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Citation: Sainidis, Eustathios (2021) Reflecting on the use of mixed methods in the subject of sustainable strategies in manufacturing SMEs. In: Sustainability and small and medium-sized enterprises: lessons from mixed methods research. Taylor & Francis, London, pp. 120-139. ISBN 9781138387270, 9780429426377

Published by: Taylor & Francis

URL: <https://doi.org/10.4324/9780429426377-7-8>
<<https://doi.org/10.4324/9780429426377-7-8>>

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Reflecting on the use of mixed methods in the subject of sustainable strategies in manufacturing SMEs

Eustathios Sainidis

Introduction

This chapter provides a discussion and critique on the application of mixed methods in researching the adoption of sustainability business practices within the manufacturing SME sector. The author has extensive research experience in the subject of manufacturing strategy in SMEs and has worked with both mono-method and multi-methods data collection and analysis approaches. It is the experience and lessons drawn from a mono-method approach and in particular the limitations of quantitative data in exploring the complexity, dynamic nature and uncertainty which drives SMEs' decisions on sustainability which attracted the author of this chapter to the prospects of mixed methods. Indeed, as the chapter will illustrate a mixed methods approach offers a better understanding of what the data is trying to say and consequently a deeper insight on how sustainability is taking shape within the manufacturing SMEs arena.

The study draws lessons from UK-based primary data containing two data-sets: quantitative (QUAN) and qualitative (QUAL). The combination of two data sets informs the mixed methods research strategy and the ontological and epistemological stance of the study. It is therefore useful to start the discussion with defining ontology and epistemology in business and management research and how these two 'worlds' contribute to the enquiry of sustainability strategies in manufacturing SMEs. The study, then continues with the 'development-type' integration of QUAN and QUAL data (Greene *et al.*, 1989) and the adoption of the associated data evaluation tools of descriptive statistics and template analysis (King, 2004; King and Brooks, 2017). Finally, the chapter concludes with a review of mixed methods validation techniques relevant to the study of sustainability strategies in manufacturing SMEs.

The study presented in this chapter is driven by the epistemological stance of *pragmatism*. Pragmatism is important to sustainability research due to the contemporary nature of the topic and offers greater depth and insight into the phenomenon. The study's research journey is based on the blending of two QUAN and QUAL data sets, it is the blending and integration of the

data which provides evidence of a mixed methods approach. Figure 1 provides a visual presentation of the research roadmap for the study, the details of the roadmap will be discussed in this chapter. The study focuses on the manufacturing SMEs (MSMEs) sector using a sample of MSMEs located in the United Kingdom. It makes use of a purposive sample of MSMEs by engaging their senior managers in a survey (QUAN) and interview (QUAL). The purpose of the study was to investigate the reasons MSMEs introduce sustainability in their operations, how they go about adopting a sustainability strategy and the impact of such practices in their business performance.

The chapter starts with an overview on the subject of sustainability in the MSMEs sector to allow the reader a degree of familiarity with the academic focus of the study. A review of the methodological position follows and how the study fits within the epistemology of pragmatism. It then reviews mixed methods as a tool to evaluate sustainability in the MSMEs arena, the benefits of a mixed methods approach, challenges and limitations.

