Capstone design for Manufacturing Engineering Programme at UKM

UNIVERSITI KEBANGSAAN MALAYSIA

The National University of Malaysia

Prof Dr Dzuraidah Abd Wahab
Course coordinator
KKKP4274 Product Design

Product Design KKKP4274

- A compulsory course for final year Manufacturing Engineering Programme
- Assessment method – Continous assessment that includes Project presentation (design brief, progress presentation; final presentation), Design report, Tests
- Design teams of 3-4 students in a group
- General design theme : Design for life improvement

Course synopsis

- *This course provides exposure, knowledge, understanding and synthesis for a systematic development of product design using the engineering design methodology. During the course, students will be introduced to the basic methods and techniques to develop products from information search to the concept design and detail design stages with considerations on product life cycle requirements in view of developing a sustainable product design. Students are expected to work in groups in order to develop a product design which will be assessed through project reports and oral presentations.*

KKKP4274 has recently been revised to take into consideration requirements of the Engineering Accreditation Council, with emphasis on societal, environment and safety

- Engineering Accreditation Council (EAC) is the body delegated by Board of Engineers Malaysia (BEM) for accreditation of engineering degrees.

- The duty of BEM is to ensure that the quality of engineering education/programme of its registered engineers attains the minimum standard comparable to global practice.

Programme Outcomes measured in KKKP4274

- **PO2 Problem Analysis** - Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;

- **PO3 Design/Development of Solutions** - Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations;

- **PO5 Modern Tool Usage** - Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations;

- **PO6 The Engineer and Society** - Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice;

- **PO7 Environment and Sustainability** - Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development;

- **PO9 Communication** - Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

- **PO10 Individual and Team Work** - Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;

- **PO11 Life Long Learning** - Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Snapshots of undergraduate design projects


OPTIPOLE
Ever Experienced These Pain After Harvesting The Fruits
BACK PAIN
NECK PAIN
SORE ARM
CAMERA to increase your vision!
BASKET to locate the harvested fruits
Adjust the height as you want!
Press this GRIPPER to cut the fruits
END IT NOW WITH THE ERGONOMIC OPTIPOLE!
With all new FEATURES!
Including:
1) Camera to increase vision!
2) Easy height adjustability!
3) Light weight!
4) Fast cutting!
Group 1: Ng Wei Loong, Natasha Emira, Arno Nellessen, Nor Hasanil Hanief


AUTOMATIC BED STRETCHER
ONE OF A KIND.
CONCEPT
DESIGN
PROSPECT
ARCHITECTURE
MULTIVIEW DRAWING
"I ALWAYS HAVE TIME TO MAKE MY BED IN THE MORNING"
SAID NO ONE, EVER.
RESEARCH TEAM
AMR ASYRAF BIN MOHAMMAD REDZUAN
ROMAN SCHMITZ
RASYIDAH BINTI AHMAD
CHIA CHONG PEIN
WAKE UP. CLICK. DONE.
ACKNOWLEDGEMENTS
PROF. MADYA DR. MOHD NIZAM BIN AB RAHMAN(ADVISOR)
PROF. DR. DZURAIDAH BINTI ABD. WAHAB (LECTURER)
DR. RIZAUDDIN BIN RAMLI
PROF. DR. JAHARAH BT. A GHANI
PROF. DR. CHE HASSAN BIN CHE HARON
UNIVERSITI KEBANGSAAN MALAYSIA
THE NATIONAL UNIVERSITY OF MALAYSIA
www.eng.ukm.my

KKKP 4274 Product Design

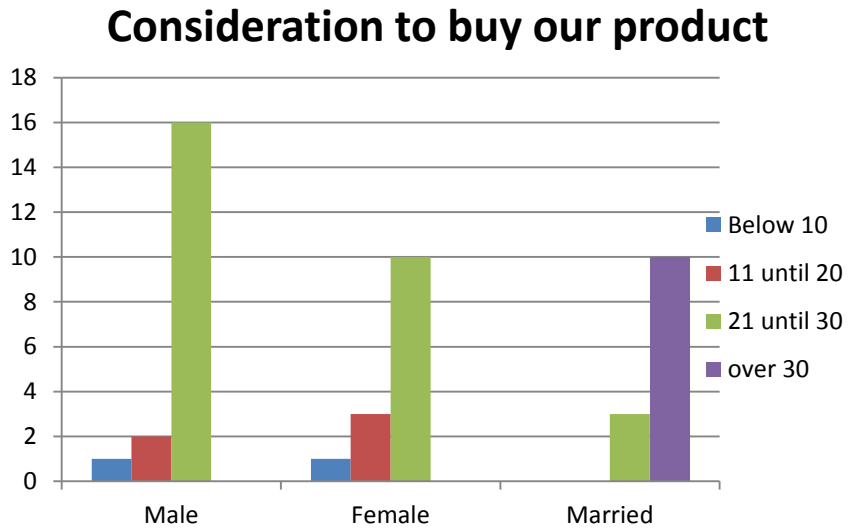
UNIVERSITI KEBANGSAAN MALAYSIA
National University of Malaysia

