Project Impulse

ChelseaFC Performance Vizathon

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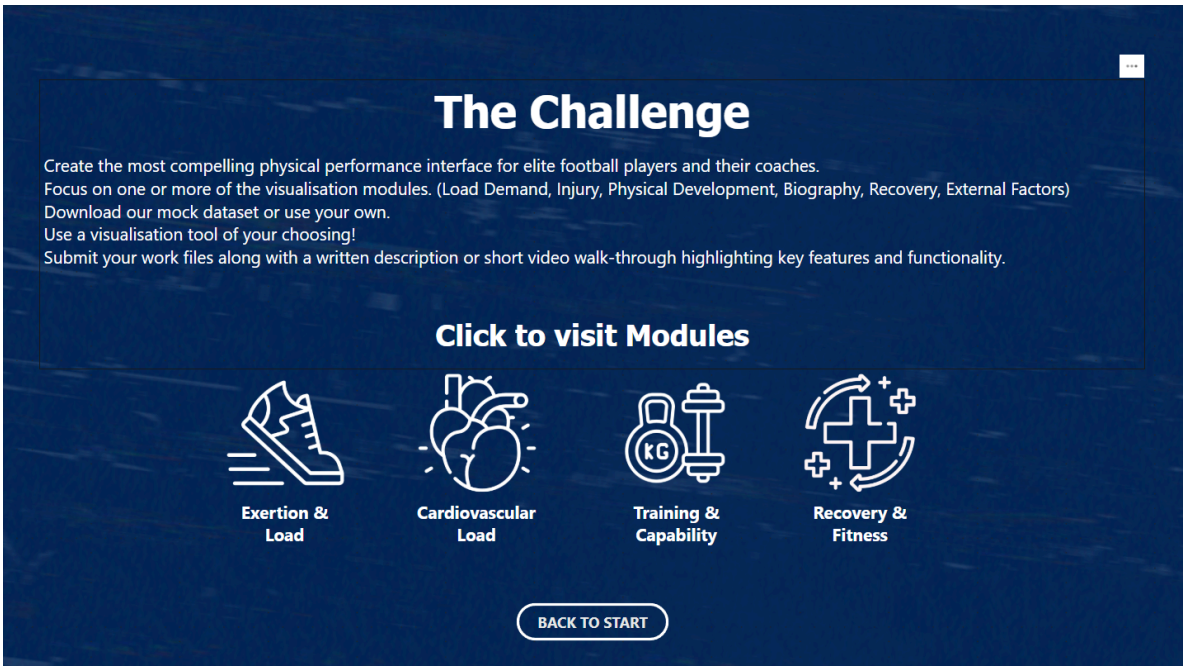
Project Impulse was developed as part of the Chelsea FC Performance Vizathon to provide a detailed and interactive dashboard for physical performance monitoring of elite football players. This solution uses Power BI to visualize key training and physiological metrics, integrating cardiovascular load, training capability, recovery, and exertion data in an intuitive and actionable format.

The dashboard centers around a player-centric view, enabling coaches and practitioners to explore movement patterns, recovery signals, and potential injury risks using robust metrics such as TRIMP, ACWR, and benchmarked physical qualities. Through strategic design and data modeling, Project Impulse bridges physiological science with high-performance analytics. It combines raw GPS and heart rate data with domain expertise in sports physiology to provide actionable insights tailored for both tactical and medical staff.

