European Journal of Academic Essays 2(3): 37-46, 2015
ISSN (online): 2183-1904
ISSN (print): 2183-3818
www.euroessays.org

Research Design and Sampling in Social and Management Sciences in 21st Century

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Abstract: This paper presents an overview of research design and sampling as a sine qua non for conducting researches in the area of social and management sciences (SMS). Ineffective research design and sampling are usually the bane of successful and logical conclusion of researches with valid useful findings and inferences for decision making. The paper was motivated by the desire to provide a study and/or teaching/training materials on research design and sampling procedures in the 21st century that will be easily understood and applied by researchers, including undergraduate and postgraduate students, trainers, trainees, teachers and a wide non-specialist audience. Through intuitive and qualitative reasoning, the paper explores the conceptual, theoretical and empirical technical issues on the requirements, classification, types, methods and processes of research design and sampling. Data collected from 98 research experts and analyzed with one-way ANOVA at 5% level of significance show that researches before and during the 21st century are the same. Also SMS researches in the 21st century are usually Information and Communication Technology (ICT) driven. Technological advances need to be incorporated in the research process in order to facilitate and expedite conducting researches for the realization of objective functions. Review of research design and sampling procedure prior to implementation, exploring and application of latest computer software and adherence to specifications are advocated for timely, quality and cost effective completion of researches in the 21st century.

Keywords: research, research design, sampling techniques, social and management sciences, 21st century, researchers.

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1. Introduction

Research is a process of seeking solutions to a problem, getting more information about it or finding an improved method or way of solving the problem. Research must be planned and methodically carried out for the attainment of its objective [1]. A research design is a plan that shows how research is to be conducted successfully to a logical conclusion. Inability to articulate an effective research design prior to the studies will be like a sailing ship without a compass. Research design is therefore the scheme that guides the process of data and information collection, analysis, interpretation and deduction from inferences. It is a logical model of proof that allows the making of casual inferences. Research designs are useful in social and management science researches because they help the researchers to develop mental image of the structure for gathering data and the analysis that will follow. The research design therefore constitutes the blueprint for the collection, measurement and analysis of data. It is the plan and structure of investigation so conceived as to obtain answers to research questions and hence, the blueprint or road map for fulfilling objectives and answering research

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questions. At this stage, the research process for the entire work plan is mapped out.

Research design also helps to specify the sampling procedure and sample size. A sample is part of a population and a sample size is the number of the population element randomly selected for the study. The decision regarding the population can be drawn from the sample size. In statistics, quality assurance, and survey methodology, sampling is concerned with the selection of a subset of individuals from within a statistical population to estimate characteristics of the whole population. Acceptance sampling is used to determine if a production lot of material meets the governing specifications. Two advantages of sampling are that the cost is lower and data collection is faster than measuring the entire population. Each observation measures one or more properties (such as weight, location, color) of observable bodies distinguished as independent objects or individuals. In survey sampling, weights can be applied to the data to adjust for the sample design, particularly stratified sampling (blocking). Results from probability theory and statistical theory are employed to guide the practice. In business and medical research, sampling is widely used for gathering information about a population. It is therefore pertinent to infer that successful statistical practice is based on focused problem definition. In sampling, this includes defining the population from which our sample is drawn. A population can therefore be defined as including all people or items within the characteristic one wish to understand. Because there is very rarely enough time or money to gather information from everyone or everything in a population, the goal becomes finding a representative sample (or subset) of that population.

Sometimes that which defines a population is obvious. For example, a manufacturer needs to decide whether a batch of material from production is of high enough quality to be released to the customer, or should be sentenced for scrap or rework due to poor quality. In this case, the batch is the population.

The sampling plan should answer four basic questions thus:

(i) Who is to be surveyed? (Sampling element or unit)
(ii) How many are to be surveyed? (Sampling size)
(iii) How are they to be selected? (Sampling procedure)
(iv) How are they to be reached? (Sampling method).

