

Scientific Research Methodology Vs. Social Science Research Methodology

Dr. Ashwani Kumar

HOD Mathematics & Statistics

Dronacharya PG College of Education Rait, Kangra, HP, India

drashwanihpu@gmail.com

Abstract: *The multiple research methodologies used in scientific and social science research such as conceptual research, empirical research, model research methodology, experimental research, formal methodologies, build research methodology, process research methodology and simulation method are discussed. The recursive scientific research cycle has been explained. The research process is compared with respect to both scientific and social science research. The less demarcation between the methodologies used in scientific and social science research is highlighted.*

Keywords: Research, Methodology, Scientific, Social

I. INTRODUCTION

“Research is an art of scientific investigation”.

----- Kothari, C.R. (2004)

Is there any clear demarcation between scientific research methodology and management or social science research methodologies? Are they complementary and cannot be separable? Science is derived from different domains and uses the research methods such as experimental, theoretical and simulation. Any science consists of body of knowledge. Ancient philosophers such as Aristotle, Plato, and Socrates have studies domains such as astronomy, philosophy, mathematics, logic and medicine. Aristotle and Galileo are the initial contributors of scientific research. Current day researchers are studying basic sciences, core sciences, engineering sciences, applied sciences, social sciences, natural sciences, biological sciences, zoological sciences, medical and health sciences. The current day social sciences include history, political science, sociology, anthropology, psychology, linguistics, philosophy and cultural studies.

Information systems research requires combination of technological and social issues (Berndtsson et al., 2008). It is derived from the domains such as cognitive science, computer science, ergonomics, organizational theory, management science, political science, economics, organization science, psychology, language theory and organizational behaviour. Information systems research can also be technical or behavioural in nature (Ramesh et al., 2003). The research process involves revising theories, facts and applications. The goal of current day research is discovery and dissemination of knowledge and information. The traditional research concentrated on finding and developing knowledge on the unknowns.

This article explains the different research methodologies used in both scientific and social science research. Those methodologies include conceptual research, empirical research, model research methodology, experimental research, formal methodologies, build research methodology, process research methodology and simulation method. The ‘Methodology’ has origins from Greek word.



II. CONCEPTUAL RESEARCH

It is useful for making derivations, definitions, propositions and deriving hypotheses based on literature gaps. This basically identifies the basic constructs in the subject knowledge base and finds the interconnections and links between constructs, factors and variables. Conceptual research is useful to make conceptual models pertaining to the subject area. Further, conceptual models are used to do empirical, causal and experimental research. Conceptual research is the primary step for empirical, causal or experimental research (Figure 1).

