
# Tactical Digital Twin in Football

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RL FOR FOOTBALL STRATEGY

# Problem introduction

Modern football analysis fails to objectively evaluate the complex, real-time tactical contribution of players on the pitch.

Our project delivers a Tactical Digital Twin solution that uses advanced reinforcement learning and self-play to discover and optimize next-generation football strategies.

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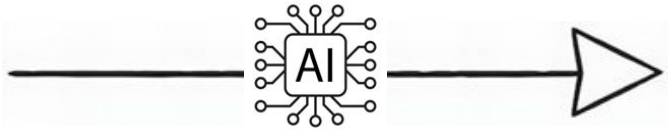
# Problem introduction

*'What happened'*

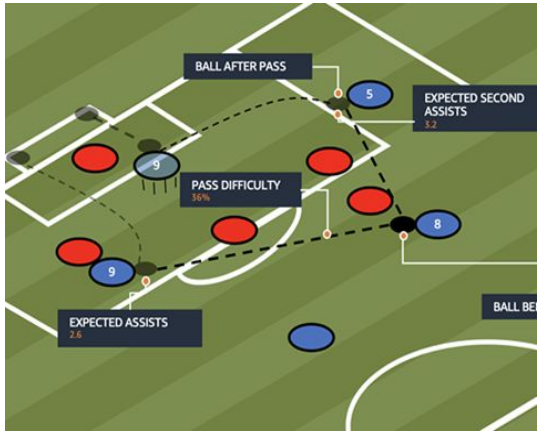
**Descriptive analytics**

**Digital twin**




**RL**

*'What can happen'*




**Predictive & Prescriptive analytics**

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# Value proposition

This project supports **Goal 9 (Industry, Innovation, and Infrastructure)** by promoting cutting-edge AI applications in the sports engineering sector, helping to improve infrastructure and innovation in performance optimization technologies.

Target 9.5: Enhance Research and Upgrade Industrial Technologies.

Target 9.4: Upgrade All Industries and Infrastructures for Sustainability.

# Objectives

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**Develop a reproducible framework** (digital twin) under realistic constraints, using real or synthetic data

Apply AI techniques to **simulate and optimize tactical behaviors**

Integrate real tracking or event data for **validation and calibration**

**Design evaluation metrics** to assess tactical effectiveness and realism

# Stakeholders

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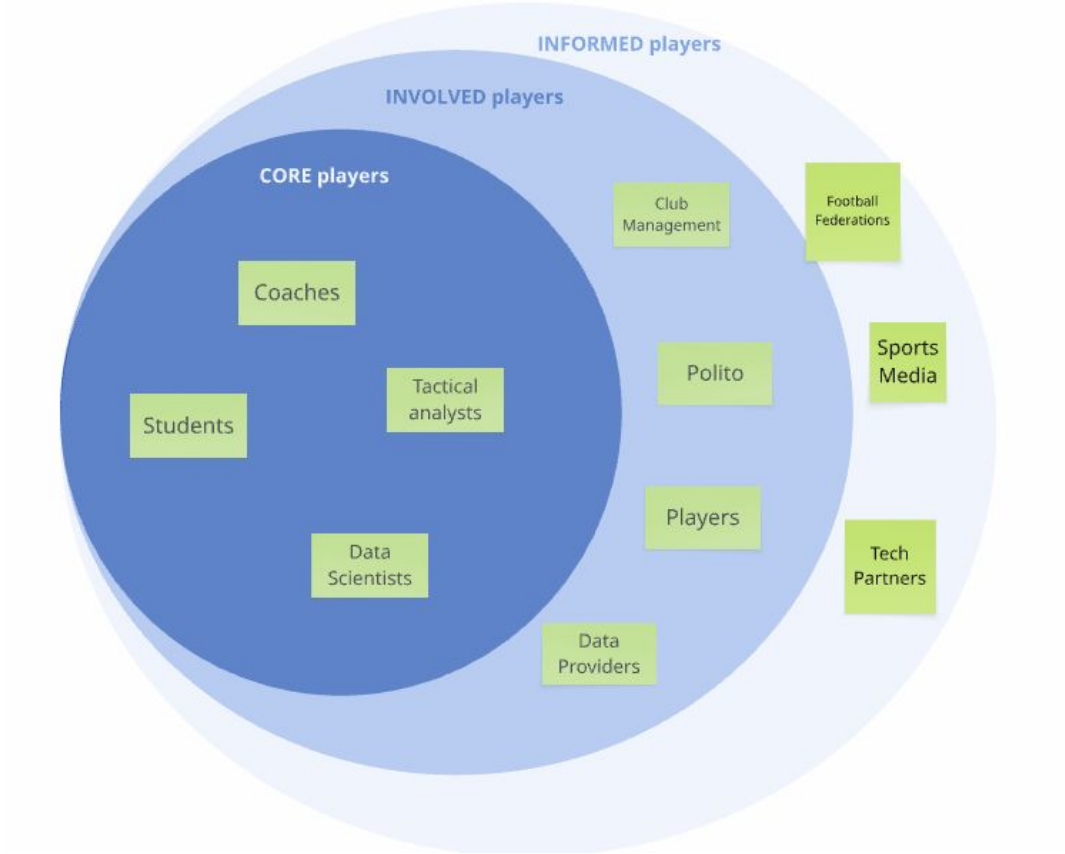

