TOC for Academic Research
Moving from common sense to common practice

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Weaving threads ...

Naku te rourou nau te rourou ka ora ai te iwi
*With your basket and my basket, the people will live*
*(Maori proverb)*
Aim

• Demonstrate how ‘threads of validity’ may be woven into academic research by using both TOC-based and qualitative research methods

Gap

• Many studies have sought to enhance validity in qualitative research
• Yet, researchers still face many difficulties ensuring validity in their research:
  – Constructing initial workable research questions
  – Research design
    • collecting the right data
  – Data analysis
    • making sense of the data
  – Communicating the findings clearly
• Researchers have not addressed how threads of validation may be woven into the various stages of the research process

Question:
• Can TOC enhance validity in qualitative research and vice versa?
• Demonstration projects
  – 4 Masters projects
  – 3 PhD projects

• Methodology
  – Qualitative research
  – TOC methodology
<table>
<thead>
<tr>
<th>Researcher</th>
<th>Degree</th>
<th>Year</th>
<th>Context</th>
<th>TOC Research Tools used</th>
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<tbody>
<tr>
<td>Kathryn Jarden</td>
<td>MMS</td>
<td>2005</td>
<td>Production decisions at Fonterra</td>
<td>5 FS, CRT, EC</td>
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<tr>
<td>Garoon Pongsart</td>
<td>MMS</td>
<td>2005</td>
<td>Research student thesis completion</td>
<td>EC, CRT, FRT, PRT</td>
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<td>Robyn Moore</td>
<td>MMS</td>
<td>2009</td>
<td>Sustainable water management</td>
<td>IO Maps, CRB/CRT, EC, PRT</td>
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<td>Dos Santos</td>
<td>MLSCM - Massey</td>
<td>2012</td>
<td>Procurement in Timor-Leste</td>
<td>CRT, EC, FRT, PRT</td>
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<tr>
<td>Garoon Pongsart</td>
<td>PhD</td>
<td>2015</td>
<td>Research student thesis completion</td>
<td>IO Maps/Goal Tree, CRT, EC, FRT, PRT</td>
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<tr>
<td>Sarah Kimani</td>
<td>PhD</td>
<td>2015</td>
<td>Quality of learning and teaching in higher education</td>
<td>Change sequence framework: Goal tree, CRT, EC, FRT</td>
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<tr>
<td>Maryam Mirzaei</td>
<td>PhD</td>
<td>2016</td>
<td>Project management</td>
<td>5FS, SOSG, freeform use of TP (CRB’s, EC’s)</td>
</tr>
<tr>
<td>Steps</td>
<td>... in the research process</td>
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<tr>
<td>Step 1</td>
<td>Research questions</td>
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<tr>
<td></td>
<td>asking the right questions</td>
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<tr>
<td>Step 2</td>
<td>Research design</td>
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<tr>
<td></td>
<td>ensuring the research can answer the questions</td>
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<tr>
<td>Step 3</td>
<td>Data collection</td>
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<tr>
<td></td>
<td>collecting the right data</td>
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<td>Step 4</td>
<td>Data analysis</td>
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<td>making sense of the data</td>
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<td>Step 5</td>
<td>Communicating the findings</td>
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<td></td>
<td>making it clear for the reader</td>
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<td>Step 6</td>
<td>Review/reflection, limitations</td>
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<td></td>
<td>what next?</td>
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Step 1: Constructing the RQ

• Validity procedures in qualitative research
  – Comprehensive literature analysis
    • Focus on gaps

• Validity procedures in TOC
  – SOSG provides questions and structure for exploratory study
    • Focus on giants and faulty assumptions
  – 5FS and TOC’s change sequence provides default RQ’s
Step 2: The research design

Procedures that enhance validity in qualitative research

- Definition of lens used by researcher / paradigm assumptions
  (Healy & Perry, 2000)
- Development of data collection instrument (Theoretical framework)
  (Yin, 2009)
- Data collection and fieldwork procedures
  (Yin, 2009)
  • Credibility of researcher, meticulous recording of data
  • Documentation, interviews, observation
- Data preparation and pre-analysis
  (Yin, 2009)
  • Pre-coding, unitising
- Triangulation of data sources
- Human Ethics protocols
Step 2: The research design contd ...