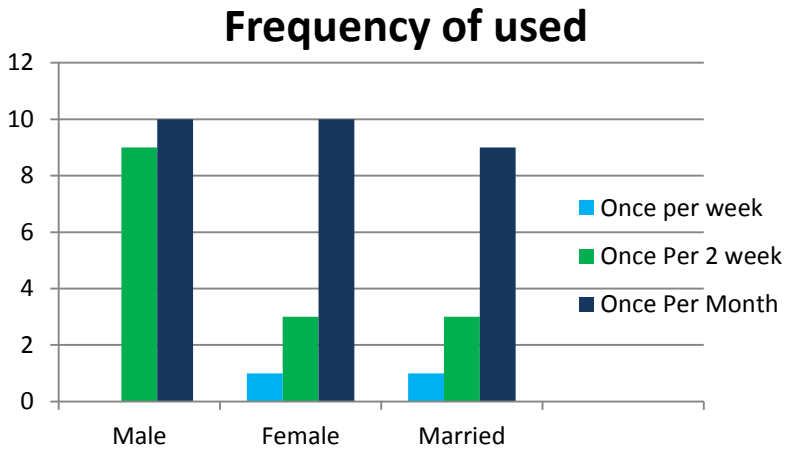
Eco -Lawncycle

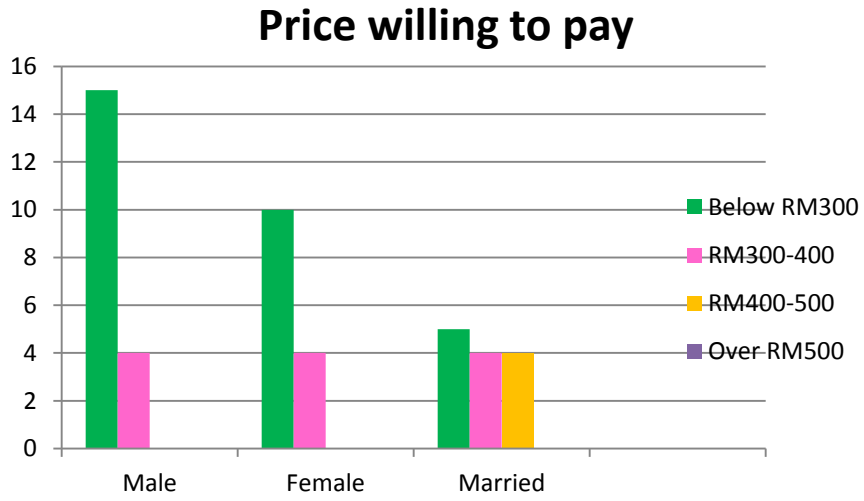
Ahmad Zafri Bin Ab Aziz	**A133411**
Loh Wei Lie	**A134068**
Wong Wei Xiang	**A134129**
Ahmet Karkar	**A142947**

