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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – I - Research Methodologies in Built Environment – SARA 5104

I Introduction

Research is undertaken within most professions. More than a set of skills, research is a way of thinking: examining critically the various aspects of your day-to-day professional work; understanding and formulating guiding principles that govern a particular procedure; and developing and testing new theories that contribute to the advancement of your practice and profession. It is a habit of questioning what you do, and a systematic examination of clinical observations to explain and find answers for what you perceive, with a view to instituting appropriate changes for a more effective professional service.

Research: a way to gather evidence for your practice

Evidence-based practice (EBP) is the delivery of services based upon research evidence about their effectiveness; the service provider's clinical judgement as to the suitability and appropriateness of the service for a client; and the client's own preference as to the acceptance of the service. EBP is fast becoming a service delivery norm among many professions.

What Is Architectural Research?

In one sense, architectural research has been conducted throughout the history of architecture. The development of particular structural forms or building materials over the centuries is the outcome of trial-and-error experimentation, systematic observation, and application of such building principles to other building projects. Take, for example, the development of the flying buttress, the first visible external examples of which are attributed to the nave of Notre Dame de Paris. A combination of archaeological reconstruction and structural analysis conducted by authors William Clark and Robert Mark demonstrates the technical validity of what they conclude to be the original buttress design. However, the authors argue that structural stress points resulting from that design, in conjunction with associated maintenance requirements, seem to have led to the major documented alterations to the buttress system early in the 13th century. More generally, continued modifications and systematic observations inn subsequent cathedral projects led to further innovations, and so on. Parallel developments in all manner of materials and structural innovation can be cited throughout the history of the field.

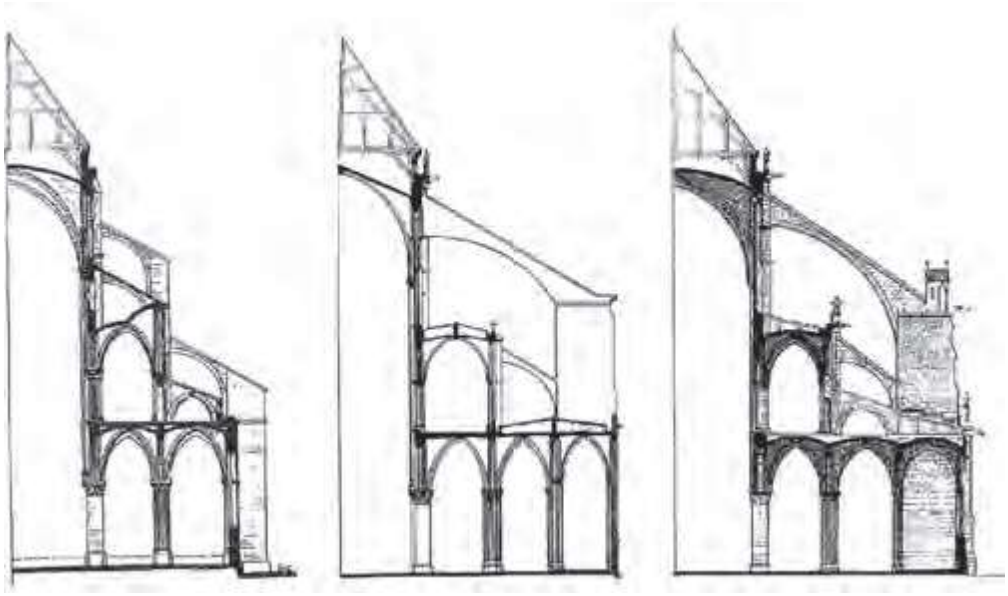

Figure 1 Major documented alterations to the buttress system

However, the conduct of architectural research outside the confines of specific building projects is a much more recent phenomenon. Although climate, product development, and building systems design seem to have been a focal point of research in the 1950s, the research enterprise in architecture emerged more broadly across a range of topic areas—including socio behavioral issues, design methods, and energy conservation—in the 1960s and early 1970s.6 It was during this period that funding from an array of federal agencies, from the National Science Foundation to the National Endowment for the Arts, became more widely available; university programs provided internal support for architecture faculty to pursue research topics; doctoral programs in architecture began to emerge in greater numbers; architecture-affiliated organizations such as the American Institute of Architects and the Association of Collegiate Schools of Architecture sponsored joint ventures to promote research; a few major architectural firms developed research-oriented divisions; and the professional journals began to publish evaluation studies and/or offer research award programs. Over the past three decades, this great variety of research activity has continued, but often in a more varied way. Many areas of research have experienced an ebb and flow of funding and interest. Energy conservation, for example, was a dominant feature of much technical research in the 1970s due to the energy crisis, but received much less attention in the 1980s. From the 1990s onward, however, interest in and funding for research in sustainability has reintroduced many of the earlier issues, but now framed within a relatively new conceptual model. Similar fluctuations in the scope of other substantive topics, the significance of particular theoretical influences, rapid advances in building technologies, innovations in design processes, and so on mean that architectural research will continue to encompass a

breathtaking range of research endeavors. That is certainly all to the good, but it also means that mastering the range of research concepts and tools to address such a diversity of research questions is all the more challenging *and* rewarding.

Research Approaches

Three research approaches are advanced: (a) qualitative, (b) quantitative, and (c) mixed methods.

Unquestionably, the three approaches are not as discrete as they first appear. Qualitative and quantitative approaches should not be viewed as rigid, distinct categories, polar opposites, or dichotomies. Instead, they represent different ends on a continuum (Newman & Benz, 1998). A study *tends* to be more qualitative than quantitative or vice versa. **Mixed methods research** resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches.

Often the distinction between **qualitative research** and **quantitative research** is framed in terms of using words (qualitative) rather than numbers (quantitative), or using closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions). A more complete way to view the gradations of differences between them is in the basic philosophical assumptions researchers bring to the study, the types of research strategies used in the research (e.g., quantitative experiments or qualitative **case studies**), and the specific methods employed in conducting these strategies (e.g., collecting data quantitatively on instruments versus collecting qualitative data through observing a setting). Moreover, there is a historical evolution to both approaches—with the quantitative approaches dominating the forms of research in the social sciences from the late 19th century up until the mid-20th century. During the latter half of the 20th century, interest in qualitative research increased and along with it, the development of mixed methods research.

Qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final written report has a flexible structure. Those who engage in this form of inquiry support a way of looking at research that honors an inductive style, a focus on individual meaning, and the importance of rendering the complexity of a situation.

Quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. The final written report has a set structure consisting of introduction, literature and theory, methods, results, and discussion. Like qualitative researchers, those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings.

Mixed methods research is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone. These definitions have considerable information in each one of them.

QUANTITATIVE RESEARCH

This approach can be further sub-classified into **inferential, experimental and simulation approaches to research.**

Inferential approach

The purpose of this research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.

Experimental approach

This approach is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.

Simulation approach

This type of research involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behaviour of a system (or its sub-system) under controlled conditions. The term ‘simulation’ in the context of

business and social sciences applications refers to “the operation of a numerical model that represents the structure of a dynamic process. Given the values of initial conditions, parameters and exogenous variables, a simulation is run to represent the behaviour of the process over time.” Simulation approach can also be useful in building models for understanding future conditions.

QUALITATIVE RESEARCH

This approach can be further sub-classified into **Narrative, Phenomenological, Grounded Theory, Ethnography and Case Studies**

Narrative research is a design of inquiry from the humanities in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives (Riessman, 2008). This information is then often retold or restoried by the researcher into a narrative chronology. Often, in the end, the narrative combines views from the participant’s life with those of the researcher’s life in a collaborative narrative (Clandinin & Connelly, 2000).

Phenomenological research is a design of inquiry coming from philosophy and psychology in which the researcher describes the lived experiences of individuals about a phenomenon as described by participants. This description culminates in the essence of the experiences for several individuals who have all experienced the phenomenon. This design has strong philosophical underpinnings and typically involves conducting interviews (Giorgi, 2009; Moustakas, 1994).

Grounded theory is a design of inquiry from sociology in which the researcher derives a general, abstract theory of a process, action, or interaction grounded in the views of participants. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information (Charmaz, 2006; Corbin & Strauss, 2007).

Ethnography is a design of inquiry coming from anthropology and sociology in which the researcher studies the shared patterns of behaviors, language, and actions of an intact cultural group in a natural setting over a prolonged period of time. Data collection often involves observations and interviews.

Case studies are a design of inquiry found in many fields, especially evaluation, in which the researcher develops an in-depth analysis of a case, often a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed

information using a variety of data collection procedures over a sustained period of time (Stake, 1995; Yin, 2009, 2012).

MIXED RESEARCH

This approach can be further sub-classified into **Sequential, Transformative and Concurrent**

Sequential Approach is the approach in which qualitative and quantitative methods are both involved and one follows the other.

Transformative approach involves methods in which researcher provides a theoretical lens which as an overarching perspective within a design that contains both qualitative and quantitative data

Concurrent Approach is an approach where the researcher converges or merges quantitative and qualitative method in order to provide a comprehensive analysis of research problem

CRITERIA FOR SELECTING A RESEARCH APPROACH

Given the possibility of qualitative, quantitative, or mixed methods approaches, what factors affect a choice of one approach over another for the design of a proposal? Added to worldview, design, and methods would be the research problem, the personal experiences of the researcher, and the audience(s) for whom the report will be written.

The Research Problem and Questions

A research problem, is an issue or concern that needs to be. The problem comes from a void in the literature, and conflict in research results in the literature, topics that have been neglected in the literature; a need to lift up the voice of marginalized participants; and “real-life” problems found in the workplace, the home, the community, and so forth. Certain types of social research problems call for specific approaches. For example, if the problem calls for (a) the identification of factors that influence an outcome, (b) the utility of an intervention, or (c) understanding the best predictors of outcomes, then a quantitative approach is best. It is also the best approach to use to test a theory or explanation. On the other hand, if a concept or phenomenon needs to be explored and understood because little research has been done on it, then it merits a qualitative approach. Qualitative research is especially useful when the researcher does not know the important variables to examine. This type of approach may be needed because the topic is new,

the subject has never been addressed with a certain sample or group of people, and existing theories do not apply with the particular sample or group under study (Morse, 1991). A mixed methods design is useful when the quantitative or qualitative approach, each by itself, is inadequate to best understand a research problem and the strengths of both quantitative and qualitative research (and its data) can provide the best understanding. For example, a researcher may want to both generalize the findings to a population as well as develop a detailed view of the meaning of a phenomenon or concept for individuals. In this research, the inquirer first explores generally to learn what variables to study and then studies those variables with a large sample of individuals. Alternatively, researchers may first survey a large number of individuals and then follow up with a few participants to obtain their specific views and their voices about the topic. In these situations, collecting both closed-ended quantitative data and open-ended qualitative data proves advantageous.

Personal Experiences

Researchers' own personal training and experiences also influence their choice of approach. An individual trained in technical, scientific writing, statistics, and computer statistical programs and familiar with quantitative journals in the library would most likely choose the quantitative design. On the other hand, individuals who enjoy writing in a literary way or conducting personal interviews or making up-close observations may gravitate to the qualitative approach. The mixed methods researcher is an individual familiar with both quantitative and qualitative research. This person also has the time and resources to collect both quantitative and qualitative data and has outlets for mixed methods studies, which tend to be large in scope.

Since quantitative studies are the traditional mode of research, carefully worked out procedures and rules exist for them. Researchers may be more comfortable with the highly systematic procedures of quantitative research. Also, for some individuals, it can be uncomfortable to challenge accepted approaches among some faculty by using qualitative and transformative approaches to inquiry. On the other hand, qualitative approaches allow room to be innovative and to work more within researcher designed frameworks. They allow more creative, literary-style writing, a form that individuals may like to use. For transformative writers, there is undoubtedly a strong stimulus to pursue topics that are of personal interest—issues that relate to marginalized people and an interest in creating a better society for them and everyone. For the mixed methods researcher, the project will take extra time because of the need to collect and

analyze both quantitative and qualitative data. It fits a person who enjoys both the structure of quantitative research and the flexibility of qualitative inquiry.

Audience

Finally, researchers write for audiences that will accept their research. These audiences may be journal editors and readers, faculty committees, conference attendees, or colleagues in the field. Students should consider the approaches typically supported and used by their advisers. The experiences of these audiences with quantitative, qualitative, or mixed methods studies can shape the decision made about the choice of design.

STRATEGIES FOR ARCHITECTURAL RESEARCH

Figure 1 below represents a conceptual model for clarifying the relationship among the several research strategies. The basic diagrammatic form is a cylinder.

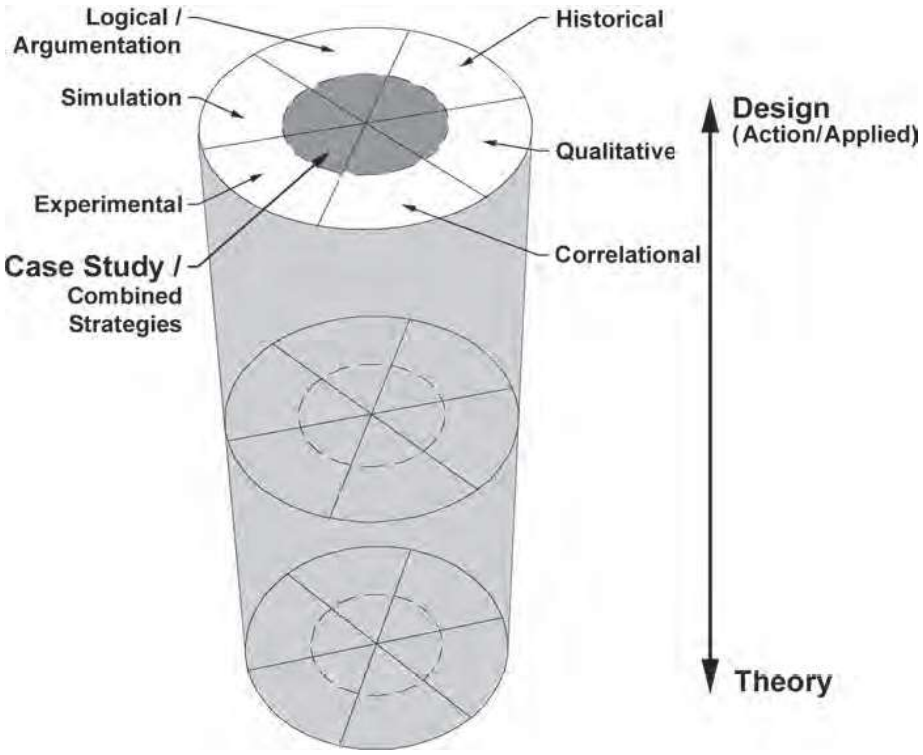

Figure 2 A conceptual framework for research methods.

The circular element is defined by pie-shaped wedges, one for each of the six main research strategies. At the center of the circle, there is a "core" that represents case studies and/or combined strategies. The periphery of the circle represents the more distinct and focused

exemplars of each particular strategy.vNext, the vertical dimension of the cylinder represents the purpose or outcome of research, defined by the dimension from theory to design (or application). As we have already mentioned, architectural research may be undertaken for different purposes and in different contexts. Sometimes a study of a theoretical concept serves as the initiation of or the outcome of research. Other times, research, particularly in the context of practice, is likely to be initiated with a particular application as the intended outcome. Finally, a critical feature of the diagram is the sequence of the research strategies within the circle. In the order represented here, each strategy is neighbored by others with common traits.

Qualitative Research strategies

Historical

Historical research strategy, typically draws upon evidence derived from archival or artifactual sources, largely because the research question focuses on a setting or circumstance from the past. In addition, because historical research frequently entails analyses of artifacts or circumstances over time, a narrative form is often employed.

Example:

Forty presents a case that, from 1850 to 1950, the concept of the home underwent significant changes, bringing about transformations in how the home as a material object came to be designed. Forty provides four headings, each describing a period within this larger time span. For each, he interprets how social-cultural factors brought about material expressions of "home." The first heading (and the only one we review here due to space) is "A Place for Anything but Work." The Industrial Revolution drew many from the countryside to the city to work in the factories. This had the impact of separating home from workplace as two distinct concepts in the communal mind for the first time. The craftsman who worked at home now became a laborer in the factory, where his freedom was curtailed and he was "subordinated . . . to the rules and directions of the managers." This, in addition to the oppressive working conditions, underlined the sense of separation between workplace and home. As a result, the home began to take on connotations of retreat, of an idealized realm in which the worker is anything but a worker.

Logical Argumentation

it is a strategy that shares with simulation an emphasis on abstraction, but it also entails a self-contained system of logical order. In that regard, it is most similar to the philosophical or mathematical framing of closed systems. Although one uses words or sentences and the other numbers, both represent relatively pure forms of logical argumentation. So we come full circle;

historical research depends on a constructed logic of interpretation, but that interpretation is based on documents and artifactual evidence, and typically entails a narrative structure.

Logical argumentation tends to take a set of previously disparate factors, or previously unknown and/or unappreciated factors, and interconnect them into unified frameworks that have significant and sometimes novel explanatory power. In other words, systems of logical argumentation tend to be innovative ones. If the explanatory system is successful, it provides a new way of looking at old facts or existing phenomena, and may well shape discourse at a paradigmatic level. The most basic trait that logical argumentation exhibits: the enumeration of first principles. A *first principle* is a fundamental proposition that is so self-evident that it need not be derived from even more elemental proofs. First principles are therefore logical building blocks by which, or upon which, broad explanatory theories can be constructed.

Example :

Finding First Principles in Designing a "Total Health Environment" (NBBJ) The architectural firm NBBJ conducted a research-based, member-focused study to generate "21 Critical Experiences" that are factors for creating "a total health environment." The following chart was the result of an iterative process of participatory workshops, literature review, market research, brainstorming sessions, and other qualitatively based research tactics These 21 factors, in effect, are being proposed as the first principles in a logical framework for designing a successful total health environment. This is a workable heuristic for the realm of practice. Critical assessment of the list can be conducted with regard to: (1) the uniqueness of each principle (do principles overlap?); sorting the factors for principles of quantity, quality, origin; and (3) testing the list, that is, gathering evidence as it accrues from project to project for evaluations of whether the list is complete, or can be simplified.

Consider a more established example: Stewart Brand's *How Buildings Learn.* Brand's insight is that any building can be conceived of as an assemblage of six layers (site, structure, skin, services, space plan, and stuff). For each layer, the rate of change over time increases from the immobile site, which never changes, to the stuff in the interior that shifts almost daily: chairs, phones, pictures, hairbrushes, and so on. Brand built his framework on an earlier model of building as- layers proposed by Frank Duffy.

Case Study/ Combined Strategies

Case studies are a design of inquiry found in many fields, especially evaluation, in which the

researcher develops an in-depth analysis of a case, often a program, event, activity, process, or one or more individuals.

In the one of the most frequently cited books on case study research, Robert Yin provides the following definition: "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." To make the definition more clearly applicable to architectural research, we would amend Yin's definition to read: an empirical inquiry that investigates a phenomenon or setting. By deleting the word *contemporary* and adding the word *setting,* this definition would specifically accommodate the explicit inclusion of historic phenomena and both historic and contemporary settings as potential foci of case studies.

Briefly, the five particularly salient characteristics are:

(1) a focus on either single or multiple cases, studied in their real-life contexts;

(2) the capacity to explain causal links;

(3) the importance of theory development in the research design phase;

(4) a reliance on multiple sources of evidence, with data converging in a triangular fashion; and

(5) the power to generalize to theory.

The essence of the case study strategy is its focus on studying a setting or phenomenon embedded in its real-life context. As Yin describes it, the case study strategy implies much more than simply studying a phenomenon in the "field." Rather, the case study involves studying a case in relation to the complex dynamics with which it intersects and from which the case itself is inseparable.

Quantitative Research strategies

Correlational Research

The signature characteristic of this research design is that specified variables of interest are Observed or measured in a particular setting or circumstance. Correlational research, similar to the qualitative strategy, focuses on naturally occurring circumstances, but it makes use of more quantitative data.

Example

During the 1970s William Whyte's study of urban plazas in New York City became a driving force in the development of revised zoning codes regarding commercial high-rises. At the time Whyte and his Street Life Project team began their research, New York City maintained a zoning

ordinance by which developers could build more floor space into their buildings if they provided public plaza spaces. Yet many of these plazas were remarkably underutilized, while others seemed to be crowded with workers taking their lunch breaks in seasonable weather. Whyte wanted to understand why and to suggest guidelines for the design of successful plazas. So, he and his team conducted six months of intensive observations of nearly 20 representative plazas, much of it with the aid of video film and basic people-counting at specified time intervals. Eventually, their charting of plaza use as a function of various plausible physical variables led them to identify the significance of several key design elements Chief among them is sitting space, a conclusion that Whyte acknowledges in hindsight should have been obvious, but was not when they first began the study. To support his analysis, Whyte presents charts that compare plaza use (numbers of people at the lunch hour) with the amount of open space available across all 18 plazas; there is no obvious relationship . However, a similar chart comparing plaza use with the amount of sittable space demonstrates a much closer relationship between these two variables. Although Whyte and his team completed most of their data collection and analysis within about six months, their efforts to influence and modify New York City zoning ordinances took another two or more years. Happily, their proposed guidelines were eventually incorporated into a revised zoning code, with the result that new plazas were built to these guidelines and, just as important, many existing plazas were modified to meet the new zoning code.

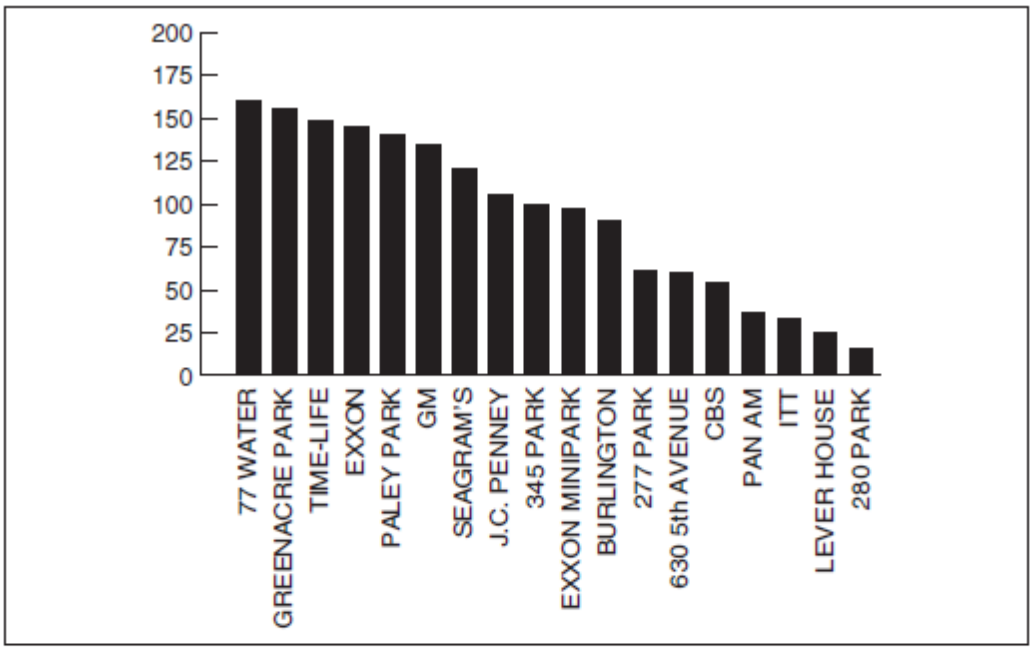

Figure 8.1 Plaza use: average number of people sitting at lunchtime in good weather. Courtesy of Project for Public Spaces, New York, New York.

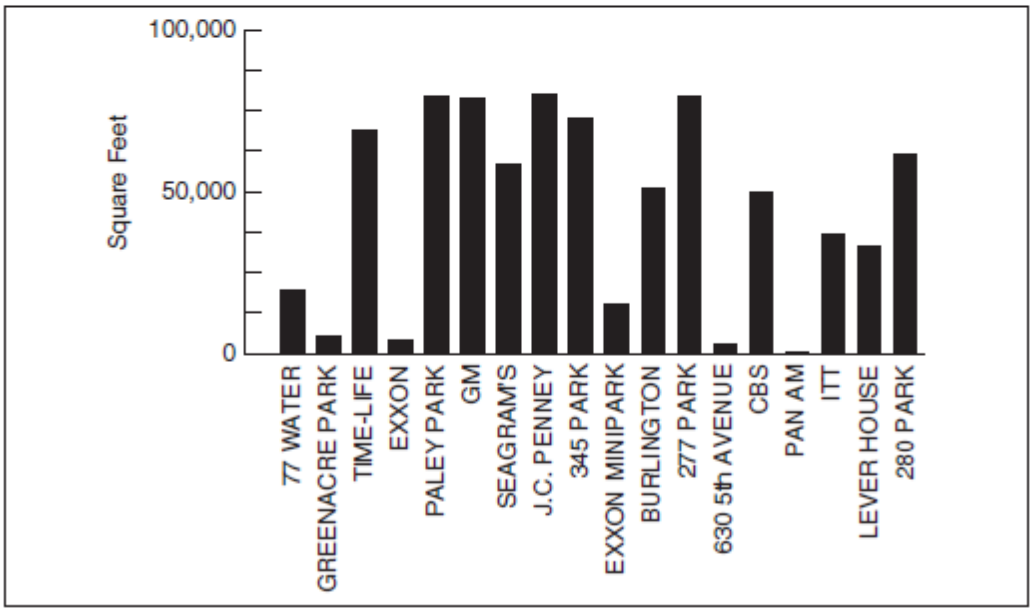

Figure 8.2 Amount of open space by lineal feet. Courtesy of Project for Public Spaces, New York, New York.

Figure 3 Data Collection, Project of Public Spaces, New York – William Whyte

Experimental Research

Experimental research shares with the correlational design the use of measurable variables, but with a requirement for a treatment controlled by the researcher. For many researchers it stands as the preeminent standard for empirical research because of its precise manipulation of variables (often in a lab setting), with the goal of attributing causality.

Example

Research on the performance of various building components has constituted a significant and long-standing domain within architectural research. Although much of this research has focused on improving various building technologies in the advanced industrialized world, a research study by Givoni, Gulich, Gomez, and Gomez focuses instead on radiant cooling by metal roofs, a significant issue for housing in developing countries.1 Givoni et al. noted that, although corrugated metal roofs are effective for cooling in the evening, they are prone to overheating houses in the daylight hours. The researchers hypothesized that the installation of operable hinged interior insulating plates under the roof would reduce daytime heating while simultaneously not interfering with the night time cooling function of the metal roofs.

