

Assignment 1

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Engineering Design Roles Context about EWB design challenge

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Executive Summary

The aim of this report is to become familiar with the context and environment of the Engineers without Border (EWB) Challenge. This included: what engineering disciplines were relevant and why, the environmental context the EWB Challenge region, in this case Cape York, the current conditions of the indigenous communities in Cape York, and the cultural background of these communities.

It was found that the most relevant disciplines were mechanical, electrical, civil, material, and environmental. The soil in Cape York is infertile, and the weather challenging. This can make conventional farming difficult. The indigenous cultures are rich and deep, but many times opposes the state's solution to improving the quality of life. Currently, the housing conditions of Aboriginals and Torres Strait Islanders living in the remote communities of Cape York are far from ideal. A few reasons for this are the lack of infrastructure in the region, the lack of government attention, inadequate water, power, shelters, and a difficult environment.

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1. Introduction

The 2021 EWB challenge is a task set out by Engineers without Borders, in conjunction with the Centre for Appropriate Technology (CfAT) to help present ideas that can help support Traditional Owners living on land. [1]

Engineers without Borders is a non-governmental organisation that aims to create a more humanitarian stance on engineering and to enable more sustainable development. They have a challenge series which takes ideas from universities and implements them. [2]

The Centre for Appropriate Technology is an Aboriginal and Torres Strait Islander controlled organisation who strives to maintain people's relationship with country. [3] They mainly achieve this by providing reliable power, water, developing skills, and building infrastructure.

The challenge task for this year was to deliver ideas in the areas of Transport and Access, ICT, Structures, Energy, Waste Management, Waste and Reuse, or Conservation and Land Management [4] in order to improve the livelihood of the remote Indigenous communities living in Cape York.

1.1 Purpose

The purpose of this report is to become familiar with the EWB Challenge. This includes outlining some relevant engineering disciplines that would most be able to assist with the situation in Cape York, knowing what that situation is, as well as to provide a general overview of the culture of indigenous people.

1.2 Scope

The scope of this report covers the living conditions of Indigenous people around the Northern Territory, and specifically the region of Cape York.

1.3 Definitions, Acronyms, and Abbreviations

Engineers without Borders (EWB)

Centre for Appropriate Technology (CfAT)

Building Code of Australia (BCA)

2. Roles and capabilities of five different types of engineering in the 2021 EWB challenge design

This section will describe and explore on the five disciplines listed below

- i. Mechanical Engineering
- ii. Electrical Engineering
- iii. Civil Engineering
- iv. Material Engineering

v. Environmental Engineering

2.1 Mechanical Engineering

Mechanical engineering covers all things to do with the analogue side of machinery or the parts that physically move. They must deal with the heat generated and forms energy to power mechanism as well as the creation, maintenance, and optimisation of the mechanisms. For this reason, mechanical engineers are adept at the concepts of ‘fluid dynamics’ and ‘thermodynamics’ [5] which is all about how force, energy, and motion interact with each other. As mechanical engineering covers things from generators for power to air-conditioning systems the discipline is essential for many projects that may be created in the remote, hot areas of Cape York to ensure comfortable, sustainable living for the groups living there.

2.2 Electrical Engineering

Electrical engineering and mechanical engineering go hand in hand. Where mechanical deals with the physical, electrical engineering is concerned with the methods of powering these machines, as well as how the communities are using this energy. There are a lot of specialisations within electrical engineering itself, like power generation and distribution engineering, which cover everything from power stations and the transport of the energy. [5] This is one reason electrical engineers are essential for the EWB challenge. Another specialisation is telecommunication engineering, which is about the systems for transmitting signals around the region. This is especially relevant to the EWB challenge, as the brief explicitly discusses the improvement of ICT infrastructure.[4]

2.3 Civil Engineering

Civil engineering is all about the physical infrastructure that a society needs to function. Not only do civil engineers design large structures, but some roles in the field also revolve around making policy, planning decisions related to transport and water, and consulting with the local community. [5] This engagement with the local community is especially important regarding the EWB challenge, as careful consideration must be taken to not disorder the cultural systems already in place. Civil engineers consider a lot of things, from cost to environmental impacts, time, and even the materials required due to the soil composition. To improve the infrastructure in isolated regions, civil engineers are key.

