UNIVERSITY OF LIVERPOOL

School of Engineering

ENGG660
Design Proposal Report – PDS

[CONCEPTUALISATION DESIGN AND DEVELOPMENT OF A MOBILE VR SIMULATOR BASE]

Authors: Swaraj Patra (201596665)

[2021-22]

Academic Guide: Dan Hibbert

1. Summary

The PDS (product design specification) for a Mobile Simulator Base can be found in this document. It is broken down into three distinct sections, the first of which is market research. This section identifies the potential size of the market for a mobile simulator base by analysing the most recent developments in the driving simulation industry and arrives at a potential market range of 0.7–1.2 million pounds. Additional study on consumer needs and existing competitors assists in identifying crucial elements such as style, commerciality, height adjustability, and modularity that are necessary to attract a wide range of customers. This assists in reducing the size of the target market, which is comprised of commercial gaming hubs and arcades since these establishments are more likely to value the portable feature of the simulator base.

According to the findings of the market research and an awareness of the product and the context in which it operates second section which is Performance specification are defined consisting of various factor with variable rating based on the importance of feature in regards to the product. During the phases of product development, this serves as a guideline that is followed quite closely and is not altered excessively. The PS provides a comprehensive analysis of several aspects, including their functioning, materials, reliability, environment, ergonomics, interface, training, and safety.

In addition to the rules that were developed to characterise performance, there is also a need to adhere to laws that are pertinent to a moving platform. the third section focuses on all of the safety constraints that need to be taken into account when the product is being developed so that it may be ready for the market. After that, a list of patents is compiled based on the probable methods that may be employed in the product in order to further prevent any potential legal concerns that could come with the product.

2. Contents

Table of Contents

3. List of Figures

4. Introduction

The famous Formula PLAYSEAT will serve as the inspiration for this project, which comprises the planning and construction of a movable base for a driving simulation. The Formula PLAYSEAT is differentiated from other driving simulator rigs by its one-of-a-kind driving posture, which imitates the stance of the driver in a formula vehicle. This allows the user to experience driving at the highest level possible. Fans of virtual Formula racing and racing professionals who want to perfect their skills in preparation for real-world competition place a high value on this kind of technology.

It would be difficult to practise racing on a variety of courses and in a variety of weather conditions in the real world, but this is made possible by virtual racing, which not only enhances the gaming experience but also allows professionally qualified drivers to practise racing on a regular basis. A stable and well-balanced base that can adjust to the user's demands is necessary for attaining a real-world-like experience in addition to the Rig, virtual head seat, steering, pedals, and so on. However, the majority of bases are not constructed to be portable, and as a result, they cannot be used to transport the system in a convenient manner.

Users of a mobile base are given the ability to transport individualised equipment in a manner with which they are most at ease. Design standards are produced in order to achieve these and other feasible enhancements in order to increase the quality of the virtual experience. These standards include a list of components that the final design should incorporate. This leads to the generation of several ideas, which, as a consequence of their interactions, provide a wide variety of concept combinations, one of which is selected to proceed to the development stage. After that, designs are crafted to address how each component is incorporated into the whole to form the finished product. After that, the comprehensive designing is done using a CAD programme to make it easier for engineers and manufacturers to produce a prototype and identify any additional modifications that need to be made before moving on to the production stage.

The stability of the rig during operation is crucial to the success of this project, and one of the potential dangers is from the question of whether or not the mechanism that will be used is reliable enough to ensure this. The components that were constructed out of the materials are strong enough to withstand the weight of the user. Because mobility increases the likelihood of an accident, the design must to be robust enough to survive moderate impacts and drops without suffering significant damage. When in use, the configuration does not place any restrictions on the user and provides them with a convenient experience overall.

5. Product Design Specification

Successfully completing a product requires a logical and comprehensive approach, with meticulous attention to detail throughout the design process.

The PDS is the most important instrument for controlling the project and increasing its likelihood of success. The customer's input is reflected in this control document, which details the end result that should be achieved. When completed, this report acts as a wraparound for the other stages of the design's foundation. The PDS regulates the whole design process by setting the parameters within which future designs must operate.
Therefore, the PDS has to have no ambiguity. At the conclusion of the design process, the product must be in harmony with the PDS. Weak PDS leads to a weak design, which bombs on the market. Even while a solid PDS can't guarantee a well-thought-out design, it may make it far more likely. As a comprehensive collection of criteria, the design is reframed by PDS.

5.1 General Product Description

It's a portable stand for virtual reality simulators, and it's designed to accommodate devices like the Formula PLAYSEAT, which simulates the experience of driving. The base can hold any regular simulator frame and roll around on its wheels for convenience. The base may also be used to attach other accessories, such as a hydraulic motion simulator, and to change the simulator's height.

5.2 Commercial Considerations

5.2.1 The Customer

Customers include VR simulator owners, arcades, Formula race training facilities, and VR racing events, since the product was developed with Formula Playset users in mind. The bulk of driving simulator setups don't have a solid base or the ability to adjust to the user's height and comfort level. When in use, the rig is more likely to topple over due to the absence of a secure study base.
The bottom surface area is increased while still enabling movement, strengthening the frame's stability. Its portability is only one of its many selling factors; other features include height adjustability, the ability to install more modules, and robust edges to protect the module while in transit.
User care and maintenance go a great way in determining the product's durability. As long as it is utilised properly and regularly maintained, it poses no risk to users. Considering the wide price spread amongst simulator rigs (often between £400 and £2000), the goal is to keep the device's pricing at or below $100.
The stakeholders include the advisory board, investors, the product development team (designers, engineers, and product managers), the manufacturing team, the marketing team, the sales department, the regulations department, the legal team, the testers, the customers, the businesses that sell virtual reality equipment, and the commercial users.