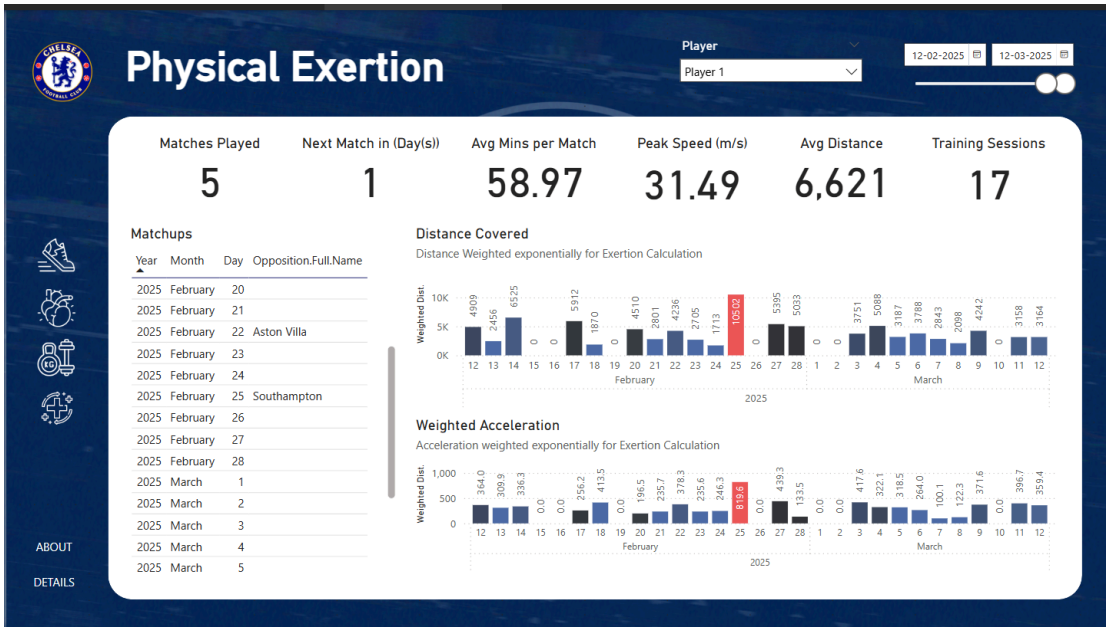


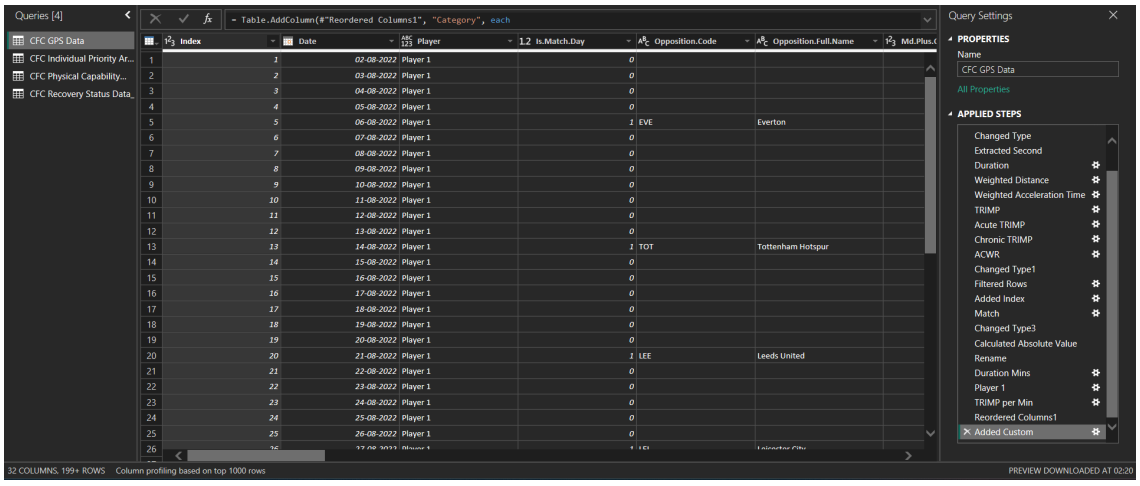
Exertion & Load Monitoring

The dashboard features core load metrics derived from daily GPS and heart rate data. A player's physical exertion is quantified using three primary indicators:

- Weighted Distance: This is calculated through an exponential scoring mechanism applied to distance covered at high-speed thresholds (>21, >24, >27 km/h). The use of exponential weights (e.g., $e^{(21-21)/3}$) gives greater focus to high-intensity running, which has been shown to correlate with match-critical actions and increased physical stress.

- Weighted Acceleration Time: Similar weighting logic is applied to durations of acceleration and deceleration events beyond set thresholds (2.5, 3.5, 4.5 m/s²). High accelerative effort is a major determinant of player fatigue and musculoskeletal risk.





A great Deal of Work was done to code this in PowerBI

Cardiovascular Load (TRIMP Model)

TRIMP (Training Impulse) is a well-established measure of cardiovascular strain that incorporates both session duration and exercise intensity. In the Project Impulse framework, a simplified TRIMP model is used:

$$TRIMP = \frac{HR1 \times 1 + HR2 \times 2 + HR3 \times 3 + HR4 \times 4 + HR5 \times 5}{60}$$

Where:

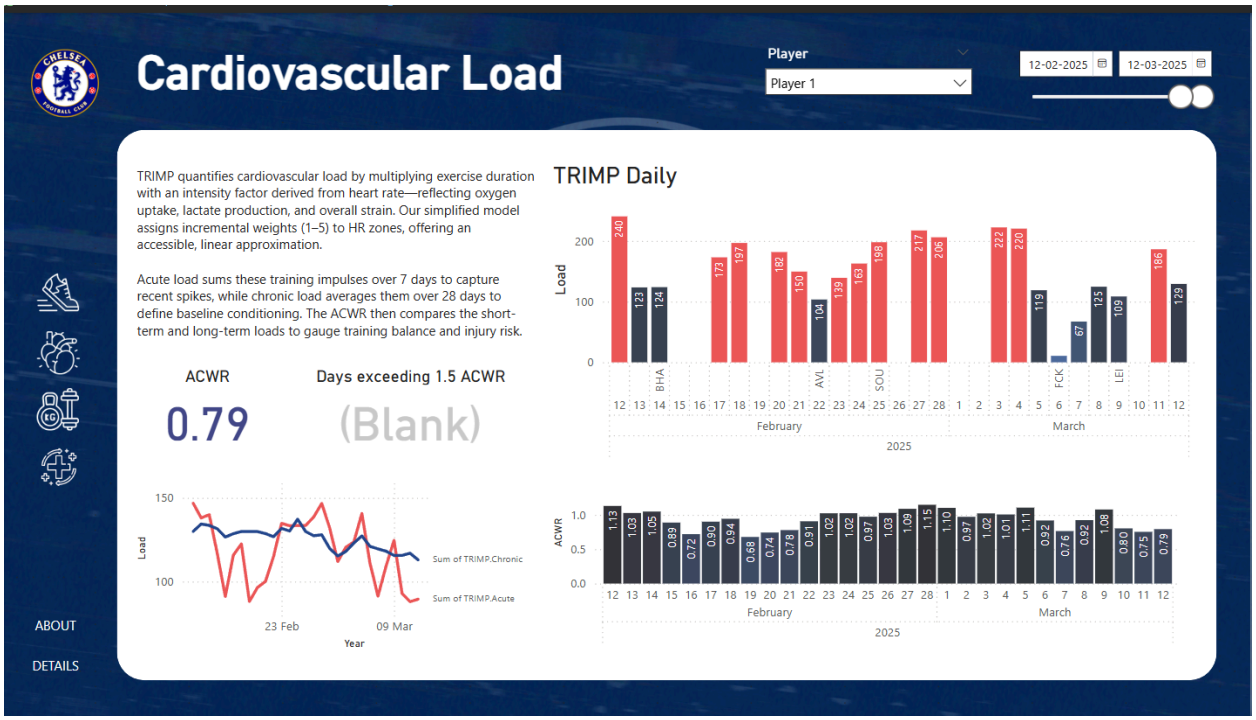
- HRx represent time spent in HR Zones 1 to 5 respectively.
- Each HR zone reflects ascending intensity from 50% to 100% of HRmax.

This linear method, while simpler than Banister's original exponential TRIMP model, retains interpretability and ease of implementation across rows of HR zone data. The dashboard also offers a time-normalized TRIMP score, scaled using session duration across the season to identify cardiovascular outliers.

These components are summed into a unified Load Daily score. A 7-day rolling sum of Load Daily produces the Acute Load, while a 28-day rolling average forms the Chronic Load. These, in turn, are used to compute the ACWR (Acute-Chronic Workload Ratio):

$$ACWR = \frac{Acute\ TRIMP}{Chronic\ TRIMP}$$

This ratio is a key flag for potential overload. Based on scientific literature, ACWR values >1.5 suggest elevated injury risk, while values <0.8 may indicate undertraining. The dashboard highlights ACWR zones using traffic light logic to support immediate decision-making.

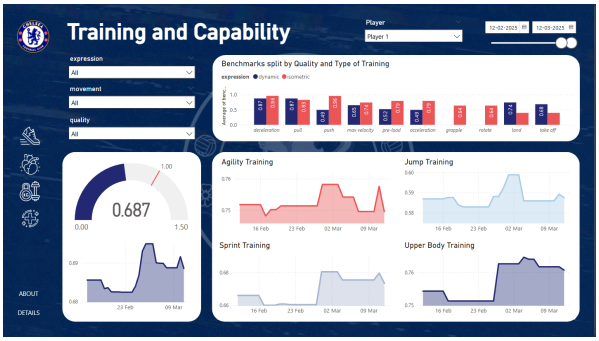


Training & Capability Metrics

Physical development is monitored through multiple test-based performance qualities, categorized by movement type:

- Sprint (including acceleration, max velocity)
- Jump (take-off, power-to-weight)
- Agility (change of direction, deceleration)
- Upper Body (push, pull, grappling force)

Each movement is benchmarked against sport- and position-specific normative scores scaled between 0 and 1. Weighted averages are calculated for training types (e.g., dynamic vs isometric), offering a granular view of neuromuscular development. For example, a player may show 0.92 in post-activation acceleration but only 0.61 in deceleration under load, guiding individual program adaptation.