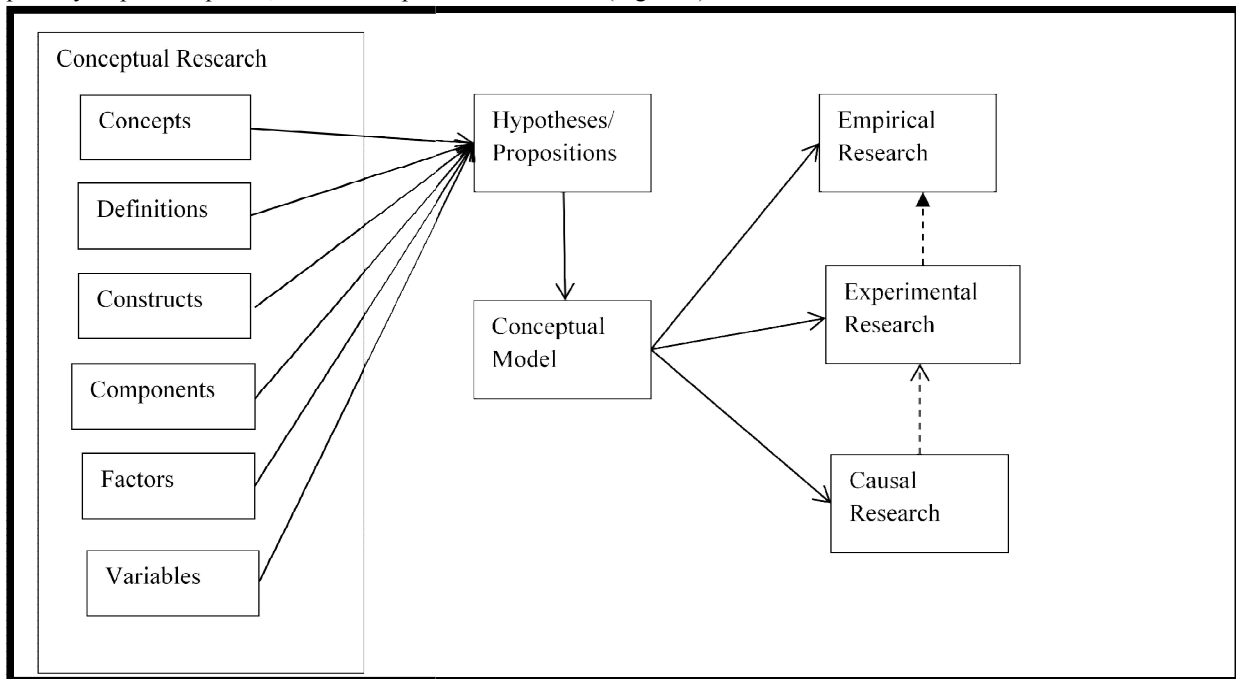


Figure 1: Social Science Research Methods

Based on the results of the experiments and observation, the hypotheses are adjusted in scientific research. Whereas, adjusting the hypotheses is not possible in management research after data analysis. In management or social sciences research, the hypotheses are either supported or not supported after data analysis. The hypothesis is consistent here. Scientific theory is based on empirical knowledge came out of observational experimentation (Freitas, 2009). The scientific research cycle is as shown in Figure 2. The scientific research cycle is recursive in nature. The research methods followed in scientific research are mostly quantitative in nature (Warfield, 2010). Whereas, research methods followed in social sciences are mostly qualitative in nature. There are cases that mixed methods are also followed in both scientific and social sciences research.



