The use of partial least squares structural equation modeling and complementary methods in international management research

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Abstract: Research in international business and management (IM) is highly complex, contextual, and spans various subfields and related theoretical lenses. These characteristics pose research challenges that require utilizing sophisticated research designs and methodologies. This paper and our focused issue on 'The use of partial least squares structural equation modeling (PLS-SEM) and complementary methods in IM research' further clarify whether and how researchers using PLS-SEM can address (some of) the challenges in IM research. We explain how researchers can benefit from the (advanced) capabilities that PLS-SEM offers; either as a stand-alone method or in triangulation efforts that leverage complementary approaches. In addition, we review the IM literature for PLS-SEM applications and evaluate whether and how researchers are already using these approaches. We identify some room for improvement when it comes to the application of both more advanced PLS-SEM capabilities and the triangulation of PLS-SEM with qualitative data analyses, and techniques such as fuzzy set qualitative comparative analyses and necessary condition analyses. We offer advice on illustrative applications of each of the above.

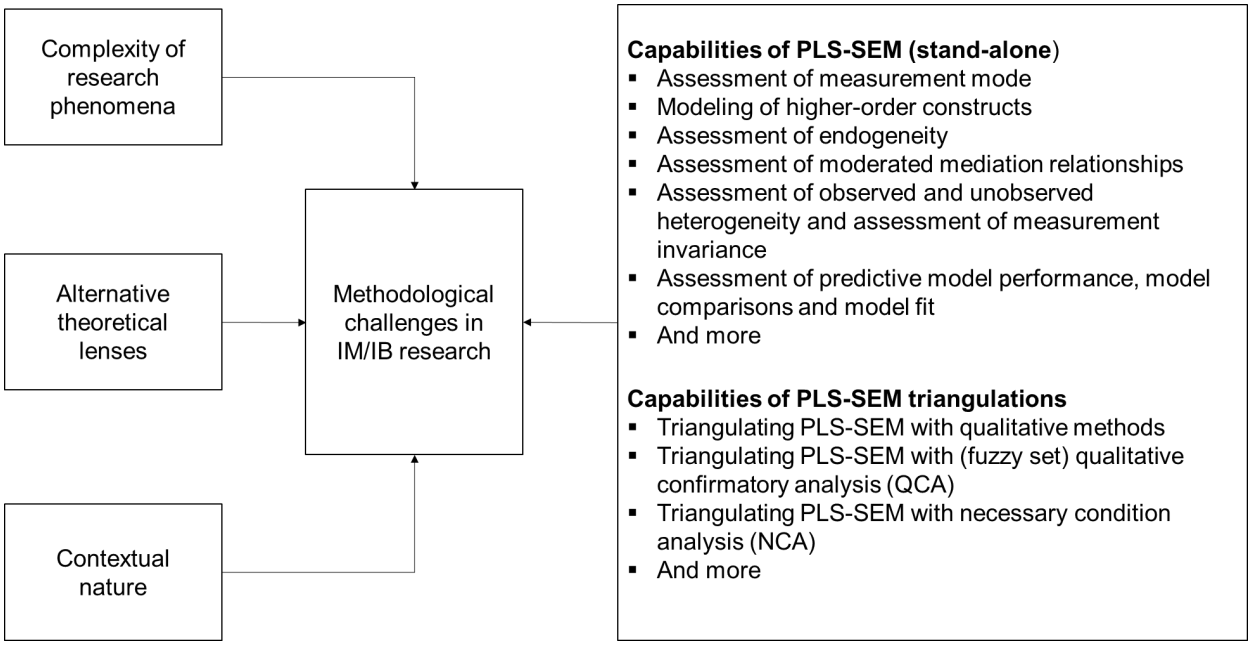
1. Introduction

Research in international business and management (IM) has its inherent challenges that, in turn, demand the application of fitting analytical methods. First, it is characterized by high complexity, which emerges from, among other factors, cross-border and cross-cultural relationships and differences in international environments, organizations and individuals under study (e.g., Cuervo-Cazurra et al., 2016; Eden & Nielsen, 2020). Second, it spans various subfields, such as economics, strategy and organizational behavior, and most theories draw on these subfields and are not unique to IM. As a result, a unified understanding is often missing, and it is not uncommon that research draws on different theoretical lenses to study the same phenomena. Accordingly, conducting research that advances theorizing and the development of overarching theories that uniquely clarify IM phenomena remains a crucial challenge (e.g., Knight et al., 2022; Oesterle & Wolf, 2011; Seno-Alday, 2010). Third, to ensure relevance IM research must be contextualized. That is, researchers face the challenge of contextualizing general (abstract) theoretical knowledge to particular IM settings, such as different institutional environments or cultures or to demonstrate that their findings and theories are context-free (e.g., Meyer, 2013; Tsui, 2007).

Selecting and applying analytical methods, therefore, must fit the complexity of the IM phenomena studied, enable development or refinement of IM theory and assessment of alternative theoretical lenses, and allow accounting for the contextual specifics that define IM phenomena. In light of such challenges, recent IM literature attests to the requirement of utilizing more sophisticated research designs and methodologies. For instance, proposed solutions revolve around the need to apply analytical techniques that allow testing

of alternative theoretical models and explanations, and to leverage method triangulation to name a few (e.g., Aguinis et al., 2020; Cuervo-Cazurra et al., 2017; Eden & Nielsen, 2020; Fainshmidt et al., 2020; Knight et al., 2022; Nielsen et al., 2020; Richter & Hauff, 2022).