- Validity procedures in TOC methodology
  - Sequential data collection and analysis that will be guided by the TOC frameworks/theory

- 5 Focusing Steps (5FS) framework
  - Identify the system’s constraint
  - Decide how to exploit the system’s constraints
  - Subordinate everything else to the above decision
  - Elevate the system’s constraint
  - If anything has changed, go back to step 1

- Change sequence framework
  - Why change?
  - What to change?
  - What to change to?
  - How to cause the change to happen?
  - How to measure and sustain change? (Cox et al., 2012)

- Standing on the Shoulders of Giants (SOSG)
## Application of Theory of Constraints to Fonterra Kapuni

*Kathryn Jarden, MMS, 2005*

<table>
<thead>
<tr>
<th>Qualitative research methods</th>
<th>TOC</th>
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<tbody>
<tr>
<td><strong>Case study research</strong></td>
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<tr>
<td>Choosing theoretical framework</td>
<td>TOC concepts and Philosophy</td>
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<tr>
<td>Data collection</td>
<td>TOC methodology for creating EC</td>
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<tr>
<td>Participant observation</td>
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<tr>
<td>Structured interview</td>
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<tr>
<td>Unstructured interview</td>
<td></td>
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<tr>
<td>Data analysis</td>
<td>EC and CRT</td>
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<td>Qualitative analysis</td>
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<tr>
<td>Quantitative analysis</td>
<td></td>
</tr>
<tr>
<td>Time series, Spreadsheet LP</td>
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</tr>
</tbody>
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**5 FS:**
1. Identify constraint
2. Exploit the constraint
3. Subordinate
4. Elevate
5. Go back to step 1
Step 2: Research Design: Five key questions to guide change

1. Why Change?
   - Goal Tree
   - List of Undesirable Effects

2. What to Change?
   - Current Reality Tree
   - Evaporating Cloud

3. What to Change to?
   - Evaporating Cloud
   - Future Reality Tree
   - Negative Branch Reservation

4. How to cause the change?
   - Prerequisite Tree/ IO Map
   - Transition Tree
   - Strategy & Tactics Tree

5. How to sustain the change?
   - Use the right measures
   - Repeat?
Standing on the Shoulders of Giants (SOSG) and the abductive research approach

Exploring applicability of TOC to projects: Critical Chain Project Management and beyond
Maryam Mirzaei PhD 2016

1. Identify a ‘giant’, not a chupchick

2. Identify the enormity of the area not addressed by the giant

3. Get on the giant's shoulders
Gain the historical perspective

4. Identify the conceptual difference between the reality that was improved so dramatically by the giant and the area untouched

5. Identify the wrong assumption
6. Conduct the full analysis to determine the core problem and develop solutions.

Application of conclusions

Reference: Kovacs & Spens, 2005
Step 2: The research design contd..

- Typical questions used in TOC TP analysis
  - **EC framework with 8 Standard questions** (Cox, Blackstone & Schleier, 2003: 90-91)
    - What is the problem (UDE) from your perspective?
    - How is the UDE undesirable or bad?
    - In what ways is it undesirable?
    - Why do you put up with the UDE?
    - What objective is being jeopardised by the UDE?
    - Is there a specific action resulting from the UDE?
    - Is there a specific action causing the UDE?
    - Does this UDE create a conflict?

- **Goal tree framework**
  - Identify the system goal
  - Identify the critical success factors (CSFs) for achieving these goals, and
  - Identify the necessary conditions (NCs) needed to bring about the critical success factors (Dettmer, 2011).

- Analysis to be guided by CLR
- Triangulation e.g. 3-cloud method
Step 2: Research Design: Combining Qual and TOC methods

Postgraduate Students’ Constraints in doing a master’s degree thesis  *Garoon Pongsart MMS, 2005*

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Questionnaire Survey</td>
<td>Identifying generic UDEs</td>
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<td>Semi-Structured Interview</td>
<td>EC</td>
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<td>Transcription &amp; content</td>
<td>Develop generic EC</td>
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<tr>
<td>analysis</td>
<td>CRT</td>
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<tr>
<td>Focus group</td>
<td>Develop generic CRT</td>
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<td>FRT</td>
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<td>PRT</td>
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</tbody>
</table>
Step 3: Data collection