Before drawing the sample, the researcher must define what is his unit of analysis or unit of study i.e. what or who is being studied and what constitutes the population from which the sample will be drawn. The unit of study is known as a case. The unit of study has one or more characteristics. For example, all managers who have second degrees may be a characteristic of the unit of study, all firms employing more than 200 workers may be another characteristic of the unit of study, i.e. all managers who have second degrees and working in a firm employing more than 200 workers.

A sample is therefore any portion of the population selected for study as a representative of the entire population. A sample may have to be used because of a number of reasons such as: the population is very large, all units of population cannot be reached, some members of the populations are unwilling to give response or cooperate with the research effort, the entire population is not available for data measurement or collection and some may be lost on transit, etc. A decision can be made regarding the characteristics of the entire population using the information derived from the sample. Sampling helps to reduce the survey time and cost of study. The sampling however, must be representative enough to permit the conclusion from the study population. Cost and time constraints would not permit a comprehensive study of all the entire population in a research of such nature. Sampling therefore becomes the best approach to handle researches in Social and Management Sciences (SMS). For instance, a research conducted in psychology on measuring the weight of smoke by [2], the researchers could not appropriately generalize the results to the broader populations and would therefore have to restrict the conclusions to populations in urban areas of developing countries.

However, it has been argued in some quarters that many researchers dabble into the research processes without providing the detailed design specifications and sampling guidelines. Consequently, researches are inconclusive, regressive, marred with frustration, cost and time overruns and without meaningful results for decision making. This paper therefore serves as a reference material which will provide study and skills, and guidance for accomplishing meaningful researches within the set objectives.

The main objective is to determine how effective research design and sampling can aid in solving the problem of frustration, cost and time overrun in social and management sciences before and during the 21st centuries.

Hypothesis: H_{01}: There is no significant difference between the effectiveness of researches before and during the 21st centuries with respect to cost and time overrun and level of frustration.

1.1 Researches in the 21st Century

Advances in technology in the 21st century both facilitate and at the same time, render more complex, the collection of data on a global basis. The growth and increasing technological sophistication of the communication infrastructure enables data on a much broader and diverse geographical scale and with rapidity previously unthinkable. In a research conducted by [3] in which they examined the implications for international research in the 21st century. According to them, the dramatic changes in the global environment coupled with the technological advances in data collection, analysis and dissemination imply that researchers will need to broaden their capabilities in order to design, implement and interpret research in the 21st century.

At the same time, researchers will need to incorporate the latest technological developments in data collection and dissemination into the research design. These enable researchers to dramatically reduce the time required to collect data across geographic distances as well as substantially enhancing and enriching the type of stimuli that can be used in collecting data from international markets. It is, however, important to recognize that use of sophisticated technological techniques is subject to certain limitations due either to the development of the technological infrastructure or the technological sophistication of respondents. [3] aver that advances in computer technology such as scanners, CATI (Computer Assisted Telephone Interviewing), and CAPI (Computer Assisted Personal Interviewing) are well established in the developed countries and are beginning to be used elsewhere. They provide faster, more accurate methods of data collection providing direct input of response and facilitating steering of data collection based on response. Techniques such as CATI and CAPI can also be used to centrally administer and organize data collection from international samples, subject to telephone and computer penetration in different countries as well as use of a common language or availability of software to automatically translate questionnaires.

As these technologies evolve and advance, they also provide new innovative ways to present stimuli and collect data particularly suited to international research issues. Multimedia CAPI makes possible the presentation of highly complex stimuli and facilitates obtaining stakeholders' reactions to video and audio stimuli [4]. Developments in virtual reality CAPI will heighten the realism in stimulus portrayal and expand the range of topics on which research can meaningfully be conducted.

Equally, as the internet evolves, it offers the potential to dramatically change the way in which much international research is conducted, both in providing ready access to secondary data, and in providing a new means of collecting primary data. Rather than visiting a traditional research library, the researcher can have virtually internet access to data from traditional sources as well as sources that are only available on the internet. The Internet can also be used to collect primary data, either by tracking visitors to a website, or through administering electronic questionnaires over the Internet. To the extent that websites are increasingly likely to be accessed by users worldwide, information on an international sample can be gathered. Behavior at the site can

be tracked revealing interest relating to the items, products and services or information offered, as well as response to promotional material or offers.

