

The Research Audit Trail: Methodological Guidance for Application in Practice

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Abstract: The merits of qualitative research remain an issue of ongoing debate and investigation. Qualitative researchers emphasise issues such as credibility, dependability, and transferability in demonstrating the trustworthiness of their research outcomes. This refers to the extent to which the research outcomes are conceptually sound and serves as the basis for enabling other researchers to assess their value. Carcary (2009) proposed trustworthiness in qualitative inquiry could be established through developing a physical and intellectual research audit trail – a strategy that involves maintaining an audit of all key stages and theoretical, methodological, and analytical decisions, as well as documenting how a researcher’s thinking evolves throughout a research project. Since 2009, this publication has been cited in greater than 600 studies. The current paper provides an analysis of the use and value of the research audit trail, based on the author’s application of this strategy across diverse research projects in the field of Information Systems management over a ten year time period. Based on a critical reflection on insights gained through these projects, this paper provides an in-depth discussion of a series of guidelines for developing and applying the research audit trail in practice. These guidelines advance existing thinking and provide practical recommendations in relation to maintaining a research audit trail throughout a research project. Based on these guidelines and the core issues that should be covered at a physical and intellectual research audit trail level, a checklist that can be tailored to each project’s context is provided to support novice researchers and those who are new to the research audit trail strategy. As such, this paper demonstrates commitment to rigor in qualitative research. It provides a practical contribution in terms of advancing guidelines and providing a supporting checklist for ensuring the quality and transparency of theoretical, methodological, and analytical processes in qualitative inquiry. Embedding these guidelines throughout the research process will promote critical reflection among researchers across all stages of qualitative research and, in tracing through the researcher’s logic, will provide the basis for enabling other researchers to independently assess whether the research findings can serve as a platform for further investigation.

Keywords: qualitative research, research audit trail, research audit trail methodology, research audit trail checklist, methodology guidelines, physical audit trail, intellectual audit trail, research confirmability, research trustworthiness

1. Introduction

Qualitative research investigations allow for an in-depth understanding and conceptualisation of a research issue (Alvesson and Sköldbberg, 2000). However, the credibility of qualitative research continues to be an issue of debate (Cutcliffe and McKenna, 2004). Its legitimacy is often placed under scrutiny by researchers who orient towards quantitative research paradigms, criticised for lacking scientific rigor, reflecting a mere collection of personal impressions and anecdotes, and being subject to researcher bias (Bowen, 2009). By some, it may be regarded as *“a disorganised stumble through a mass of data, full of ‘insightful’ observations of a mainly anecdotal nature”* (Silverman, 1993).

Undoubtedly, qualitative research is complex. A qualitative study typically involves numerous data sources and a large volume of researcher-generated data, including notes about the study’s context, methodological decisions, data analysis procedures, and the researcher’s own self-awareness. The researcher is actively immersed in this body of evidence in order to understand and explain social phenomenon through logical inference (Hinton et al, 2003) and solve what Mason (2002) calls the *“intellectual puzzle”*. The research design emerges and changes through iterative processes of data collection and analysis, requiring the researcher to make regular decisions that can change the course of the study. There is a recurring interplay between the data sources and the findings that need to be made accessible to the reader, along with a justification of the actions taken throughout the qualitative research project (Given, 2012; Wolf, 2003). According to Wolf (2003) *“investigators bear the responsibility of convincing the scientific community that the analysis and findings of human science investigations are systematic, objective, and worthy”*.

In line with Strauss and Corbin’s (1998) suggestion that the positivist canons of validity, reliability, and generalisability needed to be redefined to *“fit the realities of qualitative research”*, qualitative researchers typically focus on alternative criteria to demonstrate the trustworthiness of qualitative studies i.e. credibility,

dependability, and transferability (Bowen, 2009; Denzin and Lincoln, 2017; Lincoln and Guba, 1985). Trustworthiness is concerned with the extent to which the study is conceptually sound, based upon which the value of the qualitative research can be judged (Bowen, 2009). In evaluating a qualitative study *“the departing question for evaluation is whether the results and conclusions that the scientific forum can read in the final product are grounded in acceptable decisions during the data gathering and data analysis”* (Akkerman et al, 2006).

Strategies for establishing the trustworthiness of qualitative research need to be built into the qualitative research process. One such strategy is development of a research audit trail (Akkerman et al, 2006; Bowen, 2009; Carcary, 2009; Koch, 2006; Schwandt and Halpern, 1988). However, this strategy is not widely adopted (Akkerman et al, 2006), what constitutes an audit trail is often narrowly conceived, and there is a lack of guidance with respect to operationalising it in practice (Bowen, 2009). Hence this paper seeks to address this gap in the literature by addressing the following research question: *How can the research audit trail be effectively developed and applied in practice?* This paper analyses the use of the research audit trail across diverse research projects in the field of Information Systems management. Based on a critical reflection on insights gained through these projects, this paper provides an in-depth discussion of a series of guidelines/recommendations for developing and applying the research audit trail in practice, as well as a corresponding checklist to support its effective execution.

