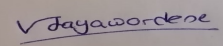
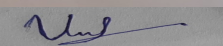
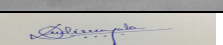
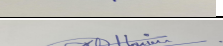
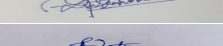


Module Details			
Module Code	CE1913	Module Title	Introduction to Sustainable Engineering
Program: SLIIT/Curtin/SHU/		Course: BSc/ BEng/	
Stream: Civil/Electronics/Mechanical/			

Assessment details			
<b>Title</b>	Final submission-Term Project	<b>Group assignment</b>	<b>YES / NO</b>
		<b>If yes, Group No.</b>	05
<b>Lecturer/ Instructor</b>	Ms Manuri Senarathne	<b>Date of Performance</b>	
<b>Due date</b>	24/09/2021	<b>Date submitted</b>	24/09/2021

Student statement and signature
<p>By this declaration, I/we confirm my/our understanding and acceptance that the work reported in this report is my/our own work. I/we also understand the consequences of engaging in plagiarism or copying others work without proper citation. Any material used in this work (whether from published sources, the internet or elsewhere) have been fully acknowledged and referenced and are without fabrication or falsification of data.</p> <p>[Copying or plagiarism will result in a "0" mark for the continuous assessment and "F" for the module after an investigation on academic misconduct;</p> <p>All academic misconduct is considered seriously and defined as dishonest and in direct opposition to the values of a learning community. Misconduct may result in penalties from failure to exclusion from the campus.</p> <p>Further help and guidance on how to avoid academic misconduct can be obtained from your academic advisor/tutor]</p> <p>By this declaration, I/we confirm my understanding and acceptance that-</p> <ul style="list-style-type: none"> <li>I/we have adhered to relevant ethical guidelines and procedures in the completion of the assignment.</li> <li>I/we have not allowed another student to have access to or copy from this work.</li> <li>This work has not been submitted previously.</li> </ul> <p>[The Institute may request an electronic copy of this work for submission to the Plagiarism detection facility (TURNITIN). You must make sure that an electronic copy of your work is available in these circumstances]</p>

Details of the student/s submitting the assignment		Signature
ID Number	Name (As per the institute records )	
En21466830	Jayawardene M.V.G .J	
EN21481130	Vindipa K.G.V	
EN21485640	Dissanayake D.M.K. N	
EN21482120	Perera M.A .D	
EN21492716	Isaka. N.A. T	

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<b>Receiving Officer</b> (seal, signature, date)	<b>Specific comments about the work (including overall comments and guidelines for improvement)</b>  <a href="https://youtu.be/5672SyPJhY">https://youtu.be/5672SyPJhY</a>		
	<b>Tutor:</b>	<b>Signature:</b>	<b>Date:</b>
	<b>Marks:</b> [ All marks are subject to external moderation and approval of board of examinations]		

# Sri Lanka Institute of Information Technology

Department of Civil Engineering

CE1913 Introduction to Sustainable Engineering

## Evaluation form- Submission 2

A.1 Project title		A Sustainable Alternative to Toothbrush																		Project No.					
																				02					
A.2 Group member Names										ID Number				A.3 Mentor details											
M1		Jayawardene M.V.G .J								En21466830				Mentor name		Ms. Manuri Senarathne									
M2		Vindipa K.G.V								EN21481130				Mentor signature											
M3		Dissanayake D.M.K. N								EN21485640				Evaluation date		24/09/2021									
M4		Perera M.A .D								EN21482120															
M5		Isaka. N.A. T								EN21492716															
A.4 Submission 2 (Questions 5 to 8)																						10%			
Assessment element			LO		Low competency level						Average competency level						High competency level								
A.4.1 Report formatting and correctness. (10%)			2		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Formatting includes margins, correctness of fonts, section numbering, cover page, referencing style, figure and table numbering and captions, referencing etc.																									
					There are many formatting errors in the report. It has many grammatical and spelling						A reasonable effort has been made to conform to the standard given in D01, and it includes						The report substantially meets the formatting standards given in D01 and has hardly any grammatical								

Correctness includes grammatical and spelling mistakes as well.  Please refer Section B of this document for full details on formatting.			mistakes. Guidelines given in D01 are substantially defaulted.							some spelling and grammatical mistakes.							and spelling mistakes.						
			Feedback:																				
A.4.2	Answer to Q5 (20%)	1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
The problem/s associated with the original product has been identified correctly  [Question 5- what is the problem with the product (by analyzing 1-iv)]																							
			The problems in the product are not identified correctly or incomplete							All problems in the product are identified but they are not clear and logical. Identification with respect to once or more aspects of environmental/social/ economical aremissing..							All the problem in the product are identified correctly and clearly with respect to environmental, social and economical considerations.						
			Feedback:																				
A.4.3	Answer to Q6 (20%)	1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
All the alternatives are clearly identified  (Q6- what alternatives are available																							
			Alternatives identified will eliminate no or only a few of the drawbacks/problems identified in Q5.							Alternatives identified will eliminate most of the drawbacks/problems identified in Q5.							Alternatives identified will eliminate all the drawbacks/problems identified in Q5.						