The Internet can also be used to collect data in a more systematic fashion that is closer in character to more traditional research practice. Subject to the availability of suitable internet sampling frames, questionnaires can be administered directly over the Internet. Questionnaires are sent via e-mail to respondents and the responses are returned via e-mail. This represents a very quick and totally automated means to conduct a survey over a broad geographic scope. The results are available almost instantaneously as the responses can be checked and analyzed in real-time as they are received. Questionnaires administered via the World Wide Web also have the advantage that research details, picture of items, designs, brands and the research environment can be portrayed with integrated graphics and sound. This approach is most suited to surveys among respondent populations that are technology literate, and at present for certain types of research as a quantitative in nature with computer software or business-to-business research. However as use on internet becomes more commonplace, e-mail surveys will begin to replace mail and phone surveys. Progress will occur most rapidly in the US and Europe and will progress more slowly in other parts of the world [5]. An important limiting factor is the extent to which Internet sampling frames correspond to respondent populations that are of interest to research. Versions of Web software available in different countries might not be compatible. Technical issues may daunt respondents, resulting in non-response bias. Factors such as overall response rate and item non response will also continue to be important. [6]

1.2 Types of Research Design

The research design commonly used in SMS could be classified as follows: survey, ex-post facto and experimental research designs [1], [7] and exploratory research design [8] These are examined as follows:

(i) Survey Research Design: This could be described as pre-test or longitudinal studies (in most cases, time dependent) which follow study subjects over a long period of time with repeated data collection throughout.[7]. [8] describe sampling survey as a type of descriptive research design. Most are observational studies that seek to identify a correlation among various factors. The longitudinal studies do not manipulate variables and are not often able to detect casual relationship. Data for analysis (usually primary data) could be collected by opinion poll using the instrument of questionnaire, work study, visit to the site, on the spot assessment, etc.

(ii) Ex-post facto Research Design: This is a retrospective study which investigates a phenomenon or issue that has occurred in the past. And such studies most often involve secondary data collection, based upon data available from previous studies or database. For example, a retrospective study will be needed to examine the relationship between levels of unemployment and street crime in Nigeria over the past 20 years. It should be noted that in this case, the researcher will not exercise control over the variables of the study. The variables will not be manipulated, but only to report what has happened in the past. In using this method, variables will not be influenced in order not to introduce bias.

(iii) Experimental Research Design: This method of research design could be described as prospective studies and it seeks to estimate the likelihood of an event or problem in the future. Thus, these studies attempt to predict what an outcome of an event is to be. The researcher uses models or systems such as simulation and probability theory, and applies them on trial and error basis so as to find answers to some questions, evaluate performance and arrive at action decision which could aid in improving the performance of a system. The major

characteristics of various conditions and relationship in actual situation were represented in a mathematical model, logic or procedure. Experimental design is used to discover whether certain variables will produce effects in the models; example, Monte Carlo simulation of; time between arrival at service facility, service time, lead time for inventory, number of employees absent from work each day, time between machine breakdown, etc.

(iv) Exploratory Research Design: In this type of study, [8] aver that the researcher is working in an uncharted and under research (if not un-research area). The purpose is to better understand some groups, events or phenomena about which little or no previous research has been done. Exploratory designs may also be used in areas in which data have been previously obtained but may reflect changing attitudes.

1.3 Research Design Processes

The researcher usually re-examines the research title, statement of problems and objectives with a view of determination, description and specification of research population characteristics and size, sampling procedure, sampling size, decision variables and data collection instrument. In a study, an investigator may have a chance of collecting the relevant data himself called primary data or relying entirely on existing data already collected by someone else known as secondary data. Similarly, methods of gathering data could be by standardized questionnaire, personals interviews, and mail questionnaire. Data measurement instrument for primary data in social and management sciences could be assigned weighted scale such as Likert's five point scale, etc. while secondary data possesses the numbers, values, characters, etc or other inherent metrics for measurement. However, data measurement in SMS is somehow indirect; the researchers are never sure that they are measuring what they intend to measure, leading to the problem of validity. According to [1], validity is concerned with the question; is one measuring what one intends to measure. There are three common types of validity as follows:

(i) Content validity: concerns with the extent to which an instrument measures what it appears to measure according to the scientist's subjective assessment and it rests on the instrument.

