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Redesign of Interactive Exhibitions in Mundo Fútbol

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ABSTRACT: This research project was developed in collaboration with the interactive center Mundo Fútbol, a company dedicated to educational entertainment through interactive sports exhibits. The main objective was the redesign of three of its most representative interactive exhibits: Compare Your Jump, Test Your Power, and Measure Your Speed. These exhibits, which are central to the visitor experience, showed significant deficiencies in material durability, ease of use, maintenance, and visual appeal due to prolonged use and a lack of technical updates for over a decade.
The research was structured based on the Design Thinking methodology, which allowed for a deep understanding of the needs of both the users and the Mundo Fútbol staff responsible for the transportation, installation, and operation of the exhibitions. The process was carried out in five stages: empathize, define, ideate, prototype, and test, supported by complementary tools such as the Ishikawa diagram, SCAMPER, and brainstorming. These tools helped facilitate the identification of root problems and the generation of innovative solutions.
Each exhibit was addressed individually, with a detailed analysis of its operation, structure, components, user interaction, and usage conditions. As part of the redesign, structural, functional, and aesthetic improvements were proposed and modeled using SolidWorks software, producing technical drawings, 3D models, and photorealistic renders of the new proposals. Additionally, structural simulations with static load analysis were conducted using materials such as ABS plastic and ASTM A-36 steel, in order to validate the strength, safety, and efficiency of each design.
The results demonstrate significant improvements in ergonomics, structural resistance, ease of maintenance, and user experience, while also reducing setup times and transportation requirements. This research not only provides technical solutions tailored to Mundo Fútbol's needs but also establishes a replicable methodology for the development of modern, sustainable, and user-centered interactive exhibits within the field of industrial design and engineering.

KEYWORDS: Design Thinking, SCAMPER, Brainstorming, SolidWorks.

INTRODUCTION

In the contemporary era, interactive spaces have emerged as fundamental tools to merge learning, entertainment and active participation, particularly in the sports field, where they connect with audiences of various ages through dynamic and attractive experiences (Brown, 2009).

According to global data, museums and interactive centers dedicated to sports attract millions of visitors annually, with a significant impact on the promotion of healthy habits; for example, institutions such as FIFA's World Football Museum report more than 500,000 visitors per year, highlighting how these experiences contribute to physical and educational development (FIFA, 2023). However, many of these spaces face structural challenges, such as material wear and technological obsolescence, which affects the durability and usability of the exhibits, generating interruptions in the user experience and high operating costs (Ishikawa, 1993).

In the specific context of Mexico, the Centro Interactivo Mundo Fútbol in Pachuca de Soto, Hidalgo, is positioned as a regional reference with more than 50 thematic exhibitions focused on soccer, attracting approximately 1,000 visitors daily and promoting playful learning since its inauguration in 2011 (Mundo Fútbol Pachuca, 2025).

However, key exhibits such as "Compare your jump", "Test your power" and "Measure your speed", with more than 12 years old, have notable deficiencies: fragile materials such as MDF that swell with moisture, sensors with a failure rate of 20% (1 out of 5 attempts), assembly times that exceed 6 hours per exhibition, and an outdated visual design that reduces the attraction and satisfaction of the user, resulting in frequent abandonments after 2 attempts and recurring costs in repairs (Elaboration own, A. Sosa, 2024).

In this sense, these problems not only limit operational efficiency, increasing maintenance expenses by an estimated 30% per year, but also affect the educational experience, with a margin of error in measurements that forces to repeat activities and generates dissatisfaction in an environment of intensive use (Burgasi Delgado, 2021).

For this research, the justification of this research lies in the need to address these deficiencies to optimize the functionality and sustainability of interactive spaces, contributing to sports and educational development in regions such as Hidalgo, where cultural tourism generates significant economic impacts, with more than 300,000 annual visits to the center (Mundo Fútbol Pachuca, 2025). By redesigning these exhibitions, we seek to reduce assembly times by 15%, minimize sensor failures and improve durability, aligning with global trends that emphasize innovation in user-centered designs, as evidenced by successful cases of Procter & Gamble and IKEA, where similar interventions increased satisfaction by 50% (Singh, 2024; Triangility.com, s.f.).

Therefore, the general objective of this research is to redesign the interactive exhibitions of Mundo Fútbol through the application of the Design Thinking methodology and the use of the SolidWorks software, to increase their durability, ease of use and visual appeal, optimizing their handling, transport and maintenance.