To test this hypothesis, the researchers built a small-scale mock-up of the typical house (termed a "test cell") whereby the heating/cooling effect of various test conditions could be measured. To be specific, Givoni et al. tested three distinct conditions of insulation operation: (1) with the insulation panels closed both day and night; (2) with the insulation panels open at night and closed during the day; and (3) with the insulation positioned as in 2, but with the addition of a small ventilating fan from midnight to 5:00 a.m. In addition, two levels of thermal mass (as represented by water-filled bottles) were also tested. Based on their testing of these conditions, the authors conclude that the combination of both insulating panels and fan venting (condition 3) provides better daytime cooling than without the fan ventilation. However, no appreciable difference in cooling was noted as a consequence of the thermal mass condition. Finally, based on these data, the authors were able to develop predictive formulae for calculating the indoor maximum temperature as a function of the swing of the outdoor temperature.

Simulation Research

Simulation research involves control and manipulation of the simulated elements, but it can eliminate the need for empirical testing characteristic of experimental research. The essential characteristic of this research design is that some aspect of the physical environment is recreated

in one of a variety of modes, from highly abstract computer simulations to a full-scale, real-life mock-up.

The dictionary defines *simulation* as "the representation of the behaviour or characteristics of one system through the use of another system, especially a computer program designed for the purpose." This definition covers the general meaning of simulation, but it also recognizes the increasing dominance of the computer in this field. In the 10 years since the first edition of this book was released, this has become the case with regard to simulation as an architectural research strategy; computer technology has enormously expanded. "Building information modeling," understood in its generic sense, not only dynamically models buildings spatially and operationally in 3D, it can also model construction management sequences of a building project (called 4D), life-cycle factors projected over longer periods of time, and project costs in real time (called 5D).

Simulation of Complex Human Factors

Evacuation of Buildings during a Fire. The first edition of this book provided a simple example of computer modeling for evacuation of a building during a fire. Advances in this technology can be seen in recent computer simulations of different evacuation scenarios in the World Trade Center North Tower during the September 11, 2001, attack: What if one stair shaft remained intact above the impact zone in the initial hours after the tower was hit? What if the occupant load was at full capacity (about 25,000 persons); how many would have perished given the actual exiting configurations? What was the impact of firefighters *entering* the building on people trying to evacuate the building? What was the wait time for people exiting from the upper floors? "Five years ago," the authors say, "it would have been considered a challenge to perform an evacuation design analysis for a 110-story building with 25,000 people. With today's sophisticated modeling tools and high end personal computers this is now possible." For example, the authors found that, for a fully occupied building, all surviving occupants above the 91st floor (topmost floor of impact) could have exited the building prior to its collapse if at least one stair remained intact. Obviously, this calls for strategic dispersal of stairs in future designs. The researchers further postulated from their modeling that, while it is intuitive that higher floors result in longer wait times for exiting, there may come a point when wait times hold steady above a threshold height. This may raise questions as to why we need to build ever-taller buildings. This study is also significant in showing that simulation research is not only useful for projecting future conditions; it can perform analyses of a forensic nature for past events.

Simulation in Earlier Stages of Architectural Design Process

Virtual Reality in Schematic Design and Design Development; Rapid Prototyping.

Earlier systems of computer-aided design were more properly called computer- aided drafting: the computer as a sophisticated pencil for producing construction documents. The second generation of computer-aided systems, such as the Revit software, is "smarter" in that the system responds to a change made by the user by updating all other conditions affected by that change. Now computers are beginning to assist design decisions in the earlier stages of schematic design and design development. For example, researchers at the University of Washington studied the use of virtual reality imaging technology in a student architectural studio. Early design ideas were programmed so the spaces could be experienced virtually. Interestingly, one result was a return of interior design as a primary architectural task: The use of VR early in the design process forced the detailed development of the interior space as much as the exterior. By having the opportunity to "go inside" the design and see it from within, the designer was forced to solve complex connections and details which would not have been apparent with other media. The technology brought to light "spatial implications . . . with and without furniture." All of this was not available by conventional means. Limitations still abound. The researchers show that early schematic design is still difficult to adapt to the computer; it is only after initial design concepts have been sketched by hand and programmed into the computer that the virtual modeling becomes helpful in design development. Nevertheless, what is significant here is the blurring of human with computer capacities in the earlier stages of architecture design, with the result that the conventional means of representing architectural design (plan, section, elevation) seems to be increasingly giving way to animation technology allowing for dynamic three-dimensional models. In actual professional practice, the architectural firm Perkins + Will is leading the way in understanding how building information modeling (BIM) simulation can inform each stage of the design process, including conceptual design and schematic design. At these earlier stages, simulation helps to understand climate information, shading scenarios, orientation,
and passive strategies.

This leads to another example of simulation in early design thinking: rapid prototyping technology. Michael Speaks has proposed that the rapidity with which this technology allows a designer to produce three-dimensional alternative solutions has blurred the distinction between thinking and doing. The prior order of things, Speaks argues, privileged thinking over doing in that design actions were guided by predetermined theoretical principles held to be true. But if thinking can be expressed almost simultaneously by three-dimensional rapid prototyping, design

prototypes can be “tested, redesigned, retested quickly, cheaply, and under conditions that closely approximate reality.

Integration of Simulation Software

UrbanSim, ESRI ArchGIS; Virtual City Template. Because it is the nature of simulation research to provide holistic representations of real-world venues or events, accuracy of representation requires inputting as much data about those venues and events as possible. Here again computers are the ideal platform for simulation research; computers can “simulate the tiny forces binding molecules . . . the support structures of huge skyscrapers . . . the behavior of the economy,” and so on. Computerized geographic information systems (GISs) construct models predicting urban growth, transportation networks, and other large-scale built phenomena.

These computer models manage extremely complex databases. For example, CityEngine is a 3D modeling software specializing in detailed urban environment simulation, used by urban planners and architects. Supporting industry-standard formats such as ESRI shapefile, 3D models, and AutoCAD DXF files, it enables designers to easily import and export data to create detailed simulation of urban environments. Its interactive design tools facilitate quick editing and modification of urban street layouts and facades. ESRI’s Virtual City Template is an example of this technology.

References:

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Groat, L. N., & Wang, D. (2013). *Architectural research methods*. John Wiley & Sons.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners*. Sage.

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UNIT – II - Research Processes – SARA 5104

II Research Processes

The research process is very similar to undertaking a journey. As with your drive, for a research journey there are also two important decisions to make. The first is to decide *what you want to find out about* or, in other words, what **research questions** you want to find answers to. Having decided upon your research questions or **research problems**, you then need to decide *how to go about finding their answers*. The path to finding answers to your research questions constitutes research methodology. Just as there are posts along the way as you travel to your destination, so there are practical steps through which you must pass in your research journey in order to find the answers to your research questions. The sequence of these steps is not fixed and with experience you can change it. At each operational step in the research process you are required to choose from a multiplicity of methods, procedures and models of research methodology which will help you best achieve your **research objectives**. This is where your knowledge base of research methodology plays a crucial role.

Quantitative and qualitative research methodologies differ both in their underpinning philosophy and, to some extent, in the methods, models and procedures used. Though the research process is broadly the same in both, quantitative and qualitative research are differentiated in terms of the methods of data collection, the procedures adopted for data processing and analysis, and the style of communication of the findings. For example, if your research problem lends itself to a qualitative mode of enquiry, you are more likely to use the unstructured interview or observation as your method of data collection. When analysing data in qualitative research, you go through the process of identifying themes and describing what you have found out during your interviews or observation rather than subjecting your data to statistical procedures.

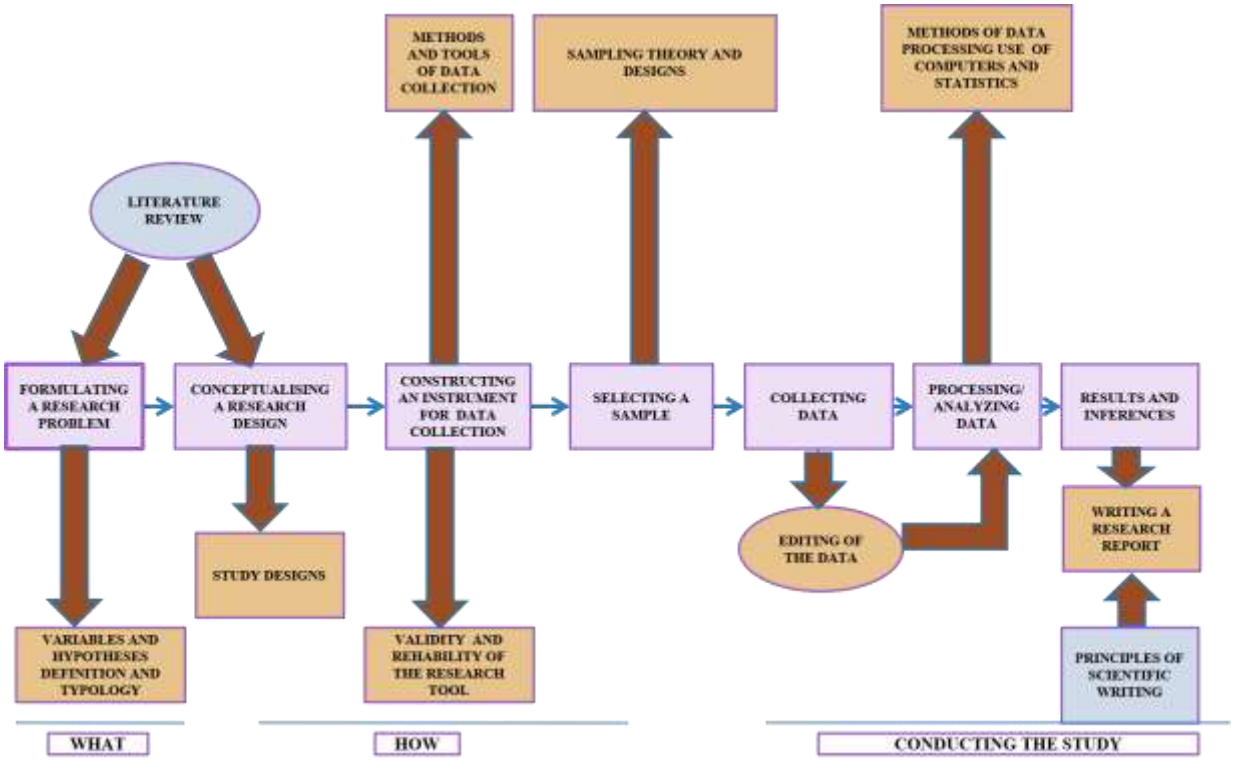

Figure 1 Research Process

FORMULATING A RESEARCH PROBLEM

Formulating a research problem is the first and most important step in the research process. A research problem identifies your destination: it should tell you, your research supervisor and your readers *what* you intend to research. The more specific and clearer you are the better, as everything that follows in the research process – study design, measurement procedures, sampling strategy, frame of analysis and the style of writing of your dissertation or report – is greatly influenced by the way in which you formulate your research problem. Hence, you should examine it thoroughly, carefully and critically. The main function of formulating a research problem is to decide *what* you want to find out *about*.

Broadly speaking, any question that you want answered and any assumption or assertion that you want to challenge or investigate can become a research problem or a research topic for your study. However, it is important to remember that not all questions can be transformed into research problems and some may prove to be extremely difficult to study. According to Powers, Meenaghan and Twoomey (1985:38), 'Potential research questions may occur to us on a regular basis, but the process of formulating them in a meaningful way is not at all an easy task.' As a newcomer it might seem easy to formulate a problem but it requires considerable knowledge of both the **subject area** and research methodology.

Once you examine a question more closely you will soon realise the complexity of formulating an idea into a problem which is researchable. 'First identifying and then specifying a research problem might seem like research tasks that ought to be easy and quickly accomplished. However, such is often not the case' (Yegidis & Weinback 1991: 35). It is essential for the problem you formulate to be able to withstand scrutiny in terms of the procedures required to be undertaken. Hence you should spend considerable time in thinking it through.

CONSIDERATIONS IN SELECTING A RESEARCH PROBLEM

When selecting a research problem/topic there are a number of considerations to keep in mind which will help to ensure that your study will be manageable and that you remain motivated. These
considerations are:

- **Interest** – Interest should be the most important consideration in selecting a research problem. A research endeavour is usually time consuming, and involves hard work and possibly unforeseen problems. If you select a topic which does not greatly interest you, it could become extremely difficult to sustain the required motivation and put in enough time and energy to complete it.
- **Magnitude** – You should have sufficient knowledge about the research process to be able to visualise the work involved in completing the proposed study. Narrow the topic down to something manageable, specific and clear. It is extremely important to select a topic that you can manage within the time and with the resources at your disposal. Even if you are undertaking a descriptive study, you need to consider its magnitude carefully.
- **Measurement of concepts** – If you are using a concept in your study (in quantitative studies), make sure you are clear about its indicators and their measurement. For example, if you plan to measure the effectiveness of a health promotion programme, you must be clear as to what determines effectiveness and how it will be measured. Do not use concepts in your research problem that you are not sure how to measure. This does not mean you cannot develop a measurement procedure as the study progresses. While most of the developmental work will be done during your study, it is imperative that you are reasonably clear about the measurement of these concepts at this stage.
- **Level of expertise** – Make sure you have an adequate level of expertise for the task you are proposing. Allow for the fact that you will learn during the study and may receive

help from your research supervisor and others, but remember that you need to do most of the work yourself.

- **Relevance** – Select a topic that is of relevance to you as a professional. Ensure that your study adds to the existing body of knowledge, bridges current gaps or is useful in policy formulation. This will help you to sustain interest in the study.
- **Availability of data** – If your topic entails collection of information from secondary sources (office records, client records, census or other already-published reports, etc.) make sure that this data is available and, in the format, you want before finalising your topic.
- **Ethical issues** – Another important consideration in formulating a research problem is the ethical issues involved. In the course of conducting a research study, the study population may be adversely affected by some of the questions (directly or indirectly); deprived of an intervention; expected to share sensitive and private information; or expected to be simply experimental 'guinea pigs'. How ethical issues can affect the study population and how ethical problems can be overcome should be thoroughly examined at the problem-formulation stage.

THE FORMULATION OF RESEARCH OBJECTIVES

Objectives are the goals you set out to attain in your study. Since these objectives inform a reader of what you want to achieve through the study, it is extremely important to word them clearly and specifically.

Objectives should be listed under two headings:

- Main objectives/ Aim of the Research;
- Subobjectives.

The main objective is an overall statement of the thrust of your study. It is also a statement of the main associations and relationships that you seek to discover or establish. The subobjectives are the specific aspects of the topic that you want to investigate within the main framework of your study.

LITERATURE REVIEW

The place of the literature review in research

One of the essential preliminary tasks when you undertake a research study is to go through the existing literature in order to acquaint yourself with the available body of knowledge in your area

of interest. Reviewing the literature can be time consuming, daunting and frustrating, but it is also rewarding. The **literature review** is an integral part of the research process and makes a valuable contribution to almost every operational step. It has value even before the first step; that is, when you are merely thinking about a research question that you may want to find answers to through your research journey. In the initial stages of research, it helps you to establish the theoretical roots of your study, clarify your ideas and develop your research methodology. Later in the process, the literature review serves to enhance and consolidate your own knowledge base and helps you to integrate your findings with the existing body of knowledge. Since an important responsibility in research is to compare your findings with those of others, it is here that the literature review plays an extremely important role. During the write-up of your report it helps you to integrate your findings with existing knowledge – that is, to either support or contradict earlier research. The higher the academic level of your research, the more important a thorough integration of your findings with existing literature becomes.

In summary, a literature review has the following functions: It provides a theoretical background to your study. It helps you establish the links between what you are proposing to examine and what has already been studied. It enables you to show how your findings have contributed to the existing body of knowledge in your profession. It helps you to integrate your research findings into the existing body of knowledge.

In relation to your own study, the literature review can help in four ways. It can:

1. Bring clarity and focus to your research problem;
2. Improve your research methodology;
3. Broaden your knowledge base in your research area; and
4. Contextualise your findings.

Bringing clarity and focus to your research problem

The literature review involves a paradox. On the one hand, you cannot effectively undertake a literature search without some idea of the problem you wish to investigate. On the other hand, the literature review can play an extremely important role in shaping your research problem because the process of reviewing the literature helps you to understand the subject area better and thus helps you to conceptualise your research problem clearly and precisely and makes it more relevant and pertinent to your field of enquiry. When reviewing the literature you learn what aspects of your subject area have been examined by others, what they have found out about these aspects, what gaps they have identified

and what suggestions they have made for further research. All these will help you gain a greater insight into your own research questions and provide you with clarity and focus which are central

to a relevant and valid study. In addition, it will help you to focus your study on areas where there are gaps in the existing body of knowledge, thereby enhancing its relevance.

Improving your research methodology

Going through the literature acquaints you with the methodologies that have been used by others to find answers to research questions similar to the one you are investigating. A literature review tells you if others have used procedures and methods similar to the ones that you are proposing, which procedures and methods have worked well for them and what problems they have faced with them. By becoming aware of any problems and pitfalls, you will be better positioned to select a methodology that is capable of providing valid answers to your research question. This will increase your confidence in the methodology you plan to use and will equip you to defend its use.

Broadening your knowledge base in your research area

The most important function of the literature review is to ensure you read widely around the subject area in which you intend to conduct your research study. It is important that you know what other

researchers have found in regard to the same or similar questions, what theories have been put forward and what gaps exist in the relevant body of knowledge. When you undertake a research project for a higher degree you are expected to be an expert in your area of research. A thorough literature review helps you to fulfil this expectation. Another important reason for doing a literature review is that it helps you to understand how the findings of your study fit into the existing body of knowledge (Martin 1985: 30).

Enabling you to contextualise your findings

Obtaining answers to your research questions is comparatively easy: the difficult part is examining how your findings fit into the existing body of knowledge. How do answers to your research questions compare with what others have found? What contribution have you been able to make to the existing body of knowledge? How are your findings different from those of others? Undertaking a literature review will enable you to compare your findings with those of others and answer these questions. It is important to place your findings in the context of what is already known in your field of enquiry.

How to review the literature

If you do not have a specific research problem, you should review the literature in your broad area of interest with the aim of gradually narrowing it down to what you want to find out about. After that the literature review should be focused around your research problem. There is a danger in reviewing the literature without having a reasonably specific idea of what you want to

study. It can condition your thinking about your study and the methodology you might use, resulting in a less innovative choice of research problem and methodology than otherwise would have been the case. Hence, you should try broadly to conceptualise your research problem before undertaking your major literature review.

There are four steps involved in conducting a literature review:

1. Searching for the existing literature in your area of study.
2. Reviewing the selected literature.
3. Developing a theoretical framework.
4. Developing a conceptual framework.

The skills required for these tasks are different. Developing theoretical and conceptual frameworks is more difficult than the other tasks.

Searching for the existing literature

To search effectively for the literature in your field of enquiry, it is imperative that you have at least some idea of the broad subject area and of the problem you wish to investigate, in order to set

parameters for your search. Next, compile a bibliography for this broad area. There are three sources that you can use to prepare a bibliography: books; journals; the Internet.

Books

Though books are a central part of any bibliography, they have their disadvantages as well as advantages. The main advantage is that the material published in books is usually important and of good

quality, and the findings are 'integrated with other research to form a coherent body of knowledge' (Martin 1985: 33). The main disadvantage is that the material is not completely up to date, as it can take a few years between the completion of a work and its publication in the form of a book. The best way to search for a book is to look at your library catalogues. Publications such as *Book Review Index* can help you to locate books of interest.

Use the *subject catalogue* or *keywords* option to search for books in your area of interest. Narrow the subject area searched by selecting the appropriate keywords. Look through these titles carefully and identify the books you think are likely to be of interest to you. If you think the titles seem appropriate to your topic, print them out (if this facility is available), as this will save you time, or note them down on a piece of paper. Be aware that sometimes a title does not provide enough information to help you decide if a book is going to be of use so you may have to examine its contents too. When you have selected 10–15 books that you think are appropriate for your topic, examine the bibliography of each one. It will save time if you photocopy their

bibliographies. Go through these bibliographies carefully to identify the books common to several of them. If a book has been referenced by a number of authors, you should include it in your reading list. Prepare a final list of books that you consider essential reading. Having prepared your reading list, locate these books in your library or borrow them from other sources. Examine their contents to double-check that they really are relevant to your topic. If you find that a book is not relevant to your research, delete it from your reading list. If you find that something in a book's contents is relevant to your topic, make an annotated bibliography. An annotated bibliography contains a brief abstract of the aspects covered in a book and your own notes of its relevance. Be careful to keep track of your references. To do this you can prepare your own card index or use a computer program such as Endnotes or Pro-Cite.

Journals

You need to go through the journals relating to your research in a similar manner. Journals provide you with the most up-to-date information, even though there is often a gap of two to three years between the completion of a research project and its publication in a journal. You should select as many journals as you possibly can, though the number of journals available depends upon the field of study – certain fields have more journals than others. As with books, you need to prepare a list of the journals you want to examine for identifying the literature relevant to your study. There are several sources designed to make your search for journals easier and these can save you enormous time. They are:

1. Indices of journals (e.g. *Humanities Index*);
2. Abstracts of articles (e.g. *ERIC*);
3. Citation indices (e.g. *Social Sciences Citation Index*).

Each of these indexing, abstracting and citation services is available in print, or accessible through the Internet. In most libraries, information on books, journals and abstracts is stored on computers. In each case the information is classified by subject, author and title. You may also have the keywords option (author/keyword; title/keyword; subject/keyword; expert/keyword; or just keywords). What system you use depends upon what is available in your library and what you are familiar with. There are specially prepared electronic databases in a number of disciplines. These can also be helpful in preparing a bibliography. Select the database most appropriate to your area of study to see if there are any useful references. Of course, any computer database search is restricted to those journals and articles that are already on the database. You should also talk to your research supervisor and other available experts to find out aboutany additional relevant literature to include in your reading list.

The Internet

In almost every academic discipline and professional field, the Internet has become an important tool for finding published literature. Through an Internet search you can identify published material in books, journals and other sources with immense ease and speed. An Internet search is carried out through search engines, of which there are many, though the most commonly used are *Google* and *Yahoo*. Searching through the Internet is very similar to the search for books and articles in a library using an electronic catalogue, as it is based on the use of keywords. An Internet search basically identifies all material in the database of a search engine that contains the keywords you specify, either individually or in combination. It is important that you choose words orcombinations of words that other people are likely to use. According to Gilbert (2008: 73), 'Most search facilities use Boolean logic, which allows three types of basic search "AND", "OR" and "NOT".' With practice you will become more efficient and effective in using keywords in combination with AND, OR and NOT, and so learn to narrow your search to help you identify the most relevant references.

Reviewing the selected literature

Now that you have identified several books and articles as useful, the next step is to start reading them critically to pull together themes and issues that are of relevance to your study. Unless you have a theoretical framework of themes in mind to start with, use separate sheets of paper for each theme or issue you identify as you go through selected books and articles. Once you develop a rough framework, slot the findings from the material so far reviewed into these themes, using a separate sheet of paper for each theme of the framework so far developed. As you read further, go on slotting the information where it logically belongs under the themes so far developed. Keep in mind that you may need to add more themes as you go along. While going through the literature you should carefully and critically examine it with respect to the following aspects:

- Note whether the knowledge relevant to your theoretical framework has been confirmed beyond doubt.
- Note the theories put forward, the criticisms of these and their basis, the methodologies adopted (study design, sample size and its characteristics, measurement procedures, etc.) and the criticisms of them.
- Examine to what extent the findings can be generalised to other situations.
- Notice where there are significant differences of opinion among researchers and give your opinion about the validity of these differences.

- Ascertain the areas in which little or nothing is known – the gaps that exist in the body of knowledge.

Developing a theoretical framework

Examining the literature can be a never-ending task, but as you have limited time it is important to set parameters by reviewing the literature in relation to some main themes pertinent to your research topic. As you start reading the literature, you will soon discover that the problem you wish to investigate has its roots in a number of theories that have been developed from different perspectives. The information obtained from different books and journals now needs to be sorted under the main themes and theories, highlighting agreements and disagreements among the authors and identifying the unanswered questions or gaps. You will also realise that the literature deals with a number of aspects that have a direct or indirect bearing on your research topic. Use these aspects as a basis for developing your theoretical framework. Your review of the literature should sort out the information, as mentioned earlier, within this framework. Unless you review the literature in relation to this framework, you will not be able to develop a focus in your literature search: that is, your theoretical framework provides you with a guide as you read. This brings us to the paradox mentioned previously: until you go through the literature you cannot develop a theoretical framework, and until you have developed a theoretical framework you cannot effectively review the literature. The solution is to read some of the literature and then attempt to develop a framework, even a loose one, within which you can organise the rest of the literature you read. As you read more about the area, you are likely to change the framework. However, without it, you will get bogged down in a great deal of unnecessary reading and note-taking that may not be relevant to your study. Literature pertinent to your study may deal with two types of information:

1. Universal;
2. More specific (i.e. local trends or a specific programme).

In writing about such information you should start with the general information, gradually narrowing it down to the specific.

Developing a conceptual framework

The conceptual framework is the basis of your research problem. It stems from the theoretical framework and usually focuses on the section(s) which become the basis of your study. Whereas the theoretical framework consists of the theories or issues in which your study is embedded, the conceptual framework describes the aspects you selected from the theoretical framework to become the basis of your enquiry.

Writing about the literature reviewed

Now, all that remains to be done is to write about the literature you have reviewed. As mentioned earlier, two of the broad functions of a literature review are (1) to provide a theoretical background to your study and (2) to enable you to contextualise your findings in relation to the existing body of knowledge in addition to refining your methodology. The content of your literature review should reflect these two purposes. In order to fulfil the first purpose, you should identify and describe various theories relevant to your field; and specify gaps in existing knowledge in the area, recent advances in the area of study, current trends and so on. In order to comply with the second function, you should integrate the results from your study with specific and relevant findings from the existing literature by comparing the two for confirmation or contradiction. Note that at this stage you can only accomplish the first function of the literature review, to provide a theoretical background to your study. For the second function, the contextualisation of the findings, you have to wait till you are at the research report writing stage. While reading the literature for theoretical background of your study, you will realise that certain themes have emerged. List the main ones, converting them into subheadings. Some people write up the entire literature review in one section, entitled 'Review of the literature', 'Summary of literature' or 'The literature review', without subheadings, but the author strongly suggests that you write your literature review under subheadings based upon the main themes that you have discovered and which form the basis of your theoretical framework. These subheadings should be precise, descriptive of the theme in question and follow a logical progression. Now, under each subheading, record the main findings with respect to the theme in question (thematic writing), highlighting the reasons for and against an argument if they exist, and identifying gaps and issues.

