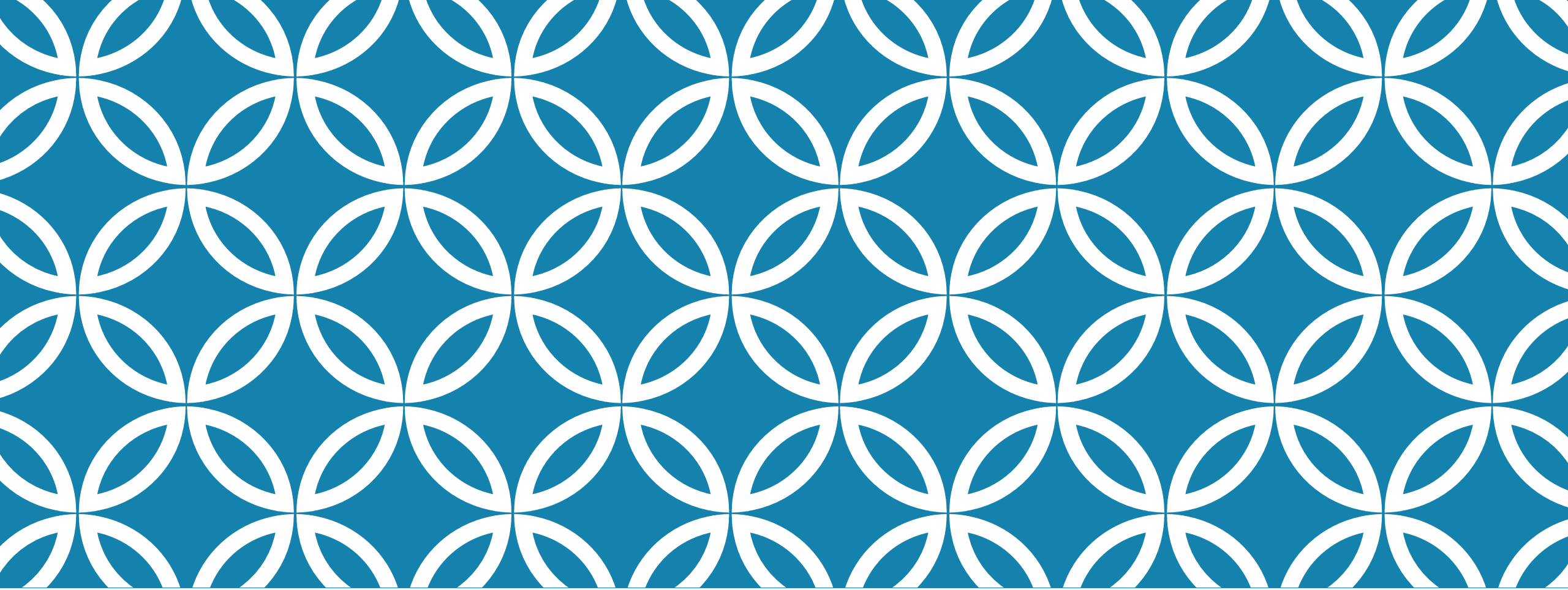


CHOOSING RESEARCH STRATEGIES: RESEARCH DESIGN

Chapter:3

LEARNING OBJECTIVES

1 The basic stages of research design.

2 The major descriptors of research design.

3 The major types of research designs.

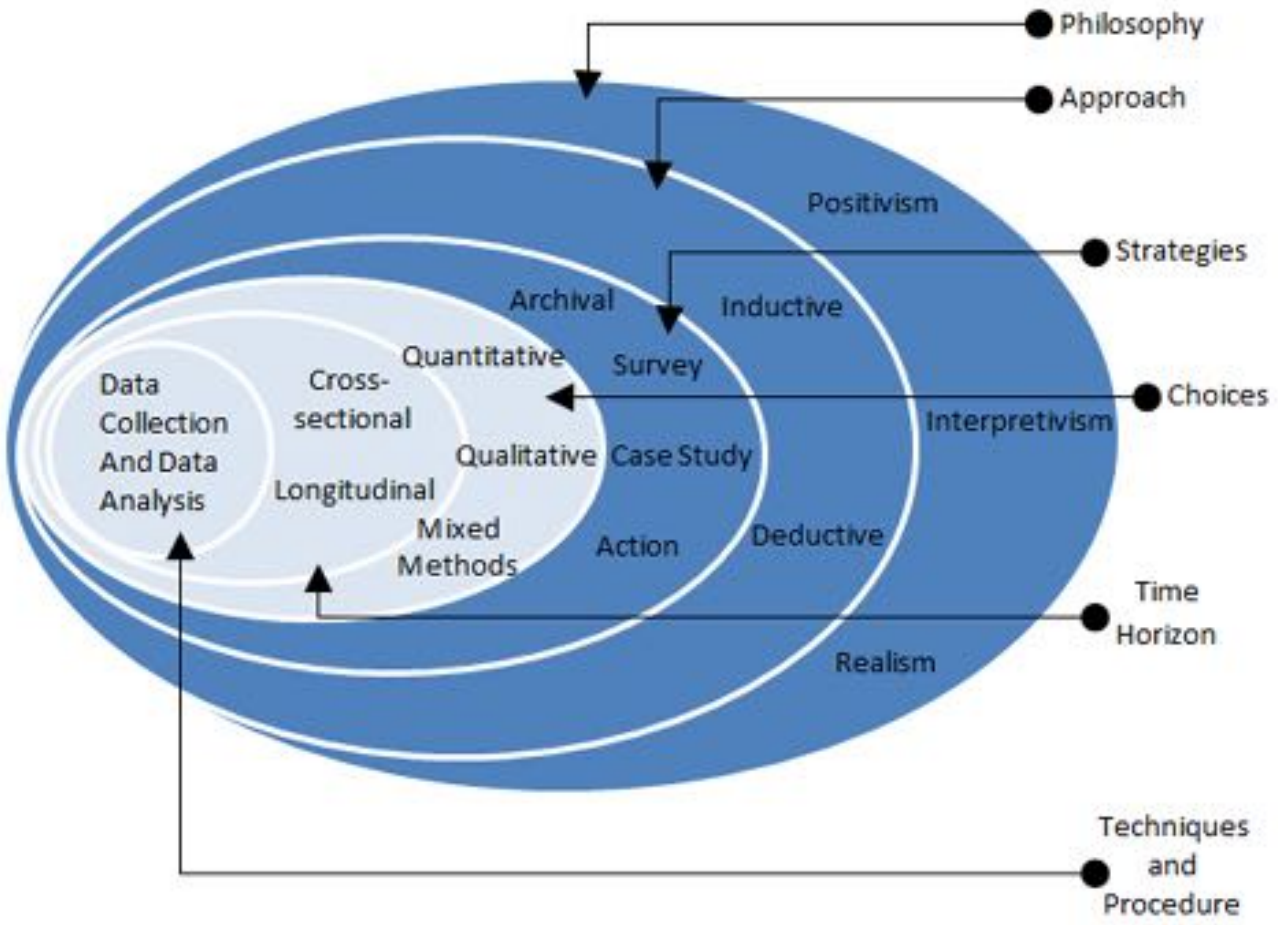
4 The relationships that exist between variables in research design and the steps for evaluating those relationships.

META SCIENCE

The science about science: systematic categorisation of research according to dimensions such as:

- Philosophy: positivist vs. interpretivist, analytical vs. design
- Approach: deductive vs. inductive
- Choice of Data: quantitative vs. qualitative
- Strategy: Survey vs. experiment vs. case study vs. …

RESEARCH ONION



Source: Saunders et al. (2009)

UNDERSTANDING THE RESEARCH PROCESS

PHILOSOPHY: POSITIVIST VS. INTERPRETIVIST

1. Positivist: believes in the possibility to observe and describe reality from an objective viewpoint

- ***observe*** the world in some neutral and objective way, ***discover*** "general" relationships and "universal" laws, ***derive*** theories, ***test*** them
- observations should be repeatable

2. Interpretivist: believes that it is necessary to understand differences between humans in our roles as social actors

- understand the world from the point of view of the social actors, different interpretations are possible and thus are subjective
- qualitative, non-quantitative questions

PHILOSOPHY: ANALYTICAL VS DESIGN

Analytical science (empirical)	Design science (constructive)
understanding reality, concerned with general statements about reality	concerned with the design of artificial constructs (concepts, designs)
fields: natural sciences, economics, sociology,…	fields: mathematics, engineering (including computer science), humanities (languages,
new research results can falsify existing theories	existing constructs remain valid but new constructs may be considered as superior

PHILOSOPHY: ANALYTICAL VS DESIGN

Analytical and design research in information systems

design science	analytical science
design and study of: • formal languages • mathematical models • algorithms • prototypes	interviews case studies

TRENDS: RESEARCH IN BUSINESS INFORMATION SYSTEMS

America: Information Systems Research

- Focus is „Explanation“
- Result: Observation
  - Properties of Information Systems
  - Behavior of users
- Social Sciences:
  - „Behaviorism“,
  - „Positivism“
- Strength: Scientific
- Problem: Relevance for practice