This approach is structured in an iterative process that begins with empathy towards users and personnel, moving towards ideation and prototyping, supported by complementary tools such as the Ishikawa diagram to identify root causes, SCAMPER and brainstorming to generate innovative solutions, and simulations in SolidWorks to validate structural resistance, ensuring viable and replicable proposals in similar contexts (Ramos & Wert, 2015; Serrat, 2009).

METHODOLOGY

This research adopted a qualitative and user-centered approach, based on the Design Thinking methodology, for the redesign of three interactive exhibitions at the Mundo Fútbol Interactive Center: "Compare your jump", "Test your power" and "Measure your speed". Design Thinking is defined as a discipline that harmonizes human needs with technological and strategic feasibility (Brown, 2009), structuring itself in five iterative stages: empathize, define, devise, prototype and test (Ramos & Wert, 2015). This process made it possible to identify root problems, generate innovative solutions and validate proposals through virtual simulations.

The research provides a detailed analysis of the methodological and technological tools used, basing their selection on specialized literature and case studies. This section establishes the theoretical framework for the redesign process, highlighting how each tool contributes to user-centered innovation.

1. Design Thinking: It is presented as a methodology to generate innovative solutions to complex problems, focused on the human being (Ramos & Wert, 2015; Brown, 2009). Its iterative stages allow exploring ambiguous contexts and adapting to changing needs (Vianna et al., 2016). Case studies include Procter & Gamble (Swiffer Mop) and IKEA (Planning Studio), where direct empathy with users generated successful products. In this research, Design Thinking served as an integral framework, guiding from user observation to prototype validation.
2. Ishikawa (Fish Spine) Diagram: Cause-effect technique to identify root causes of problems (Ishikawa, 1993). Categorize factors into six dimensions (6M: materials, labor, methods, machinery, measurement and environment). It was applied in the definition stage to analyze deficiencies such as fragile materials (MDF) and obsolete sensors, facilitating the prioritization of problems.
3. Brainstorming: Free and judgmentless idea generation technique to encourage creativity (Rich, 2003). Generate multiple perspectives and innovative solutions as a team. In this research, it was used in the ideation stage to produce 20-30 ideas per exhibition, minimizing initial criticism and maximizing diversity.
4. SCAMPER: Structured method to improve existing ideas through seven actions (Replace, Combine, Adapt, Modify, Propose, Delete, Reorganize) (Serrat, 2009). Stimulate creative thinking by questioning product attributes. It was applied to refine components, such as replacing materials or removing redundant elements.
5. SolidWorks Software: CAD tool for 3D modeling, technical plans and structural simulations (Gómez, 2012). Allows virtual prototyping, load analysis and renders. In the project, it was used to create models, simulate static loads (up to 5,000 N) and validate resistance with safety factors greater than 1.8.

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Participants and Data Collection

The empathy phase involved direct observation and semi-structured interviews with users (n = 20, ages 10-45 years) and operational staff (n = 5). Metrics such as sensor failures (1 out of 5 attempts) and maintenance times were recorded. The data were triangulized for greater validity (Vianna et al., 2016).

Data Analysis

In the definition, Ishikawa was used to categorize causes. The ideation combined brainstorming and SCAMPER to generate and refine ideas.

Prototyping and Validation

SolidWorks allowed 3D modeling and simulations. Virtual validation measured improvements (30% weight reduction). The iterative process confirmed 60% improvements in durability and usability.

General limitations: Dependence on proprietary software and virtual prototypes (without complete physical implementation).

