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Research Methods

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Master in Sustainable Energy Engineering (2018 - 2020, KTH)

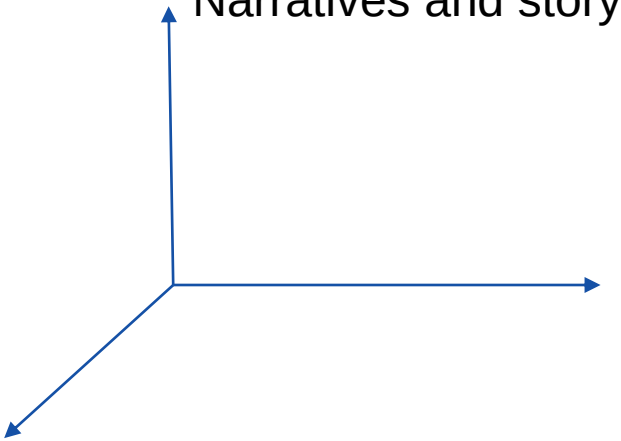
Bachelor in Electro Mechanical Engineering (2014 - 2018, Cardiff)

Research project: **Sustainable Energy Transformations in Aviation**

- *”to contribute to an acceleration of sustainable energy transformation in aviation”*
- focus on alternative fuels and technologies
  - airports, airlines, local municipalities, fuel suppliers, aircraft manufacterers, users, markets, legislation

My research (some examples)

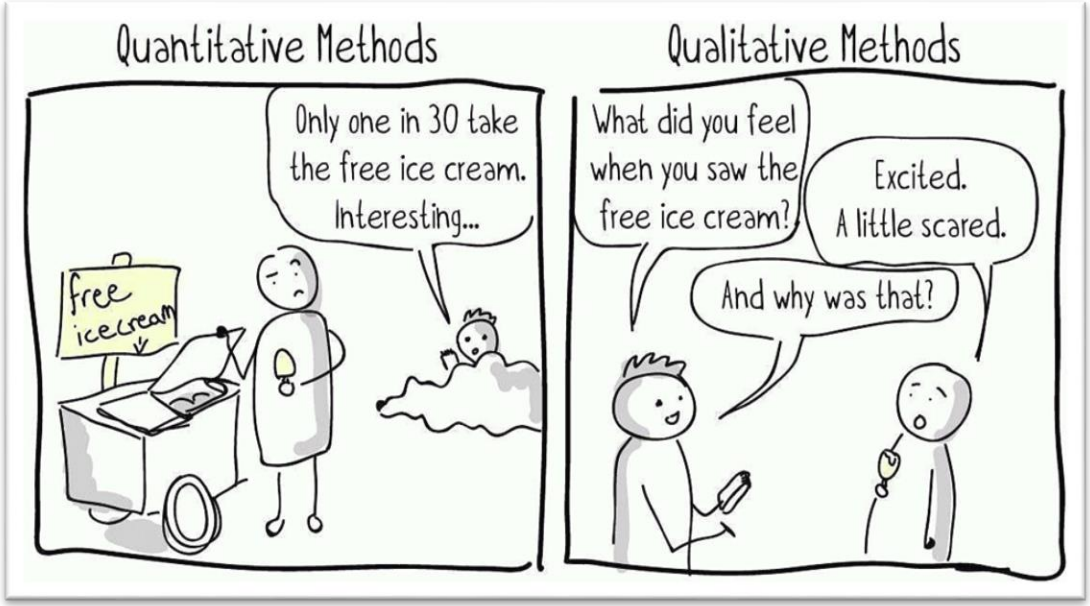
Theory/Concepts
Multi-level perspective on industrial transitions
Technological innovation systems
Narratives and storylines in discourse



Method:
Qualitative case studies

Context:
Sustainability transitions in the aviation industry in Sweden

Which method(s) do you plan to use in your bachelor thesis?



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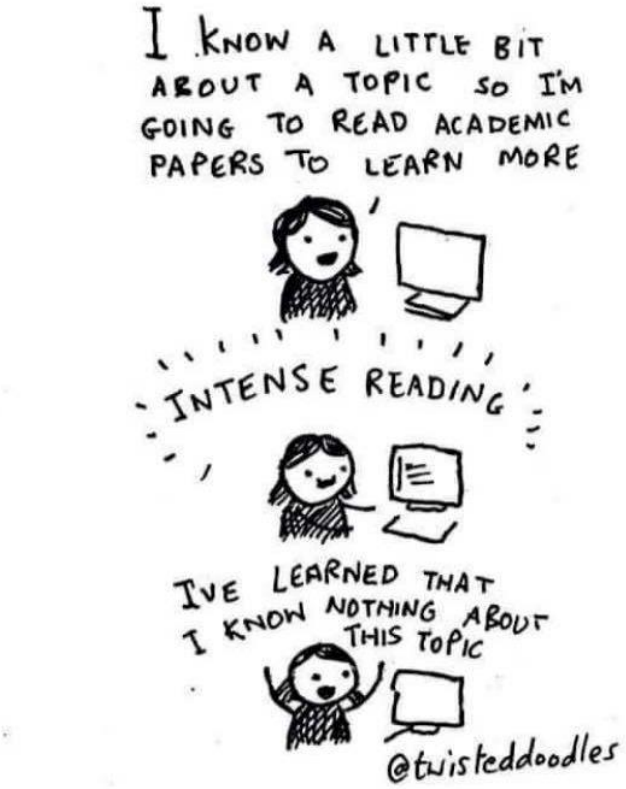
Research Methods

Questions of method are challenging…



Questions of method are challenging…

…but important.

Aim high …

KTH Industrial Engineering and Management

Energy Provision and Informality in South African Informal Urban Settlements

A Multi-Criteria Sustainability Assessment of Energy Access Alternatives

Simon Runsten

Minor Field Study

Bachelor of Science Thesis
KTH School of Industrial Engineering and Management
Energy Technology EGI-2015
SE-100 44 STOCKHOLM

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Contents lists available at ScienceDirect

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journal homepage: www.ees.elsevier.com/esr

Energy provision in South African informal urban Settlements - A multi-criteria sustainability analysis

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Informal urban settlements
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ABSTRACT

In South Africa, as in much of sub-Saharan Africa, strong urbanization trends lead to people settling in ever less suitable informal locations, which are often considered ineligible for basic service provision. This study explores how access to basic energy services can be provided to informal urban households in South Africa that are ineligible for grid electrification. This is done through a multi-criteria sustainability analysis of current and alternative ways of accessing energy services. The case of the Western Cape Province is explored, showing that barriers for electrification can be overcome in some cases, given that there is political will at the local level to do so. When electrification is unviable, off-grid electricity alternatives combined with support for access to modern cooking fuels may provide short or medium-term solutions. This study further suggests that governmental efforts of meeting basic energy needs must be persistently oriented and structured towards access to energy services, as opposed to supply of electricity.

