

Research Aspects for Methodology Design



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Abstract: *The selection of suitable methodology for conducting pertinent and meticulous research work is of paramount importance, in which the research logics should be given a great amount of consideration. In this context, it is imperative to have a consolidated study that discusses the pros and cons of various research logics and the purposes they carry. Through a structured literature review approach, the authors have filled this gap by discussing the importance of various research approaches, research logics and have drawn conclusion from the relevant literature that each approach and logic is suited to a specific scenario. It can be said that the mixed mode research method is the most suitable research method when it comes to conduction of organizational level research works where the focus is the improve the performance as well as gauge the narrative established among the members/employees of the organization. In manufacturing or supply chain excellent, mixed mode methods can yield excellent results based on their holistic nature. However, the complexity of this research methodology can be catered with modern research management tools, such as K-Chart. The research work will provide clarity to academicians regarding the selection of most suitable approach for designing a methodology.*

Keywords: *Literature review research methodology; research logics, research approaches*

I. INTRODUCTION

In conducting a research work, the researcher is required to select a suitable methodology in order to ensure the reliability of the research, as an ill-defined research methodology will make the research highly divergent instead of converging at a single point. The selection of suitable research methodology is of supreme importance and in this scenario, a gap has been

observed regarding the lack of a consolidated research work that alludes to various research logics. Referring to pertinent reasoning, [1], the research logics are categorically defined into three broad categories.

A. Induction or Inductive Logic

This research logic focuses on the data generalization facet, that eventually culminates in development of theory [2-4]. As mentioned by Saunders, Lewis [5], the category of inductive logic aids in pattern identification and thematic classifications while consolidating and developing a theory, however the definition lacks universality and cannot be approached in a holistic fashion [2, 6]. However, the main advantage of this logic lies in instilling the comprehension of the phenomenon of investigations among people [5]. The pattern of inductive logic is that after successful validations of a research hypothesis, a final theory is developed based on the observations, data collection and the results. This quality makes it highly suitable for qualitative research, specifically in the cases where sample size is small, due to its flexibility and lack of focus on the generalization of the idea.

B. Deduction or Deductive Logic

Whereas the inductive logic focuses on the formulation of theory, the deductive logic builds upon the aforementioned and transcends from theory to its validation through data collection. As Saunders, Lewis [5] have mentioned, the prime focus of deductive logic is testing of various hypotheses, both in general and specific category [7, 8]. In achieving generalized results as the facts are backed by statistical evidence whenever the sample size is sufficient, therefore making it best suited to quantitative approaches. However, these issues make this logic less flexible as the sheer focus is on the generalization of the obtained results.

A. Abduction Logic

Charles Sanders in 1994 and as Van Maanen, Sørensen [9] worked on coining the term “abduction logic” which is an amalgam of the inductive and deductive logic, stating that generation of creative ideas hinges upon oscillation between the two approaches as there is no hard and fast rule for a theory to be holistically inductive or deductive.[2, 10, 11]. Creswell [12] in his research study has utilised both the inductive and deductive logic that moves back and forth between data bases and seconds this logic. It has been observed that this logic is most suited to management and business related researches where there is a mixture of qualitative and quantitative approaches [2].

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II. METHODOLOGY

The authors have used a structured literature review approach in this research work, where the relevant data was collected from various internet sources after defining a proper search and selection criteria.

The literature collected from high impact journals, books and conference papers was thoroughly studied, which established the research gap of requirement of a consolidated review article on the research approaches and research logics.

The authors were mindful of adding the high impact journals in this research work and low-quality work was omitted, this led to selection of 15 most suitable papers that directly related to the subject matter, whereas 7 pertained to the auxiliaries. Google Scholar was the primary source of search and data from 2000-2016 was selected in the literature review.