(ii) Empirical validity: concerns with the relationship of a measuring instrument and a measuring outcome. If a measurement instrument is valid, then there should be strong relationship between the results produced by that instrument and other variables.

(iii) Construct validity: entails relating a measuring instrument to a general theoretical framework in order to ascertain whether the instrument is tied to the concepts and theoretical assumptions that are employed. It could be on the premise of content validity problem that necessitates the explorative overview and adoption of reliability test of measuring instrument. Reliability problem refers to the extent to which a measuring instrument produces data that differs from observation to observation during any one measuring instance or that varies from time to time for a given unit of analysis measured twice or more by the same instrument. These differences/variations are called variable errors and may be due to factors such as momentary distraction when completing a questionnaire during the interviewing process, ambiguities in questions and technical difficulties like complex questions.

Research design also maps out relevant applicable models and methods of data analysis or procedures for processing and analyzing collected data which is usually extensive mass of data. Data processing involves the transfer of collected data to coded data for further processing through the use of data processing instrument, preferably, the computer with software such as Statistical Program for Social

Sciences (SPSS). If the data are not many, simple frequency count can be used and statistical computation done manually. The procedures for analyzing collected data deal with the technical procedures needed to carry out the statistical or quantitative analysis. These procedures should detail how groups or variables are to be compared for the purpose of answering the stated research questions and testing relevant hypotheses. The researcher could use the following manual or computer-based applicable models, techniques or statistics or both for data analysis. For instance,

(i) Applicable models include; Gantt chart, Critical Path Method, Program Evaluation and Review Technique, Linear programming, Queuing model, Simulation, Decision network, Markov chain, Transportation model, Inventory model, Goal, integer and Dynamic programming etc. Financial appraisal models such as financial ratio, accounting rate of return, internal rate of return, net present value, payback period, etc.

(ii) Statistics include; Correlation matrix, Regression analysis, F-test, t-test, chi square test, coefficient of concordance, etc.

The research design as well specifies steps and provides an idea on answering research questions and drawing inferences from the result of data analysis and hypothesis testing. The research design also helps to specify variables for model for model formulation. For research questions and hypothesis, the following guidelines are considered appropriate:

(i) Research questions: state and explore the result of the analysis for answering the following questions: what is the result for the research question? What does such result mean? It also involves; suggesting possible reasons in the environment that may have accounted for such result, mentioning studies of other researchers, which have similar results and those which are dissimilar and suggest possible reasons for the difference in result.

(ii) Hypotheses: formulate and state the hypothesis, indicate whether the hypothesis is accepted based on calculated and critical values, what does acceptance and non-acceptance mean? Where the result shows no significance difference, why should one group obtain a higher mean score than the other? (If mean score were used). Provide suggestion based on the factors in the environment or the research itself. Where there is a significant difference, suggest factors that might have been responsible for such result. Mention studies with similar results. Mention studies with dissimilar findings and suggest reasons for the divergent.

1.4 Sampling Processes

The sampling process comprises several stages:

- Defining the population of concern
- Specifying a sampling frame, a set of items or events possible to measure
- Specifying a sampling method for selecting items or events from the frame
- Determining the sample size
- Implementing the sampling plan
- Sampling and data collecting
- Data which can be selected

1.5 Types of Sampling Design

Sampling design can be broadly classified as

(i) Probability sample design: in which every unit in the population has a chance (greater than zero) of being selected in the sample. Examples include Simple Random Sampling (SRS), systematic sampling, stratified sampling, cluster sampling or multistage sampling.