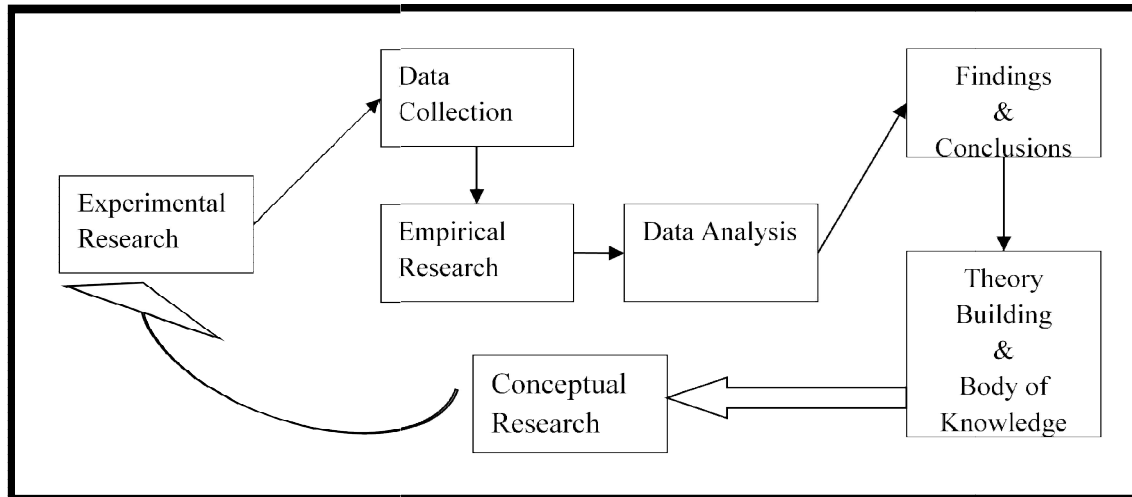


Figure 2: The Scientific Research Cycle

III. EMPIRICAL RESEARCH

Empirical research is mostly used in social sciences, behavioural sciences, sociology, psychology, industrial psychology and economics. It is based on data collection, hypothesis proving based on data and deriving conclusions from it. For example, for the past two decades, extensive empirical research is going on in areas such as software engineering, computer science and information systems. This indicates that engineering and scientific research is also using empirical methods. Empirical research methods are used in project management research also. The experimental software engineering brings in the domains such as sociology, economics, psychology and computer science. Empirical research uses techniques such as questionnaires, interviews and case studies. Using questionnaires nominal, continuous, ordinal, interval, ratio (Holz et al., 2006) and discrete data is collected. This data is further analysed for hypotheses testing and deriving conclusions using statistical techniques. The empirical research considering organizational and societal variables should be able to analyze the qualitative comments and textual inputs (Berntsen et al., 2004).

IV. MODEL RESEARCH METHODOLOGY

Model research methodology is used to define an abstract view of a complex system. Models are built to avoid the higher costs in building the entire complex systems. These models can be used to test and modify and further can be used for simulation purposes. Models are also required for experimentation. Model research methodology is usually used in combination with other research methodologies such as experiment, empirical, etc. The models built in scientific research or engineering research are physical models different from the conceptual models developed in management or social science research.

In management or social science research, conceptual models can be represented as written text or diagrams. Whereas, in scientific research models are represented in the form of physical things. In case of computer science, models can be software applications running with minimal functionality. Model is built as interacting components. It can also be a data model. Using models, one can even test the what-if scenarios, does experimentation and simulations. Model is an abstraction of a real world thing. Model is an instrument used or developed by the researchers. It is not the final objective of research. Models often give qualitative and quantitative details to the researchers.

Either in management research or in scientific research, modelling the research problem should be the first step. After modelling further research methods/methodologies can be applied to either conceptual model or the physical scientific model.



V. EXPERIMENTAL RESEARCH

Experimental research methodology is the common research methodology followed in both sciences and social sciences. However, in most of the cases it is applicable to scientific research. Experimental research has two phases in it. They are exploratory phase and evaluation phase. In exploratory phase, the research thinks about the questions to ask about the system to be evaluated and in evaluation phase he finds the answers to those questions.

In a study of 628 research papers of Computer Science published between 1995 and 1999 done by Ramesh et al. (2003), they found that 73.41% of the papers are based on conceptual or mathematical analysis, 15.13% of the papers are based on conceptual analysis, 2.87% are based on proof of concept and only 1.75% are based on laboratory experiments. Rest of the papers have followed different research methodologies. If you keenly observe in computer science research during that five years period, only 1.75% of the research publications are based on laboratory experiments. Why this percentage is very less? To make ground breaking innovations like Thomas Alva Edison and Albert Einstein, their research is purely laboratory based research changing the experimental conditions all the time. This kind of experimentation requires lot of patience and dedication. Unless these are present, future generations may not see the ground breaking innovations which make the life better. When the survival is the biggest questions, very few individuals are dedicating and venturing into these kinds of research methodologies.

Maintaining records of experimental results is very much important in each execution of the experiment. This record keeping should be in such a way that the experimental results should be able to retrieve at a later date. Repeating the experiments in social sciences or management research is not possible or difficult because of the changing organizational conditions. Where as, in scientific research, the experiments can be repeated under the same conditions. The steps in experimentation include experiment definition, experiment planning, experiment operation, analyze results, interpret results, and record the outcomes.

