Fuzzy-Set Qualitative Comparative Analysis (Fsqca) And Necessary Condition Analysis (Nca) In Tourism And Hospitality Studies: Bridging Bipolar Methodological Divides

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Abstract
Complex interactions among human behaviour, organisational processes, and consumer experiences characterise the tourism and hospitality field. Traditional symmetrical research methods often impose rigid models and linear relationships, resulting in oversimplified conclusions that fail to capture the complexities of these domains. In contrast, fsQCA and NCA provide a more detailed framework for understanding these complexities. Thus, by integrating fsQCA's configurational insights with NCA's identification of necessary and sufficient conditions, this study demonstrates how these methodologies effectively bridge gaps in symmetrical qualitative and quantitative approaches. The fsQCA allows researchers to explore causal relationships among multiple configurations without rigid dichotomisation. This flexibility is particularly beneficial in this research field, where a variety of factors are examined. Conversely, NCA emphasises discovering sufficient and necessary conditions that should be met for specific outcomes to occur, providing clarity on the constraints within which these outcomes manifest. The study illustrates the synergistic application of fsQCA and NCA through a compelling case study, revealing a complex causal recipe that enhances understanding of the factors that lead to operational efficiency and sustainability in the hospitality industry. This dual methodological framework enables scholars and practitioners to get more in-depth insights into the complexities of the field and drive impactful practices.

Keywords: Methodological Divides, Symmetrical and Asymmetrical Analyses, fuzzy-set Qualitative Comparative Analysis (fsQCA), Necessary Condition Analysis (NCA), and Tourism and Hospitality Studies

Introduction
Traditional symmetrical analysis techniques often impose uniform models and linear relationships on the complex dynamics of tourism and hospitality studies, thereby limiting their applicability. Such results may lead to oversimplified conclusions that overlook the nuanced realities of these fields. Mixed-methods approaches offer insights that single methods cannot provide (Olya, 2023); however, effectively integrating qualitative and quantitative data remains challenging due to their distinct characteristics (Geremew *et al.*, 2024). In contrast, configurational analysis methods, like fsQCA and NCA, offer more suitable frameworks for understanding the multifaceted nature of these fields. These methods can summarise cases, evaluate analytical consistency, review existing theories, and develop new theoretical frameworks. They enable thorough case analysis, enhancing or broadening existing theories (Kahwati & Kane, 2018; Fiss, 2011). This would allow researchers to investigate the configurations that yield specific results, acknowledging that multiple pathways can produce the same effect. Symmetrical methods may inadequately represent complex factors (Fiss, 2011). Asymmetrical methods offer greater flexibility than symmetrical counterparts when merging data types, enabling researchers to tailor analyses to specific contexts and complexities (Schneider & Wagemann, 2012).

fsQCA is a set-based philosophy that allows researchers to analyse causal associations between multiple sets without the constraints of strict dichotomisation. This flexibility is particularly advantageous in social sciences, where phenomena are often complex and do not fit neatly into binary categories. It converts crisp sets and multi-value data into inclusion

values between 0 and 1 (Kahwati & Kane, 2018). Continuous fuzzy sets enable users to evaluate variables with greater precision: 1 = full membership, 0.5 = crossover, and 0 = non-membership. It employs Boolean algebra operations of AND (*), OR (+), and negation (~). The AND operation finds the minimum set score, while the OR operation determines the highest value (Rasoolimanesh et al., 2021). It determines sufficient and necessary conditions by analysing combinations of antecedents (Geremew *et al.,* 2024; Rihoux & Ragin, 2012). For example, combinations of antecedents can be sufficient conditions for an outcome, while some may be necessary but not sufficient. After identifying causal configurations, the final step is to assess their coverage and consistency. Consistency indicates the ratio of cases that share the same results, while coverage reflects the ratio of memberships that account for the overall result (Kraus *et al.,* 2018). Therefore, scholars must understand these concepts as they differ from traditional symmetrical methods. NCA focuses on identifying necessary conditions for achieving specific outcomes, contrasting with traditional methods that emphasise sufficient conditions. Recognising necessary conditions clarifies the underlying mechanisms leading to results (Dul, 2016). The methodology involves several key steps, starting with identifying potential necessary conditions and assessing their relationships with outcomes. Graphical representations help visualise these relationships (Dul & Hak, 2008). It can be combined with other approaches to foster a comprehensive understanding of causality (Dul *et al.,* 2023). Thus, this research note aims to integrate fsQCA and NCA as a transformative method to bridge the bipolar quantitative and qualitative methodologies in the field's studies.