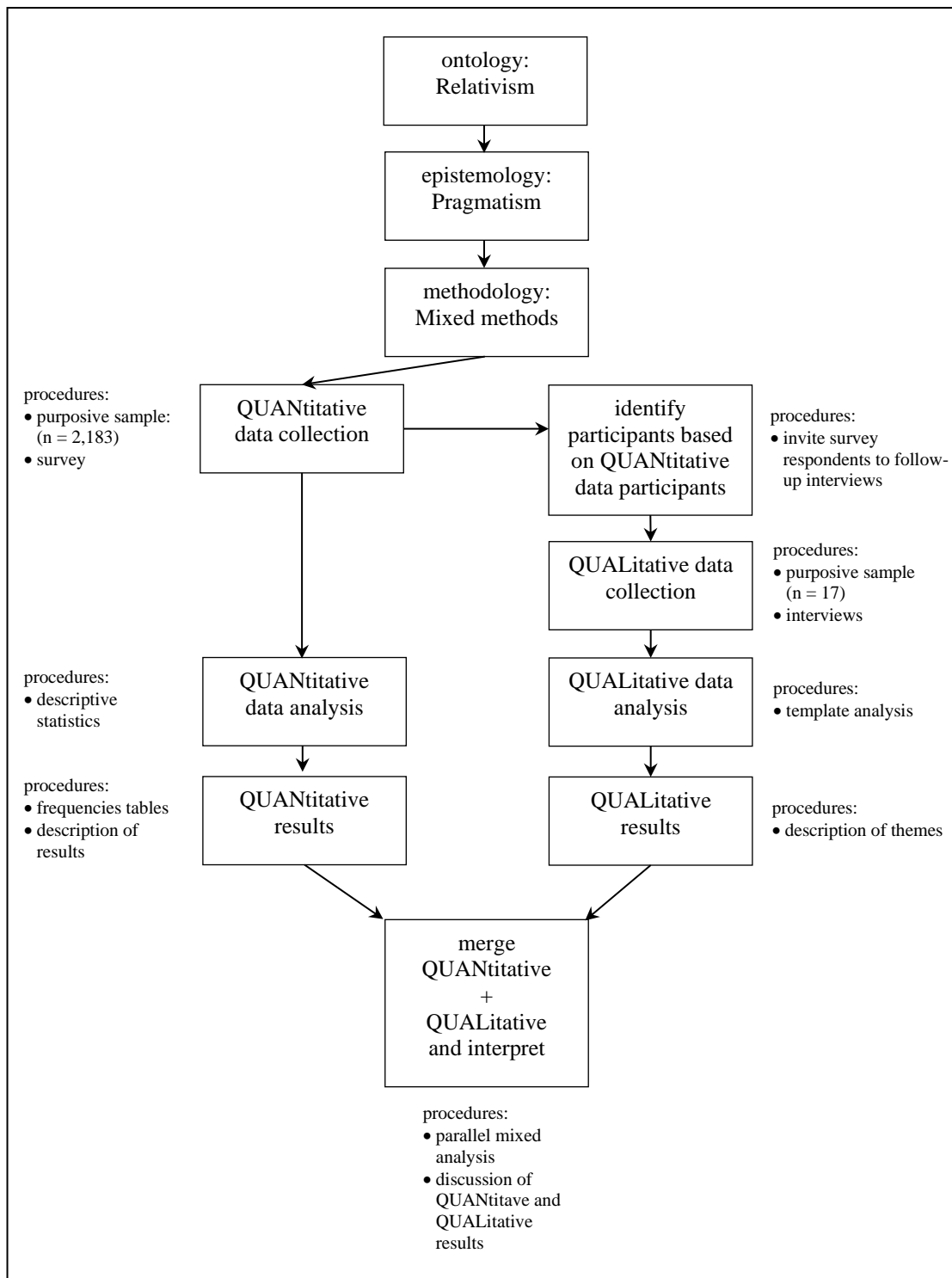


Figure 1. Research roadmap of study

Sustainability and manufacturing strategy in the SMEs sector

Research strategies on the subject of manufacturing strategy have considerably developed since Skinner’s seminal work in the late 1960s on the how manufacturing relates to and supports corporate strategy (Skinner, 1969). The research methodologies used within sustainability in

manufacturing SMEs research, have mainly been quantitative, less so qualitative and a limited number of studies have adopted a MMR approach. Researchers have called for a more equal balance between positivistic and constructionist studies (Kang and Evans, 2020). Of particular interest to this chapter is the argument that mixed- or qualitative-based research is better suited in cross-subject studies. This is evident in the work by Younis *et al.* (2019) and Molina-Azorin and Lopez-Gamero (2016), and also Barratt *et al.*, (2011) literature which indicates an ‘*integrative*’ approach within sustainability in manufacturing strategy research (SMSR) combined with operations management theories (Sousa, 2003; Salvador *et al.*, 2002; Voss and Winch, 1996).

It is worth summarising the engagement of past and current researchers with various research methods within manufacturing strategy research. Table 1 below, presents in chronological order a selection of influential researchers in the manufacturing strategy field, their research focus and applied research method(s).