2.4 Material Engineering

Material engineering is all about finding the best material for the job. Some engineers in the field even develop new, improved materials if a suitable one is unable to be found. The work they do is vital in all fields of engineering, from construction to mineral processing, as well as biomedical devices, [5] which is one reason it is such an important discipline for the EWB challenge. Another reason is that repairs would be difficult to do far out and as such, the materials chosen would have to be able to sufficiently withstand the environment for a reasonable length of time.

2.5 Environmental Engineering

Environmental engineers assess the impacts engineering projects have on the surrounding ecosystem and overall environment around the said project. They plan systems regarding how waste can safely be disposed as well as the development of alternative renewable energy sources. These engineers can assess the long-term environmental effects, as well as the problem the effect of short-term problems such as chemical spills. [5] For a location to be sustainable, and self-reliable, special attention must be treated towards how we dispose and recycle. This also helps is important to show the indigenous locals we respect their customs of respecting the land and country.

3. Environmental context of EWB challenge.

This section of the report covers the environmental context of the Cape York, the environmental context includes

- i. Geographical
- ii. Geotechnical
- iii. Climate
- iv. Flora & Fauna

3.1 Geographical

The Cape York Peninsula covers 13,720,000 hectares with 75% being mostly level plains, with 16 river basins of large, high-volume rivers. It was reported that water was plentiful, but that was back in 1995, and flows are said to be highly seasonal. [6] There are 7 major landscapes within the Cape York area, Heathlands, Batavia, Lockhart River, Edward River, Ebagoola, Mitchell, and Hordgkinson. [7]

3.2 Geotechnical

There are ten major types of soil in the peninsula, while one hundred and thirteen unique soil types have been identified. [7] Unfortunately, most of the soil had low levels of plant nutrients, as well as being nitrogen and phosphorus deficient. Many of the soils are hard setting, which means they are hard, dry and soften when wet, this along with the fact many soils are also acidic and infertility, makes it very difficult to grow plants.

3.3 Climate

The area is a monsoonal climate, which means there are distinct wet and dry seasons. The majority of the area experiences more than 2100 mm of rainfall per year and in general, more rain falls on the northern eastern areas rather than the southern western areas. [6] The average maximum temperature reaches 36 degrees in the summer months, while the average minimum reaches 24 degrees in the winter. [8]

3.4 Flora & Fauna

Over 3000 species of unique flora have been found, with 11.4% being rare or threatened. [6] Over 500 species of terrestrial vertebrates have been found including half of Australian birds, one third of its mammals, and one quarter of Australia's reptiles and frogs. A diverse amount of Australian fauna lives strictly in Cape York which makes the region especially important to

preserve. It is said two of three species living on Cape York are insects with over 700 species recorded. [9] Commercial success can be found with the diverse fish and crustacean animals found near the shores of Cape York.

4. Review for housing/sheltering conditions in remote Australian communities.

This section covers the general housing conditions of remote Australian communities all over Australia. The conditions are broken down like so,

- i. Safety
- ii. Constructability
- iii. Maintainability
- iv. Usability of Structure
- v. Cost of Housing
- vi. Impact of Life

4.1 Safety

Many indigenous families are effectively homeless, and most must rely on living with extended family. This causes two main issues, one is that this level of homelessness is under reported, as they technically have accommodation, regardless of how inadequate that accommodation is, and the other is an issue of overcrowding. Overcrowding is a big issue in indigenous communities, leading to a lack of food security as well as greatly increased rate of infections compared to a non-overcrowded household. [10] In remote areas almost 20% of households were identified as overcrowded and even this number is believed to be much lower than actual due to ‘visitors’ who live house to house alternating for accommodation. [10] Crowding also diminishes mental health which could be due to the social stress generated from a crowded household. [11]

Improvement on housing revolves around maintaining the 9 ‘healthy living practices’ that emerged in the mid 1980’s. These are: the ability to wash clothes and people, safely removing waste, the ability to store protect and cook food, reduced crowding, reducing negative contact between people and animals, insects, and vermin, reducing dust, temperature control within the living environment, and reducing trauma. [11] Only 38% to 68% of households from indigenous communities in the Northern Territory satisfied the 9 practices with the others failing to meet one or more of the criterions. [11]