Why Should Tourism and Hospitality Scholars Employ fsQCA and NCA?

Simple linear and symmetrical models struggle to explore the intricate associations arising from interrelated factors in the field (Olya & Altinay, 2016). Thus, relying solely on symmetrical analyses in complex scenarios can be misleading for several reasons: (1) A negative or positive relationship in symmetrical analysis almost always occurs (Olya, 2023; Olya & Altinay, 2016). (2) Symmetrical research provides inconclusive evidence on the positive or negative relationships between antecedent and outcome sets, resulting in frequent occurrences of net effects. (3) Multiple configurations often lead to high outcome scores, suggesting asymmetrical rather than symmetrical relationships are more insightful. (4) Correlation fails to accurately describe the non-linear associations between recipes and outcome sets (Geremew et al., 2024; Woodside et al., 2018). (5) A predictive configuration may not always be sufficient, but it is necessary to determine the magnitude of the result (Pappas & Woodside, 2021). Symmetrical associations often fail to reliably predict outcomes. (6) Strong one-to-one relationships are rare, advocating for research that focuses on predicting when specific conditions will be realised instead of merely indicating the pattern of the association (Woodside et al., 2018). (7) Multiple configurations of antecedents may result in similar outcomes (Pappas & Woodside, 2021). (8) A complex antecedent may be sufficient for an outcome but is not always necessarily required for it to occur (Woodside et al., 2018). (9) Symmetrical methods often overlook outliers, which are crucial in studies such as medical tourism and luxury services (Geremew et al., 2024; Olya & Nia, 2021). (10) Independent variables typically co-occur rather than one after the other, and the notion of "ceteris paribus" does not hold in real life (Pappas & Woodside, 2021). (11) The availability and unavailability of any recipe can cause the same outcome, subject to its combination with other factors (Geremew et al., 2024; Misangyi et al., 2017). (12) Enables non-linear relationships between the recipe and outcome sets, effectively bridging bipolar research methods and accommodating samples from very small (n = 5) to large, allowing for the exploration of both positive and negative contrarian cases (Pappas & Woodside, 2021; Olya & Altinay, 2016). (13) It also avoids the need for multicollinearity or normality tests and can be combined with other symmetrical analyses (Geremew et al., 2024; Olya, 2023). (14) It adeptly addresses the complex role of predictors, making it suitable for exploratory analysis, theory development, and testing (Woodside et al., 2018; Olya, 2023). Furthermore, QCA

calculates outcome negation, generates multiple predictive solutions, models outcome configurations, and captures the complexity of causality in the field's study.

How to Apply fsQCA and NCA in Tourism and Hospitality Studies?

The main objective of a causal recipe analysis is to examine how various recipes yield specific levels of outcomes. While high values of the antecedent set can lead to high outcome values, they are not always required for high outcomes. High outcome values may also arise from low antecedent values, suggesting that additional causal recipes contribute to achieving those outcomes (Geremew et al., 2024; Olya & Gavilyan, 2017). For example, various factors, including green technology adoption (GTA), environmental, social, and governance (ESG), green leadership (GL), green behaviour (GB), and organisational well-being (OW), may influence hospitality operational efficiency (OE). The adoption of green technology, along with environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being, may play a significant role in driving enhanced operational efficiency [□(GTA*ESG*GL*GB*OW) →□OE]. Green technology adoption, environmental, social, and governance factors, and green leadership may improve operational efficiency, independent of green behaviour and organisational well-being [□(GTA*ESG*GL) + (GB*OW) → □OE]. The absence of adopting green technology, alongside environmental, social, and governance factors, and green leadership, persists despite the presence of green behaviour and organisational well-being and may lead to low operational efficiency [~(GTA*ESG*GL) + (GB*OW)→ □OE]. High adoption of green technology, effective green leadership, and proactive green behaviour may drive high operational efficiency, irrespective of environmental, social, and governance factors and organisational well-being [□(GTA*GL*GB) + (ESG*OW) → □OE]. In contrast, low adoption of green technology and green leadership combined with high green behaviour, environmental, social, and governance factors, and organisational well-being may yield low operational efficiency [□GTA*□GL*□GB*□ESG*□OW → □OE]. Thus, high and low-outcome sets require more intricate and nuanced recipes.