			Feedback:																							
A.4.4	Answer to Q7 (30%)	1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100			
Have selected the best suitable alternative that can be manufactured/made  (Q7- select the best alternative product to replace the original product to overcome the problem/s identified in v.)		Select a suitable alternative that can be manufactured/made by your group																								
			Selection criteria for the best suitable alternative that can be manufactured/made is not clear and logical. Have looked few of the possibilities.								Selection criteria for the best suitable alternative that can be manufactured/made is clear and logical to a considerable extent. Have looked at some of the possibilities.								Selection criteria for the best suitable alternative that can be manufactured/made is clear and logical. Have looked at all the possibilities.							
			Feedback:																							
A.4.5	Answer to Q8 (20%)	1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100			
(Q8- Show how the redesign will solve the problems identified in Q v. and how the redesigned product is equal to the original product in performance)																										
			Shows no or very few relevant facts from literature how the suggested alternative serves the intended purpose.								Shows some relevant facts from literature how the suggested alternative serves the intended purpose.								Shows all relevant facts from literature how the suggested alternative serves the intended purpose.							
			Feedback:																							

## 5. What are the problems with the toothbrush (Considering the Life Cycle)?

Table 1 problems with the toothbrush

Stages of the lifecycle	Problems associated		
	Environmental	Social	Economical
<b>Extraction of raw materials</b>	<ul style="list-style-type: none"> <li>• Biodiversity damage</li> <li>• Natural habitat destruction, causing many species to be uprooted</li> </ul>	<ul style="list-style-type: none"> <li>• Poor governance and weak institutional and legal frameworks</li> <li>• Extraction of natural rubber is a labor-intensive process</li> </ul>	<ul style="list-style-type: none"> <li>• Waste of non-renewable sources</li> <li>• Have to spend much money in extracting process</li> <li>• Have to spend money when people are infected due to Sulphur gas when extracting Sulphur</li> <li>• Have to spend more money on safety features in the process and product</li> </ul>
<b>Manufacturing process</b>	<ul style="list-style-type: none"> <li>• Water pollution when chemical release</li> <li>• Air pollution due to toxic gases releasing resulting global warming</li> <li>• Land pollution due to nylon dust</li> </ul>	<ul style="list-style-type: none"> <li>• Sound pollution due to machines</li> <li>• Can cause respiratory diseases from harmful gases</li> </ul>	<ul style="list-style-type: none"> <li>• High level of energy use</li> <li>• High cost in repairing machines</li> <li>• Government labors laws and taxation policies</li> </ul>

<b>Use of product</b>	<ul style="list-style-type: none"> <li>• Microplastics released to the environment</li> </ul>	<ul style="list-style-type: none"> <li>• Some kids may chew bristles and it causes some harmful effects</li> <li>• Brushing too hard can damage teeth and gums</li> </ul>	<ul style="list-style-type: none"> <li>• Some types of toothbrushes are expensive, and some people can't afford them</li> </ul>
<b>Disposal</b>	<ul style="list-style-type: none"> <li>• Pollution of waterways.</li> <li>• Toothbrushes often ended up in waterways and oceans.</li> <li>• Harming the marine life.</li> <li>• When burning plastics, they release hazardous gas into the air.</li> <li>• Soil fertility can be lost.</li> </ul>	<ul style="list-style-type: none"> <li>• People throw plastic toothbrushes instead of recycling</li> <li>• Poor knowledge of recycling</li> <li>• Overuse of the toothbrushes</li> </ul>	<ul style="list-style-type: none"> <li>• High labor cost for collecting and partitioning the toothbrushes according to the recycling number</li> </ul>

## 6) What alternatives are available?

Table 2 Available solutions

	<b>What previous problems are addressed by the solution</b>	<b>Alternative solutions</b>
Alternative to handle	<ul style="list-style-type: none"> <li>• Recyclable</li> </ul>	PLA – biowaste plastic
	<ul style="list-style-type: none"> <li>• Reusable</li> </ul>	Stainless steel
	<ul style="list-style-type: none"> <li>• Biodegradable</li> <li>• Minimize the land pollution</li> <li>• Minimize the use of non-renewable resources</li> <li>• Minimize the high cost of material</li> <li>• Reduce the high level of energy use</li> </ul>	Bamboo sticks

