TRANSFORMING ‘UMU’ - A TRADITIONAL SAMOAN OVEN

“SUIGA O LE ‘UMU’ SAMOA”

Development of a Design Enterprise Framework integrating and sustaining new technology to benefit traditional Samoan communities

“O le tuufaatasia o ni alafua mo le fofoaina ma le mata’ituina o le taua o atina’e faaneionapo mo nu’u ma alalafaga o Samoa.”

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E muamua ona ou faatulou I ou Paia sausauo'o Samoa. O oe o le ao mamala, o le i'a iviivia o le fue lavelave. E afua mai Saua seia pa'ia le tai samasama. Tulouna lava.

Ou te fiafia e faailoa atu lenei taumafaiga, o le faaiuga o vaega e tolu o le polokalame ua faaperetaniaina o le Masters of Design Enterprise. O lenei polokalame o lo o faatinoina I le aoga matātā eseese o le Otago Polytechnic I Tanetini I Niusila.

O le muagagana faasamoa, " Toe sasa'a le fafao, toe timata le upega "

O le faamoemoe autu lea o lenei polokalame. Ia a'oa'o ina auala e toe siitia ai tulaga ma faalelei atili ai soo se taumafaiga po o ni atina'e faanei onapo, e faasino i tu ma aga , o galuega faatino I totonu o aiga ma afioaga I aso uma.Ina ia mafai ona fofoaina ni atina'e e faalelei pe faafaigofie ai le faatinoga o galuega o aso uma, aemaise o mea faigaluega e faatino ai. Ma o le matagofie o lea faamoemoe, o le faalagolago lea I finagalo o tagata o manaomia tonu nei taumafaiga.

O le tausaga 2013, na ou galue ai i se poloketi mo le faamae'aina o la'ufaailogafaainisinia I le aoga lava lenei o Otago Polytechnic. Na ou fausia ai se ***ogaumu e faaaogaai le fafie***, e pei foi o le tele o ogaumu ua mae'a ona fusia ma faaaogaina I le tatou atunuu. O le faamoemoe o lenei ogaumu ina ia mafai ona sui ai le 'umu' Samoa. Sa fauina lava I lo'u malamalama faainisinia e fua I aafiaga o le faatinoina o le "umu" I tuafale o maota ma laoa. O le mumu mae'ae'a o fafie ina ia faaitiitia le asu. O le velasia i le a'asa o le "umu". Aemaise le tele o fafie e ma'umau. O mea ia sa mataítuina ma faavaeai le fausiaina o lea ogaumu. Ua mae'a la ona fausia le ogaumu muamua I totonu o le aai o Tanetini I Niu Sila, ma faaaogaina e le aulotu E.F.K.S. E tolu foi nisi ogaumu ua mafai ona fausiaina I Samoa, ma o lo o faaaogaina nei e ia aulotu. O le naunautaiga ina ia faalelei atili lenei taumafaiga mo le siitia o le soifua o tagata. O le fesiligia o finagalo o tagata i le taufaaofiina o lenei faamoemoe I maota ma laoa aemaise le tau sailia o manatu i le faatinoina pea o le "umu" Samoa e gasese ai mea taumafa, sa tau faamaopoopoina ia maua ai ni manatu e faaleleia ai le ogaumu.

O a ni mafuaaga e faaogatele ai e tagata Samoa fafie e gasese ai meataumafa?

O Samoa e utiuti lona tamaoaiga tau I seleni maua mai I oloa faatau atu I fafo, ona o le utiuti o meatotino po o mea faigaluega aemaise le malamalama faaonaponei e gaosia ai ia oloa. O le utiuti o ia avanoa ua avea ma auala ua pa'u maualalo ai le tamaoaiga tau tupe I totonu o le atunuu. O le tele foi o lea tamaoaiga ua mafai ona maua mai e ala I tagata tafafao mai fafo ma tupe faamomoli mai aiga I fafo, ua taufaasoa lea I atinae eseese mo le manuia o le atunuu, aemaise le faatauina mai o suau'u mai fafo e gaosia ai le eletise, e faaola ai moli, faapea le faaaoga I taavale afi ma va'a la'upasese mo le femalaga'i o tagata o le atunuu.

O silafia e le mamalu o le atunuu a'afiaga o lea faatinoga?

E itiiti lava se vaega tupe ua mafai ona faasafua mo tagata Samoa ua faamanuia ina I ni avanoa faigaluega. E utiuti foi avanoa faigaluega ma e maualalo foi le totogi o tagata faigaluega, ma ua molimauina e le toatele le taugata o le soifuaga aua o lo o si'itia pea I tausaga uma le tau o oloa mai fafo. Atonu o le mafuaaga lea e tumauai Samoa I ana tu ma aga mai anamua. I le faato'a o ona lau fanua e faaaogaina mo soo se ituaiga faatoaga, ma le fagotaina o lona gataifale e maua ai meaai e tausi ai le soifua o tagata. O se itu lelei tele lea I so'u lagona aua o Samoa e tuma'ai ma faapelepele I lana aganuu ma aga I fanua. O nisi o vaega e tatau ona faataua, o le silasila toto'a I aafiaga o le soifua

maloloina o tagata ma le faasaoina o le siosiomaga e ala I le faaaoga tatau o vaomatua mo faifie po o mea tafuafi I le gaseseina o ana mea taumafa I aso uma.

E faigata tele ona talia e Samoa ni suiga fou. O le lu'itau lea o lenei faamoemoe. Ae o le aou taumafai pea mo le taliaina o lenei suiga, mo le manuia lautele o o'u tagata.

Translation

First and foremost, I wish to express my humble respects to the people of Samoa.

I am happy to present to you this report as part of a three-phase course known as the Master of Design Enterprise, MDE programme. This has been held at Otago Polytechnic in Dunedin, New Zealand.

A Samoa saying goes, ***"Empty the baskets and refill, rework the fishing net"*** which means, to re-evaluate and re-visit a situation or a series of events for insights to improve.

The purpose of this program is foster innovation by researching the impacts and costs of current practices. I saw this as an opportunity to improve products, equipment, processes and systems used by families and communities in their daily lives and so provide a better-quality lifestyle.

In 2013, I had completed my Engineering Degree, also at Otago Polytechnic. Developing an oven which uses biomass wood fuel to replace the traditional 'umu' was my graduate project. This design was informed by my own experiences as a user, targeting the most critical part of the process. Four prototypes have been built, one in Dunedin and three in Samoa.

Do the people know the impacts of using the traditional method?

So, my intention was to learn about the experiences of the Samoan people in using the traditional cooking method 'umu', compared to the use of my biomass wood fuel oven. I needed to know how much Samoans know about the health and environmental impacts of the traditional umu cooking, if they were receptive to my new technology and could recognise the benefits.

Why do they rely on Biomass wood fuel for cooking and heating?

The economy of Samoa is depressed, the cost of living is high and opportunities for employment are very slim. Many Samoans still use traditional ways for survival including the way they cook, using biomass wood fuel energy. Traditions and customs are important parts of being Samoan, so, introducing new technologies or changes to normal ways can be challenging.

This is a challenge I am committed to take on and as my improved sustainable oven will benefit the lives of all Samoans.

Acknowledgements

Undertaking this work has only been possible with support from people in four very different communities, I wish to acknowledge the support and encouragement from the following people:

First of all, I wish to acknowledge the staff of Otago Polytechnic School of Design, for the opportunity to embark on this memorable design thinking for innovation journey. The support from the following staff throughout the course duration was tremendous.

Nick Laird, Strategic designer, Lecturer, Master of Design Enterprise Programme School of Design, Otago Polytechnic

Andrew Wallace, Industrial designer, Lecturer School of Design, Product design, School of Design, Otago Polytechnic

Caroline Terpstra, Head, School of Design, Otago Polytechnic

Dr Stella Lange, Senior Lecture, Post Graduate Coordinator, School of Design, Otago Polytechnic

Secondly, I wish to acknowledge the support from the community groups and villages who participated in the research program.

1. The Ti'avea Village Community especially the group of Alii ma Faipule of Ti'avea.
2. The VaialaCongregational Church Community, especially Reverend Elder Lotu Uele and his good wife Ane Uele.

Thirdly, the support from the Government representatives has been amazing as they provided useful insights on the development of a solid enterprise project. The following Government Officials were involved:

Mr Vaito'aToelupe (Director, Civil Society Support Program, CSSP)

Mr Agafili Shem (CEO, Ministry of the Prime Minister)

Mrs LitaLui (ACEO, Aid Coordinating Department, SMoF)

Miss LitaraTaulealo (ACEO, Climate Resiliance Investment and Cordination Unit, SMoF)

Mr Roger Toleafoa (ACEO, Fair Trading, Codex Development, Legal, Metrology & Competition Policy& Law, Ministry of Labour)

I also wish to acknowledge the UNDP SGP GEF fund program which supported the pilot program in delivering the biomass wood fuel oven to the village of Ti'avea. Special thanks to the program coordinators, Ofusina Ieremia and Kilali Alailima for assistance throughout the whole project journey.

Last but not the least, I wish to acknowledge the support from my family, my wife Esmay and my three beautiful children, Jasmine (14), Javana (11) and John Tisaeloloa Junior (8). To have a family to come home to was the best support I could ever ask for. My parents FuimaonoTuiaviiPoloma and Elisapeta Eteuati, still residing in Samoa have greatly supported the proceedings of the project as well as the associated research programs.My father in law, LemaluTiseKolose and mother in law Sina Lemalu for their continuous support throughout my academic journey.

Declaration

I *John Fitu ETEUATI*, hereby declare that the information obtained and used in this document had been generated from my combined research efforts, both primary and secondary sources which are identified and referenced clearly throughout this document.

The information in this document shall be restricted to the purposes of the Master of Design Enterprise program offered by the Otago Polytechnic in Dunedin New Zealand.

……..

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EXECUTIVE SUMMARY

The following paragraphs outline the final outcome of this Master of Design Enterprise (MDE) project. The development of a framework or template that will provide communities in Samoa with a mechanism to access and secure funding to deliver tangible projects that will directly improve the quality of life for all Samoans. A non-government organisation – Renewable Energy Organisation (RENO) has been formed as a result of the research, development and implementation of an affianced, safe and healthy biomass wood fuel oven, the Jezet burner. RENO will provide a linkage between local communities and available funding bodies. Unlike existing processes, the RENO template involves the community directly in each potential project, from initial project selection to securing funding, to implementation.

This MDE document describes the three components developed; the improved, redesigned biomass wood fuel oven that is safer and more efficient – the Jezet burner; the pilot project with the United nations Development Programme (UNDP) funding agent and establishment of RENO with its working template for future projects development through community engagements.

This project has emanated from my experiences living in Samoa for 35 years, I became generally concerned with sustainability of energy consumption and associated wider infrastructure. A particular set of problems and opportunities exist with biomass wood fuel energy.

By showing initiative and focusing on these problems, the need to design a device that would transform the traditional arrangement of burning wood fuel was identified. A prototype was developed which makes better use of the combustion process to burn wood fuel more efficiently, and reduces smoke in the cooking environment. Increased efficiency reduces cooking time, compared with traditional practices.

The structure of the Master of Design Enterprise Programme, with its human centred design focus and user interface methods, has provided structure with goals set for each phase. A combination of Kumar's Design Thinking Framework for Innovation and IDEO method cards were applied throughout the MDE program and thus shape the development of the design enterprise project.

The introduction phase of the project was discussed and documented in the MDE401 report. A brief summary of the MDE401 report has been included to provide background information for the MDE501 report.

A broad contextual research was carried out, focusing on the introduction of the biomass wood fuel oven to the residential homes in communities of Samoa. The absence of efficient energy conversion technologies to use in traditional methods 'umu' for cooking, has had a great impact on the health of the people. Inhaling smoke from incomplete burning of wood fuel is dangerous. Additionally, the traditional method uses excessive quantities of wood, threatening the surrounding environment where the fuel is sourced from.