- Qualitative research protocols:
  - Implementing the data collection plan
    - Conducting focus groups and semi-structured interviews
    - Using interview guides
      - Data collection & field procedures
        - Observance of conditions of approved ethical processes
        - Consent forms
        - Conversations tape recorded with permission
        - Flip charts, notes
        - Transcribing
        - Notes checked with interviewees (member checking)
        - Security of info / confidentiality …
    - Precoding / pre-analysis
    - Saturation

Example: Kimani (2015) using above protocols and TOC diagrams
Step 3: data collection cont…

Exploring … Kimani PhD (2015)
Step 4: Data analysis

Making sense of data

• Validity procedures in qualitative research
  – Checking for representativeness
  – Confirmability (Yin, 2009; Lincoln & Guba, 1982)
  – Causal explanations (Maxwell, 2004)
  – Auditability & detailed descriptions (Patton, 1999; Yin, 2009)

• Validity procedures in TOC
  – Use of SOSG
  – Logic protocols as per CLR’s (Cox, et al, 2012)
  – Tree diagram scrutinisers/experts (Cox, Blackstone & Schleier, 2003)
Step 4: Data analysis

- **Validity procedures recommended in qualitative research:**
  - Deliberate choice of logic used: Induction, deduction or abduction (Patton, 1999)
  - Triangulation of data analysis techniques (Patton, 1999)
  - Unitisation/clustering (Saunders et al, 2007)
  - Making comparisons, noting similarities & differences (Miles & Huberman, 1994)
  - Building logical chains of evidence (Miles & Huberman, 1994)
  - Thematic analysis
  - Document analysis
  - Making conceptual coherence (Miles & Huberman, 1994)
  - TOC project illustrations: Abductive approach, triangulation, ... (Mirzaei, 2016)
<table>
<thead>
<tr>
<th>Focus Group</th>
<th>Critical Success Factors (CSF)</th>
<th>Necessary Conditions (NCs)</th>
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<tbody>
<tr>
<td>KM1</td>
<td>Up-to-date learning resources</td>
<td>Capacity in terms of books</td>
</tr>
<tr>
<td></td>
<td>{CSF1}</td>
<td>University needs finances to update the resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right accommodation</td>
</tr>
<tr>
<td>KM2 (FT)</td>
<td>Committed lecturers and tutors</td>
<td>Commitment</td>
</tr>
<tr>
<td></td>
<td>{CSF2}</td>
<td>Hardworking</td>
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<td></td>
<td></td>
<td>Wide-knowledge in their field of specialization</td>
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<td>Good teaching methodologies which include practical learning</td>
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<td></td>
<td>Self-disciplined and hard-working student</td>
<td>Self-discipline</td>
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<tr>
<td></td>
<td>{CSF3}</td>
<td>Right learning attitude</td>
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<td></td>
<td>Teamwork between students and students and lecturers (NC5)</td>
<td>Group/team work</td>
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<tr>
<td></td>
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<td>Through use of class assignments</td>
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<td></td>
<td></td>
<td>Hold social contexts such as team building</td>
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<tr>
<td></td>
<td>Maintaining a positive attitude as students</td>
<td>Attending motivational talks</td>
</tr>
<tr>
<td></td>
<td>{CSF3}</td>
<td>Approach challenges and opportunities more courageously</td>
</tr>
<tr>
<td></td>
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<td>Reading widely {CSF3}</td>
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</table>
Step 4: Data Analysis: Goal Tree (Kimani, 2015)

Goal
- Help students to synthesise, apply & communicate knowledge & skills in changing situations

CSF1: Ensure all lecturers' have capacity to deliver the program
- NC1: Provide ongoing professional development (PD)
- NC2: Provide strong administrative support
- NC3: Ensure good recruitment & hiring practices

CSF2: Ensure students' develop capability
- NC4: Provide IT support & technological skills
- NC5: Provide adequate resources (study spaces, close interactions)

CSF3: Ensure continuous improvement of program design (practical knowledge)
- NC6: Provide motivation (acknowledgements & rewards)
- NC7: Make PD accessible & meaningful
- NC8: Provide adequate funding/ongoing development

NC9: Provide clear communication & understanding of the L&T goal
**Step 4: Data analysis – SOSG process**

Exploring applicability of TOC to projects: Critical Chain Project Management and beyond *Maryam Mirzaei PhD 2016*

<table>
<thead>
<tr>
<th>TOC</th>
<th>Qualitative research methods</th>
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<tbody>
<tr>
<td>SOSG</td>
<td></td>
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</table>

1. Identify a "giant“
2. Identify enormity of issue
3. Get on the giant's shoulders
4. Identify difference between improved reality and the area still untouched
5. Identify the wrong assumption
6. Conduct the full analysis to determine the core problem, solution, etc.