5.2.2 The Market

The total value of the game simulator industry was $4.04 billion in 2020, and experts predict it will grow to $9.99 billion by 2027. Based on 2016 statistics revealing the market share of each simulator game genre and their growth potential, we may infer that the driving sim will account for about 70% of the simulator market.

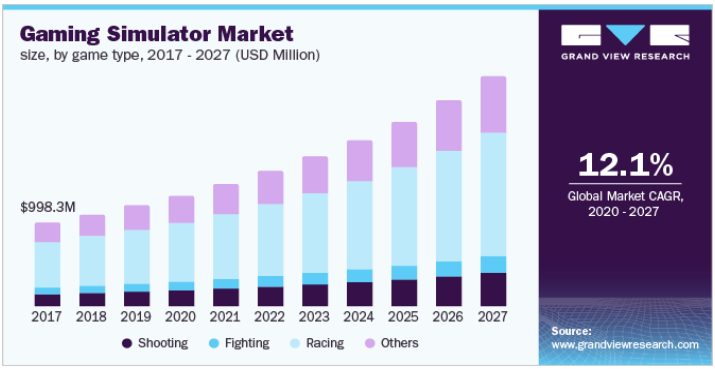


Fig1- global simulator market

Fig2- market division by game type

With a current market revenue of USD 3.9 billion, North America accounts for 35% of the market share, and firms like Hammacher Schlemmer & Company, Inc., Play seat B.V., Sony Interactive Entertainment Inc., Aeon Sim, Vesaro, and RSEAT Ltd. are among the industry's most prominent participants.

The majority of the $3.9 billion in sales are the actual parts and pieces used in a sim racing setup. A lot of variation in component prices may be expected across different user types.

There are three anticipated levels of users: novice, intermediate, and expert. How much money is needed to improve competence varies greatly.
The average cost is determined by adding up the prices of all the parts that may be utilised by the various groups.

Parts	Basic Rig (£)	Advanced Rig (£)	Pro Rig (£)
Wheel	200-600	200-600	500-1500
Pedals	80-300	80-300	300-1700
Gear shifters	50-170	50-170	-
VR/ Monitors	100-150	1000-5000	1000-10000

Cockpit	-	300-1200	900-3000
Motion simulator	-	-	2000-15000
Total cost	430-1220	1630-7270	4700-31200
Average total cost	825	4450	17950

Basic Rig- £800
Advanced Rig- £4450
Pro Rig- £ 17950

Using the data for sim wheel application 2015- 2027 percentage of Basic, pro and advanced players can be calculated.

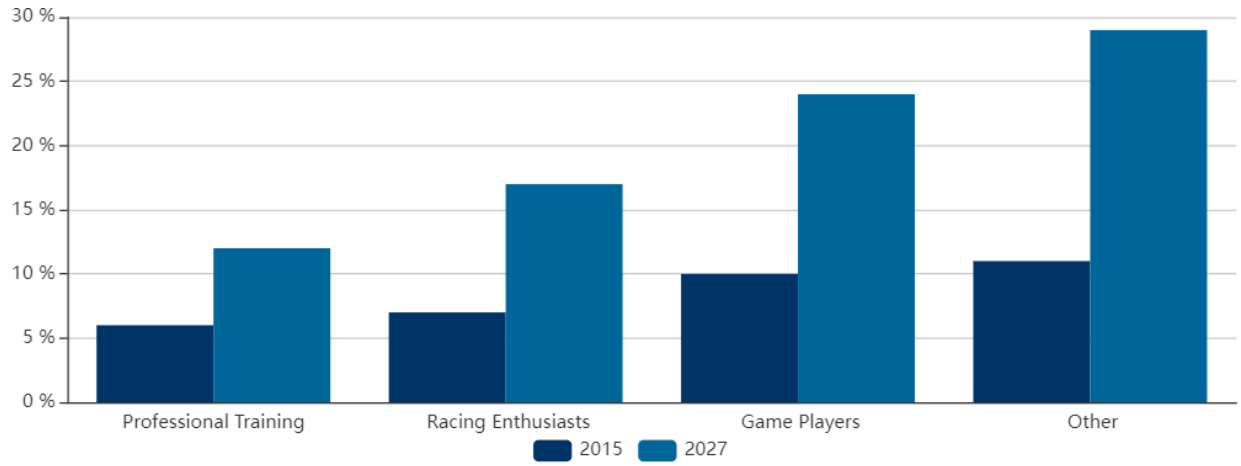


Fig3- types of players

User type	Percentage
Pro	15%
Racing enthusiasts	20%
Game players	30%
Other	35%

Assumptions made on the data are

- All pro players own pro rigs-
  Pro rigs=15%

- All Racing enthusiasts and 40% of gaming players own an advanced rig
  Advanced rig = 32%

- All Other users and 60%0f gaming players own a basic rig
  Basic rig = 53%

It's possible to further segment the market based on whether customers are businesses or households. While home users presently make up the bulk of the market, this is projected to change rapidly since not everyone can buy a full rig. However, as VR's popularity continues to rise, the number of VR arcades and events is also expected to rise.

