

Problem Definition

Design Process

Design Step

Action

Outcome

Initial Problem

Problem Definition

Surveys, Case Studies,
Action Research

Explicit Problem Defenition

Requirement Definition

Surveys, Case Studies,
Action Research

Quantitative & Qualitative
Requirements

Design & Development

Development Design
Candidates

Creative Methods,
Innovation

Mockups / Rapid
Prototyping

Select the Best Design
(Solution)

Optimization

Primary / Secondary
Design

Construct a Prototype

Machining / Rapid
Prototyping

Artifact / Fully functional
System

Demonstration

Experiments, Case Studies
/ Action Research

Demonstrated Prototype
(Basic Functionality)

Evaluate

Experiments, Case Studies
/ Action Research

Evaluated Prototype
(Meeting Requirements)

Reporting

Summary of the Design
Process / Lesson Learned

Final Report

Redesign

Explicit Problem Definition

What is the problem experienced by some stakeholders of a practice and why is it important?

- The three Goals
 - Formulate the initial problem precisely
 - Justify its importance
 - Investigate its underlying causes

Explicit Problem Definition

- Problem (Definition)
 - Undesirable state of affairs
 - A gap between a **desirable state** and the **current state**
- Example: Several customers of a car retailer complain about the long delivery times for cars.
 - Customers expect the time from order placement to product delivery
 - **Desire State:** to be less than 1 week
 - **Current State:** instead of the current 3 weeks

Gap Between Desire / Current States

- The gap between the desirable and the current state may or may not be made explicit when a problem is discussed.
 - **Obvious Gap** - The gap is so obvious that knowledge of the current state is sufficient to conclude that a problem exists
 - Example: if many customers of the car retailer complain about delivery times for cars, its management will realize that customers are dissatisfied and that there exists a problem to be addressed
 - **Non Obvious Gap** – The gap is not obvious and a problem may become apparent only when someone suggests a more desirable state of affairs.
 - Example: suppose that no customer has complained about the delivery times, but a competitor states in a marketing campaign that its delivery time of cars is only 3 days from order placement. If the management interprets this as a threat, there will be a problem, although the current state was not viewed as undesirable in itself.

Opportunity as a Problem

- Not only threats but also opportunities can be viewed as problems.
- Example:
 - An organization that receives information from its ERP (*) vendor that mobile devices can be integrated with its ERP system. Thereby, the employees can access the system from anywhere, which might increase their productivity.
 - Therefore, the problem is that currently the organization does not work as productively as possible, because its employees do not benefit from this opportunity of mobile technology.
 - (*) Note: Enterprise resource planning (ERP) is business process management software that allows an organization to use a system of integrated applications to manage the business and automate many back office functions related to technology, services and human resources.