Researchers (chronological order)	Manufacturing Research Emphasis	Research method
Ünal E and Shao J (2019)	Sustainability strategies	Quantitative
Zarte <i>et al.</i> , (2019)	Sustainability decision models	Conceptual, literature review
Venugopal and Saleeshya (2018)	Environmental priorities	Quantitative
Dangelico <i>et al.</i> (2017)	Environmental priorities	Conceptual
Longoni and Cagliano (2015)	Environmental and social priorities	Quantitative (survey)
Gimenez <i>et al.</i> (2012)	Environmental priorities	Quantitative (survey)
Hallgren <i>et al.</i> (2011)	Priorities configurations	Quantitative (survey)
Grössler and Grübner (2006)	Strategy configurations	Quantitative (survey)
Kiridena <i>et al.</i> (2009)	Process	Case studies
Kathuria (2000)	Strategy taxonomies	Quantitative (survey)
Bozarth and McDermott (1998)	Strategy configurations	Conceptual, literature based
Ward <i>et al.</i> (1996)	Strategy configurations	Conceptual, literature based
Hayes and Pisano (1994)	Process	Case study
Hill (1992)	Process and content	Conceptual, case studies
Anderson <i>et al.</i> (1989)	Strategy typology	Conceptual, literature review
Kotha and Orne (1989)	Strategy typology	Case studies
Miller (1986)	Strategy configurations	Conceptual, literature based
Hayes (1985)	Process	Conceptual, descriptive
Wheelwright (1984)	Content	Conceptual, descriptive
Stobaugh and Telesio (1983)	Strategy taxonomies	Conceptual, case studies
Skinner (1969, 1974)	Process and content	Conceptual, case studies

Table 1. Research methods applied within the subject of sustainability and manufacturing strategy

The table evidences lack of mixed methods within the subject which echoes calls from Boyer and Swink (2008) and Barratt *et al.* (2011) and more recently Edwards *et al.* (2018) for further adoption of mixed methods in manufacturing strategy research.

Mixed method proponents have pointed to the all-encompassing perspective of methodological concerns which include the philosophical considerations, disciplinary worldviews as well as the methods used within the methodological process.

The philosophy of science perspective

Understanding the philosophical underpinnings of alternative research routes will assist in the design and refinement of the research project (Easterby-Smith *et al.*, 2018). Establishing the ontological and philosophical position of the research project at an early stage guides the researcher as to how, when and why data is to be collected and interpreted, and the role of theory in the data interpretation process. *Ontology* defines the researcher's perspective on how truth can be defined, its location and how it is observed (Crotty, 1998). Relativism as an ontology argues that many scientific laws may exist aiming to explain the same phenomena (Ashton *et al.*, 2020).

Pragmatism is associated with the use of mixed methods for data collection purposes (Biesta, 2010; Morgan 2014). Pragmatism as an epistemology is pluralistic in its view of conducting research, driven by the research question and using 'what works best' rather than theoretical constraints of the two main philosophical positions positivism and constructionism. Research driven by pragmatism values both objective and subjective knowledge, may be deductive and inductive at different stages within the research journey, and utilises the advantages of quantitative and qualitative data (Creswell and Plano Clark, 2017).

Sustainability is a complex interplay of multiple truths and worldviews, this is particularly true in business and management where multiple business functions need to collectively contribute to the sustainable business model. If the actions of organisations are the outcome of an equilibrium of complex internal organisational factors (resources) and external business environment influences (Barnard, 1971), all of which represent variables that are impossible to control and measure simultaneously, we may conclude that a single law alone does not exist to explain the actions of manufacturing SMEs when they develop a sustainability agenda. As

such, relativism as an ontological stance arguably sits closer to sustainable manufacturing research and its overarching objectives.

Research driven by pragmatism values both objective and subjective knowledge and may be deductive and inductive at different stages within the research journey and utilises the advantages of quantitative and qualitative data (Creswell and Plano Clark, 2017). The advantages of a combination of quantitative and qualitative data allows for richer and well-grounded constructs which are essential for the development of sustainable manufacturing research. Hence the adoption of mixed methods in the study illustrated in this chapter.