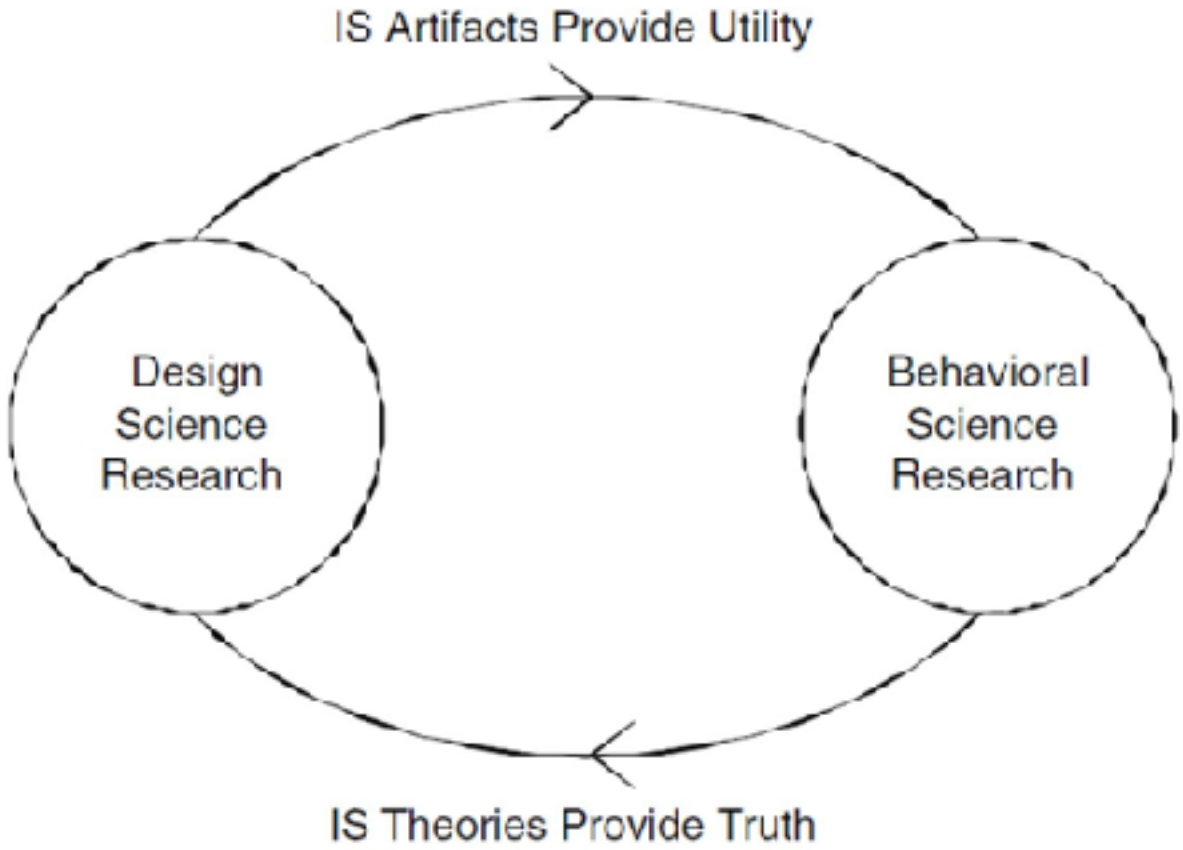
Europe: Business Informatics

- Focus is „Design“,
- Result: Artefacts
  - Constructs, methods,
  - Models, instantiations, prototypes
- Engineering:
  - „Design Science Research“,
  - „Constructivism“
- Strength: Relevance for practice
- Problem: Research methodology

GOAL OF RESEARCH

- The goals of **design-oriented** research are
  - guidelines for the construction and operation of information systems
  - innovations of information systems (instances)
- The goals of **behavioristic** research are
  - analyses information systems as a phenomenon (actual situations)
  - cause-effect relationships in the use of information systems