The second broad function of the literature review – contextualising the findings of your study –

- Requires you to compare very systematically your findings with those made by others.
- Quote from these studies to show how your findings contradict, confirm or add to them.
- It places your findings in the context of what others have found out providing complete reference in an acceptable format.
- This function is undertaken, as mentioned earlier, when writing about your findings, that is after analysis of your data.

HYPOTHESIS

Hypotheses bring clarity, specificity and focus to a research problem, but are not essential for a study. You can conduct a valid investigation without constructing a single formal hypothesis. On the other hand, within the context of a research study, you can construct as many hypotheses as you consider to be appropriate. Some believe that one must formulate a hypothesis to undertake an investigation; however, the author does not hold this opinion. Hypotheses primarily arise from a set of 'hunches' that are tested through a study and one can conduct a perfectly valid study without having these hunches or speculations. However, in epidemiological studies, to narrow the field of investigation, it is important to formulate hypotheses.

The importance of hypotheses lies in their ability to bring direction, specificity and focus to a research study. They tell a researcher what specific information to collect, and thereby provide greater focus.

A hypothesis is a hunch, assumption, suspicion, assertion or an idea about a phenomenon, relationship or situation, the reality or truth of which you do not know. A researcher calls these assumptions, assertions, statements or hunches hypotheses and they become the basis of an enquiry. In most studies the hypothesis will be based upon either previous studies or your own or someone else's observations.

There are many definitions of a hypothesis. According to Kerlinger, 'A hypothesis is a conjectural statement of the relationship between two or more variables' (1986: 17). *Webster's Third New International Dictionary* (1976) defines a hypothesis as: a proposition, condition, or principle which is assumed, perhaps without belief, in order to draw out its logical consequences and by this method to test its accord with facts which are known or may be determined.

Black and Champion define a hypothesis as 'a tentative statement about something, the validity of which is usually unknown' (1976: 126).

From the above definitions it is apparent that a hypothesis has certain characteristics:

1. It is a tentative proposition.
2. Its validity is unknown.
3. In most cases, it specifies a relationship between two or more variables.

To test a hypothesis you need to go through a process that comprises three phases:

(1) constructing a hypothesis;

(2) gathering appropriate evidence; and

(3) analysing evidence to draw conclusions as to its validity

RESEARCH DESIGN

The above definitions suggest that a research design has two main functions. The first relates to the identification and/or development of procedures and logistical arrangements required to undertake a study, and the second emphasises the importance of quality in these procedures to ensure their validity, objectivity and accuracy. Hence, through a research design you: conceptualise an operational plan to undertake the various procedures and tasks required to complete your study; ensure that these procedures are adequate to obtain valid, objective and accurate answers to the research questions. Kerlinger calls this function the **control of variance** (1986: 280).

Let us take the first of these functions. The research design should detail for you, your supervisor and other readers all the procedures you plan to use and the tasks you are going to perform to obtain answers to your research questions. One of the most important requirements of a research design is to specify everything clearly so a reader will understand what procedures to follow and how to follow them. A research design, therefore, should do the following:

1. Name the study design per se – that is, 'cross-sectional', 'before-and-after', 'comparative', 'control experiment' or 'random control'.
2. Provide detailed information about the following aspects of the study:
3. Who will constitute the study population?
4. How will the study population be identified?
5. Will a sample or the whole population be selected?
6. If a sample is selected, how will it be contacted?
7. How will consent be sought?
8. What method of data collection will be used and why?
9. In the case of a questionnaire, where will the responses be returned?
10. How should respondents contact you if they have queries?
11. In the case of interviews, where will they be conducted?
12. How will ethical issues be taken care of?

References:

Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners*. Sage

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UNIT – III – Data Collection and Analysis – SARA 5104

III Data Collection and Analysis

VARIABLE

An image, perception or concept that is capable of measurement – hence capable of taking on different values – is called a **variable**. In other words, a concept that can be measured is called a variable. According to Kerlinger, 'A variable is a property that takes on different values. Putting it redundantly, a variable is something that varies … A variable is a symbol to which numerals or values are attached' (1986: 27). Black and Champion define a variable as 'rational units of analysis that can assume any one of a number of designated sets of values' (1976: 34). A concept that can be measured on any one of the four types of measurement **scale**, which have varying degrees of precision in measurement, is called a variable.

Types of Variable

Independent variable – the cause supposed to be responsible for bringing about change(s) in a phenomenon or situation.

Dependent variable – the outcome or change(s) brought about by introduction of an independent variable.

Extraneous variable – several other factors operating in a real-life situation may affect changes in the dependent variable. These factors, not measured in the study, may increase or decrease the magnitude or strength of the relationship between independent and dependent variables.

Intervening variable – sometimes called the confounding variable (Grinnell 1988: 203), it links the independent and dependent variables. In certain situations the relationship between an independent and a dependent variable cannot be established without the intervention of another variable. The cause, or independent, variable will have the assumed effect only in the presence of an intervening variable.

MEASUREMENT SCALES

Measurement is central to any enquiry. In addition to the ideology and philosophy that underpin each mode of enquiry, the most significant difference between qualitative and quantitative research studies is in the types of measurement used in collecting information from the respondents. Qualitative research mostly uses descriptive statements to seek answers to the research questions, whereas in quantitative research these answers are usually sought on one of the measurement scales (nominal, ordinal, interval or ratio). If a piece of information is not collected using one of the scales at the time of data collection, it is transformed into variables by using these measurement scales at the time of analysis. Measurement on these scales could be either in the form of qualitative categories or through a precise unit of measurement. Those scales

which have a unit of measurement (interval and ratio) are considered to be more refined, objective and accurate. On the other hand, nominal and ordinal scales are considered subjective and hence not as accurate as they do not have a unit of measurement per se. The greater the refinement in the unit of measurement of a variable, the greater the confidence placed in the findings by others, other things being equal. One of the main differences between the physical and the social sciences is the units of measurement used and the degree of importance attached to them. In the physical sciences measurements have to be absolutely accurate and precise, whereas in the social sciences they may vary from the very subjective to the very quantifiable. Within the social sciences the emphasis on precision in measurement varies markedly from one discipline to another. An anthropologist normally uses very 'subjective' units of measurement, whereas an economist or an epidemiologist emphasises 'objective' measurement. Stevens has classified the different types of measurement scale into four categories:

1. Nominal or classificatory scale;
2. Ordinal or ranking scale;
3. Interval scale;
4. Ratio scale.

The nominal or classificatory scale

A nominal scale enables the classification of individuals, objects or responses based on a common/shared property or characteristic. These people, objects or responses are divided into a number of subgroups in such a way that each member of the subgroup has a common characteristic. A variable measured on a nominal scale may have one, two or more subcategories depending upon the extent of variation. For example, 'water' and 'taxi' have only one subgroup, whereas the variable 'gender' can be classified into two subcategories: male and female. Political parties in Australia can similarly be classified into four main subcategories: Labor, Liberal, Democrats and Greens. Those who identify themselves, either by membership or belief, as belonging to the Labor Party are classified as 'Labor', those identifying with the Liberals are classified as 'Liberal', and so on. The name chosen for a subcategory is notional, but for effective communication it is best to choose something that describes the characteristic of the subcategory. Classification by means of a nominal scale ensures that individuals, objects or responses within the same subgroup have a common characteristic or property as the basis of classification. The sequence in which subgroups are listed makes no difference as there is no relationship among subgroups.

The ordinal or ranking scale

An ordinal scale has all the properties of a nominal scale – categorising individuals, objects, responses or a property into subgroups on the basis of a common characteristic – but also ranks the subgroups in a certain order. They are arranged in either ascending or descending order according to the extent that a subcategory reflects the magnitude of variation in the variable. For example, income can be measured either quantitatively (in dollars and cents) or qualitatively, using subcategories: 'above average', 'average' and 'below average'. (These categories can also be developed on the basis of quantitative measures, for example below $10 000 = below average, $10 000–$25 000 = average and above $25 000 = above average.) The subcategory 'above average' indicates that people so grouped have more income than people in the 'average' category, and people in the 'average' category have more income than those in the 'below average' category. These subcategories of income are related to one another in terms of the magnitude of people's income, but the magnitude itself is not quantifiable, and hence the difference between 'above average' and 'average' or between 'average' and 'below average' sub-categories cannot be ascertained. The same is true for other variables such as socioeconomic status and attitudes measured on an ordinal scale. Therefore, an ordinal scale has all the properties/characteristics of a nominal scale, in addition to its own. Subcategories are arranged in order of the magnitude of the property/characteristic. Also, the 'distance' between the subcategories is not equal as there is no quantitative unit of measurement.

The interval scale

An interval scale has all the characteristics of an ordinal scale; that is, individuals or responses belonging to a subcategory have a common characteristic and the subcategories are arranged in an ascending or descending order. In addition, an interval scale uses a unit of measurement that enables the individuals or responses to be placed at equally spaced intervals in relation to the spread of the variable. This scale has a starting and a terminating point and is divided into equally spaced units/intervals. The starting and terminating points and the number of units/intervals between them are arbitrary and vary from scale to scale. Celsius and Fahrenheit scales are examples of an interval scale. In the Celsius system the starting point (considered as the freezing point) is 0°C and the terminating point (considered as the boiling point) is 100°C. The gap between the freezing and boiling points is divided into 100 equally spaced intervals, known as degrees. In the Fahrenheit system the freezing point is 32°F and the boiling point is 212°F, and the gap between the two points is divided into 180 equally spaced intervals. Each degree or interval is a measurement of temperature – the higher the degree, the higher the temperature. As the starting and terminating points are arbitrary, they are not absolute; that is, you cannot say that

60°C is twice as hot as 30°C or 30°F is three times hotter than 10°F. This means that while no mathematical operation can be performed on the readings, it can be performed on the differences between readings. For example, if the difference in temperature between two objects, A and B, is 15°C and the difference in temperature between two other objects, C and D, is 45°C, you can say that the difference in temperature between C and D is three times greater than that between A and B. An attitude towards an issue measured on the Thurstone scale is similar. However, the Likert scale does not measure the absolute intensity of the attitude but simply measures it in relation to another person. The interval scale is relative; that is, it plots the position of individuals or responses in relation to one another with respect to the magnitude of the measurement variable. Hence, an interval scale has all the properties of an ordinal scale, and it has a unit of measurement with an arbitrary starting and terminating point.

The ratio scale

A ratio scale has all the properties of nominal, ordinal and interval scales and it also has a starting point fixed at zero. Therefore, it is an absolute scale – the difference between the intervals is always measured from a zero point. This means the ratio scale can be used for mathematical operations. The measurement of income, age, height and weight are examples of this scale. A person who is 40 years of age is twice as old as a 20-year-old. A person earning $60 000 per year earns three times the salary of a person earning $20 000.

Measurement of attitudes in quantitative and qualitative research

There are a number of differences in the way attitudes are measured in quantitative and qualitative research. In quantitative research you are able to explore, measure, determine the intensity and combine attitudes to different aspects of an issue to arrive at one indicator that is reflective of the overall attitude. In qualitative research, you can only explore the spread of attitudes and establish the types of attitudes prevalent. In quantitative research you can ascertain the types of attitudes people have in a community, how many people have a particular attitude and what the intensity is of those attitudes. A number of techniques have been developed to measure attitudes and their intensity in quantitative research, but such techniques are lacking in qualitative research. This is mainly because in qualitative research you do not make an attempt to measure or quantify. The concept of attitudinal scales, therefore, is only prevalent in quantitative research.

Attitudinal scales in quantitative research

In quantitative research there are two scales which have been developed to ‘measure’ attitudes. Each of these scales is based upon different assumptions and follows different procedures in their construction.

As a beginner in research methods it is important for you to understand these procedures and the assumptions behind them so that you can make appropriate and accurate interpretation of the findings. As you will see, it is not very easy to construct an attitudinal scale. Out of the three scales, the Likert scale is the easiest to construct and therefore is used far more.

Functions of attitudinal scales

If you want to find out the attitude of respondents towards an issue, you can ask either a closed or an open-ended question. For example, let us say that you want to ascertain the attitude of students in a class towards their lecturer and that you have asked them to respond to the following question: 'What is your attitude towards your lecturer?' If your question is open ended, it invites each respondent to describe the attitude that s/he holds towards the lecturer. If you have framed a closed question, with categories such as 'extremely positive', 'positive', 'uncertain', 'negative' and 'extremely negative', this guides the respondents to select a category that best describes their attitude. This type of questioning, whether framed descriptively or in a categorical form, elicits an overall attitude towards the lecturer. While ascertaining the overall attitude may be sufficient in some situations, in many others, where the purpose of attitudinal questioning is to develop strategies for improving a service or intervention, or to formulate policy, eliciting attitudes on various aspects of the issue under study is required. But as you know, every issue, including that of the attitude of students towards their lecturers, has many aspects. For example, the attitude of the members of a community towards the provision of a particular service comprises their attitude towards the need for the service, its manner of delivery, its location, the physical facilities provided to users, the behaviour of the staff, the competence of the staff, the effectiveness and efficiency of the service, and so on. Similarly, other examples – such as the attitude of employees towards the management of their organisation, the attitude of employees towards occupational redeployment and redundancy, the attitude of nurses towards death and dying, the attitude of consumers towards a particular product, the attitude of students towards a lecturer, or the attitude of staff towards the strategic plan for their organisation – can be broken down in the same manner. Respondents usually have different attitudes towards different aspects. Only when you ascertain the attitude of respondents to an issue by formulating a question for each aspect, using either open-ended or closed questions, do you find out their attitude towards each aspect. The main limitation of this method is that it is difficult to draw any conclusion about the overall attitude of a respondent from the responses. Take the earlier example, where you want to find out the attitude of students towards a lecturer. There are different aspects of teaching: the contents of lectures; the organisation of material; the lecturer's ability to communicate material; the presentation and style; knowledge of the subject; responsiveness; punctuality; and so on.

Students may rate the lecturer differently on different aspects. That is, the lecturer might be considered extremely competent and knowledgeable in his/her subject but may not be considered a good communicator by a majority of students. Further, students may differ markedly in their opinion regarding any one aspect of a lecturer's teaching. Some might consider the lecturer to be a good communicator and others might not. The main problem is: how do we find out the 'overall' attitude of the students towards the lecturer? In other words, how do we combine the responses to different aspects of any issue to come up with one indicator that is reflective of an overall attitude? Attitudinal scales play an important role in overcoming this problem.

Attitudinal scales measure the intensity of respondents' attitudes towards the various aspects of a situation or issue and provide techniques to combine the attitudes towards different aspects into one overall indicator. This reduces the risk of an expression of opinion by respondents being influenced by Their opinion on only one or two aspects of that situation or issue.

Difficulties in developing an attitudinal scale

In developing an attitudinal scale there are three problems:

1. Which aspects of a situation or issue should be included when seeking to measure an attitude? For instance, in the example cited above, what aspects of teaching should be included in a scale to find out the attitude of students towards their lecturer?
2. What procedure should be adopted for combining the different aspects to obtain an overall picture?
3. How can one ensure that a scale really is measuring what it is supposed to measure?

The first problem is extremely important as it largely determines the third problem: the extent to which the statements on different aspects are reflective of the main issue largely determines the validity of the scale. You can solve the third problem by ensuring that your statements on the various aspects have a logical link with the main issue under study – the greater the link, the higher the validity. The different types of attitudinal scale (Likert, Thurstone) provide an answer to the second problem. They guide you as to the procedure for combining the attitudes towards various aspects of an issue, though the degree of difficulty in following the procedure for these scales varies from scale to scale.

Types of attitudinal scale

There are three major types of attitudinal scale:

1. the summated rating scale, also known as the Likert scale;
2. the equal-appearing interval scale or differential scale, also known as the Thurstone scale;

The summated rating or Likert scale

The **summated rating scale**, more commonly known as the **Likert scale**, is based upon the assumption that each statement/item on the scale has equal **attitudinal value**, 'importance' or 'weight' in terms of reflecting an attitude towards the issue in question. This assumption is also the main limitation of this scale as statements on a scale seldom have equal attitudinal value. 'knowledge of subject' is not as important in terms of the degree to which it reflects the attitude of the students towards the lecturer as 'has published a great deal' or 'some students like, some do not', but, on the Likert scale, each is treated as having the same 'weight'. A student may not bother much about whether a lecturer has published a great deal, but may be more concerned about 'knowledge of the subject', 'communicates well' and 'knows how to teach'.

The lecturer:	*Strongly agree*	*Agree*	*Uncertain*	*Disagree*	*Strongly disagree*
1 Knows the subject well	▭	▭	▭	▭	▭
2 Is unenthusiastic about teaching	▭	▭	▭	▭	▭
3 Shows concern for students	▭	▭	▭	▭	▭
4 Makes unreasonable demands	▭	▭	▭	▭	▭
5 Has poor communication skills	▭	▭	▭	▭	▭
6 Knows how to teach	▭	▭	▭	▭	▭
7 Can explain difficult concepts in simple terms	▭	▭	▭	▭	▭
8 Is hard to approach	▭	▭	▭	▭	▭
9 Is liked by some students and not by others	▭	▭	▭	▭	▭
10 Is difficult to get along with	▭	▭	▭	▭	▭

FIGURE 1 *An example of a categorical scale*

It is important to remember that the Likert scale does not measure attitude per se. It does help to place different respondents in relation to each other in terms of the intensity of their attitude towards an issue: it shows the strength of one respondent's view in relation to that of another and not the absolute attitude.

Considerations in constructing a Likert scale

In developing a Likert scale, there are a number of things to consider. Firstly, decide whether the attitude to be measured is to be classified into one-, two- or three-directional categories (i.e. whether you want to determine positive, negative and neutral positions in the study population) with respect to their attitude towards the issue under study. Next, consider whether you want to use categories or a numerical scale. This should depend upon whether you think that your study population can express itself better on a numerical scale or in categories. The decision about the number of points or the number of categories on a categorical scale depends upon how finely

you want to measure the intensity of the attitude in question and on the capacity of the population to make fine distinctions.

Calculating attitudinal scores

Suppose you have developed a questionnaire/interview schedule to measure the attitudes of a class of students towards their lecturer using a scale with five categories.

In Figure 1, statement 1 is a positive statement; hence, if a respondent ticks 'strongly agree', s/he is assumed to have a more positive attitude on this item than a person who ticks 'agree'. The person who ticks 'agree' has a more positive attitude than a person who ticks 'uncertain', and so on. Therefore, a person who ticks 'strongly agree' has the most positive attitude compared with all of the others with different responses. Hence, the person is given the highest score, 5, as there are only five response categories. If there were four categories you could assign a score of 4. As a matter of fact, any score can be assigned as long as the intensity of the response pattern is reflected in the score and the highest score is assigned to the response with the highest intensity.

The lecturer:	SA	A	U	D	SD
1 Knows the subject well (+)	5	4	3	2	1
2 Is unenthusiastic about teaching (–)	1	2	3	4	5
3 Shows concern for students (+)	5	4	3	2	1
4 Makes unreasonable demands (–)	1	2	3	4	5
5 Has poor communication skill) (–)					
6 Knows how to teach (+)					
7 Can explain difficult concepts in simple terms (+)					
8 Is hard to approach (–)					
9 Is liked by some students and not by others (+/–)					
10 Is difficult to get along with (–)					

SA = strongly agree, A = agree, U = uncertain, D = disagree, SD = strongly disagree

FIGURE 2 *Scoring positive and negative statements*

The lecturer:	SA	A	U	D	SD
1 Knows the subject well (+)	@				#
2 Is unenthusiastic about teaching (–)		#			@
3 Shows concern for students (+)			@		#
4 Makes unreasonable demands (–)		#			@
5 Communicates poorly (–)		#			@
6 Knows how to teach (+)		@		#	
7 Can explain difficult concepts in simple terms (+)	@	#			
8 Is hard to approach (–)			@#		
9 Is liked by some students and not by others (+/–)				@#	
10 Is difficult to get along with (–)			#		@

SA = strongly agree, A = agree, U = uncertain, D = disagree, SD = strongly disagree

FIGURE 3 Calculating an attitudinal score

Statement 2 is a negative statement. In this case a person who ticks 'strongly disagree' has the most positive attitude on this item; hence, the highest score is assigned, 5. On the other hand, a respondent who ticks 'strongly agree' has the least positive attitude on the item and therefore is assigned the lowest score, 1. The same scoring system is followed for the other statements.

Note statement 9. There will always be some people who like a lecturer and some who do not; hence, this type of statement is neutral. There is no point in including such items in the scale but, here, for the purpose of this example, we have.

To illustrate how to calculate an individual's **attitudinal score**, let us take the example of two respondents who have ticked the different statements marked in our example by # and @ (Figure 3). Let us work out their attitudinal score: The analysis shows that, overall, respondent @ has a 'more' positive attitude towards the lecturer than respondent #. You cannot say that the attitude of respondent @ is twice (42/20 = 2.10) as positive as that of respondent #. The attitudinal score only places respondents in a position relative to one another. Remember that the Likert scale does not measure the attitude per se, but helps you to rate a group of individuals in descending or ascending order with respect to their attitudes towards the issues in question.

The equal-appearing interval or Thurstone scale

Unlike the Likert scale, the **Thurstone scale** calculates a 'weight' or 'attitudinal value' for each statement. The weight (equivalent to the median value) for each statement is calculated on the basis of rating assigned by a group of judges. Each statement with which respondents express agreement (or to which they respond in the affirmative) is given an attitudinal score equivalent to the 'attitudinal value' of the statement. The procedure for constructing the Thurstone scale is as given in Figure 4

Step 1	Assemble or construct statements reflective of attitudes towards the issue in question.
Step 2	Select a panel of judges who are experts in the field of the attitudes being explored.
Step 3	Send the statements to these judges with a request to rate each statement's importance in reflecting an attitude towards the issue being studied. Ask them to rate each statement on an 11-point scale.
Step 4	On the basis of the judges' ratings, calculate the median value of their ratings for each item.
Step 5	If the judges' ratings of any item are scattered over the scale, this indicates that, even among the experts, there is no agreement as to the degree to which that statement reflects an attitude towards the issue in question. Discard such statements.
Step 6	From the remaining statements select items that best reflect attitudes towards various aspects of the issue.
Step 7	Construct a questionnaire/interview schedule comprising the selected items.

FIGURE 4 *The procedure for constructing the Thurstone scale*

The main advantage of this scale is that, as the importance of each statement is determined by judges, it reflects the absolute rather than relative attitudes of respondents. The scale is thus able to indicate the intensity of people's attitudes and any change in this intensity should the study be replicated. On the other hand, the scale is difficult to construct, and a major criticism is that judges and respondents may assess the importance of a particular statement differently and, therefore, the respondents' attitudes might not be reflected.

SAMPLING

Sampling, therefore, is the process of selecting a few (a sample) from a bigger group (the **sampling population**) to become the basis for estimating or predicting the prevalence of an unknown piece of information, situation or outcome regarding the bigger group. A sample is a subgroup of the population you are interested in. This process of selecting a sample from the total population has advantages and disadvantages. The advantages are that it saves time as well as financial and human resources. However, the disadvantage is that you *do not find out the information* about the population's characteristics of interest to you but *only estimate* or *predict* them. Hence, the possibility of an error in your estimation exists. Sampling, therefore, is a trade-off between certain benefits and disadvantages. While on the one hand you save time and resources, on the other hand you may compromise the level of accuracy in your findings. Through sampling you only make an estimate about the actual situation prevalent in the total population from which the sample is drawn. If you ascertain a piece of information from the total sampling population, and if your method of enquiry is correct, your findings should be reasonably accurate. However, if you select a sample and use this as the basis from which to estimate the situation in the total population, an error is possible. Tolerance of this possibility of error is an important consideration in selecting a sample.

Sampling terminology

Let us, again, consider the examples used above where our main aims are to find out the average age of the class, the average income of the families living in the city and the likely election outcome for a particular state or country. Let us assume that you adopt the sampling method – that is, you select a few students, families or electorates to achieve these aims. In this process there are a number of aspects: The class, families living in the city or electorates from which you select you select your sample are called the *population* or **study population**, and are usually denoted by the letter *N*. The small group of students, families or electors from whom you collect the required information to estimate the average age of the class, average income or the election outcome is called the **sample**.

The number of students, families or electors from whom you obtain the required information is called the **sample size** and is usually denoted by the letter *n*. The way you select students, families or electors is called the **sampling design** or **sampling strategy**. Each student, family or elector that becomes the basis for selecting your sample is called the **sampling unit** or **sampling element**. A list identifying each student, family or elector in the study population is called the **sampling frame**. If all elements in a sampling population cannot be individually identified, you cannot have a sampling frame for that study population. Your findings based on the information obtained from your respondents (sample) are called **sample statistics.** Your sample statistics become the basis of estimating the prevalence of the above characteristics in the study population. Your main aim is to find answers to your research questions in the study population, not in the sample you collected information from. From sample statistics we make an estimate of the answers to our research questions in the study population. The estimates arrived at from sample statistics are called *population parameters* or the **population mean**.

Factors affecting the inferences drawn from a sample

The above principles suggest that two factors may influence the degree of certainty about the inferences drawn from a sample:

1. **The size of the sample** – Findings based upon larger samples have more certainty than those based on smaller ones. As a rule, *the larger the sample size, the more accurate the findings*.

2. **The extent of variation in the sampling population** – The greater the variation in the study population with respect to the characteristics under study, for a given sample size, the greater the uncertainty. (In technical terms, the greater the standard deviation, the higher the standard error for a given sample size in your estimates.) If a population is homogeneous (uniform or similar) with respect to the characteristics under study, a small sample can provide a reasonably good estimate, but if it is heterogeneous (dissimilar or diversified), you need to select a larger sample

to obtain the same level of accuracy. Of course, if all the elements in a population are identical, then the selection of even one will provide an absolutely accurate estimate. As a rule, *the higher the variation with respect to the characteristics under study in the study population, the greater the uncertainty for a given sample size*.

Aims in selecting a sample

When you select a sample in quantitative studies you are primarily aiming to achieve maximum precision in your estimates within a given sample size, and avoid bias in the selection of your sample. Bias in the selection of a sample can occur if: sampling is done by a non-random method – that is, if the selection is consciously or unconsciously influenced by human choice; the sampling frame – list, index or other population records – which serves as the basis of selection, does not cover the sampling population accurately and completely; a section of a sampling population is impossible to find or refuses to co-operate.

TYPES OF SAMPLING

The various sampling strategies in quantitative research can be categorised as follows random/probability sampling designs; non-random/non-probability sampling designs selecting a predetermined sample size; 'mixed' sampling design. To understand these designs, we will discuss each type individually.

