What Works For Whom In Which Circumstances?
Managing Diversity Using Qualitative Comparative Analysis.

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ABSTRACT

Type of Paper: Working Paper.

Purpose: The one thing that unites the small business sector is its diversity. This paper argues that by explaining 'what works for whom in which circumstances' qualitative comparative analysis (QCA) manages this diversity and is therefore ideal for small business research.

Design/Methodology/Approach: The paper is based on a DBA research project which aims to explain successful information management in small business. The project is explicitly based upon critical realist theory, and uses QCA methods to identify complex causal mechanisms that neither variable-orientated nor single case methods can achieve. Instead, combinations of events in a small sample of cases will be systematically compared using Tosmana[1] QCA software (Cronqvist 2005) supported by document research and interviews where appropriate.

Findings: This is a working paper outlining proposed research design. Field work starts later this year - hopefully in conjunction with Sage UK (software not publishing) which is releasing radical new SME Business Intelligence (BI) software this autumn. The specific research objective is to identify the combinations of factors which explain successful BI adoption to allow similar small businesses to perhaps enjoy similar benefits.

Implications: The research will contribute to both knowledge and practice. The former will be achieved by providing an example of critical realist theory and QCA methods for other researchers in the small business sector to consider; the latter, by explaining the conditions in which BI software can transform the ability of small businesses to manage information to deliver business strategy.

Originality/Value: Critical realism as a philosophy to underpin research is unusual in the small business sector, although gaining increasing support in the information management field. QCA is usually the preserve of large, public policy type research, and this paper will be one of the first of its kind to introduce these techniques to both small business and information management audiences. The presentation will also be unusual in that (time permitting) it will include a live demonstration of appropriate QCA software.

Key Words: QCA, Critical Realism, Diversity / Complexity, Information Management.

INTRODUCTION

This working paper reflects recent work done as part of the research phase of the DBA programme at Durham Business School. Having completed my literature review, I am steeling myself for field work which is based largely upon qualitative comparative analysis (QCA) methods. Justifying this choice and explaining QCA's theoretical and practical potential are the primary aims of this paper.

QCA is a relatively new technique, and much of its development is being driven by a small band of enthusiasts in COMPASSS.[2] Centred in Belgium and the Netherlands, the leading European QCA 'evangelists' recently delivered a two week course on Systematic Qualitative Comparative Methods at the Essex University Summer School 2005.[3] I was fortunate enough to attend and am indebted to their teachings which shamelessly underpin a large part of this paper. The opportunity to introduce QCA into two new areas of academic research (small business and information management) means that I am optimistic they will forgive me for this indulgence.

My interest in QCA stems from earlier efforts to ensure a robust research design using a 'Research Diamond'. Addressing the ontological problem led to my developing an interest in critical realism, and its use of complex causal mechanisms to explain events resonated with the diversity that typifies the small business sector. Although critical realism advocates plurality in research methods, QCA's attention to causal patterns seemed an epistemologically sound approach to base much of my research upon. The availability of high quality QCA software to help build theory also appeals through a related interest in computer based qualitative research.

The first part of the paper looks at critical realism as a philosophy and systematic comparative analysis as a methodology. Although developed separately, there are strong theoretical reasons for using both to underpin research activity. The second part of the paper then goes on to look briefly at how QCA actually works using appropriate Tosmana software. The paper ends with a description of how these techniques will hopefully be put to good use in the imminent research project.

QCA IN THEORY.

Whether it is taken for granted, deemed irrelevant or simply foregone due to the pressures of academic work, explicit theoretical underpinning doesn't appear to feature highly in small business research. *A textual search through every one of nearly 200 papers published in the 27th ISBE National Conference (Newcastle Gateshead, 2004) found just three papers that included the word 'ontology' (or its derivatives) or 'epistemology'(or its derivatives).*[5] This is a shame, as attention to both can help select appropriate and interesting research methodologies and has guided much of the journey described in this paper.

Critical Realism. Bridging the Objective / Subjective Divide.

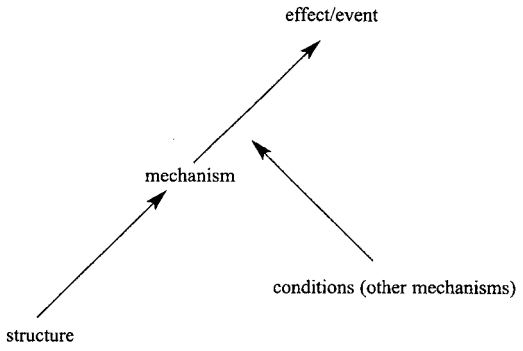
Readers will be pleased to know that word limits prohibit details of this journey, but it ended in a strong commitment to the philosophy of critical realism, which Sayer (2000) neatly summarises as an objective ontology combined with a subjective epistemology. This is not just some New Labour 'Third Way' spin; critical realism is a respected and carefully developed philosophy that is finding advocates in all areas. Miles and Huberman are just two and they 'see ourselves in the lineage of 'transcendental realism'.… that means we think that social phenomena exist not only in the mind but in the objective world – and that some lawful and reasonably stable relationships are to be found among them' (Miles and Huberman 1994: 4).