Section 2 reflects a literature review, introducing the research audit trail, and the concepts of the physical and intellectual audit trail as discussed by Carcary (2009). Section 3 demonstrates how the physical and intellectual audit trail was applied in three research projects in the field of information systems management. Section 4 reflects on key insights gained from these projects to advance guidelines for the research audit trail and it presents a checklist of issues that should be addressed at both physical and intellectual research audit trail levels to support its application in practice. Section 5 draws the paper to a conclusion and presents avenues of further research.

2. The research audit trail – literature review

Building on the concept of the fiscal audit where independent auditors authenticate a firm’s accounts, the qualitative research audit was originally established by Halpern (1983) and subsequently Lincoln and Guba (1985) in response to quality issues associated with conducting naturalistic research. This initial study introduced the concept of a ‘confirmability audit’ focused on *“certifying that data exist in support of every interpretation and that the interpretations have been made in ways consistent with the available data”* and a ‘dependability audit’ focussed on *“the processes whereby data were collected and analysed and interpretations were made”* (Akkerman et al, 2006). They suggest that by implementing an audit trail, an auditor or second party who becomes familiar with the qualitative study, its methodology, findings, and conclusions can audit the research decisions and the methodological and analytical processes of the researcher on completion of the study, and thus confirm its findings.

In simple terms, an audit trail in qualitative research is a record of how a qualitative study was carried out and how conclusions were arrived at by researchers. It provides a transparent description of the steps taken throughout a research project, supported by a thorough collection of relevant documentation (Given, 2012). Hence, an audit trail is not merely a statement that the research process was rigorous – it needs to be visible to enable others to evaluate the merits of the research for themselves. Rolfe (2006) states *“it behoves researchers to leave a ‘super’ audit trail, recounting not only the rationale underpinning the research decisions taken en route, and the actual course of the research process rather than the idealised version that the reader is usually presented with, but also ... ongoing self-critique and self-appraisal”*.

A comprehensive audit trail makes transparent the research design, and provides details of the data collection, analysis, reduction, and synthesis, the researcher’s theoretical, methodological, and analytical choices, and interpretations that led to the research findings (Wolf, 2003). Thus the audit trail requires specific information about the data and specific information about the data analysis to be recorded. A number of studies have provided guidance with respect to key items of information required when developing an audit trail (Miles and Huberman, 1994). Lincoln and Guba (1985) detail six categories of information proposed by Halpern (1983) that need to be collected:

- Raw data – including raw data, field notes, and unobtrusive measures (documents).

- Data reduction and analysis notes – including summaries and theoretical notes.
- Data reconstruction and synthesis products – including category structures, themes and relationships, findings, conclusions, connections to literature, and integration of concepts, relationships, and interpretations.
- Process notes – including research methodology notes, trustworthiness notes regarding credibility, dependability, and confirmability, and audit trail notes.
- Materials related to intentions and dispositions – including personal, reflexive notes and expectations.
- Instrument development information – including pilot work, interview schedules, and observation formats.

In this way, the audit trail challenges the researcher to be intentional and careful about record keeping throughout the study (Akkerman et al, 2006). He/she must emphasise ‘thick descriptions’ of accounts such as the study’s context, the research methods, and examples of raw data so that judgements on the merits of the qualitative study can be made by others (Houghton et al, 2013). The audit trail also details the analytical steps taken in moving from raw data to final interpretation and demonstrates that analysis follows a logical path based on the data collected. In other words, concepts, themes, and theory are shown to emerge directly from the data, grounding the findings in the research evidence as opposed to the researcher’s own preconceptions (Bowen, 2009).

Qualitative research requires a researcher to engage in critical scrutiny or active reflexivity in order to critically assess the evidence collected, debate the reasons for adopting a course of action, and challenge one’s own assumptions. An audit trail helps the researcher to maintain and demonstrate reflexivity (Bowen, 2009) or “*reflexive methodological accounting*” (Seale, 1999) throughout the qualitative study. The recursive nature of qualitative research and the need to continually go back through the data dictate that qualitative researchers need to think critically about the research decisions made and the basis for those decisions, and clarify the reasoning behind interpretations of the data. Thus, there is a need for ‘reflexive commentary’ as research decisions are made (Given, 2012), which helps the researcher to review what has been done and evaluate alternative plans. Because qualitative researchers are regarded as being part of the process, trustworthiness of the research not only depends on the research steps taken but also the researcher’s self awareness and self correction throughout the study (Bowen, 2009). A reflexive journal is “*an important expression of reflexivity*” (Houghton et al, 2013) and a useful tool for the researcher to demonstrate how theoretical perspectives impact on the research process, to keep track of methodological developments and decisions, and to make transparent the researcher’s own insights, rationales, personal challenges, interpretations, reactions, and cognitive processes (Given, 2012). Analysis of these reflections often give rise to action, sometimes reshaping how the research is progressed.