Mixed methods

Epistemologically, mixed methods marry the two research paradigms of positivism and constructionism (interpretivism), which are typically seen within the literature as two opposite paradigms. Realism and pragmatism will tell us what ultimately matters are the data collection and analysis tools that the two paradigms, in combination, can offer to answer the particular research questions (Smith and Heshusius, 1986; Carey, 1993; Kaushik and Walsh, 2019). From a purely operational perspective, the two approaches with their wealth of data collection and analysis tools can offer great benefits to the research enquiry on sustainability in manufacturing within the SMEs sector. As Creswell and Plano Clark (2017) recommend, the use of mixed methods is appropriate when one source of data (e.g. survey-based data) is insufficient to explain its results and therefore a second data set (e.g. interview-based data) will enhance the exploration and explanation of the studied phenomena. This was particularly evident to the researchers of the study presented here. Their previous experience of a mono-method (QUAN) approach failed to explain a critical perspective of the rational of manufacturing SMEs engaging in sustainability practices and the impact these business practices have on their financial and market performance. It was therefore decided to engage in a mixed methods approach to benefit from a multi-method strategy and also contribute to the lack of mixed methods in sustainable manufacturing research as evident from table 1 above. Howe (1988, 1992) supports this position by urging social scientists to move away from the pointless and never-to-be-resolved debate (Miles and Huberman, 1994) on which data collection and analysis method, and associated philosophy of science, is best suited to explain human beliefs, behaviour or attitudes. Instead, researchers of social phenomena should free themselves from the restrictive boundaries of positivism and interpretivism, and embrace the compatibility of the tools the two epistemologies can offer.

The debate amongst researchers still abounds nonetheless. For example, some users of mixed methods will even argue that qualitative research can have evidence of positivism within its approach (Reichard and Rallis, 1994; De Block and Vis, 2018). This is evident in the growing trend of qualitative–data based studies adopting thematic analysis (and its derivatives) to quantify their results using statistical tests typically associated with positivistic studies (see King and Brooks, 2017). Alternatively, Bryman (2006) adds to the argument by suggesting that researchers favouring quantitative data will eventually take an open-ended reporting approach during the interpretation of their data, often adopting an imaginative application of statistical techniques and somehow moving away from the mechanistic style of analysis typically associated with positivism. From this perspective, therefore, the boundaries between the two paradigms of positivism and interpretivism tend to be too blurred in practice to exclude mixing data collection and analysis methods from each epistemology.

Discussion within the literature on MMR has also addressed the issues of data analysis concerns. For example, Bryman (2007) and Sale *et al.*, (2002) report on the failure of several studies to fully integrate the findings from their quantitative and qualitative data analysis. Addressing this, within the research on sustainable manufacturing in SMEs, the *development* design is applied, as defined by Greene *et al.* (1989) to ensure effective ‘integration’ and ‘nesting’ of the two datasets QUAN and QUAL (Howell Smith, *et al.*, 2020). Creswell and Plano Clark (2017) refer to a similar mixed methods design with the term *explanatory*.

The explanatory MMR by design was particularly useful for this study as explanatory designs sequentially proceed with the quantitative stage. This was of particular value to this study on sustainable manufacturing in SMEs as it allowed for setting off from an initial quantitative survey to inform the sampling of participants for face to face interviews, with the same data collection instrument (questionnaire) being used in stages. Once the data had been collected, joining up the two methods was conducted in the interpretation stage, with separate analysis stages for each quantitative and qualitative data sets; the aim being to ensure evidence of interaction, influence and debate between the two datasets QUAN and QUAL. This follows the logic of Greene *et al.* (1989), *higher order expansion design* which aims to combine both methods to assess the same phenomena.

Research design

Sampling and selection

Deciding on the type and size of a sample suited for the purpose of an MMR approach involves a combination of well-established quantitative and qualitative techniques (Teddlie and Yu, 2007; Guetterman, *et al.*, 2019). With reference to Creswell and Plano Clark's (2011) explanatory design where quantitative data is collected first and informs the sample of the subsequent qualitative phase, the following recommendations by the authors were closely followed within the research project presented here (Creswell and Plano Clark, 2017:181), hence:

- Individuals who participate in the qualitative phase belong to the sample of the quantitative phase.
- The qualitative follow-up phase has a smaller sample size than the quantitative phase.
- During the quantitative data analysis stage any unclear or unexpected statistical results are to be explored, informed and explained with the aid of qualitative data results.
- The purposive qualitative sample to bear some degree of association with the demographics of the quantitative phase participants. As such, the purposeful qualitative sample mirrors the characteristics of the random quantitative sample.

