Guest editorial: Sports management research using partial least squares structural equation modeling (PLS-SEM)

The development of PLS-SEM into a standard method in management research

Wold (1982) developed the method of partial least squares structural equation modeling (PLS-SEM) (also see Jöreskog and Wold, 1982b, c). Lohmöller (1989) extended the initial method and prepared the first software (LVPLS; see Lohmöller, 1984, 1987). The dissemination of PLS-SEM started with the publication of tutorials by Barclay *et al.* (1995), Chin (1998) and Tenenhaus *et al.* (2005), as well as the availability of PLSGraph (Chin, 2003), the first software package that included a graphical user interface for Lohmöller's LVPLS program.

In the last decade, PLS-SEM has become an integral part of the methodological toolbox of economists, sociologists and several other social science disciplines. This is not only evidenced by the exponentially increased use of PLS-SEM in research articles (Hair *et al.*, 2022, Preface) but also by dedicated chapters on PLS-SEM in main methods textbooks (e.g. Hair *et al.*, 2019a) and handbooks (e.g. Sarstedt *et al.*, 2021b). Several review articles on the use of PLS-SEM (Table 1), special issues (Table 2) in different disciplines and dissemination of research networks (Khan *et al.*, 2019) echo this finding. The publication of textbooks (e.g. Garson, 2016; Hair *et al.*, 2018, 2022; Ramayah *et al.*, 2018; Wong, 2013) and "how to" articles (e.g. Cepeda-Carrión *et al.*, 2019; Hair *et al.*, 2011a, 2019b; Roldán and Sánchez-Franco, 2012) on PLS-SEM further contributed to the method's spread, as well as the availability of R software packages, like cSEM (Rademaker and Schuberth, 2020) and SEMinR (Hair *et al.*, 2021b; Ray *et al.*, 2021) and GUI-based standalone software programs, like PLSGraph (Chin, 2003) and SmartPLS (Ringle *et al.*, 2005, 2015). Of these applications, SmartPLS is particularly popular among users due to its ease of use and functionality (Memon *et al.*, 2021; Sarstedt and Cheah, 2019).

In the early phase of PLS-SEM, much of the discussion focused on comparisons with covariance-based SEM (CB-SEM). However, CB-SEM and PLS-SEM are different statistical methods, and the algorithms are designed to achieve different research objectives (Jöreskog and Wold, 1982a; Lohmöller, 1989). Their results also differ (Rigdon, 2012; Sarstedt *et al.*, 2016), and each method is known for its unique modeling capabilities (Rigdon *et al.*, 2014, 2017).

The two approaches should therefore be viewed as complementary rather than competitive. CB-SEM is particularly useful when the research objective is to test the theoretically established model structure as a whole (i.e. how well the model-implied covariance matrix fits the covariance matrix of the data sample). In contrast, PLS-SEM aims to minimize the residuals of the measurement models as well as the structural model. PLS-SEM therefore excels when the focus is on prediction-oriented research and is particularly useful when the goal is to identify the sources of competitive advantage and in success factor research (Albers, 2010; Sarstedt *et al.*, 2021b).

The choice between CB-SEM and PLS-SEM should also consider the type of model to be estimated. This is the position of Rigdon *et al.* (2017) when they state: "Our third recommendation is that researchers use a technique that is consistent with the type of model that they intend to estimate – in other words, that they correctly estimate their chosen model. There has been a tendency in the literature to treat CB-SEM and PLS-SEM as if they were

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Table 1.
Examples of PLS-SEM review articles in different disciplines