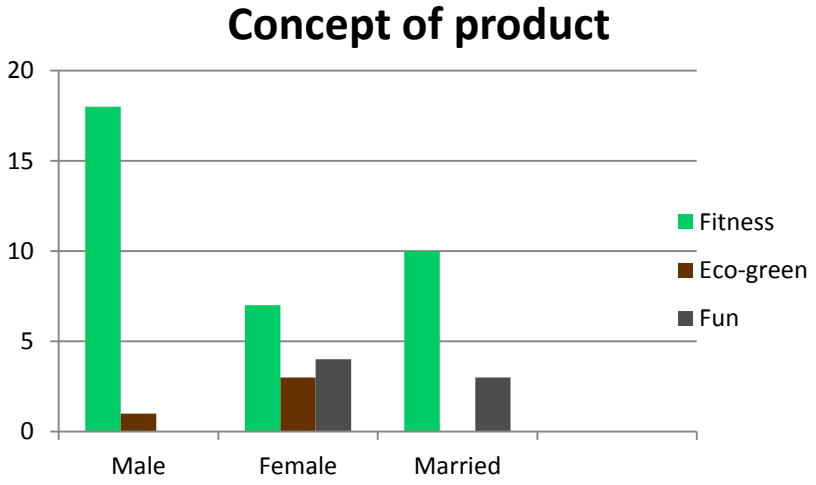
LECTURER : PROF. DR. DZURAIDAH ABD. WAHAB
SUPERVISOR : DR. RIZAUDDIN RAMLI

Survey Results





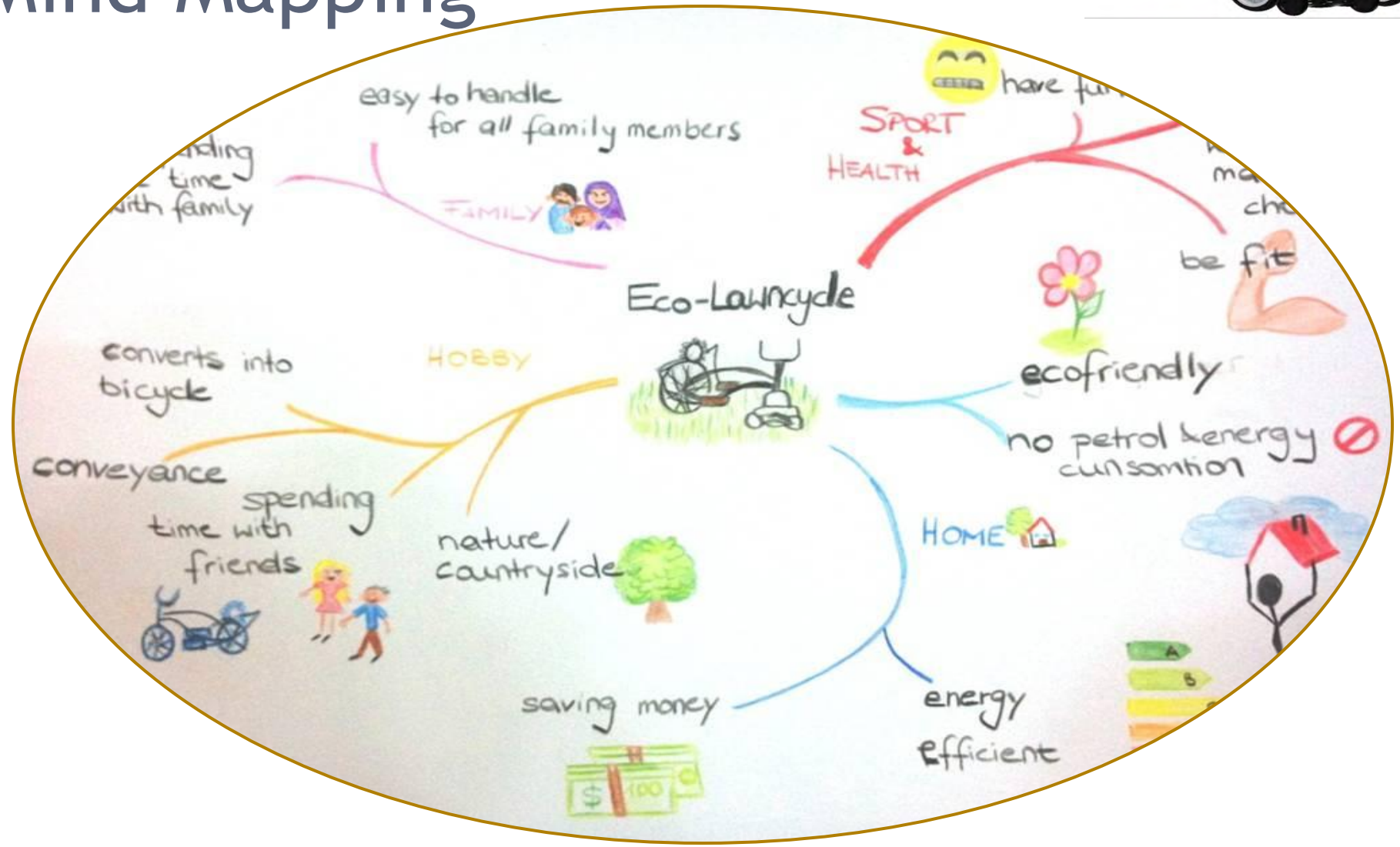




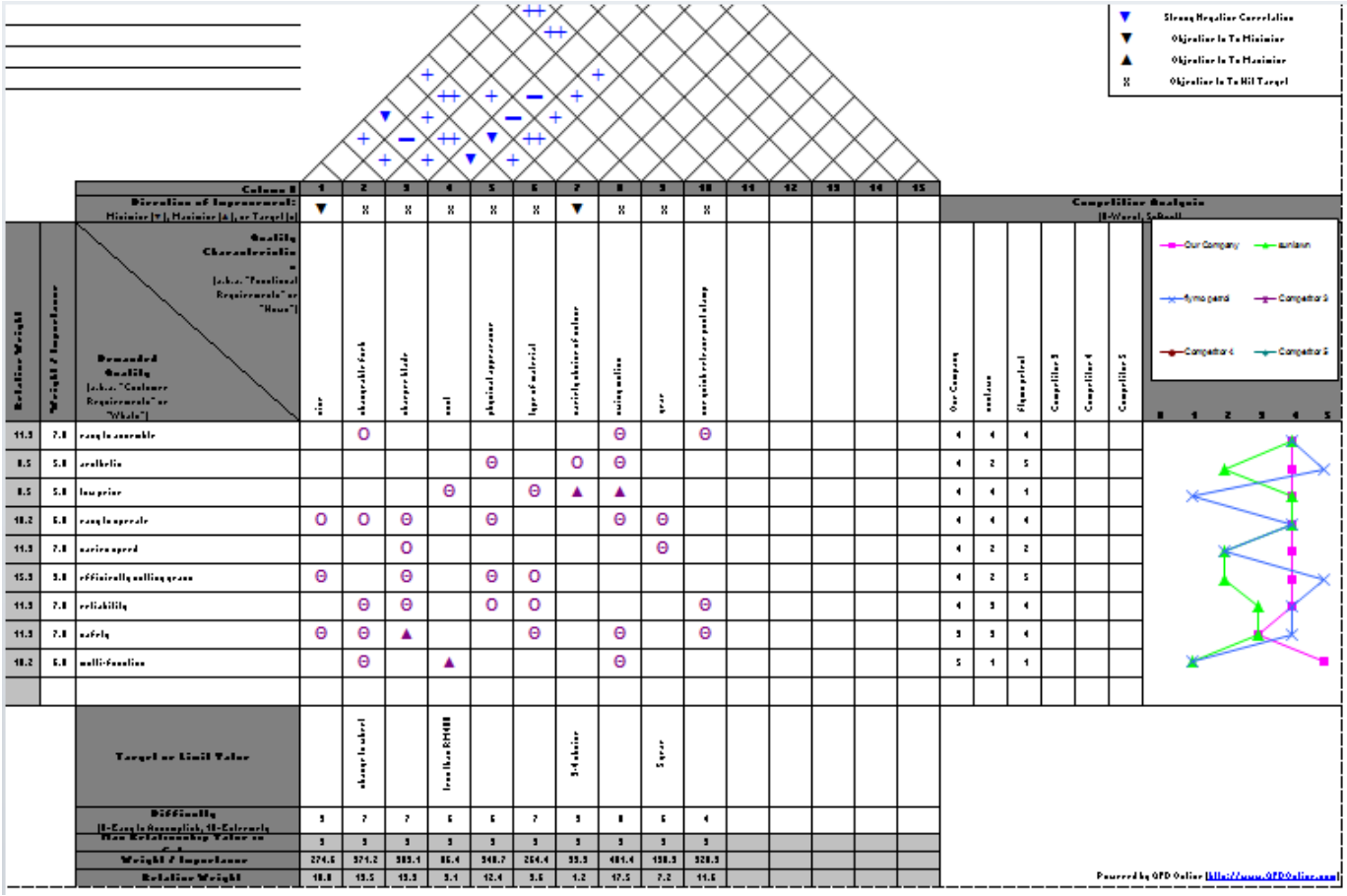
Objective Tree

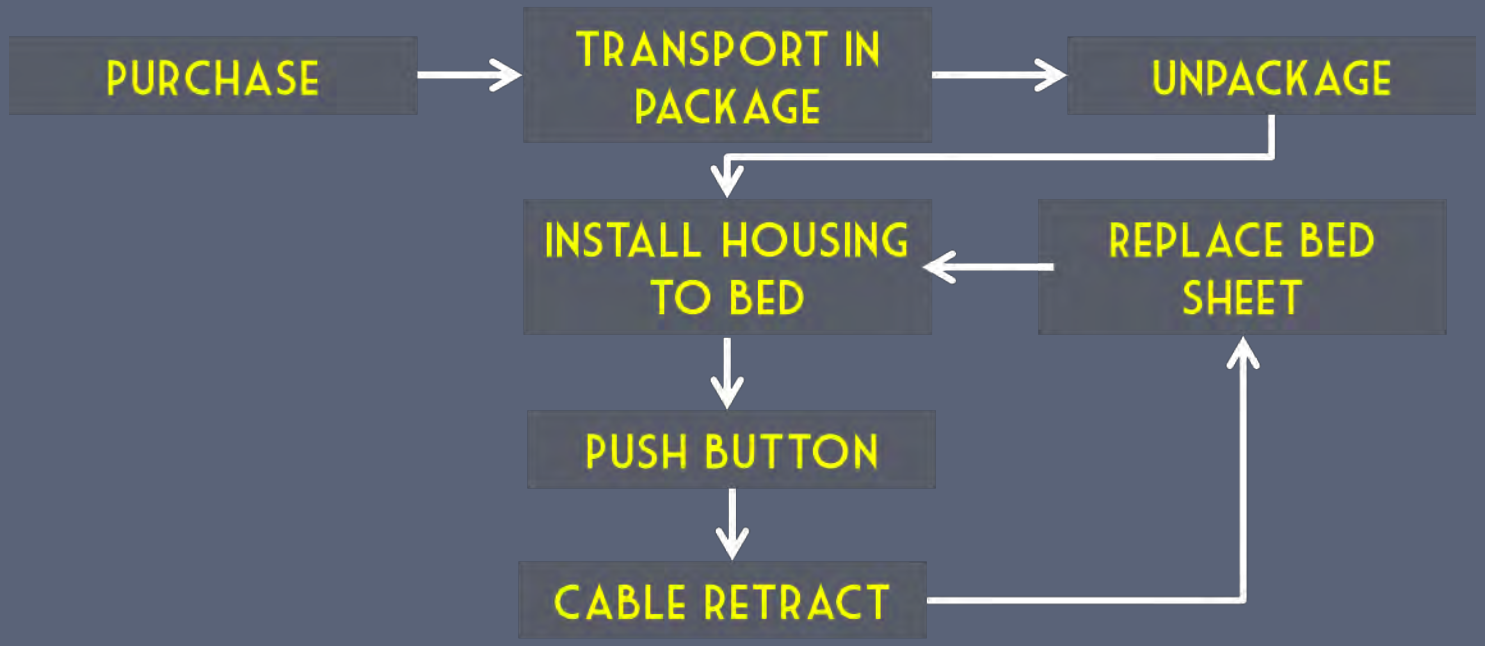
- Eco-Lawncycle
  - Function (0.5)
    - Cut grass without electrical supply (0.5)
    - Collect cutted grass (0.3)
    - Exercise (0.2)
  - Reliable (0.3)
    - Convenient (0.3)
    - Easy to assemble & disassemble (0.3)
    - Low probability of damage (0.2)
    - Low wear of moving parts (0.5)
  - Safety (0.2)
    - Low injuries (0.5)
    - Low risk of misuse (0.3)
    - Low damage to property (0.2)