Random/probability sampling designs

For a design to be called **random sampling** or **probability sampling**, it is imperative that each element in the population has an *equal* and *independent* chance of selection in the sample. Equal implies that the probability of selection of each element in the population is the same; that is, the choice of an element in the sample is not influenced by other considerations such as personal preference. The concept of independence means that the choice of one element is not dependent upon the choice of another element in the sampling; that is, the selection or rejection of one element does not affect the inclusion or exclusion of another. To explain these concepts let us return to our example of the class. Suppose there are 80 students in the class. Assume 20 of these refuse to participate in your study. You want the entire population of 80 students in your study but, as 20 refuse to participate, you can only use a sample of 60 students. The 20 students who refuse to participate could have strong feelings about the issues you wish to explore, but your findings will not reflect their opinions. Their exclusion from your study means that each of the 80 students does not have an equal chance of selection. Therefore, your sample does not represent the total class. The same could apply to a community. In a community, in addition to the refusal to participate, let us assume that you are unable to identify all the residents living in the community. If a significant proportion of people cannot be included in the sampling population

because they either cannot be identified or refuse to participate, then any sample drawn will not give each element in the sampling population an equal chance of being selected in the sample. Hence, the sample will not be representative of the total community. To understand the concept of an *independent chance of selection*, let us assume that there are five students in the class who are extremely close friends. If one of them is selected but refuses to participate because the other four are not chosen, and you are therefore forced to select either the five or none, then your sample will not be considered an independent sample since the selection of one is dependent upon the selection of others. The same could happen in the community where a small group says that either all of them or none of them will participate in the study. In these situations where you are forced either to include or to exclude a part of the sampling population, the sample is not considered to be independent, and hence is not representative of the sampling population. However, if the number of refusals is fairly small, in practical terms, it should not make the sample non-representative. In practice there are always some people who do not want to participate in the study but you only need to worry if the number is significantly large. A sample can only be considered a random/probability sample (and therefore representative of the population under study) if both these conditions are met. Otherwise, bias can be introduced into the study.

There are two main advantages of random/probability samples:

1. As they represent the total sampling population, the inferences drawn from such samples can be generalised to the total sampling population.
2. Some statistical tests based upon the theory of probability can be applied only to data collected from random samples. Some of these tests are important for establishing conclusive correlations.

Methods of drawing a random sample

Of the methods that you can adopt to select a random sample the three most common are:

1. **The fishbowl draw** – if your total population is small, an easy procedure is to number each element using separate slips of paper for each element, put all the slips into a box and then pick them out one by one without looking, until the number of slips selected equals the sample size you decided upon. This method is used in some lotteries.
2. **Computer program** – there are a number of programs that can help you to select a random sample.
3. **A table of randomly generated numbers** – most books on research methodology and statistics include a table of randomly generated numbers. You can select your sample using these tables

There are three commonly used types of random sampling design.

1. **Simple random sampling (SRS)** – The most commonly used method of selecting a probability sample. In line with the definition of randomisation, whereby each element in the population is given an equal and independent chance of selection

2. **Stratified random sampling** – As discussed, the accuracy of your estimate largely depends on the extent of variability or heterogeneity of the study population with respect to the characteristics that have a strong correlation with what you are trying to ascertain (Principle 3). It follows, therefore, that if the heterogeneity in the population can be reduced by some means for a given sample size you can achieve greater accuracy in your estimate. Stratified random sampling is based upon this logic. In stratified random sampling the researcher attempts to stratify the population in such a way that the population within a stratum is homogeneous with respect to the characteristic on the basis of which it is being stratified. It is important that the characteristics chosen as the basis of stratification are clearly identifiable in the study population. For example, it is much easier to stratify a population on the basis of gender than on the basis of age, income or attitude. It is also important for the characteristic that becomes the basis of stratification to be related to the main variable that you are exploring. Once the sampling population has been separated into nonoverlapping groups, you select the required number of elements from each stratum, using the simple random sampling technique.

3. **Cluster sampling** – Simple random and stratified sampling techniques are based on a researcher's ability to identify each element in a population. It is easy to do this if the total sampling population is small, but if the population is large, as in the case of a city, state or country, it becomes difficult and expensive to identify each sampling unit. In such cases the use of cluster sampling is more appropriate. Cluster sampling is based on the ability of the researcher to divide the sampling population into groups (based upon visible or easily identifiable characteristics), called clusters, and then to select elements within each cluster, using the SRS technique. Clusters can be formed on the basis of geographical proximity or a common characteristic that has a correlation with the main variable of the study (as in stratified sampling). Depending on the level of clustering, sometimes sampling may be done at different levels.

Non-random/non-probability sampling designs in quantitative research

Non-probability sampling designs do not follow the theory of probability in the choice of elements from the sampling population. Non-probability sampling designs are used when the number of elements in a population is either unknown or cannot be individually identified. In such situations the selection of elements is dependent upon other considerations. There are five commonly used non-random designs, each based on a different consideration, which are commonly used in both qualitative and quantitative research.

These are:

1. **quota sampling**;
2. **accidental sampling**;
3. **judgemental sampling** or **purposive sampling**;
4. **expert sampling**;
5. **snowball sampling**.

What differentiates these designs being treated as quantitative or qualitative is the predetermined sample size. In quantitative research you use these designs to select a predetermined number of cases (sample size), whereas in qualitative research you do not decide the number of respondents in advance but continue to select additional cases till you reach the data saturation point. In addition, in qualitative research, you will predominantly use judgemental and accidental sampling strategies to select your respondents. Expert sampling is very similar to judgemental sampling except that in expert sampling the sampling population comprises experts in the field of enquiry. You can also use quota and snowball sampling in qualitative research but without having a predetermined number of cases in mind (sample size).

Quota sampling

The main consideration directing quota sampling is the researcher's ease of access to the sample population. In addition to convenience, you are guided by some visible characteristic, such as gender or race, of the study population that is of interest to you. The sample is selected from a location convenient to you as a researcher, and whenever a person with this visible relevant characteristic is seen that person is asked to participate in the study. The process continues until you have been able to contact the required number of respondents (quota).

Let us suppose that you want to select a sample of 20 male students in order to find out the average age of the male students in your class. You decide to stand at the entrance to the classroom, as this is convenient, and whenever a male student enters the classroom, you ask his age. This process continues until you have asked 20 students their age. Alternatively, you might want to find out about the attitudes of Aboriginal and Torres Strait Islander students towards the facilities provided to them in your university. You might stand at a convenient location and, whenever you see such a student, collect the required information through whatever method of data collection (such as interviewing, questionnaire) you have adopted for the study. The advantages of using this design are: it is the least expensive way of selecting a sample; you do not need any information, such as a sampling frame, the total number of elements, their location,

or other information about the sampling population; and it guarantees the inclusion of the type of people you need. The disadvantages are: as the resulting sample is not a probability one, the findings cannot be generalised to the total sampling population; and the most accessible individuals might have characteristics that are unique to them and hence might not be truly representative of the total sampling population. You can make your sample more representative of your study population by selecting it from various locations where people of interest to you are likely to be available.

Accidental sampling

Accidental sampling is also based upon convenience in accessing the sampling population. Whereas quota sampling attempts to include people possessing an obvious/visible characteristic, accidental sampling makes no such attempt. You stop collecting data when you reach the required number of respondents you decided to have in your sample.

This method of sampling is common among market research and newspaper reporters. It has more or less the same advantages and disadvantages as quota sampling but, in addition, as you are not guided by any obvious characteristics, some people contacted may not have the required information.

Judgemental or purposive sampling

The primary consideration in purposive sampling is your judgement as to who can provide the best information to achieve the objectives of your study. You as a researcher only go to those people who in your opinion are likely to have the required information and be willing to share it with you. This type of sampling is extremely useful when you want to construct a historical reality, describe a phenomenon or develop something about which only a little is known. This sampling strategy is more common in qualitative research, but when you use it in quantitative research you select a predetermined number of people who, in your judgement, are best positioned to provide you the needed information for your study.

Expert sampling

The only difference between judgemental sampling and expert sampling is that in the case of the former it is entirely your judgement as to the ability of the respondents to contribute to the study. But in the case of expert sampling, your respondents must be known experts in the field of interest to you. This is again used in both types of research but more so in qualitative research studies. When you use it in qualitative research, the number of people you talk to is dependent upon the data saturation point whereas in quantitative research you decide on the number of experts to be contacted without considering the saturation point. You first identify persons with

demonstrated or known expertise in an area of interest to you, seek their consent for participation, and then collect the information either individually or collectively in the
form of a group.

Snowball sampling

Snowball sampling is the process of selecting a sample using networks. To start with, a few individuals in a group or organisation are selected and the required information is collected from them. They are then asked to identify other people in the group or organisation, and the people selected by them become a part of the sample. Information is collected from them, and then these people are asked to identify other members of the group and, in turn, those identified become the basis of further data collection This process is continued until the required number or a **saturation point** has been reached, in terms of the information being sought. This sampling technique is useful if you know little about the group or organisation you wish to
study, as you need only to make contact with a few individuals, who can then direct you to the other members of the group. This method of selecting a sample is useful for studying communication patterns, decision making or diffusion of knowledge within a group. There are disadvantages to this technique, however. The choice of the entire sample rests upon the choice of individuals at the first stage. If they belong to a particular faction or have strong biases, the study may be biased. Also, it is difficult to use this technique when the sample becomes fairly large.

The calculation of sample size

Students and others often ask: ‘How big a sample should I select?’, ‘What should be my sample size?’ and ‘How many cases do I need?’ Basically, it depends on what you want to do with the findings and what type of relationships you want to establish. Your purpose in undertaking research is the main determinant of the level of accuracy required in the results, and this level of accuracy is an important determinant of sample size. However, in qualitative research, as the main focus is to explore or describe a situation, issue, process or phenomenon, the question of sample size is less important. You usually collect data till you think you have reached saturation point in terms of discovering new information. Once you think you are not getting much new data from your respondents, you stop collecting further information. Of course, the diversity or heterogeneity in what you are trying to find out about plays an important role in how fast you will reach saturation point. And remember: the greater the heterogeneity or diversity in what you are trying to find out about, the greater the number of respondents you need to contact to reach saturation point. In determining the size of your sample for quantitative studies and in particular for cause-and-effect studies, you need to consider the following:

- At what *level of confidence* do you want to test your results, findings or hypotheses?
- With what *degree of accuracy* do you wish to estimate the population parameters?
- What is the estimated *level of variation* (standard deviation), with respect to the main variable you are studying, in the study population?

Answering these questions is necessary regardless of whether you intend to determine the sample size yourself or have an expert do it for you. The size of the sample is important for testing a hypothesis or establishing an association, but for other studies the general rule is: *the larger the sample size, the more accurate your estimates*. In practice, your budget determines the size of your sample. Your skills in selecting a sample, within the constraints of your budget, lie in the way you select your elements so that they effectively and adequately represent your sampling population.

The formula (from statistics) for determining the confidence limits is

$$\hat{x} = \bar{x} \pm (t_{0.05}) \frac{\sigma}{\sqrt{\eta}}$$

where
$\hat{x}$ = estimated value of the population mean
$\bar{x}$ = average age calculated from the sample
$t_{0.05}$ = value of t at 95 per cent confidence level

$\sigma/\sqrt{\eta}$ = standard error
σ = standard deviation
η = sample size
$\sqrt{}$ = square root

STAKEHOLDERS IN RESEARCH

There are many **stakeholders in research**, whether it is quantitative or qualitative. It is important to look at ethical issues in relation to each of them. The various stakeholders in a research activity are:

1. the research participants or subjects;
2. the researcher;
3. the funding body.

Ethical issues to consider concerning research participants

There are many ethical issues to consider in relation to the participants of a research activity.

Collecting information

One could ask: why should a respondent give any information to a researcher? What right does a researcher have to knock at someone's door or to send out a questionnaire? Is it ethical to

disturb an individual, even if you ask permission before asking questions? Why should a person give you his/her time? Your request for information may create anxiety or put pressure on a respondent. Is this ethical?

But the above questions display a naive attitude. The author believes that if this attitude had been adopted, there would have been no progress in the world. Research is required in order to improve conditions. Provided any piece of research is likely to help society directly or indirectly, it is acceptable to ask questions, if you first obtain the respondents' **informed consent**. Before you begin collecting information, you must consider the relevance and usefulness of the research you are undertaking and be able to convince others of this also. If you cannot justify the relevance of the research you are conducting, you are wasting your respondents' time, which is unethical.

Seeking consent

In every discipline it is considered unethical to collect information without the knowledge of participants, and their expressed willingness and informed consent. Seeking informed consent 'is probably the most common method in medical and social research' (Bailey 1978: 384). Informed consent implies that subjects are made adequately aware of the type of information you want from them, why the information is being sought, what purpose it will be put to, how they are expected to participate in the study, and how it will directly or indirectly affect them. It is important that the consent should also be voluntary and without pressure of any kind. Schinke and Gilchrist write: Under standards set by the National Commission for the Protection of Human Subjects, all informed-consent procedures must meet three criteria: participants must be competent to give consent; sufficient information must be provided to allow for a reasoned decision; and consent must be voluntary and uncoerced. (1993: 83)

Competency, according to Schinke and Gilchrist, 'is concerned with the legal and mental capacities of participants to give permission' (1993: 83). For example, some very old people, those suffering from conditions that exclude them from making informed decisions, people in crisis, people who cannot speak the language in which the research is being carried out, people who are dependent upon you for a service and children are not considered to be competent.

Providing incentives

Is it ethical to provide incentives to respondents to share information with you? Some researchers provide incentives to participants for their participation in a study, feeling this to be quite proper as participants are giving their time. Others think that the offering of inducements is unethical. In the author's experience most people do not participate in a study because of incentives, but

because they realise the importance of the study. Therefore, giving a small gift after having obtained your information, as a token of appreciation, is in the author's opinion not unethical. However, giving a present before data collection is unethical.

Seeking sensitive information

Information sought can pose an ethical dilemma in research. Certain types of information can be regarded as sensitive or confidential by some people and thus an invasion of privacy. Asking for this information may upset or embarrass a respondent. However, if you do not ask for the information, it may not be possible to pursue your interest in the area and contribute to the existing body of knowledge. For most people, questions on sexual behaviour, drug use and shoplifting are intrusive. Even questions on marital status, income and age may be considered to be an invasion of privacy by some. In collecting data you need to be careful about the sensitivities of your respondents. The dilemma you face as a researcher is whether you should ask sensitive and intrusive questions. In the author's opinion it is not unethical to ask such questions provided that you clearly and frankly tell your respondents the type of information you are going to ask, and give them sufficient time to decide if they want to share the information with you, without any major inducement.

The possibility of causing harm to participants

Is the research going to harm participants in any way? Harm includes:

not only hazardous medical experiments but also any social research that might involve such things as discomfort, anxiety, harassment, invasion of privacy, or demeaning or dehumanising procedures. (Bailey 1978: 384) When you collect data from respondents or involve subjects in an experiment, you need to examine carefully whether their involvement is likely to harm them in any way. If it is, you must make sure that the risk is minimal. Minimum risk means that the extent of harm or discomfort in the research is not greater than that ordinarily encountered in daily life. It is unethical if the way you seek information creates anxiety or harassment, and if you think it may happen, you need to take steps to prevent this.

Maintaining confidentiality

Sharing information about a respondent with others for purposes other than research is unethical. Sometimes you need to identify your study population to put your findings into context. In such a situation you need to make sure that at least the information provided by respondents is kept anonymous. It is unethical to identify an individual respondent and the information provided by him/her. Therefore, you need to ensure that after the information has been collected, its source cannot be identified. In certain types of study you might need to visit respondents repeatedly, in which case you will have to identify them until the completion of your visits. In such situations

you need to be extra careful that others do not have access to the information. It is unethical to be negligent in not protecting the confidentiality and anonymity of the information gathered from your respondents. If you are doing research for someone else, you need to make sure that confidentiality is maintained by this party as well.

Ethical issues to consider relating to the researcher

Avoiding bias

Bias on the part of the researcher is unethical. Bias is different from subjectivity. Subjectivity, as mentioned earlier, is related to your educational background, training and competence in research, and your philosophical perspective. Bias is a deliberate attempt either to hide what you have found in your study, or to highlight something disproportionately to its true existence. It is absolutely unethical to introduce bias into a research activity. If you are unable to control your bias, you should not be engaging in the research. Remember, it is the bias that is unethical and not the subjectivity.

Provision or deprivation of a treatment

Both the provision and deprivation of a treatment may pose an ethical dilemma for you as a researcher. When testing an intervention or a treatment, a researcher usually adopts a control experiment design. In such studies, is it ethical to provide a study population with an intervention or treatment that has not yet been conclusively proven effective or beneficial? But if you do not test a treatment/intervention, how can you prove or disprove its effectiveness or benefits? On the other hand, you are providing an intervention that may not be effective. Is this ethical? Is it ethical to deprive the control group of a treatment even if it may prove to be only slightly effective? And beyond the issue of control groups, is it ethical to deprive people who are struggling for life of the possible benefit, however small, which may be derived from a drug that is only under trial? As a researcher you need to be aware of these ethical issues. There are arguments and counter-arguments about these issues. However, it is usually accepted that deprivation of a trial treatment to a control group is not unethical as, in the absence of this, a study can never establish the effectiveness of a treatment which may deprive many others of its possible benefits. This deprivation of the possible benefits, on the other hand, is considered by some as unethical. There are no simple answers to these dilemmas. Ensuring informed consent, ‘minimum risk’ and frank discussion as to the implications of participation in the study may help to resolve some of these ethical issues.

Using inappropriate research methodology

A researcher has an obligation to use appropriate methodology, within his/her knowledge base, in conducting a study. It is unethical to use deliberately a method or procedure you know to be

inappropriate to prove or disprove something that you want to, such as by selecting a highly biased sample, using an invalid instrument or by drawing wrong conclusions.

Incorrect reporting

To report the findings in a way that changes or slants them to serve your own or someone else's interest is unethical. Correct and unbiased reporting of the findings are important characteristics of ethical research practice.

Inappropriate use of the information

How will the information obtained from respondents be used by the researcher? The use of information in a way that directly or indirectly affects respondents adversely is unethical. Can information be used adversely to affect the study population? If so, how can the study population be protected? As a researcher you need to consider and resolve these issues. Sometimes it is possible to harm individuals in the process of achieving benefits for organisations. An example would be a study to examine the feasibility of restructuring an organisation. Restructuring may be beneficial to the organisation as a whole but may be harmful to some individuals. Should you ask respondents for information that is likely to be used against them? If you do, the information may be used against them, and if you do not, the organisation may not be able to derive the benefits of restructuring. In the author's opinion, it is ethical to ask questions provided you tell respondents of the potential use of the information, including the possibility of its being used against some of them, and you let them decide if they want to participate. Some may participate for the betterment of the organisation even though it may harm them and others may decide against it. However, to identify either of them is unethical in research.

Ethical issues regarding the sponsoring organisation

Restrictions imposed by the sponsoring organisation

Most research in the social sciences is carried out using funds provided by sponsoring organisations for a specific purpose. The funds may be given to develop a programme or evaluate it; to examine its effectiveness and efficiency; to study the impact of a policy; to test a product; to study the behaviour of a group or community; or to study a phenomenon, issue or attitude. Sometimes there may be direct or indirect controls exercised by sponsoring organisations. They may select the methodology, prohibit the publication of 'what was found' or impose other restrictions on the research that may stand in the way of obtaining and disseminating accurate information. Both the imposition and acceptance of these controls and restrictions are unethical, as they constitute interference and could amount to the sponsoring organisation tailoring research findings to meet its vested interests.

The misuse of information

How is the sponsoring body going to use the information? How is this likely to affect the study population? Sometimes sponsoring organisations use research as a pretext for obtaining management's agenda. It is unethical to let your research be used as a reason for justifying management decisions when the research findings do not support them. However, it is recognised that it may be extremely difficult or even impossible for a researcher to prevent this from happening.

MAJOR APPROACHES TO INFORMATION GATHERING

There are two major approaches to gathering information about a situation, person, problem or phenomenon. When you undertake a research study, in most situations, you need to collect the required information; however, sometimes the information required is already available and need only be extracted. Based upon these broad approaches to information gathering, data can be categorised as:

primary data;

secondary data.

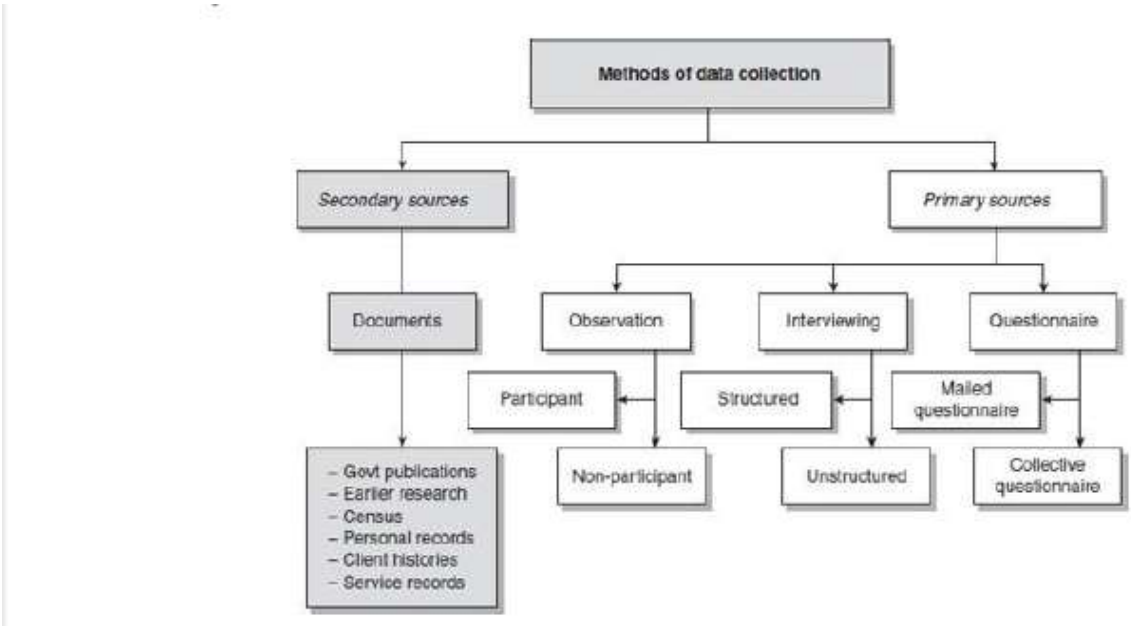

Figure 5 Methods of Data Collection

Collecting data using primary sources

Several methods can be used to collect primary data. The choice of a method depends upon the purpose of the study, the resources available and the skills of the researcher. There are times

when the method most appropriate to achieve the objectives of a study cannot be used because of constraints such as a lack of resources and/or required skills. In such situations you should be aware of the problems that these limitations impose on the quality of the data. In selecting a method of data collection, the socioeconomic–demographic characteristics of the study population play an important role: you should know as much as possible about characteristics such as educational level, age structure, socioeconomic status and ethnic background. If possible, it is helpful to know the study population's interest in, and attitude towards, participation in the study. Some populations, for a number of reasons, may not feel either at ease with a particular method of data collection (such as being interviewed) or comfortable with expressing opinions in a questionnaire. Furthermore, people with little education may respond differently to certain methods of data collection compared with people with more education. Another important determinant of the quality of your data is the way the purpose and relevance of the study are explained to potential respondents. Whatever method of data collection is used, make sure that respondents clearly understand the purpose and relevance of the study. This is particularly important when you use a questionnaire to collect data, because in an interview situation you can answer a respondent's questions but in a questionnaire you will not have this opportunity. In the following sections each method of data collection is discussed from the point of view of its applicability and suitability to a situation, and the problems and limitations associated with it.

Observation

Observation is one way to collect primary data. Observation is a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place. There are many situations in which observation is the most appropriate method of data collection; for example, when you want to learn about the interaction in a group, study the dietary patterns of a population, ascertain the functions performed by a worker, or study the behaviour or personality traits of an individual. It is also appropriate in situations where full and/or accurate information cannot be elicited by questioning, because respondents either are not co-operative or are unaware of the answers because it is difficult for them to detach themselves from the interaction. In summary, when you are more interested in the behaviour than in the perceptions of individuals, or when subjects are so involved in the interaction that they are unable to provide objective information about it, observation is the best approach to collect the required information.

Types of observation

There are two types of observation:

1. participant observation;

2. non-participant observation.

Participant observation is when you, as a researcher, participate in the activities of the group being observed in the same manner as its members, with or without their knowing that they are being bserved. For example, you might want to examine the reactions of the general population towards people in wheelchairs. You can study their reactions by sitting in a wheelchair yourself. Or you might want to study the life of prisoners and pretend to be a prisoner in order to do this.

Non-participant observation, on the other hand, is when you, as a researcher, do not get involved in the activities of the group but remain a passive observer, watching and listening to its activities and drawing conclusions from this. For example, you might want to study the functions carried out by nurses in a hospital. As an observer, you could watch, follow and record the activities as they are performed. After making a number of observations, conclusions could be drawn about the functions nurses carry out in the hospital. Any occupational group in any setting can be observed in the same manner.

Problems with using observation as a method of data collection

The use of observation as a method of data collection may suffer from a number of problems, which is not to suggest that all or any of these necessarily prevail in every situation. But as a beginner you should be aware of these potential problems: When individuals or groups become aware that they are being observed, they may change their behaviour. Depending upon the situation, this change could be positive or negative – it may increase or decrease, for example, their productivity – and may occur for a number of reasons. When a change in the behaviour of persons or groups is attributed to their being observed it is known as the **Hawthorne effect**. The use of observation in such a situation may introduce distortion: what is observed may not represent their normal behaviour. There is always the possibility of observer bias. If an observer is not impartial, s/he can easily introduce bias and there is no easy way to verify the observations and the inferences drawn from them. The interpretations drawn from observations may vary from observer to observer. There is the possibility of incomplete observation and/or recording, which varies with the method of recording. An observer may watch keenly but at the expense of detailed recording. The opposite problem may occur when the observer takes detailed notes but in doing so misses some of the interaction.

Situations in which observations can be made

Observations can be made under two conditions:

1. natural;
2. controlled.

Observing a group in its natural operation rather than intervening in its activities is classified as observation under natural conditions. Introducing a stimulus to the group for it to react to and observing the reaction is called controlled observation.