Critical realism is a theory of *being* (i.e. a theory of ontology) not primarily a theory about the *knowledge* of that being. Critical realism stratifies social reality into three different layers of social objects: *the real, the actual* and *the empirical* (Bhaskar 1978). The *real* is whatever exists, be it natural or social, and consists of the processes, structures, powers and causal mechanisms that generate events which may or may not be observed or active. The *actual*

refers to what happens if these powers are activated, and may include events that happen whether we observe them or not. The *empirical* is defined as the domain of experience i.e. what we *observe* to happen which may or may not help us to understand the actual and real domains beneath.

A key feature of critical realism is *causation* which emerges from structures which *'suggest a set of internally related elements whose causal powers, when combined, are emergent from those of their constituents'* (Sayer 2000: 14). Crucially for QCA, critical realism argues that whether these causal powers are ever exercised depends on the conditions or context in which they exist. Furthermore, critical realism's concept of causality differs from positivism's in that it emphasises the *tendency* of things to occur, rather than regular patterns of events. This tends to invalidate the conventional means of proving causation by gathering data on *regularities*, as what caused something to happen has nothing to do with the number of times it is observed happening. Instead, we need to identify the causal mechanisms and how they work, and discover if they have been activated and under what conditions (Figure 1).

Figure 1. Different views of causation



Source: Sayer (2000: 14-15)

Trying to understand these complex causal mechanisms in an open system is not easy, and a key aim of critical realism is to move from observable phenomena to the deeper (real) structures and the relations that govern them. The essential mode of inference required here is neither induction nor deduction but *retroduction* i.e. advancing from one thing (empirical observation of events) and arriving at something different (a conceptualisation of transfactual conditions). Critical realism aims to reveal the unacknowledged conditions, tacit skills and unconscious motivations that are necessary (but never sufficient) for an activity to take place. Critical realism doesn't mind how we go about exploring what it calls the intransitive dimension, and actively encourages plurality in research methodology (Mingers 2001).

Comparative Method. Bridging The Qualitative / Quantitative Divide.

Whilst critical realists were trying to bridge the realist / constructionist divide from an ontological perspective, others were more concerned with similar problems in methods. Specifically, the quantitative / qualitative divide in social research, some elements of which are summarised in Table 1.

Table 1. The Qualitative / Quantitative Divide

Feature	Qualitative	Quantitative
N	Very Small	Large
Cases	Known	Anonymous
Selection	Purposeful (MSDO / MDSO)	Preferably random
Relevance	Each case relevant	Outliers ignored
Complexity	High	Low
Causal Patterns	Possibly conjunctural	Correlational
Explanations	Thick	Thin
Predictions	Deterministic	Probabilistic
Validity	Internal	External
Range of Theory	Medium	Wide
Methods	Interpretive	Statistical

Source: Systematic Qualitative Methods, University of Essex, 2005

Until recently, one of the less obvious consequences of this divide was the inability to provide adequate tools to conduct *small-N* research i.e. 3-4 cases up to 50-100. Rihoux (2005) describes this as a battle between the 'science of words and science of numbers' and argues that neither qualitative nor quantitative methods are suited to correctly manage small-N cases.

At one extreme qualitative research examines similarities and differences among a limited number of cases; at the other quantitative research looks at relations between variables using samples to approximate large populations. The person widely regarded as originating many of the ideas discussed in this paper, Charles Ragin, calls these variable-orientated and case-orientated strategy respectively (1987).

In the variable-orientated approach, cases are aggregated into variables and their distribution analysed. Examination of patterns of variation among variables is used as a basis for making general statements about relations between aspects of cases. While the case-orientated approach avoids many of the simplifying assumptions of the variable-orientated approach, it cannot be used to address similarities and differences among *many* cases due to time issues.

Whilst case studies highlight complexity, diversity and uniqueness and provide a powerful basis for interpreting cases, it is very difficult to use this approach to examine more than a few cases at a time. A common resolution is to combine the two strategies in some way but this often presents inadequate, relativist results.

One answer to this problem is Ragin's qualitative comparative analysis. QCA uses all available and pertinent data concerning the pre-conditions of a specific outcome by examining their similarities and differences using Boolean algebra. QCA avoids linearity and additivity as it works not with samples or populations, but with all relevant instances of the phenomenon of interest. Ragin argues this method is superior to the statistical method in four respects (1987: 15).

1. Statistical methods are not combinatorial (i.e. relating to combinations of items selected from larger groups) and typically examine items piecemeal rather than looking at combinations of events,
2. Application of the comparative method produce explanations that account for every instance of a phenomenon,
3. There is no need to test for statistical significance of results,
4. The comparative method forces the researcher to become familiar with the cases investigated.

He goes on to argue that social scientists interested in discovery need to relinquish many of the homogenising assumptions that underpin quantitative methods. Instead he argues that researchers should focus on *diversity* instead. Diversity orientated research emphasises difference - especially differences in kind - using a configurational approach to social research. That is, it treats cases as specific configurations of aspects and features.

QCA is a synthetic approach that uses qualitative variables but formalised processing. As such, it belongs both to the quantitative world in terms of its methods and the qualitative approach in terms of its goals. Rihoux argues that it tries to reconcile both methods, but remains modest in terms of generalisation by moving beyond single-case description but rejecting 'Grand Theories' (2005).

It is important to remember that QCA does not to try to identify a *unique* causal model, but instead determine the number and nature of different models of causality that are at work in comparable cases (Ragin 1987). Causality is interpreted in terms of 'intersections of conditions' or what Mill called 'chemical causation' (Mill [1843] 1967), and the concept of *multiple conjunctural causation* is important here.