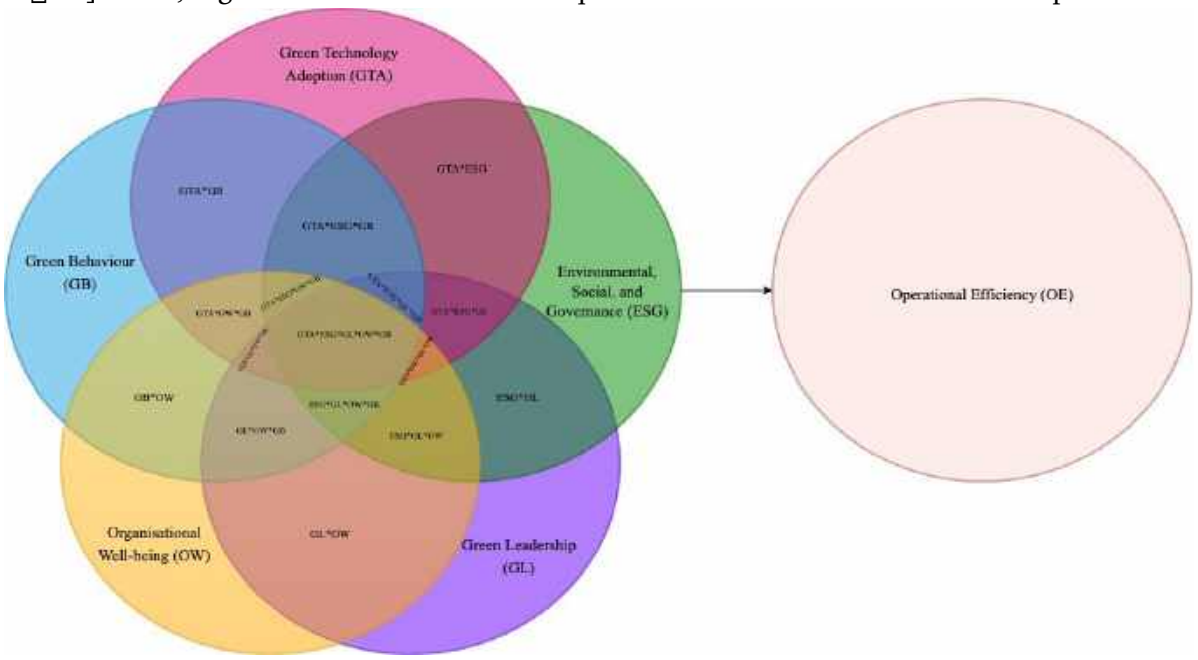

Figure 1: Asymmetrical model of antecedent and outcome sets

Such a study can utilise PLS-SEM symmetrical analysis to identify which exogenous variables influence high operational efficiency and compare the results among the exogenous variables. However, since exogenous variables interact concurrently, scholars shall combine PLS-SEM