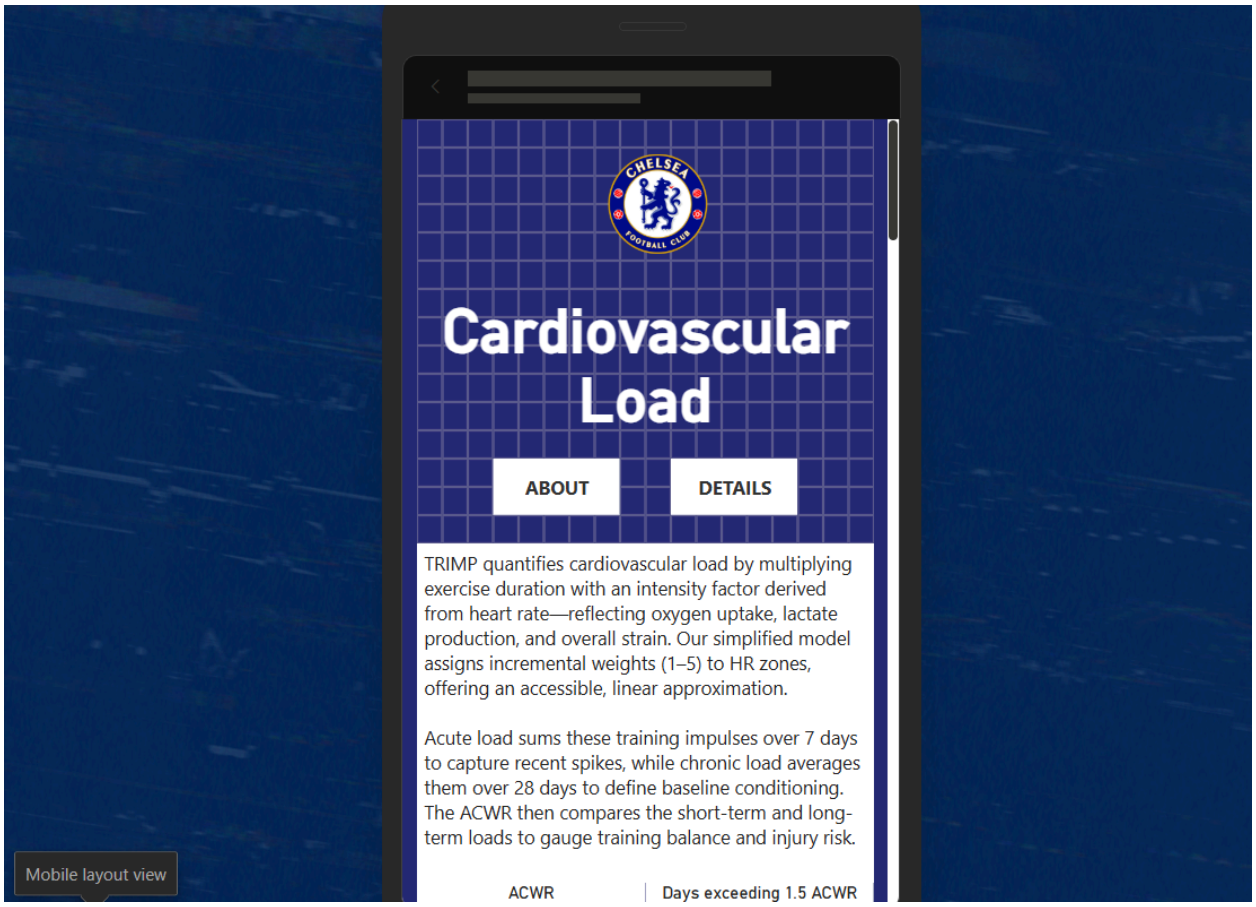
Recovery & Wellness Monitoring

Recovery is a multifaceted construct, requiring input from both objective and subjective sources. Project Impulse integrates recovery status through a Z-score framework, using factors such as:

- Sleep Duration & Quality
- Muscle Soreness
- Self-Reported Wellness
- Joint Range & Load Tolerance Tests

Each component is normalized using season-wide min-max scaling and plotted over time. The dashboard flags outliers (e.g., Z < -1) to highlight under-recovered states. This is particularly useful when load scores remain stable but recovery markers decline, indicating internal strain accumulation.

This also includes a more compact mobile view for analysis on the go whenever needed. The mobile layout has been specifically designed for smaller screens, featuring simplified visualizations, streamlined navigation, and interactive tiles that preserve key performance metrics. This ensures that coaches and players can access critical load and recovery data in real time, make informed decisions, and monitor performance trends even when away from a desktop environment.



Through this exercise, Project Impulse offers a comprehensive, scientifically grounded, and visually engaging platform for monitoring elite football performance. By using TRIMP, ACWR, and normalized load metrics with individual training benchmarks and recovery profiles, the dashboard has both depth and usability to detect risk, monitor progress, and support decision-making.