Today

1. Research purpose & research path
2. Research space & methodological field
3. Reviewing the literature
4. Research designs
5. Methods
6. Data collection and analysis

Research Purpose

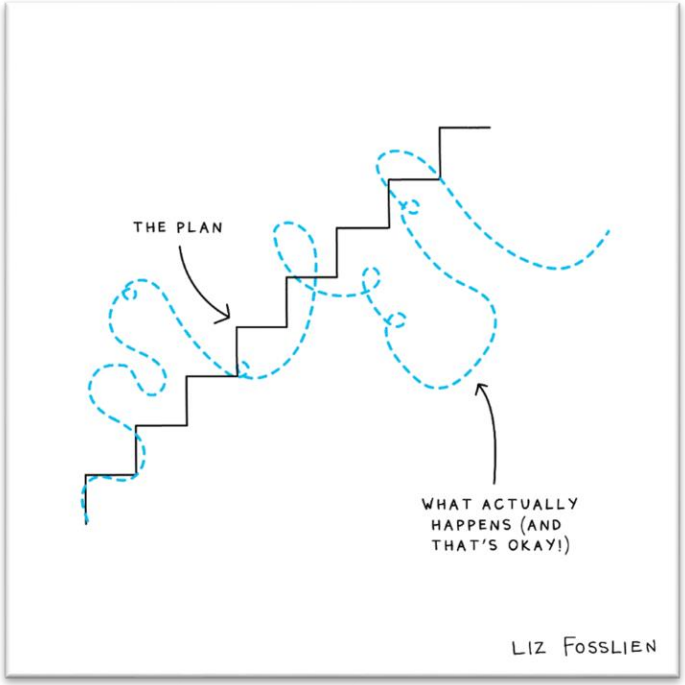
What is the purpose of research?

	Exploratory	Descriptive	Explanatory	Evaluative
Means to	Ask open questions Discover what is happening Gain insights	Gain accurate profile of events, persons or situations	Establish causal relationships between variables	Find out how well something works
Useful if you are	Unsure of an issue, problem or phenomenon	Willing to have a clear picture of the phenomenon	Aiming at explaining the relationships between variables	Concerned with assessing the effectiveness of something

Saunders et al 2016 (p.174-176)

A typical path (for a case study)

1. **Problem/topic**
   - Is it interesting to anyone?
2. **Objective**
   - What do I want to find?
3. **Literature review**
   - What is the state of the art?
   - Theoretical/conceptual Framework
4. **Emprical design/analysis**
   - Deciding the unit of analysis
   - Selecting cases
   - Collecting and analyzing the data
   - Interpreting the findings
5. **Writing and reporting**
   - Theoretical implications
   - Practical implications



But wait…
can you research problem change during the research process?

YES.

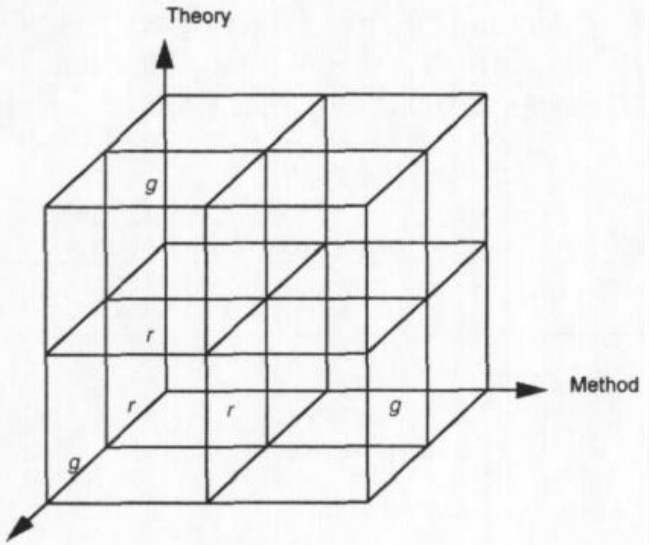
"You should not think that a case study´s design cannot be modified by new information or discovery during data collection. Such revelations can be enormously important leading to your altering or modifying your original research design (Yin, 2017, p.63)"

*"if you are conducting **exploratory research**, you must be willing to change your direction as a result of new data that appear and new insights that occur to you (Saunders et al, 2016, p. 175)"*

Research Space

Dimensions of Research

Figure 1 Potential Research Space



Where r = parameter level replication, and g = parameter level generation.
The problem dimension is held constant.

Table 1 Research Space and Levels

	Level 1
Problem	*General problem* General managerial and research question(s)
Theory	*Philosophical lens* Meta theory, including ontological, epistemological, and methodological axioms
Method	*Data generation* Methods of data production, including measurement issues, survey processes, interviews techniques, observational protocols, etc.
Context	*Investigative context* The when, where, and from whom/what data is collected (i.e., population specification and variable delineation (e.g., country, culture, industry, etc), sample issues, etc.)

(Berthon et al, 2002)

Theory …

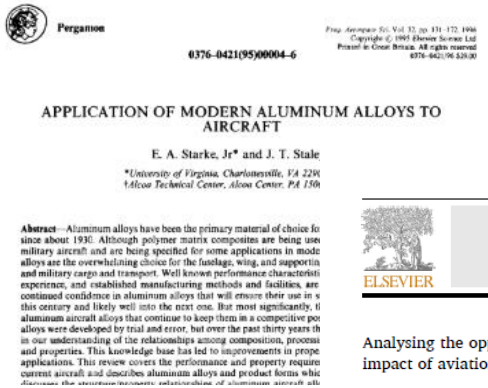
‘Theory’ is a ***formulation regarding the cause and effect relationships between two or more variables***, which may or many not tested. (Saunders, 2019, p.729)

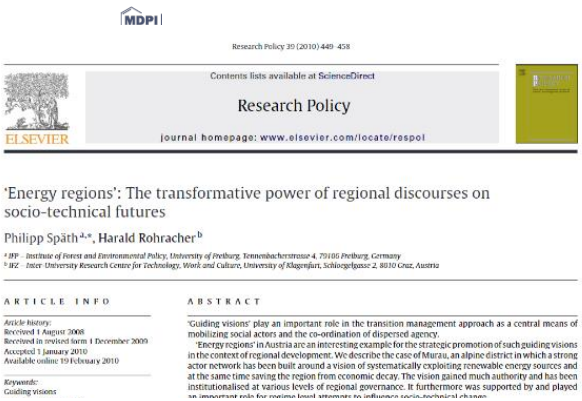
‘Theory’ is ***simply a way of of imposing conceptual order*** on the empirical complexity of the phenomenal world (Suddaby 2014, p. 407).

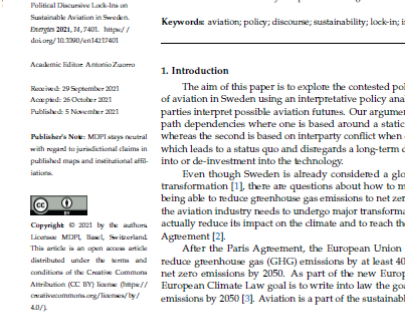
Which ‘theory’ or ‘theoretical concepts’ do you plan to use in your bachelor thesis?

