RESEARCH METHODS

HOW DO WE COME TO KNOW THINGS?

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AGENDA

- Research contribution
- Quantitative vs Qualitative Research
- Selected Research Methods
  - Case Study
  - Action Research
  - Experiment
  - Survey
  - Literature Study
- Data Collection Techniques
- Data Analysis Methods
- Research Method Review

WHAT ARE RESEARCH METHODS?

- Good research methods do not “just happen”; they are deliberately employed in ways that are designed to maximize the accuracy of the results
- Knowing about research methods help us understand how we came to know what we accept as knowledge/facts

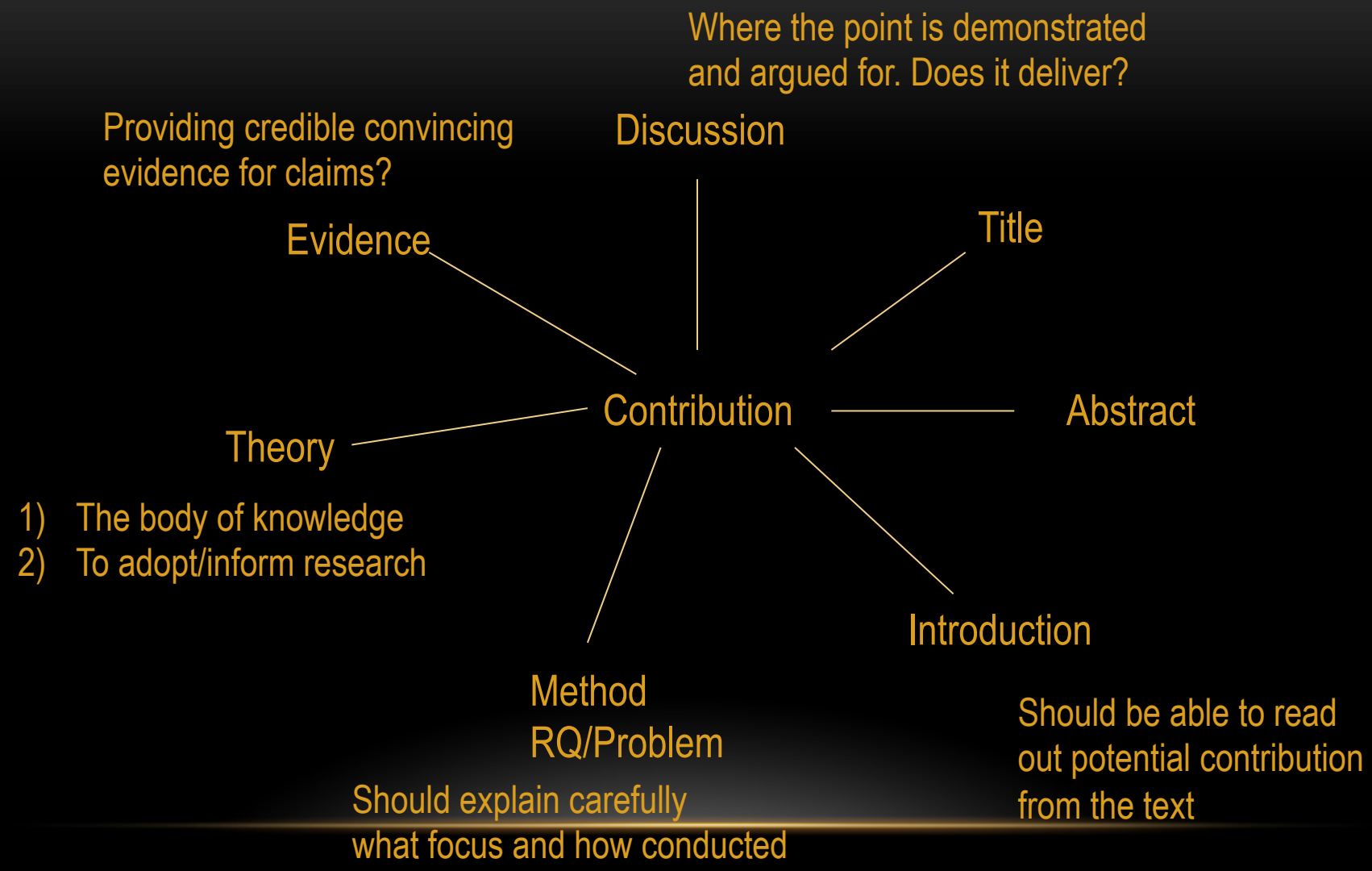
DEVELOPMENT VS RESEARCH

- What is the outcome?
  - Local result: application, system, functionality, process, method…
  - Knowledge – of general interest

MAIN ASPECTS OF SCIENCE

- Highest possible level of evidence
- Repeatable study

REVIEW OF RESEARCH PAPERS



REVIEW OF RESEARCH PAPERS

Does the research paper make (a potential) contribution?