III. LITERATURE REVIEW

A. Research Purposes

In a research onion, the third layer from outside is the layer of research purposes, which sets the soul for the research. According to **Saunders, Lewis [5]**, in their study, the most common research purposes are exploratory, descriptive and explanatory [7, 13]. Therefore, the pattern is Followed below in the, where each strategy is meticulously defined and explained. It can be observed that the issues at hand are sought after using exploratory research, whereas descriptive research provides the details and relevant particulars about a specific idea; whereas explanatory research relates two or more terms in the form of variables where change in one entity causes change in the other, therefore the casual relationships amongst variables are studied. It is pertinent to mention that there is no hard and fast rule for selecting these research purposes, and the researchers are at liberty to use any of these as deemed fit by the requirements, aims and objectives of the result; in singularity as well as unison [13-15].

Table- I Research Purpose

Exploratory	Descriptive	Explanatory
<ul style="list-style-type: none"> To discover a new item To seek new intuitions and evaluating phenomenon in new regimes To find out what is taking place Pivots on questioning Uses case study as a tool Follows the pattern of "the explorer" 	<ul style="list-style-type: none"> Detection of items/ideas Precise profiling of items Requires beforehand knowledge of items The most questions asked are related to who, what and where Follows the pattern of "The Detective" 	<ul style="list-style-type: none"> Describes items by asking for a variable based relationship The tools of numerical analysis, mathematical modelling and simulation modelling are utilized The most commonly utilised questions are how and why Follows the pattern of "The Doctor"

Source: Nasir Shafiq and Mahmood [14]

B. Research Approaches or Research Designs

Once the researchers have gathered information and knowledge regarding research strategies, the next job is selection of right research approach/strategy to achieve the research objective. Mainly, qualitative and quantitative

research approaches are used in research works, where the former deals with the human factor and the latter deals with the expression in terms of numbers and variables [16]. In some cases, as per the research requirement, the qualitative and quantitative approaches are used in unison to make an amalgam of mixed-mode research in order to attain precise, accurate and feasible results that take the case into holistic terms.

C. Quantitative Approach

Nesensohn [2] elaborated on the concept of quantitative approach, which borrows its meaning from the adjective "quantity", connoting the impressibility of an expression in terms of numbers/amounts, used for quantified researches [13, 17, 18]. The mode of this approach is inclined towards numerical analysis under controlled environmental conditions, whilst defining a design perspective of fixed nature in order to ensure the accuracy, generalization and proper testing through hypotheses of the research findings. The research works that cater to the mathematical modelling and numerical analysis domain, along with laboratory experiments exemplify the quantitative approach. This approach is motivated by the stances of positivism and deduction, however it is not restricted to the aforementioned stances and varies accordingly as per the nature of the case at hand, its aims and objectives [5]. In this research approach, the common tools are surveys and questionnaires, the responses of which are fed into statistical package tools e.g. SPSS. AMOS, PLS etc., in order to check the reliability and validity of data, which is followed by the accurate results in form of percentages with the variances mentioned as well. The details regarding the strength and weaknesses of quantitative approach are explained below in.

Table- II Quantitative Approach

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> The results can be compared, replicated, verified and eventually generalized It does not depend upon environmental conditions Requires short period of time Provision of accurate measurements using statistical tools Reliability and validity is subjective 	<ul style="list-style-type: none"> It is very rigid in nature and cannot be moulded The experiences of respondents may vary and there can be a degree of biasedness The statistical tools and survey approach may be uneconomical Carries research constraints

D. Qualitative Approach

Nesensohn [2] in his research study elaborated on the concept of qualitative approach which entails the discussion on the social enquiry, therefore hinging on the understanding and comprehension of human actions.[13, 17, 19]. The flavour of this research is slanted towards the comprehension and exploration of phenomenon under study by involvement of people [20], whilst delivering new approaches, understanding and discoveries by focusing on human actions and patterns [2]. Usually, the research develops a pattern, builds and defines a holistic picture of the research, followed by execution of study in normal settings to analyse and report the viewpoints and narratives of the informants [13, 21, 22].



This nature of research is of supreme importance in discovering new ideologies and methods, put to good use in natural and flexible settings rather than a controlled environment that is a facet of quantitative study.