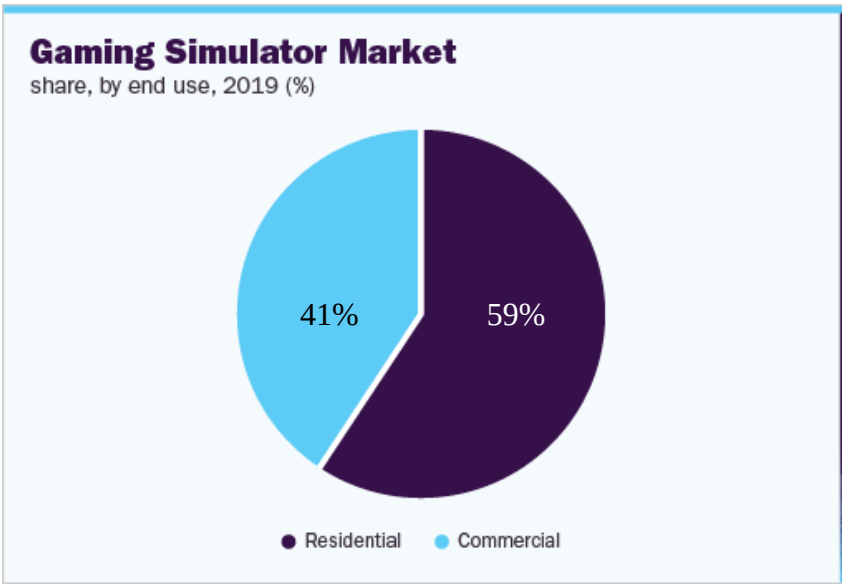


Fig4- gaming simulator market

5.2.3 Competitor Information

Few of the industry's largest simulator developers have dabbled in this segment of the market. But the amount of do-it-yourself and improvised solutions that veer from a standard support structure made of plastic to a hardwood basis indicates a need. They're cheap, but also immobile and quite basic.

A commercial VR simulator base finds most of its uses in arcades and racing events. Even here, the organisers craft unique bases with features like extra height for a monitor, strengthened stability, and space for marketing.

Fig5- Event platform

Fig6- Arcade unit

Commercial products

- Playseat floormat (£ 47)- high friction floor mat to place under the playseat.

Fig7- Playset with floormat

- Playseat flight case by swan flight (£ 834) – modified flight case with wooden support structure to support the simulator with wheels .

Fig8- Playseat on flight case

- Playseat flight case by playseatstore.com (£ 89) – modified flight case with wooden support structure to support the simulator.

Fig9- playsetstore.com Flight case

- Dunnage Rack, 1500 lb., HDPE (£116) – HDPE table to place the playseat on.

Fig10- Dunnage Rack

After through search in the market space it has been realized that there are no commercial competitor in this market space rather a trend of use if flight cases as the base or other structures made out of wood or piping's.

Analysing the trends of currently used bases it is realised that simple boxlike design is appreciated with large logos or brandings printed on it. This found to be true for both commercial and residential users.

Fig11- Sponsored Playseat event

5.2.4 Estimated Market Revenue

Estimated product cost £ 100-150

Market types

- Total Addressable Market (TAM)- Sum of Basic, Advanced and Pro Rig users for the given market valuation which is $3.85 Billion.

Number of basic rig users is 53% of $3.85 billion / average basic Rig cost.
= 2091512 users

Number of advanced Rig users is 32% of $3.85 billion / average advanced rig cost.
=227020 users

Number of pro users is 15% of $3.85 billion/ average pro rig cost.
=26381 users

Total market size is 2344913 users. Although large number of users in this market don't meet the criteria for the product to be used but this gives an idea of the potential market size. Under this market size the possible revenue can go up to £234-351 Million.

Serviceable Available Market (SAM)- Sum of Advanced and pro rig users are taken into consideration as they meet the basic criteria which is owing a VR cockpit.

Total market size is estimated to be around 253401 users. Theses are people that can be persuaded to some extent to own a mobile base. The product is not made with focus of selling to everyone in this category but can be used by everyone in this segment. The revenue in this market size is expected to be around £25-32 million.

Serviceable Obtainable Market (SOM)- It is the revenue that can be generated by selling to Pro rig users as they are the ones that are most likely to appreciate all its feature. This is the attainable market size with the current available data.

Total estimated revenue is to be considered as £2-3.9 million which can be further be concentrated using other factors for example if the product was highly marketed in on Northern America with 35% of total market, then the revenue would be around £ 0.7-1.2 million.

5.2.5Marketing Strategy.

- Conducting popup events with the playset to attract playseat users.
- Providing free trials to arcades and discounted price to arcades to attract residential users.
- Possibility to modify the platform to meet needs from advanced to pro players makes it attractive option for advanced players who are unsure of their use.
- Branding the product with the Simulators brand and providing colour schemes to match with the simulator makes it attractive for commercial as well as residential use.
- Digital marketing by running adds in areas with the greatest number of sales which are North America and Europe.
- Giving out free units to influencers who make content on VR simulation Racing.

5.2.6 Unique Selling Points

- Height adjustability
- Surface for commercial ads and logos
- Modularity to add motion simulator
- Game lightings
- Easy to assemble.
- Heigh factor of safety

Fig12- Gaming Light

Fig13- Motion simulator

5.3 Performance Specification

The parameters established by the Performance specification provide a basis for evaluating the developed product against predetermined standards. The proposed model will be tested with a variety of tools to gauge how well it stacks up against similar products in terms of usability, portability, and longevity in a variety of settings.