General Points on Contribution:

- △ Make a difference to existing body of knowledge
  - Adding
    - A hole /gap
    - A problem
  - Challenging
  - Modifying

STATE OF THE ART

- Body of knowledge
- Literature on the topic - existing knowledge
- Known problems
- Known solutions
- Applied
- Identified gaps/problems

QUANTITATIVE AND QUALITATIVE RESEARCH

- Quantitative research methods
  - Developed in **natural sciences** to study natural phenomena
  - Based on numerical data - breadth
  - E.g. mathematics, statistics, experiments…
- Qualitative research methods
  - Developed in the **social sciences** to study social and cultural phenomena
  - Based on non-numerical data – in-depth
  - E.g. ethnography, grounded theory, case study…

UNDERLYING PHILOSOPHICAL PERSPECTIVES

	Positivism	Interpretivism
Ontology: what exists	A single reality, knowable, probabilistic	Multiple realities, socially constructed
Epistemology: what is knowledge and how is it acquired	Objective; dispassionate. detached observer of truth	Subjective, i.e. values and knowledge emerge from the researcher-participant interaction
Methodology: What is valid approach to reality	Observation; quantitative, statistical	Participation; qualitative, hermeneutical, dialectical
Axiology: what is of value	Truth: universal and beautiful; prediction	Understanding: situated and description

RESEARCH QUESTIONS

Qualitative

- What?
- How?
- Focus on single phenomenon/concept
- Use explorative verbs to discover, explore, describe
- RQ

Quantitative

- Why? (cause-effect)
- How much/many?
- Test of theory - falsify
- Use of variables to compare, relate, and explain
- RQ or Hypotheses

Qualitative research is often used to gain a general sense of phenomena and to form theories that can be tested using further quantitative research

Quantitative research approach

- The generation of models, theories and hypotheses
- The development of instruments and methods for measurement
- Experimental control and manipulation of variables

Qualitative research approach

- Basic/generic/pragmatic qualitative research -eclectic approach to best match the research question at hand
- Ethnographic research - study of a people, their culture and their understanding of phenomenon
- Grounded theory – inductive research, based or "grounded" in the observations or data from which it was developed

CASE STUDY

- Investigation of a contemporary phenomenon in its own context, where the boundaries between the phenomenon and the context are unclear
- DOUBLE MEANING
  - Unit of analysis
  - Method for research
- Appropriate for
  - research or theory that are at their early, formative stages
  - for practice-based problems where the experiences of the actors and the context of action are essential

FIVE MAJOR PROCESS STEPS IN CASE STUDY

1. Case study design: objectives are defined and the case study is planned
2. Preparation for data collection: procedures and protocols for data collection are defined
3. Collecting evidence: execution with data collection on the studied case
4. Analysis of collected data
5. Reporting

(Runesson & Höst 2009)

PLAN FOR A CASE STUDY

- Objective—what to achieve?
- The case—what is studied?
  - Unit of analysis
- Theory—frame of reference
- Research questions—what to know?
- Data Collection Methods—how to collect data?
- Selection strategy—where to seek data?
- Data Analysis Methods — how to analyze data?

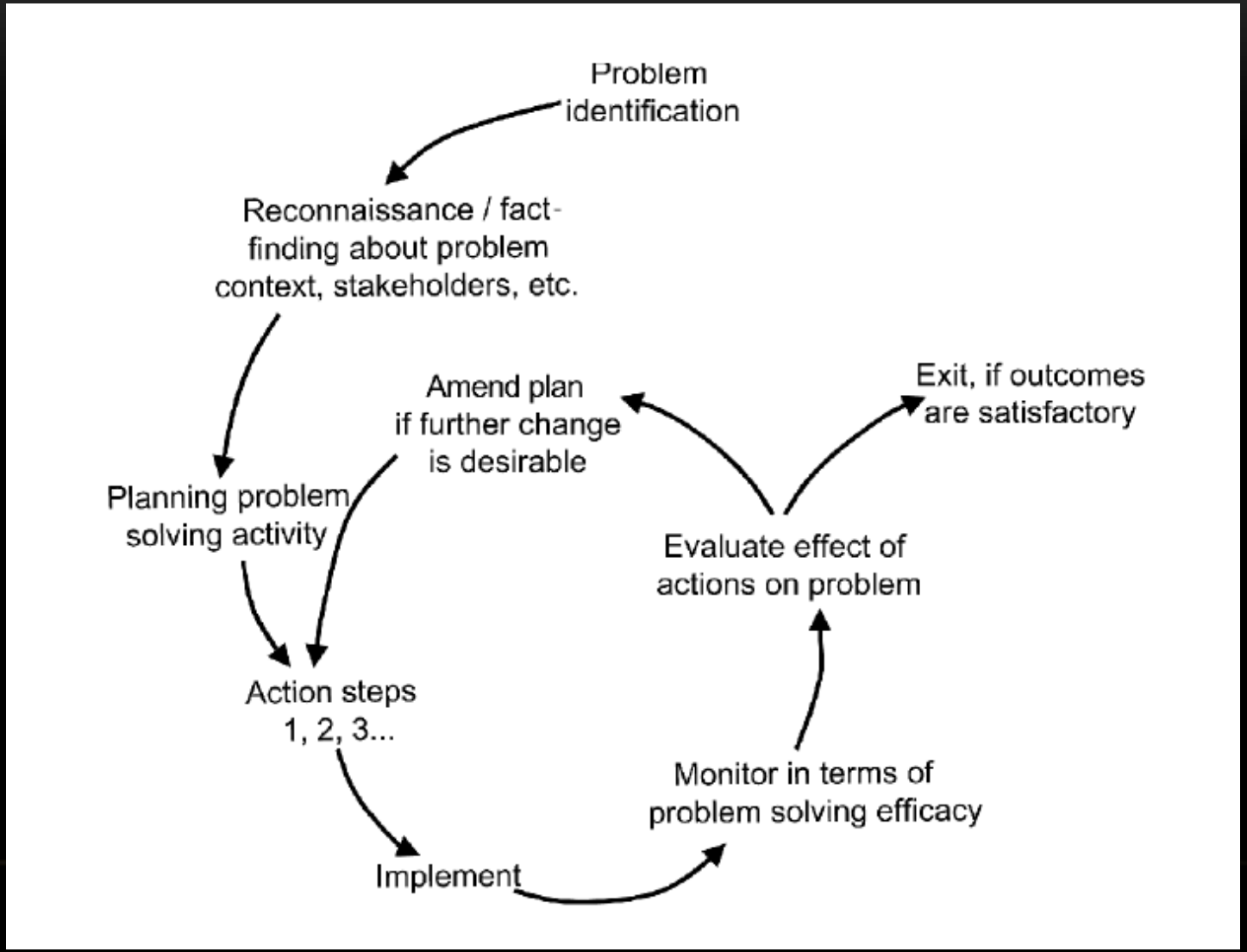
ETHICAL FACTORS

- Informed consent
- Review board approval
- Confidentiality
- Handling of sensitive results
- Incentives
- Feedback