The value of the audit trail lies in its ability to improve the rigor and transparency of qualitative research (Bowen, 2009; Grant et al, 2013) through creation of a trail of evidence. It provides a lens through which the credibility of qualitative research studies can be assessed among the scientific community and can serve as a strong defence against the criticisms of qualitative research regarding researcher neutrality (Akkerman et al, 2006; Given, 2002). A carefully constructed audit trail will help the researcher and others to reconstruct how the study was carried out, discern the researcher’s interpretations, determine how findings and conclusions were drawn, and to make assertions regarding the study’s confirmability and dependability (Bowen, 2009). “*The audit trail provides documentary evidence for neutral experts or peer reviewers with expertise in qualitative research to review and verify the path the investigator followed from raw textual data to results*” (Wolf, 2003).

Despite its introduction in 1983, the audit trail in qualitative research is not extensively operationalised as a verification strategy (Akkerman et al, 2006). What constitutes an audit trail is often narrowly conceived and there is a lack of guidance with respect to how to develop a comprehensive audit trail in practice (Bowen, 2009). Taking into account the above description, Carcary (2009) categorised the research audit trail as being physical or intellectual in nature. A physical audit trail documents the actual stages of a research study and the key research methodology decisions. It may consider, for example, identification of the research problem, development of the research proposal, documentation of the literature review, design of the research framework, development of interview schedules, sample selection, evidence collection, management, and analysis, and distillation of findings. An intellectual audit trail, on the other hand, assists the researcher in reflecting on how his/her thinking evolved throughout all phases of the study. It may consider, for example, the

researcher's reflections and insights on issues including the researcher's philosophical position, approaches for evidence collection, approaches for data analysis and evidence interpretation, and distillation of findings. Carcary (2009) has received much attention in the research literature with in excess of 600 citations. In the next section of this paper, we analyse the use of the physical and intellectual research audit trail through examining its application across three research projects in the field of Information Systems management.

3. Application of the physical and intellectual research audit trail across research projects

The concept of the physical and intellectual research audit trail has been adopted in several research studies undertaken by the author over the past ten years (see Carcary, 2020). These studies primarily reflect research projects in the field of Information Systems management. The application of the research audit trail is demonstrated here for three of the projects undertaken.

Research project 1 focused on the collaborative development of an IT management framework artefact to support Small to Medium-sized Enterprises (SMEs) in realising business value from their IT investments (Carcary and Doherty, 2015). The study focused on developing capability maturity bodies of knowledge pertaining to 10 IT capabilities identified as being important for SMEs in addressing the key IT business challenges they face. The framework developed acts as an assessment tool to understand the SMEs current and target maturity with respect to each IT capability, and provides improvement roadmaps to help SMEs continually improve their IT capability over five levels of maturity. Understanding a company's current and desired maturity levels in these areas is deemed to help set improvement initiatives that drive value delivery over time. Table 1 provides a brief summary view of physical and intellectual research audit trails for project 1.

Table 1: Research audit trail for project 1

<p>Physical audit trail</p> <p><i>Research problem identification:</i> Majority of IT management frameworks found to be primarily focused on larger organisations, reflecting a considerable literature gap given the high proportion of SMEs to larger organisations and their inherent differences.</p> <p><i>Research proposal development:</i> Research proposal to develop an SME-specific IT management framework, grounded in existing literature and insights from industry practitioners, developed and submitted to a public research funding body in the Republic of Ireland.</p> <p><i>Literature review:</i> Systematic literature review conducted focused on IT capability research, IT capabilities in the SME context, domain specific knowledge pertaining to 10 identified IT capabilities, capability maturity models, and related areas.</p> <p><i>Research framework definition:</i> Adoption of engaged scholarship and open innovation principles (Van de Ven, 2007). Formation of content development workgroups of subject matter experts, including academic researchers, industry-based SME practitioners, and consultants. Development of methodological strategy based on multiple evidence sources e.g. workgroup observation, semi-structured interviews, artefact pilot testing feedback. Documentation of notes on research trustworthiness.</p> <p><i>Sample selection:</i> Development of criteria for workgroup participant selection e.g. academic and practitioner perspectives, seniority of practitioner role, domain knowledge expertise. Purposive sampling.</p> <p><i>Evidence/raw data collection:</i> Including project documents and contextual descriptions, policy documents, independent reports, organisational/institutional websites, >50 workgroup discussions and transcripts, feedback from 50 pilot tests of SME framework in industry context, feedback from independent expert technical review committee, researcher journal and reflections.</p> <p><i>Evidence management and analysis:</i> Adoption of grounded theory approach supported by computer aided qualitative data analysis software (CAQDAS). Import of evidence into CAQDAS. Concept coding of empirical data, literature review material etc. and re-conceptualisation into hierarchy of thematic higher order categories and subcategories. Constant data comparison. Development of emergent theme memos/notes focused on thick descriptions. Linking of themes to emergent theme memos/notes. Linking of themes to reflexive memos/notes. Development of concept relationship model across hierarchical thematic structure.</p> <p><i>Artefact development:</i> Presentation, interpretation, and discussion of emergent themes and connections with previous research. Based on emergent themes, documentation of each respective IT capability's definition, capability building blocks, five level maturity curve, and practices, outcomes, and metrics to drive maturity improvement. Final project report and research paper development, including case study vignettes.</p> <p>Intellectual audit trail</p> <p><i>Clarification of philosophical stance:</i> Interpretive paradigm with ontology emphasising the capture of contextual depth and in-depth understandings of complex social issues.</p> <p><i>Consideration of alternatives for evidence collection and data analysis:</i> Documentation of analytical thinking and decision making during research framework design. Rationalisation of adopting an adapted grounded theory method</p>