(ii) Non-Probability sampling: where some elements of the population have no chance of selection or where the probability of selection cannot be accurately determined. It involves the selection

of elements based on assumptions regarding the population of interest, which forms the criteria for selection. Selection of elements is non-random, does not allow estimation errors and the conditions give rise to exclusion bias. Examples include; quota sampling, judgmental or purposive sampling, accidental or convenience sampling, etc. [9] asserts that this is only done when the processes the researchers are testing are assumed to be so basic and universal that they can be generalized beyond such a narrow sample.

1.5.1 Probability Sampling Methods

(i) Simple Random Sampling (SRS): By randomly selecting sample size *n* from population size *N*, numbers are assigned serially to *N* and also to *n* elements with random numbers of equal digit (from random number table etc.) Then from *N*, select *n* elements that correspond to each of the random numbers.

(ii) Stratified random sampling: By separating the population members into non-overlapping groups called strata, then by using SRS; select *n* from each strata e.g. N_1= 300, N_2 =500, N_3 = 200, with n_1 = 50, n_2 = 30, n_3 = 10 respectively. Therefore $N = N_1 + N_2 + N_3 = 1000$ and $n = n_1 + n_2 + n_3 = 100$

(iii) Systematic sampling: relies on arranging the study population according to some ordering scheme and then selecting elements at regular interval through that order list. It involves a random start and then proceeds with the selection of every K_{th} elements from there onwards. $K<\frac{N}{n}$. Eg. Select one-in-k (k = 5) systematic sample of size =20.For instance, randomly select any number from 1 to 5. By randomly selecting 4, the elements in *n* = 4, 8, 12, ……80.

(iv) Cluster sampling or Area sampling is a SRS, which marked off *N* into grids. Each sampling unit is a collection or cluster of elements. The grids for the studies are selected based on SRS and random numbers assigned to the *n* elements.

(v) Multistage sampling: obtained by randomly sampling each of sampling stages for where there are at least two stages. For instance, a study on household income in states in Nigeria, 10 states was randomly selected. Out of which, 5 local government areas were randomly selected from each state and 200 families were randomly selected from each local government area. Thus 10,000 households are to be interviewed in our sample.

1.5.2 Non Probability Sampling Methods

(i) Convenience or accidental sampling: the researcher selects whatever sampling units that is conveniently available and closes to hand. It is useful for pilot testing.

(ii) Judgmental or purposive sampling: in this case, sampling units from a population are selected subjectively by a researcher who attempts to obtain a sample that appears to him to represent a population or that suits his purpose.

(iii) Quota sampling: here, specific traits such as sex, age, religion, social class, race, ethnicity, etc are allocated specified number of sampling units whose aggregate will constitute the sample size. It is widely applied in market and opinion research in recent times and it is non-random.

(iv) Panel sampling; is the method of first selecting a group of participants through a SRS method and then asking that group (for potentially the same) information several times over a period of time. It could be used in studying political campaigns. [10].

1.6 Sample Size Determination

Formulation and tables exist for the determination of sample size *n*. for instance, [1] states that *n* can be calculated as: $n = \frac{N}{1+e^2}$

Where *N* = population size, e = margin of error

However, U.S. federal and military standards tables MIL-STD-105, exist especially for determination of sample sizes in acceptance sampling tests used for quality inspection by attribute in the course of quality assurance. MIL-STD-105 was a United States defense standard that provided procedures and tables for sampling by attributes based on Walter A. Shewhat, Harry Roming and Harold Dodge sampling inspection theories and formulas. They are widely adopted outside of military procurement applications. [11] some authors recommend using 1% to 10% of the *N* as *n*.

2. Materials and Methods

The study employed the technique of exploratory and descriptive field survey and non probability sampling method, which are based on the understanding of the professional skills of research experts in tertiary and research institutions in and outside Nigeria, and also on the nature of research objective. The primary data used for the study was obtained and measured through the instrument of questionnaire modeled in Likert three point scales. A total of ninety-eight (98) respondents assessed the questionnaires and the data collected were analyzed using the Analysis of Variance (ANOVA) at 0.05 level of significance.

