday I may talk to the Palemia if his available because he busy with the funerals and his trips. SO yeah that's my, that why I wanted to come talk to you guys. Come talk to Silafau because of this project and because I read his article in the paper about how he wanted to make money from rubber and plastic so why not come talk to you guys and see if this technology is sort of beneficial for you guys. Because my trying to find areas, isolated areas just like Samoa to help. But yeah this my project if you guys have any questions and stuff you have my card but yeah do you have an idea of how much plastic you are collecting.

(Cos o le lua afe male fiku ga amaka lw Pacific Recycles, amaka la ga pile up le plastic aua e le maua saga makeki, ga'o le pile up a. kusa ole lua afe male fitu to the 2011 ftoa alu ai le plastic. kusa a ole tasi le container. Just one container ae fa kausaga sa fai ai le container e kasi. kusa ga compress le container e kasi, mo mea o blocks foi gale e pile up e lava ai se weight e alu I fafo. O le problem la e leo ai se makeki I fafo e mafia ga kele se kupe e maua ai. O le fesoasoani la o le SPREP, o le SPREP ga fundiga le container e alu I ausikalia.Ae strict kele la aukunu'u la I le mamaina ole plastic. E leo magao lakou e avaku ae palapala ae avaku la e 100% pei a o le mea fou a. E strict la e ave ese le momogo, e alaku ua mama ua ave ese le label lae fafo, just plastic. O le problem la, ua kele mea e pefu, ole kele o blocks laga fai, ua pefua uma, e fiu e fa'amama ae alaku gau. E aluku le container ae oki I fafo ua, strict ua le magia a. A;o le kuai ga aka ou ke iloaga pe'o se mea ae loga akoa le 30% o le plastic lae gei. O le plastic lae kogu I gei le recycle, ae kele e lei kaikai mai. Olo'o leai se polokalame e encourage ai kagaka e aumai lakou plastic o le problem ga. Lae kau mafia Silafau se aikia e vave ga maua ai le plastic I gei I le mea e ka'u le weight levi.Like something like that, kusa e pay, e maua le kupe le plastic, pei a le faiga le bottle beer, le glass one, pau ga se idea ouke muau ai kagaka I le plastic. O le kupe le mea la. Tau mafia ga puku ma aumai I nei e fufulu. O le mea la ga, pe kau mumusu ma augaka kagaka e aumai le plastic loga e leai se mea e maua ai. Magasi kagale le velo, kagu, susugu a, pau a le auala kagaka ae e leai se taimi e kele fo'I le gau. Ae su'e aku le document lea o le container. E loa le kuaiga aka fa'akaikai e le pusa la se avefa fafo). Yeah that's that the thing, it's more about educating people. Teaching people how to recycle, instead of throwing on the ground, burying it, burning it, it's just teaching them and creating that awareness that plastics not good. It's not a good material it doesn't move on, it doesn't break down. I know that one thing you guys did here in Samoa was cut down on the plastic bags. You guys did the 70% plastic 30% starch, sort of break

down but it's still got that plastic in it. Yeah that's the sort of idea that I'm looking at. (What's this one? Does it open or?) Le'ai it's just a block I made for these. What these do they just sit on top? You know how the old fa'asamoa they teach using pictures they teach verbally before the written word came. So the idea behind that is the story is told with-in the tattoo pattern. Mea la ga lae SA 3D print. It's made of plastic and it's a scan of my family's hand. Scan le Lima, ma print I le printer lae le univesite o Vitoria. These are other example of 3D printed parts as well, if you guys want to have a look. Any information you guys have on how much plastic you guys a collecting per annum or per year will be a great help. And also what is the market for plastic around the world. Is there an actual market value? E iai se value o plastic I isi akunu'u. (e iai le value o plastic I isi akunu'u, a'o Samoa e le'o lelei se value kusa sa calculate le packing a le container ave e gau le kumpani lae sa avefa fafo. O le laki le SPREP o le SPREP e kele ga fesoasoani le fundiga le pusa. Kusa o le uiga ga ave le matou container e kasi e fa'akaikai. la o le fesoasoa le SPREP kusa o le tupe uma ga alu sa fai uma le SPREP. Kusa e benefit makou se mea e maua mai, ae alaku I fafo e strict kele kama I fafo le plastic. E le lelei se makeki, kailo la ia Niu Sila ma Ausikalia ma I isi akunu'u a'o Samoa ua Makua strict a. ae manakua e faoga kagaka samoa e utu ai lakou faguvai ma mea ga, ae le kaikai a ga kavaplastic lae sa dump.) It's one of those things that just hurts Samoa, because there not much value in the plastic, that why I decided to do this research. Why not keep it in the country and make something out of it. In Samoa you can make something out of it make money from it and jobs, that's also why I wanted to talk to Silafau, (kukusa la ole plastic talu ai e leai se price ia makou kusa o le daily a ia, kusa e mafaia ga aumai dump I gei, makele fuala, so theres no actual weight ole plastic per day. Plastic a o le aumai dump I gei. Kua fua le plastic pei e magao mia e ave se mea p eave fafo. Pau a lea se aka o le plastic, actual weight a ia o le plastic o le va o le tausaga sa aveai le plastic I le container lae maua. Lea lae alaku I fa'amaumauga lae I, o vaevaega o kuaiga plastic ese ese. PET plastic bottle bail, omi kusa la o makou distription le weight o plastic lae maua I ia a'u e iai le mixed plastic with metal pau a lea o maumauga la ia ke a'u. Can I get a copy of that? la lae la'a ou fai aku 2007-2010). That's al; good that's still quite recent. DO you guys get much plastic from the Vailima and Taula companies, because theres a lot of broken plastic, kei loa lakou crates lae iai. Theres a lot of broken ones a?