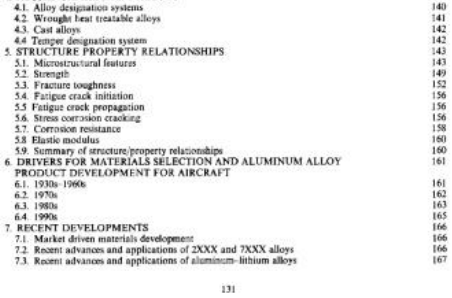
Go to www.menti.com

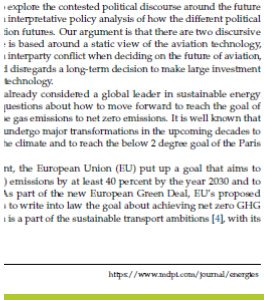
When you read a paper: Can you identify its theory, method and context?

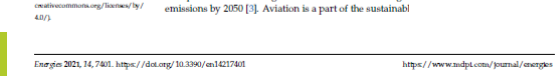












Methodological Field

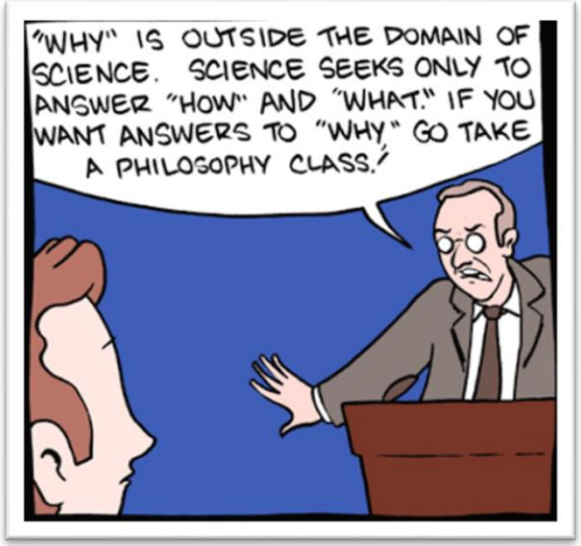
Positivism / Interpretivism

Positivist approach

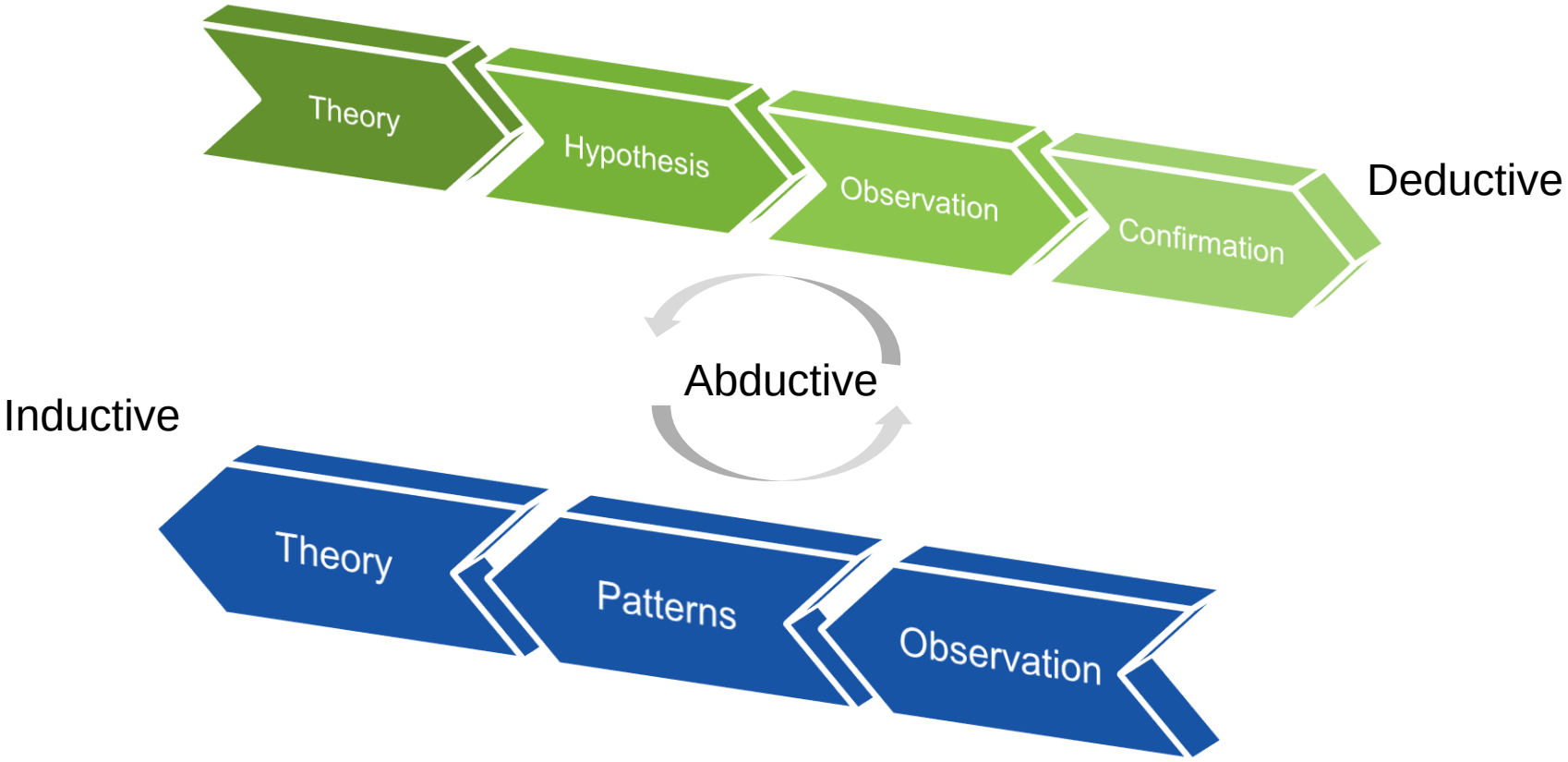
- *" […] surrounding precise empirical observations of individual behavior in order to discover and confirm a set of probabilistic causal laws that can be used* ***to predict general patterns of human activity****"*

Interpretivist approach

- *"[…] socially meaningful action through the direct detailed observation of people in natural settings in order* ***to arrive at understandings and interpretations*** *of how people create and maintain their social worlds" (Neuman, 1997:as cited in Arnaboldi 2012).*