It can be seen that the quantitative approach is inclined towards the logics of induction and abduction, oscillating between the two to form an exploratory research [23]. However, as established before, the is highly dependent upon the nature of the case, its aims and objectives and it's the prerogative of the researcher to select the most feasible solution [5]. The tools of this research approach include case studies in which open ended questions are asked from the participants, which may be transformed into semi structured questionnaires and a few structured questions to ensure reliable responses from the respondents, therefore limiting data falsification [1, 24-27]. For the data analysis, the strategies like interpreting data into codes and themes and interpreting, visualizing and describing the data in the qualitative form is very common in this strategy. The details regarding the strength and weaknesses are explained below in

Table- III Qualitative Approach

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> Highly flexible in nature and extremely resourceful The flexibility facet supplements the narrative that the research is holistic High strength of explanation Systematic delivery of new ideas hinging on good connections between people and the world Validation and reliability of the collected data Proper explanation of results that adds for novelty and uniqueness Highly economical 	<ul style="list-style-type: none"> Arduous/ laborious Dependent upon skillset Result bias

IV. RESULTS & DISCUSSION

Judging by the strengths and weaknesses of qualitative and quantitative approaches, it is pertinent to discuss the amalgam of these two approaches [28-30], known as mixed method approach where positive results are achieved of holistic nature than can be generalized and adopted easily. The strength of the approach is validated as follows in, where qualitative, quantitative and mixed-mode approaches are compared.

Table- IV Mixed Mode Approach

	Quantitative	Qualitative	Mixed Mode Approach
General	Confirmation of hypothesis Carries reality-based objectives in the facts and data collection Employed instruments are rigid and meticulous The variables defined are measurable Variables are	Inclined towards exploration of phenomenon The collected data is regarding social constructs The employed instruments are flexible The quantification is difficult because of the underlying intricacy The research focuses on the views of the	Both exploration of phenomenon and confirmation of hypothesis study is possible The collected data is regarding social constructs as well as the reality The employed instruments are flexible and meticulous Despite being quantifiable and

	commonly measured and identified The research focuses on the views of the outsider Carries design of static nature	informant The perspective of event study is from informants Carries design of dynamic nature	abstract, data is measurable The research focuses on the views of the outsider as well as the informant Carries design of static as well as dynamic nature
Drive	Hinges on deductive logic Predicts items based on cause and effect Prediction is based on cause and effect Casual explanation suffices Generalizability leads to predictive analysis Check reliability and accuracy through validity	Hinges on inductive and inductive logic Interprets items based upon their abstract relationship Various viewpoints have to be taken into consideration Carries theories based on comprehension Verification leads to accuracy and reliability	Hinges on deductive and inductive logic Carries predictable and interpretable Amalgamates casual explanation and various viewpoints Carries both generalization and understanding Check reliability and accuracy through validity and verification
Anal ytical Meth od	Quantification of variations The data is analysed through statistical analysis The analysis is dependent upon the characteristic of respondents Numerical nature of data	Description of variations Data is analysed by exploring themes in an abstract manner and informant language The analysis is based upon the individual experiences Textual nature of data	Quantification as well as description of variations The data is analysed through statistical means and uses informant language The analysis is based upon casual relationships and individual experiences Data is both numerical and text-based in nature
Study Design	Stable and rigid design The design is prone to statistical assumptions The responses are not affected by the environments	Flexible nature of design The design is repetitive and can be modified as per the learned outcome The responses are a function of environment and social situations	The design is of both stable and flexible nature The design can be repeated and prone to statistical conditions simultaneously The responses either can be a function of environment or not, depending upon nature of research
Role of Rese archer	The researcher achieves the quantified objectives through this research	The researcher is a part of the research work and is personally involved in day to day matters for complete understanding of the issue at hand	Despite working as in instrument inside the research work, the researcher can use the outside informants

Source: Elnadi [13], Nasir Shafiq and Mahmood [14], Burns [31]

In it can be clearly seen that the mixed method approach carries deductive and inductive approaches [32], whilst focusing on the rudimentary explanation and comprehension of the research issue, thereby making them an amalgam of generalization and understanding.