(free from constraints of operating in a theoretical vacuum) to support development of the SME framework content inductively from the data. Rationalisation of using CAQDAS to support data management and interrogation.
Evidence interpretation: Engagement in iterative process of data interpretation involving interaction with and reflection on the data on several levels. Documentation of analytical thinking and decision making throughout analysis, interpretations on emergent themes, and reflections on interpretations and findings.

Research project 2 focused on the development of a Digital Readiness Assessment (DRA) to analyse an organisation's preparedness for digital transformation, given its current IT infrastructure, technology, and operational approaches (Carcary, 2017). The assessment developed focused on capturing insights in relation to an organisation's digital business behaviour levels and priorities across seven key digital transformation themes. Insights gained from using the assessment include identification of the most important behaviours to sustain or accelerate further levels of digital transformation within an organisation and identification of the organisational capabilities associated with the prioritised behaviours. Table 2 provides a brief overview of physical and intellectual audit trails for project 2.

Table 2: Research audit trail for project 2

Physical audit trail

Research problem identification: Due to the proliferation and pace of change in the business and technological landscapes, organisations struggle to effect successful digital transformations. Those organisations that fail to successfully leverage digital run the risk of becoming irrelevant or even displaced in their industries by fast-moving digitally enabled players.

Research proposal development: Research proposal to develop a digital transformation body of knowledge and series of assessment and improvement instruments developed and submitted to a public research funding body in the Republic of Ireland.

Literature review: Systematic literature review conducted focused on digital transformation, digital readiness, digital behaviours, and domain specific knowledge pertaining to digital behaviour themes, including planning and execution management, ecosystem management, delivery and operations management, talent development and organisational design, investment and financial management, information exploitation management, and risk, controls, and cyber security management.

Research framework definition: Development of methodological strategy based on multiple evidence sources e.g. semi-structured interviews, artefact pilot testing feedback.

Sample selection: Development of criteria for interview participant selection e.g. participation in digital transformation projects, domain expertise, levels of seniority and experience. Purposive and snowball sampling.

Evidence/raw data collection: Including contextual descriptions, policy documents on digital transformation, independent research reports, academic and practitioner literature, 20 semi structured interviews and transcripts, feedback from 15 pilot tests of DRA in industry context, researcher journal and reflections.

Evidence management and analysis: Adoption of grounded theory approach supported by CAQDAS. Concept coding and re-conceptualisation into higher order themes i.e. categories and sub categories of key digital behaviours, digital adoption trends etc. Development of emergent theme memos/notes linked to related codes/categories. Linking of thematic structure to reflexive memos/notes. Development of concept relationship model across thematic structure.

Artefact development: Presentation, interpretation, and discussion of seven digital behaviour themes and 40 associated digital behaviours, linked to related IT capabilities. Project research paper development.

Intellectual audit trail

Clarification of philosophical stance: Interpretive paradigm focused on the capture of a breadth and depth of understanding of digital transformation issues.

Consideration of alternatives for evidence collection and data analysis: Documentation of analytical thinking and decision making during research framework design. Rationalisation of adopting an adapted grounded theory method and using CAQDAS to support data management and interrogation.

Evidence interpretation: Engagement in iterative process of data interpretation. Documentation of analytical thinking and decision making throughout analysis, interpretations on emergent themes, and reflections on interpretations and findings.