Recording observations

There are many ways of recording observations. The selection of a method of recording depends upon the purpose of the observation. The way an observation is recorded also determines whether it is a quantitative or qualitative study. Narrative and descriptive recording is mainly used in qualitative research but if you are doing a quantitative study you would record an observation in categorical form or on a numerical scale. Keep in mind that each method of recording an observation has its advantages and disadvantages:

Narrative recording – In this form of recording the researcher records a description of the interaction in his/her own words. Such a type of recording clearly falls in the domain of qualitative research. Usually, a researcher makes brief notes while observing the interaction and then soon after completing the observation makes detailed notes in narrative form. In addition, some researchers may interpret the interaction and draw conclusions from it. The biggest advantage of narrative recording is that it provides a deeper insight into the interaction. However, a disadvantage is that an observer may be biased in his/her observation and, therefore, the interpretations and conclusions drawn from the observation may also be biased. In addition, interpretations and conclusions drawn are bound to be subjective reflecting the researcher's perspectives. Also, if a researcher's attention is on observing, s/he might forget to record an important piece of interaction and, obviously, in the process of recording, part of the interaction may be missed. Hence, there is always the possibility of incomplete recording and/or observation. In addition, when there are different observers the comparability of narrative recording can be a problem.

Using scales – At times some observers may prefer to develop a scale in order to rate various aspects of the interaction or phenomenon. The recording is done on a scale developed by the observer/researcher. A scale may be one-, two- or three-directional, depending upon the purpose of the observation. The main advantage of using scales in recording observation is that you do not need to spend time on taking detailed notes and can thus concentrate on observation. On the

other hand, the problems with using a scale are that it does not provide specific and in-depth information about the interaction. In addition, it may suffer from any of the following errors: Unless the observer is extremely confident of his/her ability to assess an interaction, s/he may tend to avoid the extreme positions on the scale, using mostly the central part. The error that this tendency creates is called the **error of central tendency**. Some observers may prefer certain sections of the scale in the same way that some teachers are strict markers and others are not. When observers have a tendency to use a particular part of the scale in recording an interaction, this phenomenon is known as the **elevation effect**.

Another type of error that may be introduced is when the way an observer rates an individual on one aspect of the interaction influences the way s/he rates that individual on another aspect of the interaction. Again something similar to this can happen in teaching when a teacher's assessment of the performance of a student in one subject may influence his/her rating of that student's performance in another. This type of effect is known as the **halo effect**.

Categorical recording – Sometimes an observer may decide to record his/her observation using categories. The type and number of categories depend upon the type of interaction and the observer's choice about how to classify the observation. For example, passive/active (two categories); introvert/extrovert (two categories); always/sometimes/never (three categories); strongly agree/agree/uncertain/disagree/strongly disagree (five categories). The use of categories to record an observation may suffer from the same problems as those associated with scales.

Recording on electronic devices – Observation can also be recorded on videotape or other electronic devices and then analysed. The advantage of recording an interaction in this way is that the observer can see it a number of times before interpreting an interaction or drawing any conclusions from it and can also invite other professionals to view the interaction in order to arrive at more objective conclusions. However, one of the disadvantages is that some people may feel uncomfortable or may behave differently before a camera. Therefore, the interaction may not be a true reflection of the situation. The choice of a particular method for recording your observation is dependent upon the purpose of the observation, the complexity of the interaction and the type of population being observed. It is important to consider these factors before deciding upon the method for recording your observation.

The interview

Interviewing is a commonly used method of collecting information from people. In many walks of life we collect information through different forms of interaction with others. There are many definitions of interviews. According to Monette et al. (1986: 156), 'an interview involves an interviewer reading questions to respondents and recording their answers'. According to Burns

(1997: 329), ‘an interview is a verbal interchange, often face to face, though the telephone may be used, in which an interviewer tries to elicit information, beliefs or opinions from another person’. Any person-to-person interaction, either face to face or otherwise, between two or more individuals with a specific purpose in mind is called an interview. When interviewing a respondent, you, as a researcher, have the freedom to decide the format and content of questions to be asked of your respondents, select the wording of your questions, decide the way you want to ask them and choose the order in which they are to be asked. This process of asking questions can be either very flexible, where you as the interviewer have the freedom to think about and formulate questions as they come to your mind around the issue being investigated, or inflexible, where you have to keep strictly to the questions decided beforehand – including their wording, sequence and the manner in which they are asked.

Unstructured Interviews

The strength of *unstructured interviews* is the almost complete freedom they provide in terms of content and structure. You are free to order these in whatever sequence you wish. You also have complete freedom in terms of the wording you use and the way you explain questions to your respondents. You may formulate questions and raise issues on the spur of the moment, depending upon what occurs to you in the context of the discussion. Unstructured interviews are prevalent in both quantitative and qualitative research. The difference is in how information obtained through them in response to your questions is likely to be used. In quantitative research you develop response categorisations from responses which are then coded and quantified. In qualitative research the responses are used as descriptors, often in verbatim form, and can be integrated with your arguments, flow of writing and sequence of logic. As unstructured interviews are dominantly used in qualitative research, they are described in greater detail under ‘Methods of data collection in qualitative research’ later in this chapter.

Structured interviews

In a *structured interview* the researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule. An **interview schedule** is a written list of questions, open ended or closed, prepared for use by an interviewer in a person-to-person interaction (this may be face to face, by telephone or by other electronic media). Note that an interview schedule is a research tool/instrument for collecting data, whereas interviewing is a method of data collection. One of the main advantages of the structured interview is that it provides uniform information, which assures the comparability of data. Structured interviewing requires fewer interviewing skills than does unstructured interviewing.

The questionnaire

A **questionnaire** is a written list of questions, the answers to which are recorded by respondents. In a questionnaire respondent read the questions, interpret what is expected and then write down the answers. The only difference between an interview schedule and a questionnaire is that in the former it is the interviewer who asks the questions (and if necessary, explains them) and records the respondent's replies on an interview schedule, and in the latter replies are recorded by the respondents themselves. This distinction is important in accounting for the respective strengths and weaknesses of the two methods.

In the case of a questionnaire, as there is no one to explain the meaning of questions to respondents, it is important that the questions are clear and easy to understand. Also, the layout of a questionnaire should be such that it is easy to read and pleasant to the eye, and the sequence of questions should be easy to follow. A questionnaire should be developed in an interactive style. This means respondents should feel as if someone is talking to them. In a questionnaire, a sensitive question or a question that respondents may feel hesitant about answering should be prefaced by an interactive statement explaining the relevance of the question. It is a good idea to use a different font for these statements to distinguish them from the actual questions.

Ways of administering a questionnaire

A questionnaire can be administered in different ways.

The mailed questionnaire – The most common approach to collecting information is to send the questionnaire to prospective respondents by mail. Obviously this approach presupposes that you have access to their addresses. Usually, it is a good idea to send a prepaid, self-addressed envelope with the questionnaire as this might increase the response rate. A mailed questionnaire *must* be accompanied by a covering letter (see below for details). One of the major problems with this method is the low response rate. In the case of an extremely low response rate, the findings have very limited applicability to the population studied.

Collective administration – One of the best ways of administering a questionnaire is to obtain a captive audience such as students in a classroom, people attending a function, participants in a programme or people assembled in one place. This ensures a very high response rate as you will find few people refuse to participate in your study. Also, as you have personal contact with the study population, you can explain the purpose, relevance and importance of the study and can clarify any questions that respondents may have. The author's advice is that if you have a captive audience for your study, don't miss the opportunity – it is the quickest way of collecting data, ensures a very high response rate and saves you money on postage.

Administration in a public place – Sometimes you can administer a questionnaire in a public place such as a shopping centre, health centre, hospital, school or pub. Of course this depends upon the type of study population you are looking for and where it is likely to be found. Usually the purpose of the study is explained to potential respondents as they approach and their participation in the study is requested. Apart from being slightly more time consuming, this method has all theadvantages of administering a questionnaire collectively.

Choosing between an interview and a questionnaire

The choice between a questionnaire and an interview schedule is important and should be considered thoroughly as the strengths and weaknesses of the two methods can affect the validity of the findings. The nature of the investigation and the socioeconomic–demographic characteristics of the study population are central in this choice. The selection between an interview schedule and a questionnaire should be based upon the following criteria:

The nature of the investigation – If the study is about issues that respondents may feel reluctant to discuss with an investigator, a questionnaire may be the better choice as it ensures anonymity. This may be the case with studies on drug use, sexuality, indulgence in criminal activities and personal finances. However, there are situations where better information about sensitive issues can be obtained by interviewing respondents. It depends on the type of study population and the skills of the interviewer.

The geographical distribution of the study population – If potential respondents are scattered over a wide geographical area, you have no choice but to use a questionnaire, as interviewing in these circumstances would be extremely expensive.

The type of study population – If the study population is illiterate, very young or very old, or handicapped, there may be no option but to interview respondents.

Advantages of a questionnaire

A questionnaire has several advantages:

It is less expensive. As you do not interview respondents, you save time, and human and financial resources. The use of a questionnaire, therefore, is comparatively convenient and inexpensive. Particularly when it is administered collectively to a study population, it is an extremely inexpensive method of data collection.

It offers greater anonymity. As there is no face-to-face interaction between respondents and interviewer, this method provides greater anonymity. In some situations where sensitive questions are asked it helps to increase the likelihood of obtaining accurate information.

Disadvantages of a questionnaire

Although a questionnaire has several disadvantages, it is important to note that not all data collection using this method has these disadvantages. The prevalence of a disadvantage depends on a number of factors, but you need to be aware of them to understand their possible bearing on the quality of the data.

These are:

Application is limited. One main disadvantage is that application is limited to a study population that can read and write. It cannot be used on a population that is illiterate, very young, very old or handicapped.

Response rate is low. Questionnaires are notorious for their low response rates; that is, people fail to return them. If you plan to use a questionnaire, keep in mind that because not everyone will return their questionnaire, your sample size will in effect be reduced. The response rate depends upon a number of factors: the interest of the sample in the topic of the study; the layout and length of the questionnaire; the quality of the letter explaining the purpose and relevance of the study; and the methodology used to deliver the questionnaire. You should consider yourself lucky to obtain a 50 per cent response rate and sometimes it may be as low as 20 per cent. However, as mentioned, the response rate is not a problem when a questionnaire is administered in a collective situation.

There is a self-selecting bias. Not everyone who receives a questionnaire returns it, so there is a self-selecting bias. Those who return their questionnaire may have attitudes, attributes or motivations that are different from those who do not. Hence, if the response rate is very low, the findings may not be representative of the total study population.

Opportunity to clarify issues is lacking. If, for any reason, respondents do not understand some questions, there is almost no opportunity for them to have the meaning clarified unless they getin touch with you – the researcher (which does not happen often). If different respondents interpret questions differently, this will affect the quality of the information provided.

Spontaneous responses are not allowed for. Mailed questionnaires are inappropriate when spontaneous responses are required, as a questionnaire gives respondents time to reflect before answering.

The response to a question may be influenced by the response to other questions. As respondents can read all the questions before answering (which usually happens), the way they answer a particular question may be affected by their knowledge of other questions.

It is possible to consult others. With mailed questionnaires respondents may consult other people before responding. In situations where an investigator wants to find out only the study

population's opinions, this method may be inappropriate, though requesting respondents to express their own opinion may help.

A response cannot be supplemented with other information. An interview can sometimes be supplemented with information from other methods of data collection such as observation. However, a questionnaire lacks this advantage.

Advantages of the interview

The interview is more appropriate for complex situations. It is the most appropriate approach for studying complex and sensitive areas as the interviewer has the opportunity to prepare a respondent before asking sensitive questions and to explain complex ones to respondents in person.

It is useful for collecting in-depth information. In an interview situation it is possible for an investigator to obtain in-depth information by probing. Hence, in situations where in-depth information is required, interviewing is the preferred method of data collection.

Information can be supplemented. An interviewer is able to supplement information obtained from responses with those gained from observation of non-verbal reactions.

Questions can be explained. It is less likely that a question will be misunderstood as the interviewer can either repeat a question or put it in a form that is understood by the respondent.

Interviewing has a wider application. An interview can be used with almost any type of population: children, the handicapped, illiterate or very old.

Disadvantages of the interview

Interviewing is time consuming and expensive. This is especially so when potential respondents are scattered over a wide geographical area. However, if you have a situation such as an office, a hospital or an agency where potential respondents come to obtain a service, interviewing them in that setting may be less expensive and less time consuming.

The quality of data depends upon the quality of the interaction. In an interview the quality of interaction between an interviewer and interviewee is likely to affect the quality of the information obtained. Also, because the interaction in each interview is unique, the quality of the responses obtained from different interviews may vary significantly.

The quality of data depends upon the quality of the interviewer. In an interview situation the quality of the data generated is affected by the experience, skills and commitment of the interviewer.

The quality of data may vary when many interviewers are used. Use of multiple interviewers

may magnify the problems identified in the two previous points.

The researcher may introduce his/her bias. Researcher bias in the framing of questions and the interpretation of responses is always possible. If the interviews are conducted by a person or persons, paid or voluntary, other than the researcher, it is also possible that they may exhibit bias in the way they interpret responses, select response categories or choose words to summarise respondents' expressed opinions

Advantages and disadvantages of open-ended questions

Open-ended questions provide in-depth information if used in an interview by an experienced interviewer. In a questionnaire, open-ended questions can provide a wealth of information provided respondents feel comfortable about expressing their opinions and are fluent in the language used. On the other hand, analysis of open-ended questions is more difficult. The researcher usually needs to go through another process – **content analysis** – in order to classify the data.

In a questionnaire, open-ended questions provide respondents with the opportunity to express themselves freely, resulting in a greater variety of information. Thus respondents are not 'conditioned' by having to select answers from a list. The disadvantage of free choice is that, in a questionnaire, some respondents may not be able to express themselves, and so information can be lost.

As open-ended questions allow respondents to express themselves freely, they virtually eliminate the possibility of investigator bias (investigator bias is introduced through the response pattern presented to respondents). On the other hand, there is a greater chance of interviewer bias in open ended questions.

Advantages and disadvantages of closed questions

One of the main disadvantages of closed questions is that the information obtained through them lacks depth and variety. There is a greater possibility of investigator bias because the researcher may list only the response patterns that s/he is interested in or those that come to mind. Even if the category of 'other' is offered, most people will usually select from the given responses, and so the findings may still reflect researcher bias. In a questionnaire, the given response pattern for a question could condition the thinking of respondents, and so the answers provided may not truly reflect respondents' opinions. Rather, they may reflect the extent of agreement or disagreement with the researcher's opinion or analysis of a situation. The ease of answering a ready-made list of responses may create a tendency among some respondents and interviewers

to tick a category or categories without thinking through the issue. Closed questions, because they provide 'ready-made' categories within which respondents reply to the questions asked by the researcher, help to ensure that the information needed by the researcher is obtained and the responses are also easier to analyse.

Formulating effective questions

The wording and tone of your questions are important because the information and its quality largely depend upon these factors. It is therefore important to be careful about the way you formulate questions.

The following are some considerations to keep in mind when formulating questions:

Always use simple and everyday language. Your respondents may not be highly educated, and even if they are they still may not know some of the 'simple' technical jargon that you are used to. Particularly in a questionnaire, take extra care to use words that your respondents will understand as you will have no opportunity to explain questions to them. A pre-test should show you what is and what is not understood by your respondents. For example: Is anyone in your family a *dipsomaniac*? (Bailey 1978: 100)

In this question many respondents, even some who are well educated, will not understand 'dipsomaniac' and, hence, they either do not answer or answer the question without understanding.

Do not use ambiguous questions. An **ambiguous question** is one that contains more than one meaning and that can be interpreted differently by different respondents. This will result in different answers, making it difficult, if not impossible, to draw any valid conclusions from the information. Thefollowing questions highlight the problem:

Is your work made difficult because you are expecting a baby? (Moser & Kalton 1989: 323) Yes No In the survey all women were asked this question. Those women who were not pregnant ticked 'No', meaning no they were not pregnant, and those who were pregnant and who ticked 'No' meant pregnancy had not made their work difficult. The question has other ambiguities As well: it does not specify the type of work and the stage of pregnancy. Are you satisfied with your canteen? (Moser & Kalton 1989: 319)

This question is also ambiguous as it does not ask respondents to indicate the aspects of the canteen with which they may be satisfied or dissatisfied. Is it with the service, the prices, the physical facilities, the attitude of the staff or the quality of the meals? Respondents may have any one of these aspects in mind when they answer the question. Or the question should have been worded differently like, 'Are you, on the whole, satisfied with your canteen?'

Do not ask double-barrelled questions. A **double-barrelled question** is a question within a question. The main problem with this type of question is that one does not know which particular question a respondent has answered. Some respondents may answer both parts of the question and others may answer only one of them. How often and how much time do you spend on each visit?

This question was asked in a survey in Western Australia to ascertain the need for child-minding services in one of the hospitals. The question has two parts: how often do you visit and how much time is spent on each visit? In this type of question some respondents may answer the first part, whereas others may answer the second part and some may answer both parts. Incidentally, this question is also ambiguous in that it does not specify 'how often' in terms of a period of time. Is it in a week, a fortnight, a month or a year? Does your department have a special recruitment policy for racial minorities and women? (Bailey 1978: 97). This question is double barrelled in that it asks respondents to indicate whether their office has a special recruitment policy for two population groups: racial minorities and women. A 'yes' response
does not necessarily mean that the office has a special recruitment policy for both groups.

Do not ask leading questions. A **leading question** is one which, by its contents, structure or wording, leads a respondent to answer in a certain direction. Such questions are judgemental and lead respondents to answer either positively or negatively. Unemployment is increasing, isn't it? Smoking is bad, isn't it? The first problem is that these are not questions but statements. Because the statements suggest that 'unemployment is increasing' and 'smoking is bad', respondents may feel that to disagree with them is to be in the wrong, especially if they feel that the researcher is an authority and that if s/he is saying that 'unemployment is increasing' or 'smoking is bad', must be so. The feeling that there is a 'right' answer can 'force' people to respond in a way that is contrary to their true position.

Do not ask questions that are based on presumptions. In such questions the researcher assumes that respondents fit into a particular category and seeks information based upon that assumption. How many cigarettes do you smoke in a day? (Moser & Kalton 1989: 325) questions were asked without ascertaining whether or not respondents were smokers. In situations like this it is important to ascertain first whether or not a respondent fits into the category about which you are enquiring.

Methods of data collection in qualitative research

To draw a clear distinction between quantitative and qualitative methods of data collection is both difficult and inappropriate because of the overlap between them. The difference between

them mainly lies in the manner in which a method is applied in an actual data collection situation. Use of these methods in quantitative research demands standardisation of questions to be asked of the respondents, a rigid adherence to their structure and order, an adoption of a process that is tested and predetermined, and making sure of the validity and reliability of the process as well as the questions. However, the methods of data collection in qualitative research follow a convention which is almost opposite to quantitative research. The wording, order and format of these questions are neither predetermined nor standardised. Qualitative methods are characterised by flexibility and freedom in terms of structure and order given to the researcher.

As mentioned in the previous chapter, most qualitative study designs are method based: that is, the method of data collection seems to determine the design. In some situations it becomes difficult to separate a study design from the method of data collection. For example, in-depth interviewing, narratives and oral history are both designs and methods of data collection. This may confuse some but here they are detailed as methods and not designs.

There are three main methods of data collection in qualitative research:

1. unstructured interviews;
2. participant observation;
3. secondary sources.

Participant observation has been adequately covered earlier in this chapter and secondary sources will be covered in a later section, so at this point we will focus on unstructured interviews, which are by far the most commonly used method of data collection in qualitative research.Flexibility, freedom and spontaneity in contents and structure underpin an interaction in all types of unstructured interview. This interaction can be at a one-to-one (researcher and a respondent) or a group (researcher and a group of respondents) level. There are several types of unstructured interview that are prevalent in qualitative research, for example *in-depth interviewing, focus group interviewing, narratives* and *oral histories*. Below is a brief description of each of them. For a detailed understanding readers should consult the relevant references listed in the Bibliography.

In-depth interviews

The theoretical roots of **in-depth interviewing** are in what is known as the interpretive tradition. According to Taylor and Bogdan, in-depth interviewing is ‘repeated face-to-face encounters between the researcher and informants directed towards understanding informants’ perspectives on their lives, experiences, or situations as expressed in their own words’ (1998: 77). This definition underlines two essential characteristics of in-depth interviewing: (1) it involves face-to-face, repeated interaction between the researcher and his/her informant(s); and (2) it seeks to

understand the latter's perspectives. Because this method involves repeated contacts and hence an extended length of time spent with an informant, it is assumed that the rapport between researcher and informant will be enhanced, and that the corresponding understanding and confidence between the two will lead to in-depth and accurate information.

Focus group interviews

The only difference between a focus group interview and an in-depth interview is that the former is undertaken with a group and the latter with an individual. In a focus group interview, you explore the perceptions, experiences and understandings of a group of people who have some experience in common with regard to a situation or event. For example, you may explore with relevant groups such issues as domestic violence, physical disability or refugees. In focus group interviews, broad discussion topics are developed beforehand, either by the researcher or by the group. These provide a broad frame for discussions which follow. The specific discussion points emerge as a part of the discussion. Members of a focus group express their opinions while discussing these issues. You, as a researcher, need to ensure that whatever is expressed or discussed is recorded accurately. Use the method of recording that suits you the best. You may audiotape discussions, employ someone else to record them or record them yourself immediately after each session. If you are taking your own notes during discussions, you need to be careful not to lose something of importance because of your involvement in discussions. You can and should take your write-up on discussions back to your focus group for correction, verification and confirmation.

Narratives

The narrative technique of gathering information has even less structure than the focus group. **Narratives** have almost no predetermined contents except that the researcher seeks to hear a person's retelling of an incident or happening in his/her life. Essentially, the person tells his/her story about an incident or situation and you, as the researcher, listen passively. Occasionally, you encourage the individual by using active listening techniques; that is, you say words such as 'uh huh', 'mmmm', 'yeah', 'right' and nod as appropriate. Basically, you let the person talk freely and without interrupting. Narratives are a very powerful method of data collection for situations which are sensitive in nature. For example, you may want to find out about the impact of child sexual abuse on people who have gone through such an experience. You, as a researcher, ask these people to narrate their experiences and how they have been affected. Narratives may have a therapeutic impact; that is, sometimes simply telling their story may help a person to feel more at ease with the event. Some therapists specialise in narrative therapy. But here, we are concerned

with narratives as a method of data collection. As with focus group interviews, you need to choose the recording system that suits you the best. Having completed narrative sessions you need to write your detailed notes and give them back to the respondent to check for accuracy.

Oral histories

Oral histories, like narratives, involve the use of both passive and active listening. Oral histories, however, are more commonly used for learning about a historical event or episode that took place in the past or for gaining information about a cultural, custom or story that has been passed from generation to generation. Narratives are more about a person's personal experiences whereas historical, social or cultural events are the subjects of oral histories. Suppose you want to find out about the life after the Second World War in some regional town of Western Australia or about the living conditions of Aboriginal and Torres Strait Islander people in the 1960s. You would talk to persons who were alive during that period and ask them about life at that time. Data collection through unstructured interviewing is extremely useful in situations where either indepth information is needed or little is known about the area. The flexibility allowed to the interviewer in what s/he asks of a respondent is an asset as it can elicit extremely rich information. As it provides indepth information, this technique is used by many researchers for constructing a structured research instrument. On the other hand, since an unstructured interview does not list specific questions to be asked of respondents, the comparability of questions asked and responses obtained may become a problem. As the researcher gains experience during the interviews, the questions asked of respondents change; hence, the type of information obtained from those who are interviewed at the beginning may be markedly different from that obtained from those interviewed towards the end. Also, this freedom can introduce investigator bias into the study. Using an interview guide as a means of data collection requires much more skill on the part of the researcher than does using a structured interview.

Collecting data using secondary sources

So far we have discussed the primary sources of data collection where the required data was collected either by you or by someone else for the specific purpose you have in mind. There are occasions when your data have already been collected by someone else and you need only to extract the required information for the purpose of your study. Both qualitative and quantitative research studies use secondary sources as a method of data collection. In qualitative research you usually extract descriptive (historical and current) and narrative information and in quantitative research the information extracted is categorical or numerical. The following section provides some of the many secondary sources grouped into categories:

Government or semi-government publications – There are many government and semi-government organisations that collect data on a regular basis in a variety of areas and publish it for use by members of the public and interest groups. Some common examples are the census, vital statistics registration, labour force surveys, health reports, economic forecasts and demographic information.

Earlier research – For some topics, an enormous number of research studies that have already been done by others can provide you with the required information.

Personal records – Some people write historical and personal records (e.g. diaries) that may provide the information you need.

Mass media – Reports published in newspapers, in magazines, on the Internet, and so on, may be another good source of data.

Problems with using data from secondary sources

When using data from secondary sources you need to be careful as there may be certain problems with the availability, format and quality of data. The extent of these problems varies from source to source.

While using such data some issues you should keep in mind are:

Validity and reliability – The validity of information may vary markedly from source to source. For example, information obtained from a census is likely to be more valid and reliable than that obtained from most personal diaries.

Personal bias – The use of information from personal diaries, newspapers and magazines may have the problem of personal bias as these writers are likely to exhibit less rigorousness and objectivity than one would expect in research reports.

Availability of data – It is common for beginning researchers to assume that the required data will be available, but you cannot and should not make this assumption. Therefore, it is important to make sure that the required data is available before you proceed further with your study.

Format – Before deciding to use data from secondary sources it is equally important to ascertain that the data is available in the required format. For example, you might need to analyse age in the categories 23–33, 34–48, and so on, but, in your source, age may be categorised as 21–24, 25–29, and so on.

DATA COLLECTION AND ANALYSIS METHODS FOR DIFFERENT TYPES OF RESEARCH

Traits in historical Research

1. History research brings into view something from the past. Because the "something from the past" is not empirically accessible, the history researcher must use various tactics for unearthing evidence from a time and a world not his or her own.

2. Interpretation

Technically, evidence from the past abounds, and the researcher must know where to look for it and how to look for it; this is the technical aspect.4 The researcher must also know how to arrange the evidence in an interpretative framework, and interpretation perforce requires theoretical commitments. In recent years, due to the "cultural turn" in history research (addressed throughout this chapter), the role of schools of thought becomes all
the more important.

3. Narrative.

The output of history research is not verse, or essay, or some other literary form; the output is narrative. This may seem obvious, but "narrative" in historiography requires its own discipline.

4. The cultural turn.

Cultural turn encourages focus on local, vernacular realities rather than, for instance,
national histories. It shifts attention from privileged outlooks to what can be called everyday, or popular, culture. As well, the cultural turn values what is stored in memories and subjective "geographies" as opposed to, or in addition to, what is only captured in documents.

5. The spatial turn.

This involves connecting space to history and culture.