**Empirical**
- Deviating real-life observations
- Application of conclusions

**Theoretical**
- Prior theoretical knowledge
- Theory matching
- Theory suggestion

- Literature review
- Secondary data
- Case study
- Literature analysis and text mining

Exploring applicability of TOC to projects: Critical Chain Project Management and beyond *Maryam Mirzaei PhD 2016*
Step 4: Data analysis cont’d …

- **Comparison, consonance, complementarity with other models**
  - Biggs 3P’s model for higher education (…) Kimani, 2015
  - Appreciative Inquiry as in … Pongsart, 2015
  - Action Research as in … Pongsart, 2015
  - Stakeholder analysis as in … Moore, 2009; Kimani, 2015
  - Causal loop diagrams (Senge, 1990) as in and several other works Moore 2009, Mabin, Davies, Cox
Links with Biggs’ 3P’s model

Exploring quality of learning and teaching ... Sarah Kimani PhD 2015

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### Links with Appreciative Inquiry

TOC and Appreciative Inquiry: A comparative study of their effectiveness in improving master’s thesis students’ performance *Garoon Pongsart PhD 2015*

<table>
<thead>
<tr>
<th>Appreciative Inquiry</th>
<th>Qualitative research methods</th>
<th>TOC</th>
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</thead>
<tbody>
<tr>
<td>Identifying strengths (discovery)</td>
<td>Survey (quantitative method)</td>
<td>Identifying generic UDEs</td>
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<tr>
<td>Discovery, dream, design, destiny</td>
<td>Case study: Case selection</td>
<td>IO Map, CRT, EC, FRT, PRT for each of 12 cases</td>
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<tr>
<td>Re-apply</td>
<td>Structured Interview</td>
<td>Revised IO Maps, PRT</td>
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<tr>
<td>Discovery, dream, design, destiny</td>
<td>Transcription &amp; content analysis</td>
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<td>Semi-Structured Interview</td>
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<td>Coaching sessions</td>
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<td>Comparison analysis</td>
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</tbody>
</table>

Garoon Pongsart PhD 2015

Action research (3 cases)
Shaping more sustainable communities: A Case Study In Urban Water Management *Robyn Moore, MMS, 2009*

<table>
<thead>
<tr>
<th>Qualitative research methods</th>
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</thead>
<tbody>
<tr>
<td>Case study</td>
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<td>Interviewee Selection (stakeholder Typology)</td>
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<td>Thematic analysis</td>
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<tr>
<td>Causal loop diagram (CLD)</td>
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</table>

Links with Causal Loop Diagramming:

- IO Map/Goal Tree
- CRB/CRT
- EC
- PRT
- Final IO Map
Causal Loop Diagram

Shaping more sustainable communities: A Case Study In Urban Water Management *Robyn Moore, MMS, 2009*

Water shortages

Water storage capacity

‘Fix that Fails’

Demand for water

Delay
Step 5: Communicating findings

• Communication procedures in qualitative research
  – Causal explanations (Maxwell, 2004)
  – Auditability & detailed descriptions (Patton, 1999; Yin, 2009)
  – Use of quotes – “participant voices”

• Communication procedures in TOC
  – Generic CRT
  – fCRT
  – Goal Tree
  – Verbalising the TP diagram logic in text
Step 5: Communicating findings – Generic CRT

Figure 6.7 the generic current problematic issues encountered
Step 5: Communicating findings: Goal Tree (Kimani, 2015)

- Goal
  - Help students to synthesise, apply & communicate knowledge & skills in changing situations

- CSF1: Ensure all lecturers’ have capacity to deliver the program
- CSF2: Ensure students’ develop capability
- CSF3: Ensure continuous improvement of program design (practical knowledge)

- NC1: Provide ongoing professional development (PD)
- NC2: Provide strong administrative support
- NC3: Ensure good recruitment & hiring practices
- NC4: Provide IT support & technological skills
- NC5: Provide adequate resources (study spaces, close interactions)
- NC6: Provide motivation (acknowledgements & rewards)
- NC7: Make PD accessible & meaningful
- NC8: Provide adequate funding/ongoing development