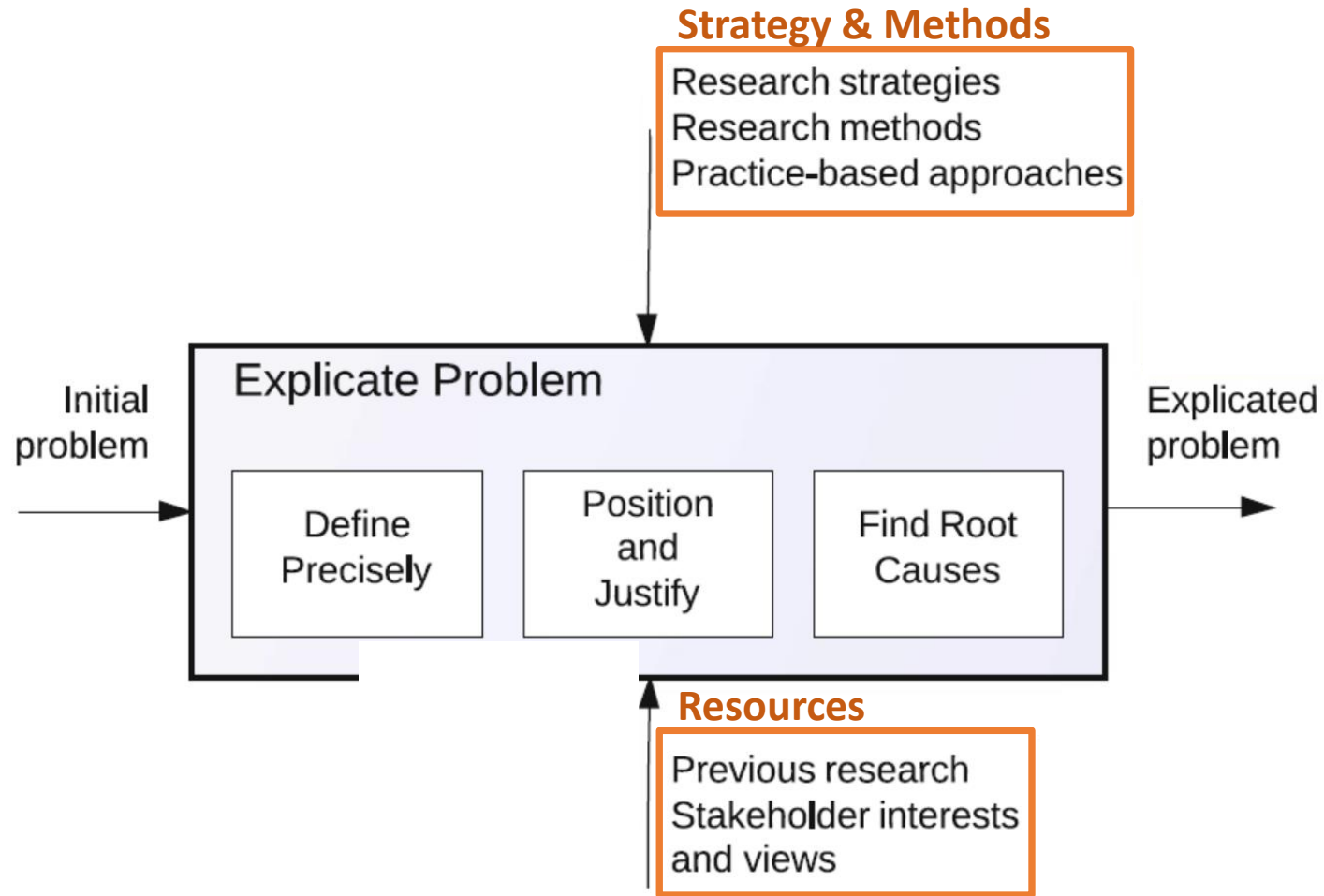
Generalizing the Problem

- The two problems mentioned previously above are situated in local practices.
- The problems need to be generalized / transformed into generic problems that are relevant for a global practice,
- Example:
 - Customers often complain over long delivery times among car retailers
 - Organizations experience productivity loss because mobile devices are not integrated with their ERP systems

