RESEARCH METHODS WORKSHOP

Necessary Condition Analysis (NCA) and Partial Least Squares Structural Equation Modeling (PLS-SEM) in (Management and Business) Research

Presented by Prof. Dr. Christian M. Ringle

Hamburg University of Technology (Germany) and James Cook University (Australia)

Place: James Cook University Townsville Bebegu Yumba Campus, ATSIP 145-030

Date: 17 March 2026 | Time: 09:15 for 9:30 – 15:30

1 Instructor and a short bio

Prof. Dr. Christian M. Ringle, Institute of Management and Decision Sciences, Hamburg University of Technology (Germany) *and* James Cook University (Australia)

Dr. Christian M. Ringle is a chaired Professor of Management and Decision Sciences at the Hamburg University of Technology (Germany) and an Adjunct Professor at James Cook University (Australia). His research, which has received over 350,000 citations according to Google Scholar, spans management and marketing, methodological development, business analytics, machine learning, and the application of advanced research methods to managerial decision making. His work has been published in leading journals such as *Industrial Marketing Management*, *International Journal of Research in Marketing*, *Information Systems Research*, and the *Journal of the Academy of Marketing Science*. Since 2018, he has been listed among Clarivate Analytics' Highly Cited Researchers.

Beyond business and economics, his methodological contributions—particularly in structural equation modeling, predictive analytics, and constraint-based reasoning—have influenced empirical research across the social sciences, including psychology, education, and public policy, and have increasingly informed method-driven research in the natural sciences and engineering, where complex systems, thresholds, and constraints are central. He is also a co-founder and co-developer of SmartPLS (https://www.smartpls.com), a graphical software package for multivariate data analysis, supporting techniques such as factor analysis, regression and path modeling, PROCESS, CB-SEM, GSCA, PLS-SEM, and necessary condition analysis (NCA).

More information about Professor Ringle can be found at
https://www.tuhh.de/mds/team/prof-dr-c-m-ringle.html

2 Workshop goals and learning outcomes

Across business, economics, the social sciences, and the natural and engineering sciences, researchers increasingly seek to understand not only what improves outcomes on average, but what must be in place for outcomes to occur at all. Reflecting this broader shift toward constraint- and threshold-based reasoning, in a relatively recent *Journal of Management* editorial, Bergh et al. (2022) highlight the growing relevance of *necessary condition analysis* (NCA; Dul, 2016) in management research and the unique potential of combining NCA with *partial least squares structural equation modeling* (PLS-SEM; Wold, 1982).

This workshop introduces the core concepts of NCA and demonstrates how it can be integrated with other widely used research methods, including PLS-SEM. NCA has been applied across multiple business and economics disciplines, such as *Human Resources, Marketing, Operations and Supply Chains, Finance/Accounting, Strategy, and Ecological Economics, as well as in the social and natural sciences, such as Environmental Management, Regional Development, Psychology, Sociology, Public Health, Ecology & Conservation Biology, Environmental & Sustainability Science, Climate Adaptation & Resilience Science, and a variety of engineering areas*. Unlike regression analysis or PLS-SEM, which rely on additive and average logic, NCA follows a *necessity logic*—interpreting cause-effect relationships as *"necessary but not sufficient"*. A necessary condition is a factor without which a specific outcome cannot occur—often referred to as a *bottleneck, critical factor,* or *constraint*. If the necessary condition is not in place at the right level, the desired outcome cannot materialize (Dul, 2020, 2024, 2025).

By introducing a complementary logic and data analysis approach, NCA enhances both the rigor and relevance of theory, data analysis, and publications (Dul, 2020). Its practical relevance has attracted increasing attention in the academic community (e.g., Bokrantz & Dul, 2023; Hauff et al., 2021; Richter & Hauff, 2022).

PLS-SEM, a regression-based method for modeling latent variables (e.g., Becker et al., 2023; Hair et al., 2019; Sarstedt et al., 2025), has been gaining increased attention in research and practice across various disciplines such as management, marketing, information systems, medicine, engineering, psychology, political and environmental sciences (SAGE Research Methods Community, 2024). Combining NCA and PLS-SEM allows researchers to distinguish between *must-have factors* (necessary conditions) and *should-have factors* (sufficiency conditions) for an outcome. Should-have factors can enhance outcomes only after must-have factors are fulfilled (Richter et al., 2020, 2023; Shukov et al., 2022; Tiwari et al., 2024; Hauff et al., 2024; Riggs et al., 2024; Sarstedt et al., 2024).

