

Master Degree Program in Information Management

Agentic and Generative AI in Sports Analytics

Diogo Domingues Godinho - 20240362

Supervisor: Vítor Duarte dos Santos, PhD, NOVA Information Management School

Context: Artificial Intelligence (AI) is transforming sports analytics, enabling more accurate injury forecasting, performance projection, and player evaluation. In the NFL, despite abundant performance, workload, and injury data, much remains underutilized in predictive decision-making (Lindsey, 2016). AI can integrate diverse sources – wearables, biomechanics, and match statistics – into actionable insights (Topol, 2019), supporting the shift from reactive to preventive health strategies (Edouard et al., 2024; Vincent et al., 2022; Fagher et al., 2020). Traditional approaches face challenges from athlete variability, complex risk interactions (Mausehund & Krosshaug, 2024), and inconsistent data quality (Nassis et al., 2023). Blockchain adds security, transparency, and traceability to athlete records (Kashyap & Chowdhury, 2024), creating a digital “Athlete Passport” to centralize performance and health histories.

Research Gap and Objectives: Existing tools often rely on isolated datasets or require significant technical resources, limiting access for many teams (Halson et al., 2014; Haller et al., 2022). Integrated solutions combining structured stats, real-time biometric monitoring, and blockchain are scarce (Lindsey, 2016). This project, hopefully, will prove how integration of Agentic AI, Generative AI, and blockchain-based athlete records can improve the efficiency, accuracy, and accessibility of injury forecasting, performance projection, and player evaluation in professional and semi-professional sports. Objectives include developing an automated workflow, validating it with NFL datasets, and ensuring its usability for low-resource teams.

Methodological Approach: The study will begin with a literature review to establish the foundations of AI in sports, followed by the design of workflows for Agentic AI support with integrated tools, automations and mathematical models. Agentic AI will automate data ingestion, historical analysis and comparisons, and autonomously create goal-oriented outputs, while Generative AI will produce tailored reports for staff and blockchain will secure and verify records. All outputs will be delivered through a centralized platform. The agents will then be developed and tested across three datasets: (1) historical yearly NFL statistics, (2) weekly performance data from the 2020 season including contextual factors such as playing surface and performance indexes, and (3) daily biometric measures from a former NFL player, including heart rate, sleep, fatigue, and wellness indicators.

Expected Results and Contributions: The project is expected to provide an Agentic AI based approach for proactively flagging potential injury warning signs at early stages, objective performance indices, and accessible player evaluations, reducing the analytics barrier for resource-limited teams (Davis et al., 2024; Moldstad, 2023). Contributions include a validated AI framework for sports analytics, a scalable deployment model, and a blockchain-enabled record standard to enhance decision-making, injury prevention, and performance optimization.

Bibliographical References:

- Edouard, P., Dandrieux, P.-E., Iatropoulos, S., Blanco, D., Junge, A., Branco, P., Chapon, J., Mulenga, D., Guex, K., Guilhem, G., et al. (2024). Injuries in athletics (track and field): A narrative review presenting the current problem of injuries. *Deutsche Zeitschrift für Sportmedizin*, 75, 132–141. <https://doi.org/10.5960/dzsm.2024.601>
- Fagher, K., Dahlström, Ö., Jacobsson, J., Timpka, T., & Lexell, J. (2020). Prevalence of sports-related injuries and illnesses in Paralympic athletes. *PM&R*, 12, 271–280. <https://doi.org/10.1002/pmrj.12211>
- Halson, S.L. Monitoring Training Load to Understand Fatigue in Athletes. *Sports Med* 44 (Suppl 2), 139–147 (2014). <https://doi.org/10.1007/s40279-014-0253-z>
- Davis, J., Bransen, L., Devos, L. et al. Methodology and evaluation in sports analytics: challenges, approaches, and lessons learned (2024). <https://doi.org/10.1007/s10994-024-06585-0>
- Mausehund, L., & Krosshaug, T. (2024). Knee biomechanics during cutting maneuvers and secondary ACL injury risk: A prospective cohort study of knee biomechanics in 756 female elite handball and soccer players. *The American Journal of Sports Medicine*, 52, 1209–1219. <https://doi.org/10.1177/03635465241234255>
- Grady Andersen (2024). The role of data science in sports analytics and performance tracking. Moldstud.com. <https://moldstud.com/articles/p-the-role-of-data-science-in-sports-analytics-and-performance-tracking>
- Nassis, G. P., Verhagen, E., Brito, J., Figueiredo, P., & Krstrup, P. (2023). A review of machine learning applications in soccer with an emphasis on injury risk. *Biology of Sport*, 40(1), 233-239. <https://doi.org/10.5114/biolsport.2023.114283>
- Haller, N., Blumkaitis, J. C., Strepp, T., Schmuttermair, A., Aglas, L., Simon, P., Neuberger, E., Kranzinger, C., Kranzinger, S., O'Brien, J., Ergoth, B., Raffetseder, S., Fail, C., Düring, M., & Stöggli, T. (2022). Comprehensive training load monitoring with biomarkers, performance testing, local positioning data, and questionnaires - first results from elite youth soccer. *Frontiers in physiology*, 13, 1000898. <https://doi.org/10.3389/fphys.2022.1000898>
- Kashyap, B., & Chowdhury, S. (2024). BLOCKCHAIN TECHNOLOGY IN SPORTS: ENHANCING ATHLETE MENTAL AND COGNITIVE PERFORMANCE TRACKING. *Public Administration and Law Review*, (4)(20), 73–81. <https://doi.org/10.36690/2674-5216-2024-4-73-81>
- Topol, E.J. High-performance medicine: the convergence of human and artificial intelligence. *Nat Med* 25, 44–56 (2019). <https://doi.org/10.1038/s41591-018-0300-7>
- Heather K. Vincent, Michael Brownstein, Kevin R. Vincent, Injury Prevention, Safe Training Techniques, Rehabilitation, and Return to Sport in Trail Runners, Arthroscopy, Sports Medicine, and Rehabilitation, Volume 4, Issue 1, 2022, <https://doi.org/10.1016/j.asmr.2021.09.032>.
- Lindsey, J. (2016, January 13). The NFL's impending data revolution. *Wired*. <https://www.wired.com/2016/01/the-nfls-impending-data-revolution>