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Information Technology Research in Developing Nations: Major Research Methods and Publication Outlets

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ABSTRACT

The multi-disciplinary nature of Information Technology has brought many methods of research with it. This has left many Information Technology specialists whose background is from the rigid scientific disciplines in a dilemma. The paper distinguishes Information Technology research from computer science research. It highlights where emphasis of research in Information Technology needs to be placed. There has been a general shift in Information Technology from focus being strictly technological to social, managerial and organizational in nature that have put demand on Information Technology researcher to acquire knew skills. The paper differentiates the emphasis between Information Technology research and computer science researcher. Both quantitative and qualitative approaches have become handy in this field of study. The most common research methods action research, case study, Ethnography, experimentation, Grounded theory, secondary method, and survey are discussed in this paper clearly giving the applicability. Important consideration and weakness of each method from the information technology perspective are discussed in this paper. The findings outlets for the field are also mentioned.

Keywords: *Computer science research, Information Technology research, IT research methods, Publication outlets*

1. INTRODUCTION

A research method can be considered as a set of organizing principles around which data is collected and analyzed [1]. It is a strategy of inquiry to research design and collection of data [2]. It is the means by which data about given Information Technology (IT) problem may be solved. A variety of methods can be used to solve problems in Information Technology. However the method to use for a particular study in Information Technology is depended on the nature of the problem being studied. The different IT problems call for different skills to be applied. The different research methods demand for different skills, assumptions and practice from the researcher. The multi-disciplinary nature of IT is calling on IT specialist of whom most have their background in computer science to acquire new skills out of the strictly science research approach of experimental method to having to learn the social science nature of research as well. Many Information Technology specialist often find it hard to select the best method to use because of either not having had a good background exposure to the many research methods available to them or not even knowing what is available to them or not understanding the methods strength and weakness. The matter is complicated further by the nature of Information Technology fields being multi-disciplinary in nature thus drawing its methods from a number of fields. This does lead to lack of consistence in terminology to describe them and even lack of consensus on how to distinguish them methods [1].

The purpose of this paper is to provide an overview of the difference between Information Technology research and computer science research. It will also discuss the most commonly applied methods in Information Technology research highlighting the important considerations of the methods and where each is most applicable and not the other. The paper hopes to use terms familiar to Information Technology specialists and offer definitions and distinction that capture the spirit of the methods. The paper also gives suggestions of places where the Information Technology researchers can disseminate the findings.

2. THE DIFFERENCE BETWEEN IT RESEARCH AND COMPUTER SCIENCE RESEARCH

IT is one of the newly emerging fields of study [3] in developing nations that is growing very fast. Unfortunately not many understand what IT is. An examination of Information Technology undergraduate and postgraduate programs being offered by many universities in the developing nations would easily reveal that they are indeed computer science programs. Computer science has been there for some time. Many of the people moving into IT are carrying with them the rigid approaches that define research in the former fields (computer science, electrical engineering) into IT without realizing the unique nature of IT. Many a time you will find one asking “What is the IT in the research?”, when in really sense he or she is looking for the Engineering or computer science in the research. In order to get an understanding on the difference, there is need to understand the difference between especially computer science where most IT specialists are converting from and Information Technology. Basically, IT is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware. IT deals with the use of electronic computers and

computer software to convert, store, protect, process, transmit, and securely retrieve information. According to Association of Computing Machines (ACM) IT, as an academic discipline, is concerned with issues related to advocating for users and meeting their needs within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies [3]. Accordingly, IT research majorly has to revolve around issues related to advocating for users and meeting their needs within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies.

Computer Science is the science of computers whilst Information Technology may or may not make use computers or any form of computer science. This implies that IT research may or may not involve the use of computers. Of course there is a big overlap between IT and computer science but in general computer science deals with the technical working of computers whilst IT is concerned more with information manipulation and the business requirements. From this perspective therefore, research dealing with technical working of computers is the work of computer scientists while that dealing with manipulation of information and the business requirements falls squarely under the IT research. Computer science is a field more closely associated with mathematics, logic, electrical engineering. IT on the other hand is more inclined towards the usage of applications or applying the technology. IT research is thus majorly concerned with technology applications or and technology usage and hence does not so much restrict it self to mathematical and engineering approaches.