Research Aspects for Methodology Design

This research approach checks the accuracy, precision and reliability of the research system through validation and verification approaches. In this approach, the data collection is of both numerical and textual nature. In this case, the researcher does not only apply the research but works as an entity inside. The table further suggests that this approach entails exploratory and hypothesis studies which help in transmission of static and dynamic research design [33]. This approach is highly flexible in nature since quantifiable entities and non-quantifiable entities are integrated in a harmonious manner to present a clear picture of the study, by analysing data gathered from insiders and outsiders of the research ecosystem.

One of the few drawbacks of this research approach is the complications of matters that arise with time, while the issues such as right application, time consumption, laboriousness, dual data collection approach, complexity and the requirement of vast expertise for data collection, compilation and analysis [34]. However, there seems to be a clear consensus among the researchers that selection of research approach is solely prerogative of the researcher, which is adequate and covers all the research requirements; but the issue remains that research should be made as simple as possible for ease of conduction and ease of access. Moreover, **Morse [35]** and **Morse [36]** in their research study establish the narrative that despite being mixed mode in nature, every such research as a major component that makes the counterpart approach play an auxiliary role. **Morse [35]** and **Morse [36]** explained that in such approaches, the primary and secondary components can do hand in hand in a sequential manner. The reasons and selection criteria for using simultaneous or sequential paced is as follows [2, 36]. Simultaneous pace is basically for:

- Ensuring the completion and concrete explanation in research work
- Helping in increasing the depth of research
- Increasing the utility of research
- Adding to the usability of research
- Increasing the scope and breadth of the research
- Increasing the richness of results
- Collecting different perspectives
- To make research richer and broader

Sequential pace is basically for:

- Solving minor issues that come with primary method
- Transferring and translating the research work to ensure smooth implementation

It can be observed that research requirement is the driving factor in the selection of right approach e.g. mixed mode approach can have a primary approach of qualitative study which is complemented by a quantitative study that is either sequentially paced or simultaneously paced. The same holds true for vice versa, thus enabling the researcher to conduct the task in a systematic and efficient manner [2, 36].

V. CONCLUSION

In this research work, the authors have discussed various research logics, research purposes and research approaches with their pros and cons to help academicians in getting a clear picture of appropriate techniques that are suited to their

research objective. The authors conclude that mixed mode method can be a suitable option for researchers since it takes the research work in a holistic manner, impressing upon using an integrated technique to achieve the research objective. However, it can be seen that even in mixed mode approaches, there are primary and secondary components that arise from qualitative and quantitative research methods that go either hand in hand or in a sequential fashion to ensure the efficient and systematic completion of research work. It can be said that the mixed mode research method is the most suitable research method when it comes to conduction of organizational level research works where the focus is the improve the performance as well as gauge the narrative established among the members/employees of the organization. In manufacturing or supply chain excellent, mixed mode methods can yield excellent results based on their holistic nature. However, the complexity of this research methodology can be catered with modern research management tools, such as K-Chart.