# User Persona

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## Michael J. Andersen

Head Coach

Former Midfielder; UEFA Pro License
15 Years of Coaching Experience

## GOALS

Build a consistent tactical identity
Make confident, evidence-based match decisions
Improve team organization in pressing, build-up, transitions

## FRUSTRATIONS

Tactical insights take too long to extract from matches
Hard to connect raw data to clear, actionable coaching decisions
Limited time to explore alternative tactical options

## NEEDS

Clear interpretation of match performance
Automatic recognition of tactical patterns
Coach-friendly visuals for team briefings
Quick evaluation of alternative tactical choices

# Michael’s Journey

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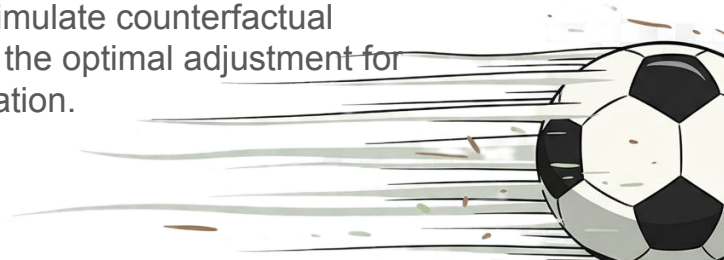
Michael searches for tools capable of connecting raw data to clear decisions, but it’s not easy to find a platform that offers quick quantitative validation of alternative tactics.

Michael exploits the evidence-based results to make a confident decision and uses the clear, coach-friendly visuals to drive team briefings, boosting player compliance and loyalty to his strategy.

Michael is frustrated after a key match loss, he gathers insights on his high-press failure, but the manual data is exhausting, and the conclusions are often inaccurate and not actionable.

Michael decides to use a new analysis system, reportedly being developed by Politecnico di Torino, to rapidly simulate counterfactual scenarios and test the optimal adjustment for his team's organization.



# User Requirements

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| | | FUNCTIONAL | NON-FUNCTIONAL |
|---|---|---|---|
| Mo | MUST HAVE | **Quantify**: the system must simulate and generate quantitative results on the effectiveness of alternative tactical choices and counterfactuals. | **Robustness**: the system must demonstrate robustness by operating reliably across different datasets, tactical scenarios, and execution conditions, ensuring that core functionalities remain stable even when inputs or environments vary. |
| S | SHOULD HAVE | **Visualize**: the system should visualize simulated scenarios and key performance indicators in a coach-friendly format for easy presentation in team briefings. | **Usability**: The system should offer Clarity through an intuitive interface and coach-friendly visuals for quick interpretation and effective team briefings. |
| Co | COULD HAVE | **Optimize**: the system could adjust decision models, and provide parameter tuning tools to optimize tactical behaviors. | **Adaptation**: the system could adapt to different tactical styles, data conditions, or evolving project goals, remaining useful as new strategies, behaviors, or analysis needs emerge. |
| W | WON'T HAVE | **Analyze**: the system won't offer real-time race strategy recommendations, focusing only on analyzing completed scenarios. | **Exclusion**: the system won't include physiological modeling, sports medicine features, or other non-essential components unrelated to tactical simulation. |

