Research Methods for Construction
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Preface to Third Edition

We welcome the opportunity to both update and improve this book in order to extend and enhance its usefulness for researchers. The amendments reflect comments and suggestions from colleagues on the first two editions of the book as well as our own research progression into new areas of interest and study and the methods we have adopted and considered, together with feedback from students on undergraduate, postgraduate and research degrees whom we have supervised and to whom we have provided modules in research methods. We extend our thanks to all who have taken the trouble to advise us of potential improvements.

Throughout the production of this edition, as previously, we have endeavoured to be rigorous in scope and depth of content and to incorporate practical examples of applications of the methods to construction-oriented research. Our involvement with CIB (Conseil International du Bâtiment (International Council for Research and Innovation in Building and Construction)) groups, conferences and publications has proved invaluable in bringing us into contact with world-leading researchers in many construction fields which has greatly enriched our appreciation of the ever-growing wealth of research relating to construction both directly and indirectly.

However, we are also ever more aware of the pressures under which researchers must work, especially in terms of funding restrictions and quantity, as well as quality, of outputs – particularly, papers in refereed journals. At one end, information searching is vastly facilitated by the internet, whilst, at the other, journals proliferate. Both developments raise important issues of validity and reliability – the web remains (largely) unrefereed and unpoliced and so, the individual information-seeker must be the initial judge of reliability of what is retrieved whilst the proliferation of journals requires many more referees, and editors, to be ‘gatekeepers’ for maintenance and enhancement, of quality.

Despite the pressures and gripes, research is, for us, at least, the most stimulating and rewarding of pursuits, both in carrying out scholarship and empirical investigations ourselves and in assisting others as colleagues or
supervisors. The sheer joy of valid discovery remains boundless; we hope this new volume helps all its readers to enjoy research too.

Anita Liu
Richard Fellows
Hong Kong, December 2007
Preface to Second Edition

‘The scientist is not the person who knows a lot but rather the person who is not prepared to give up the search for truth.’ Popper (1989, p. 334); reporting Marx and Engels.

A discipline or profession is established by developing a body of knowledge which is unique – that body of knowledge is produced through research. Construction draws on a wide variety of established subjects, including natural sciences, social sciences, engineering and management, and applies them to its particular context and requirements. Only by use of appropriate methodologies and methods of research, applied with rigour, can the body of knowledge for construction be established and advanced with confidence.

Although a number of texts are available discussing research methodologies and methods generally, there is a notable lack of such books in construction. Statistics, philosophy, natural and social sciences have produced relevant texts; this book is aimed at the broad discipline of construction. In particular, the contents of this book will be useful to students of building, civil engineering, architecture, construction management and all forms of surveying, whether researching for dissertations for Bachelors or Masters degrees or undertaking research for Masters degrees or Doctorates. Further, the book will be helpful to practitioners and students in these disciplines in providing guidance on how to instil rigour in problem-solving and on producing reports and publications.

The approach adopted in the book is to outline the process of research: the initial recognition that research is necessary; the development of a proposal; the execution of the research; the drawing of conclusions; and the production and presentation of the final report. The book comprises three main parts – producing a proposal, executing the research and reporting the results. The book discusses the main issues in research and examines the primary approaches – both qualitative and quantitative. The methods adopted for scientific and engineering experiments and simulations are evaluated as well as those employed for research into managerial issues, and social and economic investigations.

In considering the requirements for data and data analyses, the book presents discussion of important statistical considerations and techniques.
These enable the researcher to appreciate the issues which need to be evaluated in devising how research may be carried out effectively and efficiently in the practical environment of modern construction activity. Thus, the book considers a range of methodologies and methods to facilitate selection of the most appropriate research approach to adopt (from an informed perspective). It provides sufficient depth in examination of the subject materials to facilitate the execution of research projects.

Increasingly, pleas are voiced seeking special treatment (leniency) for research in construction, based on arguments concerning the particular nature of construction and the problems of research which ensue. Unless the research proposed and undertaken in construction can withstand scrutiny on the same bases as all other research, the discipline will fail to advance adequately. As construction is of major importance to all societies and economies, it is essential that the discipline advances as rapidly and as rigorously as possible.

