



## Research Philosophy Design and Methodologies: A Systematic Review of Research Paradigms in Information Technology

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### ABSTRACT

Researchers and post-graduate students most of the time have a challenge differentiating between research philosophies, research design and research methodologies. This paper therefore focuses conducting a systematic review to bring forth clarity on the differences between; research philosophy, research design, research methodologies and research paradigms in Information Technology research. The paper also highlight on the hallmarks of scientific research, fundamental of scientific research, elements of research design as well as data analysis techniques. The paper observes research philosophy, design and methodology and implications in Information Technology literature. This paper contributes to the exploration and identification of qualitative and quantitative methodologies, sampling style, sample size for different Information Technology researches. The authors used content analysis to review works done by other scholars to draw conclusions. The paper would greatly improve the quality of research work by the junior researchers, or post-graduate students who are still developing their research skills.

**Keywords:** *Research Philosophy, Research Design, Research Methodology, Research Paradigm, Information Technology*

### 1. INTRODUCTION

#### 1.1. Background of this study

Research can be defined as “an original investigation undertaken in order to gain new knowledge and

understanding” [1]. Research process can be described as a systematic and organized effort to investigate a specific problem that needs a solution or an answer [2]. Research methods refers to the ways in which research studies are designed and the procedures by which data are analyzed. Research skills are the abilities of an investigator through “acquiring knowledge and a way of thinking” to carefully define a problem of interest, identifying key variables, seeking out relevant information, and subjecting proposed solution to rigorous testing [3]. The aim of research is to explore, explain, evaluate, predict, understand, solve and develop or test theories [4].

There exist two main types of research namely applied research [5] aimed at a specific research question, and fundamental research [6] aimed at the generation of knowledge relevant to industries, organizations and researchers. Other types of research are; Descriptive, focusing on describing relationships [7], Explanatory, used as a first step [8], Theory testing/building, test validity of a theory [9], Comparative - search for similarities/differences, Longitudinal - over a long period of time, Action research - fact finding and improvement and Participatory - researcher is a participant [5].

Research can be classified as either quantitative or qualitative. Quantitative research [10]; deals with numbers, hard facts, statistics, with a positivist world view that is hypothetico-deductive [12]. Qualitative research [11] deals with soft facts, interviews, exploratory and descriptive with a relativism view of the word. The hypothetico-deductive approach [12]

involves observation, preliminary information gathering, theory formulation, hypothesizing, scientific data collection data analysis and deduction.

### 1.2. Hallmarks of Scientific Research

Scientific research should possess; Purposiveness[13], [14] -Research begun with a definite aim or purpose; Rigor - Good theoretical basis, Sound methodology including Appropriate sample, data collection method; and Testability - Hypothesis can be tested when data is collected and Do data support the conjectures; Replicability - Can others replicate the results?; Precision and Confidence - How close are findings based upon sample to reality?, - How confident (probability measure) can we be that our estimations are correct; Objectivity - Conclusions based upon facts rather than just “gut feeling”; Generalizability - Scope of the findings, and Parsimony - Economy in research models, Simplicity of explanation. The decision to research or not to research depends on the cost of the research, the choice of the method, the potential value of the research, human factors like personal and ethical issues, internal or external politics and time.

### 1.3. Purpose of the study

The purpose of this paper was to bring out clearly both the difference and relationship that exist among; research philosophy, research design, and research methodologies, thereby enlightening the junior researchers and post-graduate students with an aim of bringing forth mature and quality research work.

## 2. RESEARCH METHODS

The research approach [15] can either emphasize on nomothetic methods or ideographic methods. Nomothetic methods are deductive, explains casual relationships by covering-laws (etic), generates and uses quantitative data, uses various controls that are either physical or statistical to allow the testing of hypotheses, [16] and is highly structured research methodology to ensure Replicability through surveys and laboratory experiments.

Ideographic methods [17] are inductive, explains subjective meaning systems and explanations by understanding(emic), generates and uses qualitative data, is committed to research in every day setting, to allow access to, and minimize reactivity among the subjects of research, it is minimally structured and employs action research and ethnography. Quantitative approach is deductive [18], begins from theory, the hypothesis is firmly defined before the

research begins, analysis takes place after research has taken place and employs inductive generalizations. Qualitative approach is inductive, begins from reality, data generation, analysis and theory are concurrent and employs exemplar or analytic generalizations.

The research process entails translation of the scientific method into practice. The process of research proposes that the function of a science is to “establish general laws covering the behavior of empirical events [19] with which the science in question is concerned. The scientific method is made up of four iterative processes as the researcher pursues the solution to a scientific problem which include; observing a phenomenon, forming tentative explanations or statements of cause and effect, observing or experimenting to rule out alternative explanations and refining and retesting the explanations.