# Functional Diagram

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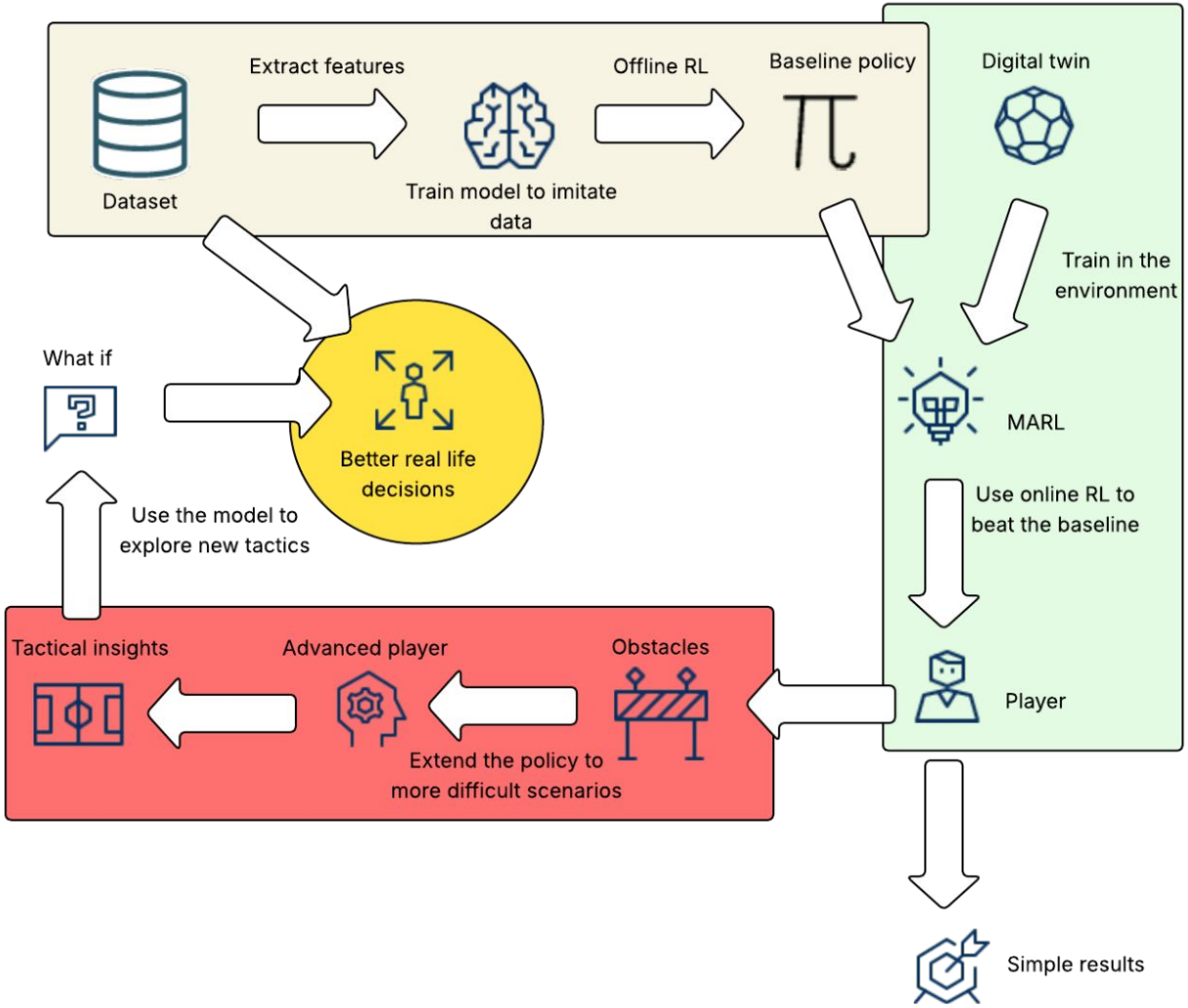


# Potential Technical Challenges

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State Representation & Feature Engineering