At the professional level, the computer scientist tends to be motivated by the computer itself, and thus works under the hood, tends to build and extend the underlying technology [3], The computer science research therefore focuses towards building and extending the underlying technology while the information technologist is motivated by using the computer as a tool to solve problems for people. IT research concerns itself with how to apply available technology to solve real-world problems for people [3]. IT research is more concerned with identifying need for technology unlike computer science research that is concerned with creating the technology for the IT researcher to use. In other words the information technologist identifies a need for technology, which the computer scientist then creates, and the information technologist finally helps people to use effectively.

At the curricular level, IT differs from computer science in many respects. First, there is a stronger emphasis on programming in computer science than in information technology. The typical computer science application involves writing large programs from scratch using traditional programming languages and focusing on software architecture, data structures and algorithm development issues. This makes computer science research and projects to be more focused on writing large programs from scratch using traditional programming languages. Computer science also requires significantly more mathematics and science than information technology, mainly because extending the underlying technology requires a more thorough mathematical foundation than applying that technology. Due to this computer science research is more inclined towards mathematics and science research methods with minimal borrowing from other fields as a result of computer science's curriculum being heavily structured with courses developing into each other at higher levels hence hardly allowing people from outside science, engineering and mathematics being able to join in.

Information technologists certainly build software applications, and programming is certainly a critical skill in IT, but the style of programming in IT differs from that in Computer Science. The typical IT research or project therefore involves gluing together available components in high-level environments and providing an accessible interface to the functionality those components provide. Since IT graduate needs to be broad enough to recognize any computing need and know something about possible solutions [3] the IT curriculum structure has a flatter pre-requisite structure which in turn allows many other field's specialist to join into it hence the diversity of research methods availed to it for studying IT.

Part of the role of IT is to apply research from the other computing disciplines [3]. According to Lunt *et al* (2008) [3], part of the research contribution of IT will be to feed new questions and results back into the research streams on which IT is built. IT research is expected to address questions related to the content of practice, and the process of practice and hence calling for methods that can effectively achieve this. The uniqueness of IT research overlapping research in other computing disciplines compels it to use methods from the other disciplines as well.

3. RESEARCH METHODS

The research methods available to an IT researcher fall into two broad categories being quantitative or qualitative. The qualitative methods involve designs, techniques and measurements that do not produce discrete type of data. The most commonly utilized methods in this category are observation, interview and participation. These methods permit the research to go beyond statistical results [4]. Methods that fall in this category are inclusive of ethnography, case study, and action research [1]. They are the methods that rely on fieldwork.

Quantitative methods on the other hand involve designs, techniques and measurements that do produce discrete values or quantifiable data [5]. The methods in this category require a good amount of time in planning. Methods that fall in this category are inclusive of experiments and surveys [1]. While qualitative methods are based on the naturalistic / interpretivism paradigm, the quantitative methods are based on the positivist paradigm [4]. However in most cases the approaches taken by an IT

researcher will normally include a combination of methods from the two categories.

3.1 Action research

For a long time, this has been a darling for computer specialists. It is conducted with the primary intention of solving a specific, immediate and concrete problem in the local setting [4]. It is hardly concerned with whether the results are generalized to any other setting since its major goal is to seek a solution to a given problem. At times this becomes the interest of an information technology researcher also. This research approach aims to intervene in the studied circumstances by improving the situation [1]. The interest here is in developing an innovation to solve a problem in society with little interest in generalization. One such good example in Kenya is the M-Pesa innovation. Action research does develop solutions that are of practical value to the people or organisations with whom the researcher is working with as it is an interactive process [6] while at the same time having minimal contribution to knowledge [2]. Though it has limited contribution to theory [4], it is useful because of its ability to provide answers to problems that can not wait for theoretical solutions. Remember, the Information Technologist work deals with interacting with organisation or users at large. The major strength of the method is in its in-depth and first hand understanding the research gets [6]. This research approach is also distinguished by there being no control group or variables. This puts of balance a number of researchers in the third world who believe so dearly in dependent and independent variables in research. Its main weakness lies in its potential lack of objectivity on the researcher [6], [4]. The lack of an agreed criterion for evaluating action research is also considered as a weakness [2]. Most software application related ideas are developed by collaborative work between the researchers and the beneficiaries.

