

Cloud Computing

**School of Engineering, Arts, Science and
Technology**

**Ipswich Town Football Club Player Performance
Cloud Integration & Migration**

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Executive Summary

Ipswich Town Football Club's leading position in the English Football League (EFL) Championship, with a 15-point advantage over second place, positions them for a highly anticipated promotion to the Premier League. As a result, they have engaged my expertise as a cloud specialist to provide recommendations for optimising their player performance strategy. To revolutionise player performance, the club has partnered with Catapult Ltd. to implement their state-of-the-art performance tracking system, Catapult One. Catapult One employs wearable devices equipped with advanced sensors, including GPS, accelerometers, and gyroscopes, to capture detailed performance metrics such as distance covered, sprint distance, top speed, acceleration, deceleration, and work rate during training sessions and matches. This comprehensive data, combined with video feeds from ongoing and past training sessions and matches, the club's medical team reports, dietary plans and reports, and scouting reports, will be integral to, and are part of the club's enhanced player performance strategy.

The scope of this report encompasses the adoption of a cloud environment tailored to the specific needs of Ipswich Town Football Club (ITFC). The primary objective is to seamlessly collect, store, and analyse data from various sources, including Catapult One (real-time IoT data), match event data (real-time video data), training footage (real-time video data), the club's medical team reports (document data), dietary plans and reports (document data), and scouting reports (document data). Leveraging cloud technology to provide actionable insights to the club's authorised personnel, the coaching staff and medical team will be able to tailor player training sessions aimed at reducing injury risks while improving players' physical conditions and optimising performance. Additionally, this will enhance strategic match preparation, including tactics and team selection, and support the coaching staff in making potential match-winning in-game decisions.

Successfully implementing my recommended cloud-based platform as a service (PaaS) will not only meet the club's goals of significantly optimising player performance analysis capabilities but also provide a cost-effective solution. This approach will alleviate the need for hands-on configuration and management, as AWS will oversee the pay-as-you-use systems, ensuring that the club can focus on leveraging the technology without worrying about the technical complexities. Moreover, the implementation will comply with GDPR regulations and secure all data from transfer (input) to analysis (compute) to end-user dashboard access (output).

Introduction

With ITFC currently leading the English Football League (EFL) Championship by 15 points, the club is strategically planning for a potential promotion to the Premier League in the 2024/25 season. To compete at this elite level, it is crucial to optimise and modernise their player performance analysis systems. Competing in English football's top division necessitates the use of cutting-edge tools and methodologies to ensure peak player performance. Considering this, the club seeks to adopt cloud technology to facilitate a data-driven approach to improving player performance, reducing injury risks, and developing superior match tactics. This report provides recommendations and a detailed roadmap for the club to migrate its historical player data to the Amazon Web Services (AWS) cloud and fully adopt AWS cloud technology.

This report will evaluate the current player performance analysis practices at ITFC, before proceeding to outline how AWS cloud technology can enhance data analysis. It will demonstrate how AWS services employ machine learning capabilities to create models using player data, while other services can query raw or transformed data. The expected outputs and insights from these queries and model predictions will be generated in real-time and securely accessed through a dashboard with secure IAM and multi-factor authentication enabled for authorised members. This real-time access will facilitate timely decision-making, ensuring that the latest data is always available to those responsible for optimising player performance.

Challenges of Cloud Adoption

Adopting cloud technology for player performance optimisation presents several challenges. Ensuring the security of sensitive player data and compliance with sport-specific regulations and GDPR, while safeguarding against unauthorized access and potential breaches, is paramount. Managing the costs associated with cloud service subscriptions also poses significant concerns.

Seamless historical data transfer to AWS cloud is critical to avoid disruptions during the migration phase, ensuring compatibility between current infrastructure and new cloud solutions. Efficiently collecting, storing, analysing and managing large volumes of data while maintaining data accuracy and consistency across different platforms is essential for effective performance analysis.

Reliability of cloud services, characterised by minimal downtime and fast data processing capabilities, is crucial for real-time analytics. Additionally, the club must recruit or train staff with the necessary skills to maintain and use these cloud services, ensuring they stay updated with evolving technology landscapes.

Encouraging coaches, analysts, and players to adopt new technologies and alter established workflows will require adequate training and support.

Addressing these challenges requires careful planning, investment in resources, and a strategic approach to technology adoption. This report takes these challenges into consideration.

Literature Review

Cloud computing has become an indispensable tool in the sports sector, providing critical support in various aspects, from performance analytics to operational efficiency. This literature review critically examines the adoption and impact of cloud technologies in football, with a particular focus on their application within the Football Association (FA) of England. Broader applications of cloud technology within Premier League football clubs and The Premier League as a brand are detailed in the Appendix A section of this report.

The FA, England's governing body for football, has partnered with Google Cloud to optimise preparations before and during tournaments, increasingly relying on physical performance data to bolster player performance and provide support both on and off the field. The need for accurate insights into fitness, conditioning, and nutrition has become paramount, especially in tournament environments where player welfare is of utmost importance (McCann, 2024). In response, The FA established the Performance Insights division within its Physical Performance, Medicine, and Nutrition department during the 2020 lockdown period. Leveraging Google Cloud, The FA aimed to revolutionise data ingestion, storage, and processing, acknowledging the overwhelming volume of data generated during a single 90-minute squad training session or football match, which can reach 1.5 million rows. To address this, The FA adopted BigQuery, Google Cloud's data warehousing solution, to transform raw data into valuable insights (Olivari, 2024).