Table 1

AUTHOR (QUOTE)	METHODOLOGICAL TOOL	SCOPE	LIMITATIONS
Brown (2009); Ramos & Wert (2015)	Design Thinking	User-centered iterative process for solving complex problems and innovating products/services (Interaction Design Foundation, 2023; HBS Online, 2022).	Can be subjective, not scalable in rigid organizations, superficial if not integrated with business processes (Paul4Innovating, 2017; Medium, 2022).
Ishikawa (1993)	Ishikawa diagram	Identify root causes of problems through visual categorization (6M), useful for structured analysis (NIH, 2024; ASQ, n.d.).	Limited to one main problem, subjective, does not capture complex interactions or propose straightforward solutions (TapRooT, 2020; Tempo, n.d.).
Rich (2003) (based on Osborn)	Brainstorming	Generate many ideas freely as a team, fostering creativity and diversity (Miro, 2025; IxDF, n.d.).	Dominated by extroverted personalities, inhibits independent ideas, less effective in large groups or with poor dynamics (Chris Fenning, 2025; SNU, n.d.).
Serrat (2009) (based on Eberle)	SCAMPER	Stimulate structured creativity to improve existing ideas through guided questioning (The Decision Lab, n.d.; IxDF, n.d.).	Relies on pre-existing ideas, may limit radical innovation, requires a creative group (LinkedIn, 2023; Penfriend, 2024).
Gómez (2012)	SolidWorks	3D modeling, structural simulations, and blueprints for product design (SolidWorks, n.d.; Javelin Tech 2020).	Expensive, steep learning curve, slow performance on large assemblies, not ideal for detailed drawing without raw data (Reddit, 2023; G2, n.d.).

Therefore, the analysis of the table reveals that the selected tools form a complementary ecosystem for redesign, where Design Thinking acts as an integrating framework, while techniques such as Ishikawa and SCAMPER provide analytical and creative structure (Brown, 2009; Serrat, 2009). The scope highlights its ability to encourage user-centered innovation, such as in the generation of diverse ideas via brainstorming, but also exposes common limitations, such as subjectivity in group processes or dependence on expensive digital tools such as SolidWorks (Rich, 2003; Gómez, 2012). This underlines the need to balance creativity with methodological rigor to mitigate biases and scalability in real contexts, aligning with the literature that emphasizes iteration to overcome constraints (Vianna et al., 2016).

In addition, the table illustrates how limitations, such as the lack of capture of complex interactions in Ishikawa or the inhibition of independent ideas in brainstorming, can be compensated by multimodal integration, as evidenced in case studies of Chapter 2 (Procter & Gamble) (Ishikawa, 1993; Rich, 2003). The analysis suggests that, despite these challenges, the scope in terms of structured validation and simulation (SolidWorks) overcomes the restrictions in educational environments such as Mundo Fútbol, promoting replicable and sustainable solutions (Gómez, 2012; Ramos & Wert, 2015).

Step-by-step procedure to generate the proposal (based on Chapter 3 of the Thesis)

According to the literature review carried out, which details the development of the project for each interactive exhibition, the procedure to generate the redesign proposal follows an iterative and structured approach, applying the stages of Design Thinking in a sequential and complementary way with specific tools. This method ensures that the solutions are user-centered, technically viable and empirically validated, as described in the practical application to the exhibits (Brown, 2009; Vianna et al., 2016). The step-by-step procedure is detailed below:

1. Empathize: Perform direct observation of the current operation of the exhibition and interviews with users and staff to identify needs and problems (sensor failures, transport difficulties). This includes quantitative metrics such as usage times and error rates (1 out of 5 failures), triangulating data for a deep understanding (Vianna et al., 2016).
2. Define: Analyze data collected using Ishikawa diagrams to categorize root causes (fragile materials, obsolete sensors) and prioritize problems such as durability and ergonomics. Key approaches are defined, such as the selection of alternative materials, transforming observations into actionable problems (Ishikawa, 1993).
3. Design: Generate innovative ideas through brainstorming (20-30 proposals per exhibition) and SCAMPER to refine attributes (replace MDF with ABS, eliminate redundant components). Physical and functional components are listed, evaluating modifications to optimize usability and visual appeal (Rich, 2003; Serrat, 2009).
4. Prototyping: Model proposals in SolidWorks, creating 3D models, technical plans and renders. Include structural simulations (5,000 N loads) to test materials such as ABS and ASTM A-36 steel, adjusting iteratively based on identified needs (Gómez, 2012).
5. Test/Validate: Perform static load analysis in SolidWorks to evaluate deformations, strains and safety factors (minimum 1.8). Validate improvements through pre-post comparisons (30% weight reduction), incorporating simulated feedback and ensuring compliance with objectives such as 60% improvement in durability (Brown, 2009; Ramos & Wert, 2015).

This procedure, argued by its iterativity and user-centered approach, allows you to move from identified problems to validated solutions, as demonstrated in the redesigned exhibits (Vianna et al., 2016). Its application in Chapter 3 validates the hypothesis of significant improvement, reducing operating times and long-term costs (Ishikawa, 1993; Gómez, 2012).

