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Identification of Factors Associated with the Performance of Not-for-profit Sport Clubs: A Machine Learning Approach

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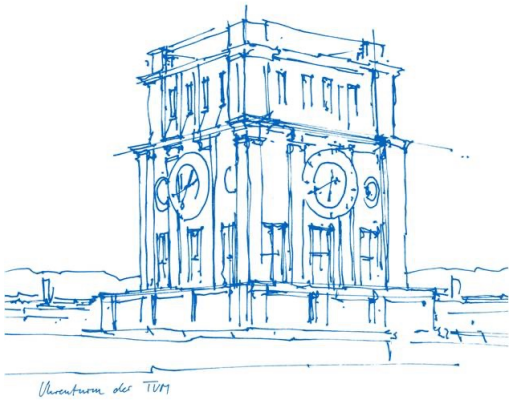
September 8, 2022

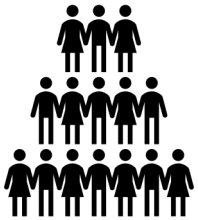


Background

Not-for-profit sport clubs are organizations that do not earn profit for their owners; all the profit goes back into running the organization (Heaslip 2021).

Performance of not-for-profit sport clubs is multidimensional

(Nowy, Wicker, Feiler, & Breuer, 2015; Winand, Vos, Claessens, Thibaut, & Scheerder, 2014).



Member Relationship

Service Quality

Financial Stability

Sporting Success

Literature Review

Factors associated with performance of not-for-profit sport clubs

Previous literature identifies multiple sets of factors, but often assumes linearity and monotony between variables (e.g., Nowy, Wicker, Feiler, & Breuer, 2015; Ivašković, 2021; Delshab et al., 2022).

- Strategic focus set
- Environmental set
- HR management practices and HR capital set
- Feelings and behavioral patterns set (e.g., trust)

Koenigstorfer and Wemmer (2019):

- Utilized nonlinear assumptions with random-forest analyses
- Focused on the performance of member relationship management
- Revealed non-linear relationships: 7 out of 10 most important predictors
- Considered 284 sport clubs from the Southwest of Germany

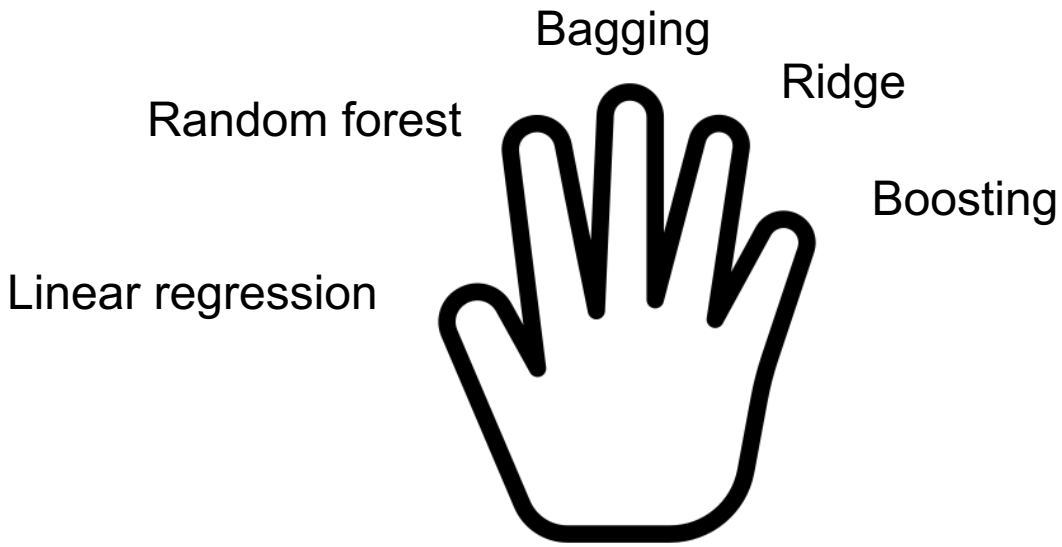
Research Gap and Aims

Research Gap

What is the best-performing model related to performance?