Within the research project described in this chapter, the research team (Sainidis and Robson, 2016; 2017) used a suitable survey and interview sample drawn from the population of UK-based manufacturing SMEs. The study made use of purposive samples for both its quantitative and qualitative data collection phase. Furthermore, the greater depth of data interpretation that purposeful sampling offers rather than the generalisability of results from probability random sampling aligns with the aims and purpose of the research study (Patton, 2002; Palinkas, 2015).

In the United Kingdom close to 28,580 companies are manufacturing SMEs (or 9.8% of the total UK manufacturing population¹). The study targeted manufacturing SMEs based in the UK by inviting their senior managers to participate in the online survey and follow-up interviews. Online surveys offer a cost advantage over postal surveys and are easy to administer and store the collected data (Nair and Adams, 2009; Evans and Anil, 2018), the literature

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/836562/BPE__2019_detailed_tables.xls

acknowledges the potential of a low response rate (Dommeyer *et al.*, 2004; Porter, 2004; Dennis, 2003; Kamel and Lloyd, 2016). Four reminding messages were sent to non-responding SMEs. The achieved 104 responses (4.7% response rate) compares well with previous academic research in the SMEs sector.

Subsequently, the 104 participating manufacturing SMEs were invited to take part in follow-up interviews, which resulted in the agreement of 17 manufacturing SMEs to participate. Although the literature advises on interviews samples of 6-12 units (Collins, 2010), in order to ensure mirroring between the survey and interviews samples and to ensure representation of SME (size, turnover, ownership), SIC code, manufacturing (production types) and geographical location, all 17 manufacturing SMEs which accepted the follow-up interview invitation were included in the interview sample.

Research instrument: questionnaire design

Given the mixed methods methodology used in this study, a single data collection instrument was developed for both survey and interview purposes. The study had a well-defined aim and research objectives with a clear purpose. The design of the questionnaire is influenced by the relevant sustainability and manufacturing strategy literature and similar studies on manufacturing SMEs. 17 questions were included in the questionnaire using either a 5-, 6-, or 7-point semantic differential scale. Frohlich (2002), Forza (2002), Dennis (2003) and Bryman and Bell (2007) have all advised piloting the research instrument, in this case the survey and interview questionnaire, to allow for structural and wording corrections and develop the researcher's experience in conducting interviews. The prototype questionnaire was piloted in two phases before it was used for the UK-wide survey and follow-up interviews.

Quantitative data collection

The survey used a self-administered online (web-based) questionnaire structured around seven sections:

1. *Covering statement*: to introduce the purpose and benefits of the research and inform participants of the ethical policy governing the research.
2. *Definition of the term 'manufacturing strategy'*: to ensure a common understanding by the research's participants.

3. *Participant's details (company name and management position)*: to ensure senior management participation and avoid response error.
4. *Participating manufacturing SME demographic details*: to allow for sample profiling.
5. *Eight questions capturing data on the issue of 'sustainability in manufacturing SMEs'*: to capture the necessary data in order to address the research question.
6. *Feedback on questionnaire experience*: to allow for minor adjustments to the data collection instrument during the survey rounds.
7. *Participant's contact details to confirm request for brief report on survey results*: to act as a response incentive.

The survey administration followed best practice taking advice from Frohlich (2002), Forza (2002) and Dennis (2003). Prior to survey questionnaire being issued participants were informed of the value of the survey to raise awareness and interest. Non-respondents were reminded over four rounds.

The collection of qualitative data, by means of semi-structured interviews, was informed by Lee (1999), Golden-Biddle and Locke (1997) and the more editorial paper by Bansal *et al.* (2018). The average duration of the interviews was 45 minutes. The researcher team also took the advice of Arskey and Knight (1999) and Azungah (2018) regarding communication, questioning and conversation techniques, as well as ethical issues during an interview situation.

Data analysis

The collected data has been subject to mixed data analysis strategies, as proposed by Tashakkori and Teddlie (1998). The parallel mixed analysis method has therefore been applied, as this allows the researcher to utilise the traditional types of quantitative and qualitative analysis techniques within the same study. A survey (quantitative data) is followed by interviews (qualitative data), the quantitative data is subject to descriptive statistics (frequencies), and the qualitative data is subject to thematic analysis.