This book results from the combined experiences of the authors in executing, supervising and managing many types of research projects over a number of years in the United Kingdom and Hong Kong in particular. This second edition has been produced to extend the scope of coverage, especially with respect to qualitative research. In this endeavour, we are grateful to the many colleagues in academia and beyond who have taken the trouble to provide valuable and constructive criticism of the first edition.

The production of this new edition has encouraged us to scrutinise the total content and to produce a volume that is more comprehensive, both in scope and critical comment on the methods discussed.

Once again we offer our deepest thanks to Julia Burden and her colleagues at Blackwell Science who have been so encouraging and patient with us throughout the preparation of the book. We apologise for fraying their nerves on occasion and assume full responsibility for the content, including any errors, omissions and contentious statements.

We hope that all readers will find the book stimulating and useful. Good luck in your research.

Richard Fellows
Anita Liu
Part 1
Producing a Proposal
Chapter 1

Introduction

The objectives of this chapter are to:

• introduce the concept of research;
• provide awareness of different classifications of research;
• outline the essentials of theories and paradigms;
• discuss the various research styles;
• introduce quantitative and qualitative approaches;
• consider where, and how, to begin.

The concept of research

*Chambers English Dictionary* defines research as:

• a careful search
• investigation
• systematic investigation towards increasing the sum of knowledge.

For many people, the prospect of embarking on a research project is a daunting one. However, especially for people who are associated with a project-oriented industry, such as property development, building design, construction, or facilities management, familiarity with the nature of projects and their management is a significant advantage. Dr Martin Barnes, an ex-chairperson of the Association of Project Managers (APM), has described a project as a task or an activity which has a beginning (start), a middle and an end that involves a process which leads to an output (product/solution). Despite the situation that much research is carried out as part of a long-term
‘rolling’ programme, each individual package of research is itself a project – an entity which is complete in itself, whilst contributing to the overall programme.

Indeed, any work which assists in the advancement of knowledge, whether of society, a group or an individual, involves research; it will involve enquiry and learning also.

Research: a careful search/investigation

Research can be considered to be a ‘voyage of discovery’, whether anything is discovered or not. In fact, it is highly unlikely that no discovery will result because discovery can concern the process of investigation as well as the ‘technical subject’ (the topic of investigation). Even if no new knowledge is apparent, the investigation may lend further support for extant theory. What is discovered depends on the question(s) which the research addresses, the patterns and techniques of searching, the location and subject material investigated and the analyses carried out. The knowledge and abilities of researchers and their associates are important in executing the investigative work and, perhaps more especially, in the production of results and the drawing of conclusions. Being open-minded and as objective as possible is vital for good research.

Research: contribution to knowledge

The Economic and Social Research Council (ESRC) defines research as ‘...any form of disciplined inquiry that aims to contribute to a body of knowledge or theory’ (ESRC, 2007). That definition demonstrates that the inquiry must be appropriately deigned and structured and that it is the intent of the inquiry which is important (to distinguish from casual inquiries) rather than the outcome per se.

The Concise Oxford Dictionary (1995) provides a more extensive definition of research as ‘the systematic investigation into and study of materials, sources etc. in order to establish facts and reach new conclusions’. Here the emphasis lies on determining facts in order to reach new conclusions – hence, new knowledge. The issue of ‘facts’ is not as clear, philosophically speaking, as is commonly assumed, and will be considered later.

The dictionary continues: ‘an endeavour to discover new or collate old facts etc. by the scientific study of a subject or by a course of critical investigation’. Here there is added emphasis on the method(s) of study; the importance of being scientific and critical is reinforced.

Therefore, research concerns what (facts and conclusions) and how (scientific; critical) components.
Traditionally, the essential feature of research for a doctoral degree (PhD) is that the work makes an original (incremental) contribution to knowledge. This is a requirement for a PhD, and many other research projects also make original contributions to knowledge. A vast number of research projects synthesise and analyse existing theory, ideas, and findings of other research, in seeking to answer a particular question or to provide new insights. Such research is often referred to as scholarship; scholarship forms a vital underpinning for almost every type of research project.