DESIGN SCIENCE VS. BEHAVIORAL SCIENCE



PROBLEMS OF DESIGN ORIENTATION

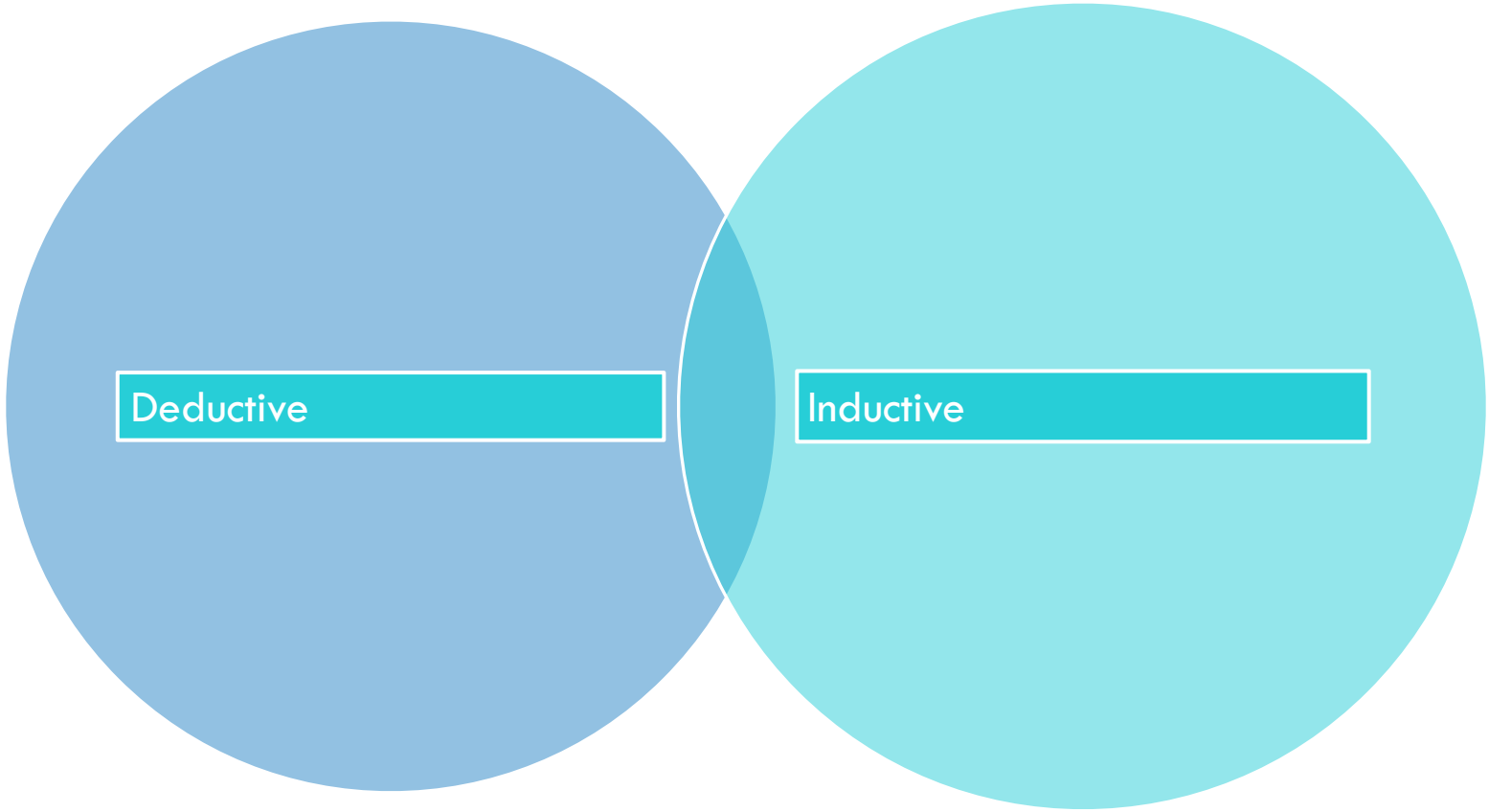
- Success criterion: relevant, useful results
- Validation often by
  - implementation in practice
  - economic payoff
- Consequence:
  - Many publications of results are without rigorous, scientific evidence

→ no research

Goal: Simultaneous achievement of

- Design orientation
- Scientific rigor

RESEARCH APPROACHES



DEDUCTIVE APPROACH

Deductive approach: from general to specific

- Develop a **theory** (out of previous findings (literature), experience, some first observations, …)
- Derive a **hypothesis** from the theory
- Make **observations**
- obtain a **confirmation** or rejection of the hypothesis

INDUCTIVE APPROACH

Inductive approach: from specific to general

- Make **observations**
- Find **patterns**
- Create a **hypothesis**, explore/validate it
- Form a **theory** out of hypotheses

THE QUANTITATIVE APPROACH

Quantitative research:

- focuses on verifying hypotheses (deductive) or finding patterns (inductive) using typically *large amounts of data*