There are of course those who disagree with the comparative method and argue that quantitative methods *are* capable of explaining qualitative issues. King, Keohane and Verba (KKV) (1994: 75-91) disagree that quantitative research is merely descriptive, and argue that 'at its core, real explanation is always based on causal inferences' . Any failure to explain is not due to poor research or lack of imagination, but the nature of the difficult and significant problems in the data they are researching. 'Good description of important events is better than bad explanation of anything' (75).

For KKV, the definition of causality is crucial. They define causality as 'a *theoretical* concept independent of the data used to learn about it. Subsequently we consider causal *inference* from our data.' (original emphasis). They go on to look at different types of causality including the *causal mechanisms* proposed in critical realism, but dismiss these as being impossible to measure using their techniques due to problems with infinite regress. They find the idea of *multiple causality* more useful, and using Ragin's definition describe this as 'the phenomenon under investigation has alternative determinants' (Ragin 1987: 42). KKV acknowledge that the same outcome can be caused by combinations of different independent variables, but argue that they can manage this providing the counterfactual conditions are specified to avoid 'omitted variable bias'.

Ragin replies to them in Brady and Collier criticising their need for large samples and a lack of attention on the case (2004: 134). He counters their multiple causality argument by showing how a Boolean statement which requires a condition to be present in some cases but absent in others could, even with controls in place, result in no relationship (Pearson's *r* of 0) using traditional quantitative analysis of the bi-variate relationship.

Miles and Hubermann (1994 :40) are advocates of QCA, and argue it represents a good method of cross-case analysis. They stress that researchers need to understand case dynamics and the key effects of key case attributes or variables, and that QCA '… does this: you can analyze multiple cases, using key variables, preserving their configurations case-by-case' (1994 :208). As critical realists they believe researchers should be interested in exploring causal relationships, and strongly support iterative display and analysis to do this. Data displays, or the 'organised, compressed assembly of information' are vital to enable interpretations of any emerging conceptual framework (Ibid : 80).

Whilst much of QCA theory clearly resonates with critical realism, it is interesting to note that much of QCA's development was initiated by those unaware of the work of Bhaskar or his followers (although Ragin is now interested in this philosophy). An even earlier exponent was Florian Znaniecki who in 1934 was critical of what he called 'enumerative induction' i.e. attempts to generalise by statistical means from a large number of cases across which were aggregated the properties of many individuals (Znaniecki 1934). He argued that what results are superficial aspects of a particular phenomenon, and contrasts enumerative induction with what he regards as the proper method of sociology – natural sciences (as does Bhaskar (1989)). This involves the study of a single or small number of cases in depth, yet still allows for specification of universals by making deterministic statements about properties and the conditions in which they appear.

Like QCA, negative cases are important and due to the need to modify existing formulation analytic induction is also a stepwise procedure. Although rebuked in the 1950s by Robinson (1951) because of its divergence between what happened in theory and practice, Hicks (1994) suggests that QCA has affinity for neo-analytic induction by extending classic analytic induction in three ways. First, like classic analytic induction, in practice it now looks at both positive and negative cases. Second, instead of a succession of single cases it looks at multiple-case comparisons. Finally, whilst classic analytic induction aspired to universal solutions, neo-classic analytic induction is happy to accept 'reasonable' theoretical closure. *The aim is development of theory, rather than theory testing.*

QCA IN PRACTICE. COMPLEXITY MADE SIMPLE.

Although relatively new to social sciences (Ragin's first book was published in 1987), the classic logic, truth tables and set theory at work in the QCA 'Black Box' go back a long way.

Gottfried Leibniz in the seventeenth century dreamt of a simple language of 0s and 1s, and provided much of the classic logic and truth table theory. George Boole later turned this dream into reality through Boolean algebra. John Venn was another who's ubiquitous diagrams prove invaluable in helping understand simple QCA logic. More recently, Willard Quine provided the algorithms that power much of QCA software.

Qualitative comparative analysis uses Boolean algebra in a truth table to help understand causal complexity. In Ragin's (1987) work, he uses 'crisp' sets of data i.e. a dichotomous set where an object is either in or out of a set and can therefore be expressed as a binary variable with two values '1' or '0'. Recent advances have enabled multiple value and fuzzy set approaches to overcome this potential restriction, but crisp sets still work well and are used for our illustration.

Converting qualitative characteristics into Boolean algebra allows us to manipulate them in a number of ways. We typically write a condition in uppercase if is present and lowercase if not. Supposing we had only two cases with combinations of three conditions – A.b.C and A.B.C. – and both led to successful outcome Z, then we could write the Boolean formula (where '+' means logical 'or' and '.' means logical 'and') as:

$$A.b.C + A.B.C = Z$$

Logical minimisation says that if outcome Z occurs no matter whether B is present or not, then it is irrelevant and can be removed. The formula can therefore be reduced to:

$$A.C = Z$$

As Ragin puts it: '*If two Boolean expressions differ in only one causal condition yet produce the same outcome, then the causal condition that distinguishes the two expressions can be considered irrelevant and can be removed to create a simpler, combined expression.' (Ragin 1987: 93)*

The following example introduces both simple QCA mechanics and Tosmana software which automates these operations and has in-built didactic tools to help explain what is going on. Although based on training material used by Rihoux (2005) it is not designed to be a comprehensive tutorial on the subject. For such assistance (and much more) visit the COMPASSS web site.[2]