Research Aims

To assess how well different machine learning-based approaches perform in explaining the four key areas of performance of not-for-profit sport clubs



Sample

Procedure

- **Design:** Cross-sectional survey
- **Sample:** Not-for-profit sport clubs in Canada

Representative characteristics

- ***N*:** 126 representatives
- **Age:** 46 (*SD* 10) years old
- **Gender:** 40% female
- **Tenure:** 10 (*SD* 9) years
- **Role:** 47% in the leading roles

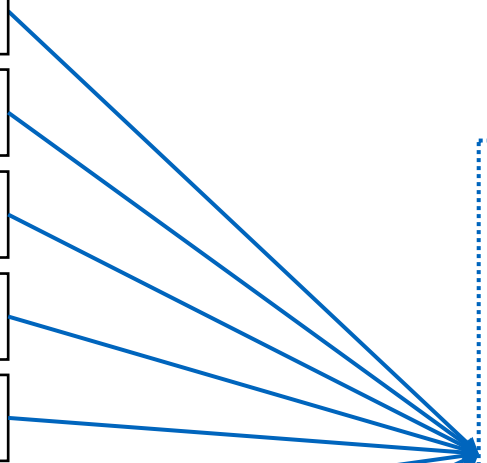
Club characteristics

- **Members:** 1206 (*SD* 3581)
- **Volunteers:** 169 (*SD* 507)
- **Types:** 82.5% uni-sport

Variables

Predictors

- Use of outside knowledge
- Trust
- Bureaucratic leadership
- Visionary leadership
- Innovation implementations
- Human resource practices
- Competition with:
  - Not-for-profit providers in sport
  - For-profit providers in sport
  - Providers outside the sports domain
- Controlling for:
  - Age; gender; role; tenure
  - Members (number)
  - Volunteers (number)
  - Type of club



Response variables

- Member relationship
- Service quality
- Financial stability
- Sporting success

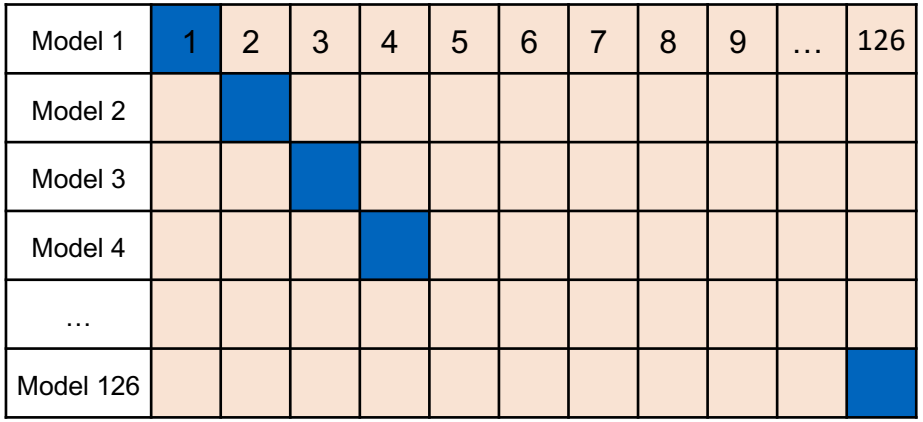
Measures: adapted from Homburg & Pflesser, 2000; Sashkin & Sashkin, 2003; Wemmer, Emrich, & Koenigstorfer, 2016.
Reliability and validity: All scales fulfilled the common requirements.

