



QUALITATIVE-COMPARATIVE ANALYSIS CASE STUDY: INTEGRATION OF WATER INTO THE BUSINESS STRATEGY

Diez Martínez, Inés ^{a1} and Peiró Signes, Ángel ^{a2}

^a Management Department, Universitat Politècnica de València, Camino de Vera, s/n, 46022 Valencia, Valencia, Spain. (^{a1} indiemar@alumni.upv.es, ^{a2} anpeisig@omp.upv.es)

ABSTRACT: Qualitative-comparative analysis (QCA) is a research based on Boolean algebra that integrates both qualitative and quantitative elements to perform the analysis of causal conditions for the production of an outcome. This study performs a use case of the QCA methodology, focused on whether water is integrated into the business strategy of companies. The purpose of this paper is to provide a case study for a “crisp” set, in which variables are dichotomous, where causal conditions and outcomes are either present or absent for each case. Within the case study, several causal conditions are explored as potential triggers to the integration of water into the business strategy of companies. The causal conditions explored are: whether companies have evaluated the effect of water in their potential growth, whether companies have experienced detrimental impacts linked to water, whether they require suppliers to report on water, and finally, whether companies have identified opportunities linked to water. Results show that the presence of both the conditions of “having evaluated the effects of water” and “identified opportunities linked to water” represent the majority of positive cases for water integration, thus, potentially being causal conditions that produce the outcome “water integration into business strategy”. However, none of the potential causal conditions are identified as necessary conditions as there is record of companies integrating water even when none of the causal conditions are present.

KEY WORDS: *Qualitative-comparative analysis, Sustainability integration, Water management.*

1. INTRODUCTION

Qualitative-comparative analysis (QCA) is a research technique used for the analysis of causal conditions, “applying set-theoretic methods to cross-case evidence” (Ragin and Benoit, 2004). QCA is based on Boolean algebra, and it bridges between qualitative and quantitative elements for the study of cross-cased patterns (Ragin, 1987; Ragin n.d.).

This research applies the QCA methodology to investigate the trigger for the integration of water into the business strategy of companies. Water management may have different implications across industries, but it overall refers to “the control and movement of water resources to minimize damage to life and property and to maximize

How to cite: Diez Martínez, I., and Peiró Signes, Á. 2021. Qualitative-Comparative Analysis case study: Integration of water into the business strategy. In Proc.: 3rd International Conference Business Meets Technology. Valencia, 23rd & 24th September 2021. 187-194. <https://doi.org/10.4995/BMT2021.2021.13694>

efficient beneficial use” (USDA, n.d.). Water management integration is important as water is a key resource for a wide range of industries, and it can be used to maximize the economic and social welfare without compromising the sustainability of ecosystems (Sun et al., 2011). Within the context of Spain, as described by Aldaya et al. (2010), water management is a key controversial topic. In Spain, despite of the increase of drought conditions in certain areas, the water crisis is more linked to water governance than to physical water scarcity.

In order to perform the study, the data used was sourced from the CDP, from a water management questionnaire (please refer to: Hammond, 2018). For the analysis, we focused on those companies in the questionnaire that were Spanish, looking into four potential triggers for the integration of water management: whether the company had evaluated how water could affect its growth strategy, had experienced detrimental impacts linked to water, requires suppliers to report on water matters and whether water presents opportunities for the company.

Purpose of the paper

The purpose of this paper is to provide a better understanding of the potential applications of QCA for the study of key sustainability topics such as companies’ integration of water management. This paper could be used by future researchers as a reference for the study of companies with what regards finding a methodology that could be used to study the triggers for sustainability integration.

Research background

The qualitative-comparative methodology is a methodology widely used in social sciences, for example in comparative politics, business and economy or sociology (Roig-Tierno et al. 2017). Three types of QCA methodologies exist: csQCA, fsQCA, and mvQCA:

- csQCA: Represents cases where values are “crisp”, dichotomous: An element would either “in” or “out” of a set, having either a value of “0” or a value of “1” (Grofman et al., 2009)
- fsQCA: In this case, the QCA technical is applied to a “fuzzy” set. A fuzzy set maintains the “out” as per “0” and the “in” for the 1, however, it also includes all intermediate values of membership such as 0.1, 0.2, 0.3 etc., any value between 0 and 1 is acceptable (Ragin, n.d.; Skaaning, 2011)
- mvQCA: “mv” stands for “multi value”. In contrast to csQCA, with a dichotomous logic, and fsQCA, which applies a fuzzy logic, mvQCA is based on multivalent logic. In the multivalent logic, both conditions and outcomes can assume multivalent structures (Thiem, 2015; Rihoux and Lobe, 2009).