Despite its image, research is not an activity which is limited to academics, scientists etc.; it is carried out by everyone many times each day. Some research projects are larger, need more resources and are more important than others.

Example
Consider what you would do in response to being asked, ‘What is the time, please?’
Having understood the question, your response process might be:

- look at watch/clock
- read time
- formulate answer
- state answer (‘The time is .’).

In providing an answer to the original question, a certain amount of research has been done.

A learning process

Research is a learning process … perhaps the only learning process.

Commonly, teaching is believed to be the passing on of knowledge, via instructions given by the teacher, to the learner. Learning is the process of acquiring knowledge and understanding. Thus, teaching exists only through the presence of learning and constitutes a communication process to stimulate learning; teaching is ‘facilitation of learning’. If someone is determined not to learn, they cannot be forced to do so, although they may be persuaded to learn through forceful means.

Contextual factors affecting research

Research does not occur in a vacuum. Research projects take place in contexts – of the researcher’s interests, expertise and experiences; of human contacts; of the physical environment etc. Thus, despite the best intentions
and vigorous precautions, it seems inevitable that circumstances, purpose etc., will impact on the work and its results. The fact that research is being carried out will itself influence the results, as described in the Hawthorne Investigations of Elton Mayo (1949) and noted in the writings of Karl Popper (1989) on the philosophy of research. Research is never a completely closed system. Indeed, much (good) research is, of necessity, an open system which allows for adaptability.

As research is always executed in context, it is important to consider the contextual factors, the environmental variables, which may influence the results through their impacting on the data recorded. Such environmental variables merit consideration in tandem with the subject variables – dependent, independent and intervening (see Fig. 1.1) – of the topic of study. The choice of methodology/methodologies is important in assisting identification of all relevant variables, their mechanisms and amounts of impact.

Example
Consider Boyle’s Law. Boyle’s Law states that, at a constant temperature, the volume of a given quantity of a gas is inversely proportional to the pressure upon the gas, i.e.

\[ V \propto \frac{1}{P} \]

\[ PV = \text{constant} \]

Laboratory experiments to examine Boyle’s Law attempt to measure the volumes of a particular quantity of gas at different pressures of the gas. The temperature is the environmental variable, to be held constant, the pressure is the independent variable and the volume is the dependent variable (following the statement of Boyle’s Law). The researcher’s breathing on the equipment which contains the gas may alter the temperature (otherwise constant) slightly and it will influence the results, though possibly not enough to be recorded. In such cases, the uncontrolled effects of environmental variables which impact on the results so that the relationship found is not in strict compliance with the statement of Boyle’s Law, are denoted ‘experimental error’.

Boyle’s Law, like the other gas laws, strictly applies only to a perfect gas, but for many ‘practical’ purposes, all gases conform to Boyle’s Law. For this reason, the purpose of the research is likely to be an important determinant of how the experiment is performed and to what level of accuracy. Considerations, such as those noted in respect of Boyle’s Law experiments, lead to research being classified as pure research and applied research. Slightly different views classify studies as either research or development whilst the
Classifications of research

Pure and applied research

Frequently, classification of work is difficult, not only due to the use of ‘fuzzy’ definitions but, more importantly, because the work occurs within a continuum. At one end there is ‘pure’ or ‘blue sky’ research such as the discovery of theories, laws of nature etc., whilst at the other, applied research is directed to end uses and practical applications. Most academics are encouraged to undertake research towards the ‘pure’ end of the spectrum whilst practitioners/industrialists tend to pursue development work and applications. Of course, particularly in contexts like construction, the vast majority of research is a combination of ‘pure’ and ‘applied’ research – of theory and applications.