Figure 1: Challenges in IM research and fitting applications of PLS-SEM



Our purpose is not to repeat the solutions already proposed, but to further clarify whether and how researchers using partial least-squares structural equation modeling (PLS-SEM) can address (some of) the challenges in IM research (see Figure 1). We explain how research in IM can benefit from the capabilities that PLS-SEM offers; either as a stand-alone method or in triangulation efforts that leverage complementary approaches. While we provide a broad overview that serves as a foundation, we specifically outline opportunities to complement PLS-SEM research designs with qualitative data analyses (see Sinkovics et al., 2022 in this focused issue) and techniques such as fuzzy set qualitative

comparative analyses (see Zhang et al., 2022 in this focused issue) and necessary condition analyses (see Bolívar et al., 2022 in this focused issue). In addition, we refer to important PLS-SEM capabilities that allow IM researchers to deal with some of the challenges they face in conducting their research. We will elaborate on recent advancements in PLS-SEM to test and compare alternative models using model fit criteria (see Cho et al., 2022 in this focused issue), and to assess complex relationships like moderated mediation (see Fredrich et al., 2022 in this focused issue).

2. Capabilities of PLS-SEM and their use in IM

IM has a long history of using structural equation models (e.g., Hult et al., 2006). In recent years, IM researchers increasingly appreciated the use of PLS-SEM, and there is further potential in the method that can be tapped by researchers in the field (Richter, Cepeda Carrión, et al., 2016; Richter, Sinkovics, et al., 2016).

PLS-SEM went through a quite typical “method life-cycle” (Bergh et al., 2022) from its invention in the 1980s to today: Wold (1982) developed PLS-SEM, which Lohmöller (1989) further extended. In the early phase of PLS-SEM, much of the discussion focused on comparisons with the statistically different covariance-based SEM (CB-SEM) approach (Sarstedt et al., 2016). Over time, PLS-SEM has emancipated itself from CB-SEM (Rigdon, 2012, 2014; Sarstedt et al., 2014). Today, in line with the early ideas of Jöreskog and Wold (1982), who have introduced both CB-SEM and PLS-SEM, the two methods are seen as complementary rather than competing (Rigdon et al., 2017). PLS-SEM is acknowledged as being suited for identifying important explanators in models (e.g., sources of competitive advantage) and for predictive research since the method aims to reduce (improve) the residuals (explanation) of dependent indicators and constructs in the

model (Dash & Paul, 2021; Richter, Cepeda Carrión, et al., 2016). It has become a well-established method that is used in a variety of disciplines (Hair et al., 2022). The publications of textbooks (e.g., Hair et al., 2018; Ramayah et al., 2018) and "how to" articles (e.g., Cheah et al., 2021; Hair et al., 2019), several review articles on the use of the method and special issues in different disciplines (see Table 1.1 in Hair et al., 2021), and impactful research networks (Khan et al., 2019; Rüdiger et al., 2021) have contributed significantly to the awareness and dissemination of PLS-SEM. Its adoption has also been triggered by the availability of open-source packages in the statistical software R (such as cSEM, matrixpls and SEMinR) and various commercial applications such as WarpPLS, XLSTAT, and SmartPLS which is particularly popular among users due to its ease-of-use (Memon et al., 2021; Sarstedt & Cheah, 2019).

PLS-SEM is moreover still profiting from advancements (e.g., predictive model assessment in PLS-SEM; Sharma et al., 2022; Shmueli et al., 2019) put forward by a dynamic field of researchers who are enthusiastic about the method (see also Sarstedt, Hair, et al., 2022 who provide an overview of advances in PLS-SEM). For researchers in IM and other disciplines who are users rather than developers of research methods, it can be difficult to keep pace with these constant advancements and to keep abreast of the potential benefits that these may bring to their discipline. To bridge this gap in knowledge transfer, we will discuss selected advanced capabilities of PLS-SEM and outline their value for IM researchers more specifically (see Table 1).