THE QUALITATIVE APPROACH

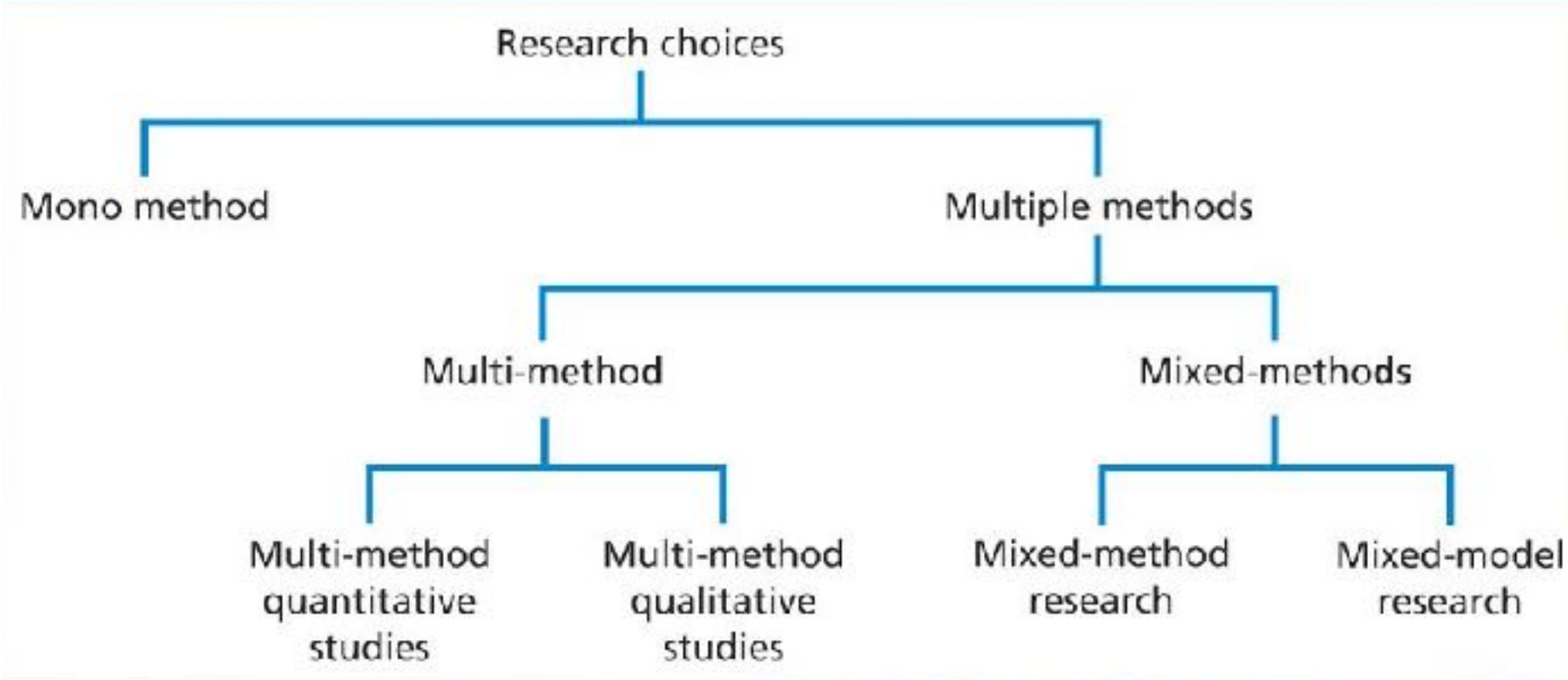
Qualitative research:

- focuses on understanding the important characteristics of typically *small samples of data*

CHOICES: QUANTITATIVE VS. QUALITATIVE

- **Example:** investigate users' response to an interface
  - quantitative approach: collect ratings, verify user acceptance
  - qualitative approach: understand *why* users interact with the interface in certain ways

RESEARCH CHOICES



RESEARCH STRATEGIES

WHAT IS A RESEARCH STRATEGY?

A research strategy usually has

- A goal: something it can be used for
- A procedure: steps to follow to achieve results
- A set of techniques involved in the procedures

…and it is often based on a certain type of science

RESEARCH METHODOLOGIES – OVERVIEW

Strategy	Goal
Experimental research	test hypotheses
Action research	iteratively solve a problem with a community of practice
Case study research	study the characteristics of a real-life instance
Surveys	find patterns in data
Design Research	generate an artefact

EXPERIMENTS

- **Goal:** test hypotheses
- **Procedure:**
  1. formulate a hypothesis
  2. collect evidence
  3. test hypothesis based on evidence
- **Techniques:** benchmarking, statistical significance tests
- **Type of research:** positivist, deductive, quantitative

EXPERIMENTS – VERIFICATION PROBLEM

- problem: falsification of a hypothesis can be done with one experiment, verification usually not!
  - it is usually not possible to draw conclusions from one instance being tested because the observed results may be different using other test data
  - E.g.: how many test instances are needed for testing your new algorithm?

EXPERIMENTS – REQUIREMENTS

1. Ensure validity of claims by careful design. Popular designs:
   a) Statistical significance testing
      - formulate a null hypothesis, then (possibly) reject it based on significance test
      - e.g. comparative evaluation with test and control groups
   b) benchmarking (compare to e.g. a gold standard)

2. Repeatability: need to describe setting of experiments and test instances carefully
   - try to control influences of environment, avoid random effects

PARTICIPATORY ACTION RESEARCH

- **Goal:** iteratively solve a problem with a community of practice
- **Procedure:**
  1. Planning:
     a) analyze problem together with practitioners
     b) develop solution(s) with the help of theories, plan actions
  2. Action:
     a) implement solution/action, evaluate
     b) Learning: improve solution as required
  3. Reflection: derive design principle(s) from outcome
- **Type of research:** interpretivist, constructive, qualitative

CASE STUDIES

- **Goal:** study the characteristics of a real-life instance
- **Procedure:**
  1. select an instance to study
  2. collect data, analyze and interpret it in a systematic way
  3. understand the reasons for characteristics of the instance
- **Techniques:** interviews, discussions, observations, questionnaires
- **Type of research:** interpretivist, inductive, empirical, qualitative

CASE STUDY APPROACH

- empirical investigation of a particular contemporary *phenomenon* within its real life *context*
- gaining a rich understanding of the context of the research and the processes being enacted
- Triangulation: using multiple, different sources of data to ensure reliability, e.g. triangulating quantitative data from questionnaires using qualitative data from semi-structured interviews
- Four case-study strategies based upon two dimensions
  - single case vs. multiple case
  - holistic case vs. embedded case