Modelling

Machine learning algorithms

- Ridge Regression
- Gradient Boosting Machine
- Bagging
- Random Forest
- Linear Regression (OLS)

Leave-one-out cross validation



Model performance evaluation

- Root Mean Squared Error (RMSE)
- R^2
- Mean Absolute Error (MAE)

Model Performance

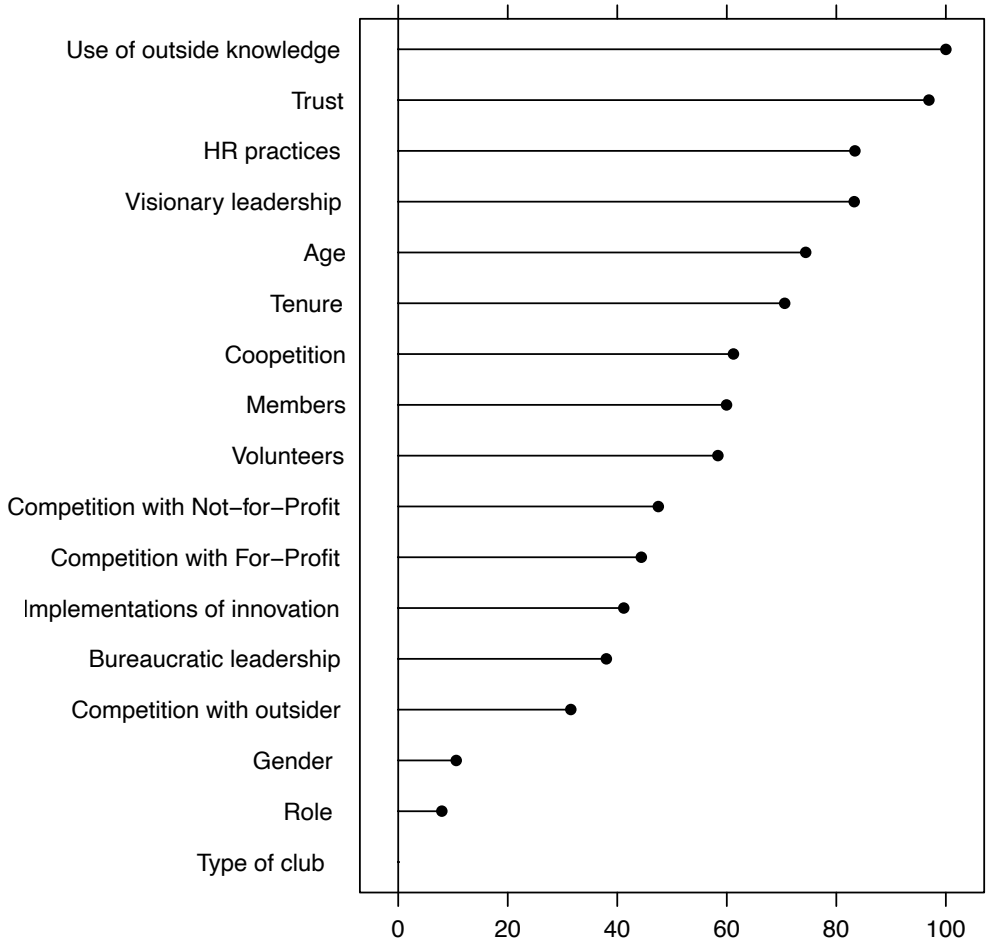
	Member Relationship			Service Quality			Financial Stability			Sporting Success		
	RMSE	R^2	MAE	RMSE	R^2	MAE	RMSE	R^2	MAE	RMSE	R^2	MAE
OLS	1.10	0.13	0.84	0.94	0.22	0.74	1.30	0.03	0.99	1.05	0.03	0.84
Ridge	1.06	**0.18**	0.91	0.91	0.24	0.71	1.22	0.04	**0.93**	0.99	0.04	0.80
Bagging	1.07	0.14	0.83	0.90	0.25	0.69	1.20	**0.08**	0.94	0.97	0.07	0.79
RF	**1.05**	0.17	0.82	**0.88**	**0.29**	**0.67**	**1.19**	0.07	0.95	**0.94**	**0.11**	**0.77**
GBM	1.08	0.14	**0.81**	0.91	0.24	0.69	1.20	0.07	0.94	0.97	0.08	0.78

