# 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*.

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## 1.1 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 an entity which is complete in itself, while contributing to the overall programme.

*Research Methods for Construction*, Fourth Edition. Richard Fellows and Anita Liu.
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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.

### 1.1.1 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 likely that some 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 existing 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, the analyses carried out and, importantly, reflection by the researcher on the results of the analyses in the context of the theory and literature and methodology/methods employed. 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, discussion of them and the drawing of conclusions. Being open-minded and as objective as possible is vital for good research.

### 1.1.2 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 designed and structured appropriately 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 and so on 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 and so on 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 comprises *what* (facts and conclusions) and *how* (scientific; critical) components. Being critical, even sceptical, rather than merely accepting, is vital; evidence to support assertions, use of methods, production of findings and so on is essential. '… critical analysis questions the authority and objective necessity of the normative framework that is taken for granted … also challenges the adequacy of … accounts … ' (Willmott 1993: p. 522). Further, it is concerned to '… situate the development and popularity of ideas and practices … in the material and historical contexts of their emergence and application … ' (*ibid*: p. 521).

The history of the nature of investigations constituting research is paralleled by the continuum of activities undertaken in a modern research project – description, classification,

comparison, measurement, establishing (any) association, determining cause and effect (Bonoma 1985). 'Studies toward the description end of the continuum might be associated more frequently with *theory building*, whereas those near the cause-and-effect end are more frequently used for theory disconfirmation [testing]' ([..] added, *ibid*: p. 201).

Traditionally, the essential feature of research for a doctoral degree (PhD – Doctor of Philosophy) 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 (including PhD). However, the importance of scholarship is, all too often, not appreciated adequately – it informs and provides a major foundation upon which further knowledge is built, for both the topic of investigation and the methodology and methods by which investigations may be carried out.

Despite its image, research is not an activity which is limited to academics, scientists and so on; 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 heard and 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.

Clearly, it is the research question, or problem, that drives the research. Methodology, method(s), data and so on are determined to best suit answering the question validly, accurately and reliably. It is dangerous to adopt a method and then to hunt for questions and problems to which the method may be applied – it may not be (very) suitable and so, lead to difficulties and dubious results.

### *1.1.3 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.

### *1.1.4 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 and so on. Thus, despite the best intentions and rigorous precautions, it seems inevitable that circumstances, purpose and so on will impact on the work and its results (a 'Hawthorne effect' or a 'halo effect'). 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 research is, of necessity, an *open* system which allows for, and accommodates, adaptability (e.g. exploratory studies, processual research).

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. (Environmental variables and constructs are fundamental, express concerns of institutional theory; Scott 1995; Oliver 1997.) 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.

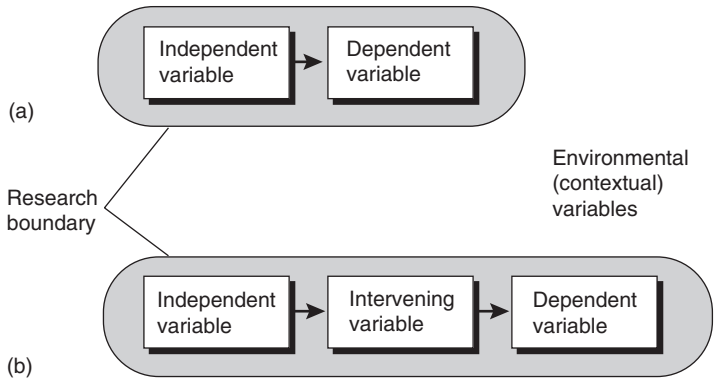



**Figure 1.1** 'Causality chain' between variables (see also Fig. 4.1, p. 105).

**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, that is,

$$V \propto \frac{1}{P}$$

$$PV = \text{constant}$$

Laboratory experiments to examine Boyle's Law attempt to measure the volumes of a particular quantity of gas at different pressures of that 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 as '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 purpose of a study often leads to academics' work being classified as research or consultancy. Ultimately, such categorisations may prove insignificant – knowledge should be improved continuously in quantity and quality and applied for advancing society, including the advancement of knowledge.

## 1.2 Classifications of research

### *1.2.1 Pure and applied research*

Frequently, classification of research is difficult, not only due to the use of "fuzzy" definitions but, more importantly, because the research occurs along a continuum. At one end, there is 'pure' or 'blue sky' research such as the discovery of theories, laws of nature and so on, 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. Both are vitally important.

Essentially, development and applications (innovations) cannot exist without the basic, pure research while 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 (synergistic continuous improvement) 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 '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.

### *1.2.2 Quantitative and qualitative research*

The other primary classification system concerns the research methods adopted (for collection and analysis of data) – 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 philosophers such as Popper (1989) and so, tend to be *explanatory*. In qualitative research, an exploration of the subject is undertaken, sometimes without prior formulations – the object may be to gain understanding and collect information and data such that theories will emerge and so, tends to be *exploratory* (as exemplified in *grounded theory*; Glaser and Strauss 1967). 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. Thus, Harrison *et al*. (2007: p. 1234) suggest that ' … qualitative research methods work best for developing new theoretical ideas and making interpretations of a theory or a phenomenon's significance; quantitative research is directed toward identifying general patterns and making predictions'.

The typology of Edmondson and McManus (2007) indicates appropriate methodologies according to the extent of development of research in a discipline. Research in construction is relatively 'nascent' or 'intermediate' in maturity and in matching to the fieldwork context. Hence, accentuation of exploratory studies using qualitative methods (rather than hypothesis testing and quantitative methods which are appropriate for mature disciplines/domains) is appropriate to foster development of construction knowledge.

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 and so on. 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 and so on to determine their impacts on behaviour and, thence, (organisational/project) performance.

The fundamental issues in designing any research, and so, underpinning 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 validity and reliability.