Disciplines	References
Accounting	Lee *et al.* (2011), Nitzl (2016), Nitzl and Chin (2017)
Engineering management	Purwanto (2021), Zeng *et al.* (2021)
Entrepreneurship	Manley *et al.* (2020)
Family business	Hair *et al.* (2020a), Sarstedt *et al.* (2014b)
Higher education and e-learning	Ghasemy *et al.* (2020), Lin *et al.* (2020)
Hospitality and tourism	Ali *et al.* (2018), do Valle and Assaker (2016), Usakli and Kucukergin (2018)
Human resources management	Ringle *et al.* (2020)
International business research	Richter *et al.* (2016b)
Management	Cepeda-Carrión *et al.* (2019), Hair *et al.* (2012b)
Management information systems	Hair *et al.* (2017), Ringle *et al.* (2012)
Marketing	Hair *et al.* (2012c)
Operations management	Bayonne *et al.* (2020), Peng and Lai (2012)
Psychology	Willaby *et al.* (2015)
Software engineering	Russo and Stol (2021)
Supply chain management	Kaufmann and Gaeckler (2015)

Table 2.
Examples of PLS-SEM special issues

Journals	References
European business review	Hair *et al.* (2021a)
Behaviormetrika	Sarstedt and Hwang (2020)
Industrial management and data systems	Henseler (2016), Shiau *et al.* (2020)
Internet research	Shiau *et al.* (2019)
Journal of hospitality and tourism technology	Rasoolimanesh and Ali (2018)
Quality and quantity	Henseler (2018)
European management journal	Richter *et al.* (2016a)
Journal of business research	Cepeda-Carrión *et al.* (2016)
Long range planning	Hair *et al.* (2021a, 2012a, 2013), Sarstedt *et al.* (2014a)
Journal of marketing theory and practice	Hair *et al.* (2011b)

estimating the same model. They are not. Researchers who intend to estimate a factor model should use CB-SEM, while researchers intending to estimate a model of composites should use a composite-based method like PLS-SEM" (p. 12).

While model fit criteria have been proposed for PLS-SEM (e.g. Dijkstra and Henseler, 2015; Lohmöller, 1989; Tenenhaus *et al.*, 2005), out-of-sample prediction-oriented assessment criteria (Shmueli *et al.*, 2016, 2019) as well as prediction-oriented model comparison approaches (Liengaard *et al.*, 2021; Sharma *et al.*, 2019) are more relevant to the application and interpretation of PLS-SEM (Hair *et al.*, 2019c). PLS-SEM is therefore uniquely designed to confirm the predictive power of models (Hair, 2021). These types of analyses enable PLS-SEM users to substantiate management recommendations in research papers (Hair and Sarstedt, 2021; Sarstedt *et al.*, 2021b). They also facilitate importance–performance map analysis (IPMA) with PLS-SEM, supporting managerial implications discussions based on these analyses (Hair *et al.*, 2018; Ringle and Sarstedt, 2016).

Sports management is a particularly appropriate discipline for exploring applications of PLS-SEM to improve our understanding of increasingly complex theoretical models (Cepeda-Carrión and Cepeda-Carrion, 2018; Engelberg *et al.*, 2012; Howat and Assaker, 2013). In addition to methodological support to identify success factors and sources of competitive advantage, sports management researchers can simultaneously estimate complex interrelationships. This

involves various constructs and indicators, including direct, indirect and moderating relationships, as well as moderated mediation that would otherwise be quite difficult and perhaps impossible to examine and disentangle. This includes, for example, confirmation of measurement models (Hair *et al.*, 2020b), control variables (Hair *et al.*, 2022), endogeneity (Hult *et al.*, 2018), higher-order models (Crocetta *et al.*, 2021; Sarstedt *et al.*, 2019), mediators (Cepeda-Carrión *et al.*, 2017; Nitzl *et al.*, 2016; Rasoolimanesh *et al.*, 2021b; Sarstedt *et al.*, 2020a), observed heterogeneity, including moderation (Fassott *et al.*, 2016; Memon *et al.*, 2019), multigroup analysis (MGA) (Chin and Dibbern, 2010; Klesel *et al.*, 2019; Matthews, 2017) and measurement model invariance (Henseler *et al.*, 2016).