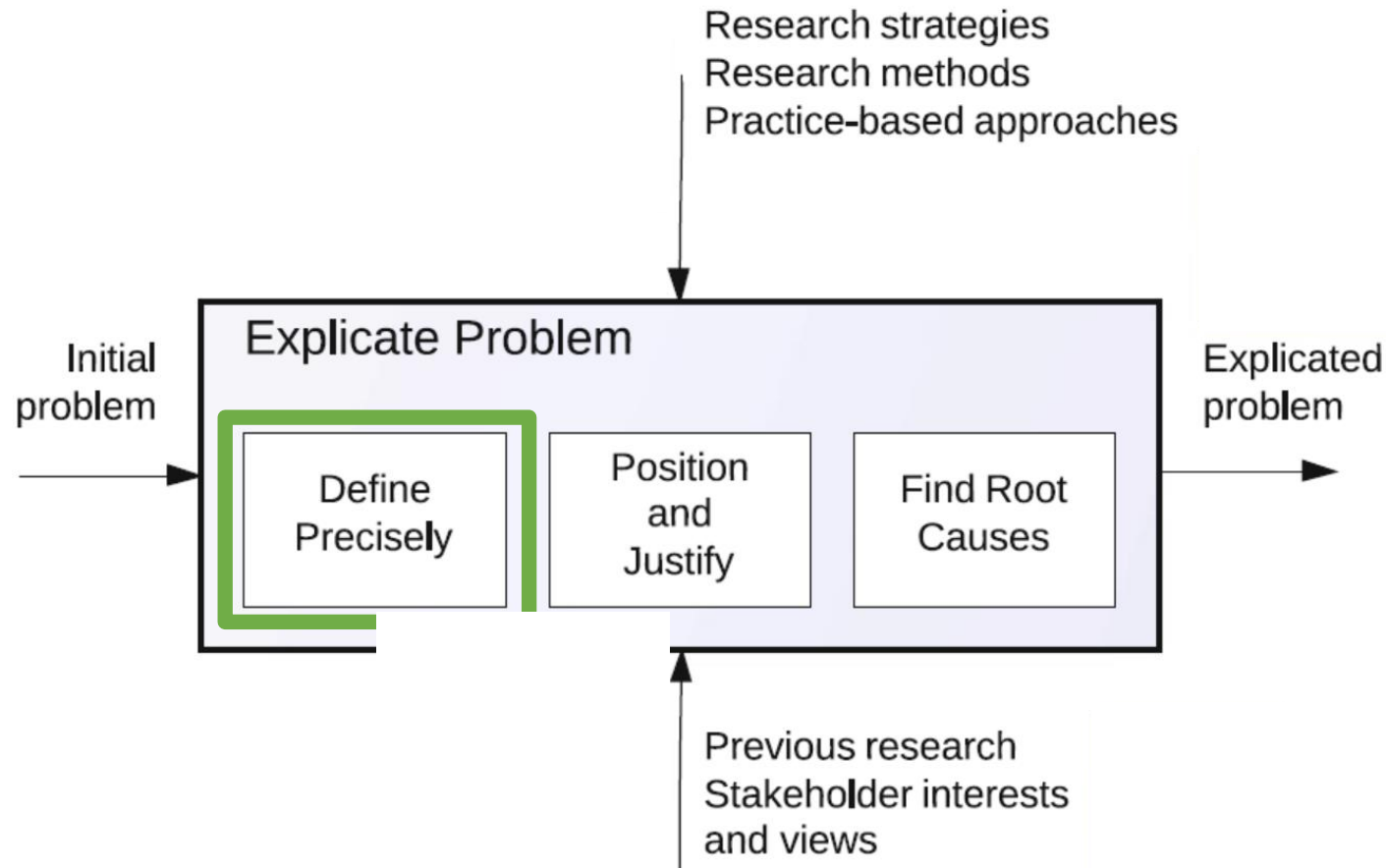
Explicate – Definition

- Meaning
 - Analyze and develop (an idea or principle) in detail.
 - "attempting to explicate the relationship between crime and economic forces"
 - Analyze (a literary work) in order to reveal its meaning
- Origin
 - from Latin *explicat*- ‘unfolded’,
 - from the verb *explicare*, from *ex*- ‘out’ + *plicare* ‘to fold’.

Explicate Problem



Explicate Problem - Define Precisely



Define Precisely - Explicate Problem

- **What is the meaning** of precise definition of a problem
 - Different people understand it in the same way
- **What is the process** to precise definition of a problem?
 - Reducing the number of ways in which the problem can be understood and interpreted
- **Example**
 - **Problem Background** - It is common that patients are treated by multiple care providers because of specialization of care providers, including specialist and general practitioners.
 - **Vague definition of the problem** - Patient care provided by multiple care providers is often of low quality
 - **Precise definition of the problem (focus on care)** - patient care provided by multiple care providers poses risks for patient safety
 - **Precise definition of the problem (focus on patient experiences)** - patient care provided by multiple care providers is inconvenient for the patients

Level of Precision - Explicate Problem

- **Positive Effects**

- **Preferences** - Precise problem definitions are to be preferred over less precise ones.
- **Scope & Success** - Precise problem definition helps to **limit the scope** of the research project, thereby **increasing** the chances for **success**.

- **Negative Effects**

- **Difficult to grasp** - highly precise problem definitions can sometimes be difficult to quickly grasp and understand
- **Narrow / Omission** - in the process of formulating a more precise problem definition, it becomes too narrow, and important aspects are omitted
- **Excluding Innovation** - An overly narrow problem formulation may also exclude potentially innovative solutions.