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 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 or judges are able to record the data in the same manner. Judgement or classification of data in scientific research should not be substantially influenced

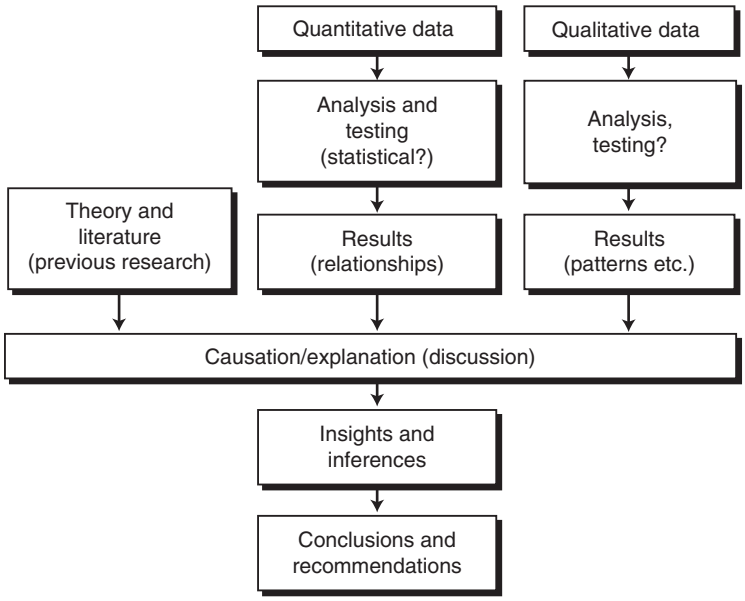



**Figure 1.2** Triangulation of quantitative and qualitative data.

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 (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 (see Van Maanen, 1988). 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 is essential and, especially where large amounts of data are collected, 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 and so on, whose presence will impact on the data collected and the results derived, and through bias which may be introduced in data collection, analyses and inferences. Such biases may be introduced knowingly – to investigate the subject from a particular viewpoint – or unknowingly, perhaps by asking 'leading questions'. Normally, the impact of the researcher and the execution of the research should be minimised through careful research design and execution; rigorous documentation and 'writing up' are vital and must specify the perspective/paradigm adopted (and rationale for its adoption).

**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 'leading' question is likely to yield more responses of agreement than if the question were phrased more objectively/neutrally.

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' should be included. Unfortunately, that additional possibility also allows respondents to opt out of expressing their opinion!

Tsoukas (1989: p. 551) cautions that ' … qualitative is a type of evidence rather than a research design' which, by analogy, applies to quantitative studies too.

### *1.2.3 Other categories of research*

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

- *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 and so on 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 (if any is applicable). A central feature is discovery of processes and so on, sometimes through the use of

propositions/hypotheses. A proposition or a hypothesis may be set up and then tested via research (data collection, analyses and interpretation of results). More usually, a complex array of constructs or/and variables is identified by the research and propositions/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, propositions/hypotheses are used but here, as the situation is known better (or is defined more clearly), theory and so on 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, for example 'the Asian financial crisis of 1997'). Interpretivism is founded on the '… assumption that human understanding and action are based on the *interpretation* of information and events by the people experiencing them … ' (Gioia and Chittipeddi, 1991: p. 435). The models used may be heuristic (using 'rules of thumb') – in which variables are grouped 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: p. 169) identifies a process as '… a sequence of events that describes how things change over time'.

## 1.3 Theories and paradigms

Usually, research is distinguished from other investigations, searches, enquiries and so on by being 'scientific'; traditionally regarded as adoption of the 'scientific method'. Scientific method is 'a method of procedure that has characterized natural science since the seventeenth century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses: criticism is the backbone of the scientific method [in plural]:the process is based on presently valid scientific methods' (Oxford English Dictionary, 2013). Today, the concept of scientific method embraces quite diverse approaches and interpretations – to the extent that different sciences (natural, social etc.) tend to use different methods, leads to the conclusion that there is *no single "scientific method"*. However, traditionalism remains strong in that some empiricists and positivists refute any approach which does not conform to the traditional concept as being 'unscientific'!

Essentially, research, as a cognitive process, comprises a logic of discovery and the (subsequent) validation of discoveries – to promote refinement and further discovery. Unfortunately, some researchers may be unaware of their underlying ontological and

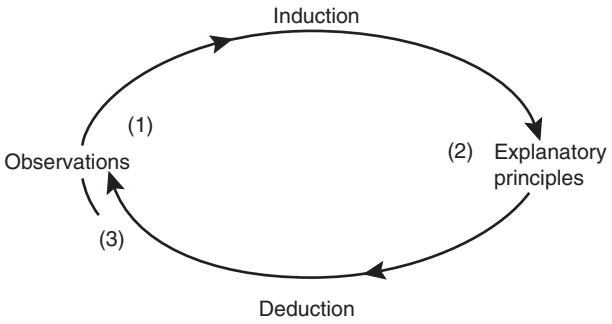



**Figure 1.3** Aristotle's inductive–deductive method (*Source*: Losee 1993).

epistemological beliefs and assumptions (which are founded in culture and early upbringing – see, n.b., Hofstede 2001) or, otherwise do not express those underpinnings in research reports and so on. The ontological and epistemological bases of research are fundamental as they inform all research activities – notably, using and developing theory, which denotes what elements in the world are relevant to the topic of investigation and how those elements are related to each other and to context (Van Maanen *et al*. 2007).

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)]'.

### *1.3.1 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 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 so, it is essential to use results and knowledge (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

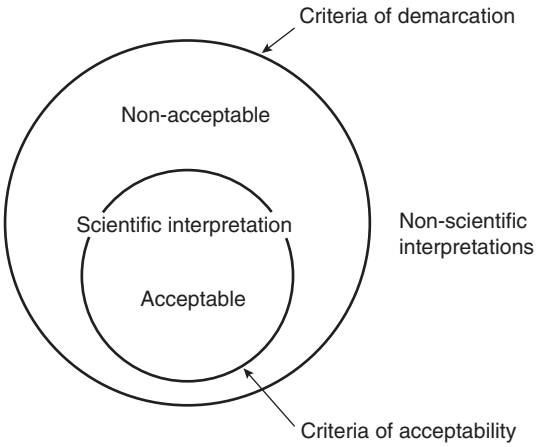



**Figure 1.4** Depiction of the approach to the advancement of knowledge, as advocated by Galileo (*Source*: Losee 1993).

observer. Conversely, Kuhn (1996: p. 113) 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' (as employed in sensemaking, Weick, 1995 – how people determine meaning).

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 problems; 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 and testing 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.

Stinchcombe (2002) postulates an alternative framework for the development of theory. The framework comprises three mechanisms that, usually, occur in the sequence of '(i) Commensuration, or the standardisation of theoretical constructs, definitions or processes that enable comparison across theorisations; (ii) evangelism, or the zealous conversion of adherents to a particular theoretical or methodological stance and (iii) truth-telling, or critical tests that can detect the most veridical theories in a particular field' (Glynn and Raffaelli 2010: p. 362).

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 and so on of terms and is determined by that person's background, socialisation, education, training and so on. 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.