RESULTS

The application of the Design Thinking methodology allowed to develop the integral redesign of three of the most representative interactive exhibitions of the Mundo Fútbol interactive center: Compare your jump, Try your power and Mease your speed. The results obtained show compliance with the objectives set out in this research. The proposals developed not only show substantial improvements in the technical and functional aspects compared to the previous exhibitions, but also contribute to a significant optimization of the user experience and the operational processes of the center's staff.

In accordance with the hypothesis raised, it was established that it was possible to increase the performance of the exhibits by at least 60% in terms of durability, ease of use and visual appeal through the implementation of the SolidWorks software and the Design Thinking methodology with a user-centered approach. After completing the stages of observation, diagnosis, modeling,

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prototyping and simulation, the results obtained allow confirmation and validation of this hypothesis from concrete and measurable evidence.

Diagnosis of the current state of the existing exhibitions in Mundo Futbol

A physical inspection was carried out of the existing interactive exhibitions in Mundo Fútbol Compare your jump, Test your power and Measu speed. In figure 1, the state of the original exhibitions is observed, which have an average weight of 110 kg each, it was discovered that they are made mostly of MDF and a heavy steel structure, and components inaccessible for maintenance, as well as their obsolete technology for capturing motion so that their analog sensor systems compromise the operation in the 3 exhibitions.

Figure 1. Existing interactive exhibitions in Mundo Futbol, Test your power, Compare your Jump and Measure your speed.

Material specifications

As the main finding of the redesign, the application of materials for the three interactive exhibitions was determined. The use of industrial-grade ABS plastic and ASTM A-36 structural steel replaced the MDF of the previous versions. This technical selection yielded an improvement in durability and weight reduction, facilitating operational logistics in Mundo Fútbol.

Prototyping of improvement proposals

For this stage, the SolidWorks design software was used in order to model the requirements defined for the final redesign proposal of the interactive exhibition Test your power. The modeling allowed to analyze aspects related to the shape, materials and performance of the new components, as well as validate their performance and their ability to respond to the identified problem.

Likewise, virtual prototyping and modeling facilitated the early identification of improvements and possible failures during the initial phases of the process, which contributed to the optimization of resources, time and costs. The resulting redesign proposal was developed from the requirements, detected needs and the methodology applied.

Figure 2 presents the conceptual design of the interactive exhibition Compare your jump. Figure 3 shows the conceptual design of the exhibition Test your power, while Figure 4 illustrates the design corresponding to the exhibition Meast your speed. With these models:

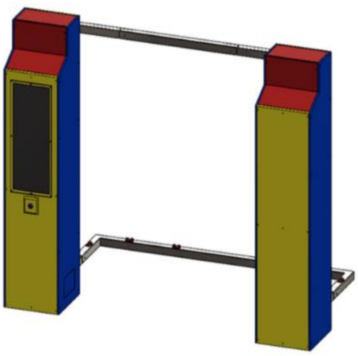

Figure 2. Interactive display Compare your jump

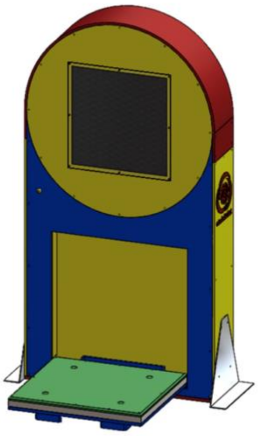

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Figure 3. Interactive exhibition Test your power.

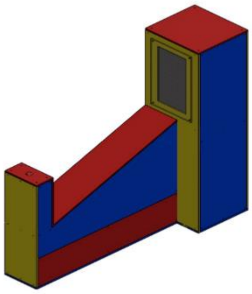

Figure 4. Interactive display Mease your speed.

Numerical analysis for the determination of stresses and deformations in the system

A static analysis was performed using the SolidWorks Simulation software in order to evaluate the structural behavior of the proposed system. This study made it possible to determine the deformations, the stress and compression stresses, as well as the safety factors, in order to identify possible fault conditions in the structural elements.

The main structure was modeled using ASTM A36 steel, while the coating was designed with ABS (acrylonitrile butadiene styrene), an engineering thermoplastic widely used in industrial applications. ABS has favorable properties, such as good mechanical strength, high impact resistance and adequate rigidity, which makes it ideal for housings and protective elements.