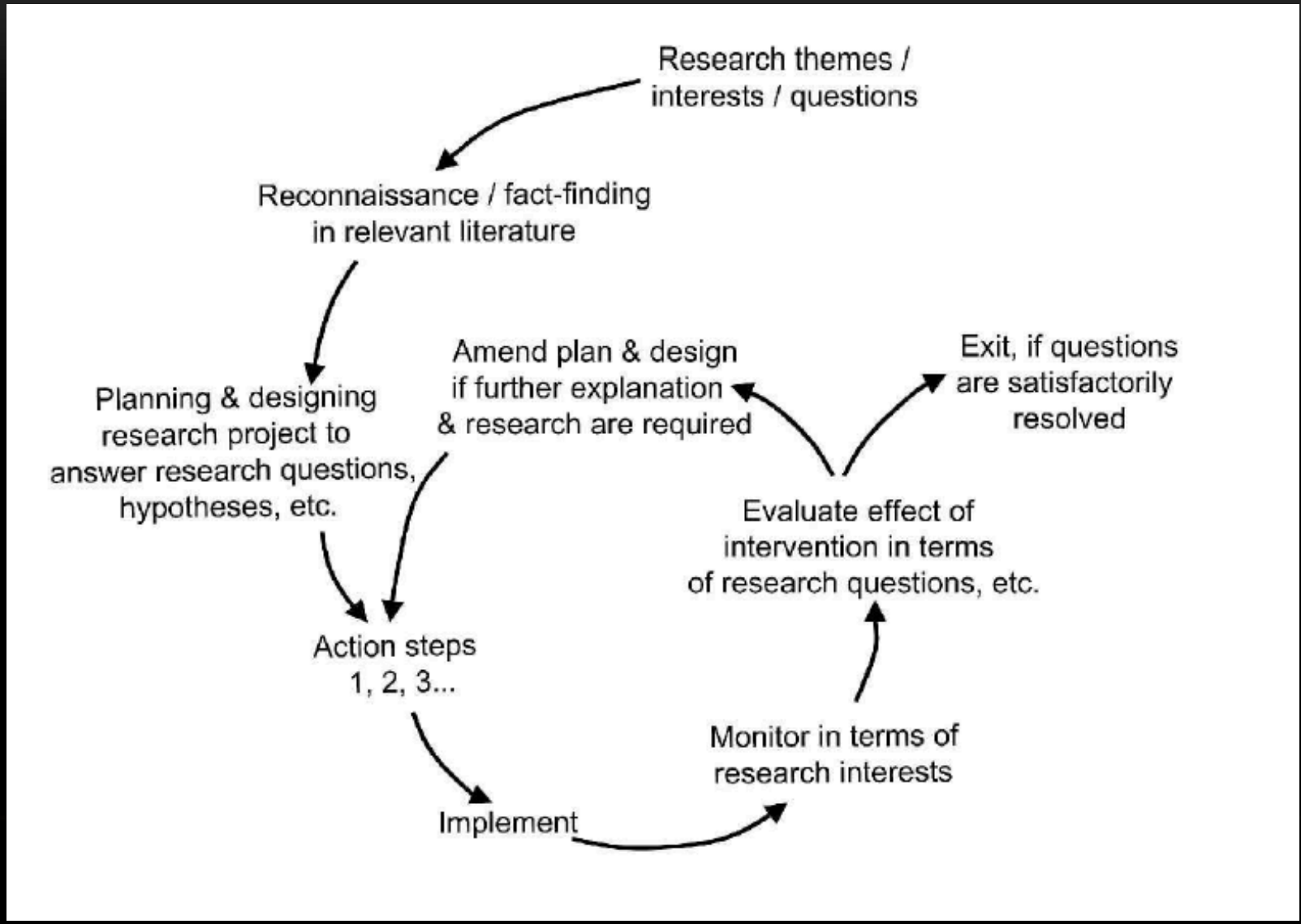
ACTION RESEARCH

- action researcher has dual aims:
  - to bring about improvements through making changes in a problematic situation
  - to generate new knowledge and new insights as a result of his/her activities