As discussed by Roig-Tierno et al. (2017), currently mcQCA has a marginal use when compared to the usage of csQCA and fsQCA.

2. METHODOLOGY

This study is focused on the application of csQCA, as the selected questions of the questionnaire for the Spanish companies were answered with “Yes” (representing “1”) and “No” (for “0”). The raw dataset used for analysis was retrieved from CDP and the software use for the application of QCA was fsQCA 3.0 (Ragin, and Davey, 2016).

- Dataset

The analysis is performed based on a CDP dataset named: “2014 – Company Water Dataset” (Hammond, 2019). CDP Worldwide is a Registered Charity no. 1122330, with a VAT registration no: 923257921 (website link: <https://www.cdp.net>). This dataset in particular is accessible in this link: <https://data.cdp.net/Companies/2014-Company-Water-Dataset/5fe7-nx93>, and the owner specified is Andrew Hammond

To be able to perform the QCA analysis, the answers to the questionnaire were processed to be made dichotomous (discarding those companies which had either “Don’t know” or “Other” or no answer). Out of the full scope of the questionnaire, the study is focused on the 15 Spanish companies that had answered to the selected questions.

- Software tools

The software tool used for the preparation of the use cases analysed for this study was Microsoft Excel. Microsoft Excel was used to filter from the initial dataset the scope of Spanish companies and to transform those answers set to “Yes” as “1” and “No” as “0”. For the QCA analysis, the software used was fsQCA 3.0 (Ragin, and Davey, 2016), Windows version. Software was used following the instructions specified in its user guide by Ragin (2016).

The main steps of the methodology are shown in Figure 1.

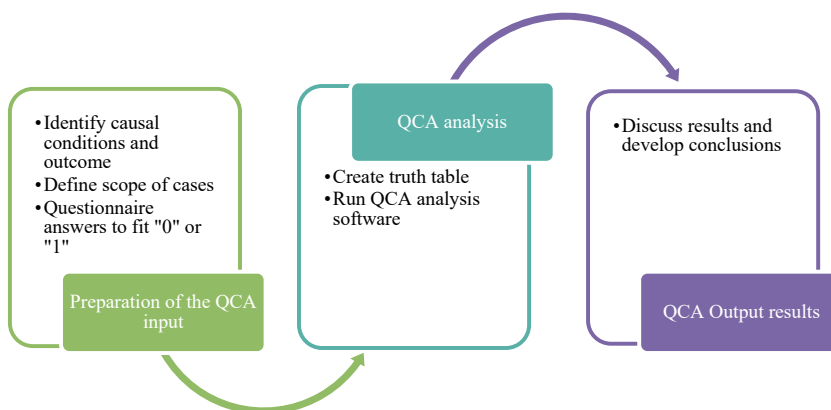


Figure 1. Research methodology steps.

3. RESULTS

QCA variables

The outcome and the causal conditions were defined as specified in Table 1. Other questions of the CDP dataset were excluded as they were deemed as not relevant or there were not enough positive/negative answers to be included for the study.

Table 1. QCA Variables.

Variable name	Variable type	Question in CDP questionnaire
INTEGRATED	Set as outcome	“W6.2 Is water management integrated into your business strategy?”
EVALUATEDEFFECT	Set as causal condition	“W1.2 Have you evaluated how water quality and water quantity affects / could affect the success (viability, constraints) of your organization’s growth strategy?”
DETRIMENTALIMPACTS	Set as causal condition	“W1.3 Has your organization experienced any detrimental impacts related to water in the reporting period?”
SUPPLIERREPORTS	Set as causal condition	“W2.5 Do you require your key suppliers to report on their water use, risks and management?”
OPPORTUNITIES	Set as causal condition	“W4.1 Does water present strategic, operational or market opportunities that substantively benefit/have the potential to benefit your organization?”

For the set of cases, variables are set with a “0” if “No” is specified, and “1” is “Yes” is specified. Further details were not taken into account for this study. For example, for the question “Evaluated how water could affect growth strategy?” answers “Yes, evaluated over the next 1 year”, “Yes, evaluated over the next 5 years” and “Yes, evaluated over the next 10 years” were considered as “1” and “Not evaluated” as “No”.

Please note, for the setup of the analysis for the intermediate answer, it was put that “SUPPLIERREPORTS”=1 was linked to the presence of the outcome as it is unlikely that the company requires suppliers to report (i.e., collects data from suppliers) without any integration of water into the business strategy. Also, the presence of opportunities could be linked to companies integrating water considerations into their business strategy. For the other two causal conditions, evaluated the effect of water does not necessarily trigger water integration as the effect evaluated could have been that water had no effect in growth or that it was negligible. For the case of detrimental impacts, it could have been detrimental impacts out of the control of the company that cannot be directly tackled through water integration.