(We pick them up, kei loa le vailima crate, lae ua I gei. Ol mea la o makou ole dump uma I gei, ma kikilo mamao po'o a se auala e fai iai pe export I fafo pe iai se,....oh so the quality must have decresed.) Because its old, (sa ave fafo le mea ga, o le weight kogu a ga o le pusa, kusa e 20tonne le container ae tuaiga weight la ga o le plastic lae sa alu. Lei kaikai, o le max o le pusa le container lapoa lele, ia e 20 tonnes ia ae compare la le tuaiga mamafa ga. E strict I mea kau plastic I isi akunu'u e kau ga kuli le weight, e kau ga mama, e kau ga o le labels e avese kusa e kele a le mea kau labour e alu ai. Kusa e leai gi masigi e fa'amama ai mea eseese). How much did you guys get back for this? (Le container sa ave, mea kau information ga ga'o Silafau a lae iloa. Ole container sa ave e lei maua se makou mea I ai. Kusa sa alaku, gau akot le container ae laki le funding o SPREP e maua ai se makou kupe, benefit makouu ae alku ae gau uma makou. Kusa leai se makeki lelei. E o'o foi le pea o pa'u, pa'u

lae pile up I ole, ia sa makou vaai pe maua se makeki I kagaka lae faia le car, le pau lae fai ai le car male kele o lakou resources. Mea pigisigi, oil ae ua kaofi uma le mea le PUMA. O le pile iga o pau sa amaka le 2007. Kusa la o le pa'u la. E kukusa e sau alu e o mai kagaka ave a fai ai lakou koga la'auia lae free po sesi e fia faogaiga. la ole weight atoa le pusa ga 7600) ta;u la o le max weight atoa o le pusa o le 20tonnes a? you guys didn't even get close to it. Hahaha (kei loga la o lesi idea e lei iai se masigi e shred ai le plastic pau a ga le idea oute iloaga e reach ai le kuai ga max ga. Shred ifo loa e laikiki loa sefe ai le space. O le problem o le compressing lae sa fai lalo, o blocka e o'omi, kaimi la e pack ai. E o'poo atu lesi aso, e alu I fo ua koe fefeke, manakua le plastic e le mafai ga compress e pau a le size. Occupy foi ma le space). That's the idea that people in Mexico are doing. (O le problem la e leai se makou shredder. Taugaka masigi) that's the thing, le mea ka'u le resource, that's only a little section of 8 tonnes worth of plastic its surprising that this sort of area there is more then what you guys shipped away but I don't know if they sorted the plastic. I think they just shredded everything and bottled it. That's the good thing with this list here, I can see the different types (lae maua I gei a. Tusa a o le vaevaega ga laae sa aumai fafo o lesi foi ga faigaka ua le kukusa uma plastic. E I ai isi plastic sa o mai I isi aka vaevae foi ma isi kuaiga plastic e fui kokogu ia o'omi foi I blocks foi ia, e o'omi ae aua le mix iga tuaiga plastic. Kele ia o mea restrictions I mea kau plastics e export aku I lakou. Po'o le mea kaua le mea lae ke sau ma oe, kua fou a lou vaai I mea ia). So yeah theres technology out there, Uni we have a lt of these machines. The idea is it takes waste or rubbished plastic and makes it worth something. Feel free to show those photos to Silafau if you want let him know that I came, I still want to talk to him when he's free but I leave to go back to NZ on Saturday. We can talk over email if he wants.... How many machines do you have here (mea kau masigi,e lua masigi lae operate I gei, ole Bailer lae lalo lae compress mea ka'u ka'avale ma le masigi lae kipia), how did you guys clean the plastic for the container, (sa hire mea or labourer, e kiligi ma sasae ese le label, kele uma o galuega sa fai elima, kalai momogo, fa'apuku momogo, e eseese momogo male fagu. E vaevae uma mea o plastic lae iai plastic lae sau ai apainu, lesi kuaiga apa. E ai foi ma mea o steel e ave ese uma).

(*Off the record discussion*)

END OF INTERVIEW

Tour of Yard



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MEMORANDUM

TO	Lionel Taito-Matamua
COPY TO	Simon Fraser
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	8 September 2014
PAGES	1
SUBJECT	Ethics Approval: 19631 Patterns of age

Thank you for your request to amend your ethics approval. This has now been considered and the request granted.

Your application has approval until 19 November 2014. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with your research.

Allison Kirkman
Human Ethics Committee

A handwritten signature in blue ink, appearing to read "Allison Kirkman".