Shortly after the launching of the three (3) biomass wood fuel oven prototypes in Samoa, early 2014, an invitation was received from the local office of the UNDP, requesting a submission of a project concept. This escalated the second phase of the MDE program, the industry placement activity. Standard templates were designed, and examples have been enclosed in the Appendices section. Figure 10 (page 33), shows the process which I experienced during the pilot project. The issues and

challenges that were encountered as well as insights for improvements, in support of the design enterprise project were recorded.

The Government of Samoa through the Ministry of Finance is the main governing body responsible for coordinating the overseas fund programmes as shown in figure 12 (page 36). The bulk of available funds are allocated to various public sectors. Funding is dependent on complementing the objectives of Strategy for Development of Samoa (SDS) plan specific to each sector, and cover public infrastructure development nationwide. The rest of the funds were allocated to various government facilities, established to focus on community based development goals initiated by the village communities and/or private organisations. Examples of these facilities are, the Civil Society Support Program (CSSP), Local Office UNDP, Small Business Enterprise Co-operation (SPEC),NZAID, AUSAID, JICA, Samoa Umbrella for Non-Government Organisation (SUNGO) and Non-Government Organisations (NGOs) and others.

The alignment of the design enterprise framework objectives and goals with the strategies for the development of Samoa was essential for a successful community project delivery plan. Water and energy projects are the focus areas under the infrastructure development priority area, especially within the rural communities. This is supported by the establishment of the Civil Society Support Program (CSSP), co-funded by European Union (EU) and Australian Aid (AusAid), which provides opportunities for communities and/or registered NGOs, to express project proposals for funding and manage project delivery plans. (Samoa Ministry of Finance, 2012)

A business model canvas has been adopted to design an effective business model for the establishment of a RENO and other associated partners. This is part of the enterprise framework strategy in order to make it a self-sufficient organisation.

Exploring the various issues experienced by the Samoan communities (applicants) and their relationships with the funders was among the main focus of this section. Gaining knowledge from this design thinking program and learning appropriate design methods will enable RENO to liaise with the communities and initiate relevant projects that will have a positive impact on their wellbeing. Partnership with technical engineering companies such as Energy Smart Limited, to provide feasible technical solutions in designing renewable energy projects is a key component of this business model, thus, having the capacity to deliver the projects by outsourcing them to private contractors.

In conclusion, the outcome of the MDE401 and MDE404 has been integrated into a developed design enterprise project. The project uses a simple and straight forward template, to enhance community outreach support programmes and initiate future infrastructure development projects. This work will be led by RENO, who will have close relations with village communities, focussing on issues or activities that matter the most to the people. This work applies design thinking methods together with human centred and user interface approach, to initiate, create and develop the most relevant projects that will improve the quality of life for all Samoans.

INTRODUCTION

1 Personal Motivation

This project has emanated from my experiences living in Samoa for 35 years. In that time, I became generally concerned with the lack of sustainability with traditional methods of cooking, particularly the energy consumption and associated wider infrastructure throughout the country. A set of problems and opportunities in particular, exist with biomass wood fuel energy.

Biomass wood fuel energy has always been the predominantly used energy source in Samoan households, dating back to the earliest settlers many centuries ago. Studies have shown consistent and predominant use of biomass wood fuel energy for cooking, especially within the rural areas (Schirnding et al,2000). It is fair to say that it will continue to be this way in the foreseeable future. Traditional method of cooking, 'umu', have been embraced by the majority of the Samoan people as a cultural tradition with significance value to their identity. But the real question is, is this really a case of cultural imperatives or simply arrogance and/or ignorance of the facts or beneficial alternatives?

Because of the absence of efficient energy conversion technologies and lack of understanding about energy efficiencies for the majority of the nation, the implications of using the traditional method have continued to negatively impact the health, environment, economic and social wellbeing of many communities. Users are exposed to harmful gases created by the incomplete burning of wood fuel as the current traditional cooking practices produces excessive smoke. Compared with other more modern cooking methods, the traditional process is inefficient, leading to excessive amounts of firewood being consumed. Continued use of these cooking methods, with their inherent inefficiencies has prevented village communities from developing and growing sustainably.

By showing initiative and focusing on these problems, the need to design a device that would transform the traditional arrangement of burning wood fuel was evident. A prototype was developed, with a more efficient combustion system that reduced smoke delivered to the cooking environment. Secondly, improved harnessed energy released in burning fuel, reduced the cooking time. Overall the innovative device was doubly productive, with more efficient use of fuel and time.

The initial design requirements of the prototype technology 'Jezet Burner' development was primarily based on my own experiences growing up in Samoa and the application of my engineering qualifications and significant work experience. Like all devices and products, the Jezet burner needed refining prior to its introduction to the village communities. This was done by engaging communities in the design thinking process.

The introduction phase of the project was discussed and documented in the MDE401 report. A brief coverage of the MDE401 report has been provided as context for in the formation of the MDE501 report.

The need for secure financial support to ensure successful delivery of the Jezet burner to the communities was essential. The communities are economically poor and unable to extend to purchase of prototypes. This phase of the project has been discussed and documented in the MDE404 report and a summary of this report has also been provided as context for the development of the MDE501 report.

The timeframe and goals for this project have been structured around the Master of Design Enterprise Programme, with its human centred design focus and user interface methods.

2 About the Masters of Design Enterprise Programme

The following paragraphs within this section, has been interpreted from the Master of Design Enterprise program document which outlines the structure and purpose of the program.

This unique 18 month program has been developed, and continues to be adapted, as a response to the increasingly complex, strategic roles which designers and design thinkers are required to play out against a background of complex environmental, economic, and social imperatives.

The program culminates in the submission for examination of a design led innovation project documented through a comprehensive report. This final phase is the only component subject to external examination. The overall program involves more and is best thought of as three distinct yet integrated phases.
Refer to figure 1 below:

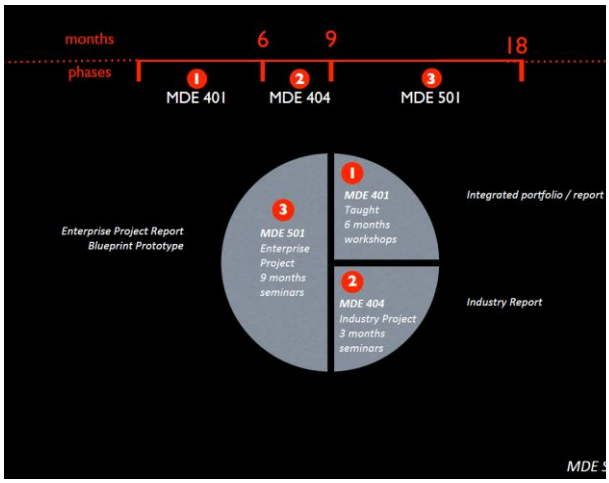

Figure 1: Structure of MDE Program

2.1 Phase 1: MDE 40I Design

The introductory phase explored Design Thinking frameworks for innovation. A special focus initially concerned how Human Centered Design methods identify needs and opportunities from broad contextual research and rapid ethnography. This taught component is delivered through a series of 6 x 3day workshop blocks, over six months. Each block comprised seminars led by selected academics, industry practitioners and business consultants, assignment workshops discussions around case studies, literature reviews and student presentations. Weekly discussions- real or virtual - with program leaders ensured development of understanding, ideas, and potential design enterprise collaborations.

The expected outcome of Phase I was an integrated report which demonstrates knowledge of and experimental application of Design Thinking frameworks for innovation, processes, and methods. From this, the report mapped the generation of a conceptual landscape from which a potential needs-based enterprise can be identified. In parallel with this context, networks involving potential industry or other organizational partners were explored as well as the motivations of users.

2.2 Phase 2: MDE 404 Industry Placement

Phase 2 allows for contextual research and application of knowledge frameworks. This includes a placement of up to 12 weeks of negotiation with relevant industries or organizations. The goal is to contribute productively while researching specific objectives within the placement. In this case the research focused on developing understanding of production and economic contexts.

The outcome of Phase 2 was a report detailing aspects of the engagement with industry and the significant learning outcomes of that interaction. The outcome of this placement was that through collaboration, a potential new, design-based opportunity was identified that formed the basis of a major project to be undertaken in the Phase 3 of the project.

The MDE 404 report discussed the Industry collaboration with the Pineapple Construction Ltd and the local funding facility for UNDP. The two placement projects focusing on the manufacturing and fabrication processes including modification of the Jezet burner plus securing of funds through the local funding facility, was a learning experience in planning, implementing and synthesizing and communicating this field research.

2.3 Phase 3: Design Enterprise Project. MDE 501

Phase3 comprised a major design led project, planned, and incubated through iterative stages of research, design, and development. The project as directed by a need for an improved cooking system for Samoan communities has been informed by Phase 1 and 2 developments.

The outcome of this final project calls for a blueprint and or developed prototype for a design led innovation. This can be a small design intervention but its development must show an understanding of wider systems and the way it is scalable. The choice at the outset of this phase of the MDE candidate is to decide whether to act in close collaboration with an established company or in a more individual entrepreneurial spirit

Note: Phase 3is the only component of the MDE program and project subject to external examination.

3 The Design Enterprise Project

The design enterprise project calls for the development of a strategic process for community engagement and infrastructure development in the renewable energy category. A combination of

researched information obtained throughout the scope of the first two phases of the MDE Program, has been integrated to define the structure of the enterprise project.

Lack of knowledge and capacity to develop and innovate within the rural communities of Samoa was identified as the driver for a service of this nature to assist with infrastructure development within the vulnerable and less fortunate families and communities of Samoa. Ethnographic observations and interviews focusing on addressing and development of renewable energy infrastructure projects provided valuable insights. Daily activities and commitments of the people, as well as developmental goals set by the community were central to the research.

Initially, the project was to develop a more efficient Jezet burner. But it has also provided an opportunity to extend the project focus to a wider range of issues, those that Samoan communities, families and/or individuals, encounter in their daily lives.

The framework ensures community needs are satisfied, support funds have been transparently and successfully utilised and the wider development objectives of the Samoa Government has been complemented. This is achieved by allowing the communities to be part of the development of alternative solutions. Communities were encouraged to identify other forms of renewable energy sources available within their surroundings that could prove suitable for local needs.

The framework included working closely with village councils through the council of village mayors. Potential infrastructure projects would be presented following case studies with village communities. This provides initial stepping-stones for wider community engagement. The involvement of communities in the design thinking process mitigated any concerns arising from cultural beliefs and customary traditions.

The framework for a community outreach program was structured to correspond with the local government infrastructure strategic development plans (SDS). Strategic Development Plans have been steered to complement objectives of foreign aid support programs. These target the impacts of climate change within the Pacific region and around the world. The Government is the entry pathway for all overseas funding to Samoa, with various Government Ministries and Government Aid Facilities assigned to administer, coordinate, and facilitate responsibilities. This approach is a viable financial support system for potential community based projects.

The development of the design enterprise project is set up as shown in figure 2.

Figure 2: Design Enterprise Project: Layout Structure for MDE 501

Typical Samoan household in the rural areas

LITERATURE REVIEW- CONTEXT

Introduction

The introduction of the improved and efficient biomass wood fuel oven to the communities of Samoa was a trial activity used for the development of the design enterprise framework. This included a desktop research approach to determine the context around the predominant reliance of the Samoan people on biomass wood fuel energy for cooking purposes.

This innovation targets the predominant use of biomass wood fuel energy inefficiently within residential homes throughout Samoa. The absence of efficient energy conversion technologies in traditional methods 'umu' for cooking has had a greater impact on the lives of the people from inhaling excessive harmful gases from the incomplete burning of wood fuel. Also, the use of the traditional cooking method requires excessive use of wood fuel, threatening the surrounding environment where the fuel is sourced from.

Multiple studies have been published by the World Health Organisation (WHO) working groups where one report specifically focused on addressing the health implications of biomass wood fuel burning as a means of energy for cooking within households (Schirnding et al, 2000). Reports such as this, indicates that various health issues are directly related to the inefficient use of biomass wood fuel energy within households of mainly poor communities. In addition, one study undertaken in Fiji by Tukana and Lloyd(1993) titled 'Cook Stoves in Fiji' confirmed the need for efficient energy conversion technologies relative to biomass wood fuel energy in the rural communities and low income families Fiji and Samoa have similar geographical and economic conditions in their poorer communities.