5.3.1 Functionality

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Mass • The overall weight needs to be low. product must be easy to carry and store when not in use	4	Intent- Keeping the total weight <15kg
2.	Utilisation: • Provide sturdiness to the frame • Provide mobility to the structure • Hight adjustment	5	The design is made with an intent to provide user with stability while using the simulator and mobility to be able to move the frame with ease. The hight adjustment is for monitor users to align the line of sight
3.	Capacity- • Taking less space • Attachable to any standard simulation unit • Handel the weight while being used	2	The unit has to be compact and able to support any standard frame made for racing simulation. The rigidity needs to be high to support the weight of the frame and user > 140kg
4.	Lifespan: • Since it's a mechanical product life span depends on use • Should at least have a 2-year warranty	3	The base is made of mechanical parts and depends on integrity of the materials being used so should be able last a long time unless handled roughly. The warranty of a playset is 2 years taking that as a standard for the products warranty. This would only cover any malfunction that might occur due to manufacturing defect.
5.	Scope and range: • Used as base for the simulation setup • Modular function for height extension • Modular light attachment • Height extendibility to most	5	The product should be able to fit a wide range of simulators with various lengths and dimensions while not compromising on stability and mobility on various surface types so it could be used efficiently both indoors and outdoors.

	monitor setup • Moved over multiple surfaces • Stability on multiple surfaces • Fit wide range of simulator lengths		The high extension and lighting should be a modular function as it is not needed by all users and can affect the product price.
6.	Illumination: • Lighting to fit the ambience of gaming room • Modular unit • Can be used as indicator to show simulator is being used	2	Modular unit that is able to synchronize with gaming to be used as indicator as well as to blend in the gaming environment
7.	Effectiveness & Efficiency: • Should be easy to set up and remove from the frame	4	Time to setup should not be more than 30 min. Height adjustment should have an

	• Small no. of steps to set up and make mobile. • Easy to adjust height with indicator • Easy to setup modular units • Handel weight and movements of uses when in use		indicator, so all side are even, and the user remembers the height. Time to setup mod should be less than 15 min. All joints and moving parts need to be sturdy to provide maximum stability.
8.	Storage: • Needs to be foldable or modular so it does not take much space during storage • Must be light so it is easy to store.	2	The product needs to within the weight rang where a single user can lift it to store when not in use.
9.	Personalization: • Available in range of colours and patterns • Surfaces to accommodate logo • Lighting mod to blend it into the environment	3	The product should look simply yet blend in with the gaming atmosphere because large number of users are gamers. Various colour schemes and logos will help it match the Frames theme and logos are good for commercial market
10.	Safety guards: • Protect the frame from collision when being moved • No sharp edges	4	Rugged edges to handle impact from collision from walls and doors. No sharp edges to avoid injury during installation and general use.
11.	Shape: • Match the gaming environment and aesthetical pleasing	2	Should not look too much robust and be able to match the frame so it doesn't stand out a lot.
12.	Weight: • Single users should be able carry it • Doesn't feel heavy while moving the unit	3	Weight of the basic unit should be less than 5kg so its easy for single user to carry and reduce shipping charges.
13.	Conductivity: • Outer walls nonconductive to heat and electricity	3	Avoid conductivity in areas where user could encounter while in use to maintain neutral nature and reduce chances of hazard.
14.	Interchangeable: • Easy to mount and remove frames and other modules • Easy to repair any defective or broken components	4	Easy to fit and remove the frame and mods. Easy to repair parts like wheels, lights and hight extender that are more susceptible to damage over multiple use.
15.	Compatibility:	3	Standard setup method and

	• Highly compatible with formula PLAYSEAT • Compatible with other standard frames		mounting so it fits well with most units to serve a larger customer base.
16.	Target Product Cost: • Needs to be affordable • Mods should cost efficient • Cost should be able to indicate quality of the product.	5	Since the setup of a racing simulator is already high around 900 to 2500 the base should not take a large portion of the expenditure. The cost should not be too low, so it is able to indicate that it is a high-quality product. The pricing should be good enough to able to compete with DIY solution with its features.

5.3.2 Materials

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Appearance: • Materials used in external parts needs to look rugged and strong. • The material finish should be suitable for the user environment	3	The material needs to look sturdy, so the user finds is reliable and strong. The finishing on the outside should be not too rough or smooth so it fits in user's environment.
2.	Colour: • Standard unit will be in black colour. • Colours on the outside should be customizable.	3	The standard black colour can fit in with most gaming equipment's without standing out a lot. It also compliments lighting and logos that could be added. Custom colours and patterns are essential for users who like to personalize their belongings.
3.	Conductivity: • Must have insulated body to not conduct heat or electricity. • Must have insulated body to protect the inner components.	2	It is essential that exterior is made of good, insulated casing to protect the user from any hazard that might be caused due to nearby leaking electricity or heat Intent- Outer body to be made of insulating materials like HDPE

4.	Density: • Aesthetic plastic parts made with low density material • Structural plastic parts made with high density material • Metal parts to be made with suitable density	3	Weight reduction as much as possible without compromising on integrity of the product. Intent- A right balance needs to be found between amount of different material being used to retain the overall balance in the product.
5.	Elasticity: • Elasticity in some parts that don't directly affect the stability of the base.	3	Only parts like spring and shock absorbers need to be elastic and not effect the stability of the base drastically.
6.	Hardness: • Should be hard enough to withstand impacts. • All support parts need to have right amount of hardness	2	Material used are combination of plastics and metals so all parts need to have right balance of strength and hardness.
7.	Phases: • The product is made for operation in both indoors and outdoors so it should be able to withstand heat and doesn't change phase.	2	Parts most susceptible to phase change when using in outdoors are wheels, low density parts and grip so suitable material needs to be used to withstand temp up to 60-70 C.
8.	Purity: • Can be compromised for recycled aluminium or plastic parts that meet the strength requirements	1	To be more eco-friendly recycled material can be used.
9.	Recycling and potential: • The materials from the product should be highly recyclable. • Easy to repair • No bonded material to be used. • Proper labelling on parts with material info and symbols	4	Since it is a mechanical product, all parts should be recyclable. Easy to repair and get spare parts so they are not disposed in case of damage. No plastic and metal binding as it makes the recycling process harder. All parts must have labelling or symbols for easy segregation while repairing.
10.	Strength: • The body needs to have high strength • It should also be able to handle small impacts while being moved	4	Use of high strength material in parts that provide structural strength to increase stability. Strength in corners to handle small impacts while being moved.
11	Texture:	3	Suitable finishing of internal

