ELECTRIC GUITAR

Industrialists

- Providing the capital, land, labor and raw materials required for the operation.
- Raw materials needed for the guitar include wood, metal, plastic and electrical components like pickups and wires.

Marketing Expert

- Finding the target audience and trying to promote the product in an effective manner.
- For electric guitars, the target audience would be guitarists. Having a signature style and sound, promotion by famous guitarists would be effective.

Technology Expert

- Producing the product in bulk in a cost-effective and efficient manner.
- Making an assembly line that can consistently create quality guitars with the same sound and look with minimal waste and errors.

Activist

- Making sure that the impact on people, animals and the environment is as positive as possible
- Ensuring use of sustainable and eco-friendly materials along with minimal emissions during the production of guitar and proper toxic waste disposal.

Consumer

- Purchasing the product if their requirement and expectations are met, leaving them satisfied.
- Wanting the looks and feel of the guitar to match their preference along with the sound of the guitar, good build quality of the neck and the fretboard, the electric pickups and pickguard being of good quality. The company being reputed and trustable for post sales services and maintenance.

Image source: https://guitar.com/features/guitars-designed-by-ai-inspired-by-film-directors/

Functional Design: Badminton Racket

Name	Badminton Racket (Yonex Duora 33)
Purpose	Allowing people to play the sport 'Badminton' by striking the shuttlecocks with the racket.
How does it work?	A handled frame with an open hoop with a network of strings stretched tightly. Striking the shuttlecocks by the tensioned strings propels them forward.
Structure and Main Parts	1. Handle 2. Frame (Shaft and head) 3. Strings
Materials and Manufacturing Process	High Modulus Graphite (Frame), High Polymer Nylon (Strings), Wood and Polyurethane. The head, shaft and handle of the racquets are joined using expandable resin inside the frame and the stringing is done afterwards using stringing machines.
Critical Detail (if any)	Proper tensioning of the strings and weight distribution.
Usability Requirement	Racket weight and flexibility, string tension, size and shape of the head, shaft length and grip size.

Material Analysis: Badminton Racket

Q1. Why are the current materials suitable for each part and how are they contributing towards the purpose?
Ans 1>

Material	Part	Contribution
Graphite (High Modulus)	Frame	Graphite is an excellent choice for the material of racket frames as it is very strong, light-weight and flexible. Various types of graphite can be used such as 'High Modulus Graphite' which is a harder, firmer and stronger graphite, making it better for more advanced rackets as it allows for more power in offensive shots.
Nylon (High Polymer with Titanium Hydride coating)	Strings	Nylon is commonly used as the main material for racket strings as it is strong and lasts long when tensioned and used correctly. Strings can have different nylon polymers for the core and the outer layer, along with having an external coating like Titanium Hydride which makes them more powerful, durable and have better repulsion.
Wood and Polyurethane	Handle	The handle body is made up of wood with a polymer plastic shrink wrapped on top of it to make it waterproof. Wood is used as it can have good shock absorption while still feeling sturdy and strong. On top of these handles, grips made up of materials like polyurethane are used to make them softer and more comfortable to hold.

Q2. What other materials are currently being used for manufacturing the same product?
Ans 2>

a) Frame: Materials like steel, aluminium, titanium and carbon fibre are used in the frames of badminton rackets. Steel and aluminium are usually used in beginner rackets that are low cost and meant for casual players. Titanium is usually only used in small quantities instead of the whole frame because of it being heavy and expensive, it is used just to reinforce and stabilize the frame. Carbon fibre is a very strong, light-weight and elastic material making it highly suitable for badminton rackets and quite popular in professional grade rackets.
b) Strings: Natural animal gut was traditionally used in badminton rackets as it provides more control and power than the nylon counterpart. However, it is no longer used commonly because of it being very expensive and lasting lesser in comparison t o nylon strings. Hence, it is rare to find any rackets with natural animal gut strings.
c) Handle: Some companies are trying to use injection-moulded plastic handles instead of wooden ones to make the racket lighter and easier to swing, however it is very uncommon. Other materials for grips include rubber for thinner and grippier grips and cotton for towel grips which are good for sweat absorption and keeping the grip non-slippery.

Q3. Suggest an unconventional material for the said product. Analyse how the material properties will have to be modified to suit the purpose.
Ans 3> Galvorn is a relatively new material made from weaving carbon nanotubes, making it lighter than carbon fibre while maintaining high strength. It is also more flexible than carbon fibre. It is easier to manufacture than carbon fibre due to its simpler and more efficient production process. It is a more sustainable alternative to carbon fibre, without making any sacrifices on performance. Galvorn production is predicted to have a smaller carbon footprint than materials like steel, copper and aluminium, making it an eco-friendly choice.

Q4. Which of the product details will not work with this unconventional material?
Ans 4> It is difficult to predict how a completely different material would work on a product without having proper simulations or prototypes. However, the above mentioned can in some cases be negative depending on the circumstances. For example, it might not be an optimal for the head of the racket as professional players who play aggressively prefer having head heavy rackets to add more explosive power to their shot. For the shaft of the racket, it being more flexible than carbon fibre might end up being a disadvantage as flexible rackets are usually better for defence and stiffer rackets for offense. All in all, I hope it can be implemented as an alternative to carbon fibre based on manufacturing processes involved in making the racket and personal preferences of the players.

Challenges and Learnings from this activity:
Challenges: Trying to come up with concerns without trying to solve the problems.
Learnings: Trying to analyse a product in a deeper manner than ever before and think about the same thing from various different perspectives and goals(changing hats).