This literature review is limited to the use of biomass wood fuel oven in Samoa. It covers the driving factors that lead people to rely on biomass wood fuel energy for cooking, particularly in the rural regions of Samoa. It also details the rising cost of electricity which restricts most families from using other alternative cooking devices such as electric ovens and stoves.

What are the driving factors around the predominant use of biomass wood fuel in Samoa?

Samoa is one of the countries which rely predominantly on biomass wood fuel energy for heating and cooking in domestic situations. Electricity is readily available, with approximately 96% coverage throughout the country as well as other imported fuels such as kerosene and liquid petroleum gas (LPG) which can be used for cooking. Recent reviews from the Samoa Ministry of Finance on energy available in Samoa indicate that the majority of the Samoan communities are still heavily reliant on biomass wood fuel energy for cooking purposes. (Ministry of Finance, 2013). Without a specific intervention, this trend will arguably continue unchanged for the foreseeable future. In support of this argument and in relation to the ***sense intent*** statement towards the project objectives, the following questions were generated to provide a clear contextual background for the Biomass Oven design enterprise project:

What are other Energy Sources available in Samoa?

Reports published by the Samoa Ministry of Finance have reviewed the energy sources available in Samoa in terms of production and consumption by different sectors. Figure 3 shows energy use by

type. Imported fuel such as petrol, diesel, kerosene, and gas make up 69% of fuel used in Samoa. Biomass wood fuel energy makes up 28%, nearly one third, and hydro energy just 3%. (Samoa Ministry of Finance, 2014)

Figure 3: Energy Outlook for Samoa 2011

Although the reports indicate the availability of more imported fuel than biomass wood fuel in the Samoa, biomass wood fuel energy tends to be the most widely used energy for cooking in the country. Therefore, it has direct implications to human health as well as the environment due to the inefficient and harmful results of existing conventional methods.

Further information from the same report as shown in figure 4, outlines the usage of these energy sources by sector. Of the imported fuels (69% of all fuel used), 80% is consumed by the transport sector and almost 20% has been used to generate electricity from electricity generation plants. Almost none of the imported fuels are used in domestic cooking. There are efficient and safe supplementary power supplies from the 3% representing the renewable energy contribution from biogas, hydro and solar energy sources but these are not used for domestic cooking. However, nearly one third(28%) of the energy comes from biomass wood and waste energy. This is used in domestic cooking situations so has a greater impact on the lives of Samoans. Figure 4 shows 99% of biomass wood fuel is used in residential homes and only 1% is used for industrial and commercial purposed. (Samoa Ministry of Finance, 2014)

The reasons why people continue to use biomass wood fuel energy as their primary source of energy for cooking needed to be explored. Additional questions below were generated to further examine and explore the energy sector, specifically electricity generation and the economics of electricity for domestic use by most Samoan communities.

Figure 4: Energy Consumption by Sector

Text inserted on image

99.9% Hydro and 0.1% Solar

What is the cost of these energy sources and is affordability a main influential factor?

As stated previously, 20% of imported fuels are used to generate electricity from diesel power generation plants, this percentage increased slightly with the commissioning of another diesel power plant within the island of Upolu in 2012. The electricity produced is distributed via overhead electrical lines all throughout the Upolu islands. The electricity tariff is determined by accounting for all costs associated with both the generation and the delivery of electricity to the customers. The high running and infrastructure costs had led to a high rate of user charges for residential customers. It is evident that these costs are directly proportional to the high cost of imported diesel to generate electricity. Worryingly most of the electricity produced is lost through power leakages over lengthy low performance electricity lines. This is unfortunately the reality behind the disproportionately high electricity costs in Samoa and customers are forced to cover the costs of these inefficiencies.

The average cost per kilo Watt hour (kWh) for usage between 1 – 50 kWh is 0.85 sene / kWh. (i.e. equivalence of 0.5cents / kWh in NZD). Table 1 shows the 2013 Electric Power Corporation electricity tariff rates. For usage of more than 50 kWh, the rate is at an average of 1 sene / kWh (i.e. 0.58c/kWh in NZD). When compared with the cost of electricity in New Zealand this seems rather cheap but the true cost can only be determined by considering the ability of residents to pay. Examining the economic situation of Samoa, especially the income earning capabilities within the

rural communities of Samoa provides a clearer picture of how affordable electricity is for general household cooking

Table 1: Samoa Electricity Tariff

1. Cash Power Customers

2014	Base Tariff (sene)		Monthly Fuel Surcharge	Final Cost per unit (sene)		Wholesale diesel prize
	1 - 50 kwh	50 kwh upwards		1 - 50 kwh	50 kwh upwards	
Jan	0.67	0.79	27.21%	0.84	0.98	302.26
Feb	0.67	0.79	28.60%	0.84	1	319.36
Mar	0.67	0.79	32.68%	0.87	1.03	305.33
Apr	0.67	0.79	32.68%	0.87	1.03	305.93

What is the status of the economy of Samoa and is this an influential factor?

The coverage of electricity extends to approximately 96% of the whole country. Government statistics showed that few people use electricity as a source of energy for cooking. Even the residents of the urban areas of Upolu Island use biomass wood fuel energy as a primary source of energy for cooking. This is not because firewood was easily and abundantly available but is due to the high cost of electricity. Many Samoan people simply cannot afford electricity on their daily, weekly, or fortnightly income.

The economic status of the country plays a significant role in ongoing trend of low electricity use in domestic situations. The Ministry of Finance economic quarterly report for 2013 -2014 (the latest available), the Gross Domestic Product (GDP) per capita continues to increase every year, for this period it increased from 1835.16 – 1862.87tala (equivalent of about $1,000 NZD). The number of people in employment continues to decline every year, a decrease by 1.6%. (Samoa Ministry of Finance, 2014) But be mindful of the fact that the number of people employed is less than 24,000 which is only 12% of the overall population of the country. Many families would have no active income earners or employed members. Most of these families would rely on farming and selling agricultural crops for their main source of income.

Subsistence living is common throughout the Samoa especially in rural communities. There are opportunities with the foreign trade industry to generate income for these families from farming and plantations. In Samoa, a plantation is referred to as a small family based farm that usually provides a subsistence level of living for the extended family and/or the community.

However, there are also issues with the low financial returns for plantation owners. Therefore agricultural trade with international markets is not supported by the poorer farmers and landowners. To put this in perspective, the foreign market price for 10 taros, about 15kg, is $15.00 tala (WST). i.e. $1.00/ kg (WST). The local market price for the same amount of taro is about $1.30/kg. A single pack of taro totalling 120kg will gain the planter $156.00 tala.

Whereas, the cost of taro sold at the South Dunedin Pak'n'Save supermarket is about $8.00 / kg (NZD). For 15kg, this will cost around $120.00 NZD (i.e. $200.00 WST). If $15.00 WST accounts for the Samoan supplier, $185.00 WST accounts for the shipment and distributor profit. Therefore, the people would prefer to take their crops to the local market for a reasonable profit.

This deeper look at the economics of many Samoan families, show many people simply cannot afford to spend much of their limited earnings on electricity for cooking. Instead they choose to use electricity for lighting at nights and refrigeration to preserve food. For most Samoans, the next best domestic fuel option is the abundantly available biomass wood fuel energy. Without significant changes to lower the cost of electricity and increments towards the incomes of local Samoans, firewood will continue to be the predominant source of cooking energy in Samoa, now and in the foreseeable future. Fortunately, the Samoa Ministry of Natural Resources and Environment (MNRE) has recently promoted replanting projects providing funds for communities to replant new trees to prevent land degradation from trees being cut for wood fuel.

How can we address these problems?

As stated in the previous sections, the project objective is to exploit the introduction of the Jezet burner to the communities of Samoa to help shape the development of the design enterprise framework. This goal is supported by the information mentioned earlier, such as the problems with the high cost of electricity and the low potential capacity for the people to afford electricity costs due to the depressed local economy. Samoa will always rely on biomass wood fuel energy for cooking in many years to come.

However, the extensive impacts of using traditional practices are quite significant. The worst part is many Samoans have very little or no knowledge of the impact of using traditional cooking methods. So, how can we address these problems?

Firstly, the problems need to be communicated logically and comprehensively to the people and communities. Successful awareness and capacity building programs had been applied to Tuvalu, Tonga and Kiribati which had the same problems (Pacific Island Forum Secretariate, 2012). A program supported by the Pacific Island Forum Secretariat (PIFS) extended across the pacific to ensure the people understand these issues and how to adapt and shift from traditional methods to new technologies. This process was made more successful by engaging local communities in the development processes. However, the implementation and sustainability of the development programs were of limited success. Unfortunately, technologies introduced were not technically reliable. The units were built with low graded materials without proper design and construction specifications so were difficult to use and unreliable.

To ensure a successful uptake of the new Biomass Wood Fuel Oven, the communities (users) will need to start considering the use of efficient energy conversion technologies to overcome the impacts of incomplete burning of wood plus other associated implications from usingconventional methods. Any new replacement method will need to maximise an alternative, affordable and reliable source of energy in an efficient and sustainable manner.

What are the implications of using traditional practices with wood fuel energy for cooking?

It is widely understood that constant exposure to harmful gases results in multiple critical medical conditions. A study conducted by the World Health Organisation (WHO) discusses the issues relative to the Impact of Household Energy and Indoor Air Pollution on the Health of the Poor (Schirnding et al, 2000). A review of evidence for health effects, documenting results from multiple studies done globally on the same issue has been extensively covered in that publication.

Although the authors of this publication have declared various shortcomings of the data collection methods and accuracy of the results in relation to biomass wood fuel contaminants within the

households selected, the information presented is alarming, and paints a clear picture of life-threatening proportions. The study enabled the identification of the common diseases diagnosed, sadly many in children directly exposed to indoor air pollution from biomass wood fuel burning. These diseases include:

- Acute lower respiratory infection ALRI
- Chronic bronchitis and chronic obstructive pulmonary disease COPD
- Lung cancer
- Cancer of nasopharynx and larynx
- Cataracts, which affect sight
- Tuberculosis
- Low birth weight
- Perinatal mortality
- Acute otitis which affects hearing
- Cardiovascular disease
- Asthma

When considered alongside other economic and social factors, the identification of these diseases resulting from inefficient burning of wood fuels in traditional domestic cooking systems is worrying. Poor communities are less able to combat the effects of these health problems, or to replace the inefficient wood cooking systems with healthier electrical or gas options. It seems essential that a safer method be developed and adopted by these communities.

Have there been any other available energy conversion technologies introduced in Samoa?

There has been evidence of stoves and ovens with a similar purpose as the Jezet burner, introduced in Samoa since the 1970s. None of these were ever documented as they were developed by enthusiastic locals who produced them for local domestic use. Unfortunately, there have been no studies undertaken in Samoa for biomass wood fuel cooking devices apart from studies undertaken within the neighbouring islands.

Tukana and Lloyd (1993), published Wood Cook Stoves in Fiji, over 20 years ago, targeting residential biomass wood fuel use in rural Fiji. They also adopted the use of foreign aid programs to enhance the deliverability of their stoves to the families.

Another development was by Mario (2001), of the South Pacific Applied Geoscience Commission (SOPAC), for the islands of Tuvalu, Tonga, Kiribati, and the Fiji Islands. This work focussed on capacity building and awareness of health and safety issues, and encouraged the adoption of an institutional biomass oven. The results of his field survey intrigued Mario, when he found out that the wood stoves had no impact in the reduction of biomass wood fuel consumption. Therefore, he shifted from developing a biomass wood fuel oven to educating the people of these islands about pros and cons of different types of biomass fuels.

Is there potential for a sustainable community outreach program to accommodate these issues?

Community outreach programs have been used globally to support community infrastructure development for under developed and developing nations, who are the most vulnerable to extreme climate events, most with assistance of foreign aid. (UNDP SAMOA, 2016) The establishment of global agreements over the years is evidence of this movement. Agreements such as the Parish Declaration, the Kyoto Protocol, and the Copenhagen Convention are now integrated as the United Nations Framework Conventions for Climate Change.