PROBLEM SOLVING INTEREST IN ACTION RESEARCH



RESEARCH INTEREST IN ACTION RESEARCH



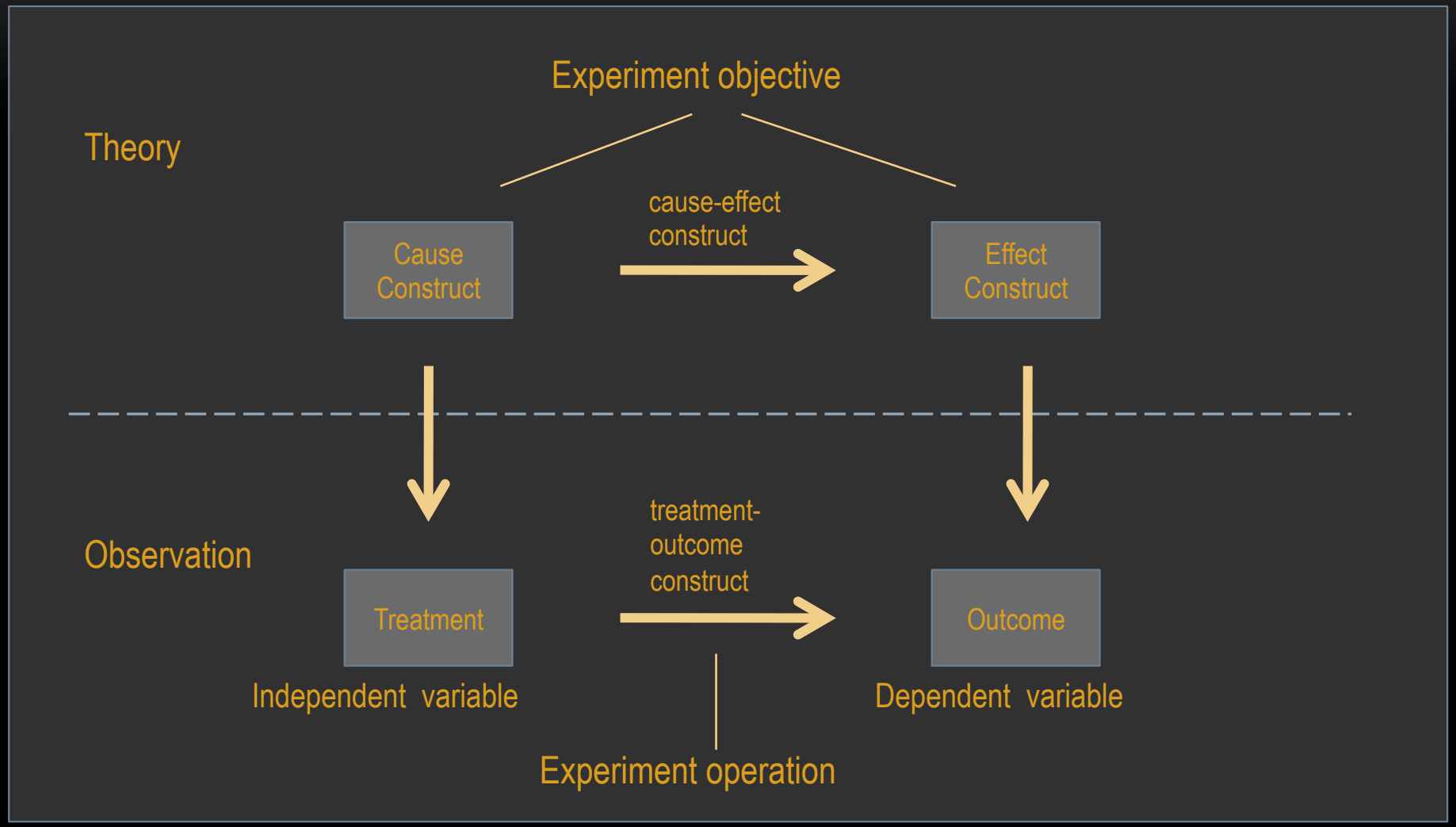
CHECKLIST CASE STUDY REVIEW (+AR)

- What is the case and its units of analysis?
- Are clear objectives, preliminary RQ, (hypotheses) defined?
- Is the theoretical basis—relation to existing literature or other cases—defined?
- Are the authors' intentions with the research made clear?
- Is the case adequately defined (size, domain, process, subjects…)?
- Is a cause–effect relation under study? If yes, is it possible to distinguish the cause from other factors using the proposed design?
- Does the design involve data from multiple sources (data triangulation), using multiple methods (method triangulation)?
- Is there a rationale behind the selection of subjects, roles, artifacts, viewpoints, etc.?
- Is the specified case relevant to validly address the RQ (construct validity)?
- See further in Runesson & Höst (2009)