As domains and disciplines mature, in terms of research relating to them, the research tends to progress through the chronological frameworks, noted earlier. Research in construction is relatively nascent and so, draws on more established research disciplines (materials science, chemistry, physics, economics, psychology etc.). In determining how to progress research, Glynn and Raffaelli (2010: p. 390) advise that 'A research strategy of compartmentalisation treats different theoretical perspectives within an academic field as fairly independent of one another, more as stand alone silos of thought. Essentially, compartmentalisation reflects incommensuration across theoretical boundaries … , or the absence of a commonly shared standard for theoretical evaluation or integration. The result is that different theoretical perspectives are neither compared nor combined in meaningful ways'. Such an approach is particularly detrimental to a field such as construction in which aspects of various, diverse disciplines are integrated for good practice; unfortunately, the 'silo' perspective may be emphasised in research funding of narrowly defined programmes which, often, focus on solving particular (industry-based) problems.

However, Glynn and Raffaelli (2010: p. 392) also note that 'Theoretical integration can result from commensuration … which enables comparison and consolidation across theories and, in this, can result in the kind of cumulative knowledge that grows in explanatory power over time … ' – an important component of organisational learning and learning organisations.

### *1.3.2 Testing a theory*

A *theory* is a system of ideas for explaining something; the exposition of the principles of science. Bacharach (1989: p. 498) 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 whole system is bounded by the theorist's assumptions … '. In particular, ' … a theory … makes its assumptions clear and empirically testable' (Mir and Watson 2001: p. 1170). Notably, 'The primary goal of a theory is to answer questions of *how, when*, and *why*, unlike the goal of description, which is to answer the question of *what*' (Bacharach 1989: p. 498).

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) – such

as an index number; for example, BCIS Tender Price Index or Building Cost Index. However, Suddaby (2010: p. 354) cautions that ' … different research traditions … have different interpretations of how constructs are constituted and how they should be used … '. A variable is an observable entity which may assume two or more values (Schwab 1980) – such as the constituents of an index number; for example, the price (at a specified date) of a tonne of 15 mm rebar.

Popper (2002: p. 9) 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 always well defined, and so, it is appropriate to consider a theory as being accepted due to the weight of supporting/confirming 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 (generic) and so, difficult to falsify; whilst precise or exact theories, with a high information content (specific), may be of much lower probability and so, quite easy to falsify – due to their narrow scope of applicability. 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'.

Traditionally, 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.

There are three major forms of inference by which people draw conclusions from data (facts); alternatively, these are regarded as forms of reasoning – deduction, induction and abduction.

In deductive inferences, what is inferred is necessarily true provided the premises from which the inference is made are true; thus, the truth of the premises guarantees the truth of the conclusion. For example, all clays are cohesive soils; this sample of soil is London clay; therefore, London clay is a cohesive soil (a necessary inference).

Inductive inferences may be characterised as those inferences that are based on statistical data only. Commonly, the data are in the form of observed frequencies of occurrences of a particular feature in a prescribed population. For example, 95% of type 'X' projects over-run on final cost by 10%; this is a type 'X' project; therefore, this project will (strictly, is 95% likely to) over-run on cost by 10% (not a necessary – but a statistically likely – inference).

Abductive inferences are similar to inductive inferences but without a (strict) basis in statistical data – they may be quite subjective. For example, most construction managers in the United Kingdom are male; Al is a construction manager in the United Kingdom; therefore, Al is male (not a necessary – but a highly likely – inference).

Inductive reasoning – from the specific example to the general statement – is not valid (without the statistical caveat – perhaps in the form of confidence intervals). 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; for example 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: p. 422) 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)'.

Abductive reasoning, as formally developed by C. S. Pierce, 'is the process of forming an explanatory hypothesis. It is the only logical operation which introduces a new idea' (Pierce 1903: p. 216; cited in Suddaby 2006: p. 639). Dubois and Gadde (2002) employ abductive reasoning to develop a method which they call 'systematic combining' which ' … is a process where theoretical framework, empirical fieldwork, and case studies evolve simultaneously, and is particularly useful for development of new theories' (p. 554). In a grounded theory context, Suddaby (2006: p. 639) notes that it is termed '" … analytic induction", the process by which a researcher moves between induction and deduction while practicing the constant comparative method'.

Abduction commences from an unexpected situation (a surprise, given prevailing knowledge); the reasoning, then, ' … works backward to invent a plausible world or a theory that would make the surprise meaningful' (Van Maanen *et al*. 2007: p. 1149). More specifically, abduction comprises ' … (i) the application of an established interpretive rule (theory), (ii) the observation of a surprising – in the light of the interpretive rule – empirical phenomenon, and (iii) the imaginative articulation of a new interpretive rule (theory) that resolves the surprise' (Alvesson and Kärreman, 2007: p. 1269).

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. |

Finally, theories must be evaluated – for use in research and in application to practical situations. Criteria for evaluation include internal consistency, validities, logic of content and structure, organisation of the theory's content and relationship to the existing body of (other) theory, clarity and parsimony, and reliability.

### *1.3.3 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 – which leads Mir and Watson (2000: p. 941) to describe a paradigm as ' … a characteristic set of beliefs and perceptions held by a discipline … '. Inevitably, the set of beliefs and perceptions and so on are important in that they impact on any study, thus, 'Within a subjective paradigm [especially], such as the interpretive, interests and biases become central. They need to be declared … ' to facilitate understanding of the findings ([ ] added, Williamson

2002: p. 1391). Hence, much work concerns verification of what is expected or/and 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'.

In 'High paradigm fields … there is 'shared theoretical structures and methodological approaches about which there is a high level of consensus' (Cole 1993: p. 112, cited in Pfeffer 1993: p 599); low paradigm fields lack such consensus and, instead, proliferate varieties of theories and methods about which there is little agreement' (Glynn and Raffaelli 2010: p. 362).

### *1.3.4 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, which remain uninfluenced by the observation and measurement. Thus, in classical positivism ' … a scientific theory was meaningful if, and only if, its elements could be empirically examined using objective data' (Alvarez and Barney 2010: p. 560). 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 (e.g. 'halo' effect, 'Hawthorne' effect, Heisenberg's uncertainty principle). 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, what is to be observed and measured, by whom, how, when and so on are all determined by human decisions. Measurement may not be accurate for a variety of reasons, such as

parallax, instrument error and so on. (See Fellows and Liu 2000 for a discussion relating to pricing construction projects.)

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 and the research criterion of reliability.

Thus, Chia (1994: p. 797) 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'.