Pacific Island Countries including Samoa have always been one of the recipients of these kinds of programs. Samoa is considered one of the vulnerable communities affected by climate change. The Government of Samoa in alliance with other small island nations has set up local funding systems to facilitate these financial support programs.

United Nations have set up policies to ensure global powers such as the United States of America, European Union, Great Britain, and Asia would contribute their fair share of costs to help vulnerable small island nations in the Pacific as well as others around the world. (UNDP/SGP, 2015)

Figure 5 shows the overall scope for the UNDP 2013 programme expenditure distribution by region. The total amount distributed was $4.2 billion dollars. Asia and the Pacific regions received a large share of this spending, at just below $1.2 billion dollars, highlighting that the developing nations have benefited under this global strategic movement.

It is clear there are globally established strategies and processes to enable vulnerable communities to survive. However, given the large body of funding being distributed there, questions about why majority of people living in these recipient nations still struggling to make ends meet? Are the funds allocated for these nations reaching the most vulnerable people? Do these programs benefit those who desperately need this assistance to enable resilience development? If not, where does the problem lie? Is it the system, processes, or the personnel in charge? These are the founding questions which have motivated my design enterprise project direction. Further details on these foreign aid programs will be discussed later in this document as this was the integral attribute in the development of the design enterprise project.

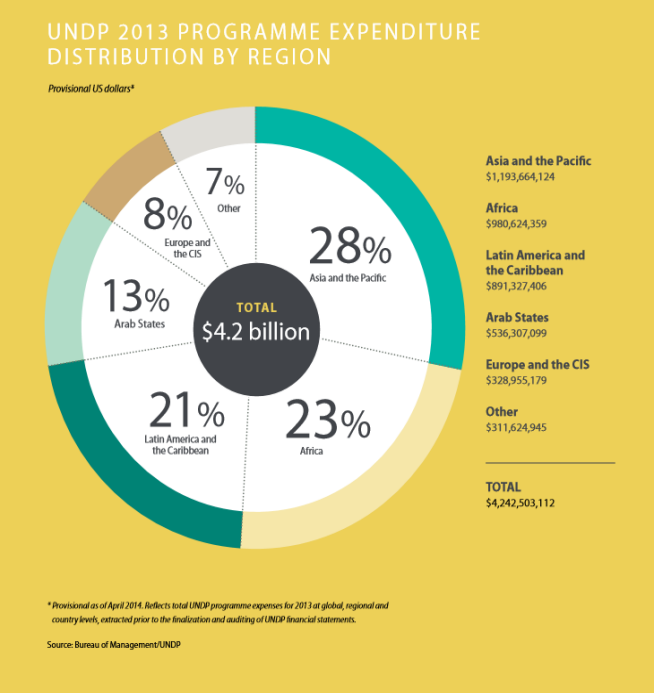

Figure 5: UNDP 2013 Programme Expenditure Distribution by Region (United Nations, 2013)

DEVELOPMENT OF A RESEARCH METHODOLOGY

Introduction

The initial objective was to optimise the introduction of the Jezet burner and communicate the benefits to the communities of Samoa. At the same time, an iterative design process was planned to improve the prototype design based on needs of the users. Maintaining customary traditions and activities were vital to the success of the project. However, as the project progressed, more opportunities were identified in relation to renewable energy and the need for infrastructure development. Therefore, the scope of this report will reflect these iterative developments whilst highlighting the insights which formed the enterprise project.

In terms of the research methodology, this meant a careful selection of frameworks and methods which would achieve these ends. All developments required careful consideration of the ethical implications of the work, as this project prioritises peoples' needs.

Towards a Definition of Innovation

Innovation, in this context is defined as successful introduction of a new idea to an existing context. **Innovation** refers to changing processes or creating more effective processes, products, and ideas. From a **business perspective**, this could mean implementing new ideas, creating dynamic products, or improving your existing services to gain more profit and increase growth of a business. (Australian Government, 2016)

A consideration of types of innovation frameworks

Types of Innovation Frameworks

The process of innovation requires a combination of several methods which focus on the usability of a proposed product or service relative to its needs and situations. Innovation typically requires the ability to identify specific methods, innovative strategies, models and/or types and match these with the contexts and general users.

Hobcrat and Phillips [2012] have developed the Collaborative Innovation Reference Framework [CIRF http://cirf.pbworks.com]and have identified nine types of innovation:

1. Management Innovation
2. Open Innovation
3. Design Led Innovation
4. Research & Development Led Innovation
5. Services/systems innovation
6. Experience-base Innovation
7. Business Model Innovation
8. Technology Innovation
9. Needs-based Innovation

Innovators, such as Microsoft and Apple (Kumar, 2013), have distinctively examined and adopted the above types, within its framework for innovation development, to understand the breadth and depth of the effort, key people, processes, and capabilities involved.

A sensible choice as far as methodology goes involves consideration of overlapping and multiplicity of innovation types. The most suitable framework will therefore be broadly encompassing and specifically customisable. For this project within the context of the Master of Design Enterprise, the primary drivers are the Design Led Innovation, Design Thinking, and Human Centred Design Frameworks.

Kumar Design Thinking Framework for Innovation

Kumar Design Thinking Framework for Innovation, as shown in figure 6, presented itself as a highly suitable framework to be applied, as it represents a more realistic approach focusing on user needs, rural community context, and relevant activity. Kumar's framework allows matching and mixing the types of innovation methods, treating these as layers which can be applied over the four main stages of the framework. These four stages are research, analysis, synthesis and realisation. Kumar's method has the capacity to foster iterative and nonlinear processes through relevant case studies. The capacity to identify and relate specific modes of enquiries to phases of the design-led innovation process is beneficial as broad context considerations are narrowed to specific needs of stakeholders.

Figure 6: Kumar's Design Thinking Framework for Innovation (Kumar, 2013)

IDEO Method Cards

Kumar's open design thinking framework for innovation allows any set of methods to be integrated into the process. I have used a combination of methods in some specific cases and used individual methods in other situations.

The way the research methodology was undertaken allowed pulling together both the HCD framework provided by Kumar and IDEO method cards. Methods were selected and matched with the focused activities specific to each section. This system provided a comprehensive structural framework for the project. For example, IDEO Method Cards has been used, where the design led innovation, design thinking and human centred design are the main drivers.

The Ethical Approval Process for the Design Enterprise Project

Before proceeding with the research project at hand, consent to undertake research which involved people, was required from the Otago Polytechnic Ethics Committee. The process started in early 2015, before commencing the second phase of the MDE program. In addition, approval was sought from the Kaitohutohu Office within Otago Polytechnic to comply with the conditions of the Memorandum of Understanding between Otago Polytechnic and Kai Tahu, the local Iwi. These systems provide ethical endorsement and support for the research project.

Families of the three church communities with Jezet burners were asked to use the devices on a trial basis for two to three months, keeping records of how much fuel they used and then providing answers to questions about the use of the device.

The most concerning issue that was encountered during the process of applying for Ethics approval, was engagement of the research participants. Although the proposed research was to take place outside of New Zealand, and would not include any New Zealanders, the committee needed to be clear the research aligned with the research ethics required by researchers at Otago Polytechnic.

Kaitohutohu and the Ethical Committee formally approved this research project on the 25 February 2016. A copy of this approval letter and the ethical application submission is included in Appendix A.

Specific Methods in the Development of the Design Enterprise Framework

A combination of Kumar's Design Thinking Framework for Innovation and IDEO method cards were applied throughout the MDE program and thus shaped the development of this design enterprise project. This is due to its ability to iterate several times whilst maintaining the focus within the design thinking framework in a structured approach.

It was exciting to note in the first phase of the MDE program, that Kumar's Design Thinking Framework for Innovation reinforced the approach I took in developing initial concepts. Although the initial development of the first working prototype was theoretically engineered and technically driven, the initiative started much earlier with an intent to target the problems implicit in the use of biomass wood fuel in Samoa. My personal experiences proved invaluable in informing specific aspects of the design together with knowledge from a review of relevant literature.

Literature Review - Methods

The main question was to understand why the Samoan people were heavily reliant on biomass wood fuel as their primary source of energy for residential cooking and asked what the influential factors were.

To research the broader context of the project and to review current knowledge, a literature review was carried out. This review was organised around, three areas and addressed the following research questions:

1. What are the main factors surrounding the predominant use of biomass wood fuel in Samoa?
    a. Are there any other Energy Sources available in Samoa?
    b. What is the cost of available energy sources and how this influences decisions?
    c. Understanding the local economy of Samoa and if this influences energy choice?
2. How can the innovative Design solve problems inherent in traditional cooking methods?
    a. What are the implications of using traditional practices for cooking?
    b. Have there been any other available energy conversion technologies been previously introduced in Samoa?
3. What is the potential for more sustainable community outreach programmes in accommodating these issues?

The main source of information was from the website for the Samoa Ministry of Finance (SMOF). Annual reports specific to energy use for Samoa were reviewed for relevant information.

An iterative model was used in this project phase providing a comprehensive and adaptable structure. This model provided opportunity to actively work towards the project objectives within the four main phases of the framework, shown in figure 6.

The core principle ***"building innovations around experiences"*** as stated in Kumar's book, 101 Design Methods, was combined with an approach focused on ***reframing the problems*** of using traditional methods of cooking, fuelled by biomass wood energy by households of Samoa. Thus, using ***key facts*** as the applied method from the ***sense intent*** mode of enquiry, desktop research of key facts was undertaken. Furthermore, adopting the approach ***Understanding the stakeholders***, the ***contextual research plan*** method was used from the ***know context*** mode of enquiry within the ***research*** phase, to support secondary research.

Innovation Phase - Community engagement and introduction of the Jezet Burner.

The design and development of the Jezet Burner needed refining further, to improve its feasibility, usability, and ergonomics for use in Samoan households. A human centred design approach was necessary to obtain the perspectives and experiences of the people, by engaging the people in using the Jezet burner.

Ethnographic observations, ethnographic interviews and rapid prototyping were selected as the more appropriate methods to be used in this phase.

The seventh mode of Kumar's methods, ***realising the offering***, ***pilot development and testing***, in combination with the ***try out*** method from the IDEO method cards, was also important as it allowed for community engagement.

In March2016, the three church communities that received Jezet burners in early 2014 were asked to participate in the design thinking process, following the approval of the ethical application in February 2016. Ethnographic interviews were conducted with 30 members of the communities who

have had the chance to use and experience the Jezet burner fora significant period of more than 6 months. Alongside this, recording ethnographic observations of other activities the church communities were engaged with connected to their infrastructure development needs provided information on the wider context.

In addition, a demonstration of the Jezet burner was carried out with one of the village communities. The village had been selected for the pilot project implementation, funded by the UNDP. Selection was based on the ease of access and communication and close relations with the community, given the time and availability to carry out the project. The details of this engagement are discussed in the next subheading. These two activities, interviews with those using the prototype and those who attended the demonstration resulted in design modifications to the designed oven. These modifications are discussed in the Innovation Phase section of this report. Further details are documented in the MDE401 and 404 reports enclosed with 501.

A Sustainable Financial Support Strategy for the Design Enterprise Framework

The economics of developing the infrastructure to produce, introduce and distribute the Jezet burner required careful consideration. In late 2014 the Small Islands Development Strategy (SIDS) conference held in Samoa highlighted the need to effectively maximise the use of overseas financial support for small Pacific Island nations including Samoa. It became clear that funding delivery of the Jezet burner to rural communities was a good fit with overseas aid programs seeking to support Samoa's development.

Under the research phase of Kumar's framework for innovation, the two modes of enquiries were exploited. A ***publication research*** method was applied to understand the context of the overseas aid programs and the implementation strategies adapted to fit with identified goals of the several overseas aid programs. ***Ethnographic interviews*** were conducted to understand the viewpoints and opinions of people involved in coordinating these financial programs. The following objectives were formalised to assist with the logical structure of this project phase:

- To explore the funding facilities available locally
- To learn and understand the processes, policies, and legislative requirements in securing funds
- To gain constructive insights for further refinement of this design enterprise project

This concept was tested as a pilot project program. The UNDP fund program, one of the aid programs available at the time was selected as a trial. Stakeholders involved in the fund program were interviewed. Interviewees included the program fund coordinators, fund recipients/applicants of various projects and members of the selected village community. This approach was informed by ***the try out*** method, one of the 48 selected IDEO methods.