In the first phase of the parallel design the quantitative stage used nominal and mostly ordinal scales. Forza (2002) recommends in the case of surveys, with non-representative samples, the use of preliminary data analysis which includes frequency distribution of variables. Relating to the first phase as Caracelli and Greene (1993), and Tashakkori and Teddlie (1998) suggest that where mixed methods apply, the quantitative data should be subject to descriptive statistics

to explore frequencies of variables. Within this research project, descriptive statistics also allows for a reasonably in-depth overview of the manufacturing SME sector and its adoption of sustainable strategies. This is in line with the epistemological stance of this study, to explore and explain the studied phenomenon, without necessarily testing for any particular theory.

All 17 interviews were digitally recorded using Nvivo as a thematic analysis software. Qualitative data collected from the interviews was analysed using template analysis as developed by King (2004). King's template analysis method is a form of thematic analysis, but at the same time influenced by the more structured data analysis methods of grounded theory and interpretative phenomenological analysis (IPA), and can be used through a variety of epistemological positions (Waring and Wainwright, 2008; King *et al.*, 2018).

Template analysis builds upon the earlier work of Miles and Huberman (1994). King (2018; 2004) defines template analysis method as a list of codes representing themes identified within the collected qualitative data. The codes are in most cases defined *a priori*, typically driven by the relevant literature. However, some codes may develop during the data analysis process as concepts emerge within the textual data which were not necessarily identified during the literature review process. As such, the template analysis allows for a degree of flexibility and creativity within the researcher's role. The list of codes generated makes the template. During the construction of the template, similar codes are grouped together in clusters (codes) with the final result presenting a hierarchy of codes. This hierarchy identifies what King defines as higher order codes, lower order codes and next level order codes. Higher order codes include the broader concepts identified within the textual data across all data items (each interview in this case). The breakdown of each higher order code into fine distinctions within and across data extracts (interview quotes in this case) generates lower order codes. When the template is complete, the next stage of the analysis can commence with the interpretation of the coded data, by exploring patterns within the coded data to identify themes. The emerging patterns should then be interpreted by the researcher in order to develop themes. Figure 2 below illustrates the template analysis process used within this research project.