.	• The inner body needs to be comfortable to handle and assemble • Outer surface should be slip resistant and user friendly. • Customizable finishing of outer surface.		components for good assembling experience. Outer surface needs to be customizable to meet users' needs and be printable.
12.	Viscosity: • The product should not exhibit any viscous properties since all parts are rigid or have mechanical movement.	1	No viscous parts present in the product except the grease in moving components like wheels.

5.3.3 Dependability

Performance specifications			
No.	Description	Importance (1 - 5)	Notes
1.	Availability: • Availability as shelf product in gaming hardware stores. • Available at most gaming online platforms.	2	Available for customers for both commercial and residential use. Easily available online and selective offline stores.
2.	Reliability: • Highly reliable • Warranty to match that of products in similar space	3	Field testing on all possible scenarios. Warranty of around 2 Years. Replacement parts for repair easily available.
3.	Modification: • Easy to modify to meet the user needs. • Modification available to increase the utility of the basic product.	4	Based on the budget and user requirements modifications can be made. Other mods available to increase functionality of the basic product.
4.	Maintainability: • Needs periodic maintenance of moving parts like wheels and joints. • Should not be kept in continuous contact with moisture	3	Periodic maintenance is needed based on the amount of use. Good maintenance will increase the life of the product. Should not be kept awaty from moisture as much as possible as it can increase the rate of corrosion of metal parts.

5.	Lifecycle cost: • Very low additional cost involved in its lifecycle	1	Very low cost on maintenance of the product.
6.	Logistical support: • Product will also be available on various online and offline platforms • Support to locate product during the delivery process	2	Delivery, Return/Replacement <1 week.
7.	Disposal: • Needs proper disposal as it contains parts that need to undergo different recycling processes • Policy for exchange for instore products • Proper guide for disposal	2	Can be easily disposed if gone through proper process. Product can be retrieved or exchanged for other instore products.
8.	Level of service: • Easy to access service for maintenance or repair • Services provided for purchase and logistics. • Commercial service for custom pattern and logo printing	4	Company services for commercial orders like rebranding and printing patters and logos. Online services- Delivery, return, refund, claim warranty.
9.	Refurbishment: Not enough value to refurbish	1	No refurbishment.
10.	Redundancy: Portability, compatibility, and easy assembly are key features	3	No redundancy in range of movement and compatibility.

5.3.4 Environment

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Access: • All joints and parts should be relatively accessible • All fittings should be easy to access • It should be easy for an expert or trained professional to access it for maintenance or disposal purpose	5	Easy to assemble, modify, repair and dispose.
2.	Corrosion: • Metal supports and mechanical connector	5	Necessary coatings on all metal parts to withstand some level of corrosion.

	susceptible to corrosion		Instruction to try avoiding using in places with high moisture.
3.	Erosion: • There is little to no chance for erosion. In case erosion occurs, product will fail.	5	High erosion resistance.
4.	Force: • The product should function well even after being subjected to force and impact	3	Should withstand impacts and movement of the user.
5.	Mass: • The mass should be minimised to make use, assembly, and storage effective	4	Wait of all parts when assembled should not weigh more than 5KG
6.	Noise, Vibration and Shock: • The product is shock proof • Resistance to user movements • Resistant to noise	3	Joints need to resist vibration. And boy needs to absorb shock without being damaged.
7.	Pollution: • Must produce least amount of pollution as possible during its life cycle	3	Less pollution in packaging and transport. Use of sustainable materials. Product should easy be recycle.
8.	Radiation: Product is not made for use in radioactive environment	1	Not designed to resist radiation.
9.	Relative Humidity. • Product can withstand humid climate	4	Can withstand a range of 30-90% humidity. Metal and rubber parts are most susceptible to change in humidity
10.	Temperature: • Suitable to function in outdoor and indoor temperature	4	Working temp without deformation of low-density plastics. 50-80 C.

5.3.5Ergonomics and aesthetics

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Illumination: • Modular fitting for lighting	3	The fitting for light needs to be modular as it significantly adds

	• Able to change colours • Wire and wireless connectivity		to the cost so buyer has option to opt depending on requirement. Change light colour part of aesthetic appeal and the unit can be both wired or wireless.
2.	Colour: • Customizable to meet commercial and user needs • Using colours that are commonly found in gaming environment like black	3	Customization of colour and pattern on large or special orders. Neutral dark colours on basic units.
3.	Controls and display: • The device does not contain any display parts. • Addition of mods might contain display or indicator parts	3	Product is completely mechanical so contains no display parts. Mods like hight adjuster may have indication component.
4.	Culture: • Nothing culturally inappropriate in the product No advertisement of any offensive nature	2	The product is simple and not offensive in any way.
5.	Signs and Indicators: • No additional sign or indicator present in device light turns on when switch is turned on	1	Light turns on if switch is at ON position.
6.	Size and Shape: • The size and shape vary for different concepts. But all of them are made to fit most standard Frame sizes	3	The shape varies depending on how movement is achieved and how the fits the frame.
7.	Transportability: • After setup easy to move and make stable. • Easy to carry when not in use.	4	The product needs to be smooth during mobility making it easy for the user to move the frame through complex path.
8.	Visual Impact: • Easy to understand and simple design. • Blend in the gaming atmosphere. • Looks well engineered.	3	Simple design and a rugged look