This overseas aid program is financially funded by an international organisation, the Global Environment Facility. This is part of the United Nations Development Programme, and is coordinated by the Small Grants Programme division. (UNPD GEF/SGP). A conceptual proposal was submitted in the first instant, to capture the attention of the funding coordinators. The proposal was quickly accepted and then the pilot journey escalated from there.

The funding program was set up in two sequential steps.

1. The Planning Grant,
2. The Full Grant.

During the Planning Grant, workshops and awareness programs were implemented to initiate introduction of the Jezet burner to the selected village community. One of the workshops held, was the demonstration of how the oven works. It was during this session that the workshop participants were given the opportunity to work the device themselves. Following the demonstration program, they were asked for their opinions and perspectives about using the Jezet burner over traditional methods. The comments and feedback towards the usability and physical appearance provided vital information, and were recorded for further refinement of the device to suit user needs.

The last three phases of the design thinking innovation framework, each with specific modes of enquiries were then exploited, ***framing insight*** involved analysing this information to ***explore different conceptual opportunities.*** Focusing not only on the prototype modifications, but also on other areas where the experiences of the users during the cooking period, were constructively transformed into other productive activities.

THE INNOVATION PHASE: COMMUNITY ENGAGEMENT AND INTRODUCTION OF THE 'JEZET BURNER'

The Initial Concept Development

In the late 1970s, I grew up in a small village on the South coast of Upolu Island, Salamumu, where I was introduced to the use of biomass wood fuel energy or firewood for cooking at home. During this time electricity was not widely available in the country. Not all the villages had access to electricity at the time.

Learning how to cook was one of the basic survival skills every child would need to acquire within a traditional Samoan family. The collecting of firewood, preparing the food and lighting the fire to start cooking the food were all part of the inherited traditional activities a child would master within the family. Without electricity and other energy sources at the time, it was compulsory to adopt and learn these skills. Thirty years later, I have noticed a continuous use of the traditional methods even after electricity became available to the communities.

Throughout this journey, I had always experienced the health and safety impacts of using the traditional methods. Most of the people of Samoa have been continuously exposed to the same damaging impacts in their daily lives.

Therefore, by having the motivation to face up to the challenge, a concept was born. Using my personal experience as a Samoan living in Samoa, I managed to refine an existing concept that can effectively combust wood fuel to suit the contexts of the Samoan people. The development focused on the reduction of air pollution from unsafe smoke as well as the deterioration of forests from the excessive use of firewood. Hence, the Jezet Burner was developed and modified as shown in figure 7 below.

Figure 7: The Biomass Wood Fuel Oven Technology 'JEZET BURNER'

Understanding the traditional 'UMU' method and its impacts

The ***'umu'*** is a traditional process whereby food is cooked on hot stones heated by firewood in an outdoor sheltered hut as shown in figure 8. The process usually takes about an hour to an hour and a half to heat up the rocks, then another hour to cook the food depending on the amount of food to be cooked. This is usually a job done by males, where older males teach young males to master the process and the custom continues for the next generation. This custom has been in place for many generations and the activity is now embraced as a cultural tradition.

Figure 8: The traditional 'umu' method

The 'umu' process is commonly carried out on Sunday mornings, but preparations would take place on Saturdays. The process involves collecting firewood, food (such as taro or other crops) as well as collecting leaves for covering the 'umu' when it's ready for cooking. Women and children take part in gathering alongside the men. This will usually take up the whole day as families would spend hours in their plantations to prepare for the 'umu' the next day. All work must be done before Sunday, as working on Sunday is prohibited in the Islands due to their Christian beliefs.

Ethnographic images record excessive smoke generated from the cooking process (*refer to MDE401 Figure 10*), increasing air pollution especially within the cooking environment making it unsafe for all involved. This pollution is directly due to the inefficiencies of the combustion process due to the way the 'umu' has been traditionally executed. Thus, a large amount of fuel is used but relatively little is completely burned.

The Design of the Combustion Chambers

Historically this traditional activity had been passed down from generation to generation, when considered alongside the fact that this had been the only affordable cooking process available to Samoans – this custom is widespread. Users have been ignorant of the very real and long-term health and environmental costs. This situation provided the opportunity to design and develop an efficient combustion chamber, to focus on reducing air pollution within the cooking environment as well as to minimise the use of valuable biomass wood fuel resources.

To achieve efficiency in the combustion process in the design approach, first and second laws of thermodynamics (ATAM, 2009) the technical calculation and the design of the combustion chambers. Principles of Fluid Mechanics were also integrated to enhance the design approach.

Theoretically, for a complete combustion process of wood, the three main factors need to be in harmony. Wood fuel, temperature and air flow need to react at a balanced ratio to achieve complete combustion. It is difficult to precisely determine this balance ratio as multiple factors are involved. The moisture content of the wood fuel and the conditions of the surrounding environment all affect the process. These are uncontrollable attributes which poses a challenge to the design.

The initial basis of the design was adopted from the Winiarski Rocket Stove concept (Rocky, 2013), I managed to improve the ability of the combustion chamber and create a natural suction effect. This resulted in a simultaneous draw in of the exact amount of air to coincide with the burning of wood.

Figure 9: Inside the OSI rocket stove (Graham, 2013)

Physics explains this process as the Air displacement principle, supported by the Law of conservation of energy and mass, together with the principles of fluid mechanics, where air rises when heat is applied while new air supply flows in to replace the displaced air. Figure 9 shows a further clarification of the same principle where two Irvine College students prepared a stove to provide help for refugees from the Middle East in 2010 (Graham, 2013).

However, in a closed chamber, movement of air particles increases when heated. This resulted in an increase in pressure against the walls of a closed chamber due to airs compressible properties, making it difficult for new air to enter. If a small opening is drilled at the top of the chamber, allowing the pressurised air to escape at a specific flow rate, the same flow rate of air will enter naturally into the chamber if another opening was at the bottom of the same chamber.

Therefore, applying an orifice arrangement was introduced to provide some restriction in air outflow when heated, while creating a natural suction effect for cool air inflow. The chambers were elevated at a predetermined height to complement the sectional area of the orifice opening, and allow for this natural inflow to occur smoothly. This process is scientifically known as natural convection.

The performance of the combustion chamber was not perfect as there was still a significant amount of smoke produced in the combustion process. A secondary combustion chamber was introduced to accommodate for this unburnt smoke. It was designed with additional openings to allow inflow of warm air from the surroundings to enter the secondary chamber with the same natural effect as the fresh air enters the primary chamber. This warm air, when fused with the turbulent access smoke at a reasonably high temperature ignites into burning flames, increasing the efficiency of the combustion process significantly.

Design of the Oven Chamber

Design of a functional oven chamber was critical. The goal was to ensure all the heat energy converted from the combustion process was harnessed effectively. At first, material selection and fabrication issues caused complications when developing the oven chamber in the first prototype made here in Aotearoa. A goal of optimising available and affordable materials selected to produce efficient results was set. Stainless sheets were eventually used for the development of the first prototype to facilitate a working prototype for initial tests.

It was evident in performance test results from the first working prototype that most of the heat energy converted was absorbed by the stainless-steel oven chamber. 30% of the heat energy generated was transferred to the food being cooked. Therefore, the need to continue researching for alternative environmentally friendly and cost effective design solutions was necessary.

In traditional ‘umu’ leaves were used to cover the food as soon as the rocks heated by burning wood are red hot. These leaves are cut off from banana trees and other crop plant ‘taamu’. They would be used twice in a traditional ‘umu’ process before they are disposed as organic rubbish. This was obviously not an environmentally friendly solution so the hunt for a better solution continued.

Ethnographic observations, recorded in still photos (displayed on the matching page), show the last part of the ‘umu’ cooking process is covering all the food with the leaves cut from the banana trees, the yam crops and/or breadfruit trees. The layer of leaves needs to be thick enough to preserve the heat from the heated rocks so it continues to cook the food for at least an hour to an hour and a half. The continual use of the leaves in umu has directly affected the growth of these plants and hinders the productivity of their fruits and crops.

Prototype Performance Analysis

Prototype 1: Stainless Steel top oven

The initial tests were carried out to determine the efficiency of the combustion process in comparison with traditional method. This was done by comparing the differences in fuel use by weight, to cook the same amount of food, with the traditional umu and the working Jezet burner. Results show that a reduction of fuel quantity by 88%. The traditional umu uses 70-75kg of fuel much more than the developed prototype which uses10 – 15kg of fuel. Refer to MDE401 report.

Prototype Cost Analysis

The cost of the first prototype built in Aotearoa was $3,850.00 NZD. Much of this was the cost of building materials and specialist tools required to build the first working prototype from scratch.

The cost of the prototypes built in Samoa has been reduced to $1,500.00 NZD per unit. This is an equivalent of $3,000.00WST. The further modified version has a further cost reduction of 20%.

User Interface to Customise Design

Following the successful launching of the first stainless top working prototype here in Aotearoa, three more prototypes were built in Samoa with a modification in the oven chamber design early 2014. This adjustment was driven by the Samoans in Dunedin who have used the Jezet burner. They shared their views towards the use of leaves to cover the food during cooking period. This was due to the use of metal materials, as in their stainless top prototype, which was not readily available in Samoa.

The clam shell concept

This is when the clam shell concept came into the picture. Growing up on a coastal environment, my brothers and I enjoyed spending time at the beach. After playing in the water for hours under the hot sun, we would cool ourselves down by burying our bodies completely under white sand. I started to notice the unique properties of the white sand to reflect the heat from the sun instead of absorbing it. I noticed that the heat of the sun does not penetrate beyond 50mm into the sand. Further than 50mm and the sand is cool. The temperatures in the island can reach up to 34 degrees. Eight hours of continuous sunlight exposure can increase the temperature of a good conductor of heat to more than twice the atmospheric temperature.

So, a concept was initiated looking at optimising white sand or other materials found at the sea shores as building materials for the oven chamber. Clam shells were the optimum choice due to their widespread availability within the island without any further use after being harvested by the people. Clam shells had the properties to reflect the heat from their white shiny surface more effectively. This can be used as an insulation material at the inner lining of the oven chamber, while the external layer and structure of the oven chamber can be built with conventional building materials, such as brick blocks and mixed cement.

A second test was carried out after the second set of prototypes was built with the insulation clam shell modification. This test compared the time taken to cook the same amount of food with both prototypes. Results show that cooking time was reduced by 50% in the insulated oven. The temperature of the surrounding atmosphere was also considered due to the difference in locations where the prototypes were built. Therefore, it was noted that cooking time was reduced by 30%, which is extraordinarily efficient. It was also noticed that with the reduction of cooking time, fuel

quantity by weight was also reduced, as the heat energy converted was directly proportional to the time spent to cook the food.

Scaling down of the Jezet Burner

The size of the developed Jezet burner was an issue raised by the individual members of the community. It was ideally suited for communal use but rather too big for residential use. In addition, the height of the oven chamber was also a concern. Placing massed food and/or removing hot masses of food to and from the oven were awkward. So, scaling down the design was necessary while ensuring the technical performance was sustained. This included alterations to the combustion chambers design to accommodate these insights as shown in the images over the page.

Addressing the Benefits of using the 'Jezet Burner'

Material Availability

This section explains the process to determine optimal use of locally available building materials to build the oven prototype. Cement was readily available to be used as a bonding agent, as was as metal rebar for reinforcement and grated sheets. All these materials were found at a reasonable price in the islands. These were the only materials used that were imported from overseas and sold at various local hardware stores. Brick blocks to build the structure of the oven prototype were made locally by various cement companies and sold at around $2.40 tala a piece.

The combustion chambers were casted in situ with the use of black sand, ash, 3/8" aggregate and cement. These materials were also found locally especially within the village surroundings and were mixed at a specific design mix formula to ensure heat resistant properties were achieved.