Tactics in historical Research

Identification	Organization	Evaluation/Analysis
Facts versus ideas	Researcher's mind	Audience
Fact finding	Accuracy	Attribution
Being a detective	Love of order	Clarification
Library	Logic	Check for falsification
Internet	Honesty	Bias
Catalogues	Imagination	Self-criticism
Encyclopedias	"Cross-questioning"	
References	Compilation	
Chronology	By topic	
Maps	By time	
Current opinion	By internal logical order	
Colleagues, "experts"	Verification	
Note taking	Composing	
	Paragraph, chapter, part	
	Use plain words, sentences	
	Tone and rhythm	
	Art of quoting	

Figure 6.7 A representative list of tactical concerns in history research mentioned in Jacques Barzun and Harry F. Graff, *The Modern Researcher,* 6th ed. (2004).

In distinction to categories of *handling* the evidence (identification, organization, evaluation), here are some categories for *types* of evidence: determinative, contextual, inferential, and recollective evidence.

Determinative Evidence

Of primary importance is evidence that situates the object of study in a particular time and a particular place. Dates are one obvious type of determinative evidence.

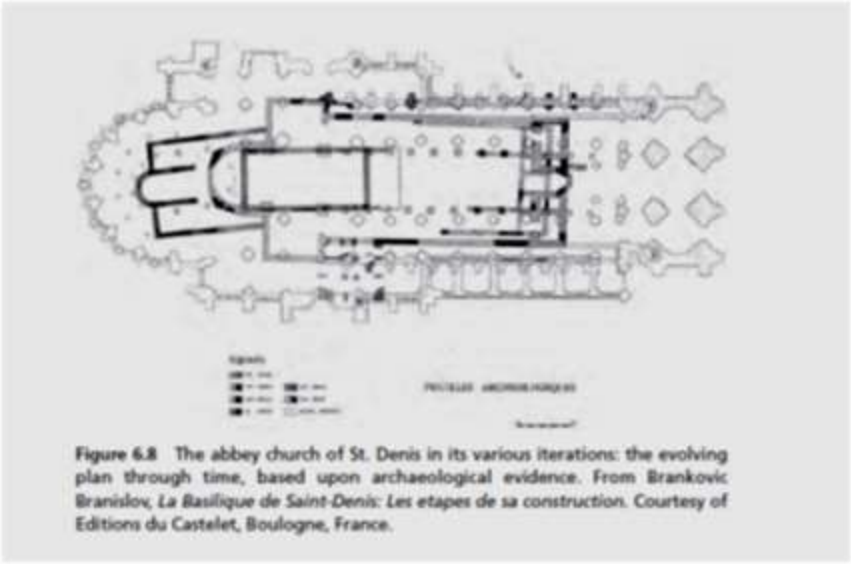

Figure 6.8 The abbey church of St. Denis in its various iterations: the evolving plan through time, based upon archaeological evidence. From Brankovic Branislov, *La Basilique de Saint-Denis: Les etapes de sa construction.* Courtesy of Editions du Castelet, Boulogne, France.

An excellent example of using the building itself as determinative evidence is Matthew Cohen's study of Brunelleschi's Basilica of San Lorenzo in Florence: By using measurements subjected to rigorous analysis as a primary source in the study of the Basilica of San Lorenzo, this investigation arrives at novel conclusions pertaining not only to architectural proportion but, unexpectedly, to the question of attribution as well. Cohen's measurements suggest that San Lorenzo contains a medieval proportional system that is based on mathematically irrational ratios. Cohen finds that it does not have a proportional system most scholars consider to be Renaissance.

Cohen himself underlines the importance of archaeology in his findings. In the postscript to his article, Cohen conceives of architectural history research as a midway point between architecture itself (in that the building at hand can be evaluated by the conventional architectural factors for any building: dimension, structure, materials, and the like), art history (i.e., the use of documentary evidence), and archaeology.70 A building in its extant condition and the same building in its archaeological condition, coupled with documentary evidence, form a "disciplinary triad" (Cohen's term) that can effectively uncover new historical knowledge.

Traditionally, photographs may also serve as determinative evidence, but advancements in digital technology reduce a photograph's dependability.

Inferential Evidence

Sometimes, by proximity of date and reasoned interpretation, one fact can be posited as very likely to be linked with another fact, even though "hard" connections of a determinative or even contextual nature may not be available.

the quality of the stonework detailing in the basilica, suggesting different phases of the work (see Figure 6.10). From this, Cohen infers haste in the less developed sections of the structure, which he relates to the shifting agendas of the patron, Cosimo de Medici.[b] Perhaps more significantly, Cohen's measurements—again coupled with archival information—suggest that the architect of record after about 1422, Filippo Brunelleschi, owed a lot to the *capomaestro* who preceded him on the project beginning in about 1421, Matteo Dolfini.[c] Dolfini, a cleric as well as an architect, appears to have been more indebted to a medieval metaphysics of number

Figure 6.10 Images on the left are of detailing on the western bays of San Lorenzo, while the images on the right are from the eastern bays. From this striking difference in quality, Cohen infers a significant gap in time during construction. By permission of Matthew A. Cohen.

[b] Ibid., 21–33.
[c] Ibid., 41–43.

Recollective Evidence

Sometimes, by proximity of date and reasoned interpretation, one fact can be posited as very likely to be linked with another fact, even though "hard" connections of a determinative or even contextual nature may not be available. It is also inferential in nature, since the interviewee is

drawing inferences about those facts in time past. The validity of recollective evidence, then, depends significantly upon who the interviewee is, what role he or she played relative to the object under study, what credibility he or she currently has, and how much of what he or she says can be corroborated by other evidence.

QUALITATIVE RESEARCH

Data collection

Among the various descriptors of data collection tactics, Creswell offers a particularly handy framework. He identifies four basic types of information: interviews, observations, documents, and audio visual information. Figure below presents a variation and elaboration of this framework, of course with the assumption that many design and architectural studies will entail objects, buildings, urban environments, and landscapes. In addition, a distinction can be made between interactive versus noninteractive engagement. For our purposes, the four main categories might be better identified as Interviews and Open-Ended Response Formats, Observations, Artifacts and Archives.

Tactics	Interactive	Noninteractive
Interviews & Open-Ended Response Formats	face-to-face or phone in-depth interviews focus groups task-oriented formats, e.g.: mapping exercises multiple sorting task projective surveys (games)	online response to open-ended questions prompted journaling activity logs photo logs
Observations	participant observation (research role concealed) participant observation (research role known)	nonparticipant observation
Artifacts and Sites	*in situ* observation & analysis of artifacts/ buildings/urban context/ landscape sites	photos, drawings, or virtual representations of artifacts and sites
Archival Documents		public documents audio visual material artifactual or site documentation personal journals, diaries, letters, sketches

Figure 7.14 The variety of data sources for qualitative research. Linda Groat and David Wang, *Architectural Research Methods* (New York, NY: Wiley & Sons, Inc. 2002); and John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (Thousand Oaks, CA: SAGE, 2009).

Steps in Data Reduction/ Coding

In most qualitative research, there are likely to be extensive, sometimes voluminous, verbal or visual materials, in the form of interview transcripts, observational notes, or artifactual documentation. Particularly in the situation of coding interview transcripts, the sheer volume of verbal material can make the coding an arduous task. There is no one way to begin coding and reducing data; however, in order to retain mindfulness in coding, it is often useful not only to make use of a coding scheme, but also to include reflective marginal remarks.

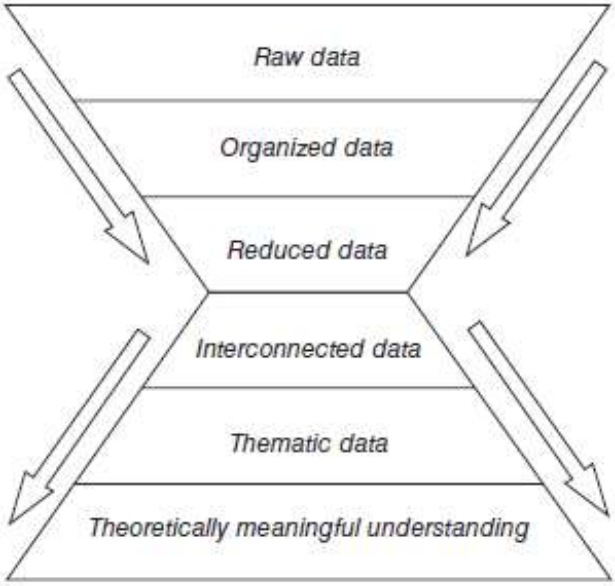

Figure 7.15 Working with qualitative data: drilling in and abstracting out. Courtesy SAGE Publications. Zina O'Leary, *The Essential Guide to Doing Your Research Project* (Thousand Oaks, CA: SAGE, 2010). p. 263, Figure 14.3.

Editing

Irrespective of the method of data collection, the information collected is called *raw data* or simply data. The first step in processing your data is to ensure that the data is 'clean' – that is, free from inconsistencies and incompleteness. This process of 'cleaning' is called **editing**.

Coding

Having 'cleaned' the data, the next step is to code it. The method of **coding** is largely dictated by two considerations:

1. the way a variable has been measured (measurement scale) in your research instrument (e.g. if a response to a question is descriptive, categorical or quantitative);
2. the way you want to communicate the findings about a variable to your readers.

Steps in Processing of Data

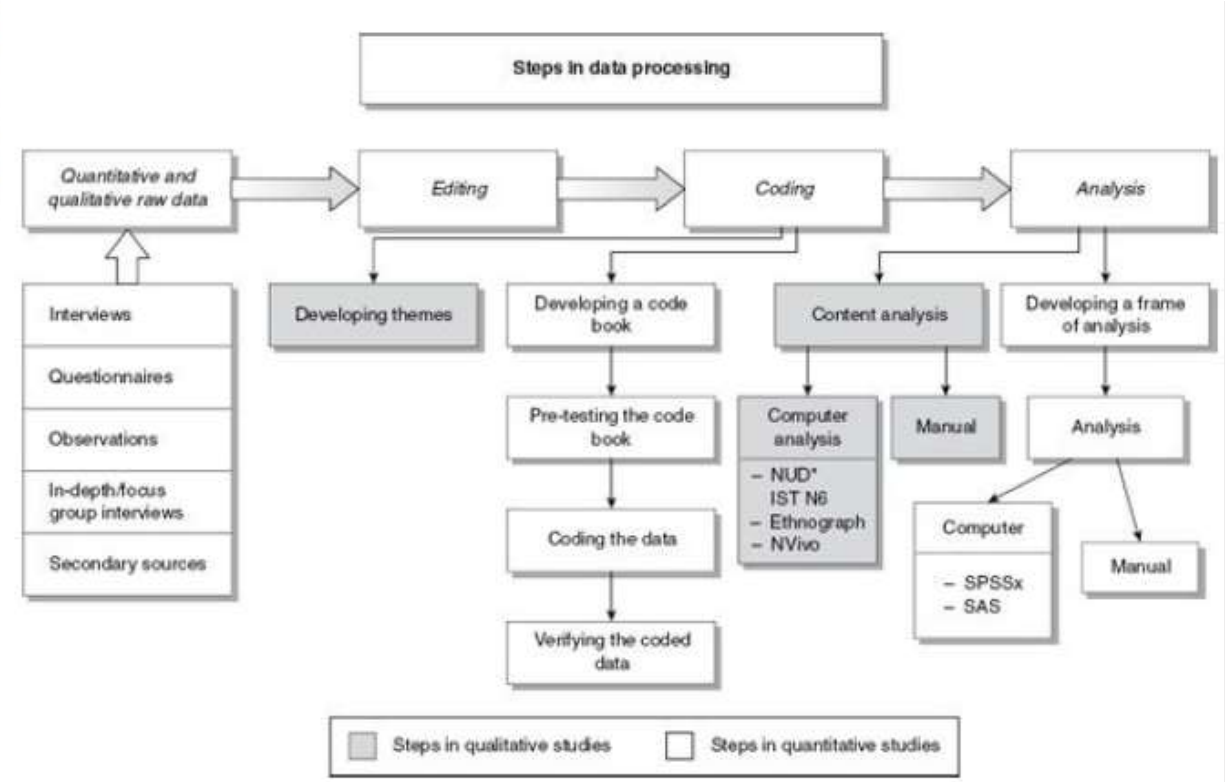

TABLE 15.1 *An example of a code book*

Col. no.	Q. no.	Variable name	Response pattern	Code
1	2	3	4	5
1–3	S. no.	ID	Actual serial number	Code actual
4	Record no.	RNO	First record	1
			Second record	2
			Third record	3
5	1(a)	Age	20–24	1
			25–29	2
			30–34	3
			35–39	4
			40–44	5
			45–49	6
			No response	9
6	1(c)	MS	Currently married	1
			Living in a de facto relationship	2
			Separated	3
			Divorced	4
			Never married	5
			No response	9
	2(b)	TEDU	Assoc. Dip.	1
			Diploma	2
			Bachelors	3
			Grad. Dip.	4
			Masters	5
			PhD	6
			Not applicable	8
			No response	9
7		TEDU1	Same as in TEDU	Code
8		TEDU2	Same as in TEDU	as in
9		TEDU3	Same as in TEDU	TEDU
		STUDY	Behavioural Sciences	1
			Business	2
			Economics/Commerce	3
			Communication	4
			Engineering	5
			Geography	6
			History	7
			Graphics	8
			Librarianship	9
			Nursing	10
			Performing Arts	11
			Secretarial	12
			Social Work	13
			Psychology	14

Data display

Although most empirical research studies involve some sort of displays, in the form of charts, tables, exemplar visual images, and so on, the qualitative research strategy is likely to include particularly complex textual and visual displays that aim to convey the multifaceted nature of the analysis and conclusions.

Drawing conclusions and verifying

Once the data have been coded/reduced and displayed, the researcher gradually moves towards clarifying patterns, providing explanations, and evaluating these findings.

CORRELATIONAL RESEARCH

Causal Comparative Studies

Causal comparative studies represent a type of correlational research that stakes out an intermediate position between the predictive orientation of relationship studies and the focus on causality that characterizes experimental research. In causal comparative studies, the researcher selects comparable groups of people or comparable physical environments and then collects data

on a variety of relevant variables. The purpose of selecting comparable examples is to isolate the plausible relevant factor(s) that could reveal a "cause" for significant differences in the levels of measured variables. However—and this is crucial—the causal comparative design can only ascribe cause in a provisional or hypothetical way. This is because causal comparative research relies on studying naturally occurring variables, as do all correlational studies. This is in direct contrast to experimental research , which characteristically involves a "treatment," which is an independent variable that is manipulated by the researcher. As a consequence, the causal comparative design depends on establishing the essential comparability between two examples that differ only in terms of the variable(s) to which cause can be ascribed. Unfortunately, there are many possible shortcomings in establishing the equivalence of the comparable examples/groups.

Data Collection

Surveys

Among the variety of data collection tactics for correlational research, the survey questionnaire is perhaps the most frequently employed. Indeed, it is so ubiquitous and well established that the term *survey research* is sometimes regarded as essentially equivalent to the term *correlational research*. Our position, however, is that the survey questionnaire is just one (although perhaps the most popular) of many possible data collection devices available for the correlational research design.

The great advantage of survey questionnaires is that they enable the researcher to cover an extensive amount of information—from demographic characteristics, to behavioral habits, to opinions or attitudes on a variety of topics—across a large number of people in a limited amount of time. The consequent disadvantage, however, is that achieving this breadth of information usually comes at the cost of indepth understanding of the issues surveyed.

General Considerations	Examples of New Urbanist Research
1. **Goals** Determine main topics to be covered Clarify the purpose of each question	Kim's topics were: overall sense of community 4 components of community demographic characteristics
2. **Response Formats** Evaluate advantages of closed vs. open-ended format	Sense of community questions used 5-pt. closed scale Demographic questions used combination of closed and open formats
3. **Clarity in Phrasing the Questions** Use short sentences Avoid making 2 queries in a single question Avoid framing questions in the negative (not, never) Avoid using ambiguous wording Employ non-threatening language	Reviewed question design with others knowledgeable in research and the respondent sample Piloted questionnaire with respondents
4. **Question Order** Use logical sequence of topics Start with interesting, nonchallenging issues Don't place important items at end of long survey	Survey starts with sense of community questions Full page demographic questions last
5. **Format** Use appealing, but simple graphics Avoid prominent or flashy design	Simple, understated graphics Though long, did not appear dense
6. **Instructions** Explain reason, context for survey Provide description(s) of what respondents expected to do Explain where respondents turn in survey	Introductory explanation provided Surveys were hand-delivered Provision for return mailing
7. **Ethics** State provisions for keeping individual responses confidential	Statement of confidentiality provided Survey submitted to university human subjects review board

Figure 8.15 Considerations in the design of a survey questionnaire. First column adapted from D. Mertens, *Research Methods in Education and Psychology,* SAGE

Observations

Various forms of observation represent another frequently used set of tactics for data collection. This method has been discussed earlier.

Mapping

Probably the most well-known example of using a mapping technique is Kevin Lynch's study, *The Image of the City.* In an effort to assess the way the physical characteristics of cities were

experienced and understood by ordinary people, Lynch conducted interviews with study respondents of three U.S. cities—Boston, Jersey City, and Los Angeles—and asked them to draw sketch maps of their city. Lynch concludes that overall there is a very high correlation between the two sets of maps for all three cities. Based on these sets of mappings from the three cities, Lynch was able to derive his now famous five general categories of urban features: path, edge, node, landmark, and district. In other words, all five types of features were delineated in each of the three cities. However, the density of these imageable features varied from city to city.

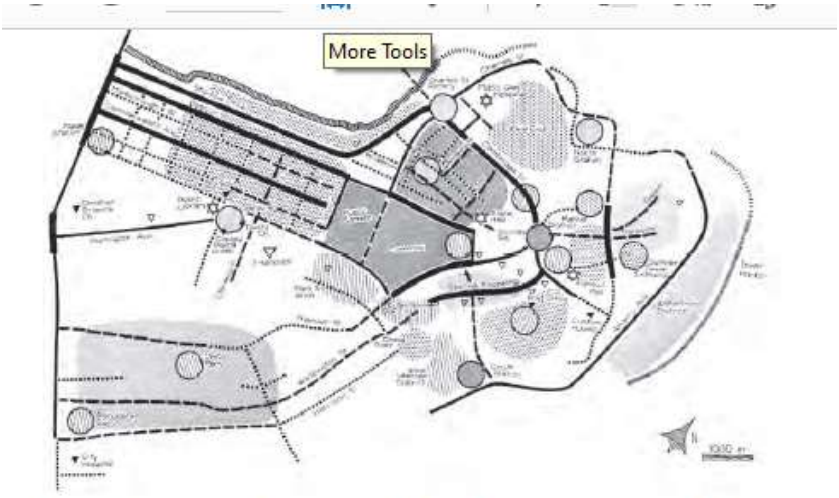

Figure 8.23 The Boston Image as derived from verbal interviews. Courtesy of MIT Press.

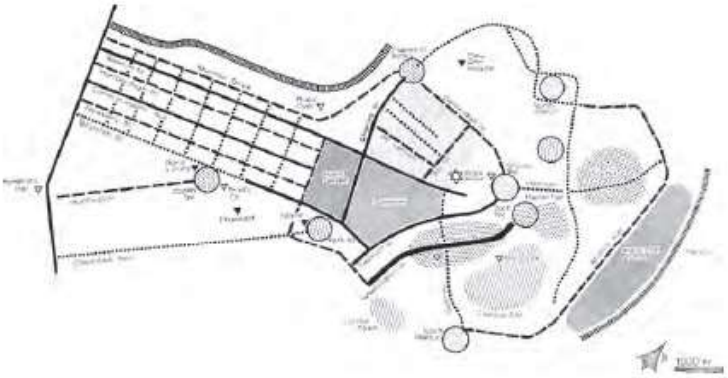

Figure 8.24 The Boston Image as derived from sketch maps. Courtesy of MIT Press.

Figure 8.22 People counts for moving and sedentary behavior in the neighborhood in southwest Detroit. Courtesy of Diaan van der Westhuizen.

More recently, Kush Patel adapted the sticker mapping technique developed by Lusk for his study of two iconic European projects: Bernard Tschumi's Parc de La Villette in Paris, and Lucien Kroll's medical student residence for L'Universite Catholique de Louvain in Woluwe-Saint-Lambert, on the outskirts of Brussels. Patel's purpose was to investigate the material implications of Henri Lefebvre's seminal work, *The Production of Space* (1974), and examine connections between Lefebvre's critical formulations of space and the built works

Bicycle Path/Greenway Survey

This voluntary survey is being conducted through the University of Michigan for a Ph.D. dissertation on the determination of attractive destinations and their features on a multi-use path. We would like you to help us identify the locations of these destinations and to also list the elements that make that destination preferred. Please use the attached stickers on the survey. Out of a trial of 6 survey techniques, use of the stickers emerged as the most effective technique.

First, use the following code for the stickers, placing them as appropriate, on the map. You do not have to use all of the categories of stickers and you can use as many or as few stickers as you like.

Second, beside the spangley star sticker for the destination or destinations, please describe the area or features so that the destinations can be located. Also, please assign a number in order of preference to the destinations with #1 being the most preferred destination. You can have as many or as few destinations as you like.

Third, on the additional sheet of paper, please list the destinations located by you on the map according to the rank order with #1 being listed first. Below each destination, please list the preferred features at this destination and identify with a check, the top three or four features at each destination.

1. Put a plain star by one or more areas that serve as the place or places you start on the path.
2. Put a spangley star by one or more areas that serve as destinations or places, which even though you may pass by, you feel you have "arrived."
3. Put a smiley face circle by the places which you particularly enjoy and/or look forward to.
4. Put squares by places that serve primarily as way-finders (visible cues about your location) that might be attractive or unattractive.
5. Put a line of small dots by stretches that you find appealing.
6. Put a long bar or many bars at the places or stretches where you are bored.
7. Put bugs/ants by individual places or things that you find unappealing.
8. Put an arrow/pointer indicating the direction where you enjoy a view.

Figure 8.26 Mapping Instructions for Lusk's greenway study. Courtesy of Anne Lusk.

Sorting

Another tactic that can be highly effective in both research and practice situations is the sorting task. This typically involves asking a respondent to sort a set of cards (usually between 20 and 30) with either words or pictures represented on them In a directed sort, the researcher specifies a set of categories into which the cards must be sorted, such as a 5- or 7-point rating scale from highly preferred to least preferred. In an open sort, the respondent can establish whatever categories make sense to him or her; so, for example, the respondent might choose to sort a set

of buildings into functional types, including houses, commercial buildings, churches, and so on. Or the respondent might choose to sort a set of houses by categories of traditional versus modern styles.

In a seminar/workshop class for architectural students, Groat has used the sorting task to clarify the design dialogue between the architect-student and a friend who serves as the client. The student is asked first to do several sortings of the 20 photos of houses both to familiarize herself or himself with the sorting process and to elicit his/her own categorizations of the houses. Next, the student conducts an interview with the "client" who does his/her sortings of the houses. There is also a column at one edge of the sortings record sheet for both student and "client" to indicate a rank order of preference. Finally, the student is urged to discuss the similarities and differences in the sorting categories and the ranked preferences with the "client." So, for example, if both architect and client sort according to building materials, but the client prefers wood shingles while the architect prefers expansive glass with steel, there is a clear difference of approach to work out. Or perhaps, if both architect and client sort the houses on the degree of exposure to landscape and sunlight, it may be that this agreement can serve as a device for resolving the conflict over materials.

In a research context, both the preference rankings and the nominal sorting category designations can be subjected to statistical measures such that correlations between practice setting—between client and architect, or among a small number of client/ users—can often serve as an effective and creative foundation for dialogue at the outset of a project.

In the essays that students have written about this experience, it is clear that a visual exercise such as the sorting task can be a very effective alternative to simply asking clients to state their preferences in a conversation or verbally oriented interview. Indeed, it is through the process of actually sorting out alternative design elements, and articulating the categories that come to mind, that many nonarchitects can begin to articulate important ways of experiencing architecture—experiences that they might not otherwise be aware of or know how to express.

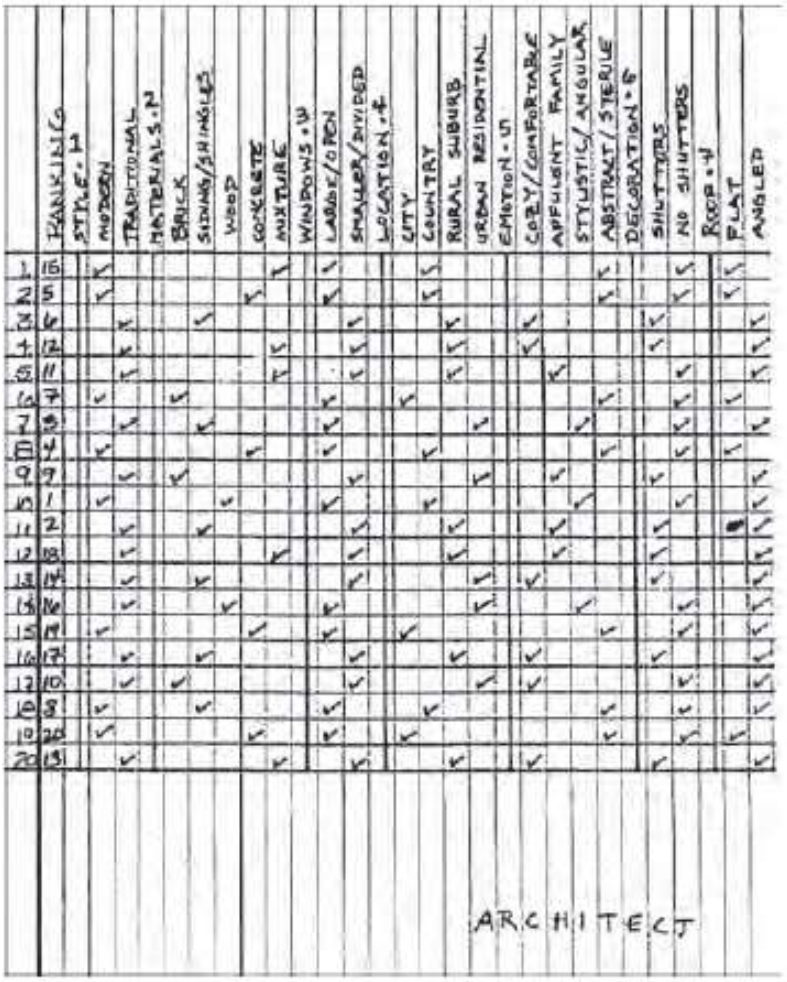

Figure 8.30 Student "architects" sorting. Courtesy of Sara Stucky.