For our example let's stay with some of the people who have contributed to QCA over the years. A brief list provides:

- George Boole (inventor of Boolean algebra)
- John Venn (inventor of Venn diagram)
- Gottfried Liebnitz (inventor of classical logic and truth tables)

- Benoit Rihoux (leading proponent of QCA techniques)
- Sakura Yamasaki (leading researcher of QCA techniques)
- Lasse Cronquist (author of Tosmana software)
- Charles Ragin (leading proponent of QCA techniques)
- Willard Quine (inventor of Boolean minimisation algorithms)

If we treat each of these as a *case*, we might want to find out the causal mechanisms that *explain* their common interest in QCA. We can do this by choosing conditions or characteristics (Tosmana calls them variables) that we think might explain the common outcome and analyse them. This sounds daunting even with this simple group, but by using logic, Boolean algebra and set theory it becomes much easier.
At this stage let's look at just three characteristics. Because I know something about the development of QCA theory and our cases already (case familiarity is a critical pre-condition of QCA) I know that both mathematicians and political scientists have been closely involved – many of whom have long since departed this world. I also know that there is a cluster of expertise in Northern Europe whilst Charles Ragin originated from Northern America.

To try to make some sense of all this, I decide to analyse my cases in terms of whether they are European, Mathematicians and still Alive. Treating these as sets, even three conditions means there are 8 possible zones (2^3) that our cases could reside in (e.g. Mathematician, European and Alive). By joining cases together (using logical 'and' 'or' 'not') we can create new objects and even at this level have 256 possible combinations (2^8) to cope with. *It is these combinations that create the complexity encountered in the real world, but with QCA techniques and supporting software we can try to explain this.*

Our first task is to convert qualitative characteristics into dichotomous variables to permit the subsequent Boolean manipulation. Even in this simple example, this is no easy task. Whilst being alive or dead, mathematician or otherwise is reasonably straightforward, the definition of European may prove problematic for say, a Turkish case.[6] The data is then displayed in a data matrix as advocated by Miles and Huberman (1994) and shown in Table 2.

Table 2. Raw Data Matrix

Name	European	Mathematician	Alive	Outcome
Liebnitz	1	1	0	1
Venn	1	1	0	1
Boole	1	1	0	1
Rihoux	1	0	1	1
Yamasaki	0	0	1	1
Cronquist	1	0	1	1
Ragin	0	0	1	1
Quine	0	1	0	1

The column on the extreme right defines the successful outcome, which in this example is 'Contribution to QCA'. Later we will see how the inclusion of *unsuccessful* outcomes is critical to a thorough analysis, but for now we'll simply use QCA and Tosmana to help visualize and simplify our understanding of our cases. Entering the data into Tosmana is straightforward as Figure 2 shows.

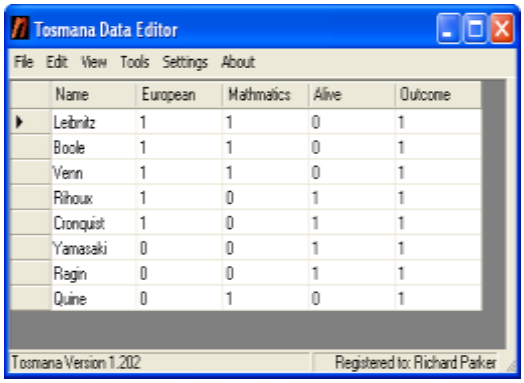


Figure 2. Tosmana Data Editor

Running MVQCA allows you to select case descriptor, independent and dependent variables, and then analyse these in various ways. Asking it to explain successful (1) outcomes provides the report shown in Figure 3.

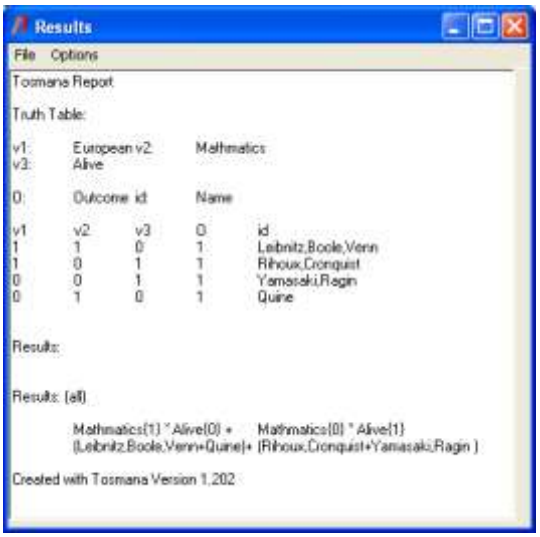


Figure 3. Tosmana Results Display

The first part of the report is a Truth Table that lists all the cases with similar configurations e.g. Leibnitz, Boole and Venn are all European (v1=1), Mathematicians (v2=1) and Dead (v3=0). This in itself is a useful feature with larger case numbers and variables.