The internal lining of the oven chamber was installed with casted clam shell tiles using a specific process. The clam shells were found across the island in plentiful numbers. Ash and cement with white sand were also used, in a special design mix formula, to achieve the heat resistant characteristics.

Sustainability - Economics

The capital cost of one prototype from using the materials mentioned, has been reduced by 66% compared to the cost of the first working prototype. The Jezet burner was designed to last 10years as a safety specification factor depending on its usability. This means that maintenance costs would be minimal, and seen as replacing the combustion chambers and applying minor repairs around the body of the oven over a decade.

Risk Free

The aim of the risk assessment was to ensure people older than 15years old could use the Jezet burner without any restraints. As the users of the traditional method 'umu' were mainly men, I wanted to ensure women and teenagers were also able to use the oven prototype and be part of the cooking activity. The elderly and young children were also considered in terms of being safe around the oven prototype.

The combustion chamber was designed as a closed chamber to avoid burns or heat radiation from an open fire arrangement. The height elevation of the chamber was designed to suit a person sitting on a low chair feeding the fuel as required. A door was also needed at the fuel feeding point for safety from the burning fire and provides completeness in the combustion process through initiating the natural convection effect.

The height of the oven chamber was adjusted to suit the average height of a Samoan woman. This was important for the women to be able to cook at a comfortable height, especially with hot food.

Clean Cooking Environment

During the demonstration session, participants from the village community commented that the use of the Jezet burner was cleaner when compared to the traditional method. They admired the absence of excess smoke from the burning wood providing a clean air cooking environment. They also noticed the slow rate at which the wood fuel was fed into the combustion chambers. Observers discussed that the oven would mean spending less time on collecting fire wood and less firewood would be needed. The use of cooking pots, metal baking trays and foil to cook the food in was also discussed to keep the food clean.

How do people feel about using the Jezet burner?

One of the participants mentioned

"Ua matua talia ma le faafetai e le matou nu'u le faamoemoe o le faalauiloaina mai o lea ituaiga ogaumu, O lea sui ai foi le vaai I le faaaogaina tatau o fafiemai le vaomatua aemaise ituaiga kukaeseese o le a faaaoga i ai. O le a faaaogalelei foi le taimi tele ma le malosi lea e alu i le tapenaga ma le faatinoga o le faapusa I nisi meatauamo le aiga."

Translation below:

"The introduction of this oven is welcomed by our community. This will change our perspective towards the use of biomass wood fuel and the way we cook our food. The amount of work, time and effort that goes towards preparing and cooking with the traditional method, will be put into other good use".

One mother claimed and I quote,

"mate omai a ma siaú tama e fai ana mea aoga I tua I le umukuka ae ou faia se kuka e faataliai le manava mai o le matou fale. O le a le toe mu la mata I se tafuina o le ulo."

Translation below:

My daughter can do her homework while I do the cooking before my family gets back from work every day. No more teary eyes from using the old open fire".

Thirty (30) participants with age ranging from 15 to 55 years old, were asked how they would feel about phasing out the traditional method, and if they had any concerns with respect to their customary traditions?

A mixture of opinions from the participants was noted as follows:

- The adults from 50years plus were against the idea of facing out the traditional methods as they believe it is vital for the young generation to obtain this knowledge and skills. (10% of the group)
- The age group below 50 years supported the idea of facing out the traditional methods, given the benefits of using the Jezet burner. (90% of the group)

Exploring opportunities with productive activities with the use of the Jezet Burner

Cooking time of 45 minutes to an hour to cook food for a family of 10

- School aged observers suggested that they could do their homework while operating the Jezet burner during the cooking period.
- Mothers suggested they can do other chores simultaneously with monitoring the oven during the cooking period. For example, hanging or collecting the washing, tidying the house, doing the ironing, or weaving fine mats and other handicraft products etc.
- Men suggested that they could mow the lawns, build a hut, carve a boat or small traditional artefacts etc.

Preparation of food

- Could now be done during or before the cooking period, in place of firewood gathering
- For Sunday feasts, food can be prepared the day before, especially the taro crops, piglet etc. Any meat products could be stored in the fridge overnight.
- Day to day benefits were identified as food could be cooked once for the whole day. Leftovers could be stored in the warm oven overnight for breakfast the next morning.

Collecting of firewood

- Can be done simultaneously with gathering the food from the plantation as much less wood is required. Instead of allocating significant amounts of time to collect massive amounts of firewood, a few pieces can be gathered every time people visit to work at the plantation. Collecting firewood is usually an everyday activity excluding Sundays.
- Less wood is required, so there is less need to cut down any trees from the forest or to chop firewood.
- Firewood can be collected from dry wood branches broken off from the trees.
- The Jezet burner is compatible to a wide variety of biomass wood fuel. Coconut husks, dried palm leaves and the light dry organic materials can all be easily used.

A SUSTAINABLE FINANCIAL SUPPORT STRATEGY FOR THE DESIGN ENTERPRISE FRAMEWORK

Introduction

Upon completion of the MDE404, it was noticed that one of the major constraints in enhancing the deliverability of the Jezet burner was securing financial support. The low potential capacity and poor economic status of local people to invest in the oven, even with the reduced capital cost estimated for the design. The most attractive option was to explore opportunities with the overseas aid programmes, already working locally; those who aim to support community based adaptation projects that target the impact of climate change on vulnerable communities. Hence, what started as a project about the biomass wood fuel oven is now turning into a charitable enterprise framework development that not only promotes the adoption of the Jezet burner, but will also implement other potential projects that will support community development.

Engagement with the UNDP, GEF SGP fund program began. The ***try out*** method from the IDEO Method cards enabled learning about the systems and processes involved. The details of this engagement are discussed in the MDE404 integrated report. A brief description of the main events and insights gained will be included in this section, to provide supportive background information on the formation of the design enterprise project.

In addition, the overall process, and requirements of the UNDP GEF SGP - CBA fund program had been further investigated. The application process cycle as shown in figure 10 was the focus of the investigation to identify gaps that can be addressed by my design enterprise framework. The activities before the call for concept phase, during the developments of project concepts and the project design phase. This included an extensive search into the financial forecast plan and targets set by the fund program.

The outcomes and objectives of the Small Island Development Strategy (SIDS) conference had also been explored to assist with the development of the design enterprise project. Primary research included interviewing expert professional government officials who have been directly involved in the coordination and facilitating of the funds in support of the SIDS development goals in harmonization with the development goals for Samoa as documented in the Strategy for Development of Samoa Plan 2016 (SDS). The results informed the development of a funding proposal.

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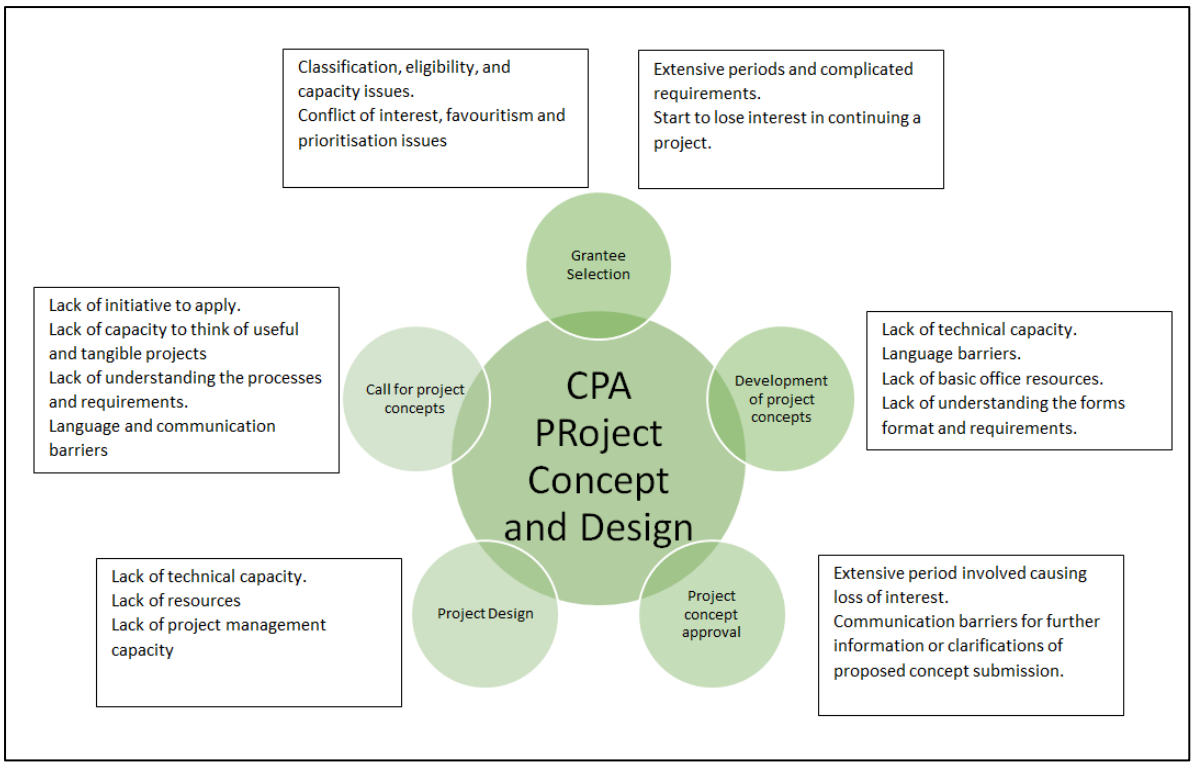


Figure 10: Community Based Adaptation Project Application Process Cycle ((UNDP/SGP), 2015)

**This image can be placed below the above paragraph*

The Pilot Project with UNDP, GEF, SGP Program and Lessons Learned

An invitation was received from the local office of the UNDP, shortly after the launching of the three (3) biomass wood fuel oven prototypes in Samoa, early 2014, requesting submission of a project concept. This escalated the second phase of the MDE program, the industry placement activity. Standard templates were designed for the submission and examples are included in the Appendices section. Figure 11, shows the process which I experienced during the pilot project. This captures the issues and challenges that were encountered as well as insights for improvements, in support of the design enterprise project - insight information.

Ongoing discussions were held via email correspondences with the UNDP officials responsible for the coordination and administration of the GEF SGP fund program throughout the engagement process. This was to ensure all the requirements were satisfied with the initial concept submission. It continued onto the rest of the application process where two further submissions were required, the Planning Grant and the Full Grant applications. I observed the process overview including timeframes and evaluation procedures were never discussed or explained in detailed. In fact, the whole communication and awareness of the system was frustratingly poorly handled which caused lengthy delays from the starting point, mid 2014, to this stage late 2016.

Figure 11 shows the actual timeline of activities for the fund program engagement. Evaluation of the planning grant application took approximately 11 months, with another 18 months for evaluation of the full grant proposal before the first disbursement was released.