Through BigQuery, The FA's Performance Insights team automates tasks and centralizes information on a single platform, fostering collaboration among various departments and minimising data silos (McCann, 2024). The flexibility of BigQuery enables data scientists to amalgamate diverse data sources, facilitating informed discussions and personalized player management (Reddin, 2019). Furthermore, BigQuery's customizable functions support interdisciplinary collaboration among medical professionals, coaches, and nutritionists, ensuring a holistic approach to enhancing player performance (Olivari, 2024).

The FA developed a specialized tool known as the Player Profile System (PPS), utilising Google Cloud infrastructure integrated with G Suite (McCaskill, 2019). PPS empowers the Technical Directorate staff to analyse a plethora of performance data, ranging from metrics extracted from players' wearable devices (such as tracking training intensity, nutrition, sleep quality, recovery time, and even mental health) to medical records, scouting reports, and club fixtures. According to Craig Donald, Chief Information Officer at The FA, "PPS enables our users to consolidate diverse information that they may not typically encounter together. This facilitates the generation of novel insights and, ideally, provides us with a competitive advantage during competitions."

Google Cloud technology enables The FA to leverage collected data more effectively, equipping team coaches with a broader spectrum of insights into individual player performance. This subsequently informs critical decisions regarding team selection and tactics on match days. The objective is to ensure user-friendliness, presenting data and reports in a manner that aligns with the coach's perspective and complements their judgment. Like BigQuery, G Suite facilitates seamless data sharing and collaboration among the coaches and staff.

Automation is crucial within compressed training windows, and BigQuery serves as the cornerstone for data manipulation, complemented by Google Cloud products and APIs for seamless data transformation (Olivari, 2022). By capturing and processing performance and training data alongside information on players' sleep, nutrition, recovery, and mental health, The FA gains actionable insights presented through visual dashboards, enhancing decision-making processes. This streamlined approach reduces the time required for data processing, providing coaches with timely and actionable information (Olivari, 2024).

In summary, The FA's adoption of cloud computing technologies, particularly Google Cloud's BigQuery, has revolutionised performance analytics and player support strategies, emphasising the importance of data-driven decision-making in modern football operations. Through automation and interdisciplinary collaboration.

Cloud Readiness Assessment For ITFC

IT Landscape Overview (Evaluation Phase)

The IT Landscape Overview is the initial phase of the Cloud Readiness Assessment, aimed at evaluating ITFC's existing IT infrastructure. This phase assesses technological readiness and compatibility with AWS cloud environment and identifies the key business drivers and objectives that will guide the cloud adoption strategy.

Data Collection

ITFC collects player performance data from six primary sources: match event data, training footage, medical reports, dietary plans and reports, scouting reports, and player self-assessments. This data is stored in a MySQL database on a local server at the club's training facility on Playford Road in Ipswich, with staff computers and devices connected via a local network.

Current Data Collection Methods

- **Match Event Data:** Video footage is recorded during matches, with the club's IT team tagging events using video analysis software.
- **Training Video Footage:** Training sessions are recorded by video cameras, and coaches and analysts manually review and note observations.

- **Medical Reports:** Physios and club doctors use Microsoft Excel to record physical examinations, fitness assessments, and injury reports.
- **Dietary Plans & Reports:** Nutritionists create diet plans, nutrition logs, and supplement recommendations using Microsoft Excel.
- **Scouting Reports:** Scouts manually fill out reports on paper during matches or training sessions, which are then entered into Microsoft Excel by the coaching staff.
- **Player Self-Wellness Data:** Players provide daily self-reported wellness scores, sleep quality, mood, and fatigue levels using paper forms or simple digital platforms.

Data Ingestion Process

After each match, match event data footage is recorded and tagged by analysts the following day. Coaching staff analyse training footage and make observational notes within a day after each training session. Every five days, staff manually document medical reports and dietary plans, while scouting reports are submitted by scouts a month before each transfer window (June to August and January 1st to 31st). All data is submitted to the club's IT team for storage in the MySQL database (DB). The data is then extracted, transformed into a consistent format, and loaded into the MySQL DB through an ETL process. This database contains structured tables for each data category, enabling easier querying and analysis by analysts and data scientists. Raw Excel files are retained on the central file server for reference and backup.

Security and Compliance

To ensure data security and compliance, the club employs various measures:

1. **Physical Security:** Rooms are secured with biometric access control and monitored 24/7 by security cameras.
2. **Network Security:** The club's network is protected by a robust firewall and monitored by an intrusion detection system. Remote access is facilitated through a secure VPN.
3. **Data Security:** All sensitive data is encrypted using AES encryption for storage and SSL/TLS for transmission. Access to the data is controlled by Role-Based Access Control (RBAC).
4. **Application Security:** Multi-factor authentication is required for accessing the club's databases and critical applications. Regular security audits and penetration tests are conducted to identify vulnerabilities.
5. **Endpoint Security:** Antivirus software is installed on all club devices, and an endpoint management solution is used to enforce security policies and updates.
6. **Backup and Recovery:** Daily backups are taken of all critical data, and a disaster recovery plan is in place and tested regularly.
7. **Compliance:** The club complies with GDPR by appointing a Data Protection Officer (DPO), conducting Data Protection Impact Assessments (DPIAs), and having clear policies for data

subject rights and data retention. Employees receive regular training on data protection and security practices.

Organisational Overview (Interview Phase)

In this phase, I examine the maturity levels of ITFC's technology, processes, and personnel through structured interviews with key staff members. This phase maps the potential business impact of adopting a cloud setup, ensuring all staff understand the implications and opportunities. Below is the summarised feedback from key members' interviews; other members' feedback is in Appendix B.

Key Staff Members Feedback

Head Coach Feedback

- **Technology Maturity:** "Currently, we rely heavily on manual data entry and basic software for analysing player performance. The new Catapult One GPS trackers together with AWS data analysis and querying will provide us with more precise data on player performance."
- **Processes:** "Our processes are quite traditional, involving a lot of manual tagging and analysis of video footage. The transition to a cloud-based system will streamline these processes significantly."
- **Personnel:** "The coaching team is moderately familiar with using digital tools, but there will be a learning curve with the new cloud technology. We are open to training and believe it will enhance our capabilities."
- **Business Impact:** "Real-time access to data will be transformative. Tailored training sessions based on the processed data will help us reduce injuries and optimise player performance. The potential for real-time decision-making during matches is particularly exciting."

Head of Medical Services Feedback

- **Technology Maturity:** "We use Excel for recording medical reports and injury data. The introduction of cloud technology will enable us to integrate this data with performance metrics from Catapult One."
- **Processes:** "Our current process involves manual data entry and periodic updates. A centralized system will make this more efficient and reduce errors."
- **Personnel:** "The medical team is relatively comfortable with basic digital tools but will need training on the new cloud system."
- **Business Impact:** "With cloud technology, we can better track injury risks and recovery progress. Access to comprehensive data will allow us to tailor recovery programs to individual players more effectively."

IT Manager Feedback

- **Technology Maturity:** "Our current IT infrastructure is robust but limited to local storage and manual processes. Moving to a cloud environment is the logical next step."
- **Processes:** "We handle data management and security through established protocols, but these can be improved with cloud technology."
- **Personnel:** "Our team has a good understanding of IT systems but will need specific training on cloud infrastructure."
- **Business Impact:** "The cloud will enhance our data management capabilities, reducing staff hands-on management as AWS will control that aspect. It will improve security and offer scalable solutions that can grow with the club's needs."

Potential Business Impact of Cloud Migration

Enhanced Decision-Making

- **Real-Time Analytics:** Cloud technology enables real-time data access, allowing coaching staff to make informed decisions during matches and training sessions.
- **Comprehensive Insights:** Consolidated data from various sources provides a holistic view of player performance, medical status, and dietary needs.
- **Machine Learning and Data Science:** Advanced machine learning models and data science analytics on the ingested data will yield accurate and actionable insights. This will enable the club to uncover patterns and trends that were previously unnoticed, enhancing strategic decisions.
- **Tailored Training Sessions:** Based on the insights from the cloud, training sessions can be customized for each player to optimize performance and minimize injury risks.

Improved Collaboration

- **Centralized Data Access:** Cloud-based systems facilitate seamless data sharing across departments, enhancing collaboration among coaching staff, medical team, nutritionists, and scouts.
- **Remote Access:** Authorized personnel can access data from anywhere, improving flexibility and responsiveness.

Operational Efficiency

- **Automated Workflows:** Cloud solutions can automate data collection, analysis, and reporting, reducing manual effort and minimizing errors.
- **Scalability:** Cloud infrastructure can scale to accommodate growing data volumes and analytical demands, ensuring long-term sustainability.

Security and Compliance

- **Enhanced Security:** Cloud providers offer advanced security features, ensuring data protection and compliance with GDPR and other regulations.
- **Regular Updates:** Cloud systems receive regular updates and security patches, reducing the risk of vulnerabilities.
- **Secure IAM:** Secure Identity and Access Management with Multi-Factor Authentication will be enabled on Amazon QuickSight to ensure secure dashboard access.

Comparison with the Market (Analysis Phase)

In this phase, I benchmark ITFC's readiness for cloud adoption against industry best practices and the current cloud solutions landscape. The club's technology, processes, and personnel are analysed in comparison to industry standards. This comparative analysis, building on the first two phases, identifies areas where the club excels and areas needing improvement to prepare for cloud migration.

Technological Readiness

Strengths: ITFC's IT infrastructure, though currently localised, shows robustness and reliability

Opportunities

Scalability: Amazon Direct Connect, AWS Kinesis Data Streams, Amazon SageMaker, Amazon Athena, and Amazon QuickSight enable dynamic scalability for ITFC. These services allow the club to adjust resources in real-time, ensuring efficient handling of data processing loads during peak times. Comparatively, Azure services offer similar scalability but with potential differences in pricing and regional availability.

Flexibility: AWS Kinesis Data Streams and Amazon SageMaker offer flexible data processing and machine learning capabilities, allowing real-time data ingestion, processing, and machine learning model development without server management. While Google Cloud Platform provides similar services, AWS services offer a more integrated experience.

Comparison with Azure: Azure's data services provide robust capabilities, but AWS Kinesis Data Streams and Amazon SageMaker have advantages in documentation and community support, offering ease of use and troubleshooting.

Process Maturity

Strengths: The club has well-established processes for data collection, albeit manual, and storage. The introduction of Catapult One for player performance tracking signifies a step towards modernisation.

Opportunities

Data Collection and Storage: AWS S3 (Simple Storage Service) provides a highly scalable and durable storage solution. It can store large volumes of data, including video footage and performance

metrics, with built-in redundancy. Azure Blob Storage offers similar capabilities but AWS S3's integration with other AWS services makes it a more seamless choice for data handling.

Data Processing: AWS Glue, a fully managed ETL (extract, transform, load) service, can automate the data extraction and transformation process from the existing spreadsheets into structured formats. This will improve data processing efficiency and reduce manual effort. Google Cloud Dataflow offers similar ETL capabilities and might have an edge in terms of stream processing, but AWS Glue's tighter integration with AWS's broader ecosystem is advantageous for overall data workflows.

Personnel Skills and Training

Strengths: The IT and operational staff show moderate familiarity with digital tools, indicating a foundation for cloud adoption.

Opportunities

Training Programs: AWS Training and Certification provides a wide range of training programs tailored for different roles, from solutions architects to developers. Investing in these training programs will ensure staff are well-prepared for cloud migration. Given that AWS is my recommended cloud provider, it is crucial for the club's personnel to focus on AWS-specific training programs to align with the proposed cloud platform.

Data Security and Compliance

Strengths: Current security measures, including physical security, network security, and endpoint security, demonstrate a commitment to data protection.

Opportunities

Advanced Security Features: AWS Direct Connect provides secure and private connectivity to AWS services. Secure IAM with Multi-Factor Authentication will be enabled to output dashboarding tool Amazon QuickSight, ensuring enhanced security. AWS offers AWS Key Management Service (KMS) for encryption and AWS Identity and Access Management (IAM) for access control. While Azure Security Center offers similar features, AWS's broader range of integrated security services can provide a more seamless security management experience.

Compliance: AWS ensures compliance with various global standards, including GDPR, ISO, and SOC. Leveraging AWS Artifact provides easy access to compliance reports and documentation. While Google Cloud also offers strong compliance features, AWS's extensive compliance offerings and reputation make it a robust choice for ensuring security and compliance.

The assessment of ITFC's readiness for cloud adoption reveals a solid foundation and significant potential for improvement. In the next section of this report, I will provide a detailed cloud architecture on AWS, outlining all processes from input to computation and processing to output.

Findings and Recommendations

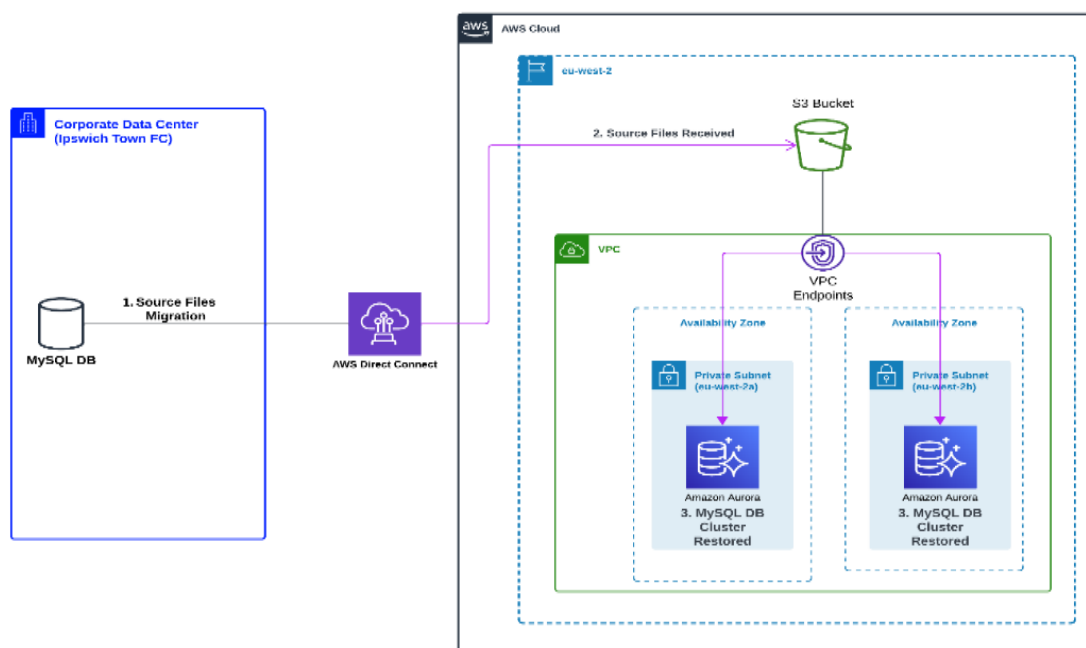
ITFC's current IT landscape relies on a local server at the training ground, where data from various sources is collected, processed, structured, and stored in a MySQL database. To leverage scalability, security, and advanced analytics, it is crucial to migrate these structured data sets to a cloud environment.

I recommend migrating these structured data sets to the cloud. This is important not only for future data processing and analysis but also to retain historical data that will enhance the accuracy and depth of insights when new data is ingested, processed, and analysed in the cloud. The primary aim is to start using cloud technology to enhance player performance, with a detailed cloud architecture to handle data from ingestion (input) to visualization (output).

Migration

I recommend focusing first on the migration process to ensure all historical data is preserved and integrated into the new cloud environment. Figure 1 visualizes the migration process.

Figure 1. Migration Diagram.



Evaluation of Migration Diagram

The MySQL database in the ITFC's local data center, identified as the source of structured data, contains essential player performance data. This database will be the primary data source for migration. I recommend using AWS Direct Connect as it provides a dedicated and secure connection between ITFC's data center and AWS. This ensures efficient and secure data transfer, minimising latency and increasing bandwidth compared to standard internet connections. It is ideal for large-scale data migration and supports continuous synchronisation until the migration is complete.

AWS Cloud Environment

- **S3 Bucket:** As the first destination for the MySQL files, the S3 bucket provides a secure and durable location for initial data storage. Storing data here before further processing is a good practice because it allows for safe and scalable storage of large datasets.
- **Virtual Private Cloud (VPC):** Ensuring that resources are isolated and secure within the AWS environment, the VPC provides a controlled and protected network environment for data processing and storage. This isolation is crucial for maintaining the security and integrity of sensitive data.
- **VPC Endpoints:** These allow secure access to S3 within the VPC without traversing the public internet. This enhances security by keeping data transfer within AWS's private network.
- **Amazon Aurora (MySQL):** Restoring the MySQL DB cluster here ensures that the data is managed in a highly available and scalable manner. Aurora provides the benefits of MySQL compatibility with the added advantages of automatic backups, fault-tolerant and self-healing storage, and automated scaling. Placing Aurora in multiple Availability Zones (eu-west-2a and eu-west-2b) ensures high availability and fault tolerance, safeguarding against data loss or downtime.

Flow of Data

1. **Source Files Migration:** Data is transferred from the MySQL Database in the corporate data center to AWS using AWS Direct Connect. This secure and high-bandwidth connection ensures that the migration process is efficient and reliable.
2. **MySQL Source Files Received:** The received data is first stored in the S3 Bucket in the AWS Cloud Environment. This intermediate step allows for safe storage and further processing without risking data loss.
3. **Data Storage and Processing:** The data from the S3 Bucket is then processed and stored in Amazon Aurora (MySQL) within the VPC's private subnets across multiple Availability Zones. This setup ensures that the database is highly available, scalable, and secure.

The AWS region selected for this migration is eu-west-2, which is geographically close to Ipswich, Suffolk. This proximity minimises latency and ensures better performance for data access and processing.

This migration approach aligns well with best practices for cloud migration, ensuring that ITFC's data is handled with the highest levels of efficiency and security. All necessary backups and preparatory steps will be communicated to ITFC to ensure a smooth transition.

Cloud Architecture

The primary objective of leveraging AWS cloud technology is to gain enhanced insights into player data, thereby improving ITFC's player performance as they are well place for promotion to the Premier League. I have recommended a comprehensive process to achieve this goal. Figure 2 illustrates the cloud architecture diagram that visualises this recommended process.

Figure 2. ITFC AWS Cloud Architecture

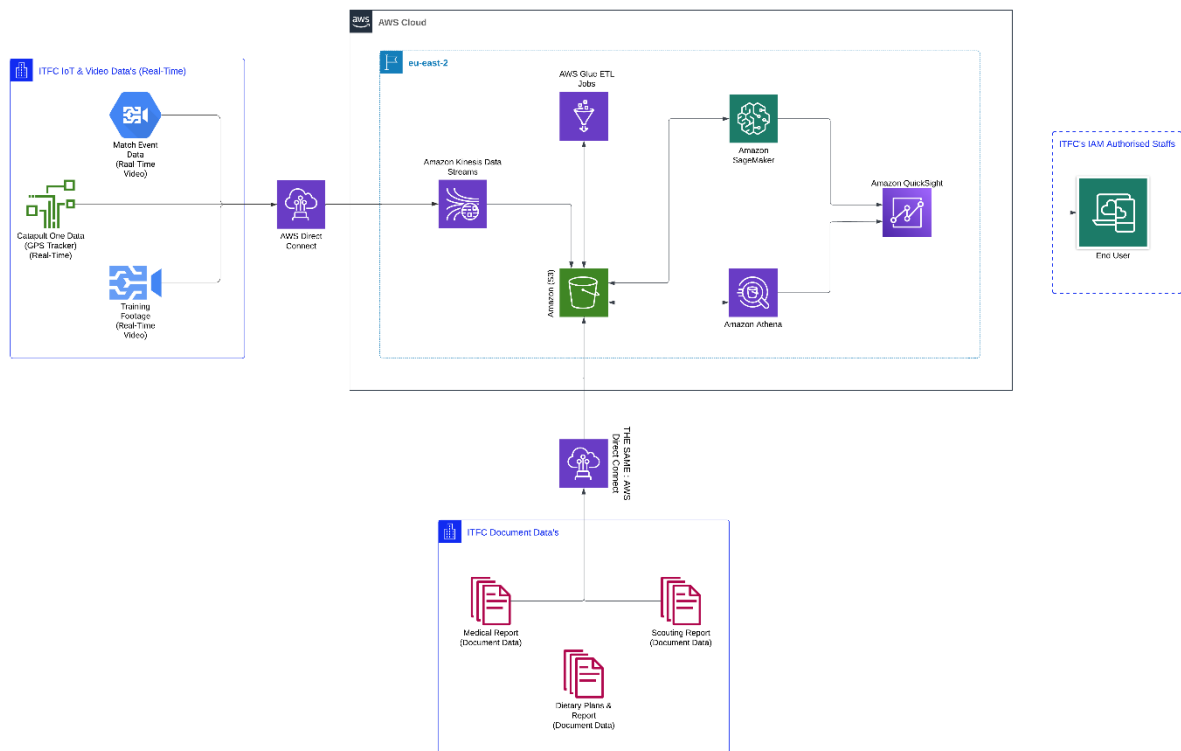


Diagram Explanation

Real-Time Data Ingestion and Storage

Real-Time Data Sources:

- Match Event Data (Real-Time Video)
- Catapult One Data (GPS Tracker) (Real-Time)
- Training Footage (Real-Time Video)

These real-time data sources are configured to send their data to Amazon Kinesis Data Streams.

Amazon Kinesis Data Streams has been selected for its paramount importance due to its scalability, low latency, seamless integration, and reliability. Its ability to handle high throughput of data is crucial for effective management of the influx of real-time data streams. Kinesis offers real-time processing capabilities with minimal latency, ensuring timely insights and actions on streaming data.

The importance of Amazon Kinesis Data Streams lies in its ability to handle large volumes of data streams efficiently, enabling real-time analytics and decision-making. Its seamless integration with other AWS services like Amazon S3, AWS Glue, Amazon SageMaker, and Amazon QuickSight enhances its significance by facilitating streamlined data processing, analytics workflows across the AWS ecosystem.

Once the data is ingested by Kinesis, it is saved to an Amazon S3 bucket. This centralized storage solution offers high durability, with 99.999999999% (11 9's) of data durability, and virtually unlimited storage capacity, allowing for easy storage of large amounts of data. Amazon S3 operates on a cost-effective pay-as-you-go pricing model and integrates easily with various AWS services for further processing and analysis.

Document Data Storage

Document Data Sources

- Medical Report (Document Data)
- Dietary Plans & Report (Document Data)
- Scouting Report (Document Data)

These document data sources are uploaded directly to the Amazon S3 bucket, ensuring secure and durable storage.

To securely ingest real-time and document data into the AWS cloud, AWS Direct Connect is used. This service provides a consistent network with low latency, ensuring the efficient and secure transfer of large data volumes.

Data Processing

AWS Glue ETL jobs are used to access the S3 bucket, collect all forms of data (real-time and document data), and prepare them for analytics. AWS Glue performs extract, transform, and load (ETL) operations by accessing the S3 bucket, transforming the data as required for analysis, and saving the processed data back to Amazon S3. AWS Glue is serverless, which means no infrastructure management is required. It automatically scales resources as needed and supports a variety of data formats and complex transformations.

Data Analytics and Machine Learning

Amazon Athena and Amazon SageMaker then read the processed data prepared by the AWS Glue ETL jobs. Amazon Athena queries the processed data using standard SQL, providing fast and cost-effective querying and analysis. Amazon SageMaker uses the processed data to train machine learning models, simplifying the process of building, training, and deploying ML models. Both services save their outputs back to S3, with stored SageMaker model predictions useful for future batch processing if necessary.

For real-time endpoint visualisation, Amazon SageMaker and Amazon Athena are connected to Amazon QuickSight, which provides interactive and rich data visualizations. QuickSight updates in real-time to reflect the latest data insights and is user-friendly, allowing end-users to create and customize dashboards easily.

For secure end-user access IAM roles and policies control access to Amazon QuickSight, ensuring that only authorized users have access. This enhances security by managing who can access the data and visualizations.

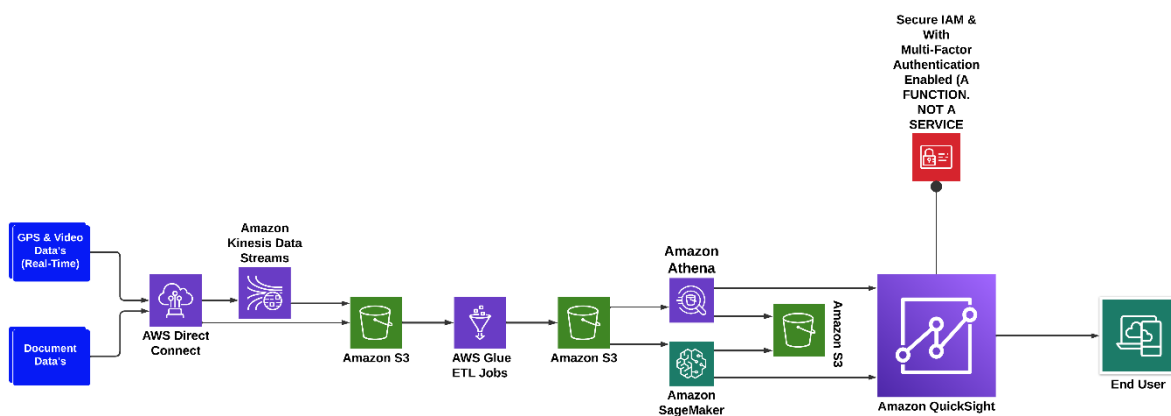
Managed Services Approach

This architecture leverages AWS managed services, falling under the Platform as a Service (PaaS) model. AWS manages the underlying infrastructure, allowing ITFC to focus on application functionality rather than infrastructure management. This approach offers several benefits:

- Cost-efficiency: Pay only for what you use, avoiding the cost of over-provisioned resources.
- Reduced management overhead: AWS handles infrastructure management, scaling, and maintenance.
- Improved security and compliance: AWS provides built-in security features and compliance certifications.
- Faster time to market: Accelerates development and deployment processes.

Data Flow and Process

Figure 3. Data Flow



1. **Data Ingestion:** Real-time data from match events, GPS trackers, and training footage are ingested into Amazon Kinesis Data Streams. Document data (medical reports, dietary plans, and scouting reports) are directly uploaded to Amazon S3.
2. **Data Storage:** All data, whether ingested in real-time or uploaded as documents, is stored in Amazon S3.

3. **Data Processing:** AWS Glue ETL jobs access the data in Amazon S3, process it, and save the transformed data back to S3.
4. **Data Analytics and Machine Learning:** Amazon Athena queries the processed data for insights. Amazon SageMaker trains machine learning models using the processed data and saves model predictions back to S3.
5. **Data Visualization:** Amazon QuickSight reads data from Amazon Athena and Amazon SageMaker to provide real-time dashboards and insights to end users.

The architecture and process flow designed effectively utilize AWS managed services to create a scalable, cost-effective, and efficient system for player performance analysis. This approach minimizes infrastructure management overhead and allows ITFC to focus on leveraging data insights to improve player performance. The use of Amazon S3 for centralized storage, AWS Glue for ETL processes, Amazon Athena for querying, Amazon SageMaker for machine learning, and Amazon QuickSight for visualization ensures a seamless and integrated solution.

Roadmap for Implementation

This roadmap outlines the key steps and timelines for implementing the cloud-based player performance analysis pipeline for ITFC. The plan includes staff training, data migration, system deployment, testing, and full operationalization. The timeline is structured to ensure minimal disruption to ongoing operations and to achieve full functionality by the start of the 2024/25 Premier League season.

Timeline and Key Actions

Initial Staff Training (8th January 2024 - 16th February 2024)

Objective: Equip staff with basic knowledge and skills necessary for working with cloud technologies.

Activities

- Fundamentals of cloud computing.
- Hands-on labs focusing on AWS services such as Amazon S3, AWS Glue, AWS Lambda, Amazon SageMaker, Amazon Athena, and Amazon QuickSight.
- Security and compliance training.

Costs: Estimated £5,000 for training materials, trainers' fees, and lab setups.

Data Migration (1st May 2024 - 30th June 2024)

Objective: Migrate existing data to the cloud with minimal downtime.

Activities

- Backup of current data systems.

- Incremental data migration to Amazon S3.
- Verification of data integrity post-migration.

Costs: Estimated £10,000 for additional storage, network bandwidth, and consultancy fees.

Advanced Staff Training (19th February 2024 - 3rd May 2024)

Objective: Provide in-depth training on service-specific, role-specific, and project-based learning.

Activities

- Service-specific training for AWS Glue, AWS Lambda, Amazon SageMaker, Amazon Athena, and Amazon QuickSight.
- Role-specific training for relevant staffs.
- Project-based learning including implementation of a pilot project.

Costs: Estimated £8,000 for advanced training materials, trainers' fees, and project implementation costs.

System Deployment and Initial Testing (1st July 2024 - 4th July 2024)

Objective: Deploy the system and conduct initial tests to ensure functionality.

Activities

- Deploy the ingestion, processing, and visualization pipeline.
- Initial tests using historical data to verify end-to-end data flow.

Costs: Included in previous training and migration costs.

Pre-Season Testing (5th July 2024 - 16th August 2024)

Objective: Fully test the system in a live environment during the pre-season.

Activities

Real-time data and documents ingestion during training sessions and pre-season matches.

Processing and visualization of all data.

Feedback collection from coaching staff and performance analysts.

Iterative refinement of the system based on feedback.

Costs: Estimated £2,000 for additional support and monitoring during testing.

Full Operationalization (17th August 2024)

Objective: Ensure the system is fully operational by the start of the 2024/25 Premier League season.

Activities

- Final verification of system readiness.

- Full-scale deployment.
- Ongoing support and maintenance setup.

Costs: Estimated £3,000 for final checks, support setup, and contingency.

This roadmap provides a structured approach to transitioning ITFC's player performance analysis system to the cloud. By adhering to the outlined timeline, ITFC can achieve a fully operational and tested system by the start of the 2024/25 Premier League season, ensuring enhanced performance analysis capabilities with minimal disruption to ongoing operations.

Conclusion

By implementing my recommendations, Ipswich Town Football Club (ITFC) will establish a robust cloud architecture, strategically designed to optimize player performance analysis and decision-making processes. The adoption of cloud technology allows ITFC to efficiently collect, store, analyze, and visualize data from various sources, enabling enhanced insights into player performance.

The structured approach outlined in this report ensures that ITFC can leverage cloud technology to its fullest extent. By embracing cloud solutions, ITFC can unlock actionable insights, leading to improved player performance, injury prevention, and strategic decision-making on the field.

This strategic transition to the cloud guarantees seamless integration and scalability, providing ITFC with the flexibility to adapt to evolving needs. Ultimately, this initiative will pave the way for ITFC's sustained success in the football arena by utilizing data-driven strategies to stay ahead in the game.

Appendix

Appendix A - Broader Applications and Future Prospects

The use of cloud computing technology in football extends beyond player performance analysis, encompassing various facets such as fan engagement, media production, and website management (Tan, 2023). Football clubs recognize the importance of engaging with their fan base through digital channels and ensuring a seamless web experience, particularly during peak periods such as match days and transfer windows.

For instance, Liverpool Football Club (LFC) leverages data analytics and cloud technology to improve fan engagement and provide real-time updates to supporters worldwide (Tan, 2023). Drew Crisp, senior vice-president of digital operations at LFC, highlighted the club's comprehensive overhaul of its digital platforms over the past three years. During this period, data has been systematically gathered from 15 to 20 digital touchpoints to gain deeper insights into fan online engagement.

According to Crisp, these touchpoints encompass various platforms such as Liverpoolfc.com, news pages, ticketing systems, and retail channels, providing valuable information on fan behaviour. He emphasised the establishment of a cloud-based data warehouse equipped with analytics capabilities, enabling the identification of factors driving the highest traffic.

Crisp elaborated on how this data facilitates the understanding of fan engagement journeys, facilitating the customisation of promotions for both the club and its partners.

Considering Liverpool's substantial global viewership, exceeding 800 million, and its predominant fan base in Asia, digital fan engagement assumes paramount importance alongside in-person interactions through retail outlets. Similarly, West Ham United Football Club collaborates with Cloudflare to deliver a secure and highly responsive match-day web experience for its supporters. With an average matchday attendance ranking third in the English Premier League at around 58,000 supporters per game, the club boasts a significant international fan base too, particularly in Asia.

West Ham United heavily relies on its website for disseminating match updates, news, and other important information to its fans worldwide. However, during match days, the website experiences a surge in traffic, sometimes up to 10 times its usual volume, driven by the club's massive social media following and restrictions on televising Saturday matches in the UK.

Unfortunately, the club faced challenges with its legacy website and cloud service provider, leading to frequent outages and slow load times. This impacted fan engagement and revenue streams, as

impatient fans sought information and merchandise elsewhere. Additionally, maintaining web performance during volatile off-season transfer windows was crucial.

In response, West Ham turned to Skye Cloud, a UK hosting provider, and partnered with Cloudflare to enhance website performance and security. Cloudflare's services, including DNS, Web Application Firewall (WAF), and DDoS mitigation, were implemented to bolster the core security of the website and mobile applications.

The Cloudflare Global Content Delivery Network (CDN) efficiently handled peak traffic loads during match days, with over 93% of requests being offloaded, significantly reducing the strain on West Ham's hosting infrastructure. This resulted in improved website reliability and eliminated revenue losses due to site outages and poor load times. Additionally, cloud hosting costs were significantly reduced.

The successful collaboration between West Ham, Skye Cloud, and Cloudflare ensured 100% uptime and provided a reliable web experience for fans (Cloudflare Case Study). As a result, the partnership is set to continue, with plans to explore other Cloudflare products such as Zero Trust to further enhance security as the club's infrastructure evolves.

In 2021, the Premier League forged a partnership with Oracle Cloud to introduce a novel suite of AI-driven analytical models designed to offer fans at home a more comprehensive understanding of the on-field action. Ariel Kelman (2021), Oracle's Executive Vice President and Chief Marketing Officer, stated, "Combining Oracle's machine learning expertise with the Premier League's wealth of football data is a significant merger of technology and sport."

These models encompassed several features, including tracking average player positioning to illustrate team organisation during both possession and defensive phases. Additionally, AI algorithms, informed by extensive historical game data, were employed to forecast the likelihood of a team scoring within the next ten seconds. Furthermore, AI simulations were utilized to determine win probabilities for each team by running 100,000 match scenarios.

Such advancements heavily relied on the computational capabilities provided by cloud infrastructure. For instance, the analytics engine within the Oracle Cloud environment facilitated complex calculations, such as monitoring midfielders' sprint frequencies over varying time intervals and correlating these trends with historical scoring patterns. According to Lee Bonfield, an Oracle Cloud team member, these diverse factors were meticulously incorporated into predictive models to evaluate the probability of scoring within specific time frames. The vision of the partnership, according to Premier League Chief Executive Masters (2021), is to implement 'Match Insights – Powered by Oracle Cloud,' which aims to present advanced player performance data and statistics during global broadcast coverage and across the Premier League's social channels. The Premier League's

partnerships with Oracle Cloud have revolutionized fan engagement by providing AI-powered analytical models for supporters (Collins, 2023).

As cloud computing continues to transform football operations, the future holds promising prospects for further innovation and integration. The use of cloud AI and machine learning algorithms services for advanced analytics and predictive modelling revolutionizes performance analysis, tactical decision-making, and player scouting. Additionally, the adoption of cloud-based solutions for broadcasting, media production, and website management is expected to enhance the overall fan experience and drive revenue generation for football clubs.

In conclusion, cloud computing technology offers a myriad of opportunities for football clubs to optimise player performance, club operations, engage with fans more effectively, and stay ahead in an increasingly competitive landscape (Tan, 2023). By harnessing the power of the cloud, clubs can unlock new possibilities for innovation and growth, ultimately shaping the future of football on and off the pitch.

Appendix B – Club Staff Feedback

Nutritionists

Head Nutritionist Feedback

- **Technology Maturity:** "We manage dietary plans using Excel, which is not ideal for integrating with other data sources."
- **Processes:** "Manual updates and isolated data storage are our current norms. Moving to a cloud system will streamline these processes."
- **Personnel:** "We are somewhat familiar with digital tools and are willing to learn new systems that will improve our efficiency."
- **Business Impact:** "Centralizing dietary data with performance and medical data will help us create more effective nutrition plans tailored to each player's needs. This can enhance overall player health and performance."

Scouting Team

Chief Scout Feedback

- **Technology Maturity:** "We use paper-based methods for initial data collection, which are then transferred to Excel. This is not efficient."
- **Processes:** "Our processes are outdated, and a cloud-based system would greatly enhance our efficiency and accuracy in player evaluations."
- **Personnel:** "Our team is less familiar with advanced digital tools but is eager to adopt new technology that will make our job easier."

- **Business Impact:** "Real-time access to scouting reports and integration with other data sources will significantly improve our scouting efficiency and decision-making regarding player acquisitions."

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