VI. FORMAL METHODOLOGIES

Formal Methodologies are used in computer science to verify certain facts before automatic verification such as finding the algorithm time and space complexity (Amaral et al., 2006). Formal methodologies are widely used in theoretical computer science. Formal methodologies also make uses of building abstract and mathematical models. These formal methodologies are used to find efficient algorithms in areas such as distributed systems, parallel computing, cryptography, combinatorials and geometry.

Build Research Methodology

In scientific research, build research methodology is also followed to build a new artefact which is not present earlier. The artefact built using this approach should have unique features which none of the artefacts have them earlier. In computer science research, build research is widely used to design and build the software systems. While building the software systems, the software components can be reused, specific programming language is selected and continuous testing is done to the software system.

Process Research Methodology

Process research methodology is used in certain areas such as artificial intelligence, software quality, software process improvement and software engineering to find out the processes accomplishing things. Process research methodology is widely used where human interaction is more. It is used in human-computer interaction, vision, and cognitive sciences.

Simulation Methodology

Simulation methodology is used where in real implementation is complex, time consuming and costly. For example in domains such as astronomy, economics, and physics, computer simulation methods are widely used.

There are other research methodologies such as action research, interpretative research, grounded theory, protocol analysis and ethnography used in scientific research. The main skills required for researchers in both scientific and social science research are the expressive, cognitive, organizational and meta-cognitive skills (Holz et al., 2006). The specific skills required for researchers in these areas include scanning papers, searching papers, critique literature, analyze literature, design models, collect data, analyze data, draw conclusions, interpreting results, finding literature



gaps, linking to previous research and building body of knowledge. The researchers filter the world through their conceptual lens (Berntsen et al., 2004).

VII. CONCLUSION

Thus, empirical and experiment research methodologies are used in both scientific and social science research. Conceptual research and model research are used in both scientific and social science research. Simulation is used in both economics and computer science. These finding indicates that there is no clear demarcation or the demarcation is very less in the methodologies used in scientific and social science research. All the methodologies are helping the researchers in both the areas in using, interpreting and making right conclusions.

REFERENCES

1. Amaral, J.N., Buro, M., Elio, R., Hoover, J., Nikolaidis, I., Salavatipour, M., Stewart, L. and Wong, K. (2006), "About Computer Science Research Methodology", CMPUT 603 Course Material, University of Alberta, Canada. Available online at <http://webdocs.cs.ualberta.ca/~c603/readings/research-methods.pdf>, pp. 1-9, (Accessed on 24-Dec-2013)
2. Berndtsson, M., Hansson, J., Olsson, B. and Lundell, B. (2008), Thesis Projects: A Guide for Students in Computer Science and Information Systems, Springer.
3. Berntsen, K.E., Sampson, J. and østerlie, T. (2004), "Interpretive research methods in computer Science", Norwegian University of Science and Technology, Trondheim, Norway, Available online at <http://www.idi.ntnu.no/~thomasos/paper/interpretive.pdf>, pp. 1-14, (Accessed on 24-Dec-2013)
4. Freitas, R. (2009), "Scientific Research Methods and Computer Science", Proceedings of MAP-I Seminars Workshop 2009, Faculdade de Cincias, Universidade do Porto, Portugal, pp. 1-6.
5. Holz, H.J., Applin, A., Haberman, B., Joyce, D., Purchase, H. and Reed, C. (2006), "Research Methods in Computing: What are they, and how should we teach them?", Proceedings of ITiCSE-WGR'06, June 26-28, 2006, Bologna, Italy, pp.96-114.
6. Kothari, C.R. (2004), Research Methodology: Methods and Techniques, Second Edition, New Age International, New Delhi.
7. Ramesh, V., Glass, R. and Vessey, I. (2003), "Research in Computer Science: An empirical study", The Journal of Systems and Software, Vol. 70 (2004), pp. 165-176.
8. Warfield, D. (2010), "IS/IT Research: A Research Methodologies Review", Journal of Theoretical and Applied Information Technology, Vol. 13, Issue 1/2, pp. 28-35.