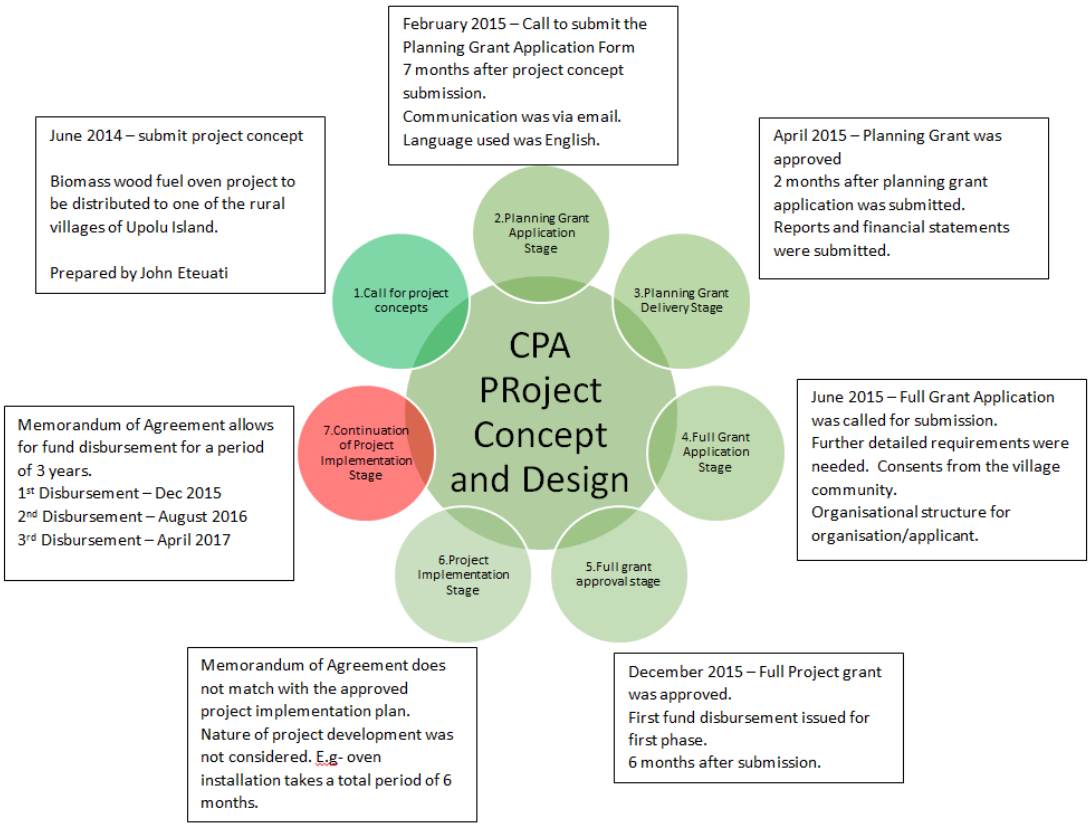


Figure 11: Actual Fund Application Process from the Pilot Project

As advised at the time, the proposal owner (Grantee) had to be representatives from a selected village based community accepting the project. For example, a village mayor plus village committee members selected by the village to act as project proponents on behalf of the village community. As the project proponents of the project, these people will be responsible for progress reporting and the overall management of the project including financials. The financial part of this set up was experienced as a conflict with the timing of the project delivery phase, as it required a third party's approval before finances were released for material procurements.

The project has now completed its first reporting phase since it was granted early 2016. It took three (3) months to complete this phase with the progress report submitted then significant waiting before the second disbursement of the fund.

What was noticed was the fact that the process overview including timeframes and evaluation procedures were never discussed or explained in detailed. In fact, the whole communication and awareness of the system was rather frustratingly poorly handled which caused lengthy delays from starting point, mid 2014, to this stage late 2016.

The financial part of this set up was seen as a problem with the timing of the project delivery phase, as it required a third party's approval before finances were released for material procurements.

Facilitators of the Overseas Fund Program(s)in Samoa

The Government of Samoa through the Ministry of Finance is the main governing body responsible for coordinating the overseas fund programmes as shown in figure 12. The bulk of the funds are then allocated to various public infrastructure development sectors complementing the objectives of SDS plan specific to each sector. The rest of the funds were allocated to various government facilities, established to focus on community based development goals initiated by the village communities and/or private organisations. Examples of these facilities are, the Civil Society Support Program (CSSP), Local Office UNDP, Small Business Enterprise Co-operation (SPEC), NZAID, AUSAID, JICA, Samoa Umbrella for Non-Government Organisation (SUNGO) and Non-Government Organisations (NGOs) and others.

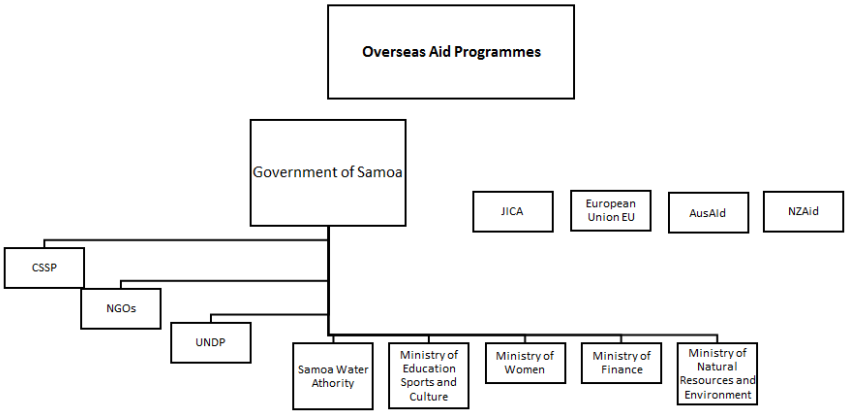


Figure 12: Structure of Overseas Fund Allocations

It has been confirmed in earlier research that Samoa is one the most vulnerable nations with the impacts of climate change. This means that there will be ongoing financial support from the global powers through international conventions to assist with climate change mitigation developments within the country. However, it was unclear how these financial support programs function in terms of targeting the issues that matter the most to the people of Samoa. Therefore, government expert officials who had direct and/or indirect affiliation with the coordination of the funds were interviewed. The vital information gathered was outlined with the corresponding questions as follows:

Is the structure which the Government of Samoa has in place to manage and coordinate the overseas aid programs effective?

Mr Agafili Shem, the CEO for the Ministry of the Prime Minister, thought it rather 'incoherent'. The fact that public sectors have been given the responsibility to manage the funds based on their strategic goals has somewhat allowed for mismanagement of funds. Mr Shem added that the funds should be better managed by a single Government body which specialises in its acquisition, distribution and has integrity. This body would nurture relationships with international funders by compiling proposals which support the Strategy for the Development of Samoa Plan. This Government body should be a separate entity but still have close relations with the Ministry of Finance (MoF). Now, there is an Aid Coordination Committee within the MoF, carrying out this responsibility with members selected from various government sectors. The idea of having a centralised mindset and a common goal towards the management of the funds to effectively meet its purpose has been evident with the progress of development in the country, especially at the local level.

What is a better way to enhance the deliverability of a community based adaptation project on a national scale?

Mr Vaito'a Toelupe, the CEO for the Civil Society Support Program (CSSP), a Government Facility established to facilitate funds to support the development within civil societies and/or community organisations, made a few comments on the question. He saw the problem with the received proposals was the lack of tangible initiatives and a great sense of need. For example, if one village community applies for funding to build a committee centre, the next village does the same. If one village asks for new water tanks, the other village follows even if these are not really needed. He added that, to enhance the deliverability of the biomass wood fuel oven to the people, on a national scale, a charitable organisation should be established to lead the proposal development and submission. Proposal grants can reach a maximum of $200,000 USD for national scale projects. If a submitted proposal supports renewable energy targets, acceptance will not be hesitated. He also added that this is the only fund that allows for multiple contracts provisions. For example, if multiple contractors are engaged in the delivery period of the project, then the fund has provision to account for those external service providers.

What can we learn from the challenges of being a Facilitator?

In 2015, UNDP launched a manual called A Practitioners Guide to Establishing a Community Based Programme to assist facilitators with implementing community outreach programmes. ((UNDP/SGP), 2015)

The following notes were selected from the guide to provide insights for the development of the design enterprise project:

> ***"A facilitator needs not only to have expert knowledge of the climate change issue the CBA project intends to address, but also an awareness of community dynamics. A good facilitator is someone who has patience and is able to control and direct a group. Motivation, a good sense of humour and time management skill is also important. If a person with both climate change and workshop facilitation expertise is not available, workshops can employ two facilitators, with one providing technical support and the other facilitating discussion and consensus-building. In some country pilots, United Nations Volunteers acted as main workshop facilitators or co-facilitators. In other projects, grantees engaged climate change experts. District community workers also make a good fit for co facilitating VRA workshops, as such workers contribute an in-depth understanding of local communities' social dynamics."*** ((UNDP/SGP), 2015)

In summary, credentials of a good facilitator are:

- Highly qualified specifically in Environmental Sciences, Climate Change, and Engineering areas.
- Exceptional personality and behaviours.
- Design Thinking capacity to initiate projects and identify people's needs is lacking in the system. Finding the people with these capabilities who can invest their time and effort to commit to such projects is not easy.

> ***"funds should be better managed by a single Government body which specialises in its acquisition, distribution and integrity" Mr Agafili Shem***

"In order to enhance the deliverability of the biomass wood fuel oven to the people, on a national scale, a charitable organisation should be established to lead the proposal development and submission." Mr Vaito'aToelupe,2016.

The relationships and engagement with the communities is a major issue which restricts the successful completion of approved funded projects. Mrs Ofusina Ieremia, the UNDP project coordinator commented that the issues with progress reporting, project monitoring and financial transparency are mostly the issues she encounters with her role. (Ieremia, 2015) Accountability and transparency is one of the main reasons with the low percentage of completed projects funded by UNDP.

Exploring Concepts from studying the Government Goals - Strategic Development for Samoa Plan

The alignment of the design enterprise framework objectives and goals with strategies for the development of Samoa was essential for a successful community project delivery plan. Water and energy projects are the focus areas under the Samoa infrastructure development priority area, especially within the rural communities. This is supported by the establishment of the Civil Society Support Program (CSSP), co-funded by European Union (EU) and Australian Aid (Aus Aid), which provides opportunities for communities and/or registered Non-governmental organisations (NGOs), to express project proposals for funding and manage project delivery plans. (Samoa Ministry of Finance, 2012)

The monitoring and implementation of the priority areas and goals of the SDS plan lie with the public sectors and Government ministries. This means that funds for proposed development and sustainability priorities supported by government annual budgets will be spent only on government-owned infrastructure, for example, water reticulation systems within the urban central business areas where water is supplied with a charge. Some villages in the rural areas operate privately-owned water schemes which are poorly sustained due to lack of financial and technical capacity support. The National Energy Coordination Committee (NECC) is made up of stakeholders from associated government authorities and private enterprises, in collaboration with the Energy Division within the Samoa Ministry of Finance (SMoF), are responsible for project appraisals submitted for Cabinet approval.

The UNDP Small Grants Program initiatives as shown below provide a more direct focus towards the infrastructure development for communities that are mostly affected by the impacts of climate change. One of the initiatives, the low carbon energy access, matches with the idea of introducing an efficient energy conversion technology like the Jezet burner. More opportunities can be developed using these specific initiatives to have direct access to financial support that is so desperately needed to foster sustainable infrastructure development within the rural communities.

Strategic Initiatives Below are the initiatives that SGP will focus on from 2015-2018:

COMMUNITY LANDSCAPE AND SEASCAPE CONSERVATION Using a multi-focal approach by involving communities in buffer zones and corridors, SGP will provide connectivity for complex landscape mosaics. Seascape approaches will support the implementation of inter-linked activities to systematically address water body environmental degradation.

CLIMATE SMART INNOVATIVE AGRO-ECOLOGY SGP will target geographical areas that show declining productivity as a result of human induced land degrading practices and the impact of climate change by working in buffer zones of identified critical ecosystems, as well as in forest corridors.

LOW-CARBON ENERGY ACCESS CO-BENEFITS SGP will focus on providing bottom-up energy solutions that are low-cost and provide high potential for carbon emission reductions to satisfy the global demand for energy services of people without access to electricity and those that still rely on traditional biomass for cooking.

LOCAL TO GLOBAL CHEMICALS COALITIONS Through this coalition, SGP will increase the phase-out, disposal and reduction of releases of POPs, ODS, mercury and other chemicals of global concern.

BUSINESS PERSPECTIVE

A business model canvas has been adopted to design an effective business model for the establishment of a charitable organisation, Renewable Energy Organisation (RENO). This is part of the enterprise framework strategy to ensure the organisation is fully equipped with the capacity and resources to become successful and self-sufficient.

Targeting the various issues experienced by the communities (applicants) and their relationships with the funders was among the focus of this section. Gaining knowledge from this design thinking journey and learning the appropriate design methods has enabled the organisation to come up with an organisational structure that will prioritise the communities by initiating relevant projects. A research and development unit/ public relations unit will be at the forefront of project concept initiation. A partnership with technical engineering firms such as the Energy Smart Limited, to provide feasible technical solutions in designing renewable energy projects is a key component of this business model. Finally, they need to have the capacity to the deliver the projects by outsourcing them to private contractors.