Mind Mapping



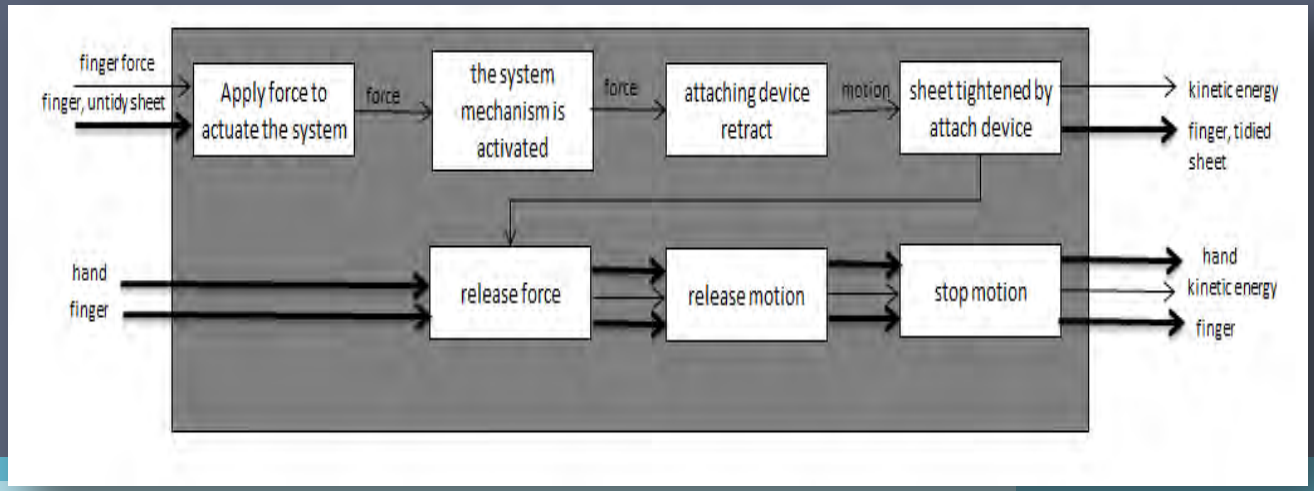
House of Quality

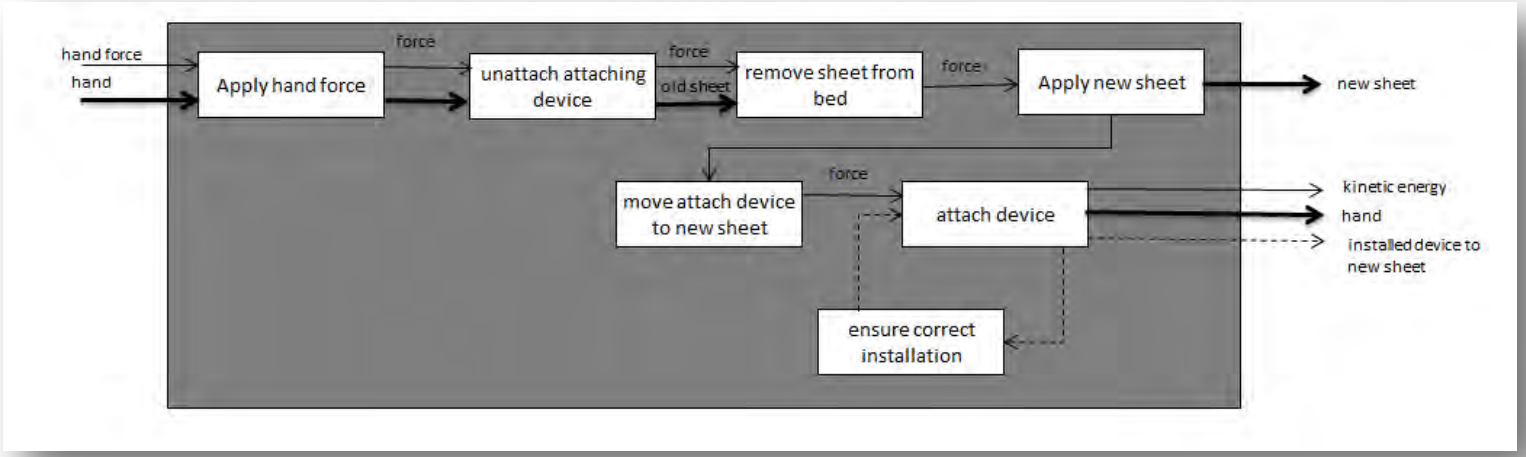




ACTIVITY DIAGRAM

ACTIVITY DIAGRAM





Functional analysis: To cut grass

Leg, Eye

Unmowed grass field

Find a point to start to mow.

User and object

Target the point

Hand , leg force, Potential energy

Move the lawncycle to the point

User, grass and object

Ready to cut

Hand , leg force, kinetic energy

Ride on the field area to be mowed

User, grass and object

Riding and cutting the grass

Hand , leg force, kinetic energy, heat, sound

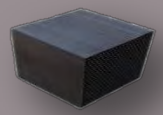
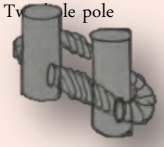
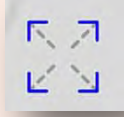
User, object and cutted grass

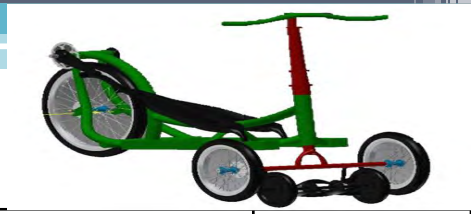
Grass field is mowed

Hand , leg force, kinetic energy, heat, sound

Mow the grass field

Use of Morphological Charts to generated concepts for automated bed stretcher

No.	Sub functions	Alternatives		
		1	2	3
1	**Medium for user**			
	1.1 Actuator	Push Button 	Pull Lever 	Sensor 
2	**Retracting mechanism**			
	2.1 Housing	Cube 	Cylinder 	
	2.2 Cable enforcer	Electrical motor 	Pneumatic 	
	2.3 Retractor	Spring 	Gear 	
	2.4 Cable Holder	Hook 	C 	T  le pole
	2.5 Retracting method	Skeletal 	Spiderweb 	Cable retract each corner 

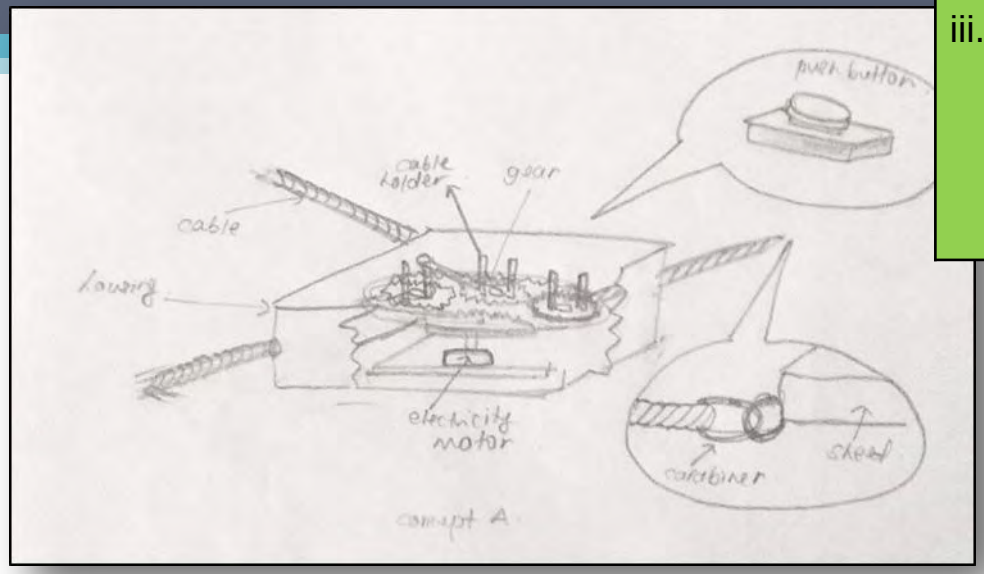


Parameter	Possible Solutions					
1.0 Support	Wheels 	Air Cushion 	Tracks 			
2.0 Control						
2.1 Moving	Cycling 	Leg swinging motion 	Running Tracks 	Linear induction r 		
2.2 Direction	Remote control 	Steering 	Gripping 			
2.3 Stopping	Brakes 	By hand	Drag by using foot	Blocks under wheels 	Reverse power	