3.2 Case study

This is an in-depth investigation of an individual, group, institution or phenomenon within its real life context especially where phenomena and context have a slim difference [2], [4], [6]. It offers an in-depth understanding of how and why certain phenomena as it reveals the mechanism by which cause effect relationship occur [1]. The main purpose of the case study is to determine factors and relationships among the factors that resulted in the behavior under study [4]. It does use purposive sampling in selecting the cases to involve in the study. The methods major weakness is that data collection and analysis is more open to interpretation and researcher bias [1]. It has been criticized of giving allowance for different interpretations by different people over the same situation. Again out of the small cases, there is no sufficient ground for establishing reliability or generalizing its findings. Case study is important in Information Technology in evaluating the tools. It is useful in avoiding scale-up problems associated with innovations of Information Technology.

3.3 Ethnography

This approach puts emphasis on sociology of meaning through the use of observation, interviews and examining of documents [1]. Its goal is to study a community of people to understand how the members make sense of the social interactions. Within Information Technology, its used to understand how technical communities build culture of practices and communication strategies that enable them to collaboratively use technologies innovations [1]. It allows for Information Technology researchers to have insight into human, social and organizational aspects of Information Technology innovations and applications [2], [6]. It is a powerful assessment of technology user's needs and allows for perceiving Information Technology innovations and applications in the eyes of the users. It allows the IT researcher to improve the understanding of human thought and action through interpretation of human actions in context [2], [6]. The merit of this approach to Information Technologists is its ability to avoid imposing any pre-existing theories as it focuses on how members of a community themselves make sense of their social and cultural settings within the technology environment [1]. It involves participation, talking and doing things with participants in their real life situation for a long period of time [7]. The main tool of the approach is observation and this is done over a period of time giving it a longitudinal perspective [4]. This approach gives an in-depth knowledge of only a particular context and situation thus making it difficult to make generalizations. It also produces highly qualitative data which is fairly difficult to present in a manner that is usable to designers [2] and can be too costly if the number of participants were to be increased.

3.4 Grounded theory

This is a method used in Information Technology to develop theory that is grounded in data systematically gathered and analyzed [2]. It is a discovery method that allows the researcher to develop theoretical accounts based on concepts, categories and prepositions. It characterizes the organisations' experiences of Information Technology innovations and applications in terms of processes of incremental or radical organizational changes out of the rapid technology changes. It is and has been used to develop theoretical framework for conceptualizing the organizational issues around the adoption and use of Information Technology innovations and applications [2]. With this approach there are no worries about the formality of the usage and hence resulting theories are explicit emergent and it does not test a hypothesis [2]. The approach's weakness lies in its sensitivity to the thoroughness and skills of researchers in

interpreting data. As such it does not favour novice researcher [2].

3.5 Survey

According to Mugenda and Mugenda [4], survey method is an attempt to collect data from members of population in order to determine the current status of that population with respect of one or more variables. This is a study that investigates relationships and outcomes [6]. The method is very useful in studying a large number of variables using a large sample size and rigorous statistical analysis [6]. The method is therefore used to describe, explain or explore existing status of a phenomenon at a given time. It is the best method for measuring characteristics in a large population [4]. It is closely associated with the use of questionnaires in data collection though structured interviews and data logging techniques get used too [1]. It is a good method to use in answering questions about what, how much, how many as well as why [4]. It has to do with questions that seek to find out about the nature of the target population. It is best utilized in situations when control of dependent and independent variables is not easily achievable or desirable. It is handy when the point of interest in the study has to be studied in its natural setting [7] and occur incurrent time or the recent past [6]. Most of the studies in Information Technology due to its rapid changing involve recent or current occurrences. Being a method used from time in history as an intervention strategy for organizational change [6] makes it handy for Information Technology researchers.