Essentially, development and applications cannot exist without the basic, pure research whilst pure research is unlikely to be of great benefit to society without development and applications. Unfortunately, much snobbery exists within the research and development sectors – those who work in one sector all too often decry (or fail to value) the contributions of others who work in different sectors. Fortunately, the advances of Japanese industry and many individual organisations which recognise and value the synergetic contributions of the various sectors of the research spectrum are fostering a change in attitude such that research and development activities are recognised as being different and complementary – each with particular strengths, approaches and contributions to make.
Often, the difference concerns the questions to be addressed rather than the approaches adopted. Pure research is undertaken to develop knowledge, to contribute to the body of theory which exists – to aid the search for the ‘truth’. Applied research seeks to address issues of applications: to help solve a practical problem (the addition to knowledge is more ‘incidental’ than being the main purpose). The (not always material) distinction may be articulated as being that pure research develops scientific knowledge and so asks ‘is it true?’ whilst applied research uses scientific knowledge and so asks ‘does it work?’

Commonly, research, especially applied research (located towards the developmental end of the research spectrum), involves solving problems. A simple dichotomous classification of types of problem is:

1. **Closed (ended) problems** – simple problems each with a correct solution. The existence of the problem, its nature and the variables involved can be identified easily. Such problems are common, even routine, and so can be dealt with easily (often via heuristics/routines) to give the single correct solution. The problems are ‘tame’.

2. **Open (ended) problems** – tend to be complex; the existence of the problem may be difficult to identify, the situation is likely to be dynamic and so, the variables are difficult to isolate. Finding a solution is hard and may require novel ideas (e.g. through ‘brainstorming’). It may not be (very) evident when a solution has been reached and many alternative solutions are likely to be possible. Such problems are ‘wicked’, ‘vicious’ or ‘fuzzy’ and may well concern/involve insight.

Clearly, most problems requiring research for their solution are likely to be open ended. However, in solving problems there are many sources of influence (bias) which may impact on the people involved – not least the approaches adopted for solving and the solutions determined for closed-ended problems.

**Quantitative and qualitative research**

The other primary classification system concerns the research methods adopted – broadly, quantitative and qualitative research. Quantitative approaches adopt ‘scientific method’ in which initial study of theory and literature yields precise aims and objectives with proposition(s) and hypotheses to be tested – conjecture and refutation may be adopted, as discussed by authors such as Popper (1989). In qualitative research, an exploration of the subject is undertaken without prior formulations – the object is to gain understanding and collect information and data such that theories will emerge. Thus, qualitative research is a precursor to quantitative research. In an ‘advanced’ body of
knowledge, where many theories have been developed and laws have been established, quantitative studies of their applicabilities can be undertaken without the need to determine theories and such afresh, thereby avoiding, ‘reinventing the wheel’ for each new study.

Generally, quantitative approaches provide ‘snapshots’ and so, are used to address questions such as what, how much, how many? Thus, the data, and results, are instantaneous or cross-sectional (e.g. compressive strength of a concrete cube; number of firms in an industry; market price of an item; content of an Architect’s Instruction). Qualitative approaches seek to find out why things happen as they do; to determine the meanings which people attribute to events, processes and structures, etc. Many qualitative studies use data regarding people’s perceptions to investigate aspects of their social world; others seek to ‘go deeper’ to address people’s assumptions, prejudices, etc. to determine their impacts on behaviour and, thence, (organisational/project) performance.

The fundamental issues in designing any research, and so, underpin the selection of quantitative, qualitative or combination approaches, concern the research question and constraints and, perhaps most particularly, what is to be measured and the requirements of reliability and validity.

Sometimes qualitative research is assumed to be an easy option, perhaps in an attempt to avoid statistical analyses by persons who do not excel in mathematical techniques. Such an assumption is seriously flawed – to execute a worthwhile research project using qualitative methods can be more intellectually demanding than if quantitative methods had been employed. The use of qualitative methodologies should not necessarily be assumed to be a ‘soft option’.

Irrespective of the nature of the study, rigour and objectivity are paramount throughout. Drenth (1998, p. 13) defines objectivity as ‘... the degree to which different observers of judges are able to record the data in the same manner. Judgement or classification of data in scientific research should not be substantially influenced by the subjectivity of the observer’. Thus, it is helpful if all the researchers agree the definitions of terms, metrics for collecting the data and the related protocols. Commonly, qualitative data, which are subjective data (such as obtained in opinion surveys), can and should be analysed objectively, often using quantitative techniques. However, one should not lose sight of the richness which qualitative data can provide and, often, quantitative data cannot. Triangulation – the use of qualitative and quantitative techniques together to study the topic – can be very powerful to gain insights and results, to assist in making inferences and in drawing conclusions, as illustrated in Fig. 1.2.