Selection Criteria		Concepts				
		1	2	3	4	
1.	Cost	S	S	S	S	
2.	Material	S	S	S	S	
3.	Weight	+	+	-	-	
4.	Aesthetics	+	-	-	-	
5.	Portability	+	+	-	-	
6.	Stability	-	-	S	S	
7.	Confortability	-	-	+	+	
8.	Ease to use					
	Control of the handlebars	+	+	-	-	DATUM
	Moving structure of paddle	S	S	-	-	
	Changeability of tires	S	S	-	-	
9.	Ease to cut Lawn	S	S	S	-	
10.	Stopping	S	S	S	S	
	Sum of "+" (better than)	4	3	1	1	
	Sum of "-" (worse than)	2	3	6	7	
	Sum of "S" (similar as)	6	6	5	4	
	Net Score	3	0	-	-	
	Rank	1	2	3	4	

CONCEPT A

NO.	SUB FUNCTIONS	
1	MEDIUM FOR USER 1.1 ACTUATOR	 SENSOR
2	RETRACTING MECHANISM 2.1 HOUSING	 CUBE
	2.2 GENERATOR	ELECTRIC MOTOR
	2.3 RETRACTOR	GEAR
	2.4 CABLE HOLDER	TWO HOLE POLE
	2.5 RETRACTING METHOD	FROM EACH CORNER
3	INSTALLING AND REPLACING 3.1 CONNECTOR BED AND HOUSING	 SCREW
	3.2 CONNECTOR SHEET AND CABLE	CARABINER



Advantages	Disadvantages
i. Efficient retracting of cable because use gear ii. The connector between cable and sheet is stable because use carabiner. iii. Convenience because user just need to push the button.	i. Wear and tear of the gear. ii. Need connect with electricity.

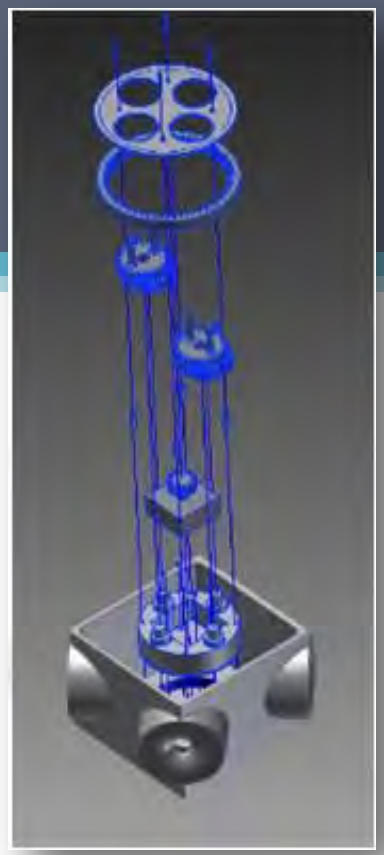
WEIGHTED DECISION MATRIX

No	Design Criteria	Weight	Concept 1		Concept 2		Concept 3		Stretchable sheet	
			A	S	A	S	A	S	A	S
1	Cost of manufacturing	0.2	4	0.8	2	0.6	5	0.15	7	0.21
3	Recycleable Material	0.18	3	0.15	5	0.25	7	0.35	4	0.2
4	Toughest of Material	0.12	8	0.4	7	0.35	3	0.15	5	0.25
6	Space Requirement	0.09	4	0.2	3	0.15	3	0.15	5	0.25
7	Cost of Material	0.2	5	1	4	0.8	6	1.2	7	1.4
8	Customer Requirement	0.21	7	2.1	9	2.7	6	1.8	2	0.6
	Total	1		6.75		6.6		4.9		4.06

DESIGN FOR ASSEMBLY

2 FACTORS

- EASE OF HANDLING INSERTION AND FASTENING OF PRODUCT
- TOTAL NUMBER OF PART



MINIMIZE ASSEMBLY DIRECTIONS

MINIMIZE NUMBER OF PARTS

Design for Environment (DfE)

- **Using human force to actuate the Eco-Lawncycle**
- **Design for Remanufacture/Reuse**
  - **i. Design for assembly/disassembly**
  - **ii. Material Aluminium Alloy and High Carbon Steel**
- **Design for Recyclability**
  - **i. Material Aluminium Alloy, High Carbon Steel and Carbon Fibre**

Packaging

Packaging Material – Fill-Air Packaging

Protect surfaces from damage or scratching during distribution

Reusable and Recyclable

DESIGN FOR ENVIRONMENT

THREE MAIN GOAL OF DESIGN FOR ENVIRONMENT:

- PROMOTING GREEN CLEANING AND RECOGNIZING SAFER CONSUMER
- EFFECTIVELY MANAGE RENEWABLE RESOURCES
- IDENTIFYING SAFER CHEMICALS