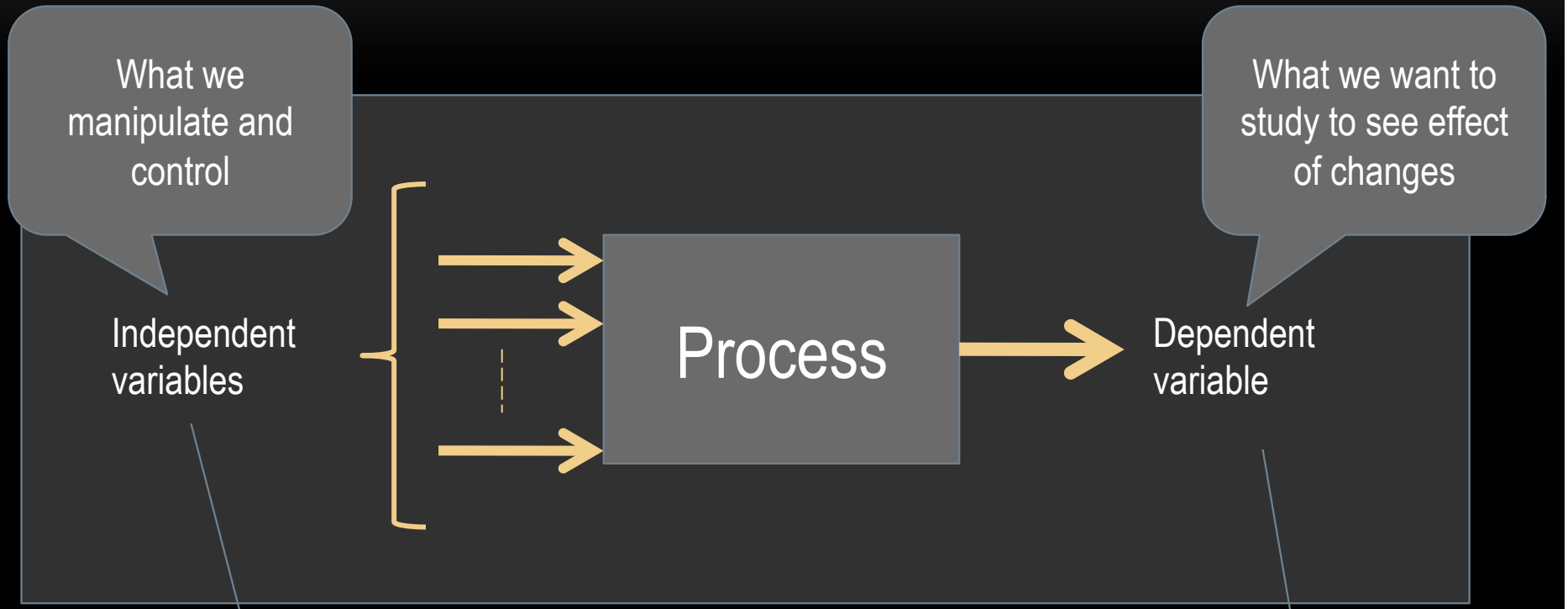
EXPERIMENT IN SE

- Aim to test the impact of a treatment (or an intervention) on an outcome, controlling all other factors that might influence the outcome

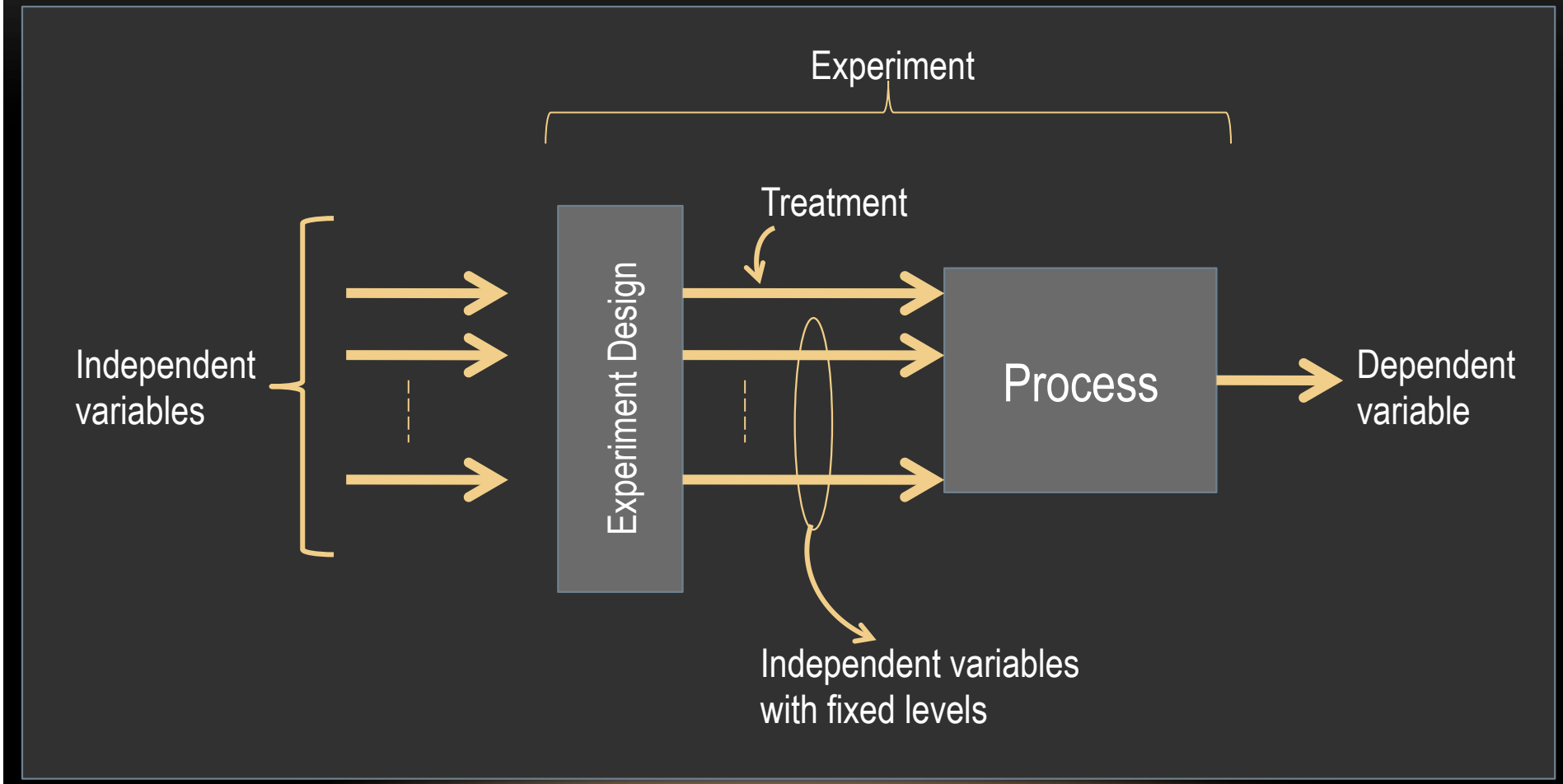
EXPERIMENT PRINCIPLES (WOHLIN ET AL 2000)



INDEPENDENT & DEPENDENT VARIABLES



EXPERIMENT ILLUSTRATION



EXPERIMENT PHASES

1. Definition
   - Motivation, object, purpose, perspective, domain, scope
2. Planning
   - Design, criteria, measurement
3. Operation
   - Preparation, execution, analysis
4. Interpretation
   - Interpretation context (e.g. statistical framework), extrapolation, impact

SURVEYS

- A common goal of survey research is to collect data representative of a population
- Information gathered from the survey is used to generalize findings from a drawn sample back to a population - within the limits of random error