Research requires a systematic approach by the researcher, irrespective of what is investigated and the methods adopted. Careful and thorough planning are essential and, especially where large amounts of data are collected,
Fig. 1.2  Triangulation of quantitative and qualitative data.

rigorous record keeping is vital – in the study of theory and previous work (literature) as well as in the field work.

The impact of the researcher must be considered, both as an observer, experimenter, etc., whose presence may impact on the data collected and the results derived, and also through bias which may be introduced in data collection, analyses and inferences. Such biases may be introduced knowingly – to examine the subject from a particular viewpoint – or unknowingly, perhaps by asking ‘leading questions’.

Example
Consider the question, ‘Do you not agree that universities are under-funded?’

The phrasing, ‘Do you not agree that . . .’, suggests that the respondent ought to agree that universities are under-funded and so, asking such a question is likely to yield more responses of agreement than if the questions were phrased more objectively.

The question could be phrased much more objectively, ‘Do you believe that universities are:

(1) funded generously, or
(2) funded adequately, or
(3) funded inadequately?’
Even phrasing the question in that way, although removing the ‘agreement bias’ is incomplete as it assumes that all the respondents have a belief about the topic – some may not and so, a fourth possibility of ‘no opinion’ is appropriate. Unfortunately, that additional possibility also allows respondents to opt out of expressing their opinion!

**Other categories of research**

Further categorisation of types of research accords with the purpose of the research (question) as set out below.

- *Instrumental* – to construct/calibrate research instruments, whether physical measuring equipment or as tests/data collection (e.g. questionnaires; rating scales). In such situations the construction etc. of the instrument is a technological exercise; it is the evaluation of the instrument and data measurement in terms of meaning which renders the activity scientific research. The evaluation will be based on theory.

- *Descriptive* – to systematically identify and record (all the elements of) a phenomenon, process or system. Such identification and recording will be done from a particular perspective and, often, for a specified purpose; however, it should always be done as objectively (accurately) and as comprehensively as possible (this is important for later analysis). The research may be undertaken as a survey (possibly of the population identified) or as case study work. Commonly, such research is carried out to enable the subject matter to be categorised.

- *Exploratory* – to test, or explore, aspects of theory. A central feature is the use of hypotheses. Either an hypothesis is set up and then tested via research (data collection, analyses, interpretation of results) or a complex array of variables is identified and hypotheses are produced to be tested by further research.

- *Explanatory* – to answer a particular question or explain a specific issue/phenomenon. As in exploratory studies, hypotheses are used but here, as the situation is known better (or is defined more clearly), theory etc. can be used to develop the hypotheses which the research will test. Also, this could be a follow-on from exploratory research which has produced hypotheses for testing.

- *Interpretive* – to fit findings/experience to a theoretical framework or model; such research is necessary when empirical testing cannot be done (perhaps due to some unique aspects – as in a particular event of recent history, e.g. ‘the Asian financial crisis of 1997’). The models used may be heuristic (using rules of thumb) – in which variables are grouped
according to (assumed) relationships – or ontological, which endeavour to replicate/simulate the ‘reality’ as closely as possible.

A further categorisation of research concerns what is being investigated – product, process or both. Research in construction includes all three categories; research into structural integrity is product oriented (e.g. strength properties of materials etc.), construction management research tends to be process oriented (e.g. organisational culture of construction firms) or both process and product (e.g. the impact of different procurement approaches on project and project management performance). Van de Ven (1992) identifies a process as ‘... a sequence of events that describes how things change over time’.

Theories and paradigms

Losee (1993, p. 6) depicts Aristotle’s inductive–deductive method for the development of knowledge as shown in Fig. 1.3. He notes that, ‘scientific explanation thus is a transition from knowledge of a fact [point (1) in the diagram] to knowledge of the reasons for the fact [point (3)]’.