'Results' shows the result of the Boolean minimisation algorithm i.e. that our 'Contributor to QCA' outcome is explained by two just terms (note: Tosmana shows logical 'and' as ' * '):

- Either being a dead mathematician (Mathematics (1) and Alive (0))
- Or being an alive political scientist (Mathematics (0) and Alive (1))

These lowest possible reductions are called *prime implicants*. It then lists the relevant cases beneath each prime implicant. *Notice that being European or otherwise is irrelevant and has been removed from the solution.*

This might seem hard to grasp, but the software author has kindly provided a 'Visualizer' function to show this graphically. Although the software can technically cope with unlimited conditions (although practical considerations usually limit this to ten) it is physically possible to only show three.[7]

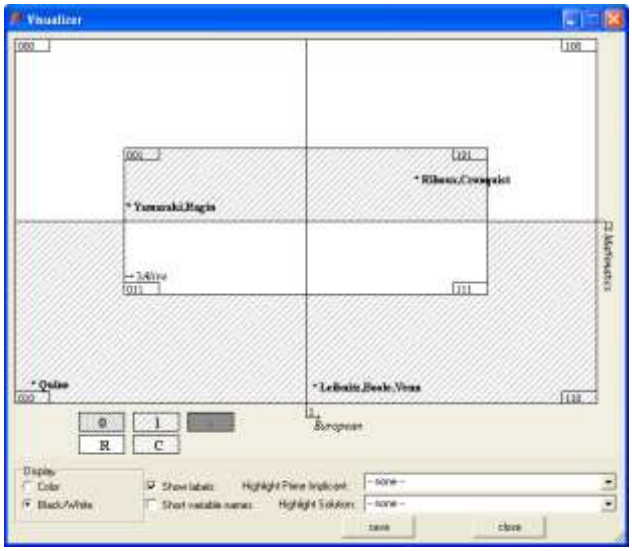


Figure 4. Tosmana Visualizer, Minimised for Outcome = 1

Figure 4 is a three dimensional Venn diagram (technically a Carroll diagram) that simultaneously delimits and structures our cases and variables. It is divided up by:

- A horizontal line which divides Mathematics (1, below) and Non-Mathematics (0, above)
- A vertical line which divides European (1, right) and Non-European (0, left)
- A rectangle in the middle which divides Alive (1, inside) and Not Alive (0, outside)

Each of the eights parts or zones has its Boolean characteristics in the bottom corner (e.g. bottom, left, outside rectangle = 010 i.e. Not European, Mathematician, Not Alive). The shaded area highlights all the zones which include successful outcomes (1) whist the non-shaded areas are labelled 'R' for Remainder.

Remainders are zones for which no cases were observed and whilst sometimes interesting in themselves (do you have to be dead to be considered a good mathematician?) have important implications for more complex minimisations (where they are, or are not included) that are beyond the scope of this paper. Finally, individual cases can be shown in their relevant zones.

But there's more. The software can be asked to explain its results and in Figure 5 the prime implicant 'dead mathematician' is highlighted using horizontal lines (it's much better in colour).

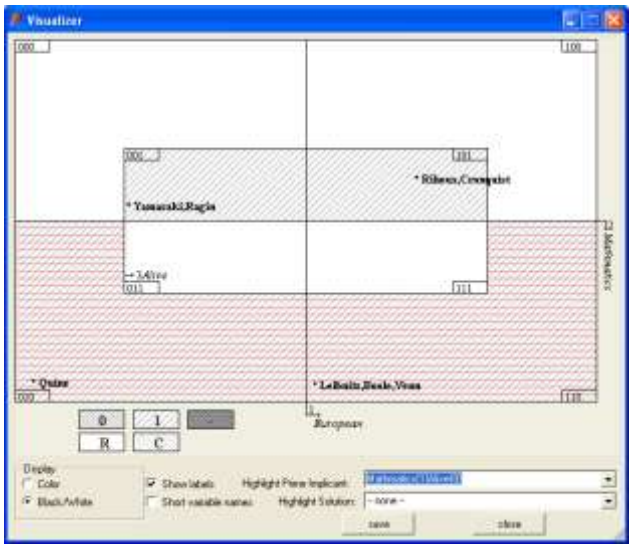


Figure 5. Tosmana Visualizer, Prime Implicant = Mathematician & Dead

Similarly, the living political scientists term can also be shown (Figure 6).

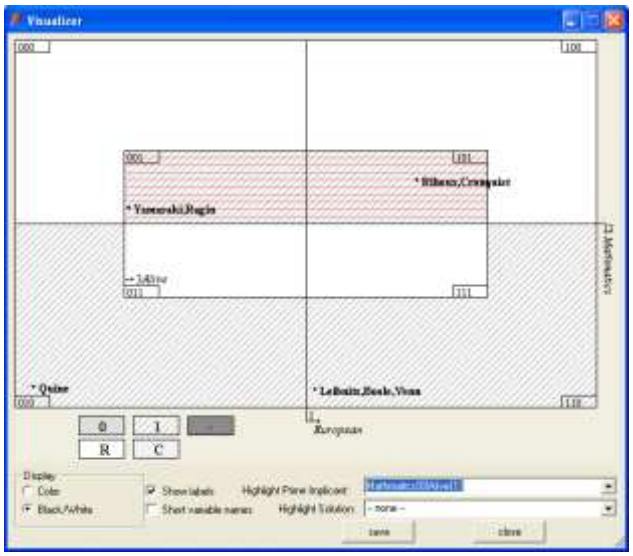


Figure 6. Tosmana Visualizer, Prime Implicant = Non-Mathematician and Alive

A term is a 'blanket' that covers part of the graph. Using the convention described above, the complete result as:

M.a + m.A
Mathematician and Dead or Non Mathematician and Alive

This actually makes some sense. *What is tells us is that elements of QCA were originally developed by very clever mathematicians often hundreds of years ago, and whose ideas have more recently been taken up and used by political scientists to help them explain complex causality in case-based research.*

Cynical readers will argue that this result doesn't tell us any more than we suspected at the start – apart perhaps from the irrelevance of geographical origin. They would be correct, but this example simply shows QCA in action. If part of a critical realist research project *genuinely* looking at origins of QCA, *such results (doubtless using different conditions and cases) will be used retroductively to translate these empirical observations into an understanding of unseen structures and causal powers at work in academic theory development.*

If Only It Were That Simple …

The above example might help jog memories for those of us who slept through Boolean algebra at school and demonstrate some impressive software, but its link to reality is somewhat tenuous. Whilst the people chosen have clearly contributed (knowingly or un-knowingly) to the development of QCA, the variables chosen to explain this do not tell the whole story. There are plenty of dead mathematicians and living political scientists who have *not* contributed to QCA.

This illustrates the importance of adding *unsuccessful* cases to the QCA analysis.[8] Just by adding a dead mathematician (Leibniz's rival – Isaac Newton) and a dead political scientist (Karl Marx) neither of whom contributed directly to the development of QCA, our model starts to struggle (Figure 7).

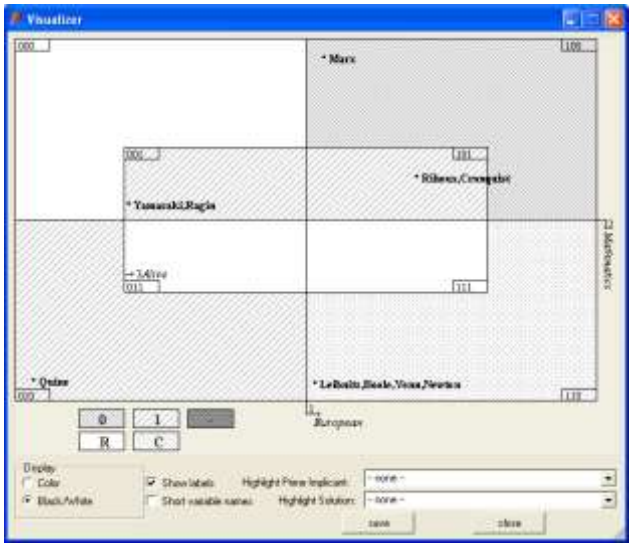


Figure 7. Tosmana Visualizer With Logical Contradiction

Whilst Marx happily occupies a new '0' Outcome in the dead, European political scientist zone in the top right (and actually re-enforces the previous solution), Newton joins the dreaded Leibniz, Boole and Venn in the dead, European mathematician zone in the bottom right. This presents a *logical contradiction* that has to be resolved before minimisation can proceed i.e. it is impossible for cases with identical characteristics to produce different outcomes.

There are several ways to resolve such a contradiction. These might include re-examining case configurations as a whole (Newton's mathematical legacy might well contribute to QCA in some way), re-examining and possibly changing dichotomisation, moving from crisp value to Multi Value QCA or Fuzzy Set QCA, adding more conditions to differentiate cases better (the living political scientists issue may be resolved by adding an 'interested in small-N research' condition), or finally removing the contradictory / outlier cases (i.e. cheating!).

QCA Best Practice

The chances of encountering such problems can be reduced by adhering to the following five step procedure (Rihoux, 2005):

Step 1. Qualitative Description Of The Cases. Rihoux regards this phase as indispensable for both intrinsic value and to gauge the richness and complexity of individual cases. Ragin concurs and stresses the need for familiarity with the theory, literature and 'most important of all, the relevant cases'. (Ragin 1987)

Step 2. Data Reduction To A Set Of Binary Variables. We need to choose one outcome and a number of characteristics / variables / conditions / causes. The number of variables is best between three and nine. Multiple value variables can be managed using MVQCA or fsQCA (see below) but multiple *outcomes* can only be managed by creating separate truth tables. The choice of variables and their dichotomisation must be both theoretically and empirically informed.

Step 3. Produce Quality Truth Table. Transforming a table of dichotomised data into a truth table (list of types of configurations) is easily done using QCA software, and allows a much clearer picture of the data. A quality truth table must be free of contradictions, and is often useful to highlight non-observed cases (remainder or logical) cases.

Step 4. Run Boolean Minimisation. This removes redundant conditions to reduce the cases to a number of prime implicants. Logical remainders may be included to make the final terms as short as possible. We always have to perform four analyses – minimising successful

configurations with and without remainders, and minimising unsuccessful configurations with and without remainders.

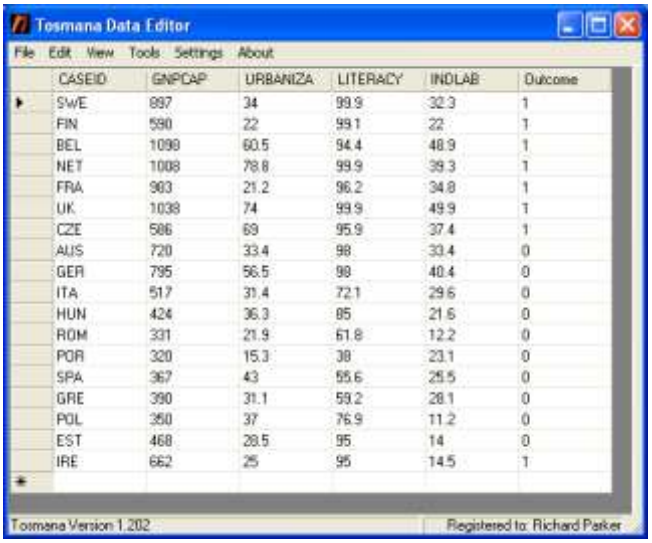
Step 5. Interpretation of Minimal Formula. The results need to be interpreted and this will usually require the researcher to return to both the theory and the cases. The process will probably need repeating before an acceptable result is obtained and repeated iteration between data, theory and cases is a key feature of QCA methods.