This interactive workshop involves five key elements:

- Part 1: Introduction to the core concepts of the necessary condition analysis (NCA)
- Part 2: NCA hands-on exercises and case studies using the statistical software *SmartPLS.*
- Part 3: Foundations of partial least squares structural equation modeling (PLS-SEM)
- Part 4: PLS-SEM hands-on exercises and case studies using the statistical software *SmartPLS.*
- Part 5: Combined application of NCA and PLS-SEM.

The workshop is designed for researchers interested in state-of-the-art methodological approaches for empirical studies and publication projects. While basic knowledge of multivariate statistics and SEM is advantageous, it is not required. Participants will gain a clear understanding of the underlying logic of NCA and PLS-SEM, as well as practical skills for applying these complementary methods in an integrated manner.

3 Teaching and learning methods

- The workshop is based on these textbooks:
  - Dul, J. (2020). *Conducting Necessary Condition Analysis*. Thousand Oaks, CA: Sage.
  - Dul, J. (2025). *Advances in Necessary Condition Analysis, Version 1.8*. Online book retrieved from: https://bookdown.org/ncabook/advanced_nca2/.
  - Hair, J. F., Hult, G. T. M., Ringle, C. M., and Sarstedt, M. (2026). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 4th edition. Thousand Oaks, CA: Sage.
  - Hair, J. F., Sarstedt, M., Ringle, C. M., and Gudergan, S. P. (2024). *Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd edition. Thousand Oaks, CA: Sage.
- Presentations: The session will cover theory and its application.
- Computer exercises using the statistical software SmartPLS 4 Ringle et al., 2024) in its newest version: Specifically, theoretical explanations underlying the software procedures and practical exercises where participants will apply their learning to real-world examples provided by the instructors.

4 Teaching resources

- *Comprehensive lecture slides will be provided to all participants*
- Bring your laptop computer and a 2 or 3-way power extension lead.
- Download and install the SmartPLS 4 software from https://www.smartpls.com/ before attending the workshop. Participants will receive detailed instructions – including a two-month SmartPLS 4 license key – shortly before the workshop starts.

5 Schedule

Place: James Cook University Townsville Bebegu Yumba Campus, ATSIP 145-030

Date: Tuesday 17 March 2026

Time	Topic
09:30 – 11:00	Introduction to the core concepts of NCA and hands-on SmartPLS software applications
11:00 – 11:30	Break
11:30 – 13:00	Foundations of PLS-SEM and hands-on SmartPLS software applications
13:00 – 14:00	Lunch
14:00 – 15:30	The combined use of NCA and PLS-SEM and hands-on SmartPLS software applications

6 References

Angelelli, M., Ciavolino, E., Ringle, C. M., Sarstedt, M., & Aria, M. (2025). Conceptual Structure and Thematic Evolution in Partial Least Squares Structural Equation Modeling Research. *Quality & Quantity*, *59*, 2753-2798.

Becker, J.-M., Cheah, J. H., Gholamzade, R., Ringle, C. M., & Sarstedt, M. (2023). PLS-SEM's Most Wanted Guidance. *International Journal of Contemporary Hospitality Management*, *35*(1), 321-346.

Becker, J.-M., Richter, N. F., Ringle, C. M., & Sarstedt, M. (2026). Must-have, Or Maybe Not? A Sensitivity-based Extension to Necessary Condition Analysis. *Journal of Business Research*, *206*, 115920.

Bergh, D. D., Boyd, B. K., Byron, K., Gove, S., & Ketchen, D. J. (2022). *What Constitutes a Methodological Contribution?*, *Journal of Management*, *48*(7), 1835-1848.

Bokrantz, J., & Dul, J. (2023). Building and Testing Necessity Theories in Supply Chain Management. *Journal of Supply Chain Management*, *59*(1), 48-65.

Dul, J. (2016). Necessary Condition Analysis (NCA): Logic and Methodology of "Necessary but not Sufficient" Causality. *Organizational Research Methods*, *19*(1), 10-52.

Dul, J. (2020). *Conducting Necessary Condition Analysis*. London: Sage.

Dul, J. (2025). *Advances in Necessary Condition Analysis, Version 1.8*. Online book: https://bookdown.org/ncabook/advanced_nca2/

Dul, J. (2024). A Different Causal Perspective with Necessary Condition Analysis. *Journal of Business Research*, *177*, 114618.