Development of knowledge

Popper (1972, 1989) argues that scientific knowledge is different from other types of knowledge because it is falsifiable rather than verifiable, tests can only corroborate or falsify a theory, the theory can never be proved to be true. No matter how many tests have yielded results which support or corroborate a theory, results of a single test are sufficient (provided the test is valid) to
Introduction

Fig. 1.4 Depiction of the approach to the advancement of knowledge, as advocated by Galileo (source: Losee 1993).

Criteria of demarcation

- Non-acceptable
- Acceptable

Scientific interpretation

- Non-scientific interpretations

Criteria of acceptability

falsify the theory – to demonstrate that it is not always true. The more general application for acceptability in scientific investigation is shown in Fig. 1.4.

Different philosophies consider that scientific theories arise in diverse ways. Cartesians, who hold a ‘rationalist’ or ‘intellectual’ view, believe that people can develop explanatory theories of science purely through reasoning, without reference or recourse to the observations yielded by experience or experimentation. Empiricists, maintain that such pure reasoning is inadequate, it is essential to use experience from observation and experimentation to determine the validity or falsity of a scientific theory. Kant (1934) noted that the scope of peoples’ knowledge is limited to the area of their possible experience; speculative reason beyond that, such as attempts to construct a metaphysical system through reasoning alone, has no justification.

Nagel (1986) suggests that the scientist adopts a ‘view from nowhere’ which implies the possibility of total objectivity and that phenomena exist totally independently of any observer. Conversely, Kuhn (1996) notes that what a man sees depends both upon what he looks at and also upon what his previous visual–conceptual experience has taught him to see.

Tauber (1997) observes that, as science has evolved, so the notion of what constitutes objectivity has changed such that different branches of science require/employ different standards of ‘proof’.

Dialectic, a development of ‘trial and error’, can be traced back to Plato who employed the method of developing theories to explain natural phenomena and followed this by a critical discussion and questioning of those theories; notably whether the theories could account for the empirical observations adequately. Thus, commonly, scientists offer theories as tentative solutions to
proposes; the theory is criticised from a variety of perspectives; testing the theory occurs, by subjecting vulnerable or criticised aspects of the theory to the most severe tests possible. The dialectic approach, following Hegel and discussed by authors such as Rosen (1982), is that a theory develops through the dialectic triad – thesis, antithesis and synthesis. The theory advanced initially is the thesis; often, it will provoke opposition and will contain weak points which will become the focus of opposition to it. Next, the opponents will produce their own counter-theory, the antithesis. Debate will continue until recognition of the strengths and weaknesses of the thesis and antithesis are acknowledged and the strengths of each are conjoined into a new theory, the synthesis. This is likely to regenerate the cycle of dialectic triad.

History, of course, has a role to play as it is likely to be influential, especially qualitatively, on how people think and behave in developing, criticising and interpreting theories. Popper (1989) uses the term ‘historicism’, whilst Clegg (1992) employs ‘indexicality’ to consider history’s impact on how people understand, interpret and behave. Indexicality is a person’s understanding etc. of terms and is determined by that person’s background, socialisation, education, training etc. Marx’s broad view was that the development of ideas cannot be understood fully without consideration of the historical context, notably the conditions and situations of their originator(s). It is possible to explain both formal social institutions (such as the UK parliament, the Sorbonne, the Supreme Court of USA, the Tokyo stock exchange, or the Royal Institution of Chartered Surveyors) and informal social institutions (such as friendship groups), by examining how people have developed them over the years.

Testing a theory

A theory is a system of ideas for explaining something; the exposition of the principles of science. Bacharach (1989) provides an amplified definition ‘...a theory may be viewed as a system of constructs and variables in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses. The while system is bounded by the theorist’s assumptions ...’. Constructs are ‘terms which, though not observational either directly or indirectly, may be applied or even defined on the basis of observables’ (Kaplan 1964, p. 55). A variable as an observable entity which may assume two or more values (Schwab 1980).

Popper (1972) notes four approaches to testing a theory:

- ‘The logical comparison of the conclusions among themselves, by which the internal consistency of the system is tested.'
• The investigation of the logical form of the theory, with the object of determining whether it has the character of an empirical or scientific theory.