The truth table was created through the fsQCA software based on the 15 Spanish companies in scope of the questionnaire, the name of the companies has been anonymized.

They represent a variety of sectors such as banking, energy, manufacturing, retail, agriculture and others.

QCA was applied both investigating results for “INTEGRATED” set as “Present”, and for “INTEGRATED” set as “Absent” investigating both the conditions that led to water integration into the business strategy and the no integration of water into the business strategy.

QCA analysis results for the presence of integration

Out of the three potential solutions available in the software: complex, parsimonious and intermediate solution. The intermediate solution was chosen because, as stated by Ragin (n.d.), it is the one that would use only those remainders that survive the counterfactual analysis with knowledge inputs.

Model: INTEGRATED=f(EVALUATEDEFFECT, DETRIMENTALIMPACTS, SUPPLIEREPORTS, OPPORTUNITIES)

Algorithm: Quine-McCluskey

frequency cutoff: 1, consistency cutoff: 1

Assumptions: SUPPLIEREPORTS (present), OPPORTUNITIES (present) For these assumptions, please note, whether they are set as present or present or absent, QCA solution does not change.

Table 2. Results for Integrated=1.

#	function	raw coverage	unique coverage	consistency
1	EVALUATEDEFFECT*OPPORTUNITIES	0.727273	0.272727	1
2	DETRIMENTALIMPACTS*OPPORTUNITIES	0.545455	0.0909091	1

solution coverage: 0.818182; solution consistency: 1.

There are 8 cases with greater than 0.5 membership for the combination of causal conditions: EVALUATEDEFFECT*OPPORTUNITIES.

There are 6 cases with greater than 0.5 membership in for the combination of causal conditions: DETRIMENTALIMPACTS*OPPORTUNITIES.

There are 5 cases with membership in both combinations (EVALUATEDEFFECT*OPPORTUNITIES and DETRIMENTALIMPACTS*OPPORTUNITIES).

QCA analysis results for the absence of integration

Model: \sim INTEGRATED = f(EVALUATEDEFFECT, DETRIMENTALIMPACTS, SUPPLIEREPORTS, OPPORTUNITIES)

Algorithm: Quine-McCluskey

frequency cutoff: 1, consistency cutoff: 1

Assumptions: SUPPLIEREPORTS (present), OPPORTUNITIES (present)

Table 3. Results for Integrated=0.

#	function	raw coverage	unique coverage	consistency
3	EVALUATEDEFFECT* \sim DETRIMENTALIMPACTS* \sim OPPORTUNITIES	0.25	0.25	1

solution coverage: 0.25, solution consistency: 1.

There is only 1 case with greater than 0.5 membership for the combination of causal conditions: EVALUATEDEFFECT* \sim DETRIMENTALIMPACTS* \sim OPPORTUNITIES.

Please note: the “ \sim ” indicates the condition is negated.

Finally, Table 4 shows the percentage of positive cases.

Table 4. Descriptive analytics for each causal condition.

Variable	Percentage of positive cases
EVALUATEDEFFECT	60.0%
DETRIMENTALIMPACTS	40.0%
SUPPLIEREPORTS	26.7%
OPPORTUNITIES	60.0%
INTEGRATED	73.3%

4. DISCUSSION AND CONCLUSIONS

The results obtained from the QCA analysis in terms of “raw coverage”, which represent the highest empirical evidence, show that evaluating the effects on the growth strategy and the identification of opportunities have the highest relevance for the production of the outcome, as the combination of these two represents 72.7% of positive cases with a consistency of 1 (every time this combination is in place, the water is integrated).

The second solution for the integration of water is also relevant as the combination of having experienced detrimental impacts and the identification of opportunities is present in 55% of positive cases, also with a consistency of 1.5 cases out of the total of 11 that integrate water are present in both solutions #1 and #2, showing that it is also common to find simultaneously having evaluated the effect of water, having experienced detrimental

impacts and being able to identify opportunities linked to water. However, the report of suppliers seems to be a less relevant variable, not a decisive causal condition for companies that evidence water management integration as the other conditions. Results also show that the integration of water management is not linked to any of the causal conditions or one of their combinations as a necessary condition.

Regarding the negative solution of the outcome, when “INTEGRATED” is set as negated, results do not show either a combination of casual conditions that could justify this absence of integration. Only solution #3 is found, and it is limited to the representation of 25% of negative cases, only involving one company, and thus, could be considered a marginal solution that cannot be extrapolated. The absence of any of the causal conditions is also not linked to the absence of integration.