Note. GBM: gradient boosting machine; OLS: Ordinary Least Squares; RF: Random Forest
MAE: Mean Absolute Error; RMSE: Root Mean Squared Error

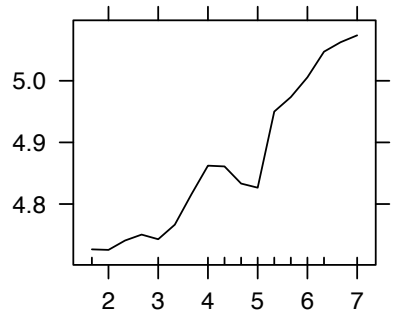
Random forest mostly outperforms the other models

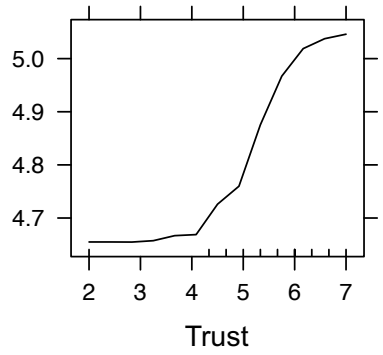
Robustness check: Seemingly unrelated regression, which jointly modeled the four domains, yields almost identical results compared to OLS.

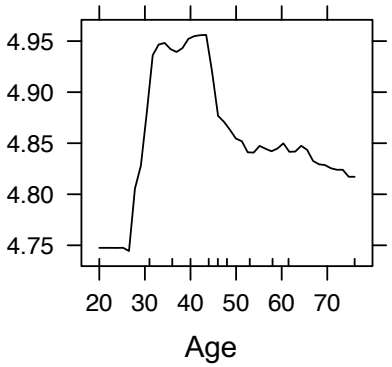
Member Relationship