• The comparison with other theories, chiefly with the aim of determining whether the theory would contribute a scientific advance should it survive our various tests.

• The testing of the theory by way of empirical applications of the conclusions which can be derived from it.

In particular, science provides rules for how to formulate, test (corroborate/falsify) and use theories.

Boolean logic states that concepts are polar in nature – they are either true or false. However, scientific theories are not of that form; they are not well defined, and so it is appropriate to consider a theory as being accepted due to the weight of supporting evidence (until falsified); rather akin to fuzzy logic. The value or usefulness of a theory may not be demonstrated by the use of probability alone; such probability must be considered in conjunction with the information contained in the theory. Broadly based, general theories may be highly probable but vague, due to their low information content; whilst precise or exact theories, with a high information content, may be of much lower probability. Theories with a high information content tend to be much more useful, which leads Blockley (1980) to require that appropriate measures to corroborate theories should be designed such that only theories with a high information content can achieve high levels of corroboration.

Tests (empiricism) can only corroborate or falsify a theory, as noted by Lakatos (1977). Losee (1993, p. 193) outlines Hempel’s (1965) notion of three stages for evaluating a scientific hypothesis:

'(1) Accumulating observation reports which state the results of observations or experiments;
(2) Ascertaining whether these observations confirm, disconfirm or are neutral toward the hypothesis; and
(3) Deciding whether to accept, reject or suspend judgement on the hypothesis in the light of this confirming or disconfirming evidence.'

Husserl (1970, p. 189) asserts that ‘the point is not to secure objectivity but to understand it’.

Scientific theories must be testable empirically. If a theory is true and one fact is known, often, another can be deduced. For example: if a theory states ‘all clay is brown’ and a sample provided is known to be clay, the deduction is that the sample will be brown. Provided the general statement of the theory is correct, in this case that all clay is brown, the deductive reasoning to go from
the general statement to the specific statement, that the sample of clay is brown, is valid. However, discovery of clay which is a colour other than brown will falsify the general theory and so, require it to be modified, if not abandoned. Hence, deduction is ‘safe’, given corroboration of the theory/hypothesis, but it does not allow knowledge to be advanced.

Inductive reasoning – from the specific example to the general statement – is not valid. A hypothesis is a supposition/proposition made, as a starting point for further investigation, from known facts. (However, in formal research terms, a proposition concerns constructs and relationships between them whilst a hypothesis concerns variables and relationships between those – see Chapter 5.) Induction is useful to yield hypotheses, such as that by inspecting a variety of samples it may be hypothesised that all clay is brown. Thus, whilst the hypothesis remains corroborated rather than falsified, deductions can be made from it. Advances are made by use of induction. As knowledge advances, hypotheses may require qualifying statements to be appended to them – such as that all clay of a certain type and found in a given location, is brown – such auxiliary statements lend precision by raising the information content of the hypothesis or theory.

Thus, deductive reasoning occurs within the boundaries of existing knowledge (and may reinforce those boundaries), whilst inductive reasoning is valuable in extending or overcoming boundaries to current knowledge but should be employed with due caution – scientifically, through the use of hypotheses to be tested. Thus, Orton (1997) notes that ‘Deductive research rhetorics tend to proceed from theory to data (theory, method, data, findings), while inductive research rhetorics tend to proceed from data to theory (method, data, findings, theory)’.

Exceptions to established general principles are called anomalies – instances in which the theory fails to provide a correct prediction of the particular reality. The presence of an anomaly usually promotes re-examination of the general principles/theory and, following further detailed investigation and use of the dialectic triad (see p. 14), the modification of the theory so that all the known instances are incorporated correctly.

The fallacy of affirmation occurs when certain observations apparently lead to particular conclusions regarding further relationships which appear to follow from the observations. However, without investigation of the validity of those conclusions on the basis of logical theory and empirical observation, false and misleading conclusions may ensue.