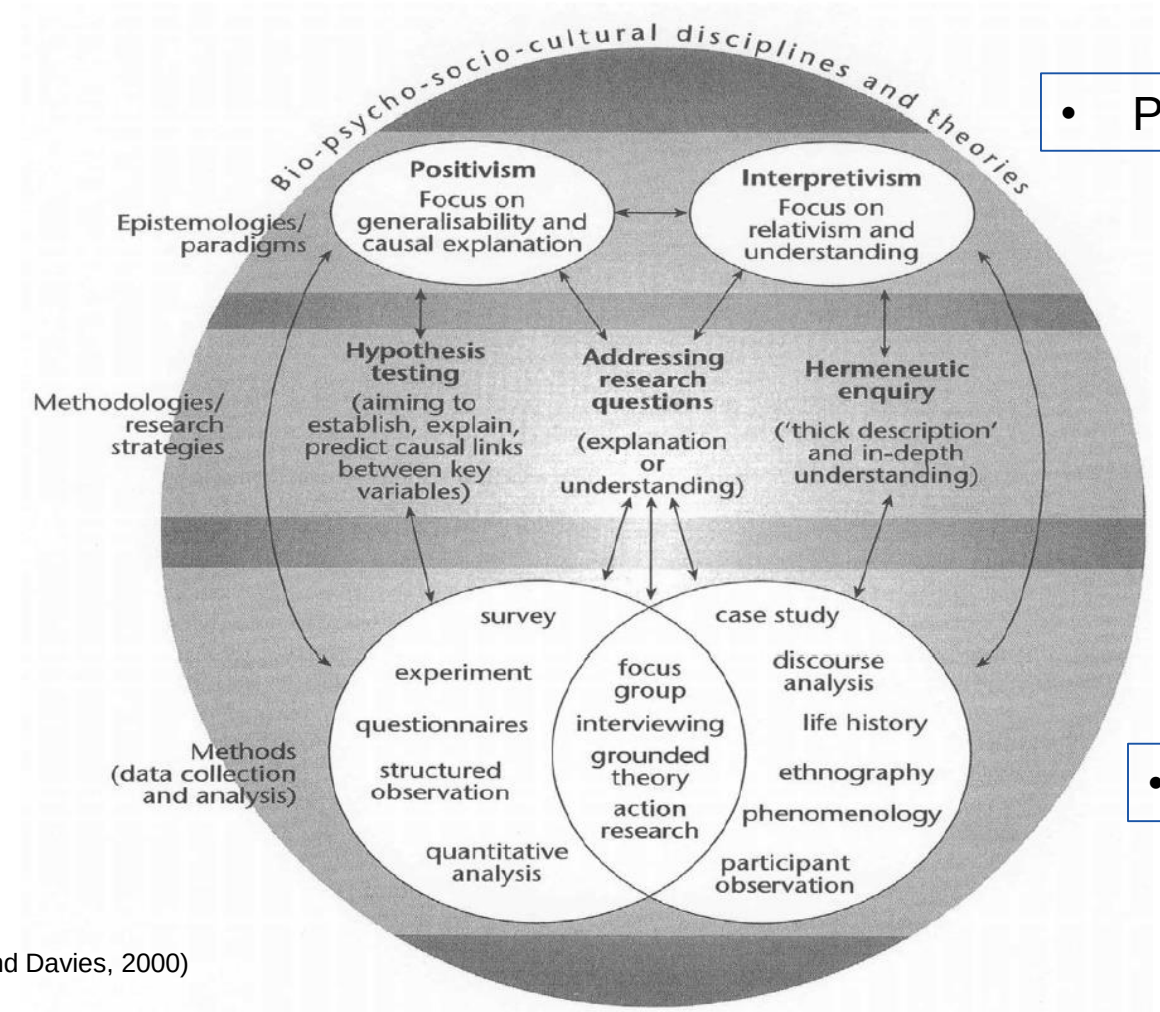


Abductive?



*"… an **abductive** approach moves back and forth, in effect combining deduction and induction (Suddaby 2006). This matches what many business and management scholars actually do (Saunders 2017, p. 148)"*

The methodological field

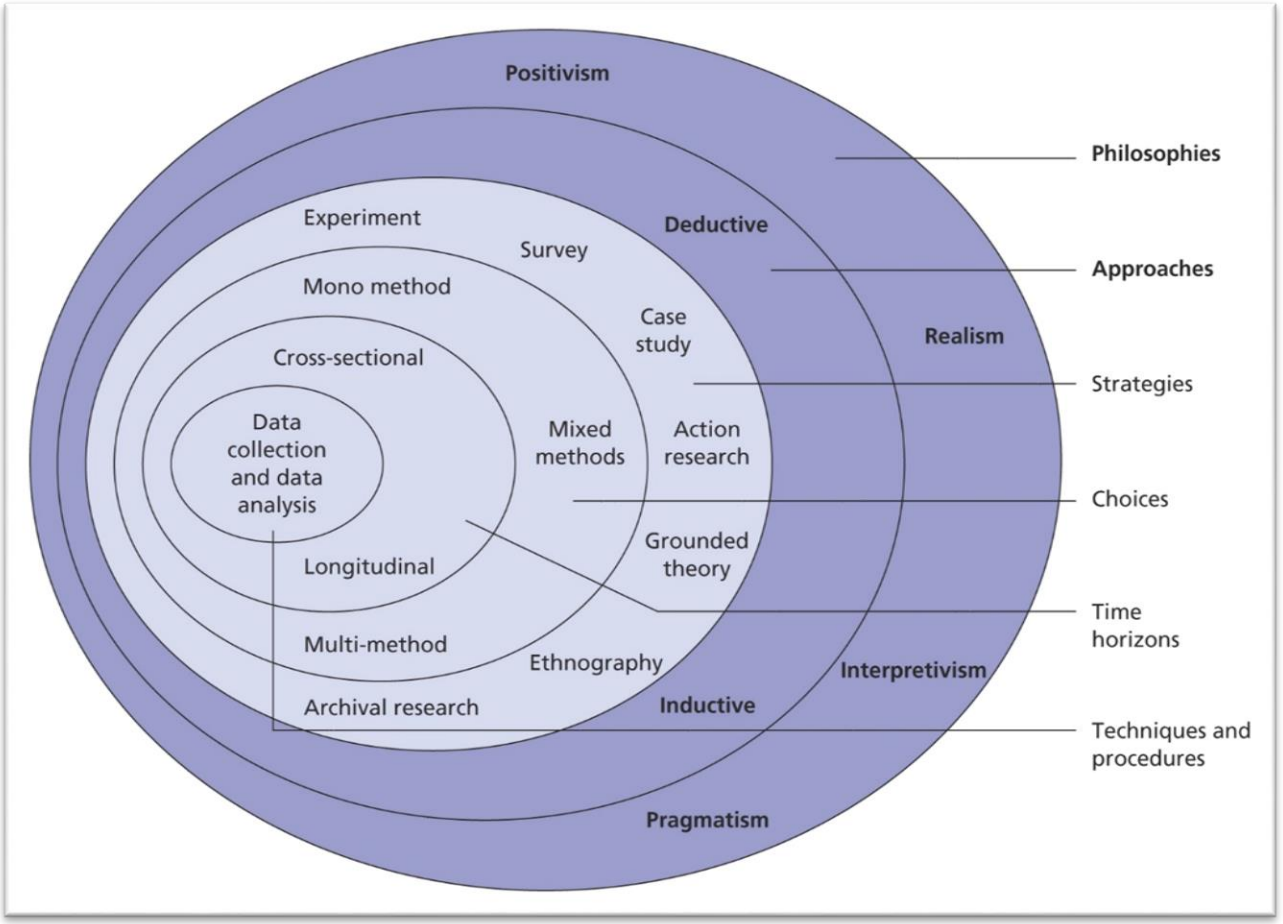


(Gomm and Davies, 2000)