REFERENCES

1. Saunders, M.N., *Research methods for business students*, 5/e. 2011: Pearson Education India.
2. Nesensohn, C., *An innovative framework for assessing lean construction maturity*. 2014, Liverpool John Moores University.
3. Maylor, H. and K. Blackmon, *Researching business and management: A roadmap for success*. 2005: Palgrave Macmillan.
4. Badurdeen, F., K. Wijekoon, and P. Marksberry, *An analytical hierarchy process-based tool to evaluate value systems for lean transformations*. *Journal of Manufacturing Technology Management*, 2011. **22**(1): p. 46-65.
5. Saunders, M., P. Lewis, and A. Thornhill, *Understanding research philosophies and approaches*. *Research methods for business students*, 2009. **4**: p. 106-135.
6. Blaikie, N., *Designing social research*. 2009: Polity.
7. Srichuachom, U., *The impact of lean approaches to support quality developments in Thailand: an investigation of a claim of universality of lean thinking*. 2015, University of Southampton.
8. Evans, J.S.B., *Deductive Reasoning*. 2005: Cambridge University Press.
9. Van Maanen, J., J.B. Sørensen, and T.R. Mitchell, *The interplay between theory and method*. *Academy of management review*, 2007. **32**(4): p. 1145-1154.
10. Suddaby, R., *From the editors: What grounded theory is not*. *Academy of management journal*, 2006. **49**(4): p. 633-642.
11. Tracy, S.J., *The toxic and mythical combination of a deductive writing logic for inductive qualitative research*. *Departures in Critical Qualitative Research*, 2012. **1**(1): p. 109-141.
12. Creswell, J.W., *Qualitative inquiry and research design: Choosing among five approaches*. 2013: Sage.
13. Elnadi, M., *An innovative framework for implementing lean principles in product-service system*. 2015.
14. Nasir Shafiq and D.A.K. Mahmood, *Research Methodology*, R. approaches, Editor. 2015.
15. Alam, R., *Development of a lean design framework for enhancing the application of product design*. 2015.
16. Taneja, S.S., P.K. Taneja, and R.K. Gupta, *Researches in corporate social responsibility: A review of shifting focus, paradigms, and methodologies*. *Journal of Business Ethics*, 2011. **101**(3): p. 343-364.
17. Robson, C. and K. McCartan, *Real world research*. 2016: John Wiley & Sons.
18. Choy, L.T., *The strengths and weaknesses of research methodology: Comparison and complimentary between qualitative and quantitative approaches*. *IOSR Journal of Humanities and Social Science*, 2014. **19**(4): p. 99-104.

19. Ormston, R., et al., *The foundations of qualitative research. Qualitative research practice: A guide for social science students and researchers*, 2014. **2**: p. 52-55.
20. Denzin, N.K. and Y.S. Lincoln, *Introduction: The discipline and practice of qualitative research*. 2008.
21. Ratcliffe, J.W., *Notions of validity in qualitative research methodology*. Knowledge, 1983. **5**(2): p. 147-167.
22. Silverman, D., *Qualitative research*. 2016: Sage.
23. Patton, M.Q., *Qualitative evaluation and research methods*. 1990: SAGE Publications, inc.
24. Van Aken, E.M., et al., *A framework for designing, managing, and improving Kaizen event programs*. International Journal of Productivity and Performance Management, 2010. **59**(7): p. 641-667.
25. Belova, I.M. and Z. Yansong, *Value stream mapping for waste reduction in playing system components flow*. Jonkoping International Business School, 2008.
26. Wisker, G., *The postgraduate research handbook: Succeed with your MA, MPhil, EdD and PhD*. 2007: Palgrave Macmillan.
27. Greenfield, T., *Research methods for postgraduates*. 2002: Oxford University Press.
28. Creswell, J.W., *Research design: Qualitative, quantitative, and mixed methods approaches*. 2013: Sage publications.
29. Todd, Z., et al., *Mixing methods in psychology: The integration of qualitative and quantitative methods in theory and practice*. 2004: Psychology press.
30. Hox, J., E. De Leeuw, and T. Klausch, *Mixed mode research: issues in design and analysis*. Total survey error in practice, 2017: p. 511-530.
31. Burns, R.B., *Introduction to research methods*. 1997: Addison Wesley Longman.
32. Hussein, A., *The use of triangulation in social sciences research: Can qualitative and quantitative methods be combined*. Journal of comparative social work, 2009. **1**(8): p. 1-12.
33. Hall, B. and K. Howard, *A synergistic approach: Conducting mixed methods research with typological and systemic design considerations*. Journal of mixed methods research, 2008. **2**(3): p. 248-269.
34. Weaver, J. *Challenges of Mixed-Method Research*. 2015; Available from: <https://anthropology.ua.edu/blogs/biocultmed/2015/04/30/challenges-of-mixed-method-research/>.
35. Morse, J.M., *Principles of mixed methods and multimethod research design*. Handbook of mixed methods in social and behavioral research, 2003: p. 189-208.
36. Morse, J.M., *Simultaneous and sequential qualitative mixed method designs*. Qualitative Inquiry, 2010.

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