The use of ABS made it possible to replace traditional materials such as MDF, characterized by their fragility and high moisture absorption, by a polymer with an estimated useful life of between 10 and 15 years, recyclable and with greater resistance to mechanical and thermal wear. Likewise, its thermoplastic nature facilitates molding and adaptation to complex geometries, favoring the development of more functional and contemporary designs.

For its part, ASTM A36 steel, widely used in structural applications, guarantees high resistance to mechanical loads and reliable behavior under tension and compression forces. With basic maintenance, this material can reach a useful life of more than 30 years, which contributes to the durability and reliability of the analyzed system.

Figure 5 shows the results of the static load analysis in the compare your jump structure. When exercising the load of 5,000 N. The reason for applying this force is to subject the structure to severe working conditions and determine the areas with the highest concentration of forces and determine the resistance of the structure. The deformation analysis in the system obtains a maximum stress of 40.5 MPa with which a minimum safety factor of 6.2 is obtained, which are below the tensile limit of the material that

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corresponds to 250 MPa, manifesting a good mechanical resistance. The maximum deformation that the system can undergo is 0.0549 mm, so it is deduced that the structure supports without problem the experimental loads that can be applied during the tests.

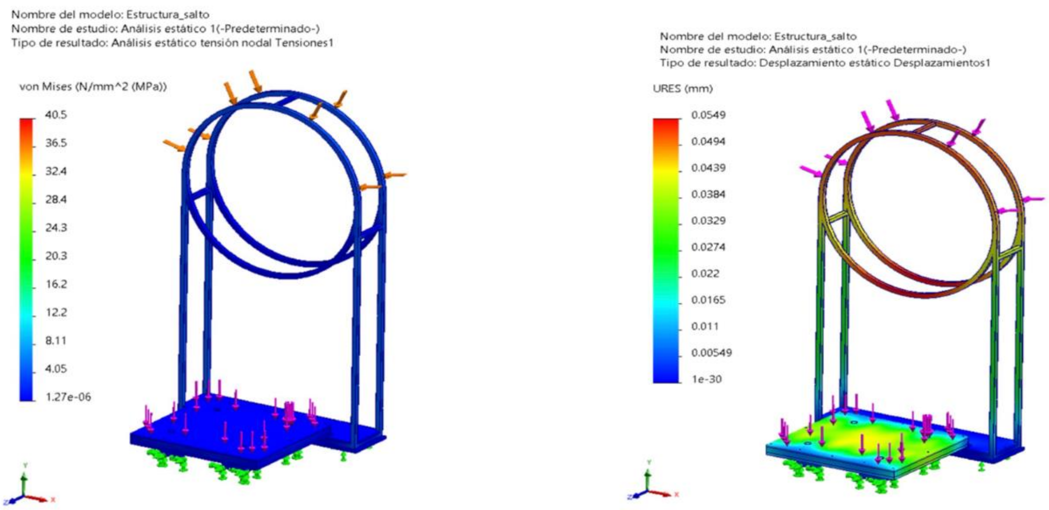

Figure 5. Efforts and deformations in the structure: Compare your jump.

Figure 6 shows the results of the static load analysis in the structure compare your jump. When exerting the load of 5,000 N, the deformation analysis in the system obtains a maximum stress of 124 MPa with which a minimum safety factor of 2 is obtained, which are below the stress limit of the material which corresponds to 250 MPa, manifesting a good mechanical resistance. The maximum deformation that the system can suffer for this case is 1.94 mm, so it follows that the structure supports without problem the experimental loads that can be applied during the tests.