The emergence of more complex modeling requirements goes hand-in-hand with (and confirms) the critical importance of advanced analytical methods and robustness checks (Sarstedt *et al.*, 2020b). These include confirmatory tetrad analysis to empirically assess the mode of measurement (Gudergan *et al.*, 2008), necessary condition analysis (NCA) and fuzzy set qualitative confirmatory analysis to support theoretically established relationships in the structural model (Rasoolimanesh *et al.*, 2021a; Richter *et al.*, 2020), nonlinear relationships (Basco *et al.*, 2021), finite mixture and prediction-oriented segmentation analysis to identify and treat unobserved heterogeneity (Becker *et al.*, 2013; Hair *et al.*, 2016; Sarstedt *et al.*, 2017, 2021a) and many other advances in composite-based SEM (for an overview, see Hair *et al.*, 2022).

This special issue on PLS-SEM in sports management highlights the method and its usefulness to the discipline via applications and empirical analysis. It has 11 articles.

Contents of the special issue

The article on "*Antecedents of the attitude toward the athlete celebrities' human brand extensions*" by Jakeun Koo looks at how effective athlete brand extensions for nonsport products are at influencing consumer responses. In this study, a celebrity athlete is viewed as a human brand. The study examines how consumers evaluate the extended human brands of celebrity athletes beyond their unique brand personality associated with sports. To respond to the objective of the study, 198 participants took part in an online survey. With PLS-SEM, the researcher used exogenous variables (athlete-product fit, attitude toward the athlete and athletes' expertise) to explain the variance of endogenous variables (image transfer and attitude toward the extension). The results suggest that some brand extension principles can be applied to human brands to better understand the efficacy of athlete brand extensions for nonsport items.

In the article on "*Effects of athletic performance and marketable lifestyle on consumers' engagement with sport celebrity's social media and their endorsements,*" Alcina Gaspar Ferreira, Cátia Fernandes Crespo and Cédric Mendes evaluate the influence of sports celebrities' image on consumers' engagement with them on social media and their endorsed brands. In this study, a final sample of 329 valid responses was drawn from an online survey of adult Portuguese consumers. Using PLS-SEM, the authors assessed both the measurement and structural model. They also analyzed the effects of moderation and mediation, while an MGA was applied to ascertain significant differences between groups determined by age and gender. They found that the incentive to participate in the social media platforms of sports celebrities is mainly associated with a marketable lifestyle. In turn, sports celebrities who are active on social media can increase consumer engagement with endorsed brands. This effect is favorably moderated by the perceived level of congruence between an athlete and an endorsed brand. Finally, an MGA revealed no significant differences in terms of gender or age.

The article titled "*Exploring the drivers and consequences of the 'awe' emotion in outdoor sports – a study using the latest partial least squares structural equation modeling technique*

and necessary condition analysis" by Yide Liu, Cheng Yu and Svenja Damberg examines the effects of awe on participant satisfaction and behavioral intention considering the perceived vastness of the natural environment, perceived professionalism and congruence of self-image as drivers. Yide *et al.* devised and empirically verified a research model based on 480 responses from a Chinese survey. Using a combination of PLS-SEM and NCA, the effect of awe is investigated from the perspectives of both sufficiency and necessity logic. This research is the first to examine the role of awe in outdoor sports. Furthermore, it establishes a methodological framework for combining PLS-SEM and NCA in sports management research by identifying awe's essential and sufficient effects on outdoor sports participants' postexperience appraisal.

The article on "*Antecedents of satisfaction and loyalty in different spectator tribes in a football context*" by Giuseppe Lamberti, Rialp Josep and Alexandra Simon examines how image and service quality influence spectator tribal satisfaction and loyalty, as well as behavior differences based on age, gender and emotional involvement, in a football environment. Using a sample of 363 spectators who attended Barcelona Football Club Camp Nou stadium during the 2017/2018 season, this study used PLS-SEM to analyze the proposed measurement and structural model. The authors applied a new hybrid multigroup that allowed them to combine classical MGA with PATHMOX analysis. The study shows how image and service quality influence spectator satisfaction and loyalty, and how satisfaction and loyalty are related to three groups: nonpassionate, younger and older passionate tribes.