Sparse Reward & Credit Assignment

Scaling & Non-Stationarity

Validation and Interpretability Gap

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# Work breakdown structure

| WP No. | WP Title | Lead Name | PM | Start Month | End Month |
|---|---|---|---|---|---|
| 1 | Project Management | M | 0.5 | November | November |
| 2 | Research | A | 0.5 | November | November |
| 3 | Data and Environment exploration | L | 0.75 | November | December |
| 4 | RL offline model | M | 1.5 | November | December |
| 5 | MARL online model | A | 1.5 | November | January |
| 6 | Documentation | L | 0.5 | November | January |

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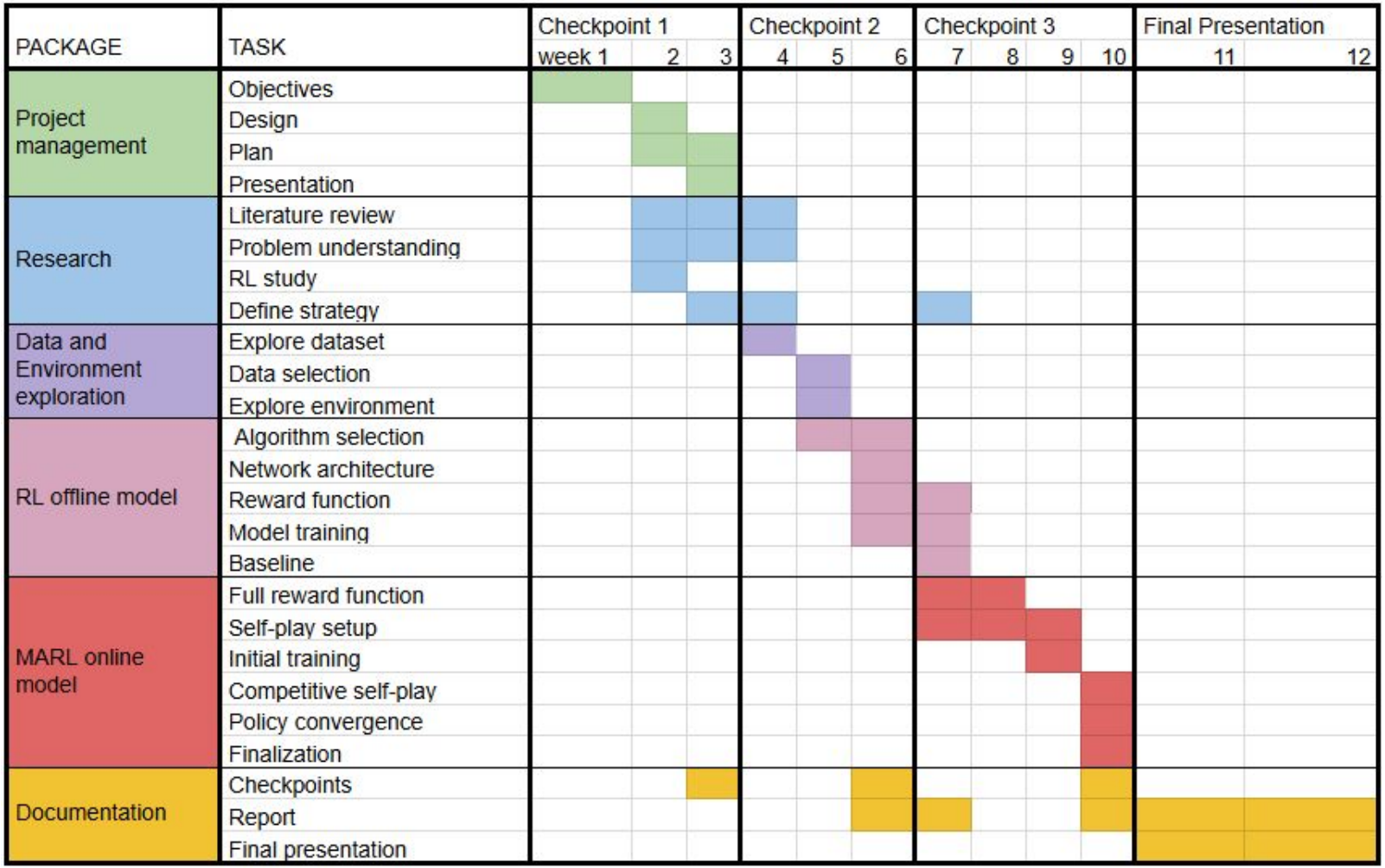
# GANTT



# Thank you !


Politecnico
di Torino

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