5.3.6 Interface

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Configuration: • Easy to fit with various frames • Easy to fit mods • All functions are easy to operate and configure	4	All parts should be easy to assemble and understand by looking the manual. All functions are easy to perform and have less no. of steps.
2.	Compatibility: • Compatible with most standard units • Compatible with future mods produced by the company.	3	Needs to support all types of standard mods. Modular fittings produce by company in future should be compatible with the older version of the base.
3.	Emissions: • All emissions during manufacturing, packaging, delivery, and disposal should be reduced.	2	Eco friendly or easily recyclable materials should be selected for manufacturing and packaging. Occupy less space so reduces emissions while being transported.
4.	Heat input and output: • Can function without problem in outdoor heat • No heat is generated	3	Good material selection is needed so it is highly functional in both indoors and outdoors.
5.	Local utilities: • Used with any simulator unit	2	Can be used as an mobile unit for moving things but main use is support simulator units and provide utility.
6.	Interchangeability: • All mods are interchangeable. • All damages moving parts are interchangeable.	4	It is easy to repair and modify the base unit to increase its life and functionality.
7.	Use and abuse tolerance: • Can withstand abusive use to some extent • Can withstand impacts, certain levels of heat and environmental factors like moisture	3	Made to endure day to day use.

5.3.7 Cost and Timing

Performance Specifications			
No.	Description	Importance (1 - 5)	Notes
1.	Unit cost: • Cost per unit online should be <£150 • Wholesale cost for order of 100 +pcs be <£100 without customization •	4	Cost per unit is not fixed but it is dependent on the amount spent by average Racing sim owner
2.	Transportation and storage: • Transportation and storage cost can be reduced by decreasing the volume and weight of product.	3	Compact packing and good material selection can reduce volume and weight, hence reducing the cost.
3.	Marketing and Sales factors: • The product needs to be marked showing its unique features. • Should market it on multiple platforms.	5	Refer marketing section.
4.	Installation and commissioning: • Easy to use, can be self-installed. • No need additional installation service available.	2	No installation services or commissioning.
5.	Customer support: • Online support on delivery and refund available. • User manual and videos available to make user familiar with the product.	3	Delivery, return, refund, user manual and videos.

5.3.8 Training and Safety

Performance Specification			
No.	Description	Importance (1 - 5)	Notes
1.	Education: • Some knowledge of fittings and assembly is needed to use the product. • Need to keep general	4	Easy to understand manual and video needs to be made to guide users in right direction. Guidelines for safety needs to mention as well.

	health and safety in mind while assembling it.		
2.	Documentation: • Proper copy of buying receipt, H&S guidelines and user manual needed. • Proper documentation of product number and process is to be made	3	Proper bill, user guide, caution, and safety instructions. Proper warranty and tracking documents are needed.
3.	Language: • Documentation supplied in few selected languages.	1	Following the UK market European countries shall be targeted therefore such languages as Czech, Slovakian, French, German, Lithuanian, Swedish and Norwegian must be accounted for
4.	Skills and experience: • Basic fitting and assembly skills or experience is required	2	Easy to use, and manual easy to follow.
5.	Tools and equipment: • Basic tools required for assembly. • Specialized tools are provided along with the product.	2	Basic tools are required for assembly and fitting. Special tools related to the product need to be provided. No additional tools to remove preassembled parts.
6.	Accessibility: • No sharp edges or corners that may be safety concern while using or assembling it	3	Safe to access, store and assemble.
7.	Cultural: • No offensive material used in the product. • No inappropriate branding related to the product.	4	No offensive use of material or branding.

5.4 Regulatory Requirements

5.4.1 Legislation

CE Marking Requirements –

All potential dangers, such as those caused by a lack of stability, a breakage in the middle of operation, a change in surface, a shift in operating conditions, contact with

moving parts, or the interaction of different machines, must be stated and safety measures must be outlined to protect against them.

Guards and other protective equipment should be specified, including the kind of guards needed, where they should be located, and how much room they have to move. Fixed guards, portable guards, and adjustable guards make up the triad of guard types.

Other dangers' risks are concerned with how far and how badly a hazard may affect a product. Electric supply, static electricity, energy other than electricity, fitting mistake, high temperature, fire, noise, vibrations, tripping, and falling are all examples of potential dangers.

Detailed instructions on how to clean and maintain the product, where to get replacement components, and what kind of tools and equipment are required should be included.

The gadget need to have the bare minimum of information and any applicable warnings. Customers should have access to all relevant safety information, including cautionary symbols, warnings about residual dangers, material marks, general principles of drafting/contents, and sales literature.

Risks posed by mechanical components, including their capabilities and potential operation environments. Wheels, mechanical strength, guide rails and rail tracks, raising and lowering weights, moving loads during handling, and controlling movement are all covered in great depth.

In addition to these rules, you need also take into account international standards like ISO's. ISO/TC 214, Elevating work platforms, is responsible for creating ISO 16368.

5.4.2 The following patents should not be breached-

While exploring all possible designs for mobile base it is important to know what ideas have already been explored and the concepts that cannot be used in your concept development as they may create legal issues down the product development process.