### 1.3.5 Interpretivism

Interpretivism may be regarded as an opposite of determinism. While determinism asserts that each and every event or situation is the necessary and inevitable (direct) consequence of prior events and situations, interpretivism argues that reality is relative and so, there can be many different, valid realities; the task of research is to interpret and understand those realities rather than to determine cause–effect relationships for general, predictive purposes.

The interpretive paradigm is particularly valuable for research in management (and other social arenas) by indicating that reality is constructed by the persons involved (social constructivism). 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 (as in ethnographic research). 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. Further, symbolic interactionists argue that truth '… results from both the act of observation and the emerging consensus within a community of observers as they make sense of what they have observed' (Suddaby 2006: p. 633).

As the interpretive paradigm is more likely to feature in qualitative studies (although it is applicable to quantitative research also), there is a 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 and customs. This may, of course, be 'interactive cycling' as 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 mechanism for establishing and refining knowledge, as noted earlier, but with a focus on validation – itself a human process.

Tauber (1997: p. 3) notes that 'science is indeed a social phenomenon, but a very special one, because of the constraints exerted by its object of study and its mode of analysis'.

Pickering's (1992: p. 1) view is that 'scientific knowledge itself had to be understood as a social product'. That perspective is echoed by Pettigrew (1997: pp. 338–339), who asserts that 'Actions are embedded in contexts which limit their information, insight and influence … the dual quality of agents and contexts must always be recognised. Contexts are shaping and shaped, actors are producers and products … interchange between agents and contexts occurs over time and is cumulative'.

The objectivity requirement of scientific positivism requires that knowledge of the observer is excluded. If personal knowledge (Polanyi 1962) – including intuitions and insights – are actually excluded, questions arise as to how investigations are instigated, how they are carried out and how conclusions are formulated. If we assume that investigations – research projects – do not just happen by pure chance but are initiated by cognitive motivation (e.g. career development), then decisions (human, goal-directed actions) are taken to answer the basic investigative questions. Further, such motivational drives are determined by society and are likely to reflect and to perpetuate current perspectives of proper investigation of subjects and methods, often by use of 'immunising strategy' involving only incremental, evolutionary change. Revolutions require bold challenges (Kuhn 1996) – such as that of Galileo.

Golinski (1990: p. 502) notes that the choices made by scientists and their managers ' … are constrained by their aims or interests and by the resources they select to advance them'.

Perhaps, it is more useful that the most suitable approaches to investigation, including the various forms of testing, are applied with rigour so that knowledge advances by employing models of maximum usefulness – following the high information content approach advocated by Blockley (1980). Such advances of science accept the roles of all types of inputs and testing – indeed, give credit to the role of triangulated approaches to modelling, testing, theory construction and paradigm 'drift' (a progressive, iterative movement between paradigms).

Whilst it is common for techniques themselves to be regarded as being 'value free', the selection of techniques to be used is 'value laden', due to indexicality (e.g. Clegg 1992) and associated factors. However, techniques are devised and developed by researchers, and so, encapsulate the values of those involved in formulating the techniques – leading to debate over the merits of alternative techniques and their applications. Such potential for biases continues throughout the modelling process, and indeed may be made explicit – as in adopting a particular theoretical position to build an economic model.

Orton (1997: p. 421) expresses the philosophical question underpinning the positivism – interpretivism debate as ' … whether theories are discovered, implying the existence of an objective world, or generated, implying the existence of a socially constructed world'. Thus, Pettigrew (1997: p. 339) observes that 'Scholars are not just scientists, they remain obstinately human beings and as such are carriers of assumptions, values and frames of reference which guide what they are capable of seeing and not seeing'.

Thus, ' … the interpretive paradigm would reject determinism and universal rules .... Its anti-positivist epistemology would not be concerned with whether samples are representative of wider populations, but with validity in the sense of findings' being representative interpretations of the world of the research subjects … ' (Williamson 2002: p. 1381).

### *1.3.6 Models and hypotheses*

A primary use of theory is to facilitate prediction. Instances where theories fail to predict correctly are anomalies. However, if a number of serious anomalies occur, the theory is likely to be rejected in favour of an alternative which is more appropriate: one which explains all the occurrences more accurately. That leads to theories which may be modified by auxiliary statements. Eventually, the theory may be rejected in favour of another theory of wider, accurate predictive ability. During the period of modifications and potential substitutions of theories, the 'competing' theories may be the subject of much debate in which advantages and disadvantages of each are considered to yield hierarchies of the theories continuously.

Another great value of theories is to enable researchers to produce models which show how the variables of a theory are hypothesised to interact in a particular situation. Such modelling is very useful in clarifying research ideas and limitations and to give insights into what should be investigated and tested.

## 1.4 Research styles

In determining what is the most appropriate approach (methodology and method(s)) to adopt – the research design – the critical consideration is the logic that links the data collection and analysis to yield results, and, thence, conclusions, to the main research question being investigated. The aim is to ensure that the research maximises the chance of realising its objectives. Therefore, the research design must take into account the research questions, determine what data are required and how the data are to be collected and analysed.

Bell (1993) suggests styles of research to be Action, Ethnographic, Surveys, Case Study and Experimental. Yin (1994) considers that there are five common research strategies in the social sciences: *surveys*, *experiments* (including quasi-experiments), *archival analysis*, *histories* and *case studies*. Unfortunately, definitions of such styles vary and so, at best, the boundaries between the styles are not well defined.

Each style may be used for explanatory or descriptive research. Yin (1994) suggests that determination of the most appropriate style to adopt depends on the type of research operation (what, how, why etc.), the degree of control that the researcher can exercise over the variables involved and whether the focus of the research is on past or current events (future events concern predictions/forecasts – which are not research but may be derived from research). Requirements of the major research styles are set out in Table 1.1.

**Table 1.1** Requirements of different research styles/strategies.

| Style/Strategy | Research Questions | Control Over Independent Variables | Focus on Events |
|---|---|---|---|
| Survey | Who, what, where, how many, how much? | Not required | Contemporary |
| Experiment/Quasi-experiment | How, why? | Required | Contemporary |
| Archival analysis | Who, what, where, how many, how much? | Not required | Contemporary /past |
| History | How, why? | Not required | Past |
| Case study | How, why? | Not required | Contemporary |

*Source*: Derived from Yin (1994).

### *1.4.1 Action research*

Generally, action research involves active participation by the researcher in the process under study, in order to identify, promote and evaluate problems and potential solutions. Inasmuch as action research is designed to suggest and test solutions to particular problems, it falls within the applied research category, whilst the process of detecting the problems and alternative courses of action may lie within the category of basic research. The consideration of quantitative versus qualitative categories may be equally useful.

