Commonality Analysis for Ball Manufacturing

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1. Introduction

Sporting equipment in the form of balls have been used even since ancient times, and they have evolved over time right from the material to the purpose, going from leather to plastic among other wide ranges. Here we analyze those common and variable parts of the product.

2. Overview

We can split the manufacture and category of balls into a few subcategories, such as

1. The Material
2. Stitching & Shaping
3. Polishing

Thus, we also examine the other related questions such as:

- What are the different types of balls?
- What materials will be used for different types of balls like football, basketball, tennis ball, cricket ball and so on?
- What will be the shape of the ball?
- What will be the weight of the ball?
- What kind of testing will it undergo as part of quality control before being dispatched for sale?

3. Definitions

The table below lists the technical definitions related to a ball.

Ball	A ball is a round object with various uses. It is used in ball games, where the play of the game follows the state of the ball as it is hit, kicked or thrown by players. Some of the games where balls are predominantly used are football, basketball, tennis, cricket and so on. Generally in most sports, the balls are spherical in shape but in some cases like the american football and rugby the ball is actually oval or prolate spheroid in shape. Also, in hockey,
Material	The material used to make different types of balls. A ball can be made from many different materials like leather, rubber, plastics and synthetics being

	most common in modern times. Like the table tennis ball is made of plastic whereas football is generally made of leather.
Stiching	For games like rugby, football, tennis, the ball needs to be assembled together by the process of stitching which is one complete movement of a threaded needle through a fabric or material such as to leave behind it a single loop or portion of thread. The stitching can be done manually or by machines.
Thermal Bonding	Instead of stitching, here the panels of the ball are bonded by heat using pressurized gasses, hence no stitchings are there. Thermally bonded balls are more durable and last longer. Also another advantage is that the ball takes up less water and keeps the original weight better when playing on a wet surface. This is good for games like football which is played in rainy conditions as well.
Shaping	It is the act of fabricating something in a particular shape. Like generally most balls are spherical in shape but in some cases like the american football and rugby the ball is actually oval or prolate spheroid in shape.
Polishing	This is the process of finishing the product with some final touches by creating a smooth and shiny surface by rubbing it or by applying a chemical treatment, thus leaving a clean surface with a significant reflection.

4. Commonalities

The following statements are basic assumptions about the domain of ball manufacturing.

Shape
Generally most of the balls have a spherical shape. For example, in games like football, tennis, cricket and basketball the balls are spherical in shape.

Material
Generally most of the balls are made from leather or rubber. Like football and basketball are made up of leather.

Content
In most of the cases the balls are generally hollow from inside.

Uses
Generally balls are used in sports or games where it is either kicked, thrown or hit depending on the game rules.

Nature
Most of the balls are generally bouncy in nature.

5. Variabilities

Shape
Most balls have spherical shape but rugby balls have a prolate spheroid shape and hockey balls have a disc shape.

Material
Made of different materials like synthetic leather, stainless steel, rubber etc.

Content
Generally balls are hollow from inside but some balls such as cricket balls are solid from the inside.

Uses
Generally balls are used in games or sports activities but they can also be used for several other purposes like in machines as essential components or in weapons as projectiles or in gym as exercise balls for better posture and spine control.

Nature
Generally balls are bouncy in nature but in games like shot put the balls are quite heavy and not at all bouncy.

6. Parameters of Variation

#	Name	Meaning	Domain	Decision Time	Default
P1	Shape	Shape of the ball	{Round, prolate spheroid}	Specification	Round
P2	Stitching	Stitching of the ball	{Hand stitched, machine stitched, thermal bonding (glue)}	Specification	Machine stitched
P3	Material	The material used to manufacture the ball	{Leather, Plastic, Steel}	Specification	Leather
P4	Weight	Weight of the ball	Real Value: {Light (less than 200 gms),	Specification	Medium

			Medium (200 to 2kgs), Heavy(More than 2kgs)}		
P5	Size	Size of the ball in diameters	Real Value: {Small (0 - 59 millimeters), Medium (60 - 400 millimeters), Large (More than 400 millimeters)}	Specification	Medium

7. Issues

I1. What can and can't be considered a ball?

A1: Only those which are used professionally are considered as balls, so not every spherical object is a ball.

A2: All spherical objects used in sports or games are balls.

A3: All spherical objects regardless of whether it is used in sports or games can be considered as a ball.

Resolution: All spherical as well as non spherical objects regardless of whether it is used in sports or games can be considered as a ball.

I2. What properties of the ball do we need to examine?

Resolution: We decided to focus on the material, manufacture, purpose, size and weight according to standards followed worldwide.

8. TODO

All sections are completed.

9. History

Date	Duration	Def.s	Comm.s	Var.s	Par.s	Issues	Res.
18 April 2022	40 minutes	3	2	2	2	1	0

21 April 2022	20 minutes	4	3	3	3	1	1
23 April 2022	20 minutes	5	4	4	3	2	1
25 April 2022	20 minutes	6	5	5	5	2	2

10. Effort

Arpit Agarwal - 1hr 40 minutes
Ronit Ray - 1hr 40 minutes
Sudipta Halder- 1hr 40 minutes
Anshul Kakraniya- 1hr 40 minutes
Akshay Choudhary- 1hr 40 minutes