Guenther, P., Guenther, M., Ringle, C. M., Zaefarian, G., & Cartwright, S. (2023). Improving PLS-SEM Use for Business Marketing Research. *Industrial Marketing Management*, *111*(May), 127-142.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2026). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 4th edition. Thousand Oaks, CA: Sage.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to Use and How to Report the Results of PLS-SEM. *European Business Review*, *31*(1), 2-24.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2024). *Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd edition. Thousand Oaks, CA: Sage.

Hauff, S., Guerci, M., Dul, J., & van Rhee, H. (2021). Exploring Necessary Conditions in HRM research: Fundamental Issues and Methodological Implications. *Human Resource Management Journal*, *31*(1), 18-36.

Hauff, S., Richter, N. F., Sarstedt, M., & Ringle, C. M. (2024). Importance and Performance in PLS-SEM and NCA: Introducing the Combined Importance-Performance Map Analysis (cIPMA). *Journal of Retailing and Consumer Services*, *78*, 103723.

Richter, N. F., & Hauff, S. (2022). Necessary Conditions in International Business Research: Advancing the Field with a New Perspective on Causality and Data Analysis. *Journal of World Business*, *57*, 101310.

Richter, N. F., Hauff, S., Ringle, C. M., Sarstedt, M., Kolev, A. E., & Schubring, S. (2023). How to Apply Necessary Condition Analysis in PLS-SEM. In H. Latan, J. J. F. Hair, & R. Noonan (Eds.), *Partial Least Squares Path Modeling: Basic Concepts, Methodological Issues and Applications* (pp. 267-297). Cham: Springer.

Richter, N. F., Schubring, S., Hauff, S., Ringle, C. M., & Sarstedt, M. (2020). When Predictors of Outcomes are Necessary: Guidelines for the Combined Use of PLS-SEM and NCA. *Industrial Management & Data Systems*, *120*(12), 2243-2267.

Richter, N. F., Sinkovics, R. R., Ringle, C. M., & Schlaegel, C. (2016). A Critical Look at the Use of SEM in International Business Research. *International Marketing Review*, *33*(3), 376-404.

Riggs, R., Felipe, C. M., Roldán, J. L., & Real, J. C. (2024). Deepening Big Data Sustainable Value Creation: Insights Using IPMA, NCA, and cIPMA. *Journal of Marketing Analytics*, forthcoming.

Ringle, C. M., Wende, S., & Becker, J.-M. (2024). *SmartPLS 4*. Bönningstedt: SmartPLS. Retrieved from https://www.smartpls.com/

SAGE Research Methods Community. (2024). Partial least squares structural equation modeling: An emerging tool in research. SAGE. https://researchmethodscommunity.sagepub.com/blog/partial-least-squares-structural-equation-modeling-emerging-tool

Sarstedt, M., Hair, J. F., & Ringle, C. M. (2023). "PLS-SEM: Indeed a Silver Bullet" - Retrospective Observations and Recent Advances. *Journal of Marketing Theory & Practice*, *31*(3), 261-275.

Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L., & Ringle, C. M. (2022). Progress in Partial Least Squares Structural Equation Modeling Use in Marketing Research in the Last Decade. *Psychology & Marketing*, *39*(5), 1035-1064.

Sarstedt, M., Richter, N. F., Hauff, S., & Ringle, C. M. (2024). Combined Importance–performance Map Analysis (cIPMA) in Partial Least Squares Structural Equation Modeling (PLS–SEM): A SmartPLS 4 Tutorial. *Journal of Marketing Analytics*, *12*, 746-760.

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2025). *Partial Least Squares Structural Equation Modeling*. In C. Homburg, M. Klarmann, and A. Vomberg (Eds.). *Handbook of Market Research* (pp. 1-47), Cham: Springer.

Sukhov, A., Olsson, L. E., & Friman, M. (2022). Necessary and Sufficient Conditions for Attractive Public Transport: Combined Use of PLS-SEM and NCA. *Transportation Research Part A: Policy and Practice*, *158*, 239-250.

Tiwari, P., Kaurav, R. P. S., & Koay, K. Y. (2024). Understanding Travel Apps Usage Intention: Findings from PLS and NCA. *Journal of Marketing Analytics*, *12*(1), 25-41.

Wold, H. (1982). Soft Modeling: The Basic Design and Some Extensions. In K. G. Jöreskog & H. Wold (Eds.), *Systems Under Indirect Observations: Causality, Structure, Prediction: Part II* (pp. 1-54). Amsterdam: North-Holland.