Sno.	Patent number	Title	Autor
1	US9591919B2	Height adjustable desk system and method	Ergotron Inc
2	US10939750B2	Height adjustable device with concealed lift mechanism	Nicholas Robert Swartz
3	US9829151B1	Height adjustable flat panel display mounts	Brett Stenhouse
4	US20180146775A1	Height adjustable workstation	Xiaodong You
5	US9504316B1	Height adjustable desktop assembly	Henry Streicher
6	US10994216B2	Virtual reality motion simulator	David Board
7	US20120160617A1	Baggage caster lock device	Shoji Hashimoto
8	JP3184846U	Caster lock device for bags	T&S

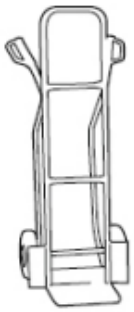
			CORPORATION
9	US7225903B2	Shopping cart tilt and tip prevention device	Jay S. Means
10	US20180319214A1	Braking and locking system for caster wheels	Shadi RENNO
11	US6163924A	Swivel caster assembly with releasable lock mechanism	Scott Corley
12	JP4908825B2	Caster locking device	Okamura Corp
13	JP2010201972A	Double-wheel caster	Masuo Katada
14	US20190039637A1	Housekeeping cart with wall protectors	Michael Thuma
15	US9993378B2	Method and apparatus for a locking caster	Michael Turturro
16	US8967636B2	Hubless wheel and related stroller	Andrew J. Horst
17	US5419619A	Hubless wheel	Paul E. Lew
18	DE102014220988A1	Steerable wheel suspension for a hubless wheel	Daniel Wolf
19	US9573417B2	Hubless wheel	Lei Feng
20	US3680495A	Pallet structure	Daniel W Pike
21	US10699591B2	Motion simulator	Jean Paul Warmerdam
22	KR101250429B1	Motion simulator	전상곤
23	US9520018B2	Controlling priority of wagering game lighting content	Edward G. Brunell
24	JP6474780B2	Apparatus, method and system for mounting an object on a mounting surface	Lee Christopher Franklin

6. References

- https://www.cognitivemarketresearch.com/sim-wheel-stand-market-report
- https://www.grandviewresearch.com/industry-analysis/gaming-simulator-market
- https://www.marketresearchfuture.com/sample_request/9560?utm_source=RD_infograph
- https://www.businesswire.com/news/home/20170104006089/en/Technavio-Says-the-Global-Gaming-Simulator-Market-is-One-of-the-Fastest-growing-Gaming-specific-Hardware-Markets
- https://simracewebshop.com/product/formula-intelligence-mercedes-amg-f1/
- https://op.europa.eu/en/publication-detail/-/publication/9cc06d44-9c8d-4b04-9d3a-b9f3d300cdd5
- https://www.iso.org/obp/ui/#iso:std:iso:16368:ed-2:v1:en
- https://www.hse.gov.uk/pubns/indg478.pdf
- http://playracecraft.com/racecraft-racing-seat/

7. Appendix

Small with one or two wheels: *eg wheelbarrows, wheelie bins or sack trucks. With this equipment the worker supports some of the load.*



Less than 50 kg	Low G/0
50 kg to 100 kg	Medium A/2
100 kg to 200 kg	High R/4
More than 200 kg	Very high R/8
Load exceeds equipment's rated capacity (manufacturer's recommended maximum weight)	Unacceptable P

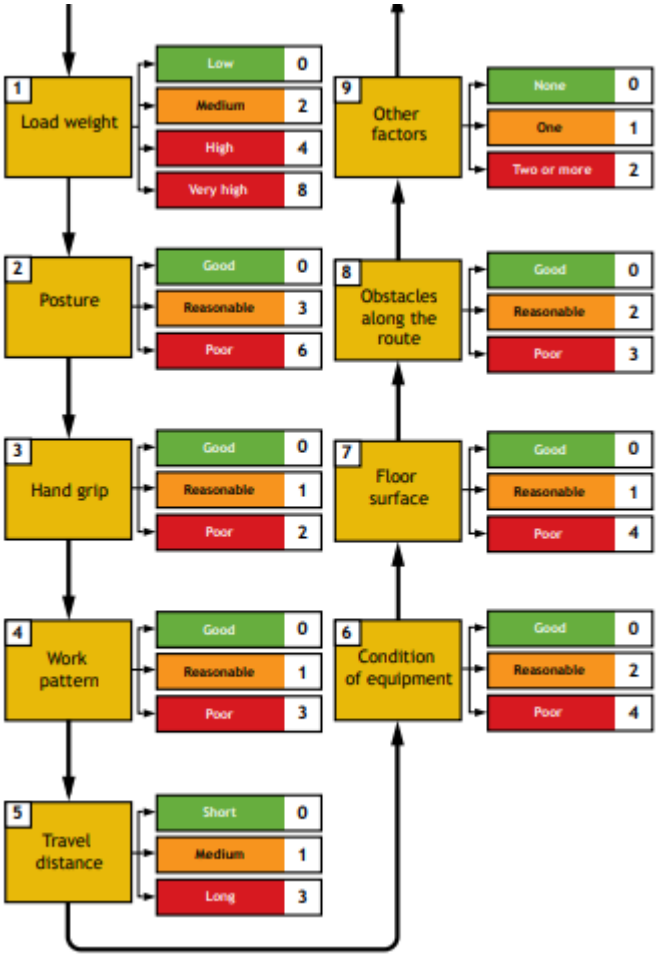
Medium, with three or more fixed wheels and/or castors: *eg roll cages, Euro bins.*

Less than 250 kg	Low G/0
250 kg to 500 kg	Medium A/2
500 kg to 750 kg	High R/4
More than 750 kg	Very high R/8
Load exceeds equipment's rated capacity (manufacturer's recommended maximum weight)	Unacceptable P

Large, steerable or running on rails: *eg pallet truck or overhead rail system.*

Less than 600 kg	Low G/0
600 kg to 1000 kg	Medium A/2
1000 kg to 1500 kg	High R/4
More than 1500 kg	Very high R/8
Load exceeds equipment's rated capacity (manufacturer's recommended maximum weight)	Unacceptable P

Grading system for moving platforms with load.