The rest of the paper shall discuss fundamentals of scientific research by focusing on research paradigms and scientific process, epistemology and philosophical issues, positivism, humanism, critical realism, postmodernism, scientific truth and bias, research design and methodologies.

### 2.1. Fundamentals of Scientific Research

Scientific research goals are characterized either by the positivist or phenomenological approach. Different assumptions about nature inform either of the above paradigms. Phenomenology addresses the purpose, process, data collection, data analysis, communication of the distinguished characteristic and statement of the purpose. Phenomenology is a qualitative research method that attempts to understand participants’ perspectives and views of social realities. Ethnography is a type of qualitative inquiry that involves an in-depth study of an intact cultural group in a natural setting. Action research is a type of applied research that focuses on finding a solution to a local problem in a local setting.

The positivist view asserts that as for the domain of natural science, the reality of this (social science) domain exists, and can be known, independently of any personal view or interpretation thereof. Such personal interpretations are inherently subjective and are deemed to be arrived at through inference rather than deductive logic. There is a clear philosophical distinction between positivism and phenomenism. In practice, any specific research approach sits in a continuum in which research methodologies which are inherently positivist are described as nomothetic. In establishing what is true or false to draw a conclusion, application of induction and deduction is

essential. Induction is based on empirical evidence whereas deduction is based on logic.

### 3. RESEARCH DESIGN STRATEGY

Research design can include survey research, case study research, action research, experimental research, surveys are essentially snapshots of practices, situations or views at a particular point in time. Surveys are undertaken using questionnaires or structured interviews from which inferences may be made. Quantitative techniques are often used in analyzing responses with a view to identifying significant results. With careful design, surveys are a good means of looking at a far greater number of variables than is the case with the experimental process.

Case study research is one of the most common approach to information technology research in the real world, given that case studies are generally considered to be a form of research, they have been included in quantitative approaches. Case study is a method of conducting qualitative research and evolved as a distinctive approach to scientific inquiry, partly as a reaction to perceived limitations of quantitative research. Case study research is a form of qualitative research. Qualitative research being a multi-method in its focus, involving an interpretive, naturalistic approach to its subject matter.

Action research is a valuable variation of the quasi-experiment research. The first conscious use of action research can be traced back to 1946 by Lewin who was concerned with the application of social science knowledge to solve social problems such as conflict between groups and the need to change eating habits in wartime [20]. Lewin does not seem to have used any comprehensive definition of the term but he nevertheless refers to research programmes within organizations whose progress is guided by the needs of the organizations, and frequently uses the expression 'problem centered research [21]. Of the most crucial issues in contrasting action research and ethnography is that the client chooses the clinician while the ethnographer chooses the subject group to be studied. Clinicians enter an organization only if they are with the client. Susman and Evered [22] attempt to legitimate action research as science locating its foundation in philosophical viewpoints which differ from those of legitimate positivist science. These are the notions of praxis, hermeneutics, existentialism, pragmatism, process philosophies and phenomenology.

#### 3.1. Research Design Techniques

Research can either be applied or basic. Applied research [15] is aimed at a specific research question whereas basic research is aimed at the generation of knowledge relevant to industries, organization and researchers. The use of multiple, but independent, measures in a single study is known as triangulation, a term borrowed from navigation and surveying where a minimum of the reference points are taken to check an object's location [26]. There are four categories of triangulation: Theoretical models, data, Investigator, and Methodological. Triangulation of theories involves borrowing models from one discipline and using them to explain situations in another discipline. Data triangulation refers to research where data is collected over the different time frames or from different sources. Triangulation by investigators is where different people collect data on the same situation, and the results are then compared. Methodological triangulation [40] is the use of both quantitative as well as qualitative methods of data collection. These can be extremely diverse to include Questionnaires, interviews, telephone surveys and field studies. Triangulating should be seen as not an end itself, but an imaginative way of maximizing the amount of data collected.

Survey research design [30] was presented by Hyman in 1964 who presented a model for a research, which later was improved by [2]. They suggest that survey research study should include the following phases: Idea-Generating Phase, Problem-definition phase, Procedures-design phase, Observation phase, Analysis phase, Interpretation phase and Communication phase.