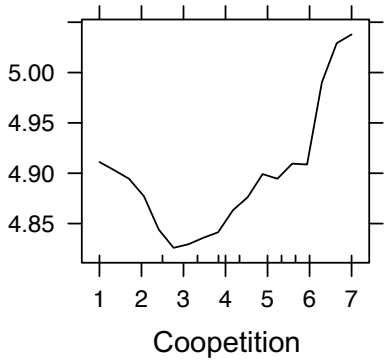


Variable Importance





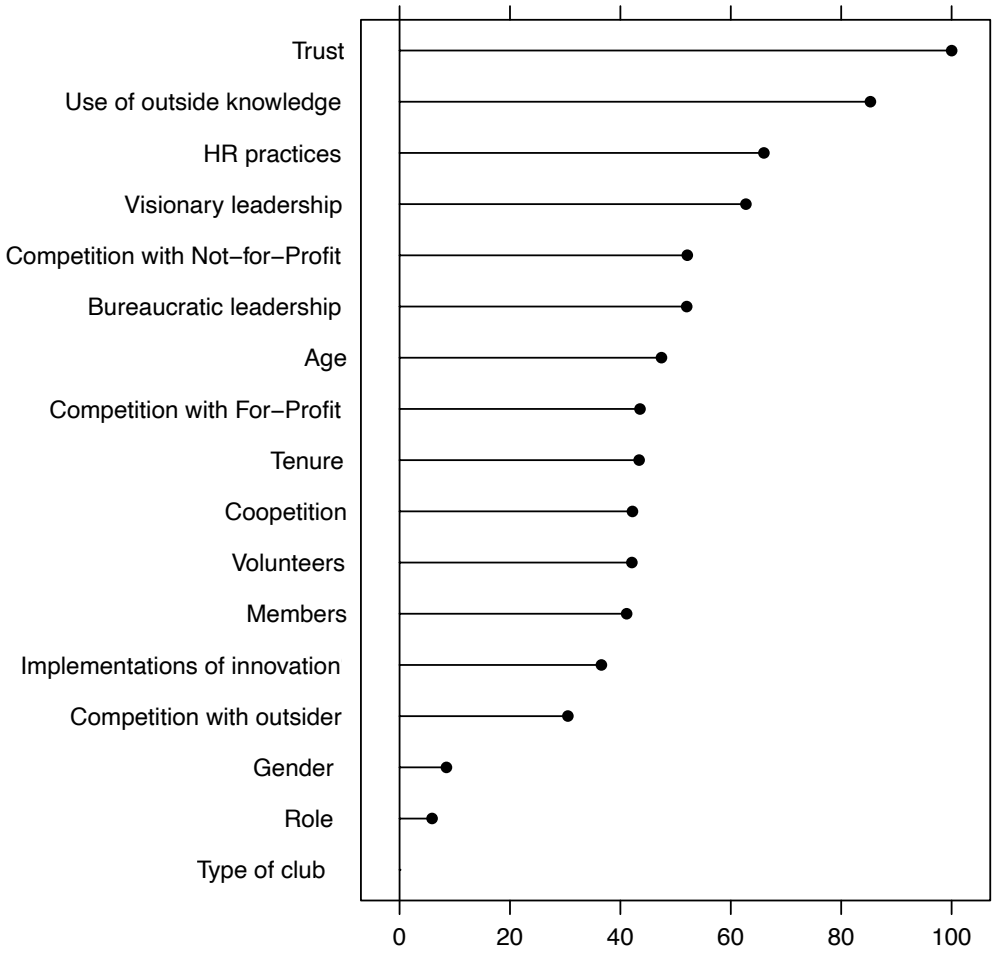




Partial Dependence

Variable importance: The percentage increase in mean squared error, scaled to be between 0 and 100.
Partial dependence: X-axis: the original unit of the predictor variable. Y-axis: marginal effect of the predictor variable on the response variable.

Service Quality



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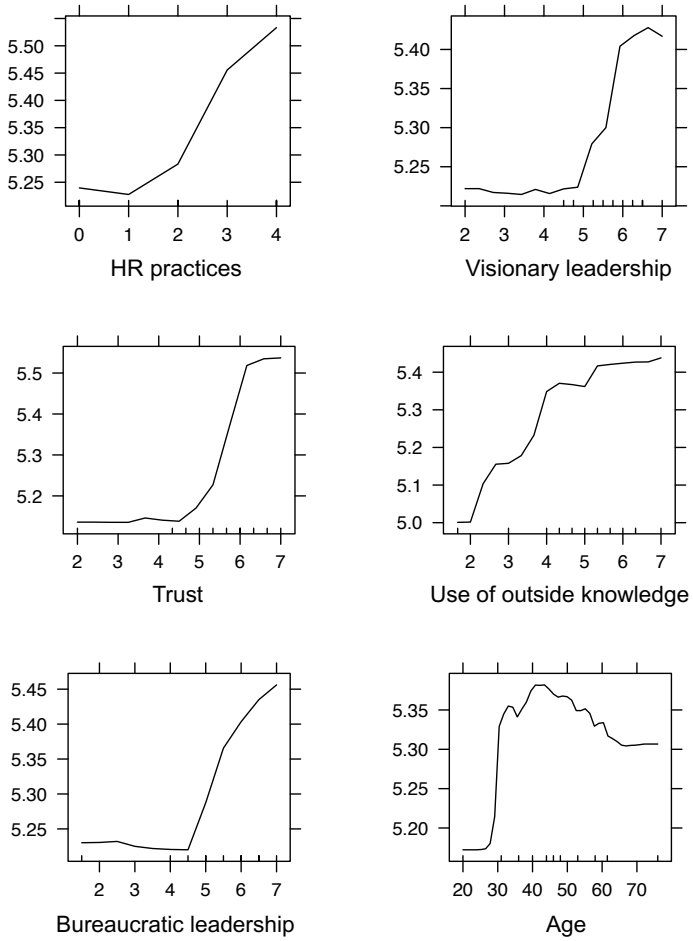