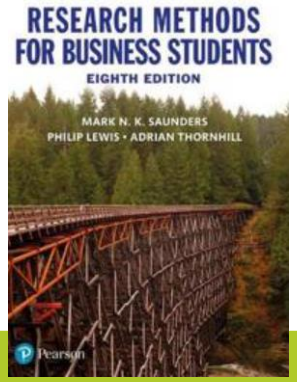
- Philosophical Worldview
- Research Design / Strategy of inquiry
- Methods

Creswell (2009)

The methodological field



Saunders' Research Onion (2007)



Reviewing the literature

literature

/ˈlɪt(ə)rətʃə/

noun

written works, especially those considered of superior or lasting artistic merit.
"a great work of literature"
synonyms: written works, writings, (creative) writing, literary texts, compositions, letters, belles-lettres; More

- books and writings published on a particular subject.
  "the **literature on** environmental epidemiology"
  synonyms: publications, published writings, texts, reports, studies, relevant works
  "the literature on prototype theory"

*Google Dictionary

Search vs. Review

Which ones are the definitions of “Review”?

A. try to find something by looking or otherwise seeking carefully and thoroughly.

B. an act of searching for someone or something.

C. a formal assessment of something with the intention of instituting change if necessary

D. a critical appraisal of a book, play, film, etc. published in a newspaper or magazine.

*Google Dictionary

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Search

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Review

*Google Dictionary

Growing literature ….

The number of science publications is growing exponentially, doubling every 9–10 years (Bornmann and Mutz, 2015)

For instance, web of Science Core Collection (WoS, 2018)

- More than 20,300 journals + books and conference proceedings
- Over 71 million records
- More than a 1 billion cited references (1900 to present)

Why should you review the literature?

Literature review let you

- determine whether the topic is **worth studying**
- provide a brief overview of **key ideas and themes** (general to narrow)
- summarise, **compare and contrast the research of the key** research streams
- **narrow down to highlight previous research** work most relevant to your own research and **compare/contrast**
- highlight those aspects **where your own research provide fresh insights**

Saunders et al (2009)

Also …

They help you to

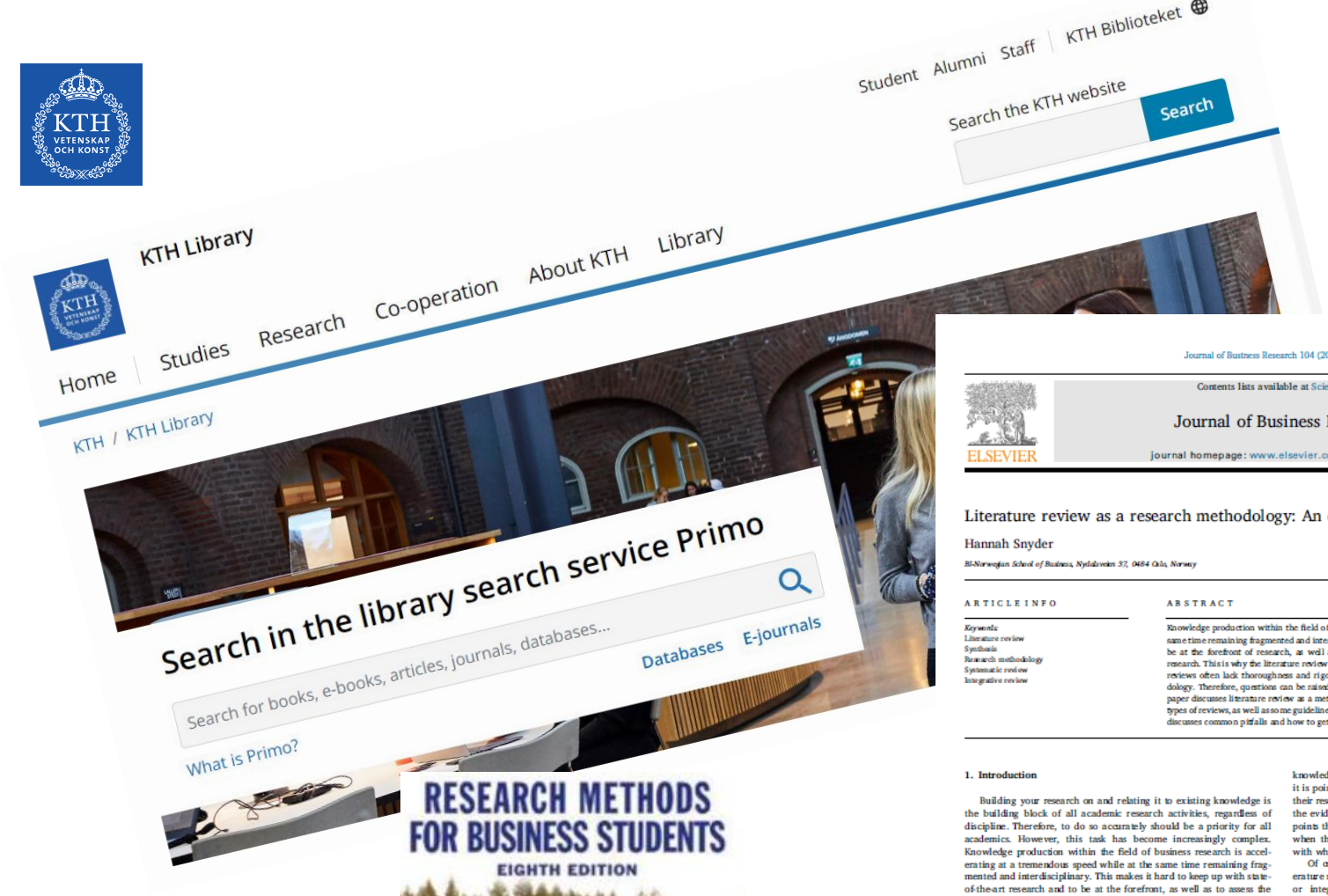
- Generate and refine your research questions
- Avoid repeating research that has been conducted already [which is very unlikely anyway]
- Learn from different research designs