Action research (Lewin 1946) is where the research actively and intentionally endeavours to effect a change in a (social) system. Knowledge is used to effect the change which, then, creates knowledge about the process of change and the consequences of change (as well as of the change itself).

In programmes of action research, the usual cycle of scientific research (problem definition – design – hypothesis – experiment – data collection – analysis – interpretation) is modified slightly, by purpose of the action rather than by theoretical bases, to become 'research question – diagnosis – plan – intervention – evaluation', the 'regulative cycle' proposed by van Strien (1975) (in Drenth 1998).

Liu (1997) notes that action research is a shared process different from a hypothetical–deductive type of research. Thus, it is necessarily highly context dependent and so, is neither standardised nor permanent as it is reliant on the project and the knowledge and subjectivity/perceptions of the persons involved. Action research is operationalised to address a problem or issue which has been subject to structuring from use of theory.

The process of action research includes problem formation, action hypotheses, implementation, interpretation and diagnostic cycles (Guffond and Leconte 1995).

Action research is complex; the observer (who should provide a systematic perspective, relatively objectively) is involved and has the main role of creating a field for discussion and interpretation of the process and products. As change/innovation is the

subject matter of the research (and the processes continue in parallel), coordination and evaluation mechanisms are necessary which involve both the researcher and the participants.

In consequence of the nature, and objectives, of action research, Henry (2000: p. 669) asserts that three primary requirements exist:

(1) 'A trust-based relationship … built up beforehand … accepted by all parties …
(2) The researchers will have fully accepted the firm's or institution's objectives for innovation or change by having negotiated the extent to which they will be involved and their freedom as regards access to information and interpretation.
(3) A research and innovation project will be jointly drawn up, which must be open ended with regard to the problems to be explored, but very precise in terms of methodology … '

### *1.4.2 Ethnographic research*

The ethnographic ((scientific) study of races and cultures) approach demands less active 'intrusion' by the researcher and has its roots in anthropology. The researcher becomes part of the group under study and observes subjects' behaviours (participant observation), statements and so on to gain insights into what, how and why their patterns of behaviour occur. That dual role of researcher–participant necessitates very extensive recording of events and activities from as many perspectives as possible – including the contrasting roles of researcher and participant, and observations of potential bases of theory. Determination of cultural factors, such as value structures and beliefs, may result but the degree of influence caused by the presence of the researcher, and the existence of the research project, will be extremely difficult (if not impossible) to determine.

The empirical element of ethnography requires an initial period of questioning and discussion between the researcher and the respondents to facilitate the researchers' gaining understanding of the perspectives of the respondents. Such interaction involves the 'hermeneutic circle' of initial questioning and transformation as a result of that interaction, all of which is embedded in the subject tradition (paradigm) of the researcher. Thus, 'Any interpretive act is influenced, consciously or not, by the tradition to which the researcher belongs' (Baszanger and Dodier 1997: p. 12).

A further consideration is how the researcher integrates the empirical data and so on into a holistic perspective. The researcher's expertise and experience of field investigations represent a crucial moment in his/her education, prior to which he may have accumulated dissociated knowledge that might never integrate into a holistic experience; only after this moment will this knowledge 'take definitive form and suddenly acquire a meaning that it previously lacked' (Levi-Strauss 1974, quoted in Baszanger and Dodier 1997: p. 12).

Complementarily, a sociological or political perspective recognises that the investigator is part of the group being studied and so, is a viable member of the group and a participant in the group behaviour as well as being the observer – more akin to the action research approach.

Thus, the approach focuses attention on determining meanings and the mechanisms through which the members of the group make the world meaningful to themselves and to others.

### 1.4.3 Surveys

Surveys operate on the basis of statistical sampling; only extremely rarely are full population surveys possible, practical or desirable. The principles of statistical sampling – to secure a representative sample – are employed for economy and speed. On occasions, it may not be possible, or practical, to adopt statistical sampling methods; in such instances, the non-statistical sampling method adopted (e.g. convenience sampling) should be explained and justified in the context of the research.

Commonly, samples are surveyed through questionnaires or interviews. Surveys vary from highly structured questionnaires to unstructured interviews. Irrespective of the form adopted, the subject matter of the study must be introduced to the respondents. For a given sample size of responses required, particular consideration must be given to the response rate (i.e. the percentage of subjects who respond) and number of responses obtained. Following determination of the sample size required, appropriate procedures must be followed to assist in securing the matching of responses to the sample selected. This is a special consideration for 'stratified' samples classified into categories, usually by proportion of the total population under investigation or measured degrees of another important, continuous attribute.

### 1.4.4 Case studies

Case studies encourage in-depth investigation of particular instances within the research subject. The nature of the in-depth data collection may limit the number of studies, when research is subject to resource constraints. Cases may be selected on the basis of their being representative – with similar requirements/conditions to those used in statistical sampling to achieve a representative sample, to demonstrate particular facets of the topic or to show the spectrum of alternatives. (See also the detailed classification in Yin (1994).) Case study research may combine a variety of data collection methods, with the vehicle or medium of study being the particular case, manifestation or instance of the subject matter – such as a claim, a project, a batch of concrete.

Commonly, case studies employ interviews of key 'actors' (key informants) in the subject of study; such interview data may be coupled with documentary (archival) data (such as in a study of a production process). Alternatively, a case study may be 'situational', such as a wage negotiation or determining safety policy, and for such research, several 'cases' may be studied by individual or combined methods of ethnography, action research, interviews, scrutiny of documentation and so on. Hence, case studies constitute a distinct 'style' of research.

Case studies operate through theoretical generalisation, as for experiments, rather than empirical/statistical generalisation (as is the approach via surveys, which employ samples designed to be representative of the population such that results, and findings, from researching the sample can be inferred back to the population with a calculated level of confidence).