SURVEY STUDIES

- **Goal:** find patterns in data
- **Procedure:**
  1. collect data from a large group of objects in a standardized and systematic way
  2. evaluate the data, e.g. by using statistical methods
  3. identify patterns, especially those which were not expected
  4. interpret results
- **Techniques:** observation, measurement, construction, questionnaires, interviews, literature research
- **Type of research:** inductive, empirical

ACTION RESEARCH IN COMPUTER SCIENCE

- The strengths of an action research strategy are a focus upon change, the recognition that time needs to be devoted to reconnaissance, monitoring and evaluation and the involvement of employees throughout the process.
- However, action research is often not applicable because
  - it is time-consuming and expensive
  - it requires to bring into practice and observe an information system and thus to re-organize an enterprise in several iterations which is not possible

SURVEY STUDIES – DATA COLLECTION

- Sources: nature, technical or information systems, people, companies, literature, …
- Means of collecting:
  - Observation: using one's senses
  - Measurement: using technical instruments (e.g. a thermometer)
  - Construction: data is obtained using an artefact (e.g., the output of some algorithm)
  - Data transactions
  - Questionnaires
  - Interviews
  - Literature research

SURVEY STUDIES – DATA COLLECTION

primary and secondary data – double meaning

1. primary data: data collected within one‘s own research

   secondary data: usage of data in research collected by someone else

2. primary data = input data of a research method

   secondary data = derived data (resulting from a research method)