Table 1: ANOVA Model

Sources of Variation	*Sum of square*	*Degree of freedom*	*Means of sum of square*	*f-ratio*
Between groups	SSB	k-1	$\frac{SSB}{k-1} = MSB$	$\frac{MSB}{MSE}$
Treatment error	SSE	n-k	$\frac{SSE}{n-1} = MSB$	

From the F-distribution table, the F-ratio (F_c) is compare with F-ratio (F_α) from the table and the decision rule is as follow: the null hypothesis Ho is rejected if $F_c \geq F_\alpha$ (k-1, n-k), otherwise it is accepted where α = level of significance.

In order to employ the ANOVA as the analytical tool, the following calculations and components of the model are considered:

SST = Sum of square of total = $\sum_{I=j}^{n} y^2 - \frac{T^2}{nk}$ 1

SSB = Sum of square between group $= \frac{\sum T^2}{n} - \frac{\sum T^2}{nk}$ 2

SSE = Sum of square of error = SST – SSE……3

i = row, j = column; degree of freedom df = n – 1

where df = k – 1,

k = number of population samples or columns of the samples.

n = number of observation in each k, T = the overall total of all the nk observation

Where df = n – k

3. Results

3.1 Testing the effectiveness of researches before and during the 21st century with respect to Cost and Time Overrun, the level of frustration and quality.

Table 2 Respondents' scores on the level of effectiveness of research design and sampling in the 21st century**.**

Effectiveness indicators	*Effective*	*Neither effective nor ineffective*	*Ineffective*	*Total*
Completed within schedule	15	12	10	37
Completed within budget	18	13	2	33
Quality	16	11	1	28
Total	**49**	**36**	**13**	**98**

Table 3 Respondents' scores on the level of frustration in conducting researches during 21st century.

Frustration	*High*	*Moderate*	*Low*	*Total*
Due to schedule	8	12	18	**98 respondents**
Due to budget	4	14	15	
Due to quality	1	12	14	

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Tables 2 and 3 were used to conduct the analysis of variance (ANOVA) for testing the formulated hypothesis.

Table 4 ANOVA Result on the Level of Difference in Researches made before and during 21st Century

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	15.019	2	7.510	1.410	.175
Within Groups	31.960	6	5.327		
Total	46.979	9			

The analysis of the data above revealed that the F-calculated value is **1.410** while the $F_{0.05}$ (2, 6) is **5.14**. So we accept the null (H_0) implying that there is no significant difference in the researches made before and during the 21st centuries. So the effectiveness of researches before and during the 21st centuries with regards to quality, cost and time overrun coupled with frustration are the same.

4. Discussions

From Table 2, it is revealed that most respondents (49) agree that the level of effectiveness of researches in the 21st century has increased with respect to cost, time and quality. This is because of the level of information technology at the disposal of researchers around the world as opined by [7]. Also Table 3, recorded that most respondent believe that the level of frustration is low in social and management sciences in the 21st century. The study then believes that the level of effectiveness and frustration in social and management sciences before and during the 21st century have almost the same.

5. Conclusion

This paper has presented result oriented discourse and rich compendium of information on the subject matter for the

benefit of students and researchers. Researches in social and management sciences require in-depth and effective research design, and sampling procedures for the realization of the relevant objective function. The paper critically examined the types, principles, processes, procedures and methods of research design and sampling, and proposed recommendation required to achieve the set objectives. The paper would boost researchers' dexterity and effectively provide solutions to myriad of research design problems that have to do with conducting researches in academics. It also specifies the processes involved in field investigation, data or information gathering, methods of analysis, results and inferences.

Since the ANOVA result of the data collected show that researches made before and during the 21st century are statistically the same. This implies that researches conducted in the 21st century must be made to adopt the appropriate research design and sampling needed to meaningfully conclude researches in the 21st century and minimize the problem of frustration, wasted time and fund witnessed in conducting SMS researches before the 21st century. However, research design and sampling requires concerted review prior to implementation and performance monitoring and evaluation during implementation in order to forestall failure, which can be very expensive with regards to quality, time and cost consideration.

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