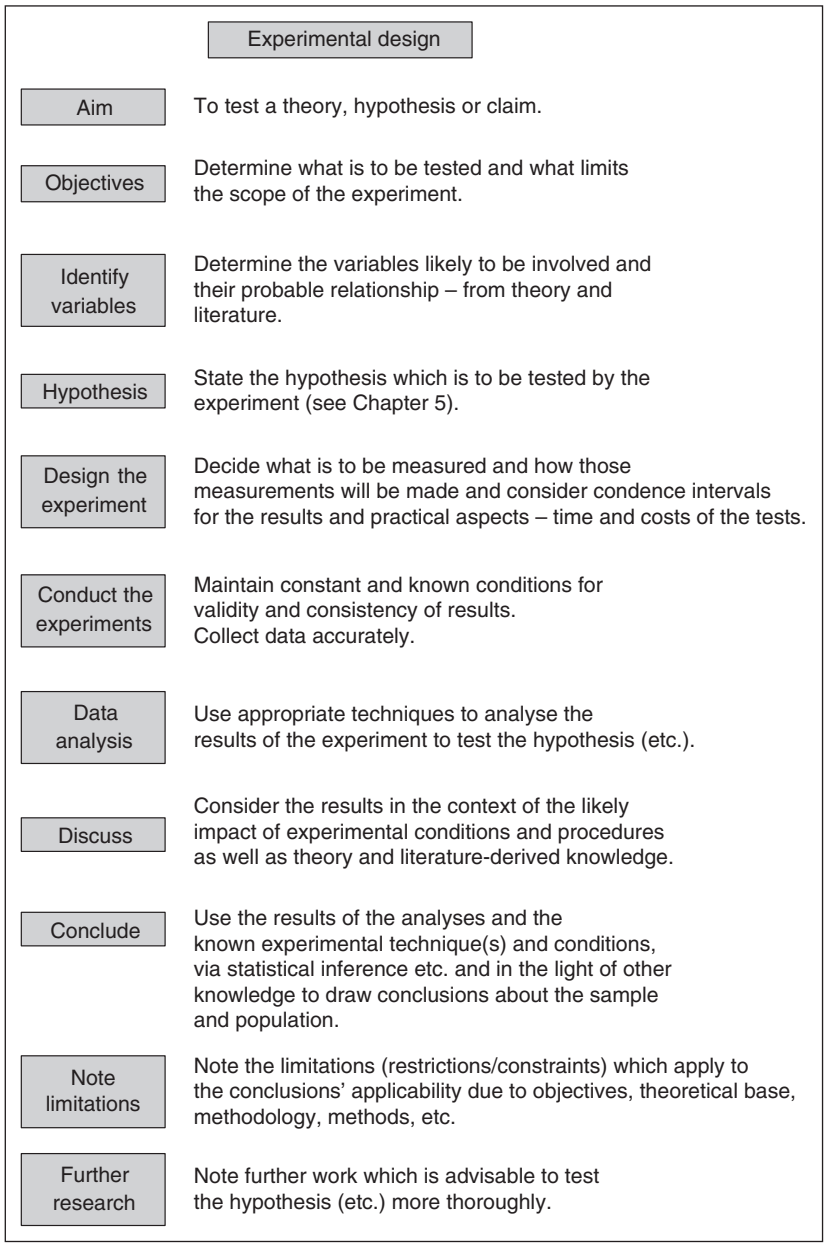



**Figure 1.5** Experimental design.

Flyvbjerg (2006: p. 242) reiterates the assertion of Kuhn (1996) regarding the importance of case studies in that '… a discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and that a discipline without exemplars is an ineffective one'.

### *1.4.5 Experiments*

The experimental style of research is, perhaps, suited best to 'bounded' problems or issues in which the variables involved are known, or, at least, hypothesised with some confidence. The main stages in experimental design are shown in Fig. 1.5. Usually, experiments are carried out in laboratories to test relationships between identified variables; ideally, by holding all except one of the independent variables constant and examining the effect on the dependent variable of changing that one independent variable. Examples include testing the validity of Boyle's Law, Hooke's Law and causes of rust experiments. However, in many cases, notably in social sciences and related subject fields, experiments are not conducted in specially built laboratories but in a dynamic social, industrial, economic, political arena. An example is Elton Mayo's 'Hawthorne Experiments' which took place in a 'live' electrical manufacturing company (Mayo 1949). Such instances are 'quasi-experiments' as the ability to control variables (independent and environmental) is limited and, often, coupled with measurement problems which impact on accuracy.

Thus, to regard a particular (geographical) area, even if tightly bounded (e.g. Isle of Man; Hong Kong), as a 'laboratory' in which studies of construction activities, real estate or town planning can be undertaken is quite false and likely to lead to erroneous results and conclusions. The best that can be achieved in such a context is a quasi-experiment, not a laboratory experiment, as it is impossible to hold independent (environmental) variables constant, even for a very short time. That is a very important concern for all research relating to construction projects and process, facility management, property development and so on and so, should be noted as an important 'limitation' of the research.

**Example**

Consider investigating client satisfaction with the provision of a construction project. What quantitative and what qualitative data are likely to be available readily on a case study of a construction project?

Quantitative data would comprise time and cost performance derived from project records – predicted versus actual; quality might be considered from records of re-worked items, corrections required due to defects recorded during the maintenance period – measured by number, value and so on.

Qualitative data could present participants' perceptions of client satisfaction with respect to the performance criteria of cost, time and quality. Such data would be obtained through questioning of those participants, identification of the variables and hypothesising of their inter-relations. Research could proceed

*(continued)*

*(continued)*

by endeavouring to hold all but one of the independent variables constant and examining the effects of controlled changes in the remaining independent variable on the dependent variable.

In certain contexts, such as medical research, the sample under study may be divided into an experimental group and a control group. After the experimental period, the results from the groups may be compared to determine any differences between the groups' results which can be attributed to the experiment. In such cases, the members of the groups must not know to which group they belong; it is helpful also (to avoid possible bias in analysis), if those who carry out the analysis of results are not informed of which person is in each group either.

Hence, experimentation is aimed at facilitating conclusions between cause and effect – the presence, extent and so on. Experimentation is at the base of scientific, quantitative method.

## 1.5 Quantitative and qualitative approaches

It is quite common for small research projects to be carried out with insufficient regard to the array of approaches which may be adopted. This may be because the appropriate approach is obvious, or that resource constraints preclude evaluation of all viable alternatives, or it may be due to a lack of awareness of the alternatives. Such lack of awareness does not mean that the research cannot be executed well, but, often, it does mean that the work could have been done more easily and/or could have achieved more.

Usually, research methods and styles are not mutually exclusive although only one, or a small number of approaches will, normally, be adopted due to resource constraints on the work. The different approaches focus on collection and analysis of data rather than examination of theory and literature. The methods of collecting data impact upon the analyses which may be executed and, hence, the results, conclusions, usefulness, validity and reliability of the study.