Table 1: Selected capabilities of PLS-SEM and illustrative main areas of use

Description	Illustrative main areas of use
Assessment of measurement mode	
Confirmatory tetrad analysis for PLS-SEM (CTA-PLS) (Gudergan et al., 2008; Hair et al., 2018) allows empirically assessing whether data support a formative or a reflective measurement model specification. In a formative measurement model the indicator variables cause the construct. In a reflective measurement model, the indicators are consequences of the construct, are often highly correlated and mutually interchangeable (Jarvis et al., 2003; Rossiter, 2002). Essentially, CTA-PLS enables researchers to empirically assess whether a measurement model specification that has been selected based on theoretical grounds is supported by the data (Rigdon, 2005). Rahman et al. (2022) provide a recent illustrative CTA-PLS application.	Most constructs in IM research are multidimensional, such as export performance, cultural intelligence, global standardization, to name a few. Therewith, the researcher needs to specify whether they are to be measured formatively or reflectively. While some constructs may have a dominant conceptualization (e.g., cultural intelligence), there are constructs for which both approaches can be and are used. CTA-PLS can confirm the empirical suitability of a reflective measurement model specification. If this analysis disconfirms the suitability of a reflective measurement model, it offers support for a formative measurement model specification. Preventing measurement model misspecification is a vital concern in empirical studies as incorrectly applying a formative or reflective mode can yield incorrect findings (e.g., Jarvis et al., 2003). In IM, Aguinis et al. (2020) find that in 73% of studies reviewed deficient measurements were a challenge. Researchers in IM started to more carefully discuss their measurement models (e.g., Sarstedt et al., 2013), but our review reveals that CTA-PLS is not yet part of the standard analytical toolset in the field.
Modeling higher-order constructs (also called hierarchical component models)	
In PLS-SEM different types of higher-order constructs can easily be modelled and tested (Hair et al., 2018; Sarstedt et al., 2019). A higher order construct represents a more general construct, measured at a higher level of abstraction (e.g., a human resource management system to integrate migrant workers), while simultaneously including its subcomponents, which cover the more concrete aspects of the higher order concept (e.g., human resource management domains that form the system). An illustrative example is found in Richter and Hauff (2021).	To address the high complexity of theories and cause-effect models in IM, researchers can benefit from higher-order constructs, as these allow the simultaneous modeling of both the higher order construct and its subcomponents. Therewith they enable more parsimonious research models, while at the same time enable the in-depth insights into special aspects involved in more comprehensive constructs. In IM, researchers often face concepts that are complex and need to be operationalized at higher levels of abstraction. Examples of complex concepts that have been modeled as higher-order constructs in PLS-SEM studies include international performance (e.g., Acosta et al., 2018), innovation capacity (e.g., Oura et al., 2016) and strategy, and environment (e.g., Chung et al., 2012). Overall, our review indicates that higher order constructs are well in use by researchers in the field.

Assessment of endogeneity

Endogeneity has more recently found its way into the discussion in PLS-SEM and authors developed a systematic procedure to identify and treat endogeneity when using PLS-SEM. Essentially, endogeneity can be addressed in PLS-SEM in various ways including control variables, instrumental variables, and Gaussian copulas (Becker et al., 2022; Eckert & Hohberger, 2022; Park & Gupta, 2012).

Endogeneity occurs when regressors correlate with the error term and therewith violate an assumption of regression analysis. Potential reasons for endogeneity are measurement errors, simultaneous causality, omitted variables. Hult et al. (2018) provide an illustrative application of the Gaussian copula approach in PLS-SEM

Research in IM is usually based on primary or secondary survey data, and seldom based on randomized controlled experiments and endogeneity challenges are prevalent in IM. Hence, researchers have called to address this issue more systematically (Reeb et al., 2020; Shaver, 2020).

In our review, three studies addressed endogeneity more explicitly using the inclusion of antecedent variables (Swoboda et al., 2018), instrumental variables (Tan & Sousa, 2019), and a careful discussion of research design aspects (Zhang & Merchant, 2020). No study has used the Gaussian copula approach that has been proposed more recently. The approach enables an assessment of the presence of an endogeneity issue. Following this approach, if endogeneity issues are identified, the researcher ought to implement instrumental variables to explain the sources of endogeneity. A further consideration of endogeneity issues in general and of modern PLS-SEM capabilities to assess endogeneity, such as Gaussian copulas is therefore advised.

Assessment of moderated (conditional) mediation relationships

A moderated mediation analysis (Edwards & Lambert, 2007; Hayes, 2015; Preacher et al., 2007) quantifies the indirect effect via the mediator at different values of a moderator.

In a mediation analysis the relationship between two constructs (e.g., foreign language skills and performance in global teams) is influenced by the inclusion of an intermediary construct, the mediator (e.g., foreign language anxiety). In a moderation model, a construct (e.g., cultural intelligence) influences the relationship between two constructs (e.g., foreign language skills and performance). A moderated mediation analysis essentially combines the two analyses. For example, cultural intelligence (the moderator) has a conditional influence on the relationship between foreign language anxiety and performance, whereby foreign language anxiety is a mediator in the relationship between language skills and performance (see Presbitero, 2020). Fredrich et al. (2022) provide an illustrative application of a moderated mediation analysis.

Rather than solely and independently considering mediated processes (e.g., how knowledge sharing mediates the relationship between cultural differences and innovativeness) or moderated processes (e.g., how country-level institutions moderate the relationship between contract specificity and alliance performance), the assessment of some IM phenomena requires the integration of mediation and moderation analyses (Ho & Wang, 2015; Kawaia & Chung, 2019; Presbitero, 2020, 2021).

Any relationship can be moderated by another variable, that is the strength of a mediated relationship may be conditional on some other variable and in IM this is often related to contextualization. Furthermore, and frequently, the process(es) through which moderating effects occur in IM may be of considerable interest. Thus, IM researchers may seek to understand the mediating mechanisms of a previously identified moderating effect, that is, through which mediated moderation processes take place.

While researchers call for the use of moderated mediation analyses in IM, they do not fully profit from the comprehensive PLS-SEM capabilities that assist in conducting moderated mediating analysis (Cheah et al., 2021; Sarstedt et al., 2020).

Assessment of observed and unobserved heterogeneity, and measurement invariance

Understanding unobserved variance (Sarstedt, Radomir, et al., 2022; Sarstedt et al., 2017; Schlittgen et al., 2016) and observed variance (Chin & Dibbern, 2010; Hair et al., 2018; Matthews, 2017) enables assessing the validity of model estimates (Becker et al., 2013); this also includes the consideration of the presence of measurement invariance in model comparisons (Henseler et al., 2016).