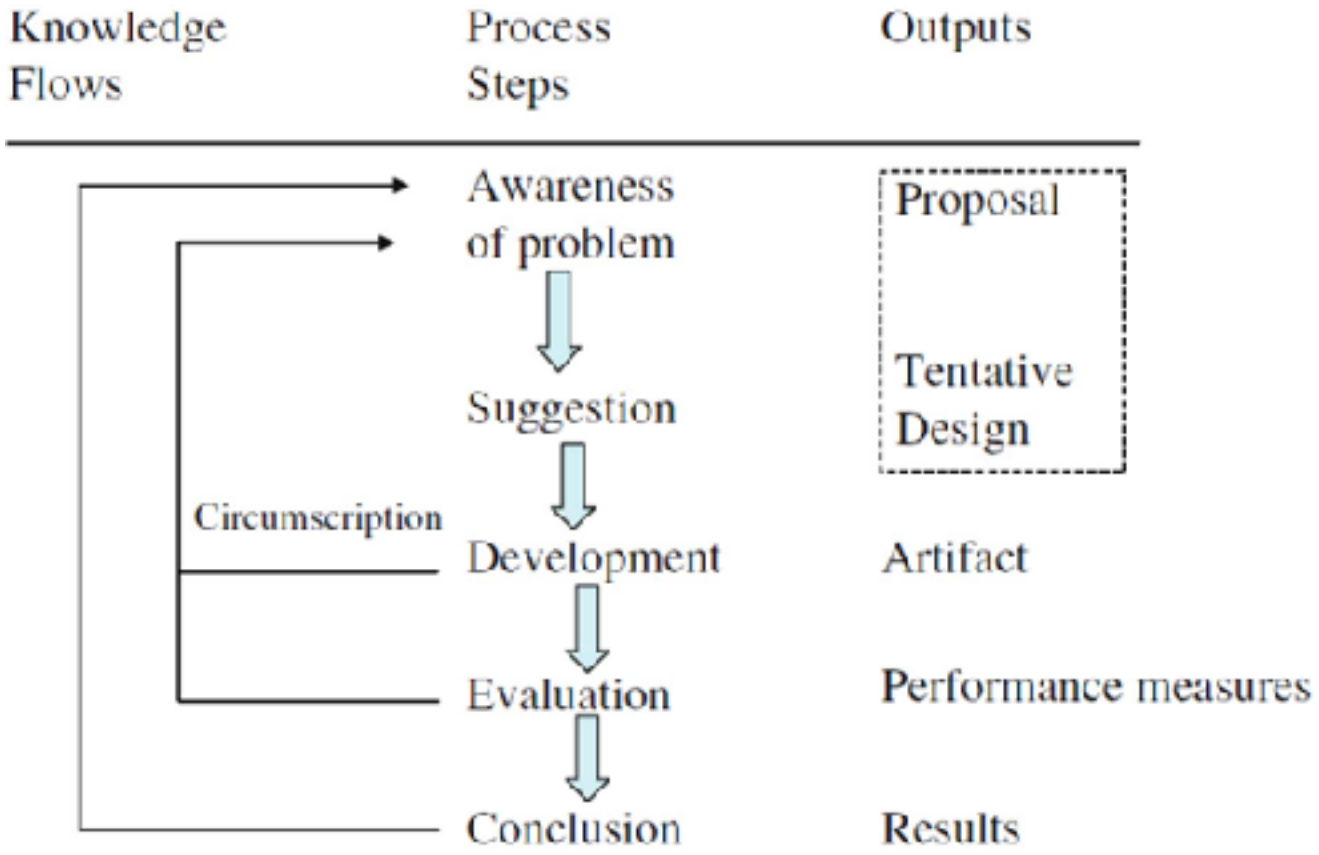
SURVEY STUDIES – INTERPRETATION OF DATA

- Quantitative analyses:
  - counting the frequency of specific events
  - observing the timing of specific events (requires some measurement)
  - counting the number of objects (e.g. persons in a queue)
- Qualitative analyses:
  - observing the specific behavior of a person (e.g. a computer user for evaluating the usability of a software)
  - interviewing stakeholders (e.g. users of an information systems)
  - observing the nonverbal communication of people in a meeting
    - some observations are hardly possible to separate from interpretation

DESIGN SCIENCE RESEARCH

- **Goal:** designing and creating artifacts (constructs, models, methods, instantiations – see above)
- **Procedure:**
  1. Analysis: analyze problem and determine research goals
  2. Development
     a) develop artifact with recognized methodologies
     b) justify solution and differentiate from known solutions
  3. Evaluation: validate approach with respect to research goals
  4. Dissemination: publication, implementation organisations
- **Type of research:** interpretivist, constructive, qualitative

ALTERNATIVE PROCEDURE: DESIGN SCIENCE RESEARCH FRAMEWORK



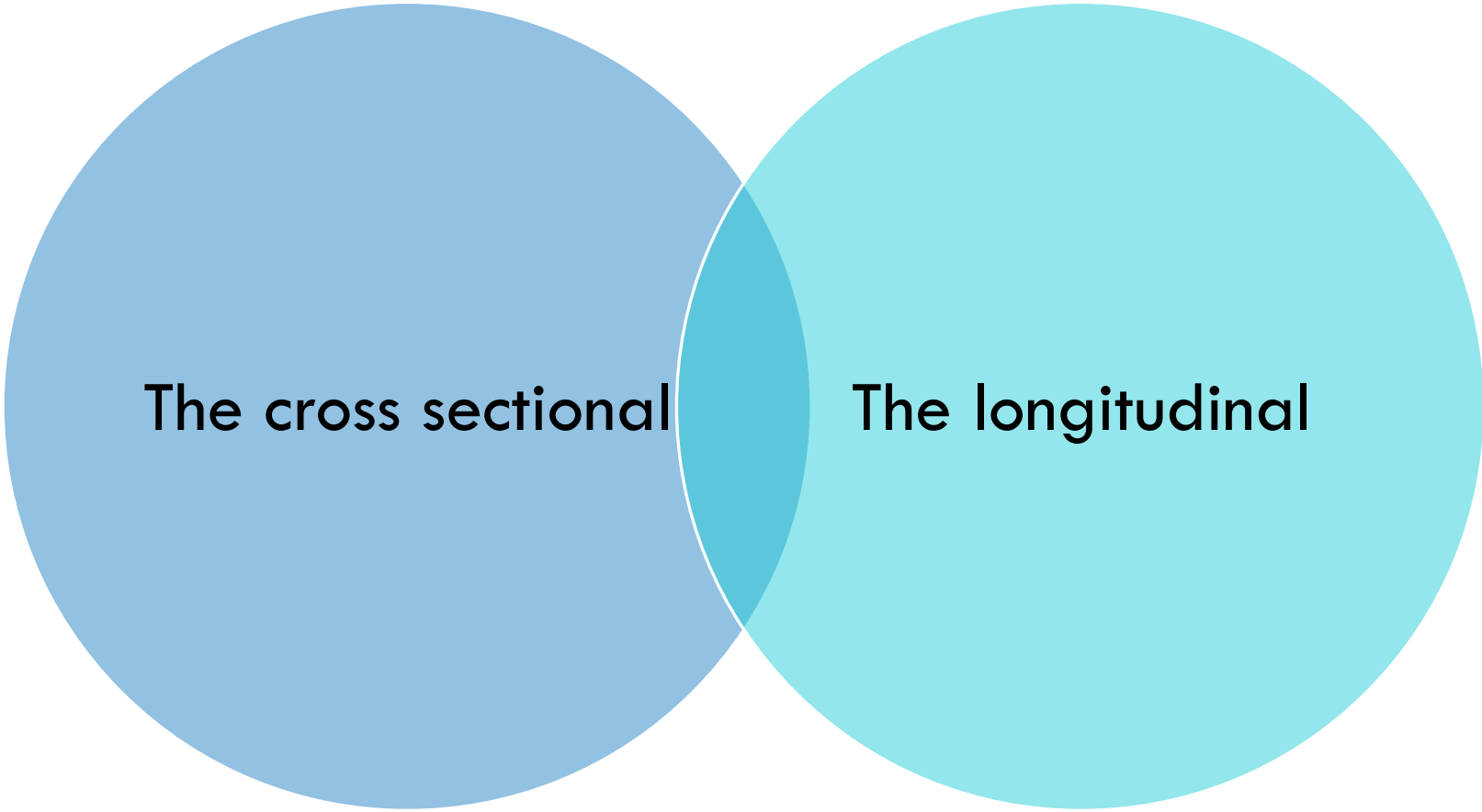
Source: researchgate.net

DESIGN SCIENCE RESEARCH FRAMEWORK

Another view on design an creation processes:

- awareness
  - recognition of a problem which can be solved by or using new artifacts
- suggestion
  - discussing what kind of artifact might solve the problem
- development
  - designing and creating the artifact
- evaluation
  - checking whether the artifact solves the problem, analyzing its strengths and weaknesses
- conclusion
  - compilation of results and future aspects such as open questions or plan for further development

TIME HORIZONS



DATA COLLECTION AND ANALYSIS

The Primary Data

First-hand sources

Secondary Data

Work options

THE BUSINESS RESEARCH PROCESS

1. Analyse
- Recognise organizational performance discrepancy
- Conduct front-end analysis
- State the problem

2. Design
- Develop research questions and hypotheses
- Select appropriate research design

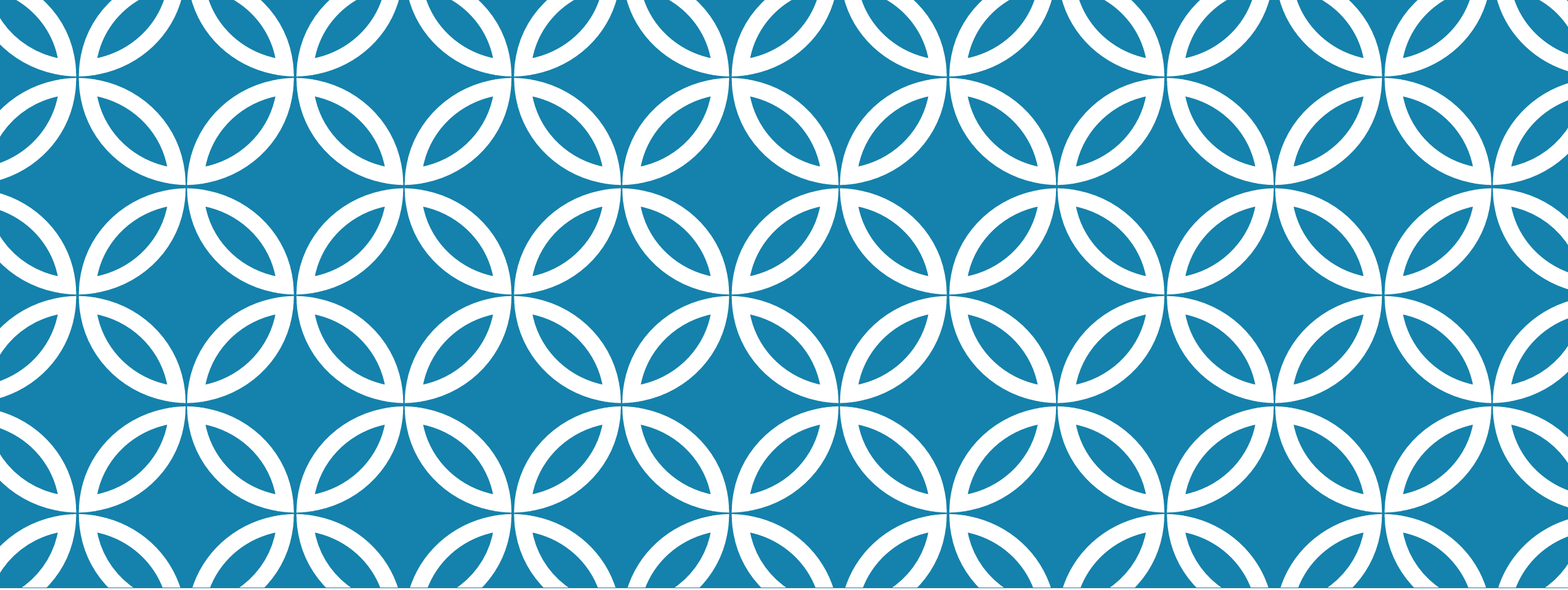
3. Implement
- Conduct research and collect data

4. Interpret
- Run statistics
Answer research questions and test hypotheses
Prepare research report

5. Act
- Make appropriate informed management decisions

CONCLUSIONS

In this study, the different stages of the research onion were described. Given the research onion comprises different stages of many research projects and can be effectively adapted to different models, this report has necessarily been summative and restricted in depth. However, the stages defined by Saunders et al. (2007) have been expounded upon, and the usefulness of the staged development of the onion demonstrated. The most effective model of its effectiveness, however, lies in its use.



THANKS FOR YOUR ATTENTION