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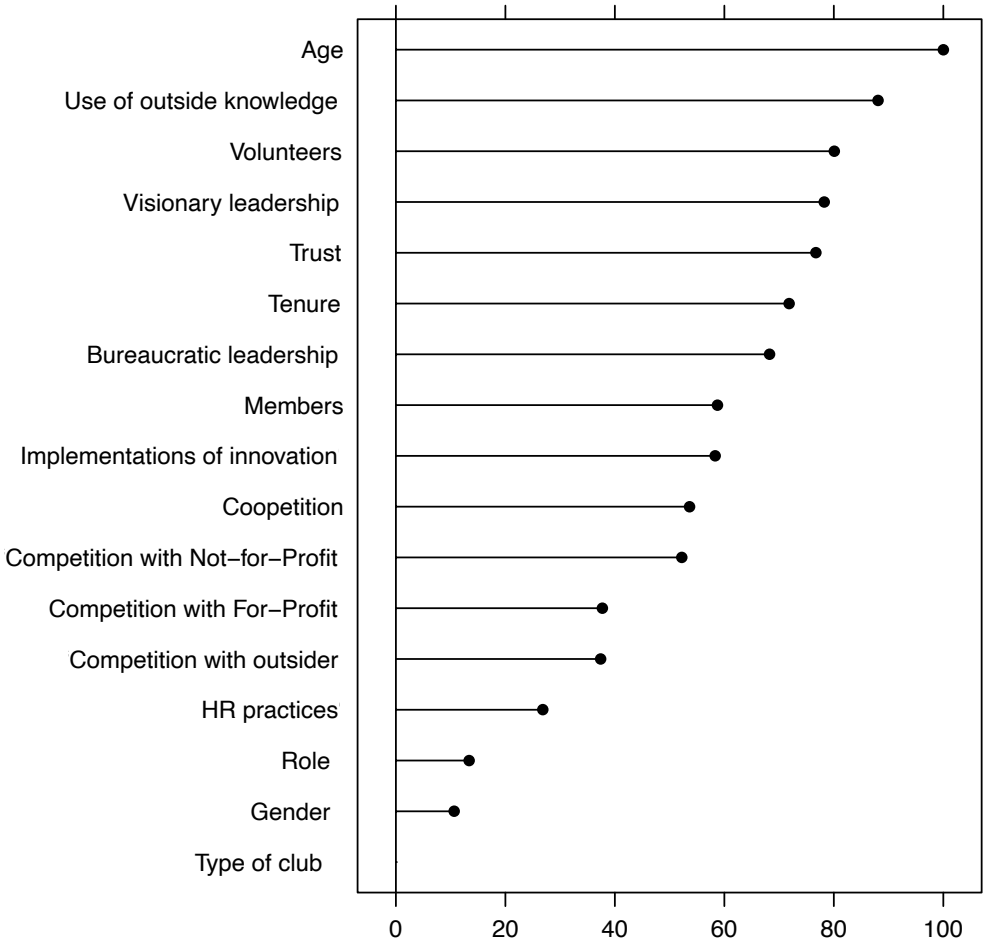
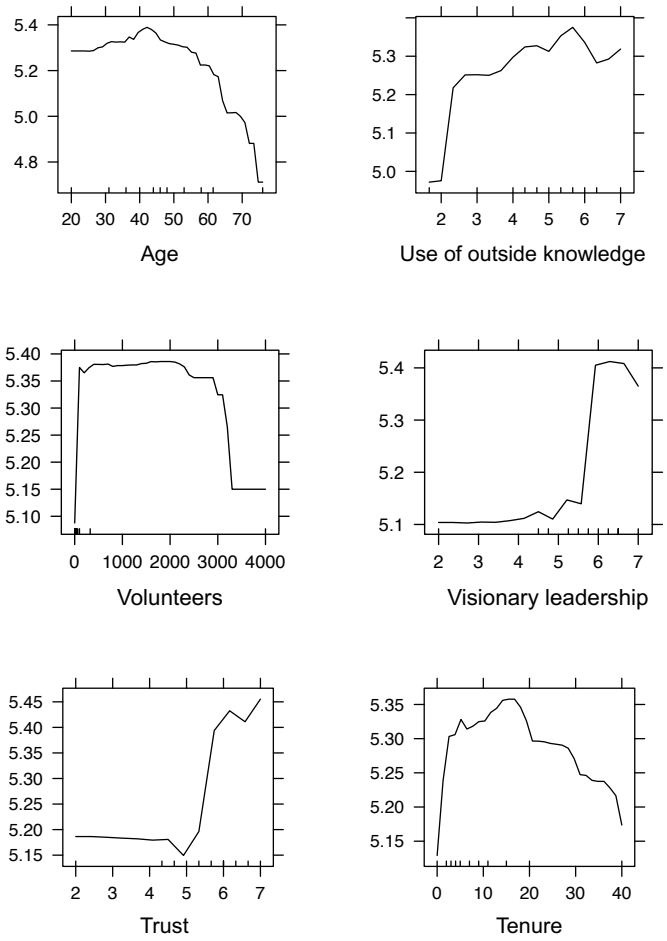
Financial Stability