In the article with the title "*Impact of market demand on recurring hallmark sporting event spectators: An empirical study of the Shanghai Masters*," Lei Luo, Yizhou Qian, Gregg Rich and James J. Zhang identify core and peripheral market demand for a recurring hallmark sporting event and to assess the effect on event identification and behavioral intentions. They also examine the effect of the core and peripheral market demand on event identification among first-time and repeat spectators. Using a sample of 540 spectators at the Shanghai Masters, the authors used PLS-SEM and PLS MGA to assess the model and test their hypotheses. In addition, $PLS_{predict}$ was applied to evaluate the model's predictive performance. Core market demand is a significant predictor of event identification and behavioral intentions. In comparison, peripheral market demand showed a substantial positive influence only on event identification. Furthermore, event identification completely mediated the links between peripheral market demand and behavioral intentions. Additionally, the influence of peripheral market demand on event identification was more considerable among first-time attendees than among repeat attendees.

The article with the title "*Motivational determinants of digital ticketing: the mediating effect of service satisfaction and the moderating effect of psychological discomfort*" by Sanghoon Kim, Ho Yeol Yu and Hyun-Woo Lee has two aims: to investigate the motivational factors influencing consumers' continuous desire to use digital ticketing via self-service technology (SST) by incorporating service satisfaction and to determine the variations among consumers based on their psychological discomfort with technology. The results show that extrinsic and intrinsic motivation is favorable predictors of the ongoing intention to use digital tickets. However, only intrinsic motivation positively impacts continued intention through service satisfaction. Furthermore, consumers with high psychological discomfort had a higher association between intrinsic motivation, service pleasure and ongoing intention than consumers with low psychological discomfort.

The article with the title "*Push–pull analysis: the mediating role of promotion types relative to visit intention to a sports museum*" by Bryan Yim, Mark Lyberger and Doori Song looks at the relationship between sports museum image, motivation, restrictions, monetary and nonmonetary promotions (as mediators), and visit intention among people who had previously visited or had never visited. This is the first study to investigate the

role of image, motivation, restraints and visit intention in the context of sports museums. Qualtrics was used to collect data from 1,607 residents in Northeast Ohio via an online survey questionnaire. Based on customers' previous visits to the Pro Football Hall of Fame (HoF) (visited group $n = 754$; never-visited group $n = 853$), two sets of data parameters were developed, and each group's monetary and nonmonetary promotion models (four models) were analyzed. IBM SPSS Statistics 26 was used to process descriptive statistics and reliability tests, while SmartPLS 3 was used to look at the structural relationships between the components. The findings show that positive perceptions of HoF have been revealed as the most important predictor of both promotions and visit (revisit) intention among all the antecedents. Regardless of the promotion, the social incentive was a powerful driver for visiting a sports museum. In addition, the impact of promotions as mediators was discovered. Cost limitations can be alleviated through monetary promotion, as represented by the monetary promotion between cost constraints and visit intention.

The article with the title "*Predicting future use intention of fitness apps among fitness app users in the United Kingdom: the role of health consciousness*" by Svenja Damberg explains the determinants of future use intention of fitness applications among users by replicating and extending the unified theory of acceptance and use of technology (UTAUT2). It adds health consciousness as a driver to current theories, which has ramifications for future studies on developing technologies in the healthcare sector and beyond. Based on a sample of 591 respondents from the United Kingdom, the author estimates the model using PLS-SEM from a causal-predictive perspective. This view leads to assessing the measurement and structural models, and the predictive relevance of the model of future app use intention using $PLS_{predict}$. To generate practical recommendations, an IPMA is also performed. The findings support the relevance of personal health consciousness and suggest that future health industry innovations could be generalized, with implications for sports marketing management theory and practice.