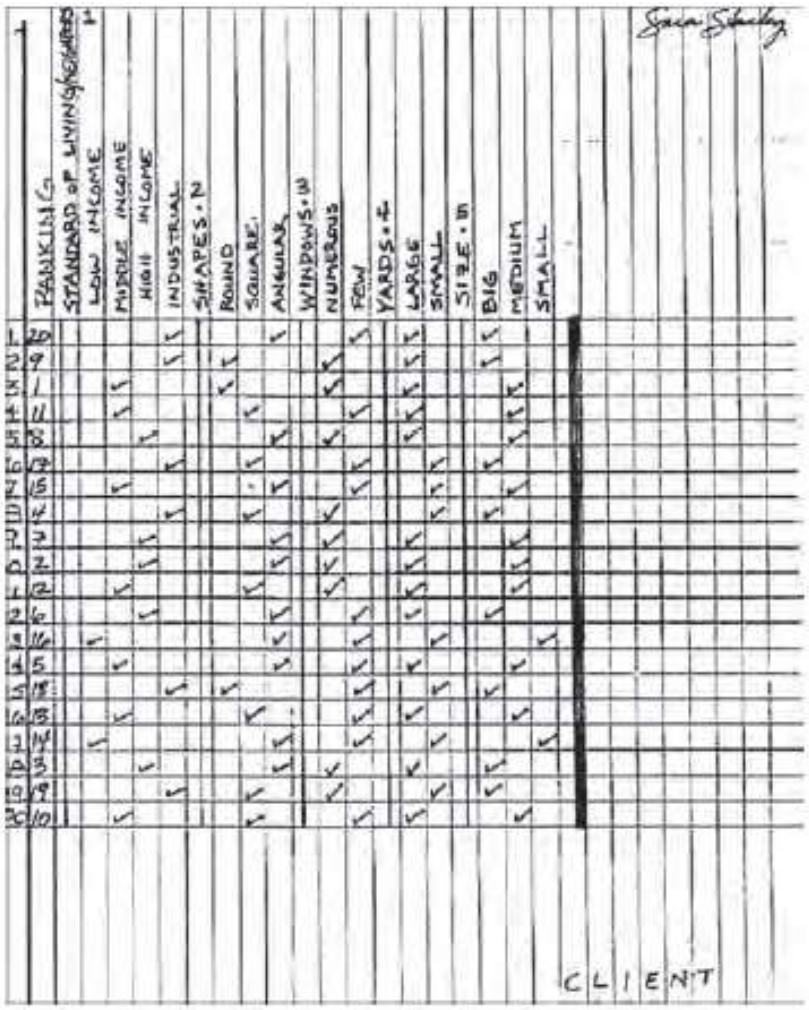

Figure 8.31 "Client" sorting. Courtesy of Sara Stucky.

Archives

Yet another, though certainly less frequently used, tool for data collection is provided by archives. In India census data provides a lot of information.

Analysis of Data

Typological Analyses

Typological analysis includes studies that incorporate analyses of multiple complex variables in order to illuminate broad categories of spatial relationships and formal attributes from the scale of building interiors to neighborhoods, and the like. In this case, rather than focusing on the analysis on each individual variable, the aim is to identify the presence and convergence of variables that, when taken together, define broad categories or types.

A research study on the walkability of three Detroit neighborhoods represents the application of typological analyses at the neighborhood scale The research, sought to understand the design

components that contribute to healthy neighborhoods, and more specifically to identify specific characteristics of the physical environment that contribute to localized physical activity. Wineman et al. study is important because it addresses walkability in less affluent neighborhoods that may lack the amenities that typically support walking, especially so in a classic exemplar of the "shrinking city" phenomenon.

Multiple Regression

- It is one of several devices that can be used to describe the strength and direction of relationships among two or more variables.
- It is appropriate for interval or ratio data where the researcher has hypothesized several independent variables that can predict the value, or measured outcome, of another variable.
- In such cases multiple regression can provide a mathematical equation that indicates the amount of variance contributed by each of these independent (or predictor) variables.

Multiple regression generally explains the relationship between multiple independent or predictor variables and one dependent or criterion variable. A dependent variable is modeled as a function of several independent variables with corresponding coefficients, along with the constant term. Multiple regression requires two or more predictor variables, and this is why it is called multiple regression.

The multiple regression equation explained above takes the following form:

$y = b1x1 + b2x2 + \ldots + bnxn + c.$

Here, bi's (i=1,2…n) are the regression coefficients, which represent the value at which the criterion variable changes when the predictor variable changes.

Factor Analysis

Like multiple regression, factor analysis also depends on interval or ratio data. But instead of multiple regression's focus on the relative salience of key variables for predicting the outcomes of other variables, factor analysis aims to articulate an overall structure or pattern among the variables. More particularly, factor analysis enables the researcher to identify thematic clusters of variables known as *factors.* Each factor is comprised of several variables that share similar patterns of responses or observations.

A good example of the use of factor analysis to uncover the underlying structure among a set of environmental design variables is provided by Kim's research on New Urbanist and conventional

suburban developments. As described in earlier segments of this chapter, Kim used a survey questionnaire to clarify the impact of a variety of physical features on residents' perceived sense of community in the two neighborhood developments.

What Kim discovered is that, even though the New Urbanist residents rated their perceived sense of community more highly than the residents of the conventional suburb, the underlying factors influencing the two groups' assessments were remarkably similar. For example, in the residents' evaluation of the community identity component of sense of community, the same three factors were identified for both neighborhood developments: community plan, community appearance, and amenities.In Figure below, the relevant physical variables associated with each factor are indicated. However, the relative salience of the three factors and the specific variables associated with them are somewhat different. Whereas the community appearance factor was most salient for the Kentlands residents (see mean score in bold), the amenities factor was more salient to the Orchard Village residents' sense of community.

Q7: Distinctive Character		Factor group themes					
		Kentlands			Orchard Village		
Q7	Physical features	Com. Plan	Com App.	Ame.	Com. Plan	Com. App.	Ame.
11	Street width	.77			.70		
14	Lot size	.76			.62		
5	Block size	.75			.62		
3	Distance between sidewalks and houses	.73			.65		
10	Arrangement of houses on the block	.71				.72	
12	Garage location	.69			.82		
1	Residential density	.66				.51	
17	Street layout	.59				.67	
16	Overall design quality of housing		.78			.86	
4	Architectural style		.71			.72	
15	Mixture of housing types		.70			.63	
7	Overall layout of Kentlands (or W.W)		.46			.67	
6	Club house-recreation complex			.75			.74
8	Street trees and other street landscaping			.63		.59	
9	Overall size of Kentlands (or W.W)					.59	
13	On street parking				.81		
2	Lakes (or Wetlands), public greens, tot lots, footpaths						.85
	Mean	4.20	4.70	4.27	3.45	4.02	4.21
	Alpha	.89	.77	.43	.89	.92	.62

Figure 8.38 Factor analysis of community identity. Courtesy of Joongsub Kim.

Multi dimensional Scaling

- Depending on the particular computer program used, it is possible to make use of nominal data as well as interval or ratio data.
- In addition, because the outcome of the analysis is a graphically represented spatial plot, it may also hold some inherent appeal for architectural researchers.
- The overall goal of multidimensional scaling is similar to that of factor analysis in that it reveals an underlying pattern or structure among the variables analyzed.

- However, some multidimensional scaling programs allow a greater degree of interpretive flexibility than is the case with factor analysis.
- Whereas factor analysis typically results in numerical designations for the degree of salience of each variable within a factor, multidimensional scaling results in a graphic plot that locates spatially the relationship among all variables. In such a plot, two points (variables) in close proximity mean that these variables represent a similar pattern of responses: distant points (variables) on the plot represent a dissimilar pattern of response observations.

Linda Groat's research on architects' and laypeople's understanding of architectural style employs a form of multidimensional scaling that accepts the nominal data derived from a sorting task. Groat was interested in investigating the extent to which architects and laypeople (in this case a group of accountants) responded differently to modern versus postmodern styles.38 Some architectural theorists and proponents of postmodernism had speculated that laypeople would find postmodern buildings more appealing and meaningful than modern buildings. So Groat asked her respondents to carry out a set of free sorts of building photographs that represented a range of modern to transitional to postmodern styles. Figure below represents the multidimensional scalogram analysis plot of a typical architect's set of sortings. Groat's interpretation of the plot reveals that basis stylistic categorizations underlie the architect's sortings, regardless of whether the architect had consciously sorted according to materials, geometric form, preference, or any other criteria. Lines have been drawn to indicate that the plot can be understood in terms of three stylistic regions that, with minor exceptions, correspond to the designations employed by architectural critics of the time. However, Figure represents a typical accountant's set of sortings. In this case, it is not possible to find distinctive stylistic regions. Groat interprets this result to mean that the accountant's sortings do *not* reveal an underlying stylistic conceptualization in the way the architect's plot does. The sorting a of all 20 architects and 20 accountants were subjected to the same multidimensional analysis procedures. Groat was able to determine that while no accountant's plot revealed a postmodern stylistic region, the plots of 10 architects did reveal a postmodern region. Further statistical analyses confirmed that this difference in response rate between the architects and accountants was significant at the .001 level, meaning that there is only one chance in a thousand that these results would be a chance occurrence. As a result of this study, Groat concluded that the argument put forward by postmodern proponents at that time—that laypeople would respond more favorably to postmodern buildings, thereby distinguishing them from the modern Building was flawed.

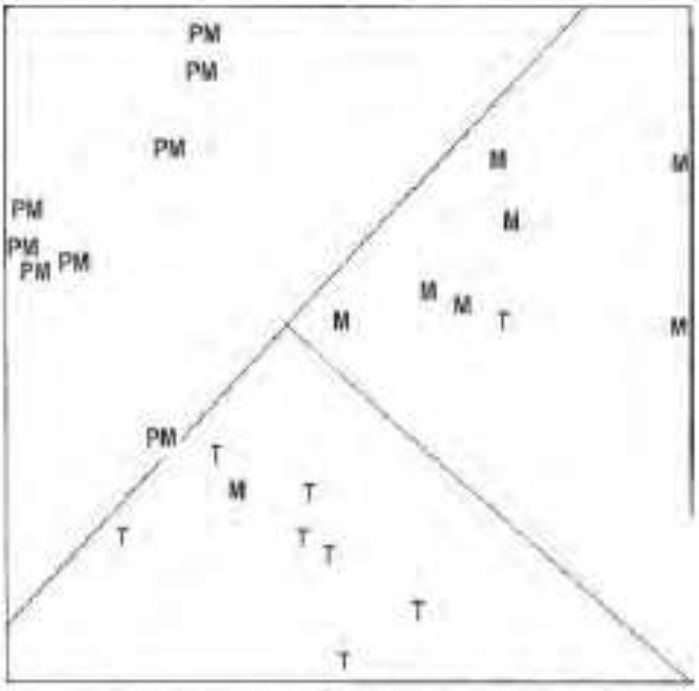

Figure 8.39 Underlying structure of an architect's sorting.

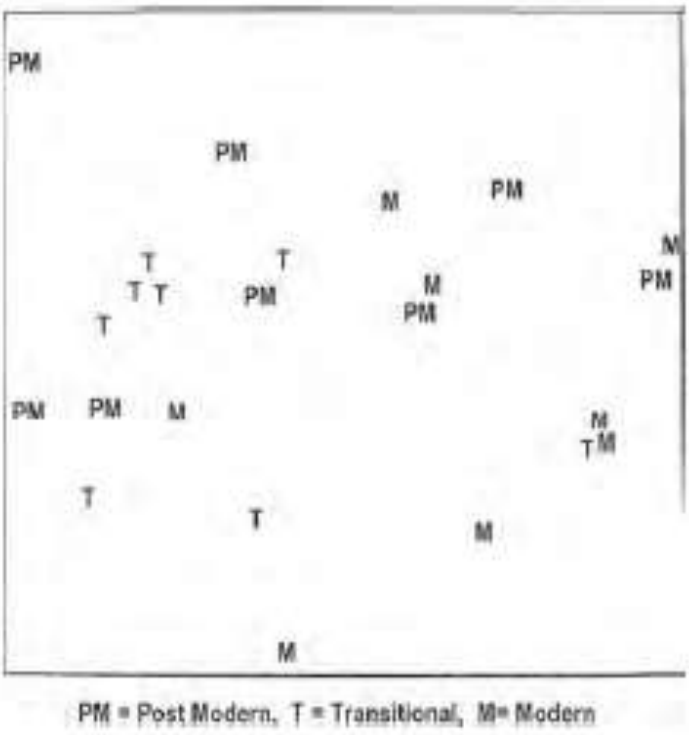

Figure 8.40 Underlying structure of an accountant's sorting.

STRATEGY OF SIMULATION RESEARCH

Here we address the defining characteristics of simulation as a research strategy. Part of this task is to clarify some terms often found in the simulation literature. Because advances in computer technology occur so quickly, it is useful to consider some of these definitions. Following these clarifications, we outline some relationships simulation research has to other research strategies.

Representation versus Simulation

The word *representation* often occurs, with various shades of meaning, in the simulation literature. For our purposes, representation denotes a fixed image that stands for a real object because the image has measurable qualities that describe and depict the real thing. In this sense architectural drawings are representations. Photographs, the medium that much of architectural education has been dependent upon up to now, are also representations under this definition. To-scale three-dimensional architectural models are representations as well. It is only when data from various scenario inputs can be generated from representations that we can say simulation is taking place. This can be achieved with fixed representations.

An example is a study utilizing photographs (slides) and to-scale models of nursing homes. Rather than bringing elderly people to the actual buildings, seniors were shown models and a series of slides of the spaces. It was shown in this case that those experiencing the depicted environments had a better "working knowledge" of the buildings than those who actually visited them. The latter group experienced difficulty finding places out of sequence from their initial site exposure, but the group that was exposed to the fixed photographs and models did not experience similar difficulty (they in fact found places not included in the simulated visit). Because data came out of these interactions with the still images, the research was included in a collection of examples of simulation research. Computer technology has further blurred the distinction between representation and simulation. For example, the popular software Sketchup, freely downloadable from Google, offers almost infinite views of a building, in plans, sections, aerial views, and the like, after the dimensions have been input. Is this representation or simulation? Most would say it is a representational tool because the many views Sketchup generates are still themselves fixed and operated by the user. It is not until there is a "smart" capacity in a computer modeling program that allows for dynamic interactions yielding measurable data that we can say simulation modelling is taking place. Closer toward simulation is something like sun path scenarios. Autodesk's Revit program projects the sun's position

relative to a building at any time and any location. These are fixed representations that nevertheless begin to offer dynamic information. Perhaps the salient point is that advancing computer technology may bring us to a point, as some of the preceding examples suggest, at which an infinite number of fixed representations in sequence achieve simulations of "real-time" behaviors. Because we are in this transitional time, the word *representation* may be used with differing shades of meaning by various commenters in the simulation arena.

What Is a Model?

This is another ubiquitous word used in simulation research. In simulation terms, a *model* is the overall system that simulates the reality being studied. A model can exist in a variety of forms: from a mathematical model comprised of abstract numerical expressions, to laboratory spaces outfitted (for instance) into conference rooms to test lighting, to what architects still most often think about when the word *model* nis used, small-scale three-dimensional representations of actual spaces . In the Netherlands, it was a practice for full-size mock-ups of entire residences to be tested before actual construction proceeded. The process is able to reveal under research conditions why, on subjective grounds, some people prefer certain environments and not others.22 (This is another example of a "fixed representation," here a full-sized replica of a residence, yielding data through dynamic interactions with "residents"; therefore, it is simulation).

Colin Clipson classifies four types of simulation models: *iconic*, *analog*, *operational*, and *mathematical.* The first two have more to do directly with physical contexts. *Iconic* models are used in the direct testing of materials or products under simulated conditions. For example, actual wall assemblies are tested for fire resistances; carpeting and other interior materials are tested under simulated conditions to determine their flame spread ratings. *Analog* denotes "dynamic simulation of an actual or proposed physical system." Flight simulators are of this variety.*Operational* models deal with people interacting within physical contexts; the data is generated by role-play. Hospital emergency room scenarios, or response to terrorist attacks, can be simulated in this way. *Mathematical* models are systems of numerical coding that capture real-world relationships in quantifiable abstract values; this is the domain of expanding computer technology vis-a-vis simulation. As noted earlier, increasingly the direction is toward computer models that integrate enormous amounts of information via databanks. Again, when representations, whether two- or three-dimensional, are deployed such that they generate measurable data from dynamic interactions under various scenario inputs, simulation is taking place.

Prediction versus Projection/Pattern

Simulation gives us knowledge about possible real-world conditions without going through the ethical barriers, physical dangers, or financial expense of the actual conditions. Let's now consider further the kind of knowledge we can obtain. We have all taken part in fire drills to prepare for the likelihood of the real thing. But what do we learn? We don't learn anything that can accurately predict future behavior. But our experience in the simulation teaches us *patterns* of behavior, or *projections* of possible behavior, grounded in a realistically and hopefully rigorously prepared replica of the actual circumstances. In the World Trade Center simulation cited earlier, the authors ran through 50 computations each of 4 scenarios to obtain their results. In other words, it was the statistical composite of 50 sets of data that gave them confidence regarding patterns of behavior for the scenarios (e.g., with and without firefighters; with and without an intact stair from top to bottom; etc.). This is not to say that projection or pattern replaces prediction; it just increases the range—or perhaps the kinds—of predictive outcomes. Building Information Modeling (BIM), for example, can easily perform simulation studies of the predictive kind, such as modelling airflow, or the curing rate for concrete in a particular application.

References:

Groat, L. N., & Wang, D. (2013). *Architectural research methods*. John Wiley & Sons.

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners*. Sage.

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – IV - Research Methodologies in Built Environment – SARA 5104

IV Research Writing

WRITING A RESEARCH REPORT

Developing an outline

Before you start writing your report, it is good practice to develop an outline ('chapterisation'). This means deciding how you are going to divide your report into different chapters and planning what will be written in each one. In developing chapterisation, the subobjectives of your study or the major significant themes that emerged from content analysis can provide immense guidance. Develop the chapters around the significant subobjectives or themes of your study. Depending upon the importance of a theme or a subobjective, either devote a complete chapter to it or combine it with related themes to form one chapter. The title of each chapter should be descriptive of the main theme, communicate its main thrust and be clear and concise. This is applicable to both types of research.

The following approach is applicable to both qualitative and quantitative types of research but keep in mind that it is merely suggestive and may be of help if you have no idea where to start. Feel free to change the suggested format in any way you like or if you prefer a different one, follow that. The first chapter of your report, possibly entitled 'Introduction', should be a general introduction to the study, covering most of your project proposal and pointing out the deviations, if any, from the original plan. This chapter covers all the preparatory tasks undertaken prior to conducting the study, such as the literature review, the theoretical framework, the objectives of the study, study design, the sampling strategy and the measurement procedures.

The second chapter in quantitative research reports should provide information about the study population. Here, the relevant social, economic and demographic characteristics of the study population should be described. This chapter serves two purposes:

1. It provides readers with some background information about the population from which you collected the information so they can relate the findings to the type of population studied.
2. It helps to identify the variance within a group; for example, you may want to examine how the level of satisfaction of the consumers of a service changes with their age, gender or education. The second chapter in a quantitative research report, therefore, could be entitled 'Socioeconomic– demographic characteristics of the study population' or just 'The study population'. This chapter could be written around the subheadings below which are illustrated by taking the example of the foster-care payment study.

As qualitative studies are mostly based upon a limited number of in-depth interviews or observations, you may find it very difficult to write about the study population. The title and contents of subsequent chapters depend upon what you have attempted to describe, explore, examine, establish or prove in your study. As the content of each project is different, these chapters will be different. As indicated earlier, the title of each chapter should reflect the main thrust of its contents. The outline should specify the subsections of the chapter. These subsections should be developed around the different aspects of the theme being discussed in the chapter. If you plan to correlate the information obtained from one variable with another, specify the variables. Plan the sequence for discussion of the variables. In deciding this, keep in mind the linkage and logical progression between the sections. This does not mean that the proposed outline cannot be changed when writing the report – it is possible for it to be significantly changed.

Writing about a variable

Having developed a chapter outline, the next step is to start writing. Though the way researchers organise their writing is extremely individualised, the following guidelines and format may prove helpful for beginners. When writing about the information obtained in response to a question (variable), write as if you were providing answers to the following questions:

Why did you think it important to study the variable?

What effects, in your opinion, may this variable have on the main variable you are explaining? (*This is where you provide your own rationale for studying the variable.*)

In the case of a cross-tabulation, what relationships have other studies found between the variables you are analysing? (*This is where the literature review is integrated into the findings of the study*.)

What did you expect to find out in terms of the relationship between the two variables? (*If you have formulated a hypothesis, state it here*.)

What has your study found out? (*Provide the hard data from your study here, as tables, graphs or text*.)

What does the data show? (*Interpret the findings of your analysis*.)

What conclusions can you draw?

How do the conclusions drawn from your study compare with those from similar studies in the past?

Does your study support or contradict them?

What explanation can you provide for the findings of your study?

The above is only a suggested format for ordering your thoughts, not a list of subheadings. You may wish to change the suggested order to make the reading more interesting.

Writing in qualitative research is more descriptive and narrative than analytical, hence you need to use your imagination in terms of placement of information, linkage between the thoughts and flow of language to make the writing interesting to read and meaningful in conveying the findings.

The suggested format is organised around the main themes of the study. There are other formats. Some researchers write everything under one heading, 'The findings'. This format is appropriate for a research paper, because it is short, but not for a research report or dissertation. Other writers follow the same order as in the research instrument; for example, findings are discussed under each question. The reader needs to refer continuously to the instrument for each question. It is segmental, lacks linkage and integration, and does not place findings into perspective.

Referencing

The report should follow an academic style of referencing. According to Butcher (1981: 226), there are

four referencing systems from which to choose:

1. the short-title system;
2. the author–date system;
3. the reference by number system;
4. the author–number system.

You need to adopt the one that is acceptable to your university and academic discipline: 'The first of these is used in most general books, the second mainly in science and social science books; the third and fourth less frequently' (Butcher 1981: 167).

Writing a bibliography

Again, there are several well-established systems for writing a bibliography and your choice is dependent upon the preference of the discipline and university. In the social sciences some of the most commonly used ones are (Longyear 1983: 83):

- The Harvard system;
- The American Psychological Association system;
- The American Medical Association system;
- The McGraw-Hill system;
- The Modern Languages Association system;

- The footnote system.

PUBLISHING IN A RESEARCH JOURNAL

Considerations for Publishing in a journal paper

- **Aims:** Your published article may help attract funding for your next research project, boost your profile and the reputation of your institution, and importantly, help to further knowledge in your field. Keep your aims in mind when writing your paper and use them to guide your decisions.
- **Audience:** Have a clear idea of your target audience, and tailor your paper to meet their needs and expectations. This might influence your decisions on the type of article you choose to write, the language you use, and which journal you choose to publish in.
- **Awareness:** Be aware of existing research, political debates, and current policy issues. Ground your work in the context of the wider landscape, referencing other work wherever appropriate.
- **Articulate:** Plan out a logical structure for your article, developing your ideas clearly and concisely. Consider writing your introduction and conclusion last, once your key points have become clear.

Get to know the journal you want to submit to

It's a good idea to choose your target journal before you start writing your paper. Then you can tailor your writing to the journal's requirements and readership and increase your chances of acceptance.

Once you've chosen your target journal, take the time to read a selection of articles already published, particularly those that are relevant to your own research. This can help you get an understanding of what the editors may be looking for and guide your writing efforts.

The journal's aims and scope is also an important resource to refer back to as you write your paper – use it to make sure your article aligns with what the journal is trying to accomplish.

Stick to the point

The strongest papers usually have one point to make. They make that point powerfully, back it up with evidence, and position it within the field.

Create a logical framework

The structure of your journal paper is just as important as the content itself, and helps to guide the reader through in a clear way.

Individual journals will have their own specific formatting requirements, which you can find in the instructions for authors.

We have a library of templates available which are accepted by many of our journals. Save time on formatting by downloading a template to apply to your article text. A large number of our journals now offer format-free submission, which allows you to submit your paper without formatting your manuscript to meet that journal's specific requirements.

Make your writing accessible by using clear language. Writing that is easy to read, is easier to understand too. Go back to thinking about your audience; are they experts in your field who will easily follow technical language, or are they a lay audience who need the ideas presenting in a simpler way?

Be aware of the other literature in your field (and reference it)

Make sure to tell your reader how your article relates to key work that's already published. This doesn't mean you have to review every piece of previous relevant literature, but make sure to show how you are building on previous work.

Make your references current and relevant

Your literature review should take into consideration the current state of the literature. So, don't talk about "recent research" if you're giving citations from the 1990s. It is important to include recent references to highlight awareness of all the current developments in the literature that you are building on. This doesn't mean you can't include older references, just make sure it is clear why you've chosen it.

When you reference something, ensure you fully understand its relevance to your research so you can make it clear for your reader.

Be original

Make sure to communicate your unique point of view to stand out. You may be building on a concept already in existence, but you still need to have something new to say. Make sure you say it convincingly, and fully understand and reference what has gone before.

STEPS IN PUBLISHING A PAPER IN JOURNALS

1. Determine the authors. When designing a research project, we recommend preparing an initial list and order of authors. Such a list authors should be based on established guidelines and should make explicit the estimated contribution of each individual to the project. We recommend that every research group establish and make known to its members the criteria for authorship on papers resulting from the work to be conducted. In so doing, the group may wish to make use of existing guidelines; see our essay on "Components of a Research Article."

A list of authors will ensure that all individuals to be involved in the project understand at the outset whether or not they can expect to be an author and, if so, what their contribution is to be. It should be viewed as a tentative list, as the final version should reflect actual contributions to the work. (Also, there may be more than one list as it might be anticipated that more than one paper will derive from a given project.)

2. Start writing before the experiments are complete. Start writing while you are still doing the experiments. Writing often evokes new ideas: you may realize that there are additional experiments to run or additional controls that you need to add. If you wait until you are done in the lab, have dismantled the equipment, and possibly moved on to another position, you will not have the opportunity to test these ideas.

3. Decide it is time to publish. It is time to publish when your findings represent a complete story (or at least a complete chapter), one that will make a significant contribution to the scientific literature. Simply collecting a given amount of data is not adequate.

4. Draft a title & abstract. Drafting a working title and an abstract helps define the contents of the paper, identifying which experiments you will publish in this paper, and which studies you will save for inclusion in another paper. (See our Components of a Research Article on the preparation of these two items.)