Datasets often involve individuals, organizations and environments that are different or heterogeneous. This heterogeneity can be observed in characteristics (e.g., country of origin). In this case, the researcher can perform separate analyses in different groups (e.g., individuals with different cultural value patterns) via multi-group analyses (e.g., Richter, Hauff, et al., 2016). In contrast, unobserved heterogeneity implies that differences between groups of data do not emerge a priori from observable characteristics but becomes apparent in differences of the strength and/or direction of path coefficients. To identify groups of data that demonstrate different path coefficients latent class techniques (e.g., FIMIX-PLS, PLS-POS) are of use (see for instance Robinson & Kalafatis, 2020 in the marketing literature).

Finally, before comparing group-specific parameter estimates, researchers need to understand whether measurement invariance exists, namely that the differences in group estimates are not due to distinctive meanings of variables across groups (e.g., Schlägel & Sarstedt, 2016).

Heterogeneity in IM datasets stems from various sources, such as different behaviors of individuals (e.g., from different cultures), different structures of organizations, and different dynamics in international environments. Several researchers call for more rigor and relevance in contextualizing IM research to capture these differences. Essentially, this is about more adequately contextualizing theory building to capture the variance in datasets and uncover differences (Michailova, 2011; Teagarden et al., 2018; Tsui, 2007).

PLS-SEM capabilities can support this process: Its options to assess differences across multiple groups help understand the influence and role of contexts. Multi-group analyses are already quite often used in PLS-SEM studies IM (e.g., Chatterjee et al., 2021; Kurt et al., 2020; Stewart et al., 2015). We encourage this use, especially to support theoretical contextualization in the field. Following Aguinis et al. (2020), researchers can, for instance, perform multi-group analyses in samples or contexts where hypotheses are more or less likely to be empirically supported to produce understanding about the theoretical boundary conditions or context specificity.

Moreover, latent class techniques can assist theory building via evaluating whether the findings are affected by heterogeneity and therewith are context-specific. That is, they can assist in identifying boundary conditions or limitations that surround the generalizability of findings. Applications of PLS-SEM capabilities in IM to identify unobserved heterogeneity are less common, and researchers seem to focus on demonstrating that unobserved heterogeneity is no threat to the validity of their findings when applying them (Alteren & Tudoran, 2016; Stewart et al., 2015; Zhou et al., 2020). Yet, in our review we could not identify a study in IM that made use of latent class analyses to more exploratorily identify different groups or segments in their datasets that could further support theory building.

Measurement invariance testing is part of the standard repertoire in IM. Yet, we encourage researchers to benefit further from using the measurement invariance of composite models (MICOM) procedure developed for the PLS-SEM use for this purpose (as in De Beule et al., 2020; Luger et al., 2022).

Assessment of predictive model performance, model comparisons and model fit

PLS-SEM offers criteria and algorithms to assess a model's predictive capabilities, which are particularly important in terms of the relevance of the results and drawing (managerial) conclusions (Sharma et al., 2022; Shmueli et al., 2016; Shmueli et al., 2019). Essentially, these approaches assess whether a research model is able to make predictions about new observations. In addition, when two alternative theoretically sound models are available, a decision can be made as to which has the better predictive power and should be selected (Liengaard et al., 2021; Sharma et al., 2019; Sharma et al., 2021).

Therewith, PLS-SEM combines assessments based on explanation (such as the models explanatory power) and prediction – referred to as the interplay of explanation and prediction theory (Gregor, 2006).

A further development that contributes to this assessment are criteria that allow a theoretically established model to be assessed 'as a whole'. Model fit criteria determine the extent to which the model-implied covariance matrix based on the estimated coefficients matches the sample covariance matrix (Cho et al., 2020; Dijkstra & Henseler, 2015); model fit can be used as an additional criterion to compare alternative theoretically derived models. An illustrative application of PLSpredict is found in Shmueli et al. (2019); an illustrative application of model comparisons based on predictive power is found in Liengaard et al. (2021).

One of the key challenges in IM research is the multiplicity of theoretical lenses that can be applied to its research phenomena, often involving alternative explanations and models. Researchers are invited to not only explain the modeled relationships, but also to rule out potential alternative theoretical explanations and models (e.g., Cuervo-Cazurra et al., 2016). While this ultimately is a theoretical discussion, new PLS-SEM capabilities on predictive model assessment, comparison and fit can be used to enrich the traditional toolset of evaluating measurement and structural models in this regard.

Researchers in IM who need to identify suitable models may profit from the more elaborate discussion and simulations on overall model fit that have more recently advanced our understanding of measures and thresholds in the PLS-SEM context. Simulation studies indicate that both the goodness-of-fit index, and the standardized root mean square residual can distinguish between correct and misspecified models and therewith can help support evaluations of the underlying theoretical foundations of alternative models. A simulation and illustrative example is provided in Cho et al. (2022) in this focused issue. Considering the recency of these development, an impressive number of studies makes use of overall model fit criteria to assess models (e.g., Chatterjee et al., 2021; Crespo et al., 2020; Jean et al., 2018).

Moreover, the assessment of a model's predictive performance can assist producing understanding about which theoretical explanation or model is better able to predict the target construct, such as international performance, innovation performance, and export performance. Especially the Stone-Geisser Q^2 criterion has found its way to IM research and is frequently applied (Ferreras-Méndez et al., 2019; Silva et al., 2017). More recent developments, such as PLSpredict and the related approaches to model comparisons have, however, not yet been used. These are easy to implement, and we encourage researchers to profit from these developments in the field.