REPRESENTATIVE SAMPLING

- Sample = *representative* when it is an accurate proportional representation of the population under study
- A truly representative sample requires every person in a population to have had an equal chance of being chosen to participate in the survey = *randomization*
- Computer-list of population – randomly generate a list of 2 percent ?
- *Stratification* - truly representative sample of the population
- Stratify a population - decide what sub-categories of the population might be statistically significant - randomly generate certain percentages of sub categories

SURVEY SAMPLE SIZE

- Procedures used in how sample size is calculated should always be reported
- Allow the reader to make own judgments whether they accept the researcher's assumptions and procedures

SURVEYS

- Data are usually collected through
  - Questionnaires
  - Interviews
- Qualitative (open-ended questions)
- Quantitative (forced-choice questions)
- Two basic types of surveys
  - Cross-sectional - gather data on a population at a single point in time
  - Longitudinal - gather data over a period of time, analyze changes in the population

BASIC STEPS IN SURVEY RESEARCH

- Organization - determine who is to be sampled and what is to be learned about the sample
- Questionnaire Design - based on the goal of the survey, prepare questions and arrange in a logical order to create the survey questionnaire
- Sampling - develop a repeatable plan to randomly choose a sample capable of meeting the survey's goals - select a sample
- Data Collection - develop a plan for contacting the sample and collecting data from participants - carry out
- Data Processing - enter collected data into computer and check for accuracy
- Analysis - compile and disseminate the results

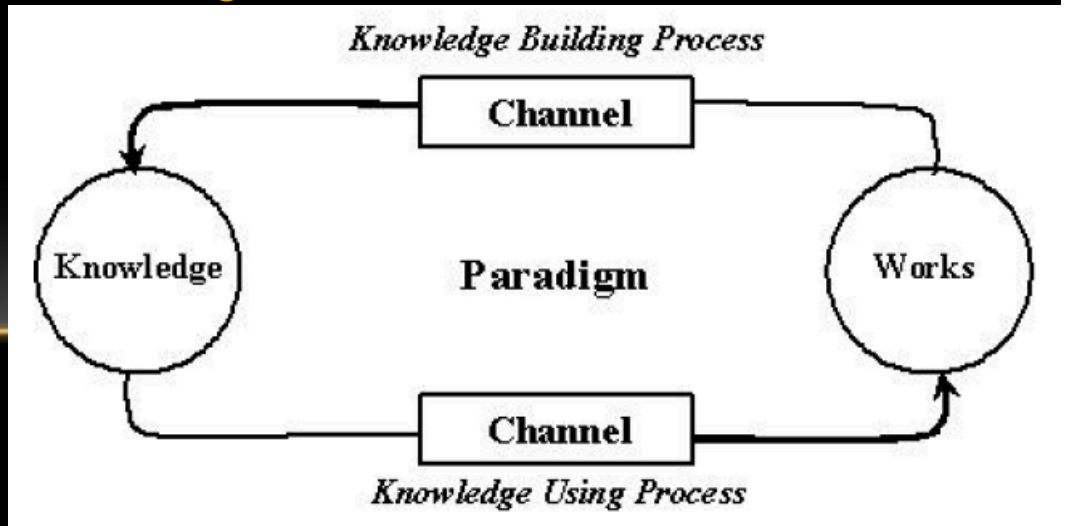
QUESTION DESIGN

A poorly designed questionnaire generates useless results

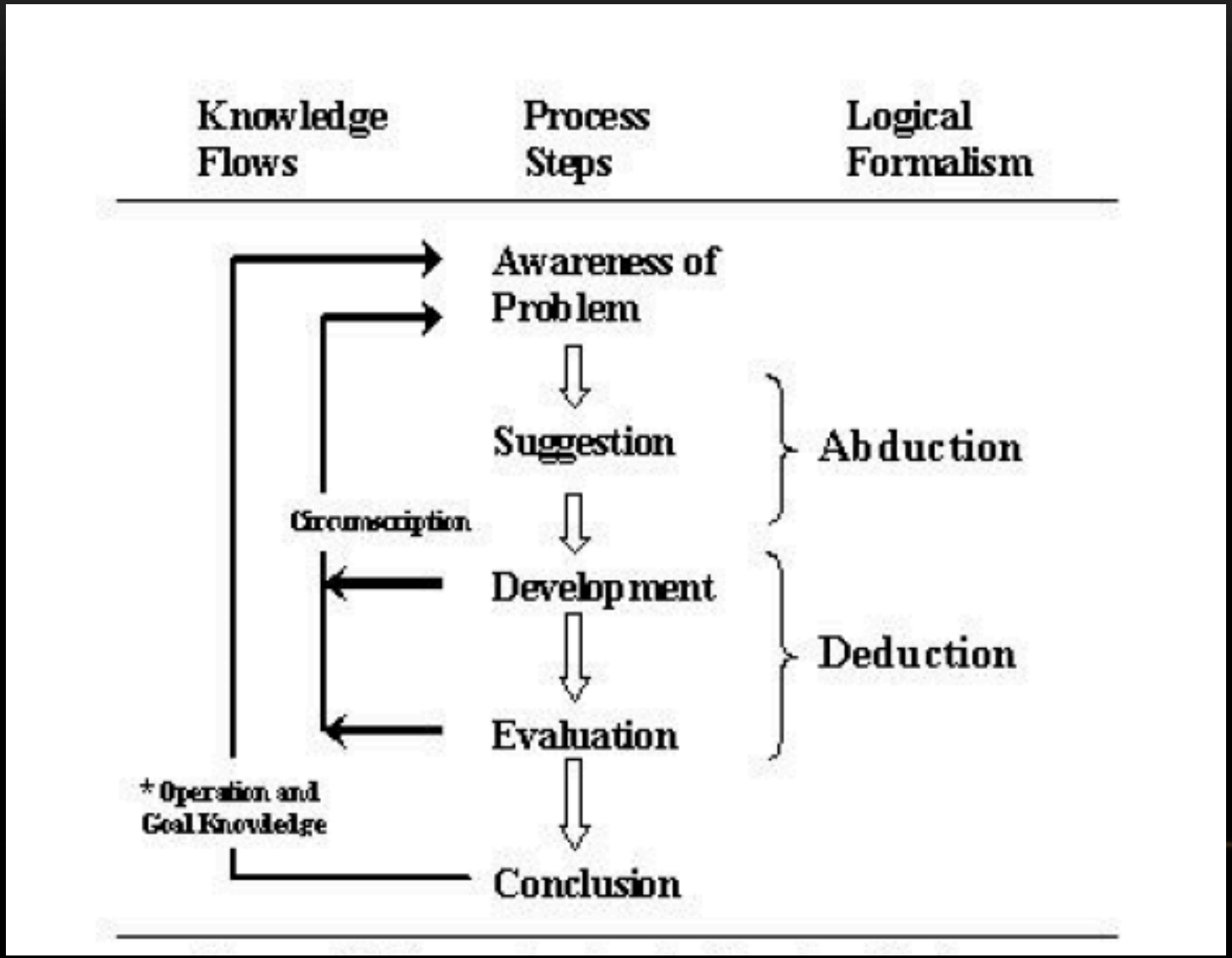
- Make sure the question asks only one clear thing
- Ask questions the respondent can accurately answer
- Questions should be relevant
- Use short items (easily read, understood, and answered quickly)
- Avoid negative items
- Avoid biased items and terms
- Avoid slang, jargon, and technical terms (unless warranted)
- Whenever possible, develop consistent response methods
- Sequence questions from the general to the specific
- Closed questions - try to develop exhaustive and mutually exclusive response alternatives
- Place questions with similar content together in the survey instrument.
- Make the questions as easy to answer as possible
- Use clear definitions for unique and unusual terms
- Make sure that questions measure what they are supposed to – pilot test, focus groups