	<ul style="list-style-type: none"> <li>Minimize the high cost of machinery</li> </ul>	
Alternative to rubber	<ul style="list-style-type: none"> <li>Minimize the use of renewable resources</li> <li>Minimize the labor-intensive process in extraction of natural rubber</li> </ul>	Silicone
Alternative to bristles	<ul style="list-style-type: none"> <li>increases softness</li> <li>Minimize land pollution and air pollution (if burned)</li> </ul>	Silicone
	<ul style="list-style-type: none"> <li>Minimize the use of non-renewable resources</li> <li>Minimize the release of non-degradable waste material to land</li> <li>Minimize the high cost of material</li> <li>Reduce the high level of energy use</li> </ul>	Bamboo strands
	<ul style="list-style-type: none"> <li>Biodegradable</li> <li>Effective at removing plaque and bacteria</li> </ul>	Boar bristles
	<ul style="list-style-type: none"> <li>Minimize the use of renewable resources</li> <li>Reduce the high level of energy use</li> </ul>	castor oil

**7. Select the best alternative product to replace the original product to overcome the problem identified in question 5.**

The most sustainable option for plastic toothbrush handles is bamboo sticks. Bamboo has many properties and it is good for the oral cavity. Plastic can replace with this rapidly growing renewable resource and it can be fully composted.

**Targeted problem to solve**

- Preventing the waste of non-renewable sources
- Reduce the damage of biodiversity
- Minimize the waste of non-renewable sources
- Minimize land pollution, water pollution, and air pollution

**Benefits to achieved**

Bamboo grows fast in nature and it is not very expensive. It is lightweight, durable, and can be composted. This bamboo handle and bristles are strong, biodegradable, and have no negative impact on the planet. Since bamboo is a renewable source, we can recycle and reuse it. Bamboo does have a smaller ecological footprint than plastic. It contributes to reducing the Carbon footprint and Water footprint. The supply of bamboo toothbrushes may be an efficient process. It is an eco-friendly product and BPA-free

**08) show how the redesign will solve the problems identified in Q 5. And how the redesigned product is equal to the original product in performance.**

William Addis invented a modern toothbrush in England around 1780. The handle is made of beef bone, and the brush section is made of pig gold hair. In 1844 the first 3 rows of brushes were created. Modern toothbrushes are usually made of plastic handles and nylon fibres. Modern toothbrush handles come in many variants, including straight, angled, or curved handles. Toothbrushes are important for us to use every day and by using toothbrushes we can able protect our teeth and gum very healthy.

Toothbrushes, which are primarily made of plastic-based materials, have been blamed for the global pollution problem. It is mainly the synthetic material from which the plastic material is made that harms the environment. It is these synthetic materials that prevent plastic from decomposing naturally. Plastic toothbrushes pollute oceans and beaches. Plastic toothbrushes stain piles of rubbish and release chemicals into the air as they enter the pile. So, this results in even more damage to the environment. The bamboo toothbrushes were fine for everyone and people loved that the fact that they are biodegradable. And also, we can reduce the air pollution due to some toxic gases release, when manufacturing bamboo handles toothbrushes. So, the bamboo handle is better than the plastic handle. These boar bristles have fewer abrasive properties than nylon bristles which means your teeth get clean but your tooth enamel is not damaged. Mainly bamboo toothbrushes are considered sustainable because they can grow in nutritionally depleted soil and regenerates quickly. And a boar bristle brush is not vegan because it contains animal parts. The bristles from a boar are made of keratin. So rather than boar bristles, we have selected the best alternative as bamboo strands because bamboo is the fastest growing plant.

When we comparing the properties which we use for our product with the original product,

*Table 3 Compare our product with the original product*

	Description
Rubber grip replace with silicone	silicone is a highly flexible and will rebound to its original shape after it is flexed or bent.
Plastic handle replaces with the bamboo stick	Bamboo grows in natural environments and is not susceptible to lengthy and polluting production processes like plastic. Bamboo toothbrushes are also more durable and waterproof handle than the plastic toothbrushes
Bristles replace with bamboo strands	Natural bamboo bristles are very soft rather than plastic and are also gentle on our gum tissue and enamel. So, bamboo strands are more eco-friendly rather than plastic.



## Reference

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# PLAGIARISM SCAN REPORT

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5.) What are the problems with the toothbrush (Considering the Life Cycle)?

Table 1- problems with the toothbrush

Stages of the lifecycle Problems associated

Environmental Social Economical

Extraction of raw materials • Biodiversity damage

- Natural habitat destruction, causing many species to be uprooted • Poor governance and weak institutional and legal frameworks
- Extraction of natural rubber is a labor-intense process

- Waste of non-renewable sources
- Have to spend much money in extracting process
- Have to spend money when people are infected due to Sulphur gas when extracting Sulphur
- Have to spend more money on safety features in the process and product

Manufacturing process • Water pollution when chemical release

- Air pollution due to toxic gases releasing resulting global warming
- Land pollution due to nylon dust
- Sound pollution due to machines
- Can cause respiratory diseases from harmful gases
- High level of energy use
- High cost in repairing machines
- Government labors laws and taxation policies

Use of product • Microplastics released to the environment

- Some kids may chew bristles and it causes some harmful effects
- Brushing too hard can damage teeth and gums • Some types of toothbrushes are expensive, and some people can't afford them

Disposal • People throw plastic toothbrushes instead of recycling

- Poor knowledge of recycling
- Excessive use of toothbrushes
- Excessive labor costs to assemble and disassemble toothbrushes according to the recycling number

6) What alternatives are available?