Note: For a more detailed explanation of these capabilities, see Hair et al. (2022).

Moreover, to understand whether researchers in IM are using the most advanced capabilities, we followed Cho et al. (2022) who searched six leading IM journals (*Management International Review, International Business Review, Journal of International Management, Journal of World Business, Journal of International Business Studies,* and *Global Strategy Journal*) from 2013 to September 2021 for studies that have applied PLS-SEM and identified N=84 studies. We will refer to this set of articles to provide insights into the usage of PLS-SEM capabilities and triangulations with PLS-SEM (see Table 1). In addition, we discuss two topics in more detail which are of particular relevance for this focused issue.

Moderated (conditional) mediation analysis is often overlooked (e.g., Cheah et al., 2021; Hair et al., 2019) but provides an important basis for analyzing a variety of interesting research questions in IM. This kind of analysis, that simultaneously accounts for mediated and moderated relationships, enables better understanding how processes can be improved or under which conditions they take place, which is not the case when mediation and moderation are tested independently. Although many researchers across a variety of business disciplines, including IM, still rely on regression analyses—as done in PROCESS. This however has been subject to considerable criticism: there is no need to use PLS-SEM and PROCESS in tandem (Sarstedt et al., 2020). Instead, as Cheah et al. (2021) outline, moderated (conditional) mediation analysis can be carried out in PLS-SEM and these advances provide an essential tool to better deal with the complexities that characterize IM. When IM researchers perform a moderated mediation analysis, they are advised to a priori form a clear and robust theoretical understanding for the moderated (conditional) mediating effect for first-stage moderation, second-stage moderation, and first- and second-stage moderation (Borau et al., 2015). That is, each moderation path

(e.g., first-stage and/or second stage) in a mediation model must be supported by and consistent with the theoretical framework that underpins the IM study.

Mediated relationships may not be moderated by a single exogenous variable but instead be moderated simultaneously by two exogenous variables. This is addressed in the focused issue paper by Fredrich et al. (2022). Their paper on 'Dynamic Capabilities, Internationalization and Growth of Small- and Medium-sized Enterprises: The Roles of Research and Development Intensity and Collaborative Intensity' illustrates an advanced application of PLS-SEM by testing a second-stage three-way moderated mediation. Their study addresses the relationship between an SME's corporate-level dynamic capabilities and its growth via internationalization (i.e., the SME's export intensity). The authors analyze whether and how the effect of internationalization on growth depends simultaneously on a firm's research and development intensity and its collaborative intensity considering an interaction between both moderators. Their results indicate a positive impact of internationalization provided that research and development intensity and collaborative intensity are proportional. In contrast, when they are disproportional, SMEs do not experience positive marginal growth. Importantly, while the authors outline the results using the well-established two-dimensional three-way plot, they further clarify the results of the second-stage three-way moderation analysis by describing and interpreting the regions of significance of the marginal effect on the impact of a mediating predictor variable (i.e., internationalization) on a dependent outcome variable (i.e., firm growth) for two simultaneously varying moderators. The illustration of this approach to assessing moderated (conditional) mediation in PLS-SEM should help IM researchers, as well as those in other business disciplines to better empirically investigate how marginal second-stage effects are simultaneously conditioned by two exogenous moderators.

In addition to the above complexities, the empirical models used in IM research often involve both factors and components. However, the majority of SEM approaches are not able to handle factors and components in the same model; therefore, if used they result in biased parameter and structural estimates. The focused issue paper on 'Integrated generalized structured component analysis: On the use of model fit criteria in international management research' by Cho et al. (2022) highlights that integrated generalized structured component analysis (IGSCA) can be used to address the need in IM research to include both factors and components in a single analysis. It is one of two approaches in PLS-SEM that can handle both factors and components well (PLSc and IGSCA) and current simulations indicate that it is a particularly promising approach. The authors show that IGSCA has so far been neglected in IM research. Using the results of a simulation study, the authors propose rules-of-thumb cutoff criteria for the goodness-of-fit index (GFI) and the standardized root mean squared residual (SRMR) that can be used in IGSCA to discriminate between correct and misspecified models. These fit indices in IGSCA enable researchers to compare different models and to evaluate which model better approximates the reality and rule out alternative explanations. This is a relevant process in IM as a discipline characterized by a variety of theoretical lenses that can be applied to its research phenomena. An empirical application using a model that examines the impact of personality traits and international experience on cultural intelligence (CQ) illustrates the efficacy of the indices and provides further insights into model fit criteria.