DESIGN RESEARCH

- Knowledge is generated and accumulated through action. Doing something and judging the results is the general model . . .
- The design research process is shown as a cycle in which knowledge is used to create works, and works are evaluated to build knowledge



REASONING IN DESIGN CYCLE



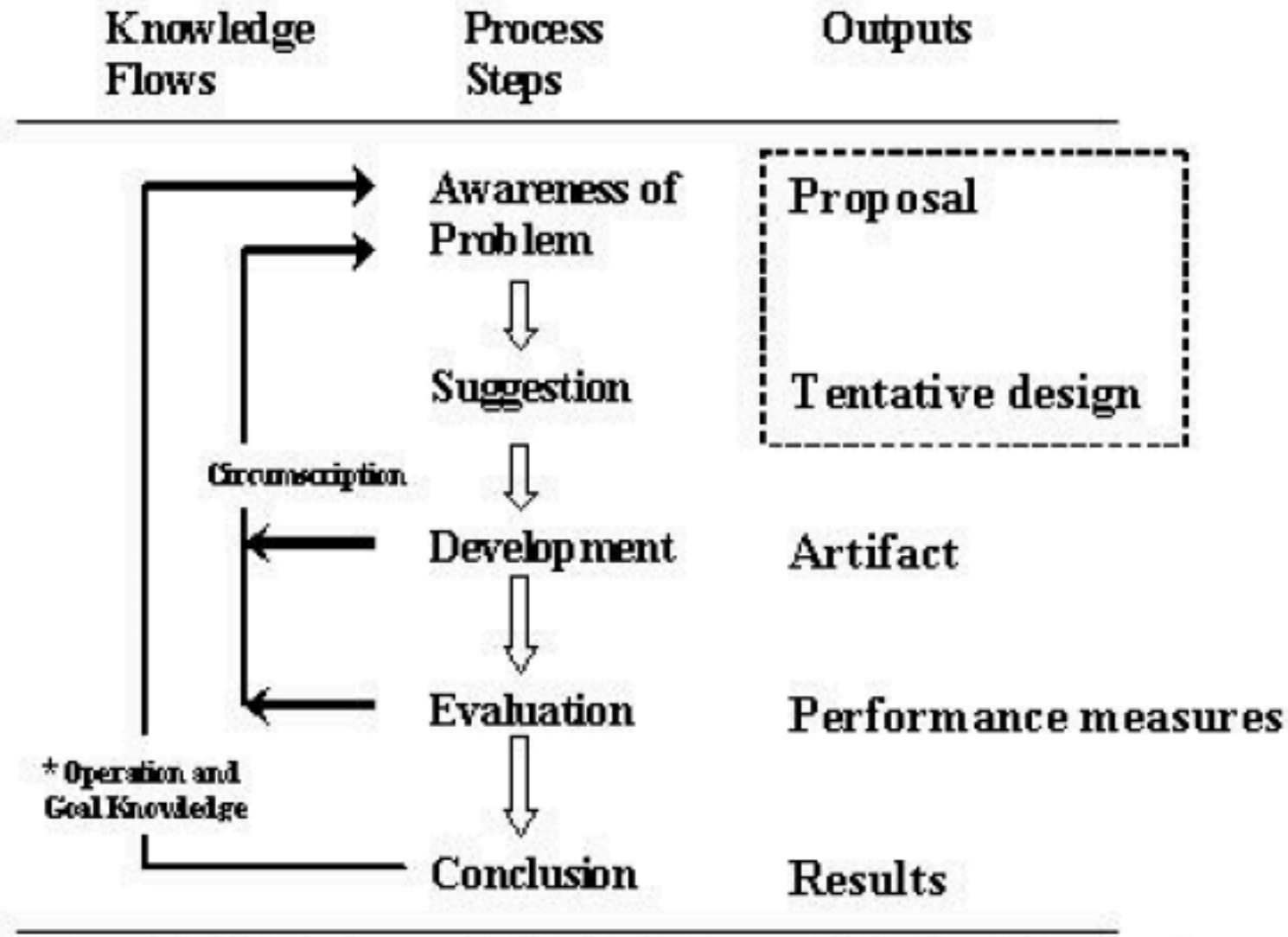


Figure 5. The General Methodology of Design Research

OUTCOMES FROM DESIGN RESEARCH

- Construct - conceptual vocabulary of a problem/solution domain. Constructs arise during the conceptualization of the problem and are refined throughout the design cycle.
- Model - a set of propositions or statements expressing relationships among constructs
- Method - a set of steps (an algorithm or guideline) used to perform a task. Methods are goal directed plans for manipulating constructs so that the solution statement model is realized
- Instantiation - operationalizes constructs, models and methods. It is the realization of the artifact in an environment.

SYSTEMATIC LITERATURE REVIEW

- A means of identifying, evaluating and interpreting all available research relevant to a particular RQ, topic area, or phenomenon of interest.
- Individual studies contributing to a systematic review are called *primary* studies
- A systematic review is a form of a *secondary* study

PLANNING - THE NEED FOR A SYSTEMATIC REVIEW

- Summarize all existing information about some phenomenon in a thorough and unbiased manner
  - Draw more general conclusion than possible from individual studies
  - Prelude to further research activities
- Ensure the need
  - identify and review any existing systematic reviews

COMPONENTS

- Background - the rationale for the survey
- RQ the review is intended to answer
- Strategy to search for primary studies (search terms, DB, journals…)
- Selection criteria and procedures - Include or exclude a study
- Quality assessment checklists and procedures
- Data extraction strategy – how obtain the information required from each primary study
- Synthesis of the extracted data - what techniques will be used
- Project timetable - define the review plan

DESCRIPTIVE SYNTHESIS

- Arrange text/tables for extracted information about the studies in a manner consistent with RQ
  - (intervention, population, context, sample sizes, outcomes, study quality)
- Structure tables to highlight similarities/difference between study outcomes
- Identify if results are consistent (homogeneous) or inconsistent (heterogeneous)
  - Arrange table to display the impact of potential sources of heterogeneity, e.g. study type, study quality, sample size
- Present quantitative data in table:
  - E.g. sample size, difference between mean values for each intervention, and confidence interval for difference…

DESCRIBE YOUR METHOD

Questions to ask and answer:

- What has been done and where?
- Why and justification
- What did you look for?
- How was it done?

METHOD DETAILS

- Study design - justification
  - qualitative, quantitative, mixed
  - case study, action research, survey, experiment, literature study
- Context – Who/What is the study about?
  - setting, participants, control subjects
- What did you do?
  - Data collection techniques, data sources
- What did you look for?