There is a lack of reliable, safe power in these indigenous communities, with 60% relying on community power supplies, which are subject to relatively frequent interruptions. In the Cape York region specifically, dengue is a common problem, as such shelters and houses must be built with the repulsion on mosquitos kept in the mind. There is an outbreak of dengue nearly every year in the region. [12] Shelters also must be built elevated to prevent snakes from entering. A lot of shelters are self-built, and means the building are ever evolving. Temporary structures are built upon to be sturdier and more permanent, and the oldest self-built structure result from 50 years of continuous work. [13] A consequence of these self-built structures is that rarely would the building comply with the standards set by the Building Code of Australia (BCA), which

comes from the fact the builders are limited by the amount of knowledge they have access to. This could lead to unsafe shelter conditions and loss of life or homes.

4.2 Constructability

In many indigenous households, there are major structural problems with one third of permanent dwelling requiring major repair or replacement. [11] Even minor structural deficiencies present risk of injury as well as introducing temperature control issues, pest, lack of privacy and personal hygiene structures all of which can affect mental wellbeing. Shelters can also be self-built, which creates an independent structure built by the indigenous people on country. These buildings do have minor structural issues and are not aligned with the standards set by the Building Code of Australia (BCA). [13]

4.3 Maintainability

In these overcrowded households, the hope is that they can maintain a steady food supply and consequently, a healthy weight, but this is very difficult to do. The falling food supply coming from the overabundance of people relying on that food. [10] Hygiene is also something whose maintenance is limited not only by knowledge, but also the infrastructure. [11] In these self-built houses, the onus of maintaining the structure is usually the 'self-builder' owner. [13] This can be difficult or easy depending on the complexity of the structure.

4.4 Usability of Shelter

Water supplies are unreliable in many Indigenous communities and consequently it becomes difficult to wash people or clothes. Pair this with the fact that there are many people living under one house, and also the inadequate sewerage infrastructure, leads to the conclusion of unsafe, ill suiting, and borderline unusable shelters. [11] Power is also essential for modern, usable housing. Unfortunately, there is a lack of safe power in these communities, with 58% of people in these communities relying on community power supplies, which are subject to frequent interruptions. [11] No power means no hot water, no temperature control, no safe fuel for cooking, and no lighting for domestic activities.

4.5 Cost of Housing

There are two main reasons why overcrowding is a problem in these communities. One is a cultural issue which will be expanded on later, the other is because the number of houses available is not sufficient for the population. [14] Many indigenous people participate in community housing rental programs just to have accommodation, and the accommodation that is given to them is still unsuitable with more than half having major structural problems. [11] The power created from community generators are unreliable as mentioned before, but even when they are working there are plenty of families that still have no power due to the lack of funds for acquiring it. A reason self-built houses are relatively prevalent is that the cost of housing is decreased massively due to lack of a need to pay for building labour as well as the cheaper or even free materials that can be found for the project. [13] Power, and water would still have to be paid for, or acquired through other means.

4.6 Impact of Life

There is a cultural facet to overcrowding. Crowding can be seen as maintaining cultural protocols, as care of extended family was identified as a deep-rooted aspect of Aboriginal culture. [10] These distant kinship connections are important and may explain partly the reason crowding in aboriginal communities is so common. Crowding can also violate some cultural protocols, such as one where a pregnant woman is meant to be kept away from her brothers. In the past all she had to do was move away, however in the communities with limited housing and crowding, this custom becomes very difficult to uphold. [10] This could lead to stress as indigenous traditions and the real-life conditions conflict. This impact of life does not even begin to mention the lack of water and power, as well as the structural issues mentioned earlier in the report all of which can introduce stress, diseases, and other adverse health effects. Compounded with the lack of medical services [15] and this leads to a challenging way of life.