3. Triangulating PLS-SEM with other methods/techniques

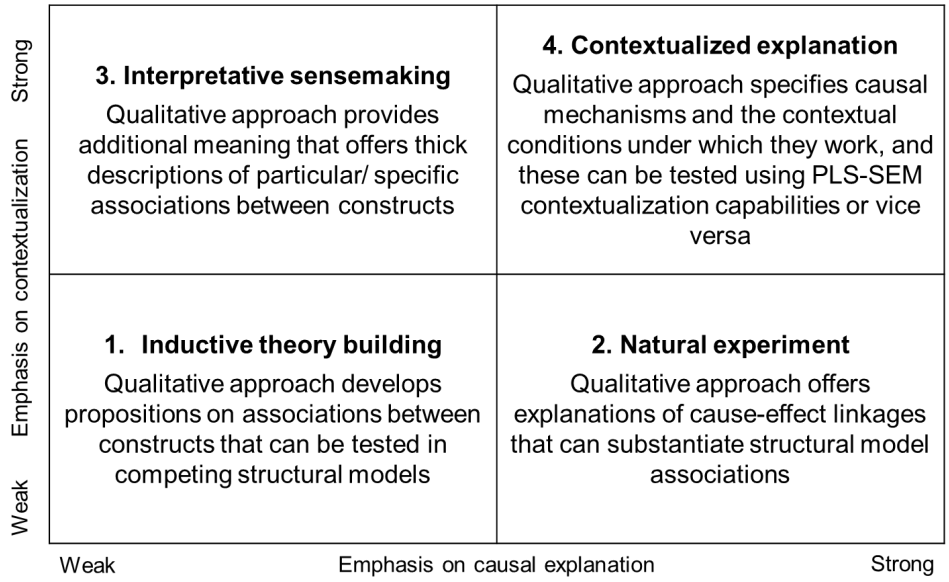
Several recent methodological reviews advocate the triangulation of methods and techniques to tackle some of the challenges that characterize IM but also other fields of research (Eden & Nielsen, 2020; Fainshmidt et al., 2021; Fainshmidt et al., 2020; Knight et al., 2022; Nielsen et al., 2020; Richter & Hauff, 2022). When it comes to triangulation of methods and techniques authors often refer to qualitative and quantitative approaches, and among the quantitative approaches differentiate traditional multivariate techniques from machine learning approaches. In the following, we will discuss the triangulation of PLS-SEM with qualitative research methods more generally, and techniques such as fuzzy-set QCA and NCA more specifically. While we believe that there is a great potential to triangulate machine learning approaches with PLS-SEM, here we concentrate on the above due to their relevance for our focused issue.

3.1 Triangulating PLS-SEM with qualitative research methods

Quantitative and qualitative research approaches have often been associated with either theory-testing (quantitative) or theory building (qualitative). Current debates, however, highlight that there are different stages in the research process that can profit from both quantitative and qualitative data and their triangulation (Doz, 2011; Knight et al., 2022; Welch & Piekkari, 2017; Welch et al., 2011; Welch et al., 2022). In IM we often face situations of nascent (i.e., little prior theory and formal theorizing) or intermediate or soft theories (i.e., partially developed constructs and explanations of relationships) (see also Knight et al., 2022). In such a situation it is specifically fruitful to triangulate PLS-SEM with qualitative approaches. Still, in our review of IM journals we found the (explicit) triangulation of PLS-SEM with qualitative approaches to be quite rare except some few examples

(e.g., Falahat et al., 2020; Jean et al., 2021; Khan et al., 2015; Sheng & Hartmann, 2019). Therefore, drawing on the four theorizing approaches outlined in Welch et al. (2011, 2022; Figure 2), we illustrate key routes to triangulate PLS-SEM with qualitative research approaches.

Figure 2: Four approaches to theorize from qualitative research (adapted from Welch et al., 2011)



Note: The two dimensions denote the main purpose of the research conducted, that is either causal explanations (or answering the how and why) and/or contextualization, that is using the context as explanatory and therewith as a part of the theory.

First, PLS-SEM can be used as a follow-up approach in the context of *inductive theory building*. Weick (1995) refers to theorizing as a process that consists of activities like abstracting, relating, selecting, explaining, and synthesizing. PLS-SEM has several capabilities that can support these various activities (see the discussions in Richter, Cepeda Carrión, et al., 2016; Richter, Sinkovics, et al., 2016). Indeed, Wold (1985) originally designed the method for research situations that are simultaneously data-rich and theory-soft and envisioned a discovery-oriented approach: Rather than committing to a specific

model a priori, he imagined researchers estimating numerous models in the course of learning something about the data and the phenomena. PLS-SEM proves particularly valuable for such predictive and exploratory purposes, because the extraction of latent variable scores in conjunction with the explanation of a large percentage of the variance in the indicator variables are useful for accurately predicting individuals' scores on the latent variables (Anderson & Gerbing, 1988; Wold, 1982); and several of its advanced capabilities that relate to comparing models based on their predictive power leverage these attributes (see Table 1). While using PLS-SEM as a stand-alone method for theory building in theory nascent situations might not be sufficient due to the potential validity challenges (Rigdon, 2016), complementing it with qualitative inductive theory building can provide the relevant base to start from. Likewise, PLS-SEM's ability to test more complex models can help researchers explore new causal relationships embedded in propositions derived from qualitative approaches.

In this focused issue, the paper on 'Business-Civil Society collaborations in South Korea: A multi-stage pattern matching study' by Sinkovics et al. (2022) shows how a multi-stage pattern matching process can help substantiate the construction of PLS-SEM models, enrich the subsequent analysis, and facilitate the interpretation of the results. Pattern matching is an umbrella term for methods that use a systematic inductive approach to identify patterns from data. Sinkovics and colleagues apply a pattern-matching process that includes three stages: partial pattern matching using systematic literature analysis, flexible pattern matching in that interview data is used to revise theoretical derived patterns, and full pattern matching which finalizes the model. The authors illustrate this multi-stage pattern matching process using business-civil society collaborations in South Korea as an empirical example. Their analyses show that the combination of qualitative and

quantitative methods can support the process of theorizing and can trigger more nuanced findings.