Research project three focused on the development of a Cybersecurity Effectiveness Assessment (CEA) to analyse an organisation's cybersecurity approaches and identify key organisational behaviours and technology adoption trends to improve the management of cybersecurity threats (Carcary, 2018; Carcary et al, 2019). The assessment developed focused on capturing insights in relation to the drivers of and barriers to the organisation's cybersecurity programme, the key threats and threat actors that impacted the organisation in the previous 12 months, the organisation's cybersecurity technology adoption trends, and its key cybersecurity management behaviour levels and priorities across eight specific themes. The insights gained from using the assessment include identification of the most important behaviours to sustain or accelerate further levels of

cybersecurity, identification of the organisational capabilities associated with the prioritised behaviours, and provision of recommended improvement practices and metrics in relation to a shortlist of those capabilities. Table 3 provides a brief overview of physical and intellectual audit trails for project 3.

Table 3: Research audit trail for project 3

<p>Physical audit trail</p> <p><i>Research problem identification:</i> The range of threats now faced by organisations is unprecedented. Across organisations, the volume of stored data is growing exponentially, increasing potential for inappropriate or illegal data use or disclosure, and creating a particular challenge for organisations in protecting personal data. The organisation's protection of its computing environment/infrastructure from cyberattacks that can impact business continuity and its protection of key information assets must now be central to its core operations.</p> <p><i>Research proposal development:</i> Research proposal to develop a cybersecurity body of knowledge and series of assessment and improvement instruments developed and submitted to a public research funding body in the Republic of Ireland.</p> <p><i>Literature review:</i> Systematic literature review conducted focused on cybersecurity drivers and barriers, threats and threat actors, technology adoption trends, and domain specific knowledge pertaining to cybersecurity management themes, including cybersecurity strategy and governance, cybersecurity awareness management, technical security operations, data security administration, identity and access management, cybersecurity risk management, cybersecurity incident management, and business continuity management.</p> <p><i>Research framework definition:</i> Development of methodological strategy based on multiple evidence sources e.g. semi-structured interviews with subject matter experts, artefact pilot testing feedback from academic researchers and industry-based cybersecurity practitioners. Documentation of notes on research trustworthiness.</p> <p><i>Sample selection:</i> Development of criteria for interview participant selection e.g. participation in cybersecurity projects, domain expertise, levels of seniority and experience. Purposive and snowball sampling.</p> <p><i>Evidence/raw data collection:</i> Including contextual descriptions, policy documents on cybersecurity, independent research reports, academic and practitioner literature, 20 semi structured interviews and transcripts, feedback from 8 pilot tests of CEA in industry context, researcher journal and reflections.</p> <p><i>Evidence management and analysis:</i> Adoption of grounded theory approach supported by CAQDAS. Concept coding and re-conceptualisation into higher order themes i.e. categories and sub categories of cybersecurity drivers and barriers, threats and threat actors, technology adoption trends, and management behaviour themes. Constant data comparison. Development of emergent theme memos/notes linked to related codes/categories. Linking of thematic structure to reflexive memos/notes. Development of concept relationship model across thematic structure.</p> <p><i>Artefact development:</i> Presentation, interpretation, and discussion of eight cybersecurity management behaviour themes and 45 associated behaviours, linked to related IT capabilities. Project research paper development.</p> <p>Intellectual audit trail</p> <p><i>Clarification of philosophical stance:</i> Interpretive paradigm focused on the capture of a breadth and depth of understanding of cybersecurity effectiveness issues.</p> <p><i>Consideration of alternatives for evidence collection and data analysis:</i> Documentation of analytical thinking and decision making during research framework design. Rationalisation of adopting an adapted grounded theory method to support development of a CEA inductively from the data and of using CAQDAS to support data management and interrogation.</p> <p><i>Evidence interpretation:</i> Engagement in iterative process of data interpretation. Documentation of analytical thinking and decision making throughout analysis, interpretations on emergent themes, and reflections on interpretations and findings.</p>
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4. Guidelines for application of the research audit trail in practice

Based on a critical reflection of constructing physical and intellectual audit trails across these projects, this section provides a detailed description of five key guidelines and a supporting checklist for developing and applying the research audit trail in practice. A number of these guidelines build on the work of Carcary (2020) and other previous researcher contributions and reflect, from the author's perspective, the core issues that (novice) researchers should focus on when applying the audit trail in their research undertakings.