Table 2 – Available alternatives

What previous problems are addressed by the solution Alternative solutions

Alternative to handle • Recyclable PLA – biowaste plastic

- Reusable Stainless steel
- Biodegradable
- Minimize the land pollution
- Minimize the use of non-renewable resources
- Minimize the high cost of material
- Reduce the high level of energy use
- Minimize the high cost of machinery Bamboo sticks

Alternative to rubber • Minimize the use of renewable resources

- Minimize the labor-intensive process in extraction of natural rubber

Silicone

Alternative to bristles • increases softness

- Minimize land pollution and air pollution (if burned) Silicone
- Minimize the use of non-renewable resources
- Minimize the release of non-degradable waste material to land
- Minimize the high cost of material
- Reduce the high level of energy use Bamboo strands
- Biodegradable
- Effective in removing plaque and bacteria Boar bristles
- Minimize the use of renewable resources
- Reduce the high level of energy use castor oil

7. Select the best alternative product to replace the original product to overcome the problem identified in question 5.

Selected Alternative- Bamboo sticks to the plastic handle and Bamboo strands to bristles

Why plastic handles and bristles can replace with bamboo?

The most sustainable option for plastic toothbrush handles is bamboo sticks. Bamboo has many properties and it is good for the oral cavity. Plastic can replace with this rapidly growing renewable resource and it can be fully composted.

Targeted problem to solve

- Preventing the waste of non-renewable sources
- Reduce the damage of biodiversity
- Minimize the waste of non-renewable sources
- Minimize land pollution, water pollution, and air pollution

Benefits to achieved

Bamboo grows fast in nature and it is not very expensive. It is lightweight, durable, and can be composted. This bamboo handle and bristles are strong, biodegradable, and have no negative impact on the planet. Since the bamboo is a renewable source, we can recycle and reuse it. Bamboo does have a smaller ecological footprint than plastic. It contributes to reducing the Carbon footprint and Water footprint. The supply of bamboo toothbrushes may be an efficient process. It is an eco-friendly product and BPA-free.

08) show how the redesign will solve the problems identified in Q 5. And how the redesigned product is equal to the original product in performance.

William Addis invented a modern toothbrush in England around 1780. The handle is made of beef bone, and the brush section is made of pig gold hair. In 1844 the first 3 rows of brushes were created. Modern toothbrushes are usually made of plastic handles and nylon fibers. Modern toothbrush handles come in many variants, including straight, angled or curved handles. Toothbrushes are important for us to use every day and by using toothbrushes we can able protect our teeth and gum very healthy. Toothbrushes, which are primarily made of plastic-based materials, have been blamed for the global pollution problem. It is mainly the synthetic material from which the plastic material is made that harms the environment. It is these synthetic materials that prevent plastic from decomposing naturally. Plastic toothbrushes pollute oceans and beaches. Plastic toothbrushes stain piles of rubbish and release chemicals into the air as they enter the pile. So This results in even more damage to the environment. The bamboo toothbrushes were fine for everyone and people loved that the fact that they are biodegradable. And also, we can reduce the air pollution due to some toxic gases release, when manufacturing bamboo handles toothbrushes. So, the bamboo handle is better than the plastic handle. These boar bristles have less abrasive properties than nylon bristles which means your teeth get clean but your tooth enamel is not damaged. Mainly bamboo toothbrushes is considered sustainable because it can grow in nutritionally depleted soil and regenerates quickly. And a boar bristle brush is not vegan because it contains animal parts. The bristles from a boar are made of keratin. So rather than boar bristles, we have selected the best alternative as bamboo strands because bamboo is the fastest growing plant.

When we comparing the properties which we use for our product with the original product,

Table 3 – compare our product with the original product

Description

Rubber grip replace with silicone silicone rubber is highly flexible and will rebound or return to its original shape and configuration after it is flexed or bent.

Plastic handle replaces with the bamboo stick Bamboo shrubs grow in a natural environment and are not susceptible to long and contaminated product processes such as plastic Bamboo toothbrushes are also more durable and waterproof handle than the plastic toothbrushes.

Bristles replace with bamboo strands Natural bamboo bristles are very soft rather than plastic and are also gentle on our gum tissue and enamel. So bamboo strands are more eco-friendly rather than plastic.

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