Multi Value QCA

Although this paper is a far from exhaustive review of QCA methods, two recent developments and their associated software are worthy of mention.

The first is Multi Value QCA (MVQCA) which was created by Lasse Cronqvist and has many technical and conceptual advantages over crisp or dichotomous QCA.[9] Its main use is to reduce the number of contradictory cases by permitting a *range* of ordinal variables (e.g. High, Medium, Low) instead of dichotomous '0' or '1'. This feature has to be used sparingly however, or it will produce 'individuality' of cases with limited common combinations of features.

Unlike fsQCA which uses fuzzy set scaled variables with probabilistic tests to avoid dichotomous measurements (Ragin, 2000), MVQCA retains the original objective of producing a parsimonious solution: 'The solution contains one or more *implicants* which each cover a number of cases with this outcome, while no cases with different outcomes are explained by any of the implicants' (Cronqvist 2005: 2). MVQCA uses the ideas of Multi-Value Logic Synthesis developed by electronic engineers at Berkeley University (Brayton and Khatri 1999).



CASEID	GNPCAP	URBANIZA	LITERACY	INDLAB	Outcome
SWE	897	34	99.9	32.3	1
FIN	590	22	99.1	22	1
BEL	1090	60.5	94.4	48.9	1
NET	1008	78.8	99.9	39.3	1
FRA	903	21.2	96.2	34.8	1
UK	1038	74	99.9	49.9	1
CZE	586	69	95.9	37.4	1
AUS	720	33.4	98	33.4	0
GER	795	56.5	98	40.4	0
ITA	517	31.4	72.1	29.6	0
HUN	424	36.3	85	21.6	0
ROM	331	21.9	61.8	12.2	0
POR	320	15.3	38	23.1	0
SPA	367	43	55.6	25.5	0
GRE	390	31.1	59.2	28.1	0
POL	350	37	76.9	11.2	0
EST	468	28.5	95	14	0
IRE	662	25	95	14.5	1

Figure 8. Tosmana Data Editor, Ordinal Values

When running with MVQCA data, the Tosmana data tables looks very different (Figure 8). Whilst the outcomes remain dichotomous, the condition variables are ordinal values.

Tosmana helps by grouping these values into sets by using a 'Threshold Setter' to choose and evaluate appropriate ordinal thresholds. In Figure 9, three sets are created: less than 500, 500 to 845 and greater than 845. Changing thresholds is a matter of simply 'dragging' the vertical lines or adding new ones.

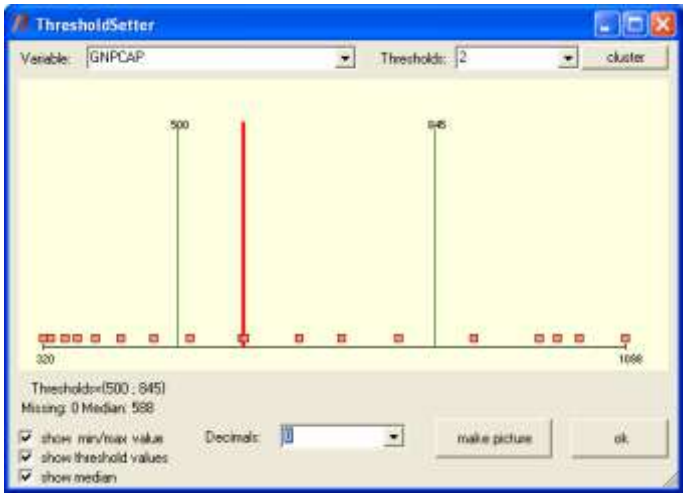


Figure 9. Tosmana Threshold Setter

Fuzzy Set QCA

Ragin (2000) has gone on to develop his arguments further by using fuzzy set techniques to replace dichotomous sets. Fuzzy sets define membership in the interval between zero and one whilst still relating to qualitative states, and make it '*possible to extend and deepen diversity-orientated research strategies'* (Ibid: 5).