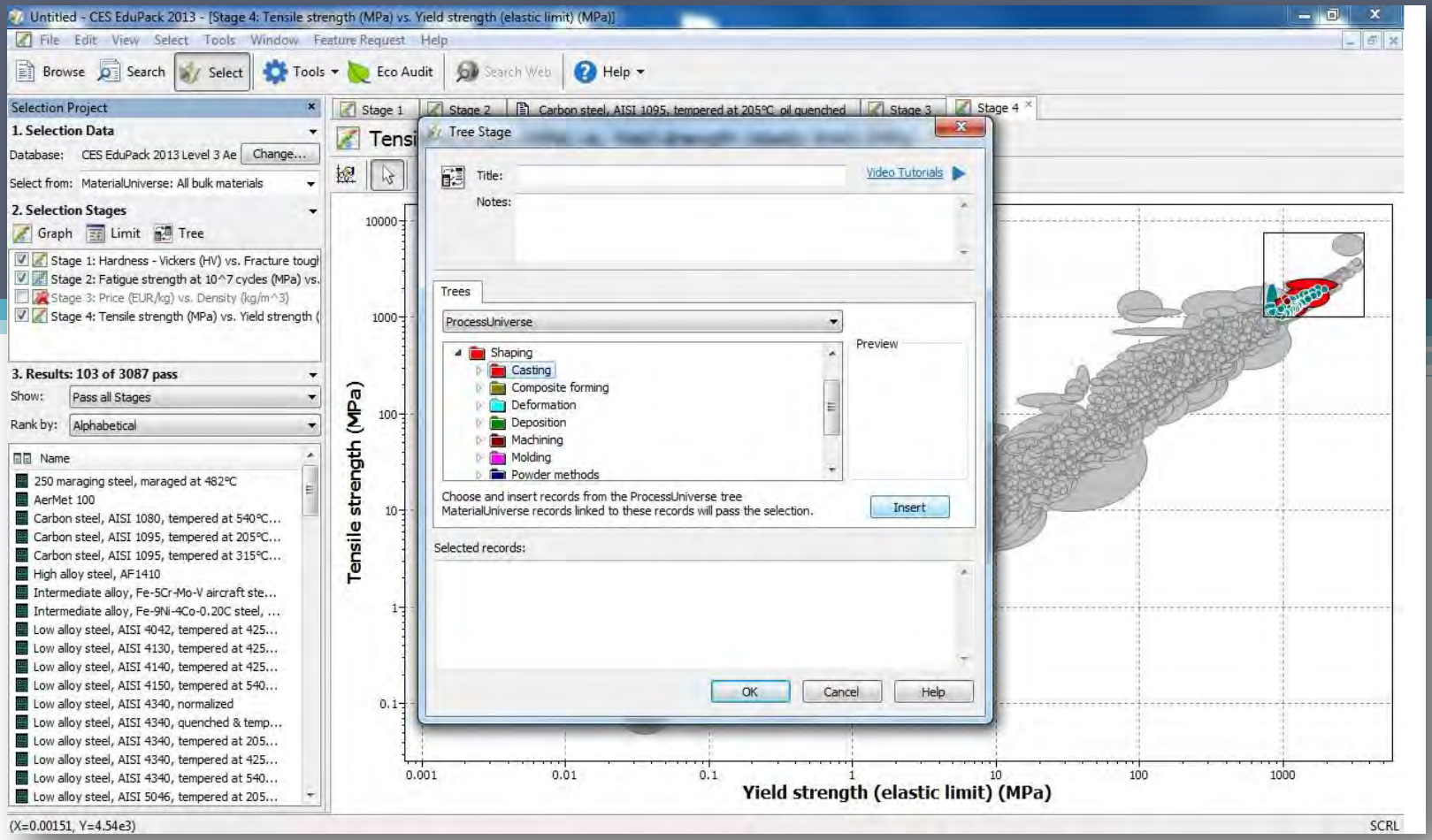
LOW POWER CONSUMPTIONS

NOT CONSUME MUCH ENERGY

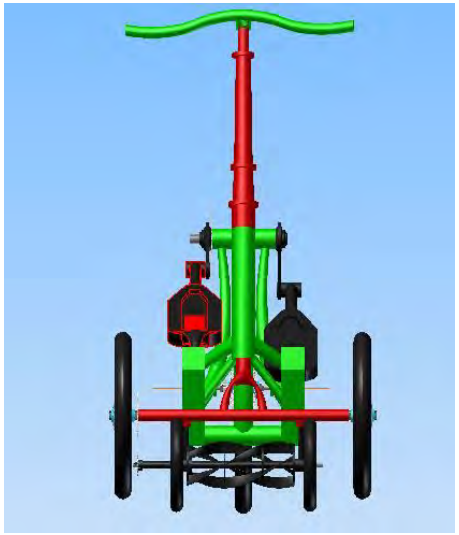
NOT RELEASE TOXICS OR SMOKE DURING OPERATION