For example: Fact (1) Some penguins are flightless birds
Fact (2) Some penguins are chocolate biscuits
False conclusion: Some flightless birds are chocolate biscuits
A paradigm

A paradigm is a theoretical framework which includes a system by which people view events (a lens). The importance of paradigms is that they operate to determine not only what views are adopted, but also the approach to questioning and discovery. Hence, much work concerns verification of what is expected or explanation of unexpected results to accord with the adopted, current paradigms. As progressive investigations produce increasing numbers and types of results which cannot be explained by the existing paradigms’ theoretical frameworks, paradigms are modified or, in more extreme instances, discarded and new ones adopted – the well-known ‘paradigm shift’.

Normally, the advance of knowledge occurs by a succession of increments, hence it is described as evolutionary. Only rarely are discoveries made which are so major that a revolutionary advance occurs. Often, such revolutionary advances require a long time to be recognised and more time, still, for their adoption, such as Darwin’s theory of evolution. Hence, in terms of scientific progress, a theory which is valid at a given time is one which has not been falsified, or one where the falsification has not been accepted. Whilst objectivity is sought, research does have both cultural and moral contents and so, a contextual perspective, especially for social science research, is important to appreciate the validity of the study.

Kuhn (1996, p. 37) asserts that ‘… one of the things a scientific community acquires with a paradigm is a criterion for choosing problems that can be assumed to have solutions … A paradigm can … insulate a community from those socially important problems that are not reducible to the puzzle form because they cannot be stated in terms of the conceptual and instrumental tools the paradigm supplies.’

Positivism

Positivism originates in the thinking of Auguste Comte (1798–1857). It recognises only non-metaphysical facts and observable phenomena, and so is closely related to rationalism, empiricism and objectivity. Positivism asserts, in common with one branch of the Cartesian duality, that there are observable facts which can be observed and measured by an observer, who remains uninfluenced by the observation and measurement. Clearly, there is a strong relation to quantitative approaches.

However, the presence of ‘facts’ independent of the observer, and the feasibility of totally objective and accurate observation are being increasingly challenged. Whilst certain facts are, indeed, likely to exist independently of observation, this may be relevant and true as regards the ‘natural world’
only – the natural laws of the universe. Inevitably, observation and measurement affect what is being observed and measured (such as the issues involved in experiments to measure the temperature of absolute zero). Further, the matters of what is to be observed and measured, by whom, how, when, etc. are all determined by human decisions. Measurement may not be accurate for a variety of reasons, such as parallax, instrument error, etc.

In apparently separating reality of the natural world from those who attempt to observe and measure it, scientific positivism maintains the Cartesian duality to (supposedly) yield consistency of perception – the same inputs under the same circumstances yield the same outputs/results – the principle of replication.

Thus, Chia (1994) contrasts positivist and Kantian approaches as ‘Positivist theories . . . maintain that . . . laws and principles are empirically discoverable, while Kantian theory insists that the basic categories of logic, time and space are not “out there” but are inherent constituents of the mind.’

**Interpretivism**

The interpretive paradigm is particularly valuable for research in management (and other social arenas) by indicating that reality is constructed by the persons involved. Thus, one person’s reality, derived by observations and perceptions and modified by socialisation (upbringing, education and training) is likely to be different from another’s. Therefore, truth and reality are social constructs, rather than existing independently ‘out there’ and so, researchers should endeavour to determine truth and reality from the participants’ collective perspective(s) – to see things through their eyes. Such determination is likely to require extensive discussion with the participants, in order to achieve agreement on the representation (description) of their truth and reality and subsequent, further discussion to verify that the researcher’s representation is correct.

As the interpretive paradigm is more likely to feature in qualitative studies (although it is applicable to quantitative research), there also exists the risk of influence (bias) by powerful participants who may be either individuals or groups. Therefore, the impact of social structure should be considered, including the perspective of **structuralists**, who argue that structure is fundamental to how society operates and to the determination of its values, customs, etc. This may, of course, be ‘interactive cycling’ societal values help to determine social structure, which then impacts on values, and so on.

Knowledge, then, may be regarded as constituting reality with a human component in that it is what, perhaps only for a time and place, counts as reality in being accepted as such by individuals or the population. Science is a