1) Emphasise procedural rigour and 'systematicity' in the literature review: The emphasis in the literature on research audit trails is often placed on the processes and procedures through which empirical research data such as interview or focus group data is collected. Research audit trails should also demonstrate that the qualitative research study's literature review is well executed as this is an area that is often overlooked in research studies. This is particularly so in the author's field of study - IS management – due to the interdisciplinary nature and thematic and methodological diversity of the field, and the associated difficulties in delineating the boundaries of the literature review and in providing a relatively complete census of existing

studies (Rowe, 2014; Webster and Watson, 2002). An effectively executed literature review adds new contributions to the field through the reviewer's use of 'analytical criticism' (Okoli, 2015) to not just present a synthesis of the 'current state' understanding of the existing body of knowledge, but to also interpret prior studies and evaluate their findings vis-à-vis other prior contributions (Levy and Ellis, 2006). The literature review can also highlight emerging issues and key knowledge gaps in a specific field and acts as a solid theoretical foundation from which knowledge can be advanced, substantiating the existence of a research problem and often providing a guiding research direction in terms of extending current theories. Several authors emphasise the importance of ensuring literature reviews are systematic, that is they "*consist of a clearly formulated question and use systematic and explicit methods to identify, select, critically appraise, and extract and analyse data from relevant research*" (Tricco et al, 2011).

This 'systematicity' in the literature review process should be made visible as part of the study's research audit trail. The researcher needs to explicitly describe the procedures by which the literature review was conducted in accordance with key methodological guidance (e.g. Okoli, 2015; Brereton et al, 2017; Levy and Ellis, 2006; Pare et al, 2015; Vom Brocke et al, 2015; Carcary et al, 2018; Whitemore et al, 2014) in order to enable others to reproduce the study using the same reviewing approach. At a minimum, the research audit trail should document the following issues of importance:

- The literature review's purpose, research goals, audience, and dissemination strategy.
- A piloted/externally validated protocol or roadmap stating key steps and procedures, for example, guidelines for data search, screening, appraisal, extraction, storage, retrieval, analysis, and software tool usage.
- The literature search scope and search process (e.g. conducted in a sequential or iterative manner), publication sources to be consulted (e.g. bibliographic databases, citation indices, library search portals, journals, books, conference proceedings), and the search strategy and parameters (e.g. keyword search strings, forward and backward searches).
- Screening criteria for including and excluding studies (e.g. specific keywords, a specific publication language, specific publication outlets, prominent authors in the field, specific methodologies, specific date ranges).
- Quality appraisal standards (e.g. generalisability and validity of a paper's findings or analysis of a paper's arguments and how they are backed by evidence).
- Data extraction process (e.g. use of open, axial, and selective coding and qualitative data analysis software to identify and record relevant data).
- Data classification and analysis process to structure and make sense of relevant data (e.g. use of thematic analytical categories, conceptual frameworks, concept maps/matrices, qualitative data analysis software).

2) Maintain comprehensive documentation at both a physical and intellectual audit trail level: Comprehensive supporting documentation is the cornerstone of a comprehensive audit trail as it puts transparency at the core of the research process. This includes documentation on the research study's context, the research framework and methodological decisions and changes to this over the course of the study, the literature review approach, data analysis processes and analytical memos, and the personal reflections and insights of the researcher. An emphasis on 'thick description' across all relevant aspects of the research project helps ensure that no important issue is left unconsidered in the emergent analysis and this increases a researcher's confidence in the findings reported.

With respect to the researcher's personal reflections, a reflexive journal proves useful. Providing a convincing explanation of a body of evidence requires what Alvesson and Sköldbberg (2000) term "*reflexive interpretation*" – a need for reflection and interpretation on several levels. The act of reflection involves examining how "*the theoretical, cultural and political context of individual and intellectual involvement affects interaction with whatever is being researched*" (Alvesson and Sköldbberg, 2000). A reflexive journal supports development of the researcher's critical thinking and analytical abilities, enabling researchers to examine "*personal assumptions and goals*" and clarify "*individual belief systems and subjectivities*" (Russell & Kelly, 2002). The journal also enables creative connections to be made transparent across the research evidence, and contributes to insightful perspectives on issues based on an emerging understanding. Ultimately, effective documentation of the researcher's thinking enables the logic of the researcher's conclusions to be assessed by others (Wickham and Woods, 2005). The researcher's thoughts become a critical component in finalising the research's thematic

categories and sub categories, in documenting the research findings, and ultimately in formulating new research contributions. The nature of qualitative research is that different individuals may not interpret data in the same ways. The audit trail documentation and reflexive journal help ensure that a clear trail of evidence exists throughout the research study, demonstrating how specific events lead to the emergent findings. They can make *“the messiness of the research process visible to the researcher who can then make it visible for those who read the research”* (Ortlipp, 2008). This enables others to trace through the researcher’s logic in arriving at a particular interpretation of the data at a particular point in time and to judge the merits of the qualitative study for themselves.