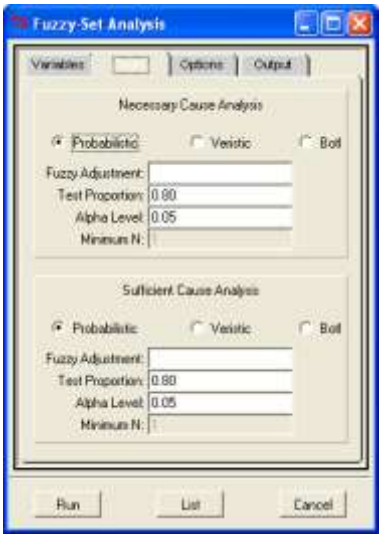


Figure 10. fsQCA – Test Settings for Necessary and Sufficient Analysis

Whilst MVQCA still uses crisp sets for analysis, in fsQCA the boundaries of the set become blurred. Furthermore, fsQCA uses probabilistic numbers and therefore needs to work on larger numbers of cases to produce reliable results. As a rough guide MVQCA works well up to 50 cases, fsQCA from 30 upwards; either can be used in the 30 to 50 range.[10]

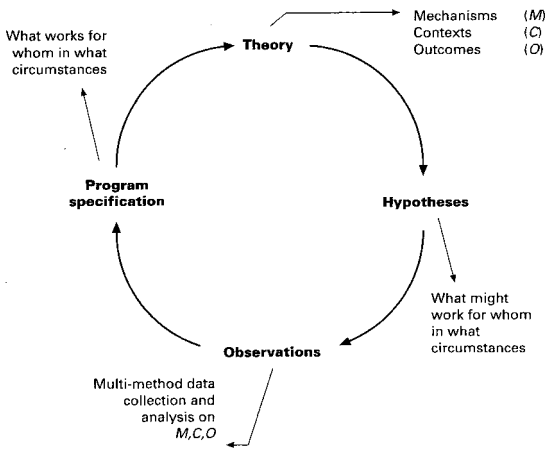
Figure 11. fsQCA Necessary and Sufficient Cause Analysis Results

Another difference is that fsQCA use continuous scales not ordinal data. The scales are of equal grade and because it is probabilistic, fsQCA looks for necessary and sufficient causes. It is important to realise these are *not* prime implicants, as fsQCA does not use Boolean algebra. To change ordinal data thresholds, adjustments to the probability threshold (e.g. 60%) and probability of error (e.g. 5%) are required to adjust the result's sensitivity. Figures 10 and 11 show how test proportion and alpha levels can be adjusted until a statistically significant result is achieved.

CONCLUSIONS AND NEXT STEPS

By explaining complex causal relationships in small numbers of cases, critical realist ontology and QCA methods work well together and are ideally suited to handle the diversity found in small business. Both will underpin the 'Observations' phase of the realist evaluation cycle adopted in my subsequent research, to hopefully identify 'what works for whom in which circumstances' (Pawson and Tilley 1997).

Table 3. The realist evaluation cycle



Source: Pawson and Tilley (1997: 85)

But QCA and the critical realist philosophy which support it have far wider implications for small business and information management research.[11] Rihoux (2005) suggests QCA can add value to such research by:

- Enabling the analysis of more than a few cases at a time thus enabling a certain amount of generalization.
- Enabling a controlled observation of cases by careful selection and grading of conditions.
- Using the conception of causality to logically manage complexity.
- Reducing complexity by identifying causal regularities (prime implicants) which can be expressed without reproducing all potential explanatory variables.
- Combining holistic (each case is treated a whole) and analytic (each case is sliced into variables) perspectives.
- Encompassing qualitative (differing by nature) and quantitative (differing by degree) phenomena.
- Allowing replication through formal Boolean analysis and transparent methods.
- Providing simplicity and accessibility by avoiding complex statistical processes.
- Offering different uses including data description, theory development and hypothesis testing.
- Supporting different fields of research including politics, public policy and management.

The are many excellent examples of QCA-based research, but the large majority are in the field of retrospective, political science (Coverdill and Finlay 1995; Kompier, Cooper et al. 2000; Kitchener, Beynon et al. 2002), etc.[12] However, as Miles and Huberman state 'QCA clearly has the potential to go beyond the historical and cross-national contexts originally envisaged by Ragin' (1994: 162).

This project will go into that beyond!

NOTES

1. Tosmana stands for Tool for Small-N Analysis.

2. The COMPASSS web site can be found at http://www.compasss.org/. Make sure you add 3 Ss.

3. The course was delivered by Prof. Benoit Rihoux and Prof. Dirk Berg-Schlosser with teaching assistants Lasse Cronqvist and Sakura Yamasaki. Details at http://www.essex.ac.uk/methods/Courses2005/2K05.htm.

4. Ontology or derivatives were explicitly mentioned in (Knowles, Mughan et al. 2005: 7) (Barbosa 2005: 11) (Morris 2005: 11). Epistemology or its derivatives in Morris only.

5. I also suspect that Sakura Yamasaki was born in Japan but was brought up in France, so am unsure of her exact nationality. I guess Lasse Cronqvist is pretty handy at maths too, and may resent a 0 for this condition!

6. For a fascinating story about the history of Venn diagrams and visual images of up to 14 set diagrams, read Edwards (2004).

7. Something Peters and Waterman and other 'Airport Lounge' authors would do well to consider.

8. For more information on MVQCA and Tosmana see Cronqvist (2003; 2003; 2005; 2005; 2005) plus the Tosmana web site at http://www.tosmana.net/. For information on Computer Assisted Qualitative Data Analysis (CAQDAS) in the UK visit http://caqdas.soc.surrey.ac.uk/index.htm,

9. Advised verbally by Lasse Cronqvist at Essex Summer School 2005.

10. Explicit support for critical realism seems more prevalent in information management research. See (Mutch 1997), (Mutch 1999), Morton (2003), Dobson (2001), (Dobson 2002), Mingers (2001) and (Carlsson 2002).

11. For access to these and other QCA papers, visit the very comprehensive resources of QCA material at www.compasss.org.

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