#### 3.2. Data Analysis Techniques

Statistics [41] are tools that help us interpret the results of research studies. The appropriate statistic(s) depend on the nature of data and the question being asked. The first step to statistical analysis is to organize and enter data on a file accessible to data-analysis program. Software used for Data analysis include using SPSS [42] Windows Version 7.5. Analysis techniques include Descriptive Statistics, Correlation [43] and mean standard deviation, Pearson's correlation, t-tests and Multiple Variance analysis, Multi-variate Credible Model. Data Analysis entails; Measurement and Measures. For Data (Descriptive Statistics) include; Mean values, Standard Deviations and Variance. Goodness of Data (Inferential Statistics) include; Reliability of Data, Validity of findings (Pearson Correlation Matrix), Hypothesis testing [44] and Multiple Regress Analysis. Descriptive statistics entails; Measures of Central Tendency including; Mean - is

the arithmetic average of all scores. This is computed by adding scores and dividing by the number of scores, Median - is the middle score or the score at 50<sup>th</sup> percentile, Mode - is the most frequently occurring score. Measures of Variability include; Variance, Standard deviation - is the square root of the variance. Measures of Relationship include; Pearson product-Moment correlation and Spearman Rank-Order correlation.

#### 4. RESEARCH PHILOSOPHY

Research philosophy refers to the set of beliefs concerning the nature of the reality being investigated and the choice of the type of research philosophy applied in an area of research study depends on the knowledge being investigated [23]. Ontological philosophy is concerned with the nature of reality and outlines the difference between reality, our perception about reality and how this influences everything around us [24]. The concept of praxis [25] is concerned with the art of taking action in problematic situations in order to change them, and is guided by good judgment. Hermeneutics [26] has probably been more influential in the social sciences in continental Europe than positivist approaches. Positivist [27] science tends to regard the researcher as sole possessor of knowledge from which action will ensue and sole originator of action to be taken on an essentially passive world. By contrast, the action research [20] process is essentially collaborative, synthesizing the contributions that both action researcher and client make to solving problems. The action researcher with theoretical [28] ideas and broad practical experience may help clients make more sense of their practical knowledge and experience in situations in which they are trying to solve their particular problems.

A key criterion for the success of the action research approach may lie in such behaviors as empathetic [29] understanding, taking the role of the other and in specific research methods that are more collaborative, such as participant observation and non-directive interviewing has, action research would not be granted the status of a valid science on the basis of the covering-law model of explanation. The ultimate criterion is the perceived likelihood of chosen actions to produce desirable consequences for the organization. Therefore, Action Research is a kind of science with a different epistemology [26] which produces a different kind of knowledge of use to the particular organization, in the course of which its members are developed to solve, their future problems.

Experimental research design [30] strategy employs Field Experiments [31]–[33]. Field experiments are

abstracts of the real worldview of a system or problem being solved within their natural setting. Field experiments involve the process of designing experiments to model real system or organizations and conducting experiments with this model for the purpose of understanding the behavior of the system and /or evaluating various strategies for the operation of the system" [34]. Field experiments are an extension of laboratory experiments into the real world of organizations/society. They focus on attempting to construct an experiment in a more realistic environment than is possible in the artificial, sanitized laboratory situation [35]. Like laboratory experiments, is the difficulty in finding systems or organizations prepared to be experimented on! Replication [36] is problematic, in that it is extremely difficult to achieve sufficient control to enable replication of the experiment with only the study variables being altered. Field experiments have several strengths which include: Useful in building theory that can subsequently be tested, Creation of new ideas and insights, Recognition that the researcher will interpret what is being studied in a particular way, Contributes to cumulative knowledge, Practical as well as theoretical outcomes most often aimed at emancipatory outcomes, and Biases of researcher made known. Field experiments have weaknesses [37] which include: Complexity [38] and changing relationship of variables under study, Scenarios are not 'true' pictures of the future but enable decisions re. reactions in different 'futures', Dependent on precision/relevance of past data and expertise of scenario builders, Possibility of self-fulfilling prophecies, Difficulties associated with devising a simulation that accurately reflects the real world situations, Restriction to a single event/organization, Difficulty in generalizing, given problems of acquiring similar data from a statistically [39]meaningful number of cases, Lack of control of variables and Different interpretations of events by individual researchers/ stakeholders.

#### 5. CONCLUSION

Certain approaches in research are best suited to be applied in Information Technology and Information Systems. A critical component of science is communication of research findings. Scientific communication occurs through presentations at scientific meetings and through publication in journals and books or in Research Reports. Scientific publications should describe procedures in detail, not only so that other scientists can understand the research, but also to allow them to replicate (repeat) it if they wish. By presenting full accounts of research rationales, procedures, findings, and interpretations,

the researcher is contributing to public scientific activity, and the work can be fully evaluated by others, even to the point of replicating the research.

## 6. REFERENCES

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