'A measure is valid when the differences in observed scores reflect the true differences in the characteristic one is attempting to measure and nothing else … ' (Churchill 1979: p. 65); in practice, it is inevitable that there will be some error in that the observed measure is the aggregate of the true measure, systematic error (bias) and non-systematic (random) error; aggregation of those errors may be additive or multiplicative, depending on the model adopted. 'A measure is reliable to the extent that independent but comparable measures of the same trait or construct of a given object agree' (*ibid*).

However, Flyvbjerg (2006) notes that the (often hot) debate over sharp separation of quantitative and qualitative research methods is spurious. Thus, ' … good social science is opposed to an either/or and stands for a both/and on the question of qualitative versus quantitative methods. Good social science is problem driven and not methodology driven in the sense that it employs those methods that for a given problematic, best help answer the research questions at hand' (*ibid*: p. 242).

### 1.5.1 Quantitative approaches

Quantitative approaches tend to relate to positivism and seek to gather factual data, to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously (literature). Scientific techniques are used to obtain measurements – quantified data. Analyses of the data yield quantified results and conclusions derived from evaluation of the results in the light of the theory and literature.

It is essential to ensure that the subject matter of investigation is both comprehended well by the researcher and is defined precisely as, otherwise, the variables cannot be measured (reasonably) accurately and so, compromise the analyses and findings. Edmondson and McManus (2007: p. 1171) note that '… it is difficult to create measures of acceptable external validity or reliability when phenomena are poorly understood'. Further, they caution that quantitative approaches may restrict the scope and potential of investigations, 'Quantitative measures indicate a priori theoretical commitments that partially close down options, inhibiting the process of exploring new territory (Van Maanen 1988)' (*ibid*).

### 1.5.2 Qualitative approaches

Qualitative approaches seek to gain insights and to understand people's perceptions of 'the world' – whether as individuals or groups. In qualitative research, the beliefs, understandings, opinions, views and so on of people are investigated – the data gathered may be unstructured, at least in their 'raw' form, but will tend to be detailed, and hence 'rich' in content and scope. Consequently, the objectivity of qualitative data often is questioned, especially by people with a background in the scientific, quantitative, positivist tradition. Analyses of such data tend to be considerably more difficult than with quantitative data, often requiring a lot of filtering, sorting and other 'manipulations' to make them suitable for analytic techniques.

Analytic techniques for qualitative data may be highly laborious, involving transcribing interviews and so on and analysing the content of conversations. Clearly, a variety of external, environmental variables are likely to impact on the data and results and the researchers are likely to be intimately involved in all stages of the work in a more active way than usually is acceptable in quantitative studies.

### 1.5.3 Triangulated studies

Both qualitative and quantitative approaches may adopt common research styles – it is the nature and objectives of the work together with the nature of the data collected and analytic techniques employed which determine whether the study may be classified as qualitative or quantitative. Given the opportunity, of course, triangulated studies may be undertaken. As triangulated studies employ two or more research techniques, qualitative and quantitative approaches may be employed to reduce or eliminate disadvantages of each individual approach while gaining the advantages of each, and of the combination – a multi-dimensional view of the subject, gained through synergy. Thus, triangulation may be used for entire studies (such as by investigating a topic from several, alternative

paradigms or/and research methodologies) or for individual part(s) of a study (such as collecting quality performance data from archival records of defects, questionnaires administered to project participants and results of participant observation). Jick (1979) notes that between methodology triangulation seeks to enhance a study's external validity whilst within methodology triangulation seeks to enhance internal validity and reliability.

Triangulation may occur in four main ways – data (sources, types), investigator (more than one researcher – student and supervisor, primary investigator and co-investigator(s)), theoretical and methodological/methods (for data collection and data analysis). Thus, triangulation principles are applied quite widely and are also termed 'mixed method' studies or 'multimethodology'.

Whatever approach, style or category of research is adopted, it is important that the validity and applicability of results and conclusions are appreciated and understood. In particular, it is useful to be demonstrably aware of the limitations of the research and of the results and conclusions drawn from it. Such limitations and so on are occasioned by various facets of the work – sampling, methods of collecting data, techniques of analysis – as well as the, perhaps more obvious, restrictions of time, money and other constraints imposed by the resources available. Hence, it is very helpful to consider the constraints, methods and so on at an early stage in the work to ensure that the best use is made of what is available. Indeed, it may well be preferable to carry out a reduced scope study thoroughly than a larger study superficially – both approaches have validity but achieve different things.

Thus, whilst triangulation employs plural methods, 'bridging' involves linking two or more analytic formats (research methods) to make them more mutually informative, while maintaining the distinct contributions and integrity of each independent approach/discipline. Therefore, 'bridging' uses plural methods to link aspects of different perspectives.

### *1.5.4 Data sources*

As with any project, the planning phase is crucial and it is wise to evaluate what is being sought and the alternative approaches available as early as possible. Of course, re-evaluations may be necessary during the course of the work, in instances such as where the data required prove to be unavailable. As data are essential to research, it is useful to consider what data are required, and alternative sources and mechanisms for collection, during the planning phase. Use of surrogate data (indirect measures of what is sought) may have to be used, especially where the topic of study is a sensitive one (e.g. cost, safety, pricing, corruption, labour relations).

Where researchers have good contacts with potential providers of data, use of those sources is likely to ease the data collection process. If trust and confidence have been established, it is likely to be easier to obtain data and it may be possible to obtain data which might not be available otherwise. Trust and confidence are important considerations in data collection – the more sensitive the data, the more trust in the researcher which is required by the provider. This is an important application of research ethics – see Chapter 8.

Especially for obscure and complex processes, and sensitive/historical subjects, finding sources of data/respondents may be difficult. However, once an initial source has

been found, it may be possible to find others (progressively) by information from that initial source (from a paper or book as well as a person). The 'snowball' approach concerns the progressive discovery and investigation of different sources for a particular event whilst the tracer approach moves between sources relating to the development/operation of a process.

In undertaking research in construction management, Cherns and Bryant (1984: p. 180) note that, 'A basis must exist between the researchers and the [respondent] system for negotiating a relationship which has something to offer to the [respondent] as well as to the researchers'.

'Access must provide for deep and continued penetration into the [respondent] system at the earliest possible stage of the [building] project, preferably before the decision to [proceed]' ([ ] added; *ibid*).

Often, it is essential to ensure that the providers of data cannot be traced from the output of the research. Statements ensuring anonymity are helpful as are methods which demonstrate anonymity in the data collection, such as not requiring names and addresses of respondents. However, anonymity must work. It is hardly providing anonymity if one identifies respondents as A, B … N rigorously in the research report but thanks respondents by name in the acknowledgements section.