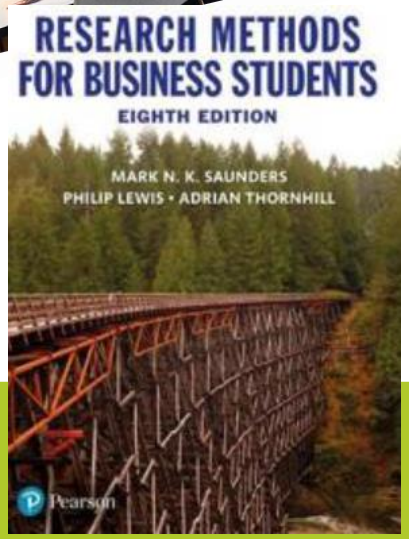
The databases

Google Scholar

WEB OF SCIENCE™

Scopus®





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Literature review as a research methodology: An overview and guidelines

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ARTICLE INFO

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Synthesis
Research methodology
Systematic review
Integrative review

ABSTRACT

Knowledge production within the field of business research is accelerating at a tremendous speed while at the same time remaining fragmented and interdisciplinary. This makes it hard to keep up with state-of-the-art and to be at the forefront of research, as well as to assess the collective evidence in a particular area of business research. This is why the literature review as a research method is more relevant than ever. Traditional literature reviews often lack thoroughness and rigor and are conducted ad hoc, rather than following a specific methodology. Therefore, questions can be raised about the quality and trustworthiness of these types of reviews. This paper discusses literature review as a methodology for conducting research and offers an overview of different types of reviews, as well as some guidelines to how to both conduct and evaluate a literature review paper. It also discusses common pitfalls and how to get literature reviews published.

1. Introduction

Building your research on and relating it to existing knowledge is the building block of all academic research activities, regardless of discipline. Therefore, to do so accurately should be a priority for all academics. However, this task has become increasingly complex. Knowledge production within the field of business research is accelerating at a tremendous speed while at the same time remaining fragmented and interdisciplinary. This makes it hard to keep up with state-of-the-art research and to be at the forefront, as well as to assess the collective evidence in a particular research area. This is why the literature review as a research method is more relevant than ever. A literature review can broadly be described as a more or less systematic way of collecting and synthesizing previous research (Baumeister & Leary, 1997; Tranfield, Denyer, & Smart, 2003). An effective and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster & Watson, 2002). By integrating findings and perspectives from many empirical findings, a literature review can address research questions with a power that no single study has.

It can also help to provide an overview of areas in which the research is disparate and interdisciplinary. In addition, a literature review is an excellent way of synthesizing research findings to show evidence on a meta-level and to uncover areas in which more research is needed, which is a critical component of creating theoretical frameworks and building conceptual models. However, traditional ways of describing and portraying the literature often lack thoroughness and are not undertaken systematically (Tranfield et al., 2003). This results in a lack of knowledge of what the collection of studies is actually saying or to what it is pointing at. As a result, there is a great chance that authors build their research on flawed assumptions. When researchers are selective of the evidence on which to build their research, ignoring research that points the other way, serious problems can be faced. In addition, even when the methodology of the reviews is valid, there are often issues with what constitutes a good contribution.

Of course, there already exist some guidelines for conducting literature reviews that suggest different types of reviews, such as narrative or integrative reviews (e.g., Baumeister & Leary, 1997; Wong, Greenhalgh, Westhorp, Buckingham, & Pawson, 2013), systematic reviews, and meta-analysis (e.g., Davis, Mengersen, Bennett, & Mazerolle, 2014; Liberati et al., 2009; Moher, Liberati, Tetzlaff, & Altman, 2009) or integrative reviews (e.g., Torraco, 2005). There have also been some attempts to develop guidelines specifically for business or management research (e.g., Palmatier, Houston, & Hulland, 2018; Tranfield et al., 2003). By building on and synthesizing these different types of literature reviews, this paper takes a broader view by summarizing and integrating the different guidelines, including how to apply them in business research. More specifically, the purpose of this paper is to provide an overview of and guidelines for different types of literature reviews as a research method in businesses research.

In the following paper, it will be argued that the potential for making theoretical and practical contributions using the literature review as a method will be advanced by clarifying what a literature review is, how it can be used, and what criteria should be used to evaluate its quality. The paper has several contributions. First, this paper separates between different types of review methodologies; systematic,

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How to write and structure a literature review chapter?

One example: Funnel approach

1. Start at a more general level before narrowing down to your topic

2. Provide a brief overview of key ideas and themes

3. summarise, compare and contrast the research of the key research streams

4. narrow down to highlight previous research work most relevant to your own research

5. highlight those aspects where your own research will provide fresh insights

How to structure

My advice: Do not list/summarize papers one by one.
Instead, you can come up with themes and snythesize the knowledge!

Research designs

Research Designs

It can be called “strategies of inquiry” as well

Two main type of designs

- Qualitative (i.e., non-numerical)
- Quantitative (i.e., numerical)

They should not be viewed as polar opposites or dichotomies

Mixed approaches are possible

Qualitative vs Quantitative

Some examples (not dichotomies):

	Qualitative	Quantitative
Data	E.g., using words or observations	E.g., using numbers
Purpose	Exploring and understanding	Examining the relationships among variables
Questions	Open-ended	Close-ended
Strategies	Case study etc.	Experiment etc.

Quantitative Designs

Some examples:

- **Survey research**
  - a quantitative or numeric description of
    - trends,
    - attitudes,
    - or opinions
  - Studies a sample of a population.
- **Experimental research**
  - seeks to determine if a specific treatment influences an outcome
  - true experiments, natural experiments, quasi-experiments

Qualitative Designs

Some Examples:

- **Narrative research**
  - researcher studies the lives of individuals
  - provide stories about individual lives
  - involve a narrative chronology