Second, qualitative research approaches like analyses of case studies as *natural experiments* can be a fruitful complement to PLS-SEM in order to substantiate cause-effect linkages. Qualitative approaches can be used as a complement to validate associations in a structural model that ultimately may – due to the often cross-sectional nature of the underlying data –not be sufficient to demonstrate causality. We did not come across a study in our review that drew more extensively on the triangulation of both PLS-SEM and a case study analysis in the form of a natural experiment, though a few researchers did drew on case studies that complemented their analyses (e.g., Sheng & Hartmann, 2019; Su et al., 2021).

Third, in terms of *interpretative sensemaking,* qualitative approaches can be used to offer richer descriptions of specific (maybe counterintuitive) associations found in a structural model. For instance, Khan et al. (2015) in their study on knowledge transfer between international joint ventures and local suppliers conduct qualitative interviews after their quantitative data analysis to assist the interpretation of findings and offer additional insights into the knowledge transfer process. In the context of PLS-SEM, authors refer to this kind of triangulation also as an additional evaluation of the validity of findings from PLS-SEM (e.g., Sheng & Hartmann, 2019).

Fourth, the triangulation can be used for *contextualized explanations* in order to advance the understanding of causal mechanisms that relate to different research contexts. PLS-SEM enables multigroup analyses which allows testing associations across different contexts. In addition, its more explorative or prediction-oriented procedures such as FIMIX-

PLS or PLS-POS (see Table 1) can help identify relevant contextual factors that define relevant subgroups that could be validated using qualitative research methods (see also Richter, Sinkovics, et al., 2016). While different PLS-SEM capabilities for contextualization are commonly used, we did not come across a study that followed this kind of triangulation. Yet, authors complement their PLS-SEM analyses with qualitative data to contextualize: For instance, Jean et al. (2021) in their study on international customer-supplier relationships used qualitative interviews with managers to frame the context of the study and to obtain conceptual input relevant for contextualizing their survey instrument.

3.2 Triangulating PLS-SEM with (fuzzy-set) QCA

Researchers may complement their PLS-SEM analyses with techniques that relate to a different causal logic, such as fuzzy-set QCA (Ragin, 2000). When applying PLS-SEM, researchers explicitly or implicitly refer to an additive sufficiency logic. According to this logic, each of the antecedent constructs in a structural model is sufficient (but not necessary) for changing the dependent construct, while the single constructs can compensate each other. For instance, in PLS-SEM studies on the sources of competitive advantages, each antecedent is assumed to contribute to higher performance, and the absence of one success factor can be compensated by other success factors (see for instance the PLS-SEM study on global sourcing succes by Richter et al., 2019).

A different causal logic is configurational logic which is reflected in fuzzy-set QCA. It builds on the assumption that an outcome is usually not produced by a single antecedent construct but by a combination of different determinants, which are called configurations. Within these configurations, the presence or absence of different antecedents are decisive for the outcome. Thus, the focus is on configurations of antecedent constructs and the

question concerns which of these antecedents need to be present or absent within a configuration to enable the outcome. Thereby, researchers using fuzzy-set QCA assume that multiple configurations can lead to the same outcome. For example, Lin (2020) examines the role of global sourcing strategy for the performance of firms sourcing globally. Using a fuzzy-set QCA, the author identifies configurations of global sourcing strategy (related to the disaggregation, dispersion and governance structure of the firm) leading to either a high financial performance or leading to high innovation performance. The study provides insights into the configurations that contribute jointly to these outcomes and highlights the need to jointly consider the combined effect of degree of disaggregation, degree of dispersion of business service activities and governance structure when recommending certain global sourcing strategies. Therewith, studies using fuzzy-set QCA contribute to IM research by better addressing the complexities that are inherent in the field, acknowledging that an outcome in IM may follow from several different combinations of antecedent constructs (Fainshmidt et al., 2021).

Fuzzy-set QCA has become a more popular toolset in the IM field in recent years with authors using it to enrich the conceptual understanding of, for example, country attractiveness to foreign investors, and the antecedents of internationalization and entry modes to name a few (see the overview in Fainshmidt et al., 2020). However, even if there is a step-by-step guideline for researchers aiming to combine both PLS-SEM and fuzzy-set QCA (Rasoolimanesh et al., 2021), this kind of triangulation seems to not yet be very common: none of the studies in our review triangulated PLS-SEM and fuzzy-set QCA. Notably though, there are a few studies that use the two techniques to generate advanced insights into IM phenomena (e.g., Hernánez-Perlines et al., 2016), and the triangulation of the two

is more prominent in management research in general (e.g., Carlson et al., 2019; Cruz-Ros et al., 2021; Gelhard et al., 2016).

In this special issue, Zhang et al. (2022) demonstrate the benefits of combining PLS-SEM with fuzzy-set QCA. Their paper on 'The Development of Individual Ambidexterity Across Institutional Environments: Symmetric and Configurational Analyses' examines how individuals' self-efficacy and resilience affect individual ambidexterity across different institutional environments. The PLS-SEM results reveal that resilience mediates the relationship between self-efficacy and individual ambidexterity, and that this relationship is stronger when economic freedom is low. Fuzzy-set QCA analyses complement these findings by showing that individual ambidexterity can be achieved by multiple configurations of psychological self-efficacy, resilience, characteristics related to institutions, and personal demographic factors. Thus, this study shows that a combination of the two methodologies can enrich IM research by providing a more nuanced understanding of research phenomena.