- NC9: Provide clear communication & understanding of the L&T goal
Step 5: Communicating results:

Focused Current Reality Tree (fCRT) (Kimani, 2015)
Step 5: Communicating the results – verbalising diagrams

Application of TOC concepts and Lean tools as an innovative approach to the Timor-Leste public procurement process

*Dos Santos 2012, MLSCM Massey University*

<table>
<thead>
<tr>
<th>Value Stream Map (VSM)</th>
<th>Qualitative research methods</th>
<th>TOC</th>
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</thead>
<tbody>
<tr>
<td>Map the flow of documents through the procurement system</td>
<td>Survey, Interviews, Document analyses, Observation, Interviews helped capturing logic, Developing a storyline helped capturing the logic, Identifying and validating accuracy and importance of UDE’s</td>
<td>TOC application used, CRT, CLR, EC, CLR, FRT, PRT</td>
</tr>
</tbody>
</table>

Examiner: Narrative based on TOC diagrams – remarkably clear and persuasive
Step 6: Reflecting/ reviewing, limitations, what next?

Reflections:
• Student researchers report that TOC frameworks offer:
  – Clear directions in problem structuring
  – Clear guidance in designing data collection instruments + pre-coded themes
  – More focused approaches to data analysis and reporting

Limitations:
• Small sample of TOC-based qualitative research studies
• Post-positivist / pragmatist lens mostly
• Selection of qualitative methods
  – There are other qualitative research designs / methods, including ...
    ... ethnography, grounded theory, phenomenology, and historical research ...
    ... that may use different evaluative criteria for validity ...
    ... at different stages of the research process.
## Reviewing - Threads of validation

### From Qualitative Research Methods

<table>
<thead>
<tr>
<th>From Qualitative Research Methods</th>
<th>Stage of research</th>
<th>From TOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining RQ’s, literature review, selection of cases, participants, ethics, triangulation of data sources</td>
<td>Design</td>
<td>(Literature review) Research questions based on change sequence (incl. goal tree and 5FS)</td>
</tr>
<tr>
<td>Questionnaires, interviews, recording, note taking, saturation, member checking of transcripts</td>
<td>Data collection</td>
<td>Standard questions Filling ‘frames’</td>
</tr>
<tr>
<td>Transcription, coding, unitisation, identification of themes, concepts</td>
<td>Data analysis</td>
<td>Change process using TP guides analysis, data easier to code, safety net of TP, CLR &amp; UDE protocols</td>
</tr>
<tr>
<td>Quotes in participants’ voices, lend weight to arguments</td>
<td>Write-up</td>
<td>Diagrams as visual aids, give logical flowing narrative of cause and effect plus explanations</td>
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<tr>
<td>Audit trail</td>
<td>Throughout</td>
<td>Transparency of process, harnessing resistance to change</td>
</tr>
<tr>
<td>Process validity</td>
<td>Results</td>
<td>Face validity</td>
</tr>
</tbody>
</table>

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Conclusions

Contributions of TOC:

• TOC guides
  – construction of research questions, and interview questions

• Causal mapping facilitates
  – robust and clear argument

• Logic protocols provide
  – threads of validation manifest through narrative and diagrams
Contributions of qualitative research

Qualitative research improves validity through:

• Triangulation, saturation, case study and ethical protocols
• Quotes from interviews illustrate particular points of view, provide
  – provide the participants’ voice, and ...
  – bring TOC-style statements to life.
• This paper provides a documentation of:
  … the rigorous and systematic ways of threading validity
  …. in qualitative case studies
  … through the phases of the research process.

• We conclude that:
  – TOC can help overcome many difficulties associated with qualitative research methods
  – TOC can also gain from using qualitative research methods to enhance the validity of TOC projects
  – Use of both (qualitative & TOC) together provides strong ‘threads of validation’
  – The ‘common sense’ combination is becoming our ‘common practice’.

Naku te rourou nau te rourou …
With your basket and my basket, we will be better off!


Dettmer, HW. (2011). Our goal is … what is our goal? www.goalsys.com


Healy, M, & Perry, C. (2000). Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. *Qualitative Market Research*, 3(3), 118-126
<table>
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<td>Exploring Applicability of TOC to projects: Critical Chain Project Management and Beyond.</td>
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</table>
Kia ora / Thank you

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