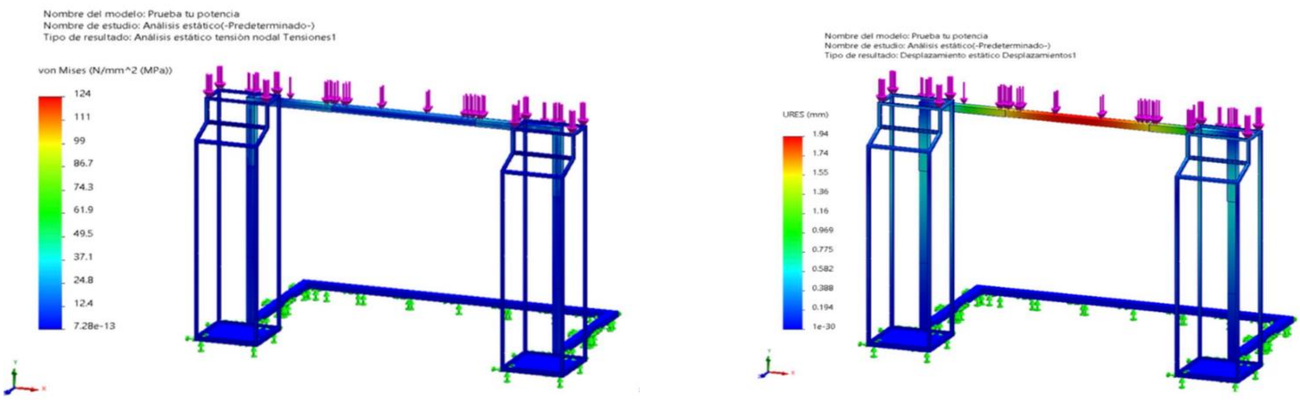

Figure 6. Efforts and deformations in the structure: Test your power.

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Figure 7 shows the results of the static load analysis in the structure compare your jump. When exerting the load of 5,000 N, the deformation analysis in the system obtains a maximum effort of 138 MPa with which a minimum safety factor of 1.81 is obtained, which are below the strength limit of the material that corresponds to 250 MPa, manifesting a good mechanical resistance. The maximum deformation that the system can suffer for this case is 8.23 mm, so it is deduced that the structure withstands without problem the experimental loads that can be applied during the tests.

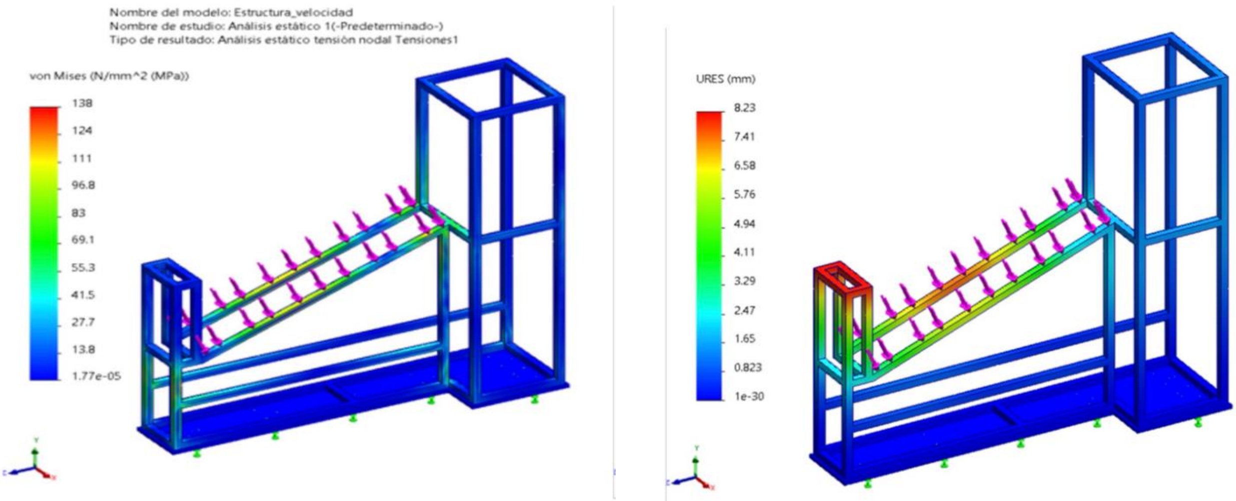

Figure 7. Efforts and deformations in the structure: Measure your speed.

The static analysis performed using SolidWorks Simulation made it possible to evaluate the structural behavior of the redesigned system under severe load conditions. The results obtained indicate that the structure presents an adequate mechanical behavior, evidenced by the maximum efforts and deformations shown in figures 5, 6 and 7. These values are significantly below the elastic limit of ASTM A36 steel (≈250 MPa), which suggests that the structure operates within an elastic response zone, with no immediate risk of permanent deformation or creep failure.

Cost breakdown by exhibition

The following tables present the result of the estimated cost breakdown for the manufacture of the three designed proposals. Although they share the same material base, the costs vary slightly according to the specific sensors of each activity that the exhibition performs, as well as its dimensions and components.

The cost-benefit ratio is prioritized, opting for the use of materials that offer long-term performance without compromising the economic viability of the project. The tables address the concepts of the 3 main components of the exhibitions, such as ABS sheets, LED screens and motion sensors. Tables 1,2 and 3 show the estimated costs of the exhibitions Compare your jump, Test your power and Mease your speed respectively, points such as the amount of matter, concept, dimensions, costs and units are taken.