with fsQCA and NCA to analyse which configurations lead to high efficiency and which are necessary and sufficient conditions (Rasoolimanesh et al., 2021). Integrating both methods provides more profound insights into complex causal relationships than PLS-SEM alone (Olya, 2023). The fsQCA can be integrated with PLS-SEM based on the following procedures: (1) Extracting the standardised latent variable scores of PLS-SEM. (2) Calibrating these scores to a range of [0, 1], a crossover point 0.50. (3) Creating a truth table for all possible configurations (2^n, where n = number of antecedent sets), removing cases with two or fewer and consistency below 0.80. (4) Compute the coverage and consistency of all recipes using an intermediate score. (5) Set coverage greater than 0.20, consistency greater than 0.80 for sufficiency, and values of 0.90 and above for necessary conditions can be considered. (6) Randomly dividing the sample into two subsets; fsQCA can be executed on the first group to identify recipes. The other group can generate a graph to verify coverage and consistency scores, confirming the model's predictive power. Although fsQCA enables necessary analyses in kind, it does not reveal the specific antecedents required for achieving high outcome scores at varying levels. Therefore, conducting a separate NCA may be crucial as it reduces the likelihood of errors (Dul, 2016). Its purpose is to identify regions in the graphs of recipes and outcomes that indicate the availability or unavailability of necessary recipes by establishing a ceiling line above (Richter *et al.*, 2020). It also displays graphs for recipe sets relative to the outcome. The effect size compares the empty zone relative to areas containing observations. It is categorised as small (up to 0.1), medium (from 0.1 to 0.3), large (from 0.3 to 0.5), and very large (above 0.5) (Rasoolimanesh et al., 2021; Dul et al., 2023). To calculate its parameters, ceiling zone, scope, and effect size, 10,000 bootstrapping and permutation analyses can be conducted using SmartPLS 4.

The antecedents of green technology adoption (GTA), environmental, social, and governance (ESG) factors, green leadership (GL), green behaviour (GB), and organisational well-being (OW) have a significant impact on shaping operational efficiency (OE) in the hospitality industry. This framework illustrates the contributions of fsQCA and NCA as follows: *Tenet 1: In a symmetrical analysis, a simple exogenous variable may be statistically significant and necessary, yet not sufficient for reliably predicting specific endogenous variables.* A high recipe score can predict a high result in symmetric analysis; however, this is not the case with the asymmetric method (Rasoolimanesh et al., 2021; Pappas & Woodside, 2021). A maximum recipe score does not reliably lead to a high outcome score, even with a large effect size. For instance, while the increased adoption of green technology may enhance the likelihood of operational efficiency, (GTA OE) depends on other factors in asymmetric analysis. High OE also requires strong green leadership, environmental, social, and governance, green behaviour, and organisational well-being. The sufficiency model suggests that high levels of GTA, ESG, GL, GB, and OW collectively contribute to high OE, as indicated by the following relationship: [(GTA*ESG*GL*GB*OW) → OE]. Thus, green technology alone is necessary but insufficient to achieve high overall efficiency (OE). *Tenet 2: Complex antecedents configured with simple recipes are sufficient for high outcome scores.* Complex recipes formed from the configurations of green technology adoption, environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being can consistently achieve high scores in operational efficiency. There are 32 recipes (2^5), and accurate outcome predictions are required for these complex configurations (Geremew et al., 2024; Woodside, 2014). The simple recipes of all antecedents combine to form more complicated recipes that can lead to high operational efficiency outcomes.

Tenet 3: Different ways to achieve a typical result, equifinality. In asymmetrical analyses,

multiple complex recipes can lead to similar conclusions. Although a multifaceted configuration can be sufficient for achieving a result, it is not inherently required. Different configurations do not occur equally; the key challenge is constructing highly consistent configurations. Model selection relies on consistency and coverage. A consistency threshold of at least 0.85 is advised for macro-level data, while coverage above 0.2 indicates recipe sufficiency (Woodside et al., 2018). Different recipes for green technology adoption, including environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being, can support higher operational efficiency but are not strictly necessary. High green technology adoption alone may not be sufficient for achieving high operational efficiency, as both complex and straightforward recipes can yield similar results. *Tenet 4: Recipes are unique and not contradictory, causal asymmetry.* Support and rejection are distinct concepts; the reasons for one do not necessarily explain the reasons for the other. Asymmetric models are essential for scholars to address both rejection and support separately (Geremew et al., 2024; Olya, 2023). The causal recipes predicting high operational efficiency from green technology adoption, environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being do not merely contradict those for low operational efficiency; □(GTA*ESG*GL*GB*OW) does not replicate □(GTA*ESG*GL*GB*OW). No single antecedent is necessary or sufficient for achieving high OE, as high scores do not sufficiently account for low scores. This distinction does not contradict different configurations. Furthermore, the negation of recipes does not imply their complete absence; it represents a reduction in value, expressed as ∼(GTA*ESG*GL*GB*OW) = 1 – (GTA*ESG*GL*GB*OW).