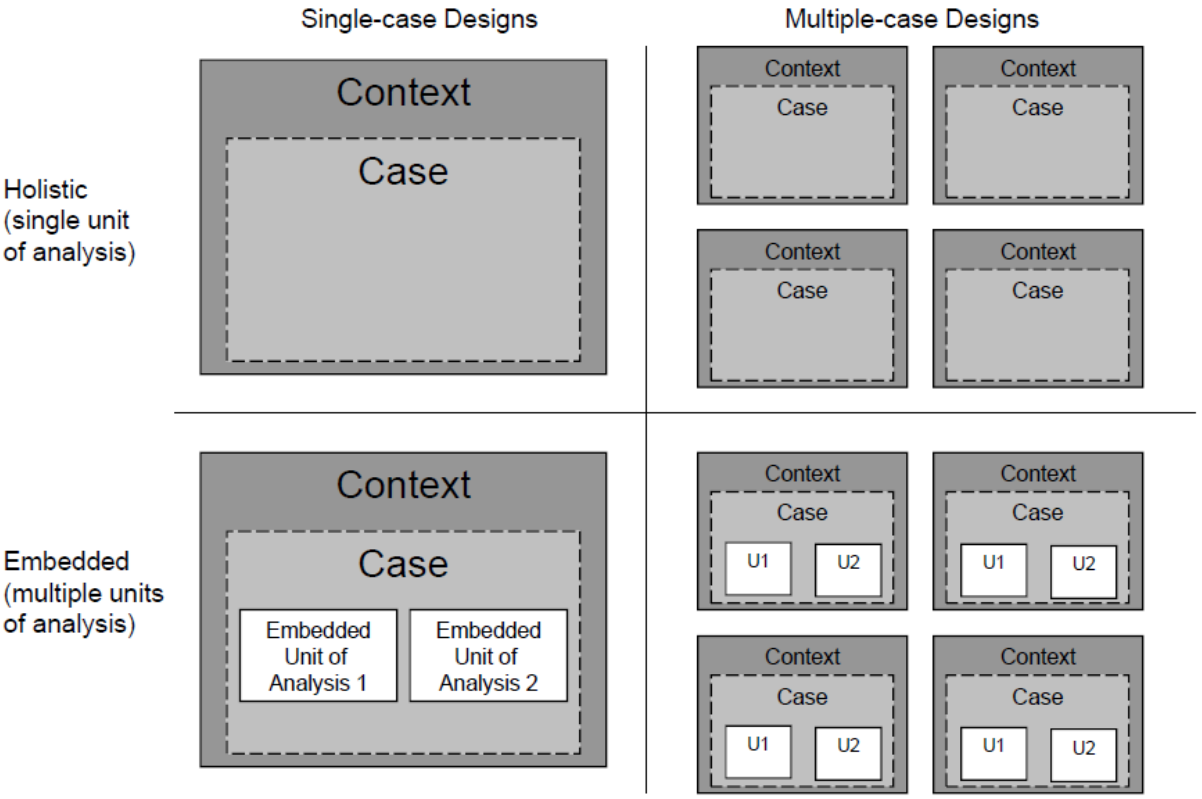
- **Phenomenological research**
  - Grounded theory approach
  - Ethnography
  - Case studies

For instance …

A **case study** is an empirical inquiry that

- investigates a contemporary phenomenon **in depth and within its real-life context**,
- copes with a distintice situation in which there are **many variables**
- relies on **multiple sources of evidence**
- may benefits from the prior development of **theory to guide data collection and analysis** (Yin, 2009; p.18)

Single vs. Multiple Units of Analysis



(Yin, 2009:32)

Methodological Differences

	Survey	Case Study	Econometrics	....
Source of Data	Responses to questionnaires	**Human words, observation, documents etc.**	Large databases	
Position of the researcher	Outside the field	**Entering and observing the field**	Outside the field	
Data Analysis	Mathematical	**Non Mathematical**	Mathematical	
Software/tool	Yes	**Sometimes**	Yes	
Type of research questions	Hypothesis and relations among variables	**Open ended questions**	Hypothesis and relations among variables	
Phenomenon	Reducible into a model	**Complex**	Reducible into a model	

(Arnaboldi, 2012)

Research Questions

	Research question	Control of behavioural events	Focus on contemporary events
Experiment	How? Why?	yes	yes
Survey	Who? What? Where? How many? How much?	no	yes
Case Study	How? Why?	no	yes

(Yin, 2016)

Research Methods

Research Methods

But ….

What is difference between method and methodology?

“The most common definitions suggest that

- *methodology is the overall approach to research linked to the paradigm or theoretical framework*
- *the method refers to systematic modes, procedures or tools used for collection and analysis of data.”*

(Mackenzie and Knipe, 2006)

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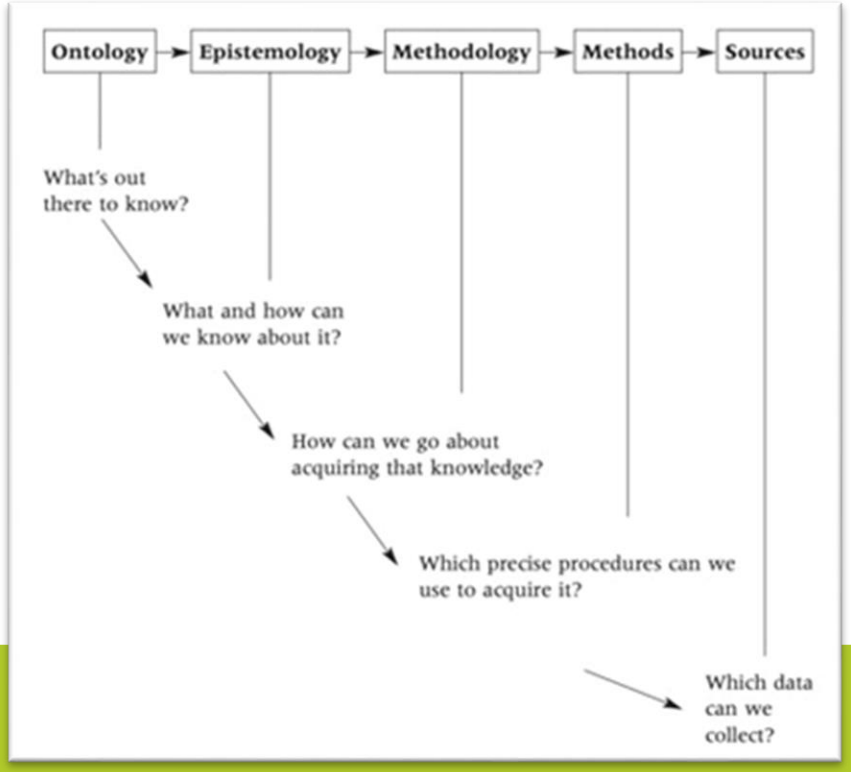


(Grix,2002)

Research Methods

Research methods

- involve the forms of data collection, analysis, and interpretation that researchers propose for their studies

Some examples

- Big data analysis
- Questionnaires
- Experiments
- Observations
- Focus groups
- Interviews
- Documents
- Records etc.

For instance: Interviews

Interviews

Interviewing is a method to know about phenomenon by asking open-ended questions to informants

- **Who to interview?**
- **Which questions?**
  - It depends on research question
  - Let them talk
- **Structured semi-structered?**
- **Recording**
  - Always ask in advance
  - Ask additional questions after turning off the recorder

Different types of interviews vs. research purpose

	Exploratory	Descriptive	Explanatory	Evaluative
Structured		++	+	+
Semi-structured	+		++	++
Unstructured	++			+

++: more frequent
+: less frequent

Saunders et al 2016 (p. 393)

Different types of interviews

Structured interviews

- Based on predetermined and standardized questions
- More often in quantitative research

Semi-structured interviews

- Non-standardized
- More often in qualitative research
- Researcher has some themes and some key questions to cover (although their use may vary from interview to interview)
- Some questions can be dropped and some others can be added
- Room for open discussion

Unstructured interviews

- Ideas on what aspects to explore
- No predetermined questions
- Informal and non-directive

Saunders et al 2016 (p. 391)