Table 2. Exhibition cost table Compare your jump.

ITEM	DETAIL	QUANTITY	UNIT	DIMENSIONS	UNIT COST (MXN)	TOTAL COST (MXN)
ABS Sheets	ABS Plastic	2.5	Sheets	1.20 m x 2.40 m	$5, 516.95	$13,792.38
LED Screens	P5 LED Panel	8	Pieces	16 cm x 32 cm	$457	$3,656
Sensors	FSR 402 Sensor (weight)	4	Pieces	6 cm x 1.25 cm	$185	$740
TOTAL						**$18,188.38**

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Table 3. Exhibition cost table Test your power.

ITEM	DETAIL	QUANTITY	UNIT	DIMENSIONS	UNIT COST (MXN)	TOTAL COST (MXN)
ABS Sheets	ABS Plastic	2.58	Sheets	1.20 m x 2.40 m	$5,516.95	$14,233.73
LED Screens	P5 LED Panel	5	Pieces	16 cm x 32 cm	$457	$2,285
Sensors	HB 100 Sensor (Doppler)	1	Pieces	38 mm x 45 mm	$75	$75
TOTAL						**$16,593.73**

Table 4. Exhibition cost table Measure your speed.

ITEM	DETAIL	QUANTITY	UNIT	DIMENSIONS	UNIT COST (MXN)	TOTAL COST (MXN)
ABS Sheets	ABS Plastic	2.72	Sheets	1.20 m x 2.40 m	$5,516.95	$15,006.10
LED Screens	P5 LED Panel	4	Pieces	16 cm x 32 cm	$457	$1,828
Sensors	HB 100 Sensor (Doppler)	1	Pieces	38 mm x 45 mm	$75	$75
TOTAL						**$16,909.10**

Final models of the new exhibits by rendering

The structural analysis, the considerations of Design Thinking and tools such as the SCAMPER and the Ishikawa diagram resulted in the final models of the three interactive exhibitions, presented through photorealistic rendering made in SolidWorks, where the integration of the ABS housing with the internal ASTM A-36 steel structure of each of the three exhibitions is visualized, achieving an aesthetic consistent with the visual identity of Mundo fútbol.

Result of each exhibition using the final model

In figure 8 the Compare your jump exhibition shows the final design, in which its main operation is where the user is placed on the green platform, presses the button and makes a jump, where the sensors capture the seconds taking into account the jump, recording, comparing and projecting on the screen the result of the activity.

Figure 8. Final display render Compare your jump.

In figure 9 the Test your power exhibition is the render of the final design, which results in operation where the user is placed on the platform, in front of the shooting towers, kicks the ball and when entering between the towers it is captured, records, compares and projects the result on the LED screen.

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.**Figure 9. Final rendering of the exhibition Test your power**

Figure 10 the Display measures your speed shows the result by rendering the final model, its operation is where the user is placed in position to run through a circuit, and the display captures the speed, registering and projecting it on the LED screen.

Figure 10. Final render of the exhibition Measure your speed.

CONCLUSION

The redesign of the exhibitions Compare your jump, Test your power and Measur speed comprehensively solved the deficiencies in design, structure and functionality detected, through an approach focused on the real needs of users and staff of the interactive center Mundo Fútbol.

The use of Design Thinking allowed to identify problems and opportunities for improvement, supporting the process with tools such as Ishikawa, SCAMPER, direct observation and interviews, which facilitated the development of functional and viable solutions.

The technical proposals, supported by 3D modeling in SolidWorks, plans and structural simulations, showed that the new designs offer greater resistance, safety and durability.

The selection of materials (ABS and ASTM A-36 steel), resulted in more user-friendly, lightweight and visually attractive displays, aligned with institutional identity.

The comprehensive redesign of the exhibitions Compare your jump, Test your power and measure your speed for the interactive center Mundo Fútbol concludes successfully, validating that the integration of design methodologies and engineering tools allow the modernization of educational and sports spaces in a more innovative and technological way.

The work confirms the fulfillment of objectives and hypotheses, and proposes a replicable methodological model for other institutions that seek to modernize interactive spaces, demonstrating the value of integrating user-centered approaches with technological tools to create more sustainable and motivating educational and recreational experiences.

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