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# The Golf Blueprint

A Smarter Way to Play Golf - Driven by Analytics

Table of Contents

[The Golf Blueprint 2](#_Toc193376145)

[Glossary 4](#_Toc193376146)

[Introduction 5](#_Toc193376147)

[Problem Statement 5](#_Toc193376148)

[Project Aims and Objectives 6](#_Toc193376149)

[Specific Objectives 6](#_Toc193376150)

[Methodology 7](#_Toc193376151)

[Agile Methodology 7](#_Toc193376152)

[Risks and Mitigation Strategies 9](#_Toc193376153)

[Project Research 11](#_Toc193376154)

[References 13](#_Toc193376155)

# 

# Glossary

**Course Management -** The strategic decision-making process during a round of golf, including club selection, target selection, and risk assessment. Good course management involves choosing safer options when appropriate and understanding when to take calculated risks.

**Green -** The closely mown area of grass between the tee and the green, providing the most advantageous position for the next shot.

**Approach Shot -** A golf shot played toward the green, typically from a distance of 50-200 yards from the hole.

**Fairway -** The closely mown area of grass between the tee and the green, generally providing the most advantageous position for the next shot.

# 1. Introduction

## 1.1 Problem Statement

Golf has a significant global presence with over 42.7 million players worldwide (The R&A, 2024), making it one of the most popular sports in the world. Whether you are a professional golfer touring the world, or an amateur who plays socially on the weekends, the player base faces a common challenge: the complexity of ‘course management’ and its impact on being able to shoot a good score. Amateur players often lack structured guidance, or the knowledge required for making strategic decisions during their rounds, which I believe creates a gap in the market for The Golf Blueprint to become an innovation in amateur golfers’ improvement.

Having played golf for 13 years and achieved a handicap of 3, I have experienced firsthand the evolution from novice to skilled amateur player. My own dedication to improvement over a long span of time has provided unique insights into how course management influences performance across different skill levels. My experience has revealed a crucial observation: while technical skills are important, strategic course management is often the most important factor in whether a golfer is able to shoot a good score. Golf at all skill levels is a game of misses. Nobody can hit a ‘perfect’ shot every time, so managing where you ‘miss’ your shots is essential.

The Kendleshire Golf Club, where I have been a member for four years, provides a clear example of this importance. I have gradually begun to notice subtle trends about each of the 18 holes there. For example, if a player misses the green to the left-hand side of the second hole with their approach shot, they will typically get a higher score on that hole than if they were to miss to the right-hand side. This is because the subsequent shot is generally much more difficult from the left side of the green as opposed to the right. As a result of this, I have now begun to favour missing my own approach shots to the right side of this green, which has led to me improving my average score on this hole.

However, I regularly see other golfers fail to account for this, as well as similar, but unique pitfalls depending on which hole they are playing. These dangers can occasionally be easy to identify during a round of golf, but more often than not, minute intricacies about each hole are either simply overlooked, or perhaps not understood in the first place. I believe that The Golf Blueprint would be able to visually represent ways to improve scores across all 18 holes in a way that is easy to understand and visualise for golfers of all skill levels. This would allow golfers who use The Golf Blueprint to benefit from knowing which areas of the golf course they should either try to avoid or look to aim at with their shots during their rounds to shoot lower scores.

## 1.2 Project Aims and Objectives

The primary aim for this project is to develop a data-driven golf course management tool, that is specifically tailored to The Kendleshire Golf Club, allowing its members and others who may play there to make informed strategic decisions during their rounds of golf, allowing them to improve their scores and to greater their experience.

## Specific Objectives

1. Design and create detailed animated top-down view recreations of every hole at The Kendleshire, which will not only be used to collect the shot data from the golfers at The Kendleshire, but to also display the findings from the data, in the form of heatmaps.
2. Design and implement a system to collect and analyse shot data from golfers. This system must be very simple, and easy to use to ensure that golfers will be happy to take the time to input their data, and to ensure that the data collected is as accurate as possible.
3. Create a secure database to store golf shot data, user account information and golf course information, complying to GDPR regulations. The database will be the foundation for the resource and is essential to make it possible to provide meaningful, data-driven course management recommendations to the users.
4. Design an intuitive, and good-looking user interface, which displays to the user all the features of The Golf Blueprint. This is a very important consideration as the user interface will serve as the main point of interaction between the users and the resource’s functions and capabilities.
5. Ensure that the resource meets the needs of the users, by conducting testing with at least 10 users, and gather feedback from the users to gain an understanding of what elements of the resource they enjoy, and what could be improved.

# 2. Methodology

## 2.1 Agile Methodology

For this project to run smoothly, and with as minimal issues as possible, it is essential that I use a software development methodology. A methodology forms a framework for planning and controlling the creation of a software project (Kute and Thorat, 2014). To accommodate for the flexibility and adaptability that developing The Golf Blueprint requires, an agile methodology would be more appropriate. I am creating this project in my third year of university, and there could be periods of time where I am extremely busy with other academic projects, that could cause a lengthy delay to my progress. Using an agile methodology will not force me to follow fixed-length sprints, allowing for a more flexible workload to fit around my varying university workloads. My agile methodology of choice will be Kanban. Kanban requires full transparency of work and presents work items visually on a Kanban board (Radigan, 2024).

In Anderson’s work (2010), he emphasises the importance of limiting work in progress (WIP) for maintaining the quality of work while preventing overload. If I can limit myself to having only a manageable number of tasks at any given time, I will be able to complete them to a higher standard (Sjøberg, 2018). The visual nature of Kanban boards will also allow me to quickly identify any bottlenecks in the development process and address them promptly (Lei *et al.*, 2017). This visibility is particularly valuable as it will help me prioritise tasks effectively when balancing multiple simultaneous university commitments.

Another significant advantage of Kanban for this project is its focus on continuous delivery, which (Ahmad *et al.*, 2013) identify as a key benefit of the methodology. Unlike methodologies that require waiting for sprint cycles to complete, Kanban allows features to be released as soon as they are ready. This will be useful for me as it will allow me to share any updates to my project supervisor, and to potential future clients at The Kendleshire.

To implement Kanban for this project, I have set up a digital Kanban board using Jira, Atlassian's project management software (see Figure 1.1). The board is organised into three columns: To Do, In Progress, and Done. The ‘To Do’ column contains all planned features and upcoming work, prioritised based on project requirements and dependencies. The ‘In Progress’ column, limited to three tasks to prevent WIP, shows current development activities. The ‘Done’ column provides a clear record of completed features and helps track project progress. This structure is complemented by Jira's additional features such as time tracking, issue linking, and automated workflows, which enhance project visibility and control. This structure aligns with key Kanban principles of workflow visualisation and process management (Anderson, 2010). This straightforward approach ensures I maintain a clear overview of the project's status while managing it alongside other academic A screenshot of a survey

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*Figure 1.1: Kanban project board.*

## 2.2 Risks and Mitigation Strategies

For The Golf Blueprint to be successful, it is essential to identify potential risks and develop appropriate mitigation strategies. There are various potential risks that could impact the project's success, and they must be carefully managed.

***Technical Risks***

The primary technical risk for The Golf Blueprint involves data accuracy and validation. Since the resource's ability to provide meaningful, data-driven course management insights relies entirely on user-submitted data, ensuring this data's accuracy is crucial. To mitigate this risk, multiple validation techniques will be implemented. The application will provide clear visual feedback for marking shot locations, combined with intuitive instructions for data entry. An intelligent validation system will be implemented to detect potential errors, including outlier detection to identify unusual patterns in shot data. Users will be limited to entering only two rounds of golf per calendar day to help prevent fabricated data from entering the database. Also, if a user attempts to enter an unrealistic number of shots for the same hole or records shot distances beyond normal playing capabilities, the system will challenge these entries, requesting verification before acceptance.

***User Adoption Risks***

The success of The Golf Blueprint heavily depends on user engagement and consistent data contribution. A significant risk exists that golfers at The Kendleshire might find the process of inputting shot data into The Golf Blueprint too time-consuming or complex, potentially leading to limited data collection and reduced effectiveness of the system. This risk will be addressed through careful interface design that will allow for simple and time efficient data entry. Clear user instructions will be provided for accurate shot location marking, and the overall user experience will be developed to encourage regular participation.

***Data Protection Risks***

Due to the nature of the application, The Golf Blueprint will collect and store personal information from the users as well as golf shot data. This makes having a robust data protection strategy essential. The system will implement secure user authentication to protect personal information, alongside encrypted data storage for all user information. For the database, I will be using MongoDB, which has built in security features, meaning that all of the users’ data will be completely secure.

***Project Management Risks***

There are several project management risks that need to be considered. The primary challenge lies in balancing the project development with my other academic commitments. I will mitigate this risk by utilising the features available with the Jira Kanban board that can help me keep on track with what parts of the project need to be completed at any given time. Jira has time tracking functionality, and by logging time spent on different aspects of the project, I can identify which components are taking longer than anticipated and adjust my development schedule accordingly.

***Version and Document Control Strategy***

A robust version and document control strategy is essential for maintaining the integrity and traceability of The Golf Blueprint's development. Git will serve as the primary version control system, hosted on GitHub to ensure secure and reliable code management. The repository structure will follow a clear branching strategy, with the main branch containing stable, production-ready code, and a development branch for ongoing implementation work.

For feature development, each new component will be created in a dedicated feature branch, following the naming convention 'feature/description-of-change'. For example, when developing the shot tracking interface, the branch would be named 'feature/shot-tracking-implementation'. This structured approach ensures that new features can be developed and tested without risking the stability of the main codebase.

To maintain code quality and documentation standards, all code changes will follow a strict commit message convention. Each commit message will begin with a type identifier (style, test etc.) followed by a concise description of the change. For instance, 'test(heatmap): implement shot density visualisation' or 'test(validation): correct shot distance calculation'. This systematic approach to commit messages makes it easier to track the project's evolution and understand the purpose of each change.

Document control extends beyond code management. All project documentation, including requirements specifications, design documents, and user guides, will be stored in a dedicated 'docs' directory within the repository. This ensures that documentation remains closely coupled with the code it describes and benefits from the same version control mechanisms. The documentation will follow a clear naming convention, allowing for easy chronological tracking of document versions. Regular backups of both code and documentation will be maintained through GitHub's cloud storage, protecting against potential data loss.

# 3. Project Research

This project utilises both primary and secondary research techniques to ensure that I developed an enhanced understanding of what I am looking to achieve, and to validate my proposed solution to the problem. The first part of the research phase of my project was secondary research. An important goal of mine for the secondary research was to not only explore the existing golf analytics technology that exists, but to also try and find a gap in the current market that The Golf Blueprint can fill.

To ensure the quality and reliability of the research that I found and used, I searched the UWE Library Database, and Google Scholar. Key search terms included: “golf analytics technology”, “importance of course management”, “global participation in golf”, “strokes gained” and “data used in professional golf”. This secondary research was able to provide me with an abundance of useful information, which all directed related to my project.

## 3.1 Secondary Research

The game of golf at all levels is continuously evolving, with technology and data analytics playing an increasingly crucial role in player development and performance optimisation. The PGA Tour's implementation of ShotLink technology in 2003 marked a significant turning point for golf, by collecting detailed data on every shot played in professional tournaments (Broadie, 2014). Broadie demonstrates how data analytics has revolutionised the understanding of golf performance, introducing new metrics such as "strokes gained" which compares different facets of a players’ golf game to other players (Plummer, 2024). These metrics have become standard tools for not only professional player analysis but are also useful for weighing the value of different strengths, such as the power of exceptional ball-striking versus superior short game skills (Ehrlich and Kamimoto, 2024).

According to research published in the International Journal of Sports Science & Coaching, the integration of launch monitors and ball tracking technology has fundamentally changed how golfers practice and compete (Betzler *et al.*, 2012). Professional golfers utilise these resources frequently to analyse their own performance and arrange their practice schedule around their own weaknesses to improve and try to gain an edge on their competitors.

Course management has become a very big part of the modern professional game and is something that the world’s top players always look to when trying to improve (MacKenzie, 2023). Professional golfers will also always without fail complete multiple ‘practice rounds’ before a tournament. During these practice rounds they identify which areas of the course they must avoid, and which areas of the course they should aim to utilise to benefit their scores, and in turn results (Stenzel, 2023). Understanding effective course management can help any golfer save some strokes every time that they play (Turner, 2023).

## 3.2 Primary Research

To complement the secondary research and to help validate the need for The Golf Blueprint, I conducted primary research targeting the specific user base at The Kendleshire Golf Club. This research was essential to capture real-world insights from potential users, understand their current course management approaches, and identify specific features that would provide the most value to them.

I utilised a Qualtrics survey as the data collection tool. The survey was distributed between February 15th and March 15th, 2025, using both digital channels (UWE Golf society WhatsApp group) and in-person recruitment at the clubhouse for regular members. This dual-distribution strategy ensured representation across different age groups and technology comfort levels, helping to hopefully avoid sampling bias toward younger golfers at university.

The survey (accessible at: https://uwe.eu.qualtrics.com/jfe/form/SV\_5vdeIIMs1zUsifc) was designed following UWE ethical guidelines, with questions carefully crafted to avoid leading participants and to capture both quantitative metrics and qualitative insights. The survey structure addressed:

* Informed consent and participant rights
* Demographic data and playing ability (handicap range, frequency of play)
* Current understanding and application of course management principles
* Usage patterns of existing golf technology solutions
* Interest in The Golf Blueprint concept and data contribution willingness
* Feature preferences and priorities for the proposed application

The survey received responses from 86 members of The Kendleshire Golf Club. The respondents were formed of a diverse range of playing abilities, with most players (55%), having a current handicap of 11-20. The data also highlights that the respondents have good familiarity with the golf course, with 34% of them playing there once per week, and 38% playing there twice a month.

**Current Understanding of Course Management**

I asked the respondents their current understanding of course management, with five options ranging from ‘Very Good’ to ‘Very Bad’. I wanted to try and gain an understanding of this, as The Golf Blueprint aims to provide its users a much better understanding of the importance of good course management.

In the survey, 80% of respondents report currently having either an ‘Average’, a ‘Bad’ or a ‘Very Bad’ understanding of course management.

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*Figure 1.2: Graph showcasing the data of current course management understanding.*

This data showcases a significant gap in current knowledge of course management of players at The Kendleshire. This signifies an opportunity that The Golf Blueprint could address to improve these statistics. As I have identified in the secondary research, employing good course management is an effective technique for improving at golf.

**Current Use of Golf Apps or Technology**

I asked the respondents whether they currently use any golf related golf applications or technology as a part of their golf game. I asked this question to gain an understanding of whether members at The Kendleshire may be likely or not to adopt a new golfing resource such as The Golf Blueprint, based on their current habits.

In the survey, a slight majority of 52% of respondents answered that they do currently use a golf related app or technology.

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*Figure 1.3: Graph showcasing the data of current adoption of golf apps/technology*

When asked in detail what specific features of these apps that the respondents find the most useful, 10 respondents (12%) answered that they utilise these apps for getting yardages for their next shots while playing. Also, 21 respondents (25%) replied that they like to use these apps for entering and keeping track of their scores while they are playing.

These findings showcase that there is a significant proportion of golfers at The Kendleshire who regularly use golf applications or technology at the moment. This is positive for The Golf Blueprint, as it shows it could easily become a part of these golfers’ routines.

**Interest Levels in an App/Website such as The Golf Blueprint**

I asked the respondents their interest levels in a resource such as The Golf Blueprint, with four options ranging from ‘Very Uninterested’ to ‘Very Interested’. I wanted to ask this question to directly ask the prospective users whether they think it would be something that they would be likely to adopt.

The question provided very positive results, with 72 respondents (85%), responding with either ‘Very Interested’ or ‘Interested’.

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*Figure 1.4: Graph showcasing the data of interest levels in The Golf Blueprint.*

This data shows a very high level of interest from the respondents towards The Golf Blueprint. This supports my own beliefs that the resource would be very popular.

**Willingness to Participate in the Required Data Collection**

Finally, I wanted to gain some insight into whether the respondents would be willing to contribute their own data from their rounds of golf towards the resource. This is an important consideration because the success of the resource will rely on users supplying the database with accurate data for trends to begin to form.

This question also provided very positive results, with 75 respondents (88%), saying that they would be willing to provide data to benefit The Golf Blueprint’s accuracy and usefulness.

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*Figure 1.5: Graph showcasing the data of willingness to participate in data collection.*

This strongly suggests that the potential future users of The Golf Blueprint would be happy to contribute their own data, which would create a sustainable resource.

**Desirable Features of The Resource**

The final question of the survey asks the respondents specifically what features they would like to see on the website/resource. I wanted to make sure that I was directly asking the target audience of this resource what features may be important to them, to hopefully help me with my design phase of the software development.

The qualitative data gained from this question provided me with the following information around their wishes. 12 respondents (14%) specifically mentioned that they would want the resource to be easy/simple to use. This is a very important consideration for me as I will be targeting a wide age range of users, who may have differing technological capabilities. This has highlighted the necessity for me to create an easy-to-use interface to ensure user satisfaction.

## 3.3 Key Findings

The comprehensive research conducted through primary and secondary research provide clear validation for The Golf Blueprint concept and helps to give specific direction for its development.

The primary research confirms a significant gap between current golf technology offerings and golfers' strategic needs, with 80% of respondents, regardless of current golfing ability reporting to have an ‘Average’ or worse understanding of course management. Although 52% of respondents currently use golf technology, these applications focus primarily on distance measurement (12% of users) and score tracking (25% of users), with little support for course management decision-making. This gap directly correlates with the 85% interest level in The Golf Blueprint concept, validating the core premise of the project.

I must make sure that I create a well-designed user interface that is easy to use. I will be relying on the users to input their own golfing data to create as useful a resource as possible, making retaining the users a necessity. The interface must allow for users to quickly enter in their shot data, to prevent it from taking up too much time from their day.

**Research Limitations**

While the research provides strong validation for The Golf Blueprint concept, some limitations should be acknowledged. Despite efforts to include diverse participants, the sample may over-represent more engaged club members, with 46% of respondents playing at least once a week or more. This could mean that although very keen golfers may be interested in the resource, I might need to adopt a different approach for gaining traction with those who do not play as much.

Another limitation was the number of participants involved in the survey. Although I was able to gather data from 86 members, this is still a small sample size for a club that has over 600 active members. The data that I have collected could fail to represent the views and wishes of the entire member base.

# 4. Requirements

## 4.1 User Stories and Use Cases

User stories capture what the users of the resource will want to be able to accomplish. They use the following format: “As a [type of user], I want [an action] so that [benefit/value].”

1. As a golfer who has limited knowledge of course management, I want to be able to see heatmap visualisations of every hole so that I can make better decisions during my rounds.
2. As a regular golfer at The Kendleshire, I want to be able to contribute my own data towards the database so that I can help to build an accurate and useful resource for all to use.
3. As a low-handicap golfer, I want to be able to study the heatmap visualisations so that I can identify any areas of the course that may be beneficial that I have not considered before.
4. As a high-handicap golfer, I want to be able to try and identify which areas of the course are danger areas, so that I can begin to improve my scores when I play.
5. As a golfer who is planning to visit The Kendleshire for a golfing holiday, I want to be able to study the course before I arrive so that I can gain an advantage over my peers.
6. As a golf coach at The Kendleshire, I want to be able to access the heatmap visualisations during my lessons, so that I can give the best advice to students as possible.
7. As a grounds maintenance staff member, I want to be able to see the heatmap visualisations so that we can address whether certain areas are too unfair, or too forgiving.
8. As a new golfer, I am not so interested in course management. I want to be able to enter my scores into the database so that I can track my progress as I improve.

## 4.2 Use Case Diagrams

**System Overview**

**A diagram of a golf course

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*Figure 4.1: The Overview Use Case Diagram*

This diagram provides an overview of the entire program. It displays all user types and main functions and how they interact with each other.

**Contribute Shot Data**

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*Figure 4.2: The Contribute Shot Data Use Case Diagram*

This shows how different types of golfers input their data from their rounds of golf into the system including the required steps of logging in, selecting dates, marking shot locations, and recording scores.

**Heatmap Visualisation**

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*Figure 4.3: The Heatmap Visualisation Use Case Diagram*

This diagram shows all of the users who are able to access the heatmap visualisations and the associated functions, including hole selection, and viewing detailed statistical analysis of different areas of the course.

**Preview Course**

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*Figure 4.4: The Preview Course Use Case Diagram*

This diagram shows how golfers who are planning on visiting The Kendleshire would be able to use the resource to remotely preview the course. It includes viewing hole heatmaps, analysing scoring patterns and creating personalised strategy guides for their visit.

**Course Maintenance Analysis**

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*Figure 4.5: The Maintenance Analysis Use Case Diagram*

This diagram illustrates how maintenance staff would use the resource to analyse how the course is playing at the moment, with the ability to view heatmaps for each hole, and view detailed statistics for every zone throughout the course, allowing them to create their own maintenance reports to potentially alter the course if required.

**Progress Tracking**

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*Figure 4.6: The Progress Tracking Use Case Diagram*

This diagram shows how a new golfer who is less interested in course management would be able to use the resource in order to track their broader progress as they play more rounds of golf.

## 4.3 Functional Requirements

This section outlines the functional requirements for The Golf Blueprint, systematically derived from research findings and user stories. These requirements represent specific capabilities the system must provide to deliver value to the users. The requirements are prioritised using the MoSCoW method, using ‘must have’, ‘should have’, ‘could have’, and ‘will not have’ (Brush, 2023).

* **Must have:** Requirements that are critical to project success - these deliver the minimum viable product and address core user needs. Without these, The Golf Blueprint would fail to deliver its fundamental value proposition of improving course management through data visualization.
* **Should have:** Important requirements that significantly enhance the system but are not absolutely critical. These features provide substantial value and should be included unless they would jeopardize delivery of the "must have" requirements.
* **Could have:** Desirable features that would provide additional value but could be deferred if necessary. These enhancements would improve the user experience but are not essential to achieve the project's primary objectives.
* **Won't have:** Features that were considered but explicitly excluded from the current version. These have been documented to set clear expectations and provide a roadmap for future development.

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*Figure 4.7: Table showcasing the User Account Management Functional Requirements*

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*Figure 4.8: Table showcasing the Data Collection and Input Functional Requirements*

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*Figure 4.9: Table showcasing the Visualisation and Analytics Functional Requirements*

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*Figure 4.10: Table showcasing the Round History Functional Requirements*

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*Figure 4.10: Table showcasing the Administration Functional Requirements*

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*Figure 4.11: Table showcasing the Won’t Have Functional Requirements*

The requirements for The Golf Blueprint were systematically derived through a structured approach that ensured comprehensive coverage of all stakeholders needs while maintaining traceability to research findings

Requirements were elicited through multiple complementary techniques:

* **Survey Analysis:** The survey of 86 members at The Kendleshire Golf Club provided quantitative data on user needs, specifically highlighting the desire for improved course management capabilities and ease of use.
* **User Story Development:** Eight detailed user stories were created to capture the diverse perspectives of different user groups, from high-handicap golfers to maintenance staff.
* **Use Case Modelling:** Six detailed use case diagrams were developed to visualize system interactions, helping identify functional boundaries.

## 4.4 Non-Functional Requirements

Non-functional requirements define the quality attributes of The Golf Blueprint. These requirements are organised according to the ISO/IEC 9126 Software Engineering Product Quality standard (ISO, 2024), ensuring comprehensive coverage of all quality aspects. Like the functional requirements, these are also prioritised using the MoSCoW method.

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*Figure 4.12: Table showcasing the Usability Non-Functional Requirements*

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*Figure 4.13: Table showcasing the Functionality Non-Functional Requirements*

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*Figure 4.14: Table showcasing the Reliability and Performance Non-Functional Requirements*

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*Figure 4.15: Table showcasing the Maintainability Non-Functional Requirements*

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*Figure 4.16: Table showcasing the Security Non-Functional Requirements*

# Software Design

## 5.1 Software Architecture

The Golf Blueprint implements a client-server architecture following the Model-View-Controller (MVC) pattern to ensure separation of concerns and maintainability. This architecture consists of three primary components:

1. **Client-Side Application (View and Controller)** - A responsive HTML/CSS/JavaScript web application that provides the user interface and handles user interactions
2. **Server-Side API (Controller)** - A Node.js Express server that processes requests and mediates between the client and database
3. **Database (Model)** - A MySQL database that stores all persistent data

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*Figure 5.1: This image showcases the SQL Database Schema for The Golf Blueprint*

(TO BE INSERTED LATER)

The Golf Blueprint differentiates itself by focusing specifically on course management at The Kendleshire Golf Club, utilising crowd-sourced data to create a comprehensive understanding of each hole's strategic challenges. Unlike generic golf GPS apps that simply provide distances, or personal tracking systems that focus on individual performance metrics, this project aims to capture and visualise the collective experience of players at The Kendleshire. This local focus allows for the identification of specific course management patterns that generic golf analytics solutions cannot provide.

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