Tenet 5: Antecedents can influence outcomes positively or negatively. It relies on the availability or unavailability of other configurations (Olya, 2023; Woodside, 2014). Causal recipes are crucial for illustrating how various configurations lead to differing outcome scores. For instance, high green technology adoption and environmental, social, and governance factors may enhance operational efficiency (OE), □(GTA∗ESG)→□OE. However, high green technology adoption combined with green behaviour may not yield the same positive effect on operational efficiency, □(GTA∗GB) ≠ □OE. This distinction helps scholars analyse high and low OE outcomes, regardless of the presence of ESG. These models can guide hospitality organisations in proactively addressing potential failures in ESG and mitigating remediable causes.

Tenet 6: Antecedent sets have negative and positive relationships with outcome sets (Geremew et al., 2024; Olya, 2023). A recipe of high green technology adoption, environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being may be necessary to achieve high positive operational efficiency outcome □(GTA*ESG*GL*GB*OW)→□OE. Conversely, high adoption of green technology, environmental, social, and governance factors, green leadership, and green behaviour alongside negative organisational well-being can lead to low operational efficiency outcomes, □(GTA*ESG*GL*GB)*∼OW→□OE. Thus, the impact of these antecedents on the positive or negative outcome depends on the direction of the recipe.

Tenet 7: Exceptions for high antecedent scores in predicting outcomes. High antecedent scores may not influence outcomes unless they are very low or high in other configurations (Geremew et al., 2024; Woodside et al., 2018). High operational efficiency typically requires a strong adoption of green technology, as well as environmental, social, and governance (ESG) factors, green leadership, green behaviour, and organisational well-being. This tenet emphasises that fsQCA should be applied using combinatorial rules.

Tenet 8: Recognising contrarian cases in complex outcomes. Scholars often examine outcome antecedents separately, but analysing them as components of causal recipes can enhance the understanding and forecasting of outcomes (Woodside et al., 2018; Olya, 2023). High or low operational efficiency can arise from varying configurations of green technology adoption, environmental, social, and governance factors, green leadership, green behaviour, and organisational well-being. Examining conditions of both high and low green technology adoption helps achieve a deeper understanding of outcomes—for instance, observing cases where high adoption leads to high efficiency (□GTA→□OE), but also contrarian cases where low adoption still results in high efficiency (□GTA→□OE). Therefore, moving beyond single-variable analysis to examine complex recipes that integrate factors such as green leadership leads to a more nuanced understanding of operational efficiency outcomes.

Conclusion, Limitations, and Future Research

Combining fsQCA and NCA with other symmetrical analyses represents a significant advancement in research methodologies in this field. By bridging bipolar methodological divides, these approaches enhance understanding of intricate relationships. As the landscape evolves, diverse methodologies will be crucial for addressing emerging challenges and opportunities. Scholars can benefit from a pragmatic approach that incorporates various antecedents into their models (Olya & Nia, 2021). This conceptual note has limitations due to its theoretical nature and absence of empirical data. Thus, future research should address methodological and analytical gaps in fsQCA and NCA using actual data. Furthermore, integrating symmetrical analyses with asymmetrical approaches warrants further exploration, particularly through qualitative research for the development of theory. Subsequent investigations may also examine mediator relationships within sets and explore the applications of fsQCA. Refining fsQCA and NCA methodologies for longitudinal studies is crucial, particularly in identifying configurations that promote sustainability in the industry.

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