Data Analysis

Quantitative vs. Qualitative data

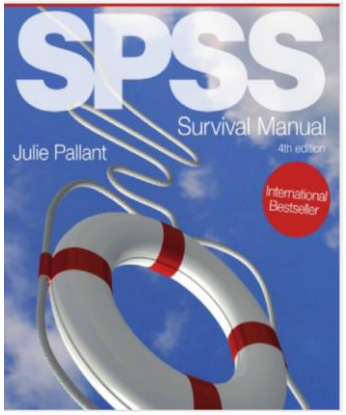
	Quantitative data	Qualitative data
Data type	Based on meanings derived from **numbers**	Based on meanings expressed through **words**
Data structure	Collection results in numerical and **standardized data**	Collection results in **non-standardized data** requiring classification into categories
Data analysis	Analysis conducted through the use of diagrams and **statistics**	Analysis conducted through the use of **conceptualisation**

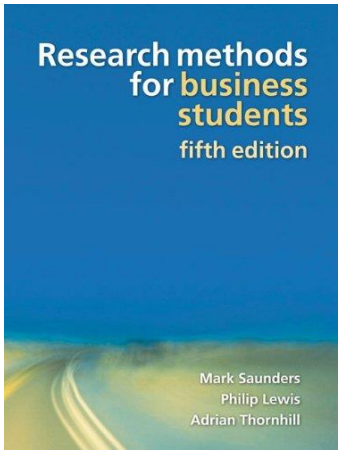
Saunders et al 2016 (p. 482)

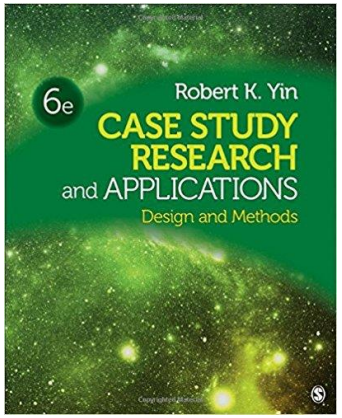
Some suggestions

Quantitative analysis

Qualitative analysis







For instance: interview analysis

Have you analyzed any interviews so far?

For instance: interview analysis

The primary source for case study are interviews

- Once transcribed you start analyze the text
- Which steps:
  - Deciding on your approach to analysis
  - Coding text
    - If you are in group: make the first coding separately and then cross-check results
  - Identify variables/dimensions
  - Identify:
    - Patterns
    - Relations

Approach to analysis

Using a **deductive** approach

- Existing theoretical framework help you organize and direct your data analysis

Using an **inductive** approach

- You do not use a predetermined theoretical framework
- You start to collect data and then explore them

Remember:

- It is an interactive and iterative process
- Abductive approaches are common
- You can change your approach along the way

Saunders et al 2016 (p. 569-571)

Coding the text

- A code is a concept, a word that signifies “what is going on in this piece of data.”
- Coding, on the other hand, is the analytic process of examining data line by line or paragraph by paragraph (whatever is your style) for significant events, experiences, feelings, and so on, that are then denoted as concepts (Strauss & Corbin, 1998)
- Codes can be based on
  - Themes, Topics
  - Ideas, Concepts
  - Terms, Phrases
  - Keywords

An example

Interviewer: Tell me about teens and drug use.

Respondent**:** I think teens use drugs as a release from their parents Well, I don't know. I can only talk for myself. For me, it was an experience. You hear a lot about drugs You hear they are bad for you.

Source: *Basics of Qualitative Research, (*Strauss & Corbin,1998).

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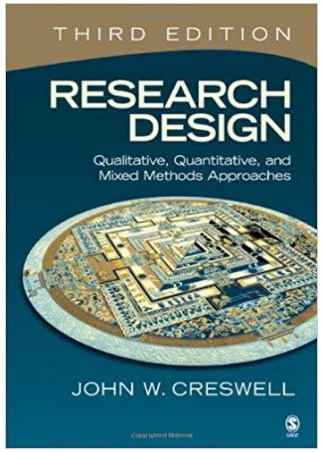
AFTER CODING

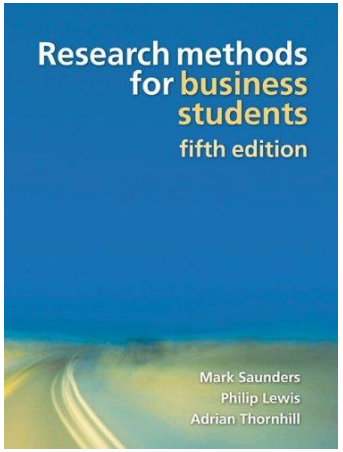
Interviewer: Tell me about teens and drug use.

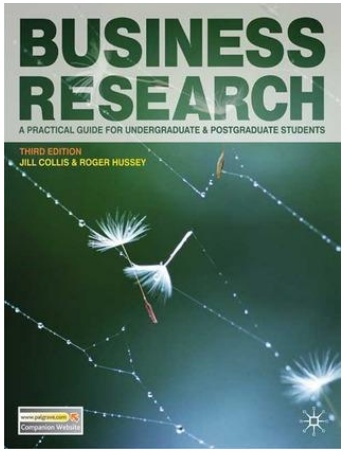
Respondent**:** I think teens use drugs as a release from their parents **["rebellious act"].** Well, I don't know. I can only talk for myself. For me, it was an experience **["experience"]** You hear a lot about drugs **["drug talk"].** You hear they are bad for you **["negative connotation" to the "drugtalk"].**

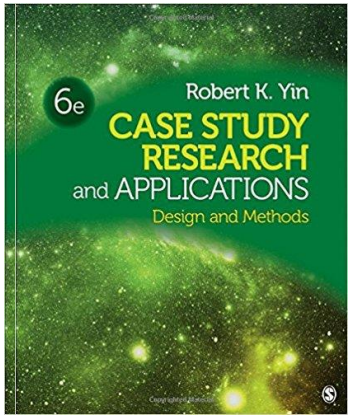
Source: *Basics of Qualitative Research, (*Strauss & Corbin,1998).

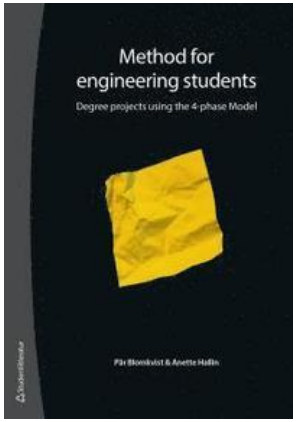
Some key books …

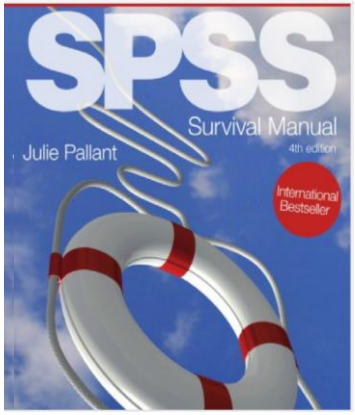












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GET SUNLIGHT.
YOU'RE BASICALLY A HOUSE PLANT WITH MORE COMPLICATED EMOTIONS.
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