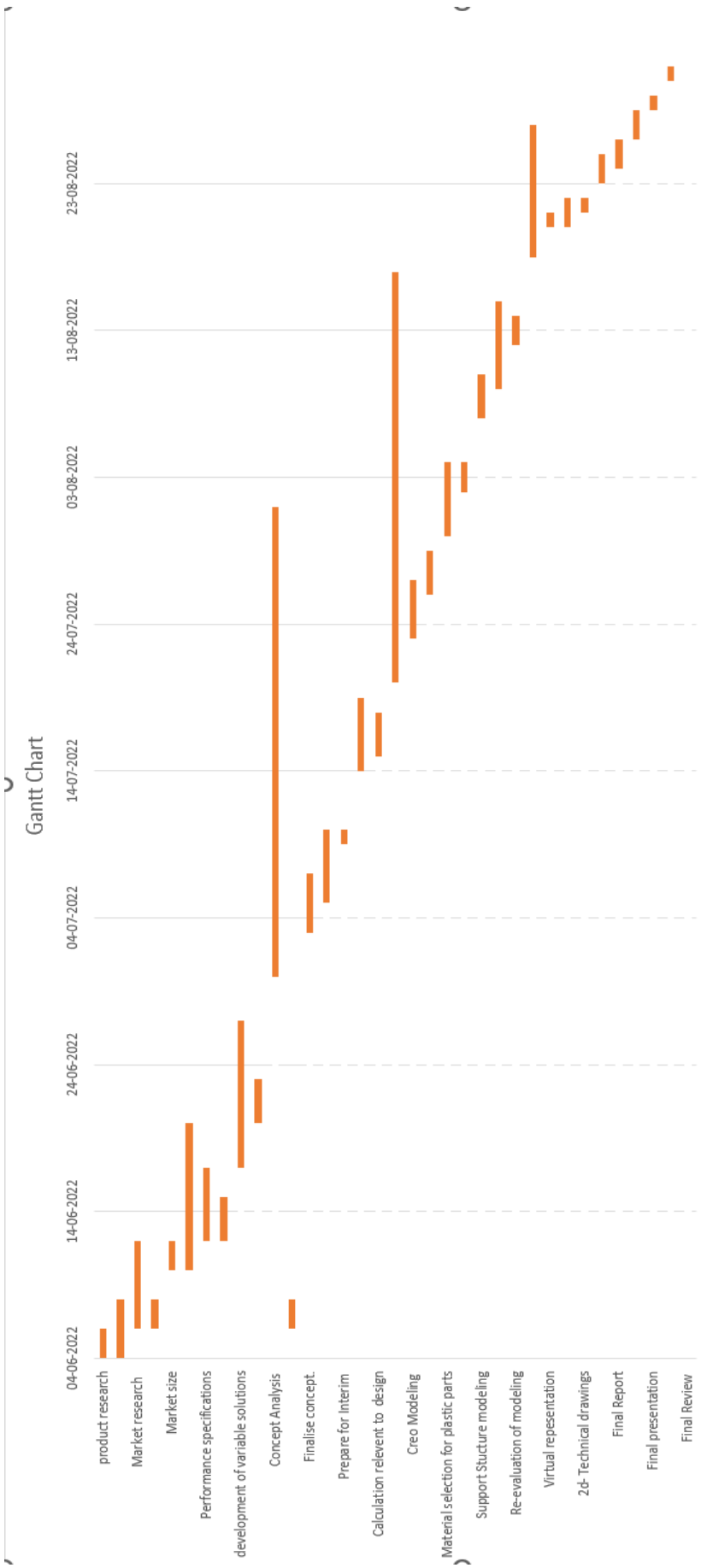


Types of VR simulator

Playseat-


playseat
PETRONAS
playseat


playseat
playseat



	Final Review	Final Review prep	Final presen tation	Presen tation boards	Final Report	Ethics and Sustain ability statem ent	2d-Techni cal drawin gs	Re-visit PDS	Virtual repese ntation	Assem bly of parts	Re-evaluat ion of modeli ng	Modeli ng of Screws and mount s	Suppor t Stuctur e modeli ng	Creo Modeli ng of outer body	Materi al selecti on for plastic parts	Mecha nisum selecti on	Creo Modeli ng	Outsou rced Compo net selsecti on	Calcula tion relevenIn t to design	Interim e for Interim	Prepar Presen tation boards	Finalise concep t	Final PDS	Concep t Analysi s	Finalise 10 concep ts	develo pment of variabl e solutio ns	Concep t develo pment	Perfor mance specific ations	Specifi ng feature s	Market size	PDS with format	Market researc h	PDS first draft	produc t researc h
start date	31-08-	30-08-	28-08-	26-08-	24-08-	23-08-	21-08-	20-08-	20-08-	18-08-	12-08-	09-08-	07-08-	02-08-	30-07-	26-07-	23-07-	20-07-	15-07-	14-07-	09-07-	05-07-	03-07-	06-06-	30-06-	20-06-	17-06-	12-06-	10-06-	06-06-	06-06-	04-06-	04-06-
2		1	1	2	2	2	1	2	1	9	2	6	3	2	5	3	4	28	3	5	1	5	4	2	32	3	10	3	5	10	2	6	4	2