Results suggest that the causal conditions studied may be need to be extended and that there are also other conditions linked to companies that may trigger not only the outcome, but also the causal conditions, such as, for example the industry. Energy or textile companies naturally integrate water, are more likely to identify opportunities linked to it etc., as the success of their business is inherent a high dependency on water. On the other hand, there are other industries that are less dependent on water, thus being less likely to have in place systems to identify opportunities, or for example, evaluated the effect of water.

Overall, this reached the objective of promoting a better understanding of QCA and further the develop the causal conditions related to companies’ decision to integrate water into the business strategy. However, there are certain limitations as discussed in the next section.

5. LIMITATIONS AND FUTURE RESEARCH

One of the limitations of this study is linked to the scope of companies responding the questionnaire and its reference period, knowing that it is possible that in the past few years companies may have adopted a different position towards water integration. It would be useful to repeat this study once the CDP publishes a updated questionnaire with more contemporary data.

Another current limitation of the present study as it only considered the four potential variables defined. Future research direction can be linked to further study the implications of the specific company or sector characteristics for the integration of water into the business strategy. For example, water may have a different degree of relevance for an energy company than for a textile or a metallurgical company. In a similar manner, other elements such as the size of the company may influence the capabilities that the company has to create a detailed business strategy to include elements such as resource management policies.

REFERENCES

- Aldaya, M. M.; Garrido, A.; Llamas, M. R.; Varela-Ortega, C.; Novo, P.; Casado, R. R. (2010). Water footprint and virtual water trade in Spain. *Water policy in Spain*, Chapter 6 (Water footprint and virtual water trade in Spain), 49–59.
- Grofman, B.; Schneider, C.Q. (2009). An Introduction to Crisp Set QCA, with a Comparison to Binary Logistic Regression. *Political Research Quarterly*, 62(4), pp. 662–672. doi:10.1177/1065912909338464
- Hammond A. (2018). 2014 - Company Water Dataset. CDP dataset. <https://data.cdp.net/Companies/2014-Company-Water-Dataset/5fe7-nx93>.
- Ragin, C.; Benoit, R. (2004). Qualitative comparative analysis (CQA): State of the art and prospects. *Qualitative & Multi-Method Research*, 2 pp. 3–13. <https://doi.org/10.5281/zenodo.998222>
- Ragin, C. C. (1987). *The Comparative Method. Moving Beyond Qualitative and Quantitative Strategies*. Berkeley, Los Angeles and London: University of California Press.
- Ragin C.C. (n.d.). *What is Qualitative Comparative Analysis (QCA)?*. http://eprints.ncrm.ac.uk/250/1/What_is_QCA.pdf
- Ragin, C. C.; Davey, S (2016). *Fuzzy-Set/Qualitative Comparative Analysis 3.0*. Irvine, California: Department of Sociology, University of California.
- Ragin, C. C. (2018). *User's Guide to Fuzzy-Set/Qualitative Comparative Analysis 3.0*. Irvine, California: Department of Sociology, University of California.
- Roig-Tierno, N.; Gonzalez-Cruz, T.F.; Llopis-Martinez, J. (2017) “An overview of qualitative comparative analysis: A bibliometric analysis”. *Journal of Innovation & Knowledge*, 2, i. 1, pp. 15–23. <https://doi.org/10.1016/j.jik.2016.12.002>
- Skaaning, S-E (2011) Assessing the Robustness of Crisp-set and Fuzzy-set QCA Results. *Sociological Methods & Research*, 40(2), pp. 391–408. doi:10.1177/0049124111404818
- Sun, F.; Chen, M.; Chen, J. (2011) *Integrated Management of Source Water Quantity and Quality for Human Health in a Changing World, Encyclopedia of Environmental Health*, Elsevier, pp. 254–265, ISBN 9780444522726, <https://doi.org/10.1016/B978-0-444-52272-6.00286-5>.
- Rihoux, B.; Lobe, B. (2009) Chapter 12: *The case for Qualitative Comparative analysis (QCA): Adding leverage for thick cross case comparison of The SAGE Handbook of Case-Based Methods*, SAGE Publications Ltd, ISBN: 978-1-4129-3051-2
- Thiem, A. (2015) Parameters of fit and intermediate solutions in multi-value Qualitative Comparative Analysis. *Qual Quant* 49, pp. 657–674. <https://doi.org/10.1007/s11135-014-0015-x>
- USDA (United States Department of Agriculture) (n.d.) *Water Management, Natural Resources Conservation Service*. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/>