Confidentiality is a similar, ethical issue to anonymity: anonymity refers to persons and organisations whilst confidentiality relates to the data also. The two issues are closely related such that confidentiality concerns neither revealing persons' or organisations' identities or data to anyone nor using the data for purposes other than those for which the respondents have given permission. Both confidentiality and anonymity are very important components of research ethics, the moral underpinnings of which dictate that the *express*, *informed consent of the respondents must be obtained and adhered to rigorously*.

Occasionally, respondents wish to scrutinise a report prior to its 'publication'. Whilst such provision is useful in building confidence over data provision and confidentiality, and may assist in ensuring accuracy of data and so on, it may be regarded as an opportunity for the respondents to comment on the research, and, possibly, to demand changes – perhaps, to remove portions with which they disagree or which they dislike. Such changes should be resisted, provided the research has been conducted properly (accuracy of data and results, compliance with anonymity and confidentiality etc.), as they would distort the research report and, thereby, devalue the work.

For applied research, it is increasingly popular to form a *steering group* of the principal investigators, industrialists and practitioners. The steering group helps to form the strategy for the execution of the work and to monitor and guide the research during its execution. The objective is to ensure the combination of rigorous research with practical relevance. Of course, there are spin-off benefits of the researcher's enjoying easier access to data via the practitioners, and the practitioners' gaining knowledge and insight of issues/problems which are important to them.

## 1.6 Where to begin

*Research methodology* refers to the principles and procedures of logical thought processes which are applied to a scientific investigation; a system of methods. *Methods*

concern the techniques which are available (for data collection, analysis etc.) and those which are actually employed in a research project. Any management of a research project must address certain questions in making decisions over its execution. The questions involved are:

- What?
- Why?
- Where?
- When?
- How?
- Whom?
- How much?

It is these questions which the study of this book will assist in answering or, rather, provide some information to help to reach an answer. By addressing the issues explicitly and logically, noting requirements, constraints and *assumptions*, the progress through research projects will smooth and ease progressively as expertise and experience develop.

Often, a researcher is able to select a supervisor or supervisors. In selecting a supervisor, three considerations apply – that person's experience and expertise in the subject matter/topic, research experience and expertise and, perhaps the most important factor differentiating potential supervisors, the ability to relate to and communicate well with the researcher. The best research tends to be executed by people who get on well together as well as possessing complementary skills and expertise.

It is important to determine the scope of the work at the outset; the most common problem is for a researcher to greatly overestimate what is required of the work, what can be achieved and the amount of work that can be done. It is a good idea to consult an experienced supervisor or 'third party' to ensure that the programme and scope of the research intended are *realistic*.

**Example**

*What*? Concerns selection of the topic to be researched with consideration of the level of detail. It is useful to note the resources available and constraints so that an appropriate scope of study can be determined.

*Why*? May command a variety of answers, each of which applies individually but some of which may apply in combination. So, 'required for a degree', 'required by employer', 'interest', 'career development', and, possibly, many other reasons, may be advanced to say why research is being undertaken. However, why a particular research project is being carried out or proposed, apart from the reasons given already, may be due to its being topical or because the researcher has expertise in that subject and wishes to use that expertise to acquire and advance knowledge in that field.

*(continued)*

*(continued)*

*Where*? Obviously, all research occurs somewhere – the host institution may be a university, as well as the various places at which individual research activities occur – libraries, data collection points, visits to experts and so on. It may be useful to consider the amount of travel, both cost and time, as an input to the strategy for executing the research.

*When*? The timing of the research and time available to carry it out usually will be specified. It will be necessary to produce a timetable for the work by dividing the time available between the component activities. Often, there will be restrictions on the time for data collection – allow for holiday periods, very busy periods and so on; what sequences of activities are necessary and what are the alternatives? To what extent can the activities overlap? A common problem is to devote insufficient time to planning the work and to the scholarship stage (searching theory and literature) and to forget, or, at least, to under-estimate, the time necessary for data analyses, production of results and conclusions and for preparation of the report. All too often the only real focus is on fieldwork (data collection) – such enthusiasm is healthy but must be kept under control.

*How*? Is the issue of methodology and of methods. In some instances, the methodology is obvious – virtually 'given' – as in computational fluid dynamics. Commonly, a topic may be investigated in a variety of ways, individually or in combinations, so a choice must be made. The choice will be influenced by the purpose of the research, the subject paradigm, the expertise and experience of the researcher and supervisor (if any), as well as practical considerations of resource and data availabilities.

*Whom*? Four main groups of people are involved in the execution of research – the researcher, the supervisor, the respondent personnel – who provide the data or access to it, and others who can help – such as laboratory technical staff. Naturally, a research project is 'commissioned' by someone – for instance, a university, as a requirement of a course of study, an academic agency such as a research council or a commercial agency, perhaps a government body, company consultant practice and so on.

*How Much*? This issue concerns the resources which can be used. Many resources, such as money, are fixed but people's time tends to be rather flexible – especially the time input by researchers themselves. No research project is really completed from the researcher's point of view as there is always a bit more which could or ought to be done. Hence, each report contains a list of recommendations for further research.

## 1.7 Summary

This chapter introduced the main concepts of research – a rigorous search, learning and contributing to knowledge – to provide a firm basis for producing a good research proposal and for undertaking research successfully. A definition of research was provided and a variety of contexts of undertaking research were discussed so that appropriate and informed selections of subject, methodology and method(s) may be

made, acknowledging the potential effects of contextual variables. Different approaches (classifications) to research were examined – notably, pure and applied; and qualitative and quantitative – together with their combination through 'triangulation' and the different types of problem (research question) to be addressed. The concepts of theories and paradigms were introduced as fundamental bases for executing a research project with discussion of how they develop and evolve through progressive testing according to scientific methods in which refutation is an important concern. Paradigms constitute perspectives on research – 'lenses' through which research is viewed – and so indicate theoretical frameworks, issues for investigation and appropriate methodologies and methods. Main forms of reasoning – deductive, inductive and abductive – were introduced. Positivism and interpretivism were explained and contrasted. Styles of study were considered – including action research, ethnographic research, surveys, case studies and experiments – and questions which research projects address were discussed. Issues relating to data collection were introduced. The ethical issues of confidentiality and anonymity were discussed, and the essential need for objectivity was emphasised. The chapter ended with discussion of practical issues of how to progress a research project by addressing a progressive series of questions to guide the development of a project/proposal.

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