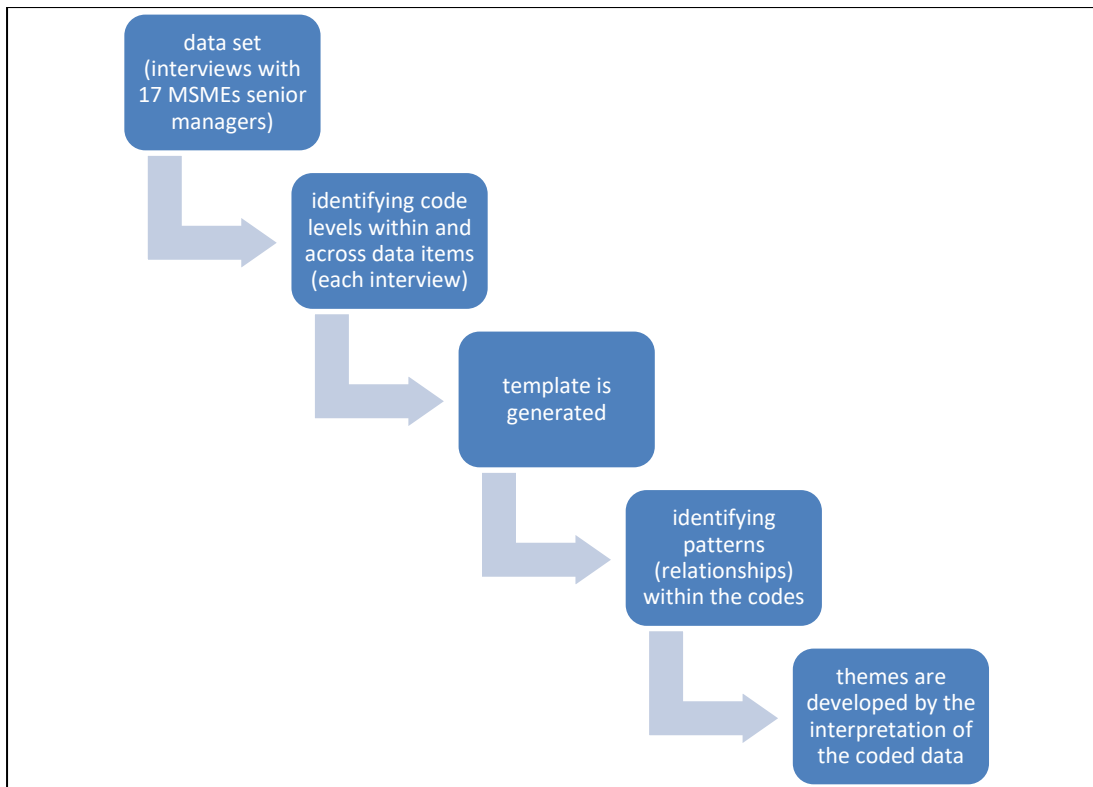


Figure 2. Template analysis process used within this study

The interpretation of the template analysis results took advice from King and Brook (2017). It was structured around the main themes, utilising powerful data extracts to prove each theme. Themes represent the core of this approach, with data extracts in the form interview quotes complementing the themes. This approach allows for a clear and concise thematic discussion, however there is a danger of making the discussion too broad with too much generalisation failing to pay attention to the experiences of the study participants. The latter is important given the contemporary nature of sustainability in the manufacturing SMEs sector. The researcher aims to capture the management beliefs and business practices on sustainability and its impact on business performance.

Discussion: mixing of data sets

Creswell and Plano Clark (2017) list three challenges when applying mixed methods. First, the researcher's level of skills required to collect and analyse quantitative and qualitative data. In particular they stress that training in quantitative and qualitative data analysis methods or taking advice by experienced researchers in mixed methods is advisable. Second, time and resources required to collect and analyse both sets of data. Online surveys have short lead-time and cost

advantages over a postal survey. The use of the specialised software packages of SPSS and Nvivo for analysis of the quantitative and qualitative data sets respectively contribute in speeding up the process. Third, supporting the validity of mixed methods. Mixed methods is seen as a 'novice' approach, with researchers questioning its lack of philosophical grounding and rigour (Johnson *et al.*, 2017). However, within the subject of sustainable manufacturing there is a growing trend towards the publication of MMR, see for example Journal of Cleaner Production, Risk Management, Journal of Quality in Maintenance Engineering.

Onwuegbuzie and Johnson (2006, p. 52) and more recently Creamer (2018, 2017) add to the debate by pointing to the '*problem of integration*' in MMR. They note that in the case of parallel mixed analysis, the researcher needs to ensure that the discussion of results derived from the two independent sets of quantitative and qualitative data, shows evidence of true integration and avoid it becoming two separate research reports. Yin (2006) recommends a '*nesting*' sampling technique where the samples used for each method bear a degree of relationship and commonality. The analyses and discussion of results should also show evidence of integration with all data sets addressing and commenting upon the same variables. The experience of the authors agrees with Harrison *et al.*, (2020) and Almandoz (2012) view QUAN data offering objective evidence on sustainability in the SMEs manufacturing sector but it is the QUAL data which offers rich context to allow a greater level of interpretation of the overall results. In particular, the authors found the integration and nesting of the QUAN and QUAL data sets as complementary and crossover mechanisms during the interpretation and discussion of the study results.

This study used the same data requirements table for both QUAN and QUAL data sets. The developed data collection instruments were ethically approved by the researchers' university before they were piloted and finalised in their design. Using a common data requirements table for both QUAN and QUAL ensured early integration of the data collection methods (Bryman; 2007). The sampling process ensured that interview participants would have already participated in the survey. This allows for a greater response rate to the follow up interviews as the survey generates interest in the study. In a mixed methods scenario it allows for better consistency, mirroring and nesting between the QUAN and QUAL data sets. Within sustainability research a common data collection instrument and survey and interviews samples offered a greater insight into the decision-making factors, attitudes and beliefs residual in the owner/managers, critical in understanding sustainability in SMEs.