The major challenge of this approach is in controlling against sample bias. The bias can greatly compromise the generalization of the findings of the study. The other limitations of this approach include its being dependent on the cooperation of respondents hence they determine the degree of the reliability of the results. In most case information unknown to respondents can hardly be tapped and information that is fairly secret and personal may easily be inaccurate. Surveys are not useful in obtaining data that can be used for forecasting things to come [4].

3.6 Experimentation

This has for a long time been the commonly used approach for computer scientist. Experiments are undertaken where the researcher needs to have control over the situation with direct and precise and systematic manipulation of the behaviour of the phenomenon under study [4], [6]. An experiment method is one where the investigation of one or more dependent variables is manipulated to measure the effect on one or more variables. The key characteristic of the method is the control aspect. The method is most important in circumstances where testing of theories or hypothesis is at the centre of the study.

3.7 Secondary

Secondary research makes use of data obtained from previous published studies to undertake a research synthesis to combine findings of different studies on a research problem [6]. It is also referred to as content analysis. Its main purpose is to study existing documents such as documentations of Information Technology systems, books, other research findings amongst others to determine factors that explain a given phenomenon of interest [4]. It's the best approach to identifying crucial areas and questions that have not been adequately addressed [6].

The main strength of the approach lies in its ability to economies on time and money as well as the easiness with which one can be able to detect and correct errors hence minimizing the chances of drawing incorrect and misleading conclusions as a result of biases in the primary study or from the review itself. The method has no effect on what is being studied [4]. The major undoing of the approach is its limitation to recorded communication where ascertaining the validity of the data is not easy.

4. MAJOR PUBLICATION OUTLETS IN INFORMATION TECHNOLOGY

Research work as well as knowledge in the field of information Technology can be shared out with the community at large through journal publications and conference all over the world. Some of the major journals in this area include computer and Information Science journal, IEEE Computer society, Decision Science, Elsevier Science Publishers, MIS Quarterly, Information Systems Research, International Journal of Information and Communication Technology Research, Journal for strategic Information Systems, Journal of Information and software technology, Journal of Information Technology, Journal of Information Technology Education, journal of Management Information Systems, Journal of Systems and Software and Eastern African journal of Engineering science and Technology amongst others. Most of this journals organize conference through which dissemination of research findings of Information Technology can be done along side those organized by universities. Many of the journals also do not charge for publishing with them.

5. CONCLUSION

IT is a new and rapidly growing field that started as a grassroots response to the practical, everyday needs of business and other organizations [3] and as such IT research is closely associated to IT's rapid changes and responses to the practical every day needs of businesses. IT research may or may not involve the use of computers. It is mainly concerned with the manipulation of information and business requirements. It does focus on

the application usage and technology application. It focuses towards application of technology to solve the every day problems. IT research is concerned with the identifying need for technology and how to effectively and efficiently glue together available technology components in high level programming environments and providing accessible interface to the functionality of the components provided by the technology. IT research is not overly inclined towards science, engineering and mathematics only but in-cooperates all fields due to its multi-disciplinary nature.

Out of its multi-disciplinary nature, it is not possible to say only one approach or method from one discipline is applicable to IT research. It draws its methods of research from all disciplines. None of these methods therefore, can be said to be the best but instead the best method to use will be determine on the basis of the nature of the problem to be studied, the time and funds available. The problems vary from being highly technological, behavioural and social in nature. In most cases a combination of these methods will be handy to a researcher as all of them have strength and weakness. Use of a combination of methods is handy to overcome the weakness and emphasis the strength. The findings of Information Technology researches have many openings to be shared out amongst many sources ranging from those that are highly technical to those that are highly social depending on the nature of the study.

In developing nations, a number of computer science researcher have end up doing IT research and vice versa, however, there is need to have the difference clearly defined out. The discussion give in this paper goes a long way in doing just this.

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