5. Indigenous culture study

Indigenous culture is rich and complex, and there are many aspects of their culture. The aspects specifically covered in this report are

- i. Before Coloniasation
- ii. After Coloniasation
- iii. Dreaming
- iv. Country
- v. Acknowledging Country

5.1 Before Coloniasation

Before the arrival of European colonisation, the Aboriginal people had complex societal structure. They had a law system, education, deep seated knowledge of the environment, resource management, customs, traditions, and more. [16] Children were cared for, and each community was independent. Long distance trade existed between these communities. Trade was not motivated by an economic incentive, but rather a desire to increase societal connection. If tribes met to settle disputes or to have ceremonies, goods would commonly be brought to trade. [17]

5.2 After Coloniasation

Once the Europeans arrived, the aboriginal way of life was completely uprooted. The people were massacred and were subject to documented atrocities. [16] They were forced off their traditional land and placed under the custody of the colonist in the name of protection. Culture was stamped down and as such a lot of it was lost. There were 250 languages [17] in Australia at the time of European arrival; now only 18 languages strongly remain.

5.3 Dreaming

The concept of dreaming can be described as the collective knowledge of all indigenous ancestors when become deceased. It can also be seen as a barrier separating the physical and the metaphysical. Dreaming is passed down the generations through stories, dance, and art. It is understood that once knowledge has been passed to you, you become a ‘holder’ of this knowledge; It is a responsibility and is seen as a great honour. [17]

5.4 Country

The indigenous people do not only see the land around them as a physical thing, to manipulate and exploit, it is also seen as a spiritual thing. Aboriginals and Torres Strait Islanders do not place themselves above the plant, animals, and land, instead they see themselves as belonging with them. Disputes among tribes did occur in the past, but never territorial as they had no desire to 'own' the land. [17]

5.5 Acknowledging Country

At a major public meeting, a 'Welcome to Country' is usually performed at the beginning. Always done by an Elder either in their language, or in English. An 'Acknowledgement to Country' on the other hand can be performed by anyone, indigenous or not. There is no set wording for a 'Acknowledgement to Country' but often they will contain an acknowledgement to the traditional owners, and a payment of respect towards their elders past and present. These protocols are done to increase the connection with country and thereby increasing the wellbeing of Aboriginal and Torres Strait Islander peoples. [18]

6. Summary

The aim of this report was to provide a general overview on the context of the EWB Challenge. What the EWB challenge was, the environment of the challenge area, the housing conditions of indigenous people as well as a surface exploration of their culture.

The environment of Cape York is quite hostile, with low quality soil to grow conventional plants, and uncomfortably hot temperatures. A lot of Native Australian wildlife depend on this area of the country, making it important to preserve. The most relevant engineering disciplines to improve Cape York were explored and an explanation on why they were relevant were given. The living conditions of the indigenous people were found to be barely adequate, with an over proportional amount of overcrowding occurring compared to other groups living in Australia. The culture and history of the First Australians was found to be fascinating as well as cruel. With a consequence of their history with the colonisers leading to a lower quality of life on average in the present day.