Study validation

Extant literature on mixed methods offers a range of criteria to assess the validity of a research study. Creswell and Plano Clark (2017) recommend researchers applying mixed methods to consider the quality of their study and reflect on the criteria used by other researchers. The literature on mixed methods provides some further checklists as to how to validate the data collected and analysed. These checklists question the process of conducting the research when mixed methods are used. Bryman *et al.* (2008) suggest four criteria to test the rigour of applying mixed methods within a study:

- The use of mixed methods needs to be relevant to the research aim and questions. In this research project, the primary research question as to how UK-based Manufacturing SMEs develop and implement a sustainability agenda requires an exploratory approach in identifying, understanding and explaining the underlying factors of the SMEs' owners/managers in adopting sustainability policies which have strategic, operational, product, market and certainly financial implications. A mixed methods approach offers an in-depth evaluation and discussion of the complexity of sustainability decisions and the role of cross-functional relationships within an SMEs environment. In addition, mixed methods offer the advantages of both quantitative (identifying) and qualitative (understanding and explain) research methodologies.
- The researcher should provide evidence of data analysis to offer transparency about the mixed methods procedures. Collins *et al.*, (2013) offer an insight into transparency in mixed methods transparency with the use of interview debriefing protocol. Sustainability in the manufacturing SMEs sector is a contemporary and still under development discipline and for mixed methods to become an established research methods strategy within it requires an honest and open account of the data presented and how it is discussed.
- The findings need to be integrated or mixed. Parallel mixed method approach (Tashakkori and Teddlie, 1998) was applied in the study presented here. Certainly, the experience of the authors of this chapter has been that many mixed methods-based studies in the sustainability topic do not in many cases provide a transparent and evident account of data nesting. Although mixed methods is a powerful tool in exploratory research researchers do not always provide strong evidence of how the datasets were integrated.

- A rationale for the application of mixed methods. Mixed methods literature offers a wealth of sources, approaches and justifications for future studies in sustainability and in particular manufacturing SMEs arena. Researchers should base their choice of research tools on either past examples of MMR or identify gaps and opportunities where MMR can add innovation to the research method choice.

In addition to the above mixed methods validation process, O’Cathain *et al.* (2008) have developed a more extensive set of criteria to validate the process of mixed methods within a study, known as Good Reporting of a Mixed Methods Study (GRAMMS):

- The planning quality of the mixed methods study: feasibility and transparency. During the planning stage of this research the required IT resources (Kompass UK, surveymonkey.com account, access to SPSS and Nvivo) and funding were identified and allocated early to ensure the feasibility of the study. The issue of transparency has already been discussed above using the Bryman *et al.* (2008) framework.
- Design quality: suitability of the design, strength and rigour. As discussed above, the use of mixed methods as research design allowed for the exploration of the research phenomena in question and corresponds to research methodology development within the subject of manufacturing strategy in SMEs.
- Data quality: detailed description, rigour and validity of sampling and data analysis.
- Interpretive rigour: relationship of research findings to relevant literature, exploring agreements and inconsistencies with other researchers.
- Inference transferability: conclusions applied to other settings. Although the primary focus of the present study is restricted by its research question, the research findings extend to issues of public policy on UK manufacturing and in particular on its SME sector.
- Reporting quality: successful completion and reporting of study. The ultimate outcome of the study carried out is the compilation of a publishable research outputs. Participants and policy developers of the study will also benefit by issuing a practitioner-oriented report posted to them.
- Synthesisability: whether the study provides evidence of synthesis.
- Utility: the value of the results.

Concluding remarks

Two sets of data were used in our research to explore the phenomenon of sustainability in manufacturing SMEs in the United Kingdom, one quantitative the other qualitative. MMR offers an innovative, value-added strategy and great opportunity for the collection of rich and powerful data. The data sets collected as part of an MMR approach were integrated and nested which allowed for greater insights into the phenomenon studied and well-informed conclusions. Challenges obviously exist in both process and outcome of a mixed methods approach. The researcher needs to ensure the integration and nesting of data and avoid bias towards one or the other ontological positions of realism or relativism but instead stay faithful to pragmatism. Finally, the validation of the study is vital to ensure justification of the choice of data collection method, process of analysis and reporting mechanism.

This chapter identified the advantages of using MMR-based research for the exploration of the contemporary topic of sustainability in the particularly dynamic business sector of manufacturing SMEs. There is good evidence within the sustainability in manufacturing SMEs discipline of an increased interest and adoption of mixed methods. The limitations of a mono-method approach are well documented in the literature of SMEs (Harrison *et al.*, 2020; Reilly and Jones, 2017). The recent study by Muñoz-Pascual *et al.*, (2019) also supports the need for a mixed method approach in the SMEs discipline and the engagement of SMEs with sustainability-oriented business practices. This is particularly true in the unstable, complex and diverse business environments SMEs tend to operate in.

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