Variable Importance



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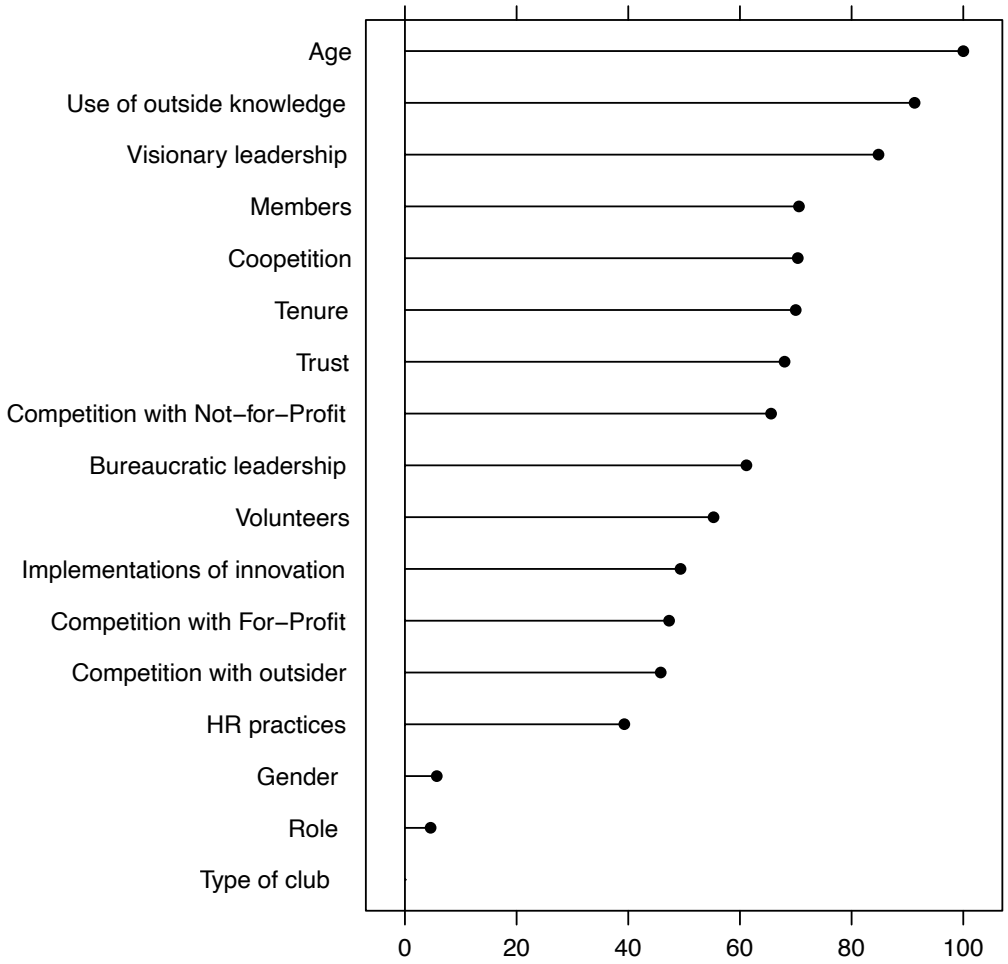
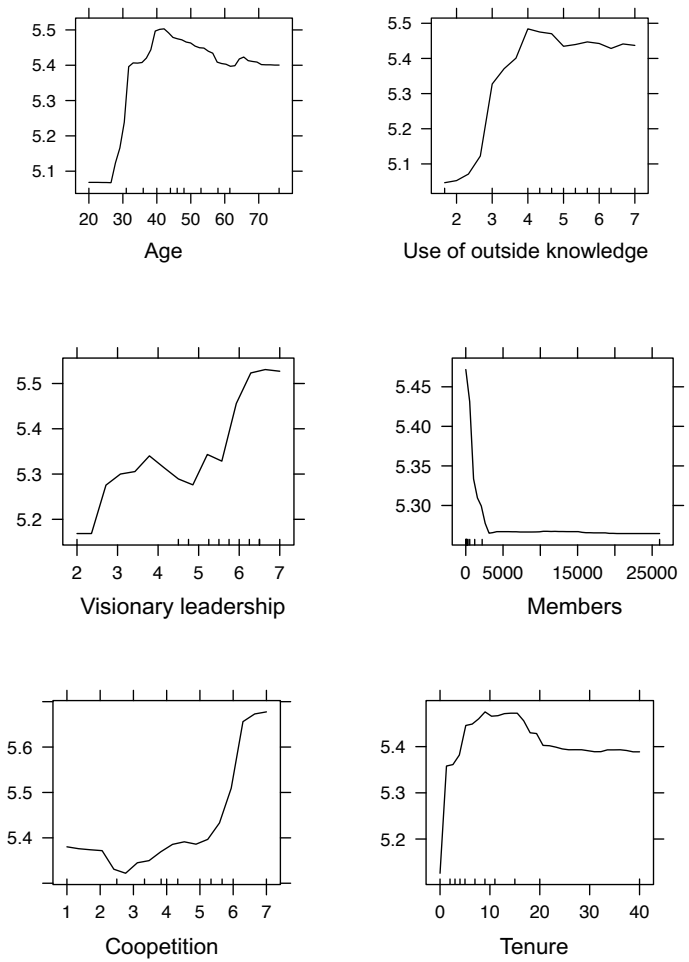
Sporting Success



Variable Importance



Partial Dependence

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Contributions and Limitations

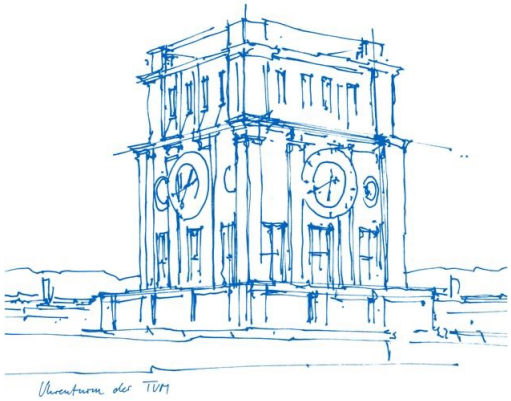
Contributions

- Theoretical: Insights into the most important factors that are associated with the four key areas of performance of not-for-profit sport clubs
- Methodological: Using advanced machine learning approaches helps improve the explanatory power compared to linear models, and identifies non-monotonous relationships
- Practical: Implications for sport club managers on how to increase performance in different domains

Limitations

- Sample
- Subjective measure of performance

Thank you very much for your feedback!



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