3.3 Triangulating PLS-SEM with NCA

Necessity logic and NCA as a technique to identify necessary conditions in data sets (Dul, 2016, 2020) have recently gained recognition in IM (e.g., Fainshmidt et al., 2021; Fainshmidt et al., 2020; Richter & Hauff, 2022) and other fields (e.g., Bokrantz & Dul, 2022; Dul et al., 2021; Hauff et al., 2021). Necessity logic implies that an antecedent construct is necessary but not sufficient for a dependent construct. If the necessary cause is not in place, the outcome will not materialize. A necessary condition cannot be compensated by other antecedent constructs, its absence will guarantee failure. These kinds of

relationships can be tested using NCA. That is, NCA tests whether single conditions are necessary for an outcome.

The combination of PLS-SEM with NCA, and therewith complementing PLS-SEM with necessity logic, is rather new. There was no study in our set of reviewed IM journals that complemented the two. However, other journals offer examples (e.g., Richter, Schlaegel, et al., 2020). Yet, it is a fruitful avenue for generating complementary insights for IM research in PLS-SEM contexts. It enables additional insights into causal mechanisms and offers a new angle to test alternative theoretical arguments in IM, namely arguments that refer to necessity or must-have factors and arguments that refer to drivers of success or should-have factors. To illustrate this, in their study, Richter et al. (2021) analyzed the antecedents of high performance in multicultural teams. They hypothesized that the cultural intelligence (CQ) of the team leader and the CQ of team members are positively associated with the team's performance and tested these relationships using PLS-SEM. In addition, they hypothesized that the team's average CQ is a necessary condition for high team performance. That is the team will not be able to achieve high performance, if its members are not culturally intelligent. They complemented their PLS-SEM analysis with NCA and demonstrated that a certain average level of CQ among team members is necessary for a team's good performance using the findings from NCA; and that an increase in the team's average CQ is a driver of its performance using the findings from PLS-SEM. In contrast, the team leader's CQ was no necessary condition, but a significant antecedent to performance. That is an increase in the leader's CQ increases the team's performance, but there is no bottleneck level of leader CQ that needs to be satisfied for a good performance to materialize. Hence, there are basically three scenarios of result combinations of relevance (see Table 2).

Table 2: Results scenarios when combining PLS-SEM with NCA

Scenario	PLS-SEM results	NCA results	Conclusion
1: Exogenous construct is a…	significant determinant	and a necessary condition	On average, an increase in the exogenous construct will increase the outcome. However, a certain level (see NCA bottleneck tables) of the exogenous construct is necessary for the outcome to manifest.
2: Exogenous construct is a…	significant determinant	but no necessary condition	On average, an increase in the exogenous construct will increase the outcome; no minimum level of the construct is needed to ensure that the outcome will manifest.
3: Exogenous construct is a…	nonsignificant determinant	but a necessary condition	A certain level (see NCA bottleneck tables) of the exogenous construct is necessary for the outcome to manifest. However, a further increase is not recommended, as it will not increase the outcome any further.

Source: (Richter, Schubring, et al., 2020)

As demonstrated in Richter and Hauff (2022), there are various fields in IM research that involve necessity relationships from a conceptual perspective, among them studies related to internationalization (patterns) and the existence and performance of multinational firms, studies that investigate knowledge sharing, transfer and creation among international partners, and studies on foreign entry mode and the success of different entry modes. There is a step-by-step guideline for researchers aiming to combine PLS-SEM and NCA (Richter, Schubring, et al., 2020), which is a straightforward process using the latent variable scores from PLS-SEM in NCA (and has recently been implemented into the easy to use software application SmartPLS 4; Ringle et al., 2022).

The special issue paper on ‘Speed of International Expansion: The Mediating Role of Network Resources Mobilisation’ by Bolívar et al. (2022) demonstrates the value of combining PLS-SEM with NCA. Both methodologies are applied to better understand how the structural embeddedness of firms within a network of international alliances and the network resources mobilization of firms impact the speed of international expansion among MNEs.

Their results show that network resources access is a predictor and necessary condition of international expansion speed, and that network resources mobilization acts as a mediator that is also necessary for further international expansion. Consequently, the paper highlights that the combination of different methodologies can provide more detailed and enriched insights in IM research.

4. Concluding remark

Research in IM is challenging, in particular due to the complexity of the research phenomena, the use of alternative theoretical lenses and the need to contextualize theory and empirical findings. PLS-SEM has several capabilities that can help researchers face these challenges. Researchers may also complement their PLS-SEM analyses with findings from other methods. Our review of six leading IM journals showed that researchers in IM have started using some of the advanced capabilities of PLS-SEM and are also starting to engage more in triangulating their PLS-SEM analyses and results with other methods. However, we still see a huge protentional to make better use of the methodological extension and breadth of PLS-SEM applications. This paper and the articles presented in this focused *MIR* issue provide IM researchers with guidance and inspiration for the advanced use of the method to achieve their own research goals. We are confident that the contributions in this focused *MIR* issue will generate a great deal of interest in advanced methodological IM research and stimulate new applications with interesting research questions.

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interest in our focused *MIR* issue on PLS-SEM. They have made vital contributions to the knowledge and understanding of IM, especially the emerging applications of the PLS-SEM analysis method in IM research. Finally, we are especially grateful to the reviewers who helped us select the articles most likely to contribute to the goal of this focused issue and to further IM research. Without the tremendous support of our reviewers and their constructive support and guidance, this focused issue would not have come to fruition.

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