7. Project management

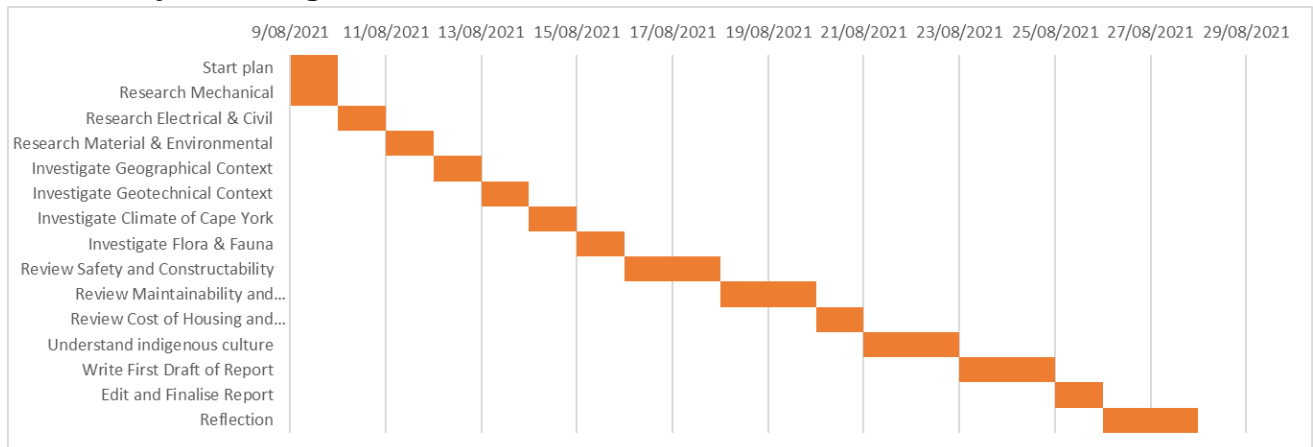


Figure 1. Budgeted Gantt Chart

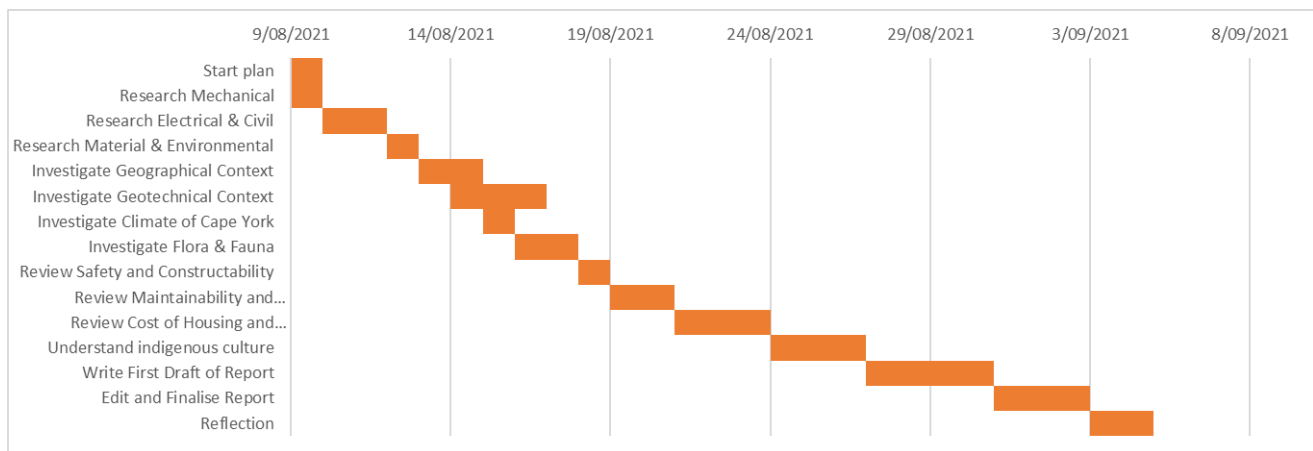


Figure 2. Actual Gantt Chart

The figures above show my budgeted Gantt chart as well as my actual Gantt chart. As you can see, I predicted that I would finish on the 28th of August, but instead I finished on the 5th on September. That is nine days later.

I followed the budgeted time accurately until the third task which was researching about the electrical and civil disciplines. The reason for this was that was when the first tests were coming out that I had to study for. That was the reason for nearly all my delays, studying for tests. In hindsight I should have seen them coming and planned better accordingly.

I originally planned to do all my task in series, it ended up me doing some task in parallel to try 'catch up' and restore myself to the original plan. This worked for a bit, but there are some tasks I severely underestimated how much time they would take. I assumed the first draft of the report could be finished in a day, instead it took double that time. Eventually I decided I may as well use as much time as I could and 'redid' the plan in my head to minimise stress.

8. Reflection on your learning

The most transformative way my understanding has changed was exploring just how difficult life in remote indigenous communities were. I knew they had a more challenging experience, but actively researching and learning in depth on the conditions of their living environments really made me understood and realise how little I knew before. This would be useful in the future as it is evidence of how little I know compared to how much I think I know. This realisation would prevent me from jumping to conclusion when I think I know all the facts and help me take more perspectives in before deciding on a solution or making a judgement.

The most transformative capability I have developed was learning how the reference properly. This assignment forced me to learn how to use Endnote which help with citations and references. This would be incredibly useful for all future reports or assignments requiring referencing.

I think the most troublesome part for me was writing down the report, choosing the perfect words to use, making paragraphs and sentence flow nicely, and making the report an overall pleasure to read. The researching part took relatively little time compared to writing up all that research. It is still troublesome for me, and the only way I overcame it in this task was time. I just spent hours staring at the screen waiting for the right words to come up. Hopefully I get better as I have more practise with it.

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