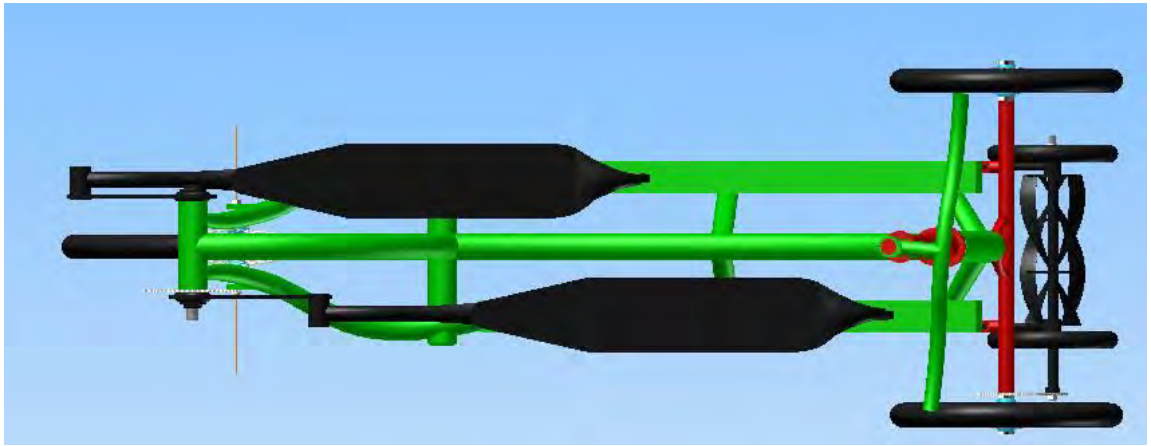
CES 2013

SORT FOR HIGH YIELD STRENGTH AND TENSILE STRENGTH + KIND OF MANUFACTURING

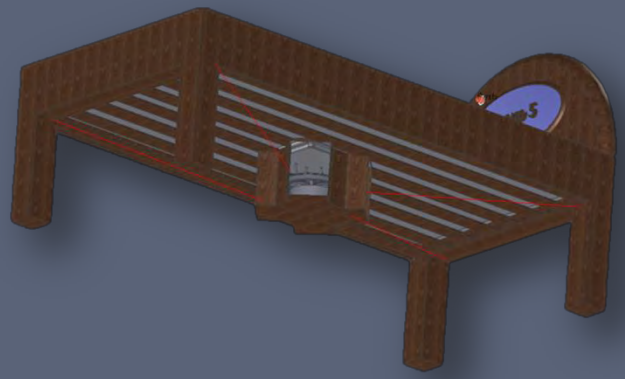


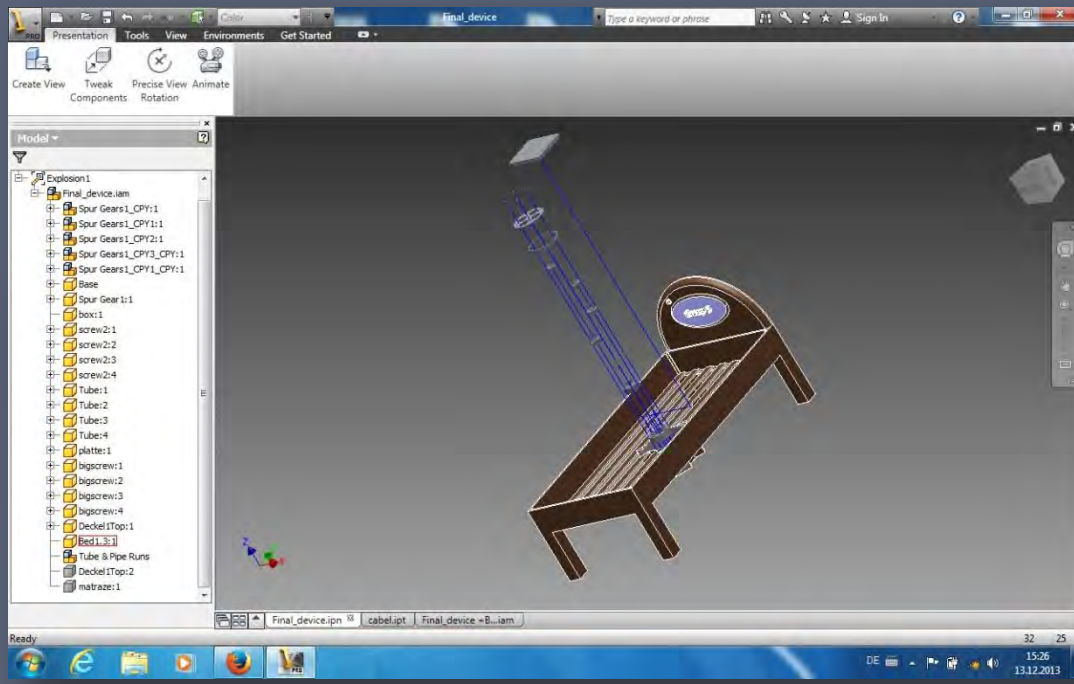
System function	Failure mode	Cause of failure	Effect of failure	(S)	(O)	(D)	Risk of priority (RPN)	Detection method	Corrective action	New (S)	New (O)	New (D)	New (RPN)
To move lawncycle	Twisted handlebar	Screw get lose	Lose control of direction	4	2	1	8	Visual inspection	tighten screw	3	2	1	6
	Pedals snap	Pedals tracks are rust or dirt pile up	Lose motional function	4	3	4	48	Mechanical inspection	Grease oil & clean	4	3	3	36
	Sprocket broken	Wear of sprocket	Pedals fail to rotate	8	7	1	56	Visual inspection	Use high robust material	3	2	1	6
	Deformation of body frame	Weak material	Lose support function	7	6	1	42	Visual inspection	Use high robust material	3	2	1	6
To cut grass	Abrasive wear of blade	Friction between blade & rough object	Lose cutting function	7	6	4	168	Visual and mehanical inspection	Improve the strength of cutter by selection of high strength, durable material	3	3	3	27
	Blade broken	Wear material	Lose cutting function	8	5	2	80	Visual inspection	Improve the material of cutter	3	2	2	12

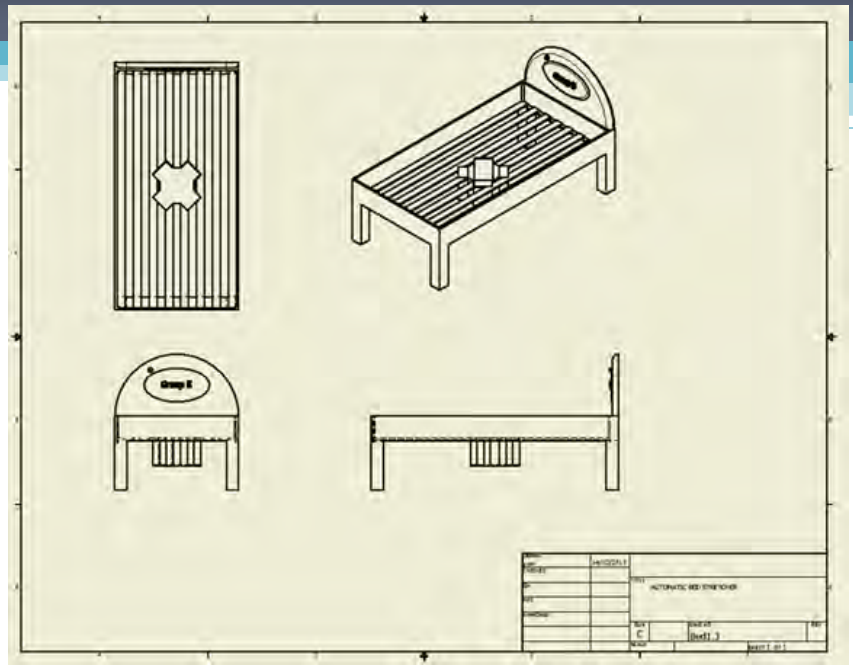




DRAWING DESIGN







STRESS ANALYSIS

SQUARE –OPTION: