Projecting Future Scenarios

2022 SOA Student Challenge

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DKA

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1

Executive Summary

1 Executive Summary

DKA has proposed the following:

- Raritan National Team (RNT) with 21 players from various leagues, with the players mainly based from Rarita. The proposed team is expected to have a 31% chance of winning the tournament from 2025.
- Construction timeline of 8 stadiums across different regions of Rarita to facilitate internal mobility within the country

The report utilizes the data set provided by the committee on the 2021-2022 soccer season, with reference to EPL league data to sense check the results.

1.1 Scope and Objective

DKA aims to develop a comprehensive simulation model for the committee, with no defined parameters based on the dataset, to allow the committee to continuously monitor the performance of the RNT without adjusting the model. In addition to the model, we aim to provide a development plan that would promote soccer in Rarita and boost the economy in the surrounding region.

To further assist the committee to monitor and review the team performance, we have provided several frameworks to minimize the human bias in decision making. We have also provided a review schedule and metrics that the committee should assess on a timely basis.

DKA has recognizes the limited dataset that the committee has provided us and have highlighted the assumptions and relevant risk associated within this report.

2

Team Selection

2 Team Selection

2.1 Model Design

DKA has defined a five-step procedure to identify the optimal team outlined in Figure 1.

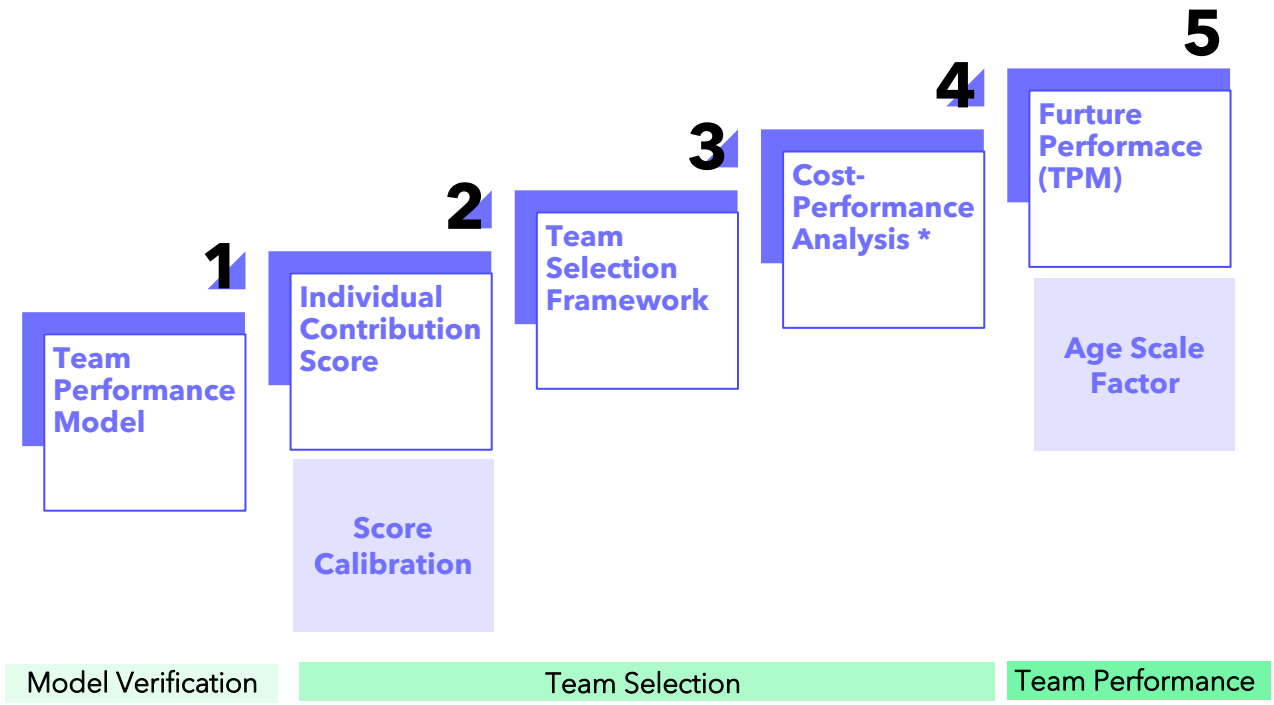

Figure 1: Team Selection Process

2.1.1 Team Performance Model

DKA has developed a simulation-based approach to predict the outcome of individual games.

The advantage of this approach include:

- Scalability of the model as there are no parameters defined.
- Results can be monitored as the model is independent of yearly data.
- Minimize assumptions required due to limited data, as opposed to GLM, GBM approaches. [1]

1 Refer to Appendix A.1

The components of the TPM can be separated as below.

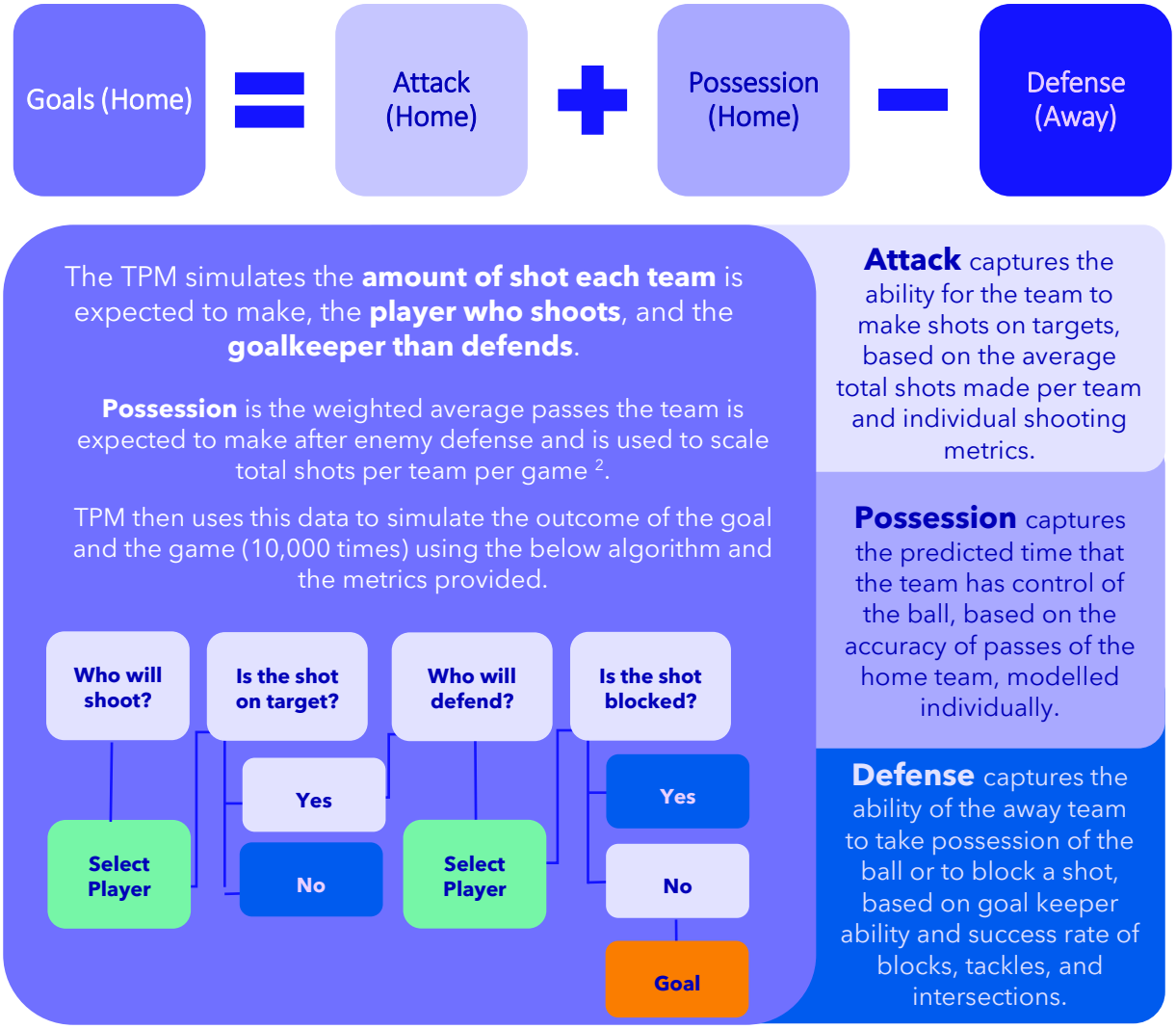

Figure 2: Components of the Team Performance Model

A further elaboration of the methodology is provided in Appendix A.2.

2 Korl M, Chmura P, Chmura J, et.al, Pass Completion Rate and Match Outcome at the World Cup in Brazil in 2014, Polish Journal of Sport and Tourism. January 2017

2.1.2 Individual Contribution Score

The **Individual Contribution Score (ICS)** is a single simplified measure, ranging from 0.5 to 1, to rank the player's predicted marginal contribution under the TPM. [3]

The ICS includes the three core elements, attack, possession, and defense, with the weights differing based on the position of the player as shown in Table 1.

Table 1: Components of the Individual Contribution Score

	Attack	*Possession*	*Defense*	*Defense – Goalkeeper*
Unique Components	Total Shots per game, Shot on Target %, Goals per shot	Various pass success rates	Block, intersection and tackle success rates, Errors	Shot save success rate
Common Components	Age, Average time played, League			
Forward	50%	25%	25%	-
Midfield	25%	50%	25%	-
Defense	25%	25%	50%	-
Goalkeeper	-	25%	25%	50%

The score is standardized to ensure that it is not biased based on the player's home league.

The standardization procedure includes:

- Calculating the ICS at both the league and tournament level.
- Comparing the score for players with experience, and available data in both leagues.
- Finding the average scaling factor by league and position. [4]

Although we are unable to validate the scaling factor with past history and the selection bias that is naturally present in tournament-players, it offers a conservative estimate to allow more accurate representation of the players.

3 Refer to Appendix A.2.1 for more detail on treatment of League B data and scaling factors.

4 Results are scaled to span the range of 0.5 to 1 to avoid computational issues.

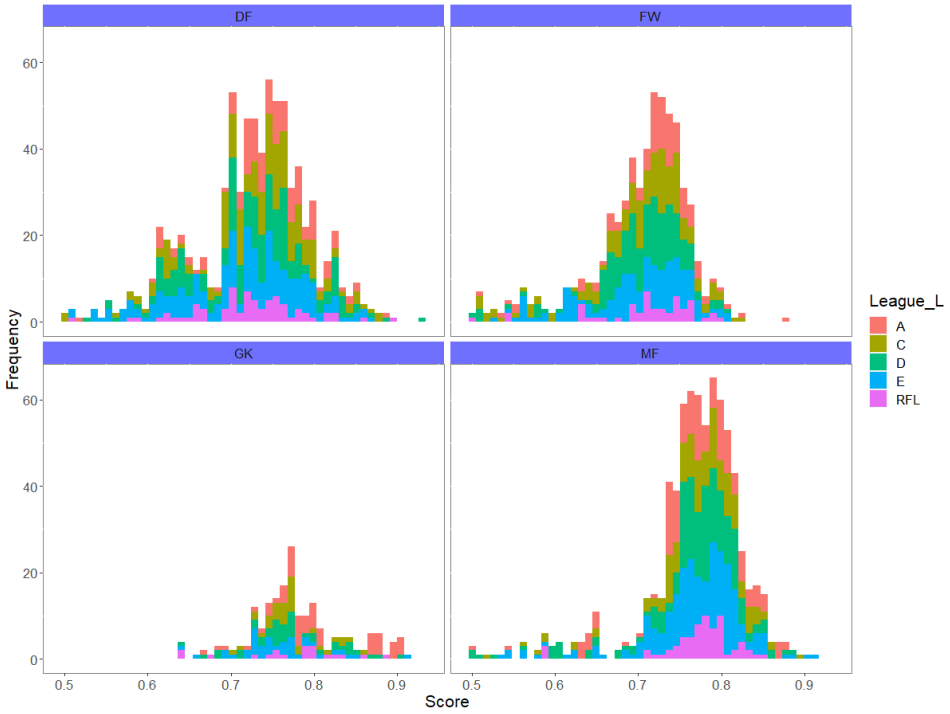

Figure 3: Distribution of ICS for players in different position and League

Key Observations:

- Players are predominately from League A, C & D.
- The distribution across all league and position is fairly normal, with a more concentrated sample for mid-fielders.
- ICS is unable to capture qualitative measures, such as synergies and nationality.

2.1.3 Team Selection Framework

To select the optimal Raritan National Team (RNT), DKA has developed a qualitative decision tree, the **Team Selection Framework (TSF)**. The TSF is introduced to remove the human bias in assessing the ICS score and other qualitative measures highlighted below, and to ensure the same standards can be replicated when reviewing the current methodology.

The main criteria for team selection include: [5]

- Age: to minimize need to source new players due to retirement. [5]
- Tournament Experience: to train Raritan players, who do not have tournament experience.
- Synergy [6]: to ensure that team has commonality (nationality, club, or league)
- Nationality and League

5 Refer to Appendix A.2.2 for the full decision tree.

6 Synergy is considered as a response to the cultural integration risk from Section 6.1

DKA acknowledges the **ethical issues** surrounding the use of nationality and age as criterions, in particular:

- Is it ethical to introduce foreign players into the national team when empirical results have shown that they are subject to heavy criticism and potential racism? [7]

An analysis on the above issues is included in Appendix A.2.3.

A cost-performance analysis is included in Section 2.2.

2.1.4 Future Performance Metric

The **Future Performance Metric (FPM)** outlines the probability and expected rank of the selected team. It is an application of the TPM, with input metrics scaled with the **Individual Ageing Score (IAS).**

The IAS is an aggregated measure of improvement (or decay) and is the calculated as the ratio of the current year's performance metric over the past year's metric. The results are then summarized by age and position as shown in Figure 4.

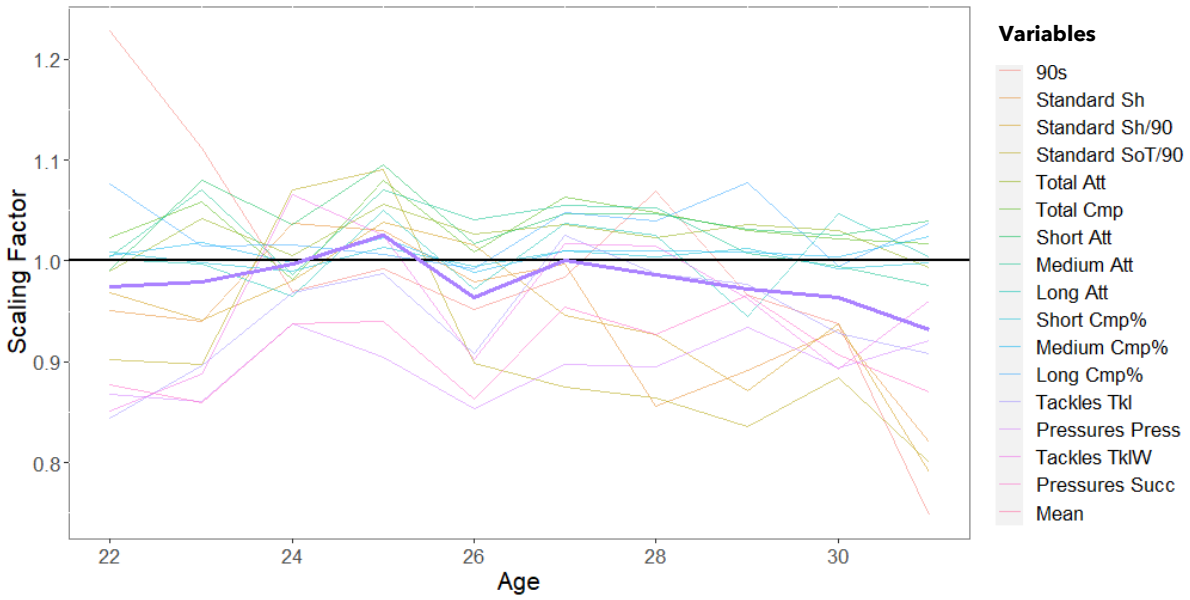

Figure 4: Individual Ageing Score Breakdown

Key Observations

- Observed Peak age at 25-27 [8]
- Slight increase in performance at age 27 can be explained by under-performing players retiring at 26.
- Clear decline in performance post-27

7 Lanlani F, Zafar H, "Racial abuse of England players exposes deep societal fractures and the need for change", *World Economic Forum,* July 2021

8 Dendir S, "When do soccer players peak? A note" *Journal of Sports Analytics 2*. January 2016

Table 3: Breakdown of age factor groups

Age Group	Age Factor	Rationale
Development *(<25)*	1.05	Empirical research has indicated players improve significantly as they gain experience in this age group. [9]
Stagnation *(25-27)*	1.00	Stagnation period where under-performing players exit the league. No decay is applied to smoothen the trend.
Decline		
(28-30)	0.95	Performance declines with age, this is evident in both the dataset and empirical studies.
(>30)	0.9	

For the Raritan National Team, it is assumed that all players must retire upon reaching age 30, with the optimal replacement age being 27.

9 Dendir S, "When do soccer players peak? A note" *Journal of Sports Analytics 2*. January 2016

2.2 Projected Outcomes

In this section, the proposed IAS and ICS scaling rates from Section 2.1 is applied to calibrate the data.

For each competition year, DKA:

- Projected the expected rank of each team after a round-robin tournament
- Projected the probability for the top 16 teams to reach the quarterfinals, semi-finals, finals, and win the tournament under a single elimination configuration. [10]

The rates are assumed to be flat after the 5-year period and will be updated on a rolling basis annually. Refer to Appendix B.6 for detailed calculations.

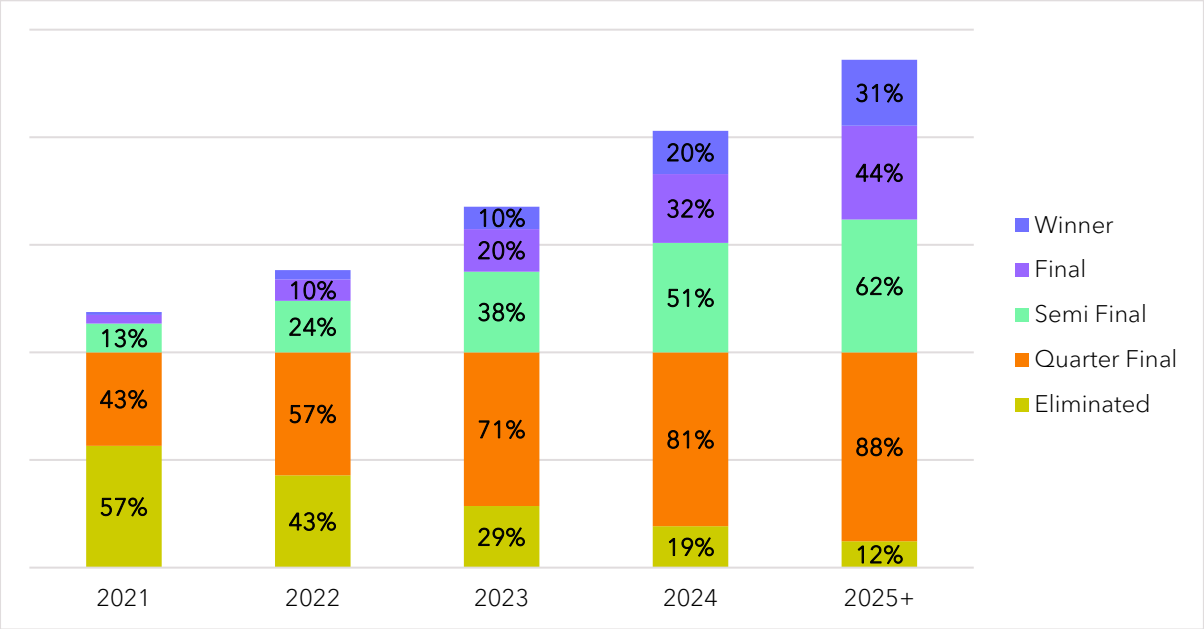

Figure 5: Projected Probabilities in tournament of RNT

Key Observations:

The proposed RNT:

- Consistently ranks amongst the top 16 teams.
- Meets the Commissioner's definition of competitive.
- Probability of reaching the finals expected to grow after the initial valuation as projects discussed in (Section 4) are realized.

10 Ward A, "9 questions about the 2018 World Cup you were too embarrassed to ask?" *Vox*, July 2018

2.3 Cash Flow Analysis

2.3.1 RNT Player Salary

The salary applied in 2.3.2 is calculated as 20% the player's annualized salary, with additional profit share. Currently, players from other nations are not remunerated or receive a small appearance fee when playing for the national team[11]. The salary shown in Table 4 is the annualized, unadjusted salary.

Table 4: RNT Player Selection

Player	Nationality	Age	League	Pos	Projected Score	Salary	International Experience
A. Khainza	Sobianitedrucy	21	RFL	GK	0.83	$ 1,490,000	Yes
A. Tindimwebwa	Rarita	20	RFL	FW	0.74	$ 2,170,000	
B. Ayuba	Rarita	20	E	MF	0.81	$ 21,950,000	
B. Klemeni	Dosqaly	24	C	DF	0.76	$ 11,280,000	Yes
B. Luki?	Dosqaly	7	E	DF	0.78	$ 13,420,000	Yes
C. Baluka	Rarita	20	RFL	DF	0.80	$ 7,760,000	
E. Nakanjako	Rarita	20	A	MF	0.80	$ 10,750,000	
F. Akumu	Rarita	20	RFL	GK	0.80	$ 5,600,000	
H. Valentini	Rarita	24	D	MF	0.72	$ 9,460,000	
I. Iddrisu	People's Land of Maneau	21	A	MF	0.82	$ 17,300,000	Yes
K. Namuwaya	People's Land of Maneau	24	A	FW	0.75	$ 25,750,000	Yes
N. Ono	People's Land of Maneau	23	A	FW	0.76	$ 27,840,000	Yes
N. Terzi?	Rarita	22	RFL	DF	0.79	$ 5,000,000	
P. Villa	Rarita	20	RFL	MF	0.80	$ 7,820,000	
R. Taketa	Rarita	23	RFL	DF	0.80	$ 980,000	
T. Ichikawa	People's Land of Maneau	22	A	FW	0.75	$ 31,170,000	Yes
T. Larsson	Rarita	20	RFL	DF	0.79	$ 1,140,000	
V. Ãlvarez	Rarita	24	A	MF	0.72	$ 27,580,000	
V. Sultan	Rarita	20	RFL	DF	0.78	$ 5,080,000	
X. Kho	Mico	23	D	DF	0.79	$ 24,660,000	Yes
Z. Nakiwala	Rarita	24	E	FW	0.70	$ 24,480,000	

11 Parkinson J, "Reality Check: Do footballers get paid for internationals?" *BBC*, July 2018

2.3.2 Projected Team Revenue and Expense

DKA has provided a valuation on the direct revenue and expenses of acquiring and maintaining RNT.

Assumptions:

- Inflation Rate: 2.87%
- Salary Growth: 4.87% (Inflation + 2%)
- Expected win rates (Section 2.2)

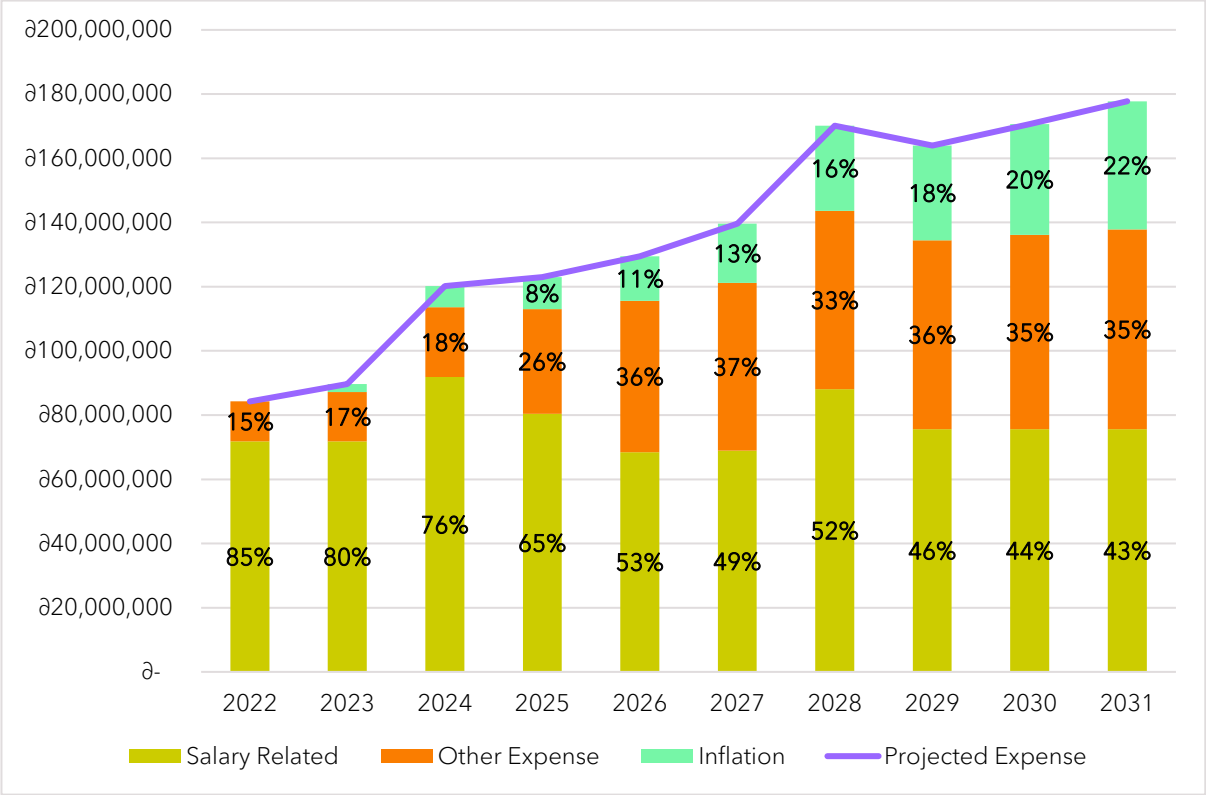

Figure 6: Breakdown of Projected Expenses

Key Observations:

- Majority is spent on player salary, with decline driven by stronger reliance on Academy players from the 6th year.
- Increase in other expense driven by more travel, training and infrastructure support as the team becomes more competitive. [12]

12 Refer to Appendix B.1

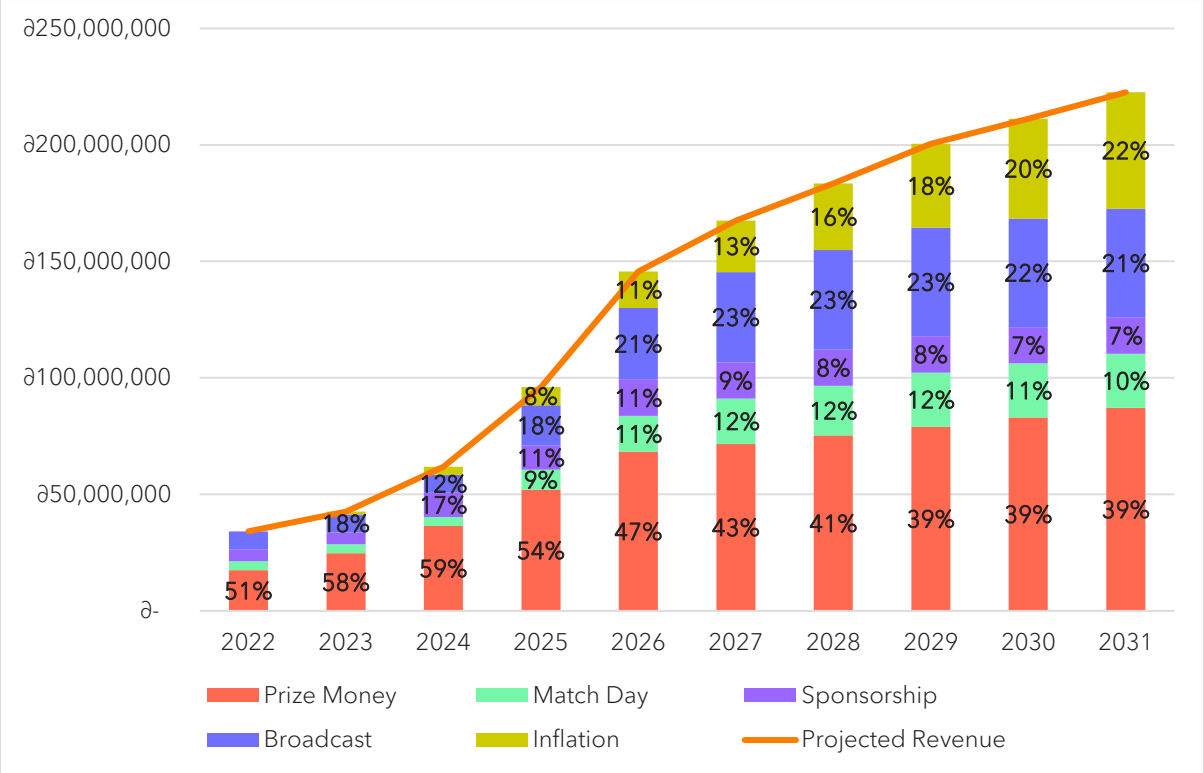

Figure 7: Breakdown of Projected Revenue

Key Observations:

- Sponsorship, matchday and broadcast projected to be a long-term, stable revenue source as RNT gains international success.
- Large Growth in 4th year driven by expected completion of new stadiums, allowing higher attendance (Section 4.2.1).

More analysis on adequacy and variations in assumptions provided in Section 6.2.1. For further revenue and expense breakdown, refer to Appendix B.1.

3

Economic Impact

3 Economic Impact

DKA has identified two key sources of growth for Rarita over the next 10 years, growth from achieving competitive performance abroad and indirect economic impacts from proposed projects refer to Section 4.

3.1 Competitive Performance

3.1.1 Economic Growth and GDP

Historically, there has been a strong relationship between nation's GDP and strong international performance. In the case of Rarita, we expect:

- Increase consumption following each win in the elimination stage of approximately 20%, with a significant loss of approximately 40% if eliminated due to consumer sentiment, celebrations, and merchandise. [13]
- Increase participation in sports (1-3%) inspired by strong RNT results leading to higher consumption in sports-related purchases [14]

These effects are generally short-lived and are credited from expected future consumption.

3.1.2 Equity Market

- Depending on the performance of RNT in the elimination round, there will be increased short-term volatility within the equity market for the winner and runner-up.
- Based on empirical data, the winning nation is expected to outperform the market by 3.5%, with the runner-up underperforming by 4%. [15]

The effects are generally reversed within one year.

3.1.3 Tourism and International Reputation

- Rarita is expected to see a surge in international recognition and support following competitive results.
- Larger awareness across social media platforms, with TikTok followers expected to triple, matching other nations with similar performance
- This will lead to more tourism across Rarita, especially after the development of new stadiums from 2026.

13 Olenski S, "The Impact Of The World Cup On Shopping And Consumer Spending", *Forbes,* July 2014

14 Hammond C, "Do big sporting events make us do more sport?", *BBC,* August 206

15 Goldman Sachs, "The World Cup and Economics 2014", May 2014

3.2 Proposed Project

3.2.1 Infrastructure

The proposed stadiums are concentrated around East and West Rarita and expected to:

- Increase employment in the construction sector of 3% in the local areas.
- Distribute wealth between Central Rarita and East and West Rarita as more investments are made around the stadiums.
- However, the jobs are likely to be temporary and the revenue generated from the revenue may not be fully realized by local community.
- Furthermore, as more stadiums are constructed, the maintenance cost and renovation cost may cause the committee to be insolvent.
- DKA proposes a set of long-term infrastructure projects to facilitate job growth and recommend the committee to hire local vendors within the stadium.

3.2.2 Hosting Tournaments

After the proposed stadiums are built, Rarita will be eligible to host the tournament. Expected benefits (and costs) include:

- Significant growth in tourism (short-term boost of > 1 million) with potential to attract more tourist in the long run with gained international exposure.
- Increase connectivity within Rarita with added transportation to support the tournament.
- Long term growth if the infrastructure built during the tournament is transferable for daily use of local citizen.
- However, this might conflict with other infrastructure development in Rarita affecting economic growth. [16]
- May lead to significant debt post-tournament, which may take years to repay. [17]

At this stage, we recommend the committee to host isolated, friendly tournaments. This will significantly reduce the cost of hosting and:

- The committee can target specific development regions and promote tourism and retailing by hosting frequent friendly competitions.
- Introduce foreign investment into West Rarita, to reduce the inequality in wealth distribution.

16 Matheson V, "Were the Billions Brazil Spent on World Cup Stadiums Worth It?", *FiveThiryEight,* June 2014

17 Borga J, " Hosting the FIFA World Cup: An Economic Analysis of how the World Cup has Impacted the Economy of a Developed and a Developing Nation", *University of Lynchburg,* June 2020

4

Implementation Plan

4 Implementation Plan

DKA has created a timeline of expected deliverables for the committee.

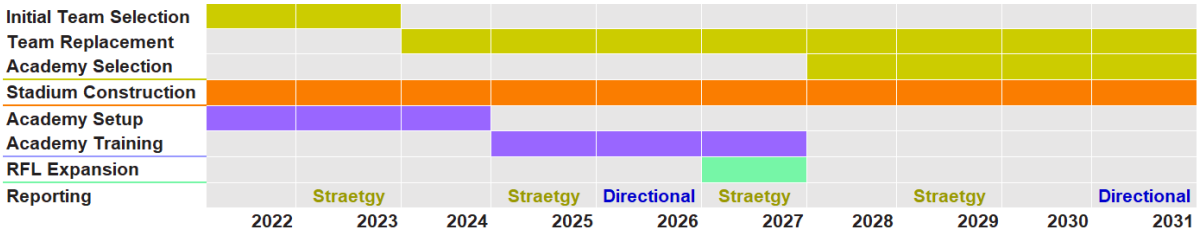

Figure 8: Overview of Implementation Plan

4.1 Team Selection

The proposed team consists mainly of domestic Raritan players from a mixture of leagues, that are not in a national team. To supplement the lack of international exposure, several loaners are included in the initial team.

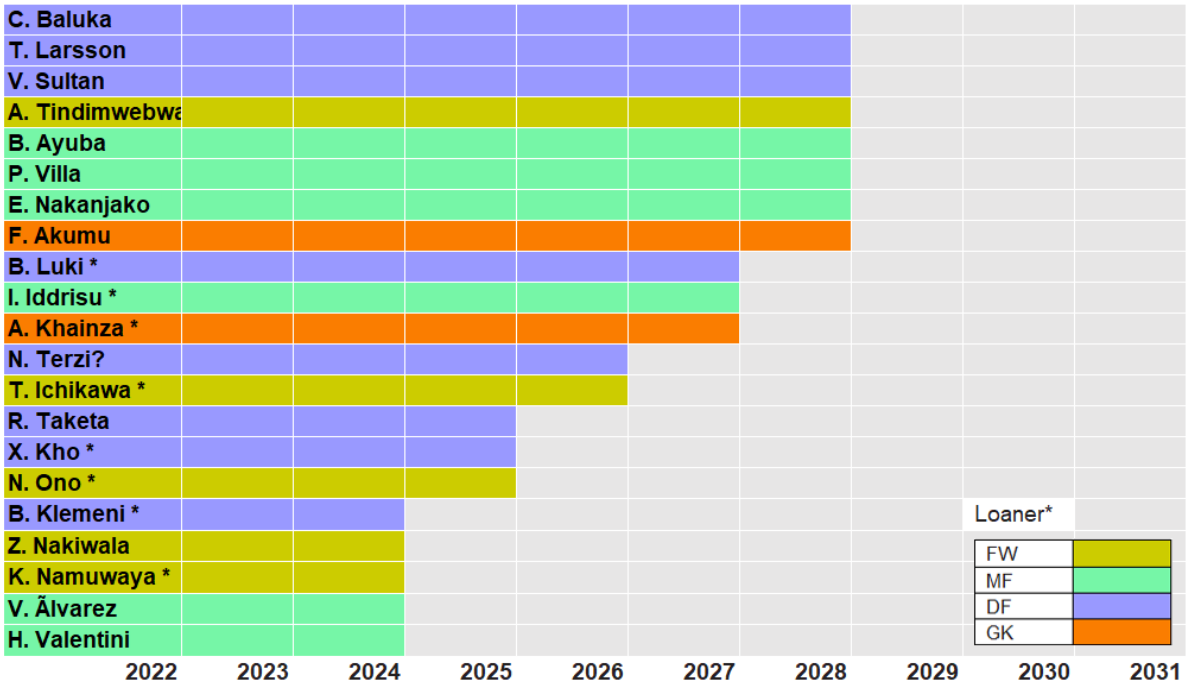

Figure 9: Initial Team Playing Schedule

In the case where loaners are unwilling to compete for Rarita, DKA recommends the committee to:

- Increase the salary to 30% of player's salary
- Increase profit split to 15% when winning tournament

At the current stage, the loaners are fundamental to the development of the team and there are minimal replacements of their caliber and age.

DKA advises the committee to introduce replacement players one year in advance, for retiring players reaching age 27 to allow the transfer of skills and game knowledge. The first replacement begins in 2024 for 5 players.

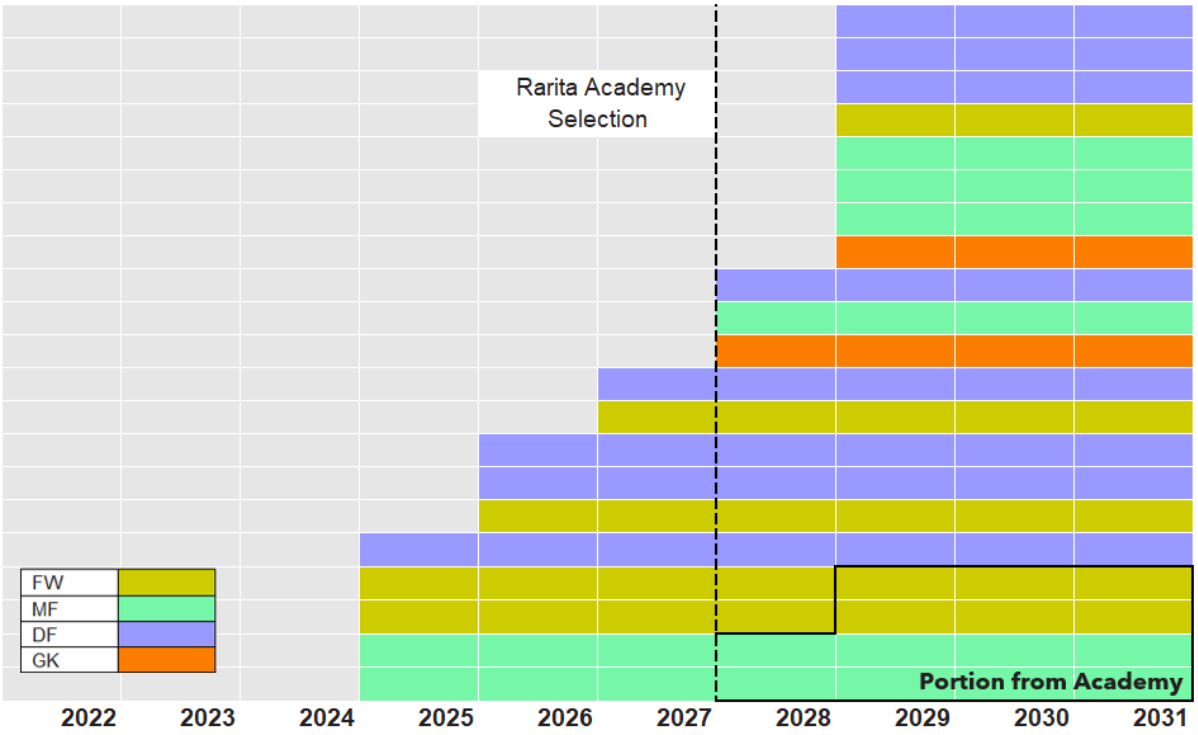

Figure 10: Player Replacement Schedule

In the period 2025-2027, DKA expects that all replacements are from Rarita, with 20% of the national team composed of Academy players from 2028. The current salary estimates are, ∂10 million for academy players and ∂20 million for non-academy players, which includes a buffer for loaner if required.

For a further breakdown in cashflow related to team selection, see Appendix B.2.

4.2 Development Plan

DKA has developed a 10-year development plan for the committee to promote soccer in Rarita. A detailed cashflow breakdown of each of the below item is available in Appendix B.3.

4.2.1 Stadium Development

To meet and boost the projected growing demand of soccer in Rarita, DKA recommends:

- Developing 8 stadiums with training facilities in the next 10 years
- Establish connections and sponsorships with local companies and the RFL.

DKA has projected the revenue and expense (excluding initial investment cost) of the stadiums upon completion . We observe that stadiums could generate a strong revenue stream upon international success of RNT. The fund will be vital for future hosting endeavours and strengthening RFL and RNT.

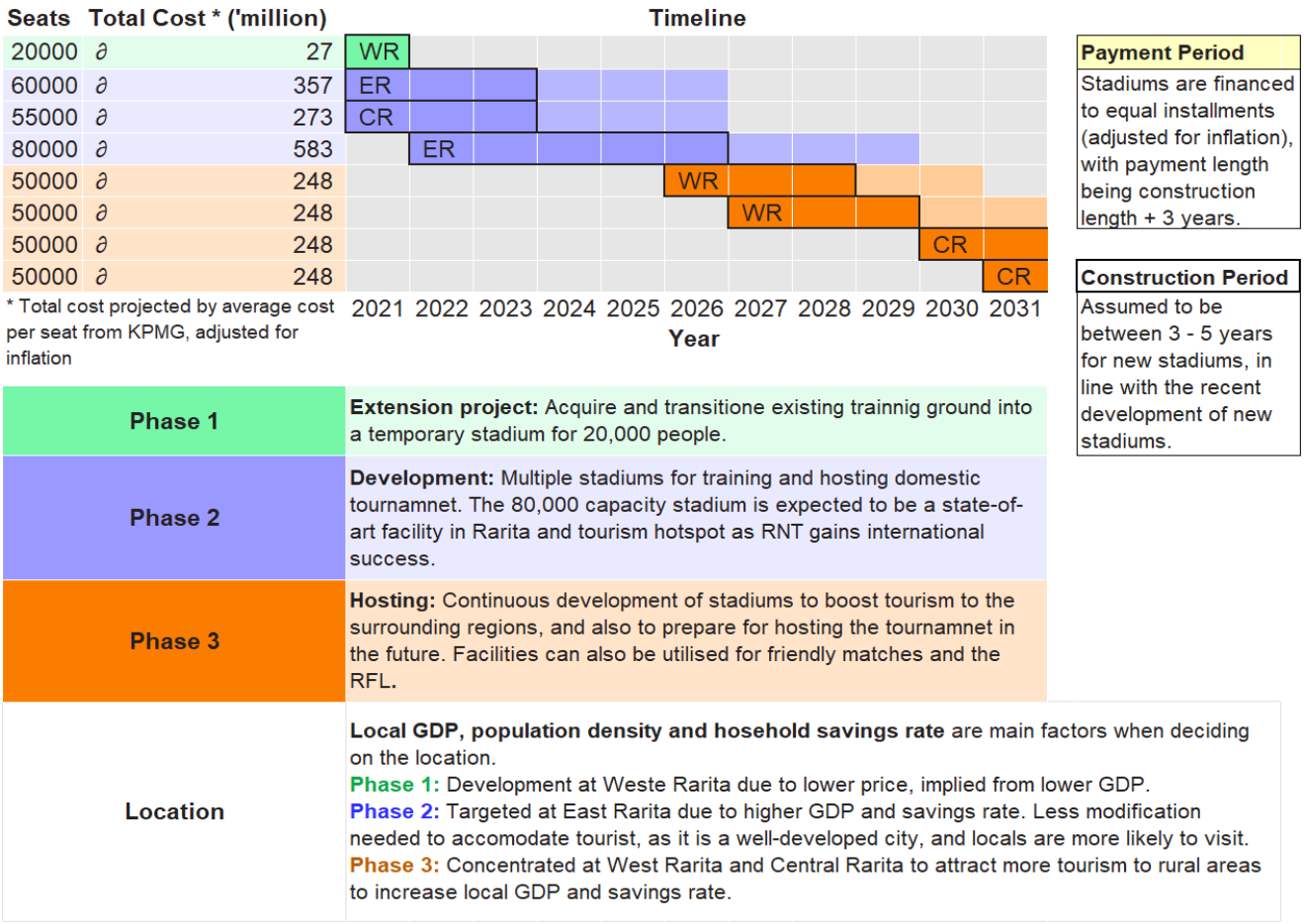

Figure 11: Infographic on stadium development in Rarita

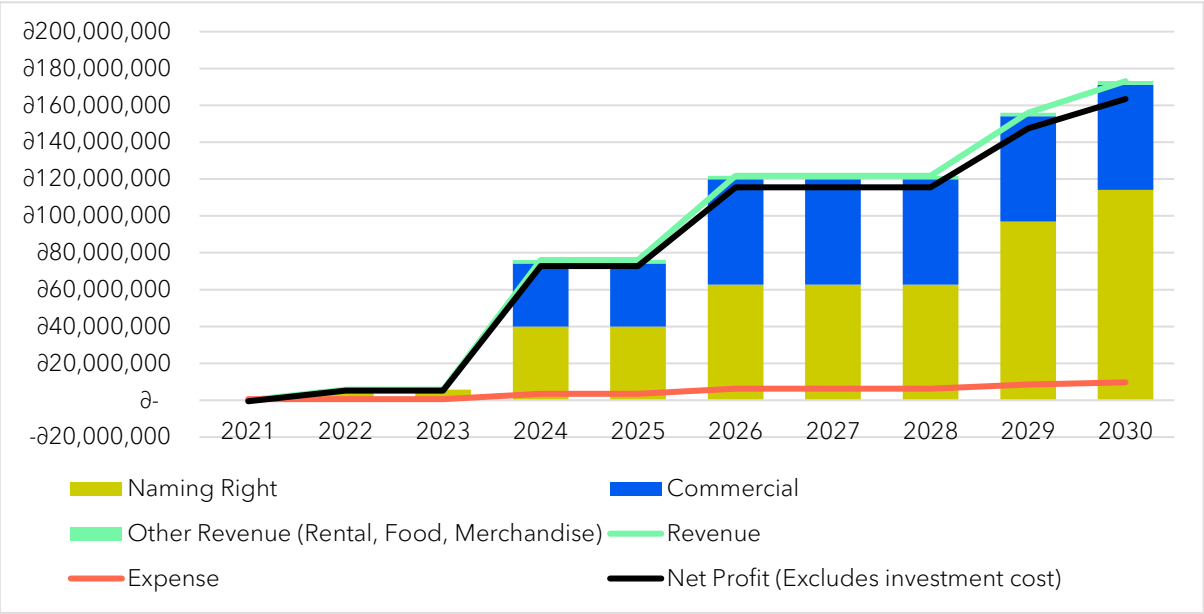

Figure 12: Projected Revenue and Expense for Stadiums

4.2.2 Academy Team

To capture young talents in Rarita and to lower reliance on loaners, DKA recommends Rarita to establish a soccer academy. The timeline and total expense per annum is shown below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Scouting - Scout x 6										
			Training - Coach x 3							
			Salary - Player x 20							
						Transition to Main Team				

Total Expense	
∂	547,680
∂	171,150
∂	100,000
N.B: Captured in 2.3	

Figure 13: Academy Team Timeline

A detailed breakdown is available in Appendix B.3

4.2.3 Expansion of RFL

To further attract international talent, DKA has proposed the committee to inject a one-off sum into the RFL after RNT as achieved international success. The current proposed amount is a ∂ 50 million injection in 2027. The sum is intended to restructure the league whilst leveraging on RNT's international success. Further details should be evaluated in the directional review in 2026.

4.3 Reporting Metrics

DKA has taken a multi-level reporting timeline to evaluate the development progress.

	Metric	Rationale
Annual Review	Projected Probability (TPM)	Monitor and track the relative position of RNT against other national teams. If the probability has declined relative to previous valuation, RNT should devote more resources in hiring quality players in the market.
	Adequacy Ratio	Understand the risk of RNT becoming insolvent and identify potential mitigation strategies. A valuation has been made in Section 6.
	Net Profit (Loss)	Identify the gap between projected net profit (loss) with the actual experience and adjust future valuations accordingly.
Strategy Review	RNT Age Distribution	Visualise whether the retirement strategy has been met, and whether extra provision is required for retirement-related expense.
	Academy Transition Rate	Performance review of the academy team and their recruitment of oung talent.
	RNT Retention Rate	Identify potential loss of RNT players to other national teams. If retention rate is lower, remuneration strategies and other league expansion strategies should be considered.
	Attendance Rate	Decreasing attendance rate signals the need for marketing campaigns, and/or improvements needed to attract more viewers.
Directional Overview	Delay Ratio	Ratio of delayed days to expected completion days of new stadiums. Buffer regions should be considered when projected future cashflows based on expected experience.
	Breakeven Ratio	Ratio of total revenue generated and total investment cost of each stadium. Restructure (e.g. renovate, repurpose) stadiums that have brokeven, and are no longer attracting as much revenue.
	Sponsorship Revenue	Negotiate new deals with sponsors, commercials and broadcast station.

Figure 14: Proposed Reporting Timeline

5

Assumptions

5 Key Assumptions

5.1 Team Selection

- Selected metric is representative of the team performance and that players do not suffer from injury and/or down time.
- The data for 2021 is representative of the average performance of the player and not biased by other external factors.
- All teams will not have fundamental replacements to the team, such that it greatly deviates from the performance in 2021

5.2 Economic Analysis

- Assumed that the demand will be sufficient to meet the progressive expansion planned, with no significant opposition to mass stadium building.

5.3 Cashflow Projections

- Rarita Inflation Rate: 2.87% with 1.19% volatility
    - This is selected as the 10-year average and volatility observed in Rarita
- Rarita Risk-free Rate: 0.19% with 0.06% volatility
    - This is the average and volatility of the 10-year forward rate as of 2021
- Investment Rate: 10.6% with volatility 18.49%
- Wage Growth is fixed at 2% above inflation

DKA has provided additional analysis on the selection of inflation and risk-free rate in Appendix B.4.

6

Risk & Risk Mitigation

6 Risk and Risk Mitigation

6.1 Risk Heat Map

DKA has identified and summarized the key risks of the above proposal.

Risk		Projected Impact									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 +
C	Demand Deficiency				I			I			
E	Cultural Integration Risk	T									
E	Climate-related risk										
F	Market Risk										
F	Insolvency due to over-budget projects				M					M	
F	Model Bias					(D)				(D)	
T	Performance Risk	T									
T	Injury Risk	T						(A)			
T	Lack of Talent							(A)			
T	Model & Data Bias				(D)			(D)			

Risk Categories:
C = Consumer Discretionary
E = Environmental, Social & Governance
F = Finanicial
T = Team Performance

Risk Enhancer:
I = Infrastrucure Expansion
M = Market-related Forces
T = Team Expansion

Risk Mitigator:
(A) = Academy
(D) = Improvement in quality of data

Consumer Deficiency

Consumer Deficiency is the risk of insufficient demand on matchday tickets and broadcast. This is mainly driven by the expansion of stadiums and increasing capacity.

ESG

ESG risk arises mainly from cultural integration of loaners to Rarita and climate-related policy changes. DKA expects that environmental standards will be stricter in the future, either in the form of carbon pricing or other taxes.

Financial

Finanical risk is the risk of unable to meet finanical obligations arising from contractual liability or inadequate provisions. The main driver of finanical risk is market forces and also lack of data of the Raritan equity markets.

Team Performance

Team Performance is the risk of the team underperforming or unable to perform due to external forces. The main risk arises from injury and model bias, as only two years of data is available.

Risk:
Low
Moderate
High

Figure 15: Infographic on the Key Risks faced by developing RNT

6.1.1 Risk Mitigation Strategies

Consumer Discretionary

- Large disruptions may affect future attendance rates, e.g. further lockdowns from COVID-19
- Economic recession may impact attendance as individuals have lower disposable income

Mitigation: Adopt a flexible pricing model, with admission price adjustments reviewed biannually (strategy review). Marketing strategies can be adopted in combination with sponsors to boost viewership both in person and at home.

ESG

- Cultural differences in loaner's home country and Rarita (languages and values)
- Climate related revenue reduction from physical risk and increase in expenses from policy changes (E.g. carbon pricing)

Mitigation: Consider cultural fit in addition to performance when considering loaners. Strategy review should assess and include provisions required for climate-related items. Currently, no provisions are made as there is insufficient information on the regulations in Rarita.

Financial

- Exchange rate fluctuations may disincentivize tourist from attending Raritan tournaments.
- Investment rates are implied from the market and not representative of Raritan equity markets
- Insolvency due to market fluctuations and project delays

Mitigation: Currently, there is limited data on the market rates of the Raritan equity market, to mitigate the risk, the model should be updated annually and adjust for previous experience. The committee could consider discounts for tourist attending soccer events when exchange rates are high to smoothen the demand deficiency.

Team Performance

- The current probability projections rely heavily on two years of observed data, the model may be biased or inaccurate.
- Performance and injury risk can significantly affect attendance, and we are unable to project it due to lack of data.

Mitigation: The accuracy of the model will increase with more observed data as the ICS and IAS projections become more accurate. The expected team performance should be evaluated on an annual basis. To accommodate for performance and injury risk, the team includes 9 substitutes.

6.2 Sensitivity and Scenario Analysis

6.2.1 Adequacy Analysis (Scenario)

To further assess the solvency risk of the combined RNT project and whether additional funding is required, DKA conducted an adequacy analysis by:

- Simulating the probability of adequacy over 10,000 simulations, by setting inflation, investment, and wage growth as random variables
- Comparing different scenarios: with or without injection of $100,000,000 at 2025, different proportion of asset invested (0%, 40%, 80%)

DKA recommends that a 70% probability of adequacy is maintained.

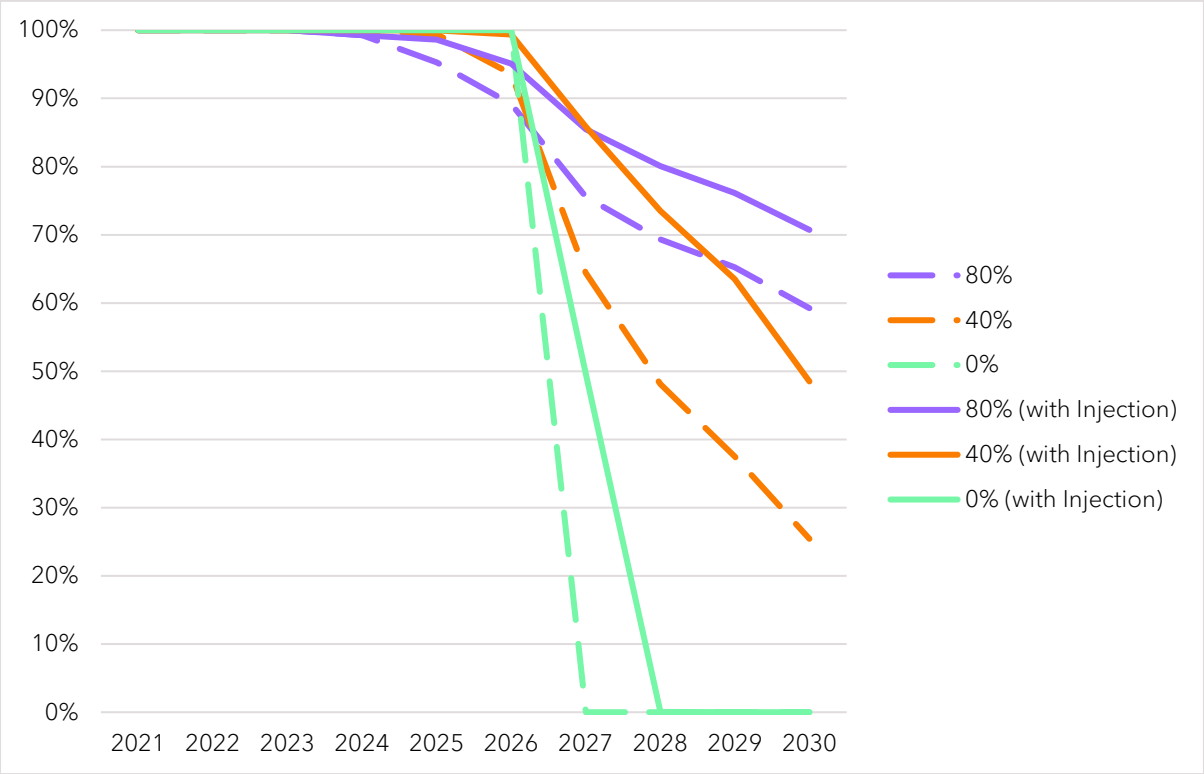

Figure 16: Probability of adequacy for RNT in the next 10 years

Key Observations:

- Without investment, insolvency is certain by 2028
- Optimal allocation at 40% invested (with injection) as it is less subjected to investment fluctuations with significant benefit over not-investing.

A more detailed analysis on the adequacy is provided in Appendix B.5.

6.2.2 Team Performance Model (Sensitivity)

DKA has performed a sensitivity analysis on the key assumption on the model – individual ageing factor. Currently, the model relies on the one year of observation period (between 2020 to 2021) and empirical data to identify the aging effects experience by players. It is expected that there will be variations between the observed and actual figures.

Table 5: Changes in prediction with different aging factor (5% to 2.5%)

	2022	2023	2024	2025	2026
Eliminated	6%	14%	20%	22%	20%
Quarter Final	-6%	-14%	-20%	-22%	-20%
Semi Final	-4%	-10%	-18%	-25%	-26%
Final	-2%	-6%	-13%	-21%	-25%
Winner	-1%	-3%	-8%	-15%	-21%

We note that the variations are rather large, and the assumptions should be reviewed next year to adjust the aging factor accordingly.

A breakdown on the TPM results for different settings is included in Appendix B.6.

7

Data Limitations

7 Data Limitations

DKA has identified some key areas in the dataset that may influence the accuracy of the above prediction.

Table 6: Data Limitation and Treatment

Data Limitation	Effect	Treatment
Limited data across all metrics for soccer players.	Unable to cross validate the model experience other than 2021.	Applied a simulation-based approach, rather than a modelling approach, hence same model can be applied in future to validate the projections.
No data available on equity markets and investment rates in Rarita.	Unable to predict available products available to Rarita for the next 10 years.	Assumed Rarita has access to the S&P 500 and will invest a portion in the market.
Lack of updated data for GDP.	Unable to monitor the economic growth due to winning tournament based on experience.	Assumed that GDP growth will be in line with countries winning the FIFA world cup.
No data on the tournament structure and prize pool.	Assumption is required to predict the potential revenue and position the team will be in .	Use of the Qatar 2022 data as a basis to define prize pool and tournament structure.
Individual match results not available.	We are unable to identify whether the recorded data is representative of the team or skewed based on opponent.	A round robin treatment was used to compare the model and expected results to ensure that bias is minimal.

A

Appendix

Appendix A Model Consideration

A.1 Model Selection

A simulation-based approach was adopted to reduce the reliance of the model itself on the quality of the data, rather using the inherent definition of each metric to define a relationship.

- A tradition GLM, GBM approach will estimate parameters which requires to be updated and reviewed this year.
- The simulation model should be able to be applied to any league and tournament given that the data required is available.

A.2 Model Design

The is constructed in a way which mimics the actual interaction within a soccer game. The simulation includes the following steps:

Possession

- Simulate the average possession of each time based on the "passing data" and the oppositions "defence data"
- Determine the expected goals that each team will attempt.
    - This value is sense checked and aligns with EPL average (500-600 per game)

Attack

- The code then selects the player that is expected to shoot, which is based on the "Standard Shot per game", scaled by the time the player plays "90s".
- Based on the selected players individual "Shot on Target %" and determine whether the shot is a shot on target.

Defend

- Based on the proportion of time each goalkeeper plays "Playing Time 90 mins", the goalkeeper who will defend that shot is selected.
- Based on the "SoT Save%", the code will determine whether the goal is saved or not.

The attack and defend procedures are ran for 10,000 simulations times the amount of goal each team is expected to shoot. The process is vectorized for efficiency.

A.2.1 Individual Contribution Score

League B Treatment

League B is removed from the observation as there is limited data available (19 as seen in Table A). DKA is unable to provide a reasonable estimate on the scaling factor, and hence ICS of League B players.

Applied Scaling Factors

Table A: Summary of ICS and Corresponding Scaling Factors

League	Mean ICS_T	Mean ICS_L	Count	Scaling Factor
A	0.7543425	0.7613542	71	0.9907905
B	0.7730253	0.7708670	19	1.0027999
C	0.7363255	0.7539335	79	0.9766451
D	0.7335013	0.7498982	63	0.9781345
E	0.7289548	0.7627989	36	0.9556317
RFL	0.7672400	0.7673077	32	0.9999118

The above rates were using in the simulation model. Mean ICS_T represents the sample ICS mean within the tournament setting, and ICS_L is within their respective league.

A.2.2 Team Selection Framework

Figure A provider a breakdown on how 21 players are selected from the 2727 players that were considered. HDS refers to human defined step, where DKA assess the synergy between the available players and the team.

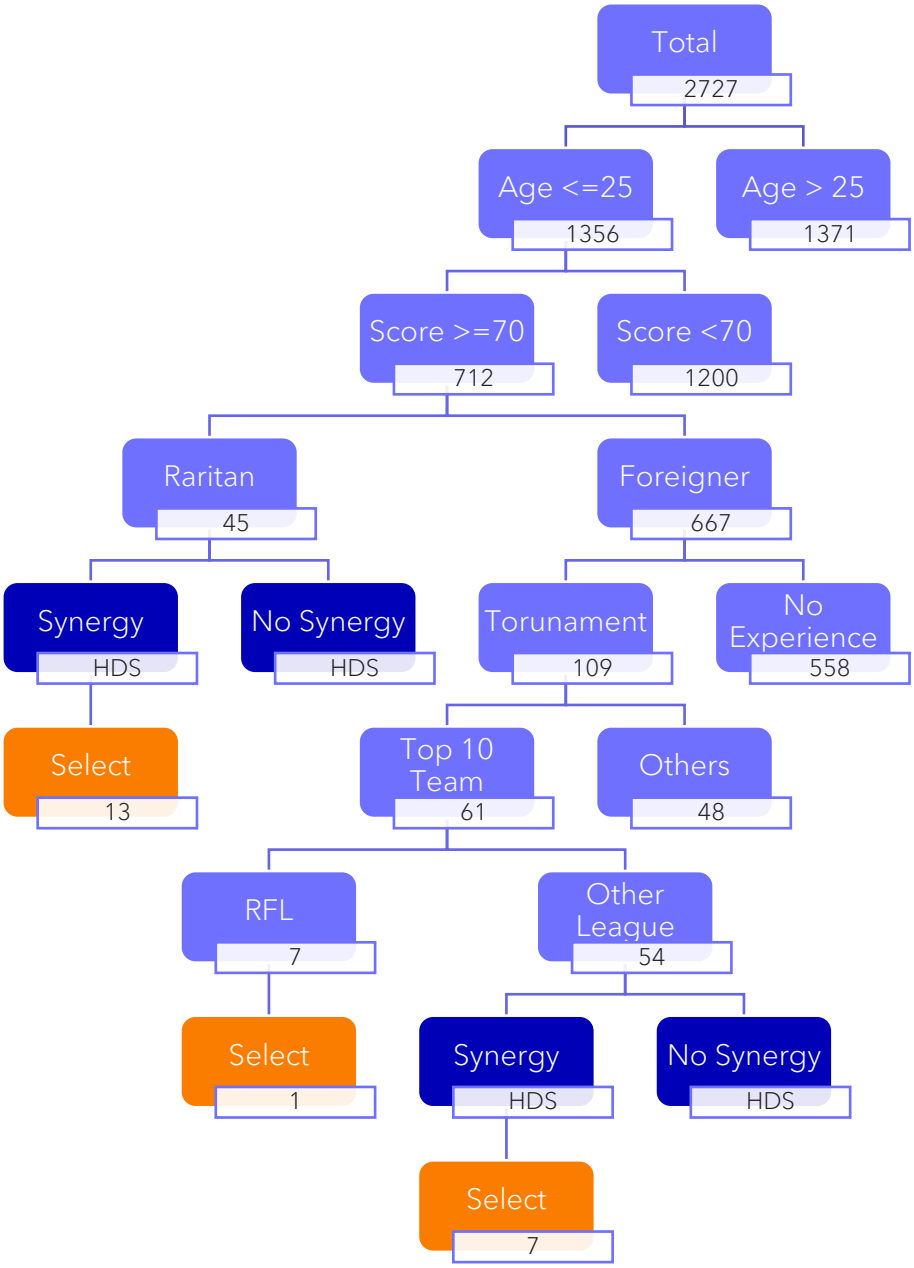

Figure A: Decision Tree in Selecting Optimal RNT

A.2.3 Ethics Framework

DKA has provided the committee with a qualitative framework to address ethical issues arising from decision-making. The chosen framework for this report is virtue ethics, which is highlighted in the Actuaries Institute Australia, and designed by the Ethics Centre.

For the purpose of this report, the principle that we recommend being applied is **the golden mean.** The golden mean aims to quantify the potential actions that are applicable in the situation and find the mid-point between 2 actions.

To encourage the use of virtue ethics, DKA has designed a visual model for the committee.

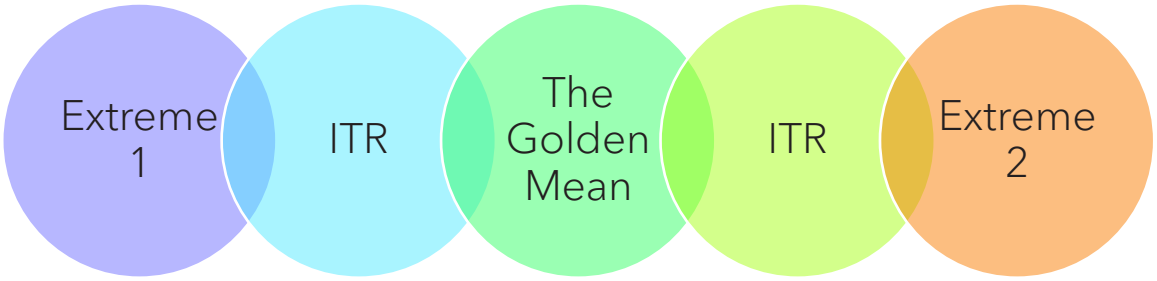

Figure B: Ethics Framework - Virtue Ethics

Often, when assessing ethical issues, our initial response will be in between the initial thought region (ITR). The goal of the framework is to intercept the thought process and achieve a better balance between the two extremes.

The ethical dilemma in the case of Rarita is:

- Is it ethical to introduce foreign players into the national team when empirical results have shown that they are subject to heavy criticism and potential racism?

Below is a simple illustration of DKA's decision making process

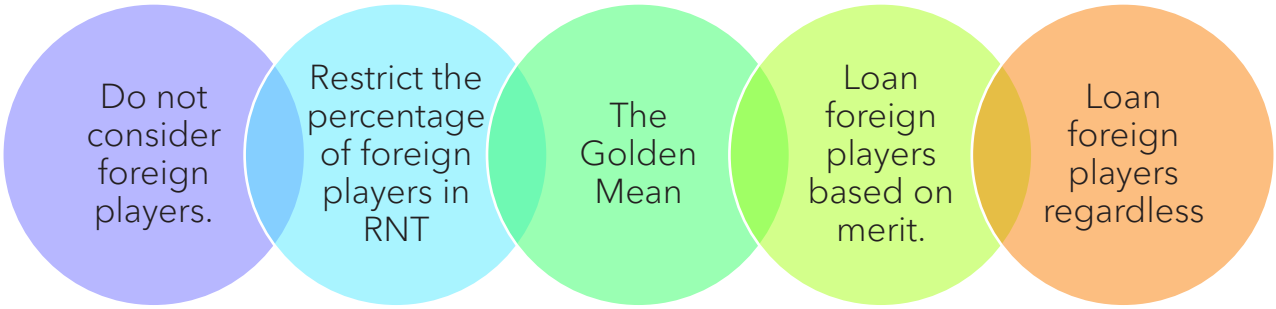

Figure C: Ethics Framework - Application in Rarita

To achieve the golden mean, DKA recommends:

- Loan foreign players only if players of similar standard are not available in Rarita
- Set a "goal" for foreign player ratios with in the RNT, which is flexible by nature
- Ensure that the proposed foreign players do not have cultural clashes with team prior to signing contract.
- Ensure that the team provides support as players adapt to the customs in Rarita.

DKA recommends the committee to adopt this approach when evaluating future ethical issues to evaluate different perspectives before making decisions.

A.3 Model Verification

To determine the suitability of the proposed model, DKA has calibrated the model based on the 2021 tournament season, in which we have data for.

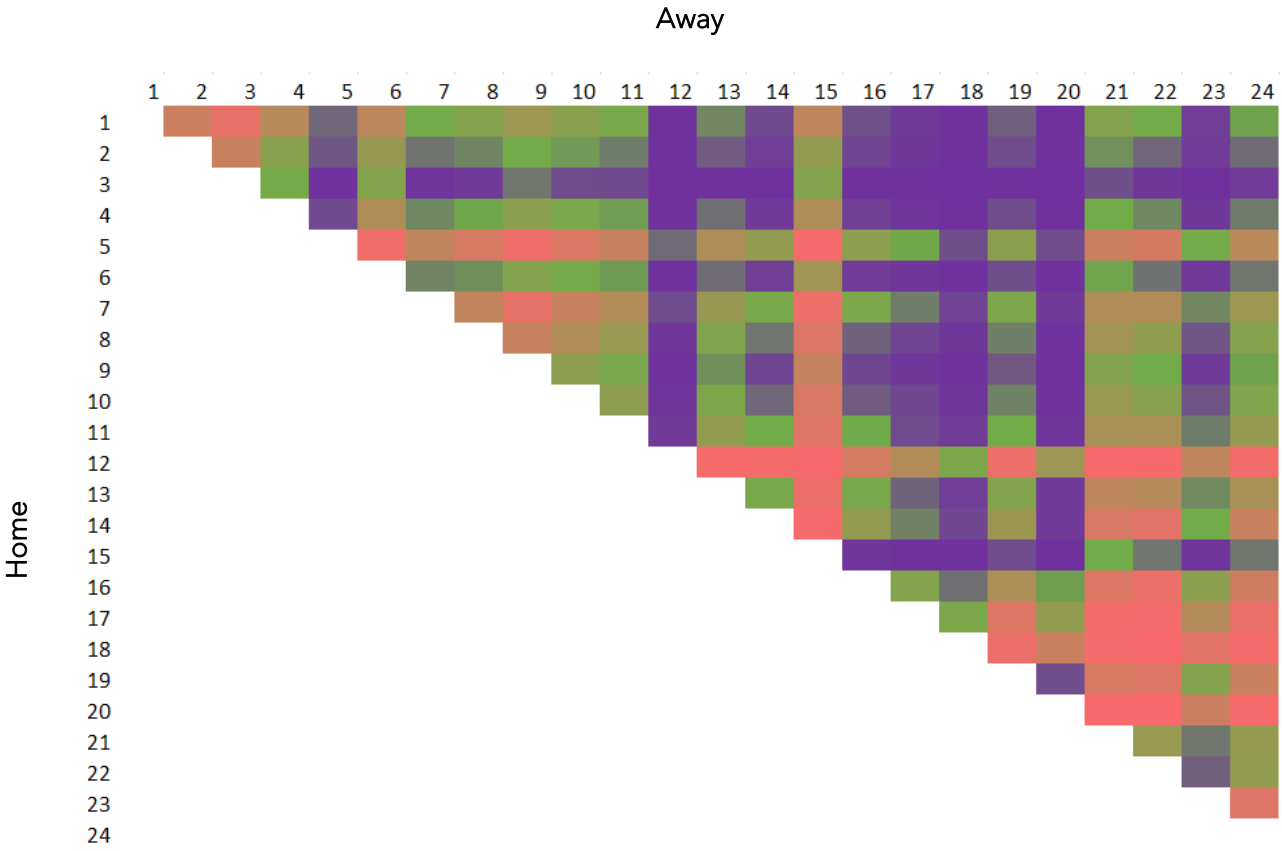

Figure D: Heatmap of Projected Results

Figure D shows the heatmap of the projected vs actual experience. The teams are ranked from 1-24 based on their performance. The colours represent the probability that the home team will beat the away team. Red represents that the home team loses, green represents the home team has a probability of winning greater than 50%, and purple represents 100%-win rate.

The expected result is that no red regions are spotted in the graph. The overall accuracy of the model is 85% for the Top 10 teams, and 72% overall. The discrepancy can be explained by the fact that the colours are based on the probability, whereas tournament results often only depend on one match.

The model gives us an indication on the **average** outcome to be expected.

Appendix B Excel Breakdown

Table B: Breakdown of Excel Contents

Appendix	Detail	Workbook	Tab
B.1	Cashflow Breakdown	02_CashFlow.xlsx	-
B.2	Team Selection Cashflow Breakdown	04_06_implementation_adequacy	01_cfs_detail
B.3	Development Plan Cashflow Breakdown	04_06_implementation_adequacy	02_proj_detail
B.4	Selection of Interest and Inflation Rates	04_06_implementation_adequacy	xx_infl_int_rates
B.5	Adequacy Analysis	04_06_implementation_adequacy	03_adq_results
B.6	TPM Results	01_SOA_Model_results.xlsm	Top 16 Calc

The code for the TFM model (Appendix B.6) is also included in "dka_01_SOA_Model_v1.0.R". The file path must be updated for the code to run, and for the output to be assessed correctly, it the R code must be called from the excel: "01_SOA_Model.xlsm". A further elaboration will be provided in the Github landing page.

B

Reference List

Reference List

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