3) Exploit the data management and interrogation potential afforded by Computer Aided Qualitative Data Analysis Software (CAQDAS): The use of computers has played an extensive role in research projects for many years, for example, in preparing project plans, transcribing recorded data, and writing research reports. From a data analysis perspective, the emphasis is heavily weighted on using computers to assist in the statistical analysis of quantitative evidence. The number of CAQDAS packages available, however, has grown considerably in recent years, in general providing qualitative researchers with content searching, coding, querying, annotating, and mapping capabilities (Lewins and Silver, 2009). As highlighted by other researchers (e.g. Bowen, 2009; Carcary, 2011; Given, 2012; Sinkovics and Alfoldi, 2012), CAQDAS is a useful support tool in audit trail development. It provides an efficient data management system that supports the systematic organisation of unstructured qualitative evidence that would prove onerous using ‘pen and paper’ methods. And as stated by Wickham and Woods (2005), *“an efficient and well-structured data management system is critical to tracking, accessing, and documenting the data available and the analyses applied to it”*. CAQDAS also enables the researcher to concentrate his or her energy on the conceptual work of analysis, and on reflection and interpretation of the evidence base (Carcary, 2009).

The folder structure in CAQDAS supports efficient emergent thematic analysis of the data coded, with the ability to interrogate the data, query specific text items across all literature extracts, interview transcripts, and field notes, and move backwards and forwards between raw data, codes, and themes. It supports the iterative reclassification of emergent themes into a series of categories and sub categories, helping to organise related concepts in relation to the overall research. In addition, the researcher can also build more easily on the existing analysis and can create memos to clarify emerging concepts over time. Hence, previous thinking as reflected in notes or memos, cross indexed with early code development, can influence later emergent thinking as the researcher revisits and reconsiders the data and its evolving analysis on multiple occasions throughout the research study. Hence, CAQDAS enables principles of constant data comparison and helps maintain a comprehensive trail of interpretations and decisions during the data analysis process, thereby enhancing transparency of the research findings. The CAQDAS folder structure can also be systematically used to import research documents to support the audit trail elements e.g. interview schedules, research frameworks, and reflexive notes, while some CAQDAS tools also work with non-textual data in the form of pictures, video and audio. The CAQDAS visual diagramming and model exploration tools can also help to visually depict the data analysis procedures and demonstrate relationships between concepts and categories. These features play a vital role in effectively distilling the research findings in a systematic manner and provide a useful framework for demonstrating the transparent procedures followed as part of audit trail development.

4) Provide specific examples that demonstrate how emergent findings are firmly grounded in the body of evidence: It is worth emphasising the value of providing specific examples within a final research report that show how findings can be traced step-by-step back to the raw data. The tracing of findings to the raw data take account of the *“muddle, confusion, mistakes, obstacles, and errors”* (Boden et al, 2005) that are inherent in a research process and demonstrate that the final conclusions are arrived at through an iterative process as opposed to a seamless, neat and linear one. This grounding of the findings in the body of evidence can be demonstrated in an appendix which details instances of how certain aspects of raw data were coded, how and why certain codes were combined into higher order themes and where this fits in relation to the overall thematic structure, what an emergent memo in relation to this theme looks like, and how researcher’s reflections and insights evolve. Following this guideline can in particular add credibility to the work of novice researchers or those undergoing scrutiny at doctoral thesis level.

5) Be cognisant of the audit trail audience and its understandability: Clarity of audit trail presentation is important. The audit trail not only needs to be comprehensive, it also needs to be clearly structured (e.g. in chronological order) with supporting, cross referenced documentation, and be documented in a manner that

others can easily understand. Hence, it should be created under the assumption that it will be reviewed by parties external to the research project (and perhaps from unrelated disciplines) who seek to confirm the accuracy and legitimacy of the research process.

Taking into consideration these guidelines and the core issues that should be addressed at a physical and intellectual research audit trail level, the following checklist is offered as a useful tool in developing and maintaining a research audit trail throughout a research project. This checklist is provided as a scaffold or guide that should be tailored to the specifics of each project context. For example, the specific research framework will differ across projects – some will employ interviews, some focus groups, some action research. While the research methods will vary, the need for an overarching, clearly defined research framework will be common across all projects. Similarly, projects will differ in their approaches to sample selection, sources of evidence, data management and analysis strategies, among others. Nonetheless, the specifics of each of these topics need to be clearly documented for an audit trail to be deemed comprehensive. It is intended that this checklist will serve as a support to novice researchers and those who are new to the research audit trail strategy. The checklist, for simplicity divided into physical and intellectual audit trail components, is provided in Table 4.