  - What did you ask, focus
- How did you analyze your data

METHODS FOR DATA COLLECTION

- Interviews – structured – semi-structured - unstructured
- Focus groups
- Observation – Participant /non-participant
- Field notes
- Questionnaires
- Automatic – log files, measuring instruments…
- Archival research
- Written data sources
  - Published and unpublished documents
  - Company reports
  - Memos, Letters, Email messages
  - Reports
  - Newspaper articles ….

QUALITATIVE DATA ANALYSIS

- Coding, summarizing, patterns, …
- Basic objective of the analysis is to derive conclusions from the data, keeping a clear chain of evidence
- Characterized by having analysis carried out in parallel with the data collection and the need for systematic analysis techniques
- Note! Qualitative analysis is flexible and new insights are found during the analysis

QUANTITATIVE DATA ANALYSIS

- Analysis of descriptive statistics - e.g. mean values, standard deviations, scatter plots
- Correlation analysis and Development of predictive models
- Hypothesis testing
- Note! Quantitative analysis assume a fixed research design

REVIEW OF METHOD

- Research Question – Hypothesis - Problem
  - Clear, relevant, logical, realistic…?
- Research Design – appropriate for RQ/H/P? Justified?
  - Research process?
  - Data sources?
  - Data collection techniques?
  - Data analysis?

VALIDITY - TRUSTWORTHINESS

- Validity of a study denotes the trustworthiness of the results
- Results not biased by the researchers' subjective point of view
- Must be addressed during all phases of the research
- Construct validity: studied operational measures really represent what's intended
- Internal validity: causal relations - investigated factor affected by other factor(s)
- External validity: possible to generalize findings, i.e. defining a theory
- Reliability: data and analysis dependent on the specific researchers
- Examples of ways to improve validity:
  - triangulation
  - developing and maintaining a detailed protocol
  - having designs, protocols, etc. reviewed by peer researchers
  - having collected data and obtained results reviewed
  - giving sufficient concern to analysis looking for theories that contradict your findings

(Runesson & Höst 2009)

CHECKLIST FOR ANALYSIS REVIEW

- Is the analysis methodology defined, including roles and review procedures?
- Is a chain of evidence shown with traceable inferences from data to research questions and existing theory?
- Are alternative perspectives and explanations used in the analysis?
- Is a cause–effect relation under study? If yes, is it possible to distinguish the cause from other factors in the analysis?
- Are there clear conclusions from the analysis, including recommendations for practice/further research?
- Are threats to the validity analyzed in a systematic way and countermeasures taken? (Construct, internal, external, reliability)

WRITING UP RESEARCH

- Hard to over-emphasize the importance of good writing
- Don’t leave the writing until the end!!!
- Don’t wait until you got “the story” figured out
- Writing is thinking
- Writing helps a researcher to think straight and to figure out how to best tell the story
- Start writing as soon as possible

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