Organisational Structure

The organisation will be an ***intermediary grantee***, which provides full control and responsibility with the feasibility development, implementation, and commissioning of the proposed projects. Furthermore, ongoing programs will also be included for the sustainability of the projects.

The organisation will focus on securing financial support from the Government Facilitators such as the Civil Society Support Program. This will enable the delivery of potential projects at a multi-community scale. It will also allow for potential projects to be completed in a more realistic timeframe with its fund disbursement structure which is a lump sum payment for one financial year. If the organisation comes up with at least three potential projects within one financial year, it will possibly be receiving a sum of approximately $600,000 WST to deliver these projects to multiple communities within that financial year. The projects can span for an extra year for sustainability and maintenance activities, but these can be supported separately from the capital funds depending on the success of the projects implementation.

Figure 13 shows the layout structure for the established charitable, non-government organisation and partnerships with registered companies to provide a complete packaged service within the design enterprise framework.

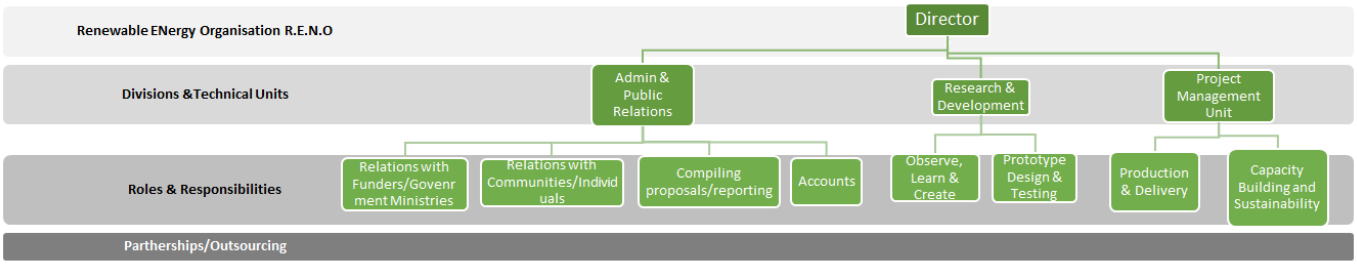


Figure 13: Organisation Structure 'RENO'/ images of business canvass development

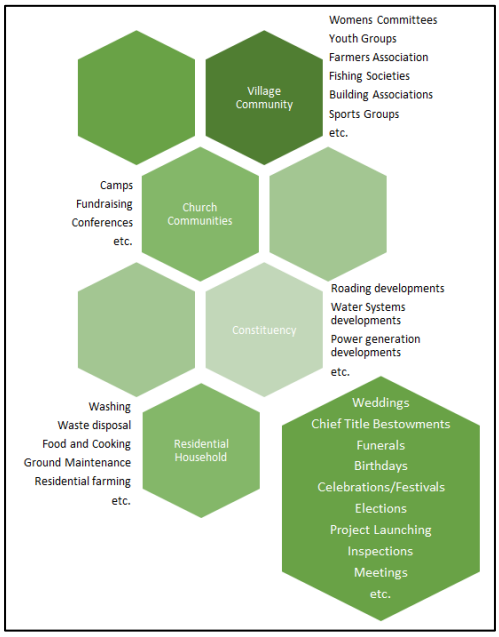
RENO will be focusing on administration, coordination and communications with the government fund facilitators and/or overseas funders. They will also be responsible for public and community relations, ensuring the appropriate consents are in place and communication with the communities are clear.

The Design Enterprise Framework – Template for future projects (DEF-tfp)

Table 2 below shows the activities potentially involved in the design enterprise framework. The proposals and project development will be in accordance with the requirements of the overseas fund programs set by the established facilities. This will be managed by the charitable organisation, RENO in collaboration with the technical engineering firm, Energy Smart Limited (ESL) as shown in figure 13.

Discussions: Activities with opportunity for potential project from gaining insights

There are activities at a national level such as the Samoa Independence Day, Teuila Festival etc. But the activities that will be explored through the application of the DEF-tfp will be at a communal and residential level. Such activities include, weddings, funerals, bestowing of chief titles, village meetings, land development, fishing, and farming to name a few. Refer to diagram over the page.



Framing Various Activities for Project Insights

Table 2: The Design Enterprise Framework - Template for future projects

Identify Needs	Concept Development	Detailed Design	Prototype Testing	Distribution	Sustainability
RENO will apply for funding to carry out project feasibility research. **OBSERVE** Engage with communities by observing and learning about daily activities and needs. Identify what are mostly needed in relation to activities Secure interest and consent of the community Select a project committee from the village Secure contacts and communication modes Develop Project Plan	Analysis of information will assist the exploration of concepts. **LEARN** The Energy Smart Ltd will work closely with the village project committee to finalise a concept solution.	The ESL will develop a detailed design. **CREATE** ESL will carry out the technical feasibility analysis and design checks. ESL will develop scope of project work required. ESL will develop cost estimate of total project scope.	RENO in collaboration with ESL, will compile a proposal submission for a pilot project fund. **TEST** ESL will build pilot project and apply testing. RENO and ESL will compile a full grant project proposal to fund a full scaled community project.	Depends on the nature of the project. **DELIVER** Infrastructure system that serves the whole community. Infrastructure that serves small village committees. Infrastructure projects that serves residential families.	RENO and ESL will carry out ongoing capacity building training, towards the operation, maintenance and sustainability of the projects. **SUSTAIN**

CONCLUSION: THE DESIGN ENTERPRISE FRAMEWORK.
TEMPLATE FOR FUTURE PROJECTS

In conclusion, the outcomes of the MDE401 and MDE404 had been integrated to develop a design enterprise project. This is presented as a simple and straight forward template, to enhance community outreach support programmes and initiate future infrastructure development projects so desperately required. The template is designed to be used by communities who can identify a need. The template will be written in both Samoan and English for everyone to understand. This will be led by the Renewable Energy Organisation (RENO), which will have close relations with village communities, focusing on the issues that bring the most benefit to the local people. Potential projects will adopt design thinking methods, human centred and user interface approaches, to initiate, create and develop the most relevant projects that will improve the quality of life for all Samoans. Refer to visual summary map below of process improvements with the introduction of RENO.

The introduction of the Jezet burner to the communities, as detailed in MDE401 report has enable modifications to the prototype to improve its usability and desirability. This activity has confirmed the need for further attention in the project initiation category within the village community context. This could even be extended to the residential situation depending on the social, economic, and environmental activities they are engaged in on a daily basis. Refer to the customer journey map below for an overview of customer experience with the use of the Jezet burner in comparison with the traditional umu.

The following list outlines the activities related to both the residential and community context, which presents a wide range of opportunities for tangible projects to be initiated, created and developed through the application of a human centred design approach and design thinking frameworks for innovation.

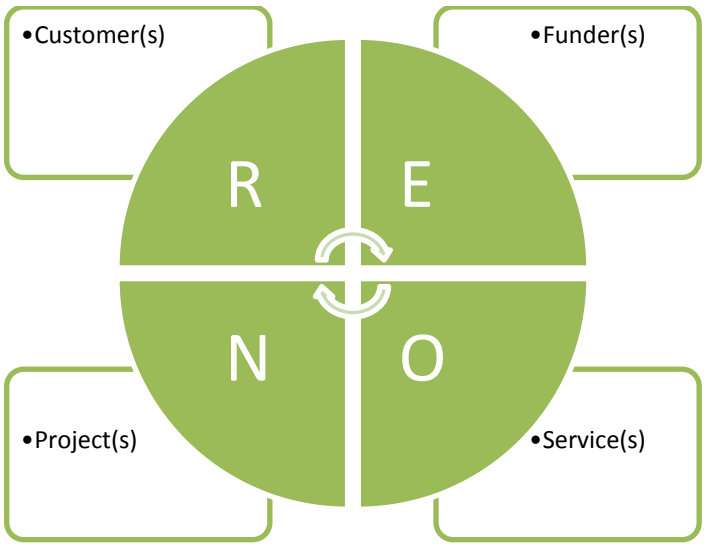
- Clean and sustainable water: Opportunities to improve health and prevent water born deceases
    - Maximise available natural water sources (river streams, underground aquifers and rain water)
    - applying natural water treatment systems
- Farming necessities: Opportunities to develop resources suitable to location and context of each village. (e.g. portable huts, transport carts etc.)
- Fishing necessities: Opportunities to develop resources suitable to location and context of each village. (e.g. fishing ports, fishing tools etc.)
- Macro-economic development: Opportunities with copra, coffee and cocoa production at a residential and communal scale.
- Environment protection from disasters: Vulnerable areas. (e.g. flash flood areas, coastal affected areas, etc.)

Customer Journey Map.

The map below shows how the customer(s) would engage RENO in assisting with proposed development projects and vice versa. Customer(s) can be individuals, community groups, village

communities, families, organisations etc. The map shows two diferent routes whereby it reveals the differences between the existing and the new process.

Figure 10 and 11 show the impacts how the existing processes play out including the actual experience encountered. By using these experiences, a new refurbish process map has been integrated into a single, straight forward and simple process map where the customer(s) would easily utilize.



1. Customers can approach RENO or vice versa if RENO wishes to introduce a project to the customer(s). Customer(s) will only deal with RENO throughout the project phase until completion.
2. RENO acts as an intermediary grantee, whereby the funders will endorse managing the project from proposal to implementation phase.
3. RENO will be responsible for procuring materials and engaging professional service providers to implement the project.
4. RENO will also be responsible for reporting and monitoring on behalf of the customer(s) throughout the project duration.
5. Customer(s) will be engaged with project consultations and meetings throughout the project phase from concept to implementation.
6. Customer(s) will also be asked to engage with the implementation of the project(s) to ensure compassionate and ongoing support.

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APPENDICES

1. Ethical Approval
2. Ethics Application Submission
3. Tiavea Pilot Project Memorandum of Agreement.
4. Project Phase 1 Financial Reporting
5. Acknowledgement for a Church Community
6. Video of community consultation

PERSONAL BIO – Helping the underprivileged is my reward.

John Eteuati is the fifth child of ten siblings with three sisters and six brothers, plus numerous cousins from a huge extended family. He was born and grew up in Samoa within a strong Christian family, where he valued trust, honesty, respect and love.

These qualities continue to fuel his passion for helping the underprivileged all throughout his Engineering career. Serving in the Public Sector for thirteen years as a Water Networks Engineers, he has helped with water projects for many communities in remote areas of Samoa.

He now resides in Dunedin, New Zealand, since 2010, and works at the Dunedin City Council within the Water and Waste Services as an Asset Planning Engineer, since 2014. This was after he graduated from the Otago Polytechnic with his Bachelor of Engineering Technology degree, where he was sponsored financially by the Dunedin Community Trust through the Pacific Islands and Maori Students scholarship scheme. He continues to serve the Dunedin community as a way of giving thanks for their support during his studies.

John continues to offer his services to the less fortunate people not only in Samoa but all around the world through monthly donations to various charitable organisations such as Unicef and Green Peace.

He is currently completing his Master on Enterprise Design with Otago Polytechnic, where he has been blessed with the opportunity to develop a framework for future projects towards infrastructure development within the rural communities of Samoa, as his design enterprise project. During this program, he has managed to introduce his biomass wood fuel oven technology to a few communities in Samoa, in place of the traditional method of cooking 'Umu'.

John loves to spend his weekends with his wife and three kids, especially serving them with a special feast on Sundays. This is after carrying out his responsibilities as the Treasurer for the Samoan Methodist Church denomination in Dunedin, which they attend every Sunday. He often goes golfing on Saturdays with friends if he has spare time, but highly unlikely if he knows someone is in need of help. If he does not have work at home on his car or maintaining his property, he would help mow someone else's lawn or offer to do other jobs for free.

He dreams of setting up a Second-Tier Education Program through a Trades Institution in Samoa and the around the Pacific region, to provide a second opportunity for year 13 students who have missed out on scholarship schemes and cannot afford to pursue tertiary level education.

John's motto summarises the depth of his personal biography: "Helping the underprivileged is my reward".