Table 4: Research audit trail checklist

<p>Physical audit trail</p> <p><u>Research problem identification and proposal development:</u></p> <ul style="list-style-type: none"> • Is the research problem (e.g. the gap in the existing literature) clearly defined? • Is a research question specified? • Are the research aims and objectives stated? • Is a formal research proposal (as required) submitted to and approved by the relevant funding body? <p><u>Literature review:</u></p> <ul style="list-style-type: none"> • Is a literature review protocol (key steps and procedures) clearly documented and validated? • Is the literature search scope defined? • Are all publication sources documented (e.g. bibliographic databases, library search portals, journals)? • Are literature search parameters documented (e.g. keyword search strings)? • Are literature screening criteria documented (e.g. specific keywords, language, authors, date ranges)? • Are literature quality appraisal standards defined (e.g. grounding of findings in the body of evidence)? • Is the literature data extraction process outlined (e.g. use of coding, CAQDAS)? • Is the literature data classification and analysis process outlined (e.g. use of thematic categories, conceptual frameworks, and concept maps)? <p><u>Research framework definition:</u></p> <ul style="list-style-type: none"> • Is a research methods strategy specified (e.g. use of interviews, focus groups, case studies, design science)? • Is the rationale for the chosen research methods specified? • Are notes on research trustworthiness maintained? • Are changes to the research framework and methodological decisions over the course of the study, and the rationale for same, documented? <p><u>Sample selection:</u></p> <ul style="list-style-type: none"> • Are criteria for research participant selection defined (e.g. domain expertise, seniority)? • Is the sampling strategy (e.g. purposive, snowball) and rationale for its selection defined? <p><u>Evidence/raw data collection:</u></p> <ul style="list-style-type: none"> • Are all sources of secondary evidence specified (e.g. contextual descriptions, policy documents, research reports)? • Are all sources of primary data specified (e.g. interview or focus group transcripts, pilot validation feedback)? • Are researcher journals and reflections on the body of evidence recorded? <p><u>Evidence management and analysis:</u></p> <ul style="list-style-type: none"> • Are all thematic codes and categories documented? • Are memos developed to enable emerging thematic categories to be traced to the body of evidence? • Are reflexive memos attached to the thematic categories? • Are relationships across the thematic structure explored (e.g. diagrammatically modelled)? • Are examples of how the emerging analysis is grounded in the body of evidence maintained (e.g. in an appendix)?
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Artefact development:

- Is the research audience and dissemination strategy specified?
- Is the research report/research paper documented in a manner that the intended research audience will clearly understand?
- Are the research findings discussed vis-à-vis prior research studies?

Intellectual audit trail**Clarification of philosophical stance:**

- Is the researcher's philosophical position clarified?

Consideration of alternatives for evidence collection and data analysis:

- Is the researcher's analytical thinking and decision-making transparent during the design of the research framework?
- Is the rationale for the data management and analysis approach clearly specified?
- Is the rationale for use or non-use of CAQDAS, and the benefits of the chosen approach, specified?

Evidence interpretation:

- Are the researcher's analytical thinking and decision-making transparent during the data analysis?
- Are researcher interpretations on emerging thematic categories recorded in memos?
- Are research findings appropriately grounded in the body of evidence (with supporting examples)?
- Are researcher reflections and insights on findings and interpretations documented?
- Are the researcher's personal assumptions and subjectivities made transparent in a reflexive journal?

5. Conclusions

This paper sought to answer the following research question: *How can the research audit trail be effectively developed and applied in practice?* In addressing this question, the paper provided and discussed a series of guidelines and a supporting checklist for developing and applying the research audit trail. These guidelines and checklist can serve as useful tools in adhering to a methodologically consistent approach in adopting the research audit trail as a useful verification strategy.

Previous research has claimed that the research audit trail *"can serve as a means of holding up to scrutiny the methodological and theoretical decisions made throughout the research process"* (Bowen, 2009). That is not to say that the absence of a research audit trail brings into question the credibility of research findings. Indeed Cutcliffe and McKenna (2004) state that expert qualitative researchers who are more adept at intuitive analysis do not need to strictly adhere to methodological orthodoxies.

While this position is accepted, the author's view is that making development of the physical and intellectual audit trail a core component/deliverable of a research project can result in the researcher being more attuned and aware to the necessity of maintaining high quality at all stages of a research project. This is in terms of keeping records regarding the actual steps of the research process (the physical audit trail) and in maintaining a reflexive journal on the evolution of the researcher's thoughts and insights (the intellectual audit trail). Maintaining a clear focus on both the physical and intellectual audit trail – separate but integrated, ensures that the researcher doesn't overlook the important aspect of reflexivity and self-questioning in favour of a singular view on methodological steps and procedures.

In the author's experience of audit trail development, the research audit trail has proven a useful strategy for demonstrating the trustworthiness and transparency of qualitative inquiry, ensuring that significant emphasis is placed on the theoretical, methodological and analytical. Other researchers can independently judge whether research inferences are logical, whether findings are grounded in the data, and whether a study's research process is suitable as a basis of further inquiry.

The guidelines and checklist presented in this paper are based on the author's own insights from applying the research audit trail across a series of research projects over a ten year period. As an avenue of further research, it is suggested that these are adopted by qualitative researchers in future studies, and are not only used as the basis for supporting research audit trail development, but are also continually refined based on their experiences in application. In this way, the guidelines and checklist become a 'living' document that articulates evolving best practice experience in research audit trail development.

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