Define Precisely – Input Group Providers

Soft System Methodology

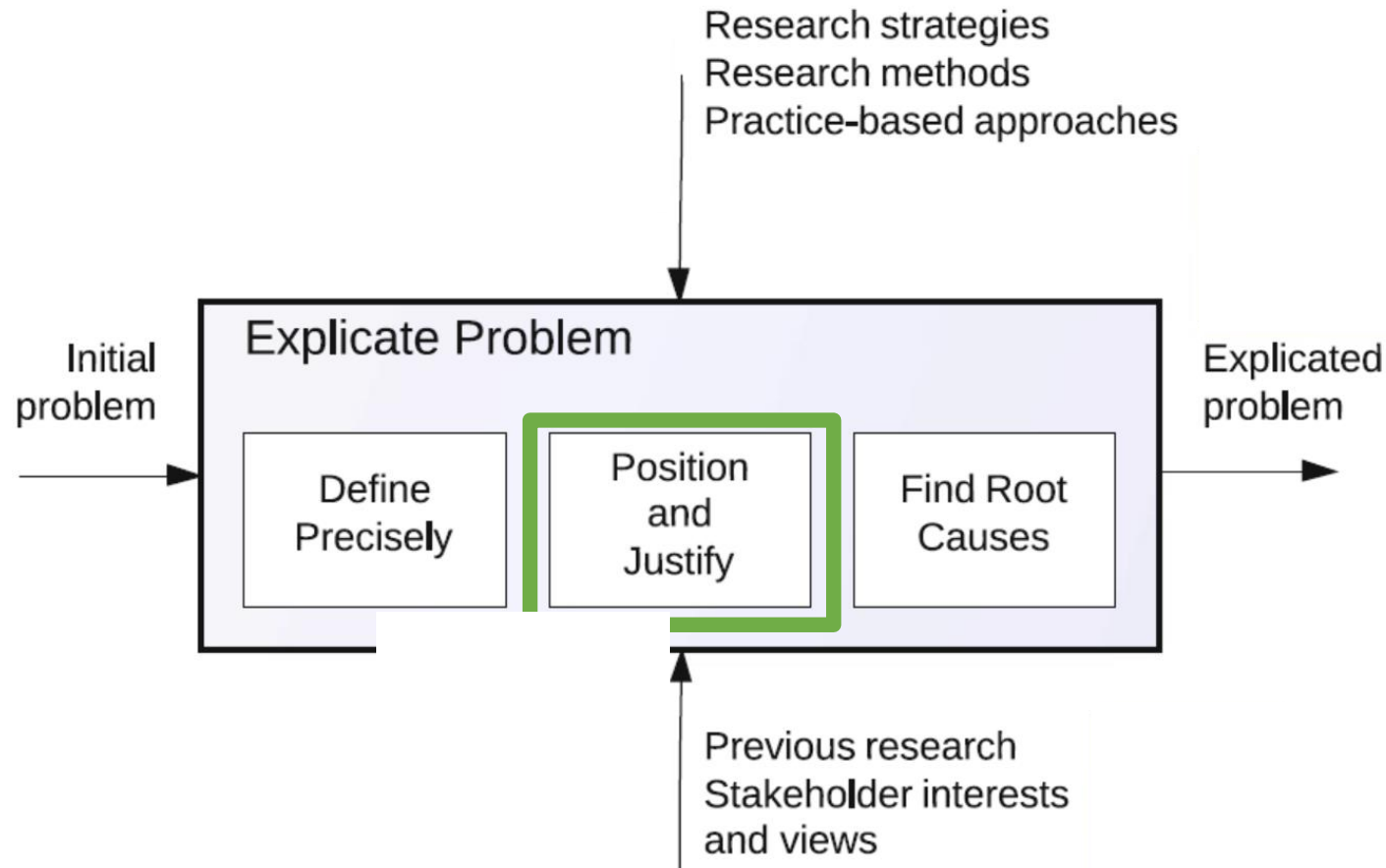
- **Group Diversity**

- Different groups often have different views on the problem and therefore have different expectations on the solution to be designed and developed.
- A problem definition can preferably be left somewhat vague but complemented with a number of more detailed problem definitions, each related to a certain group's view of the problem.