In the article with the title "*Will destination image drive the intention to revisit and recommend? Empirical evidence from golf tourism*", Tat-Huei Cham, Jun-Hwa Cheah, Hiram Ting and Mumtaz Ali Memon focus on golf tourism, which is the largest sports travel market among the many sports involved with sports tourism, with an expected value of US$20 bn by 2023. In the Malaysian context, they investigate the impact of country-related elements on the destination image of golf visitors and the interrelationships between perceived service quality, perceived value, satisfaction and behavioral intention. Data analysis is performed using the PLS-SEM technique with 360 golf tourists to respond to the objective. The findings show how country-related characteristics (accessibility, safety and security, and golf course setup) influence Malaysia's image as a golf tourism destination. The moderation assessment reveals that enthusiasm for golf in Malaysia improves the link between satisfaction and behavior intention. This is one of the few studies that look at the value of destination image in the context of golf tourism.

In the article on "*Predicting consumers' intention to purchase eco-friendly athletic wear in a moderated model of individual green values and gender*", Nisar Ahmed Channa, Beenish Tariq, Altaf Hussain Samo, Niaz Hussain Ghumro and Naveed Akhtar Qureshi examine the effect of environmental factors (environmental attitude, environmental concerns, perceived environmental responsibility and peer influence) on consumers' intention to purchase eco-friendly athletic wear. With this aim in mind, the authors use three theoretical frames: organismic integration theory (OIT), the theory of values–belief–norm (VBN) and gender schema theory (GST). PLS-SEM was used to analyze data from a final sample of shoppers of eco-friendly athletic wear from four cities in Pakistan. Moderating effects were assessed using interaction term generation and MGA, while the model's predictive performance was evaluated using $PLS_{predict}$. All antecedent variables are positively associated with green purchase

behavior. On the other hand, the authors find that some of the hypothesized moderating effects of individual green values and gender are significant.

The article with the title "*A social epidemiological perspective on local tennis league participation: A multigroup mediation structural analysis using PLS-SEM*" by Amy Kim, James Du and Jeff James addresses the social context incorporated into explanations of one's health condition in social epidemiology. Based on the participants' level of involvement in the tennis league, the authors investigate the linkages between individuals' feeling of community generated by participation in local sports leagues, social support and health-related psychological effects. Participants came from 150 tennis leagues in the southeastern USA. They used component-based PLS-SEM with SmartPLS 3 to examine the proposed multigroup moderated-mediation structural model. The results of the multigroup study reveal that the association between social support and happiness differs significantly between the least involved and more involved groups. The findings suggest that people can improve their sense of community, social support and health-related psychological outcomes by participating in local sports leagues.

Concluding observations

As evident from this brief overview of recent methodological developments in PLS-SEM and the application articles in this special issue, measuring and assessing issues in sports management is a thriving and ongoing effort among scholars in this discipline. At the same time, we cannot forget that the field of sports management is increasingly exploring more complex theoretical models, as are other social science disciplines. Sports management scholars therefore need to continue to update their research designs and methodological tools. We are confident that the articles in this special issue will trigger significant interest in sports management methods and emerging applications and will stimulate interesting follow-up research.

We would like to thank the editor of the *International Journal of Sports Marketing and Sponsorship*, James J. Zhang, for allowing us to edit this special issue. It was a long and arduous process for everyone, including the authors who stuck with us through numerous revision rounds. We thank the reviewers who assisted us in selecting the articles most likely to contribute to the sports management discipline, without whom this special issue would not have been possible. Many scholars cooperated to enable what we are confident is a decisive contribution to understanding the field of sports management, particularly the emerging application opportunities for the PLS-SEM composite-based analytical method.

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