5. (Re)examine the list of authors. When you have now determined which experiments will be included in this paper you must select the authors and the order in which they will appear. If you have followed our advice to this point, you already have such a list. Re-evaluate it based on the contributions that were made to those experiments and the additional contributions that

will be made through the preparation of the manuscript. If a list already exists, make adjustments to ensure compliance with your guidelines. Of course, any changes should be done with caution and tact.

6. Determine the basic format. There are three basic formats for peer-reviewed research articles:

• *Full-length research articles*: These articles contain a comprehensive investigation of the subject matter and are viewed as the standard format. It uses the "IMRAD" format: Introduction, Methods, Results and Discussion. (See "Components of a Research Article.")

• *Short (or brief) communications*: While not as comprehensive in scope as full-length research articles, these papers also make a significant contribution to the literature. Their length will be set by the journal but is usually 3500 words or less and will contain up to 2 tables and figures. Unlike full papers, methods, results, and discussions may be combined into a single section.

• *Rapid communications*: These articles quickly disseminate particularly "hot" findings, usually in a brief communication format. Articles that have immediate implications for public health would be appropriate for such a format, as might findings in a highly competitive and quickly moving field.

7. Select the journal. There are several factors to consider when choosing a journal. It is unlikely that one journal will have all the features you are looking for, so you may have to compromise. However, there is one essential feature you should not compromise on – *manuscripts must be peer reviewed for publication if they are to be considered research articles*.

8. Language: English has become the dominant form for international scientific communication. Thus, if you are interested in communicating your results widely to the international scientific community, then it is essential to publish in English. If, on the other hand, you wish to communicate to a more localized community (e.g., physicians in a particular geographical area), you might chose a journal that permits another language.

9. Focus: What type of research does the journal publish? Is its focus broad or narrow? Which disciplines are represented? What is the journal's orientation – for example, is it clinical or basic, theoretical or applied?

10.Indexing: Is the journal indexed in the major electronic databases such as Medline, Biological Abstracts, Chemical Abstracts, or Current Contents?

11. Availability: Is the journal broadly available? Is there an online version of the journal? Are papers provided in PDF format?

12. Reputation: Although it can be rather subjective, there are several ways to gauge the reputation of a journal. Ask colleagues which journals they respect. Look at recent articles and judge their importance. Check the members of the editorial board and determine if they are leaders in their fields. Determine the journal's impact factor (an annual measure of the extent to which articles in a given journal are cited. How selective is the journal in accepting papers for publication? Note, however, these ratings can be artificially inflated in journals that publish review articles, which tend to be cited more than research articles.

13. Format: Do you like the appearance of published articles – the format, typeface, and style used in citing references? If relevant, does the journal publish short and/or rapid communications?

14. Figures: Do figures published in the journal have the resolution that you need? Time to Print: Using the "date submitted" and a "date accepted" that are published on the article, along with the date of the issue, you can estimate the length of the review process as well as the time from acceptance to publication in print.

15. Charges: Some journals bill the author for page charges, a cost per final printed page. Most journals have a separate charge for color plates. This may be as much as $1000 per color plate. Many journals will waive page charges if this presents a financial hardship for the author; color plate charges are less-readily waived and would at least require evidence that the color is essential to the presentation of the data (e.g., to show a double-labeled cell).

Once you decide on a journal, obtain and read that journal's instructions to authors. This document describes the format for your article and provides information on how to submit your manuscript. You can usually obtain a copy of the journal's instructions to authors on its Web site or in the first issue of a new volume.

16. Stock the sections of your paper. As you think about your paper, store relevant material in folders marked Introduction, Methods, Results, and Discussion. This will save time and

avoid frustration when the writing begins. Stored items might include figures, references, and ideas.

17. Construct the tables, figures, and legends. Yes, create figures and tables before the writing begins! The entire paper should be organized around the data you will present. By preparing the tables and figures (and their legends and appropriate statistical analyses), you will be certain of your results before you worry too much about their interpretation. You also may be able to determine if you have all the data you need. Note: except under unusual circumstance, you may not include any data that you have already published. (See "Components of a Research Paper.")

18. Outline the paper. An outline is like a road map. An outline details how you will get from here to there, and helps ensure that you take the most direct and logical route. Do not start writing without it! If you have co-authors, you may wish to get feedback from them before you proceed to the actual writing phase. And if you have "stocked" your sections (Step 8), those files should be useful here and in the writing that follows.

19. Write the first draft. Write the first draft of the entire manuscript. If you are writing with co-authors, you may wish to assign different aspects of the manuscript to different authors. This can save time, allow more individuals to feel that are making substantive contributions to the writing process, and ensure the best use of expertise. However, it also can lead to a mixture of styles. Thus, if you take this approach, be certain that the final product is carefully edited to provide a single voice. "Components of a Research Article" discusses what goes into each section of the manuscript. For a more extensive presentation of this and many other aspects of preparing a paper, see Day (1998). At this point, do not worry about it being intelligible. That comes later.

Some people recommend that you begin your writing with the Introduction and continue through in order each section of the paper. This can help ensure flow. However, others suggest that you start wherever you wish – anything to get rid of that blank screen or piece of paper. Whatever your approach, heed the advice of Charles Sides (1991): "If you try to write and edit at the same time, you will do neither well." And because editing is often a lot easier than writing, push through this step as quickly as possible. If you are taking much more than two full days, you have probably paused to edit!

20. Revise the manuscript. This step involves three major tasks, each to be carried out in the order given:

21. Make major alterations: Fill in gaps, correct flaws in logic, restructure the document to present the material in the most logical order.

22. Polish the style: Refine the text, then correct grammar and spelling.

23. Format the document: Make your manuscript attractive and easy to read. It is important to do the tasks in the stated order. Otherwise, you may find yourself spending a lot of time revising material that you later delete.

24. Check the references. Ensure that the citations are correct and complete. Do one last literature search to make certain that you are up to date. (See "Components of Research Article" on the matter of reference selection.)

25. Write the final title and abstract. Many changes are made during the editing process. Make certain that your title and abstract match the final version of your article.

26. Reread the journal's Instructions to Authors. Review the details of how the manuscript is to be formatted and submitted. Revise where necessary.

27. Prepare the final illustrations. Ensure that your tables, figures, and figure legends are complete, clear, self-contained, and in the format required by the journal. Do not allow any chance for misunderstanding.

28. Get feedback on your manuscript and then revise your manuscript again. Getting feedback is one of the most important things that you can do to improve your article. First, be sure your co-authors have had a chance to read and comment on the draft. Then, when it is ready, give the manuscript to some colleagues. Indicate when you would like to receive their comments, and what levels of information you would like (e.g., comments on the science, logic, language, and/or style). After you get their comments, revise your manuscript to address their concerns.

Do not submit your manuscript until you feel it is ready for publication. Once it is accepted, further changes in your manuscript will be difficult and may also be costly.

29. Submit the manuscript to the editor. Follow the Instructions to Authors to determine what items you need to submit, how to submit them, and to whom you should send them. Note that some journals permit (or even require) a "pre-review,"i.e., a letter indicating the content of the article so that the editors can determine whether they will accept the manuscript for a full review. At this point you may wish to list possible reviewers (or individuals to be avoided). If necessary, contact the editor to be sure that the manuscript was received. And if after a month you have not received a response concerning the acceptability of your manuscript for publication you may wish to contact the editor about this, too.

30. Deal with reviewers' comments. Most manuscripts are not accepted on the first submission. However, you may well be invited to resubmit a revised manuscript. If you choose to do so, you will need to respond to the reviewer comments. Do this with tact. Answer every concern of the reviewers, and indicate where the corresponding changes were made in the manuscript if they were, indeed, made. You do not need to make all of the changes that the reviewer recommended, but you do need to provide a convincing rationale for any changes that you did not make. When you resubmit the manuscript, indicate in your cover letter that this is a revised version. An alternative is to submit the manuscript to another journal. However, if you do so, it may still be best to take the reviewer comments into consideration. Even if you feel that the reviewers have misunderstood something in your paper, others might do the same. Of course, if you submit to another journal you probably will need to modify the format. And please note: You may not submit your manuscript to more than one journal at a time!

31. Check the proofs. Once the manuscript is accepted and prepared for print, the publisher will send the corresponding author page proofs of the article. This may be accompanied by a list of queries, such as missing information regarding a reference. The proofs may be sent via e-mail or as hard copy. If there is a chance that you will be away when the proofs arrive, have a plan for making certain that they are received and you are notified. You may only have 24–48 hr to return the proofs. Carefully correct any typos and factual errors. And read the manuscript for clarity – this is your last chance!

However, try to limit changes to editorial queries plus minor modifications. If you think anything more major is required, you must first get permission from the journal editor and be prepared for additional costs and publication delays.

INDEXES AND DATABASES

Whether you are writing a thesis, dissertation, or research paper it is a key task to survey prior literature and research findings. Especially, you will be looking for trusted resources, most likely peer reviewed research

Scopus

Scopus is one of the two big commercial, bibliographic databases that cover scholarly literature from almost any discipline. Beside searching for research articles, Scopus also provides academic journal rankings, author profiles, and an h-index calculator.

- Coverage: approx. 71 million items
- References: 1.4 billion
- Discipline: Multidisciplinary
- Access options: Limited free preview, full access by institutional subscription only
- Provider: Elsevier

Web of Science

Web of Science also known as Web of Knowledge is the second big bibliographic database. Usually, academic institutions provide either access to Web of Science or Scopus on their campus network for free.

- Coverage: approx. 100 million items
- References: 1.4 billion
- Discipline: Multidisciplinary
- Access options: institutional subscription only
- Provider: Clarivate (formerly Thomson Reuters)

ERIC

For education sciences, ERIC is the number one destination. ERIC stands for Education Resources Information Center, and is a database that specifically hosts education-related literature.

- Coverage: approx. 1.3 million items
- References: NA
- Discipline: Education science
- Access options: free
- Provider: U.S. Department of Education

IEEE Xplore

IEEE Xplore is the leading academic database in the field of engineering and computer science. It's not only journal articles, but also conference papers, standards and books that can be search for.

- Coverage: approx. 5 million items
- References: NA
- Discipline: Engineering
- Access options: free
- Provider: IEEE (Institute of Electrical and Electronics Engineers)

ScienceDirect

ScienceDirect is the gateway to the millions of academic articles published by Elsevier. 2,500 journals and more than 40,000 e-books can be searched via a single interface.

- Coverage: approx. 16 million items
- References: NA
- Discipline: Multidisciplinary
- Access options: free
- Provider: Elsevier

Directory of Open Access Journals (DOAJ)

The DOAJ is very special academic database since all the articles indexed are open access and can be accessed freely of charge.

- Coverage: approx. 4.3 million items
- References: NA
- Discipline: Multidisciplinary
- Access options: free
- Provider: DOAJ

JOURNAL-LEVEL METRICS

What are research metrics?

Research metrics are the fundamental tools used across the publishing industry to measure performance, both at journal- and author-level.

Research metrics are sometimes controversial, especially when in popular usage they become proxies for multidimensional concepts such as research quality or impact. Each metric may offer a different emphasis based on its underlying data source, method of calculation, or context of use.

For a long time, the only tool for assessing journal performance was the Impact Factor – more on that in a moment. Now there are a range of different research metrics available. This "basket of metrics" is growing every day, from the traditional Impact Factor to Altmetrics, *h*-index, and beyond

Journal Impact Factor (JIF)

The **impact factor (JIF)** is a measure of the frequency with which the average article in a journal has been cited in a particular year. It is used to measure the importance or rank of a journal by calculating the times it's articles are cited.

How Impact Factor is Calculated?

The calculation is based on a two-year period and involves dividing the number of times articles were cited by the number of articles that are citable.

Calculation of 2010 IF of a journal:

A = the number of times articles published in 2008 and 2009 were cited by indexed journals during 2010.

B = the total number of "citable items" published in 2008 and 2009.

A/*B* = 2010 impact factor

CiteScore

It is the number of citations received by a journal in one year to documents published in the three previous years, divided by the number of documents indexed in Scopus published in those same three years.

CiteScore for 2015 counts the citations received in 2015 to documents published in 2012, 2013 or 2014, and divides this by the number of documents published in 2012, 2013 and 2014.

What are the differences between CiteScore and Impact Factor?

1. CiteScore is based on the Scopus database rather than Web of Science. This means the number of citations and journal coverage in certain subject areas is notably higher.
2. CiteScore uses a three-year citation window, whereas Impact Factor uses a two-year citation window.
3. The CiteScore denominator includes all content published in the journal. The Impact Factor denominator includes only articles and reviews.
4. CiteScore covers all subject areas, whereas the Impact Factor is only available for journals indexed in the SCIE and SSCI.

CiteScore suffers from some of the same problems as Impact factor; namely that it isn't comparable across disciplines and it is a mean calculated from a skewed distribution

SNIP - Source Normalized Impact per Paper

SNIP is a journal-level metric which attempts to correct subject-specific characteristics, simplifying cross-discipline comparisons between journals. It measures citations received against citations expected for the subject field, using Scopus data. SNIP is published twice a year and looks at a three-year period.

The SNIP calculation is:

Journal citation count per paper, divided by citation potential in the field.

SNIP normalizes its sources to allow for cross-disciplinary comparison. In practice, this means that a citation from a publication with a long reference list has a lower value.

SNIP only considers citations to specific content types (articles, reviews, and conference papers), and does not count citations from publications that Scopus classifies as "non-citing sources". These include trade journals, and many Arts & Humanities titles.

SJR - Scimago Journal Rank

The SJR aims to capture the effect of subject field, quality, and reputation of a journal on citations. It calculates the prestige of a journal by considering the value of the sources that cite it, rather than counting all citations equally.

Each citation received by a journal is assigned a weight based on the SJR of the citing journal. So, a citation from a journal with a high SJR value is worth more than a citation from a journal with a low SJR value.

The SJR calculation is:

Average number of (weighted) citations in a given year to *Journal X*, divided by the number of articles published in *Journal X* in the previous three years.

As with SNIP and CiteScore, SJR is calculated using Scopus data.

Eigenfactor

In 2007, the Web of Science JCR grew to include Eigenfactors and Article Influence Scores (see below). Unlike the Impact Factor, these metrics don't follow a simple calculation. Instead, they borrow their methodology from network theory.

What is an Eigenfactor?

The Eigenfactor measures the influence of a journal based on whether it's cited within other reputable journals over five years. A citation from a highly-cited journal is worth more than from a journal with few citations.

To adjust for subject areas, the citations are also weighted by the length of the reference list that they're from. The Eigenfactor is calculated using an algorithm to rank the influence of journals according to the citations they receive. A five-year window is used, and journal self-citations are not included.

This score doesn't take journal size into account. That means larger journals tend to have larger Eigenfactors as they receive more citations overall. Eigenfactors also tend to be very small numbers as scores are scaled so that the sum of all journal Eigenfactors in the JCR adds up to 100.

Very roughly, the Eigenfactor calculation is:

Number of citations in one year to content published in Journal X in the previous five years (weighted), divided by the total number of articles published in Journal X within the previous five years.

Article Influence Score

What is an Article Influence Score?

The Article Influence Score is a measure of the average influence of a journal's articles in the first five years after publication. A score greater than 1.00 shows above-average levels of influence.

The Article Influence Score calculation is:

(0.01 x Eigenfactor of *Journal X*) divided by (number of articles published in *Journal X* over five years, divided by the number of articles published in all journals over five years).

These are then normalized so that the average journal in the JCR has a score of 1.

Like 5-year Impact Factors, journals don't receive an Article Influence Score unless they have been covered by the JCR for at least five years, or from Volume 1.

Altmetrics

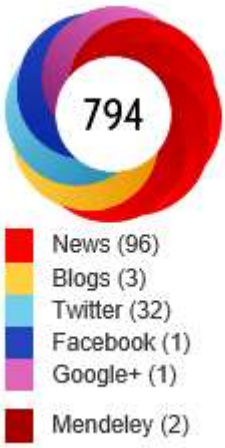
What are altmetrics?

Alternative metrics (or "altmetrics") help you to measure the impact of a journal by looking at the social activity around it. They use quantitative and qualitative data alongside traditional citation- and usage-based metrics to provide an insight into the attention, influence and impact of academic research.

The most common method of reporting on altmetrics is the Altmetric Attention Score. This tool tracks a wide range of online sources to capture the conversations happening around academic research.

How is the Altmetric Attention Score calculated?

Altmetric monitors each online mention of a piece of research and weights the mentions based on volume, sources, and authors. A mention in an international newspaper contributes to a higher score than a tweet about the research, for example.



The Altmetric Attention Score is presented within a colorful donut. Each color indicates a different source of online attention (ranging from traditional media outlets to social media, blogs, online reference managers, academic forums, patents, policy documents, the Open Syllabus Project, and more). A strong Altmetric Score will feature both a high number in the center, and a wide range of colors in the donut.

Discover the different ways you can make Altmetric data work for you by reading this introduction from Altmetric's Head of Marketing, Cat Chimes.

Popular Research Indices Currently Used:

Research indices are calculated based on either citation values of research publications of a research scholar or the number of research papers published by a research scholar for a given period. There are many research indices developed in various by many researchers which include H-, i10-, G-, H(2)-, HG-, Q2-, AR-, M-quotient, M-, W-, Hw-, E-, A-, R-, W-, J-index, etc. [6]. Out of these citation-based research indices, hindex, G-index and i10-index are commonly used in some of the Citation databases. Table 1, lists some of the popular research indices used based on Citations.

S.No	Research Indices	Developer	Commonly using in Citation Databases
1	h-index	Jorge Hirsch (2005)	Web of Science Indexing. Scopus Indexing. Google Scholar Indexing. Chemical Abstracts
2	G-Index	Leo Egghe (2006)	Encyclopaedia of Information Science and Technology
3	i10-Index	Google (2011)	Google scholar indexing.
4	R-index	Reserchgate	Reserchgate
5	m-index	Jorge Hirsch	Improvement in H-index

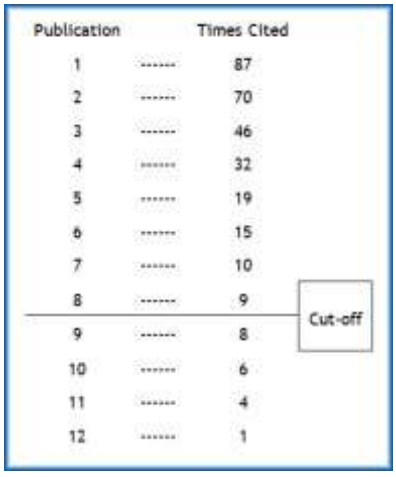
H-index

What is the H-index and how is it calculated?

The H-Index is a numerical indicator of how productive and influential a researcher is. It was invented by Jorge Hirsch in 2005, a physicist at the University of California. Originally, Professor Hirsch wanted to create a numerical indication of the contribution a researcher has made to the field.

Calculating your h-index

Your h-index is based on a list of your publications ranked in descending order by the Times Cited count. The value of h is equal to the number of papers (N) in the list that have N or more citations.In the example below, the researcher would have an h-index of 8, as 8 articles have been cited at least 8 or more times, and the remaining articles have each been cited 8 times or less.



The h-index is calculated by counting the number of publications for which an author has been cited by other authors at least that same number of times. For instance, an h-index of 17 means that the scientist has published at least 17 papers that have ***each*** been cited ***at least*** 17 times. If the scientist's 18th most cited publication was cited only 10 times, the h-index would remain at 17. If the scientist's 18th most cited publication was cited 18 or more times, the h-index would rise to 18.

i10-Index:

i10-Index is the number of publications of an author with at least 10 citations. This very simple measure is only used by Google Scholar and is another way to help gauge the productivity of a scholar.

G-Index:

G-index is an improved version of h-index. In the theory and practice of the g-index, the inventor, Leo Egghe aims to improve on the h-index by giving more weight to highly-cited articles. The g-index is an index for quantifying scientific productivity based on publications and calculated based on the distribution of citations received by a given researcher's publications. So, given a set of articles ranked in decreasing order of the number of citations that they receive, the g-index is the (unique) largest number such that the top g articles received (together) at least g2 citations. For the citations received and given a number of papers ranked in a decreasing order according to the citations received till now, the G-index is the biggest number such that the top G articles received (altogether) at least G2 (G square) citations.

M-Index:

The m-index, also proposed by Hirsch, is defined as h-index divided by the number of years since the researcher’s first publication. The index is meant to normalize the h-index so that early- and late-stage scientists can be compared. The m-index averages periods of high and low productivity throughout a career, which may or may not be reflective of the current situation of the scientist.

ETHICS IN RESEARCH

We start with two broad conceptions of the word *ethics*: the forging of bonds that create a community and the moral choices we face when we act in that community. The term *ethical*

comes from the Greek *ethos*, meaning either a community's shared *customs* or an individual's *character*, good or bad. But as does any social activity, research challenges us to depend on our individual ethical principles and then to make choices that honor or violate them. At a glance, a purely academic researcher seems on relatively safe ethical ground. No teacher will pay you to write a report supporting her views, and you probably won't have occasion to fake results to gain fame—like the American researcher who became famous (and powerful) for discovering an HIV virus, when he had in fact "borrowed" it from a laboratory in France.

Even so, you will face such choices from the very beginning of your project. Some are the obvious *Thou shalt not*s:

• Ethical researchers do not plagiarize or claim credit for the results of others.

• They do not misreport sources, invent data, or fake results.

• They do not submit data whose accuracy they don't trust, unless they say so.

• They do not conceal objections that they cannot rebut.

• They do not caricature or distort opposing views.

• They do not destroy data or conceal sources important for those who follow.

We move beyond simple conflicts between our own self- interest and the honest pursuit of truth, or between what we want for ourselves and what is good for or at least not harmful to others. If reporting research is genuinely a collaborative effort between readers and writers to and the best solution to shared problems, then the challenge is to find ways to create ethical partnerships to make ethical choices (what we traditionally call *character*) that can help build ethical communities. Such a challenge raises more questions than we can answer here. Some of those questions have answers that we all agree on; others are controversial. The three of us answer some of them differently. But one thing we agree on is that research offers every researcher an ethical invitation that, when not just dutifully accepted but *embraced*, can serve the best interests of both researchers and their readers.

• When you create, however briefly, a community of shared understanding and interest, you set a standard for your work higher than any you could set for yourself alone.

• When you explain to others why your research *should* change their understanding and beliefs, you must examine not only your own understanding and interests, but your responsibility to them if you convince them to change theirs.

• When you acknowledge your readers' alternative views, including their strongest objections and reservations, you move closer not just to more reliable knowledge, better understanding, and sounder beliefs, but to honoring the dignity and human needs of your readers.

In other words, when you do research and report it as a conversation among equals working toward greater knowledge and better understanding, the ethical demands you place on yourself should redound to the benefit of all—even when we cannot all agree on a common good. When you decline that conversation, you risk harming yourself and possibly those who depend on your work.

It is this concern for the integrity of the common work of a community that underscores why researchers condemn plagiarism so strongly. Plagiarism is theft, but of more than words. By not acknowledging a source, the plagiarist steals the modest recognition that honest researchers should receive, the respect that a researcher spends a lifetime struggling to earn. And that weakens the community as a whole, by reducing the value of research to those who follow.

That is true in all research communities, including the undergraduate classroom. The student plagiarist steals not only from his sources, but from his colleagues by making their work seem lesser by comparison to what was bought or stolen. When such intellectual thievery becomes common, the community grows suspicious, then distrustful, then cynical—*Everyone does it. I'll fall behind if I don't.* Teachers must then worry as much about not being ricked as about teaching and learning. What's worse, the plagiarist compromises her own education and so steals from the larger society that devotes its resources to training her and her generation to do reliable work later, work that the community will depend on. In short, when you report your research ethically, you join a community in a search for some common good. When you respect sources, preserve and acknowledge data that run against your results, assert claims only as strongly as warranted, acknowledge the limits of your certainty, and meet all the other ethical obligations on your report, you move beyond gaining a grade or other material goods—you earn the larger bene>t that comes from creating a bond with your readers. You discover that research focused on the best interests of others is also in your own.

Doing research is the best way to learn to read and think critically. And we know for a fact that the vast majority of our students will have careers in which, if they do not do their own research, they will have to evaluate and depend on the research of others. We also know that most of that research will be in written form, even if it happens to be delivered online. And we can think of no way to prepare for that responsibility better than doing research of one's own.

Ethical principles	Definition
Honesty	It is a must to achieve honesty in all science-related communication. The scientist must honestly present information on the data, results, research methods and procedures, and publication status. It is prohibited to falsify and distort the data, to deceive colleagues, agencies aiding grants, or the public.
Objectivity	Partiality should be avoided in the formulation of the research stages plan, analyzing and interpreting data, as well as evaluating the work of colleagues, recruiting the staff, writing applications for the award of grants, giving expert testimony, and other aspects of the scientific research where objectivity is essential. It is recommended to try to avoid partiality and self-deception. The researcher must disclose any personal or financial interests that might influence the scientific research.
Morality	The researcher must comply with the promises and agreements, be honest and seek the sustainability of thoughts and actions.
Prudence	The researcher must avoid careless errors and omissions. It is important to evaluate carefully and critically both own and colleagues' work. It is proposed to collect/systematize good, research-related activity (e.g., data collection, planning research stages and correspondence with agencies and journals), notes.
Openness	The researcher must share the data, ideas, tools, and resources, be open to criticism and new ideas.
Respect for intellectual property	The researcher must respect patents, copyright rights, and other forms of intellectual property, not to use unpublished research data, methods, or results without permission, quote where you must cite and thank properly for their help in the research. It is strictly forbidden for the researcher to plagiarize.
Confidentiality	The investigator must save confidential information, such as articles submitted for publication, records of employees, professional or military secrets and the records of patients' health stories.

Generalized summary of ethical principles.
Source: Compiled by the authors according to Shamoo and Resnik

References:

Aithal, P. S. (2017). Comparative study of various research indices used to measure quality of research publications. *International Journal of Applied and Advanced Scientific Research (IJAASR)-2 (1)*, 81-89.

Booth, W. C., Booth, W. C., Colomb, G. G., Colomb, G. G., Williams, J. M., & Williams, J. M. (2003). *The craft of research*. University of Chicago press.

Kumar, R. (2018). *Research methodology: A step-by-step guide for beginners*. Sage.

https://authorservices.taylorandfrancis.com/publishing-your-research/writing-your-paper/writing-a-journal-article/

https://editorresources.taylorandfrancis.com/understanding-research-metrics/

https://www.unl.edu/gradstudies/connections/twenty-steps-writing-research-article

https://www.intechopen.com/books/management-culture-and-corporate-social-responsibility/research-ethics