- **Group Members**

- Managers
- Employees
- Customers

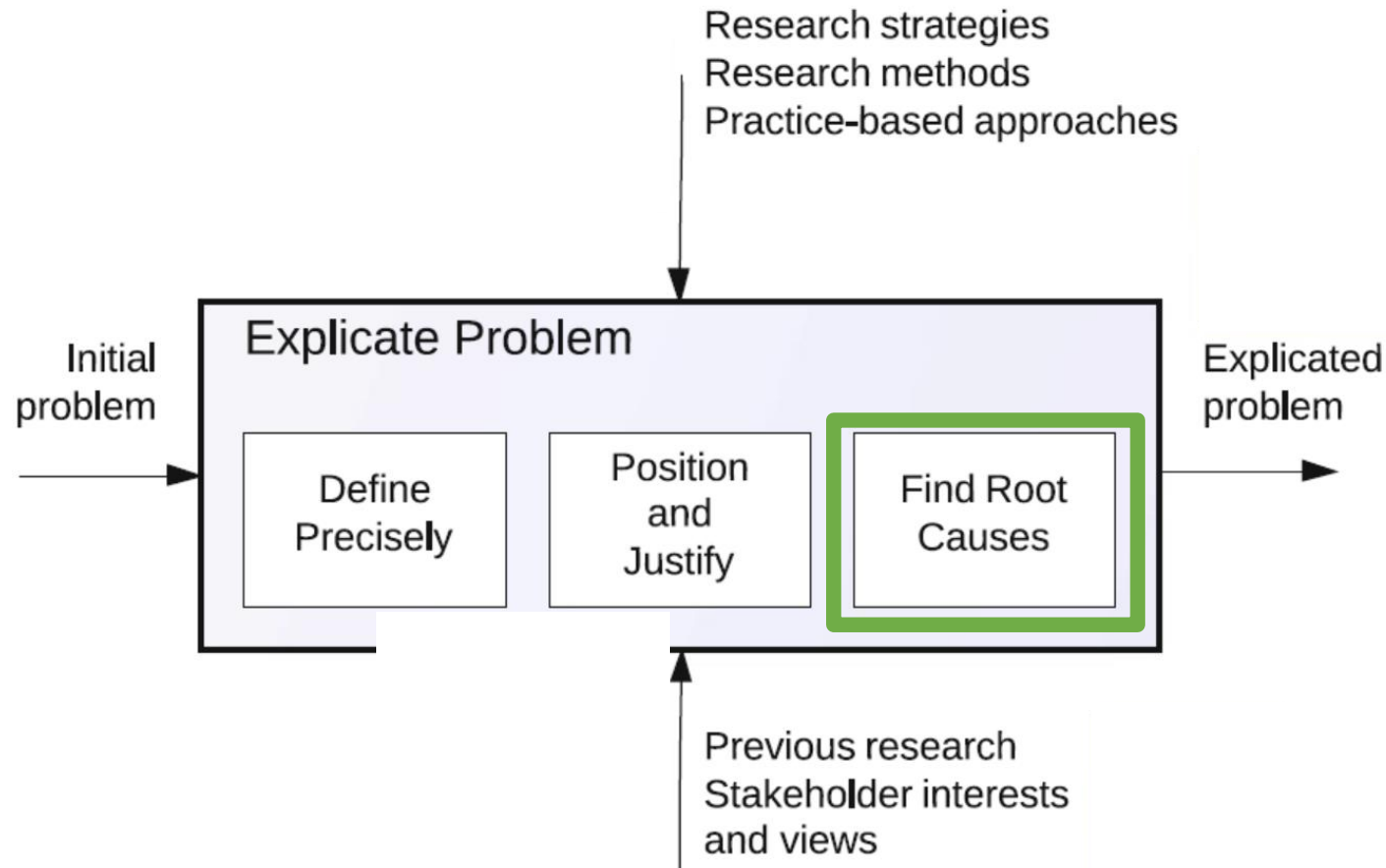
Explicate Problem – Position & Justify



Position & Justify

- **Position / Context** - put the problem into a context, which can be done by positioning it in the practice within which it occurs, i.e. describe the purpose, stakeholders, activities, and environment of the practice.
- **Justifiable** – People can agree that it is worthwhile to address it
- **Significant** - Viewed as important by stakeholders who want to find a solution to it.
- **General Interest (Comprehensive)** - it should not matter only to a single local practice
- **Challenging** - A solution to it does not already exist or trivial
- **Original** - Common when technological innovations have created new opportunities
- **Ethical and Societal Consequences**

Explicate Problem – Find Root Causes



Find Root Causes -

- **Early Stage Problem Definition –**
 - Impressionistic Way
 - Expressing a feeling that some state of affairs is unsatisfactory
- **Root Cause Analysis –** The underlying causes are
 - Identified,
 - Analyzed
 - Represented.
- **Addressing the Causes and not the Symptoms**

Find Root Causes – Example - Patient care

- **Initial Problem Definition:** Patient care provided by multiple care providers poses risks for patient safety
- **Root Causes**
 - Information deficiencies
 - Lack of competence
 - Inadequate Incentives
 - Unclear responsibility structures
- **Redefinition of the Problem based on Root Cause - Focusing on information deficiencies** - three underlying problem causes are:
 - Different care providers lack information about other providers' performed, ongoing, and planned activities.
 - Different care providers do not have knowledge and shared understanding about the problem and status of the patients
 - Different care providers do not have knowledge and shared understanding about the care goals of the patients.

Find Root Causes - Ishikawa Diagram

Cause-Effect Diagram or Fishbone Diagram

- Kaoru Ishikawa (July 13, 1915 – April 16, 1989)
- Japanese organizational theorist
- Professor at the Faculty of Engineering at The University of Tokyo
- Noted for his quality management innovations.
- Key figure in the development of quality initiatives in Japan, particularly the quality circle.
- Best known outside Japan for the Ishikawa or cause and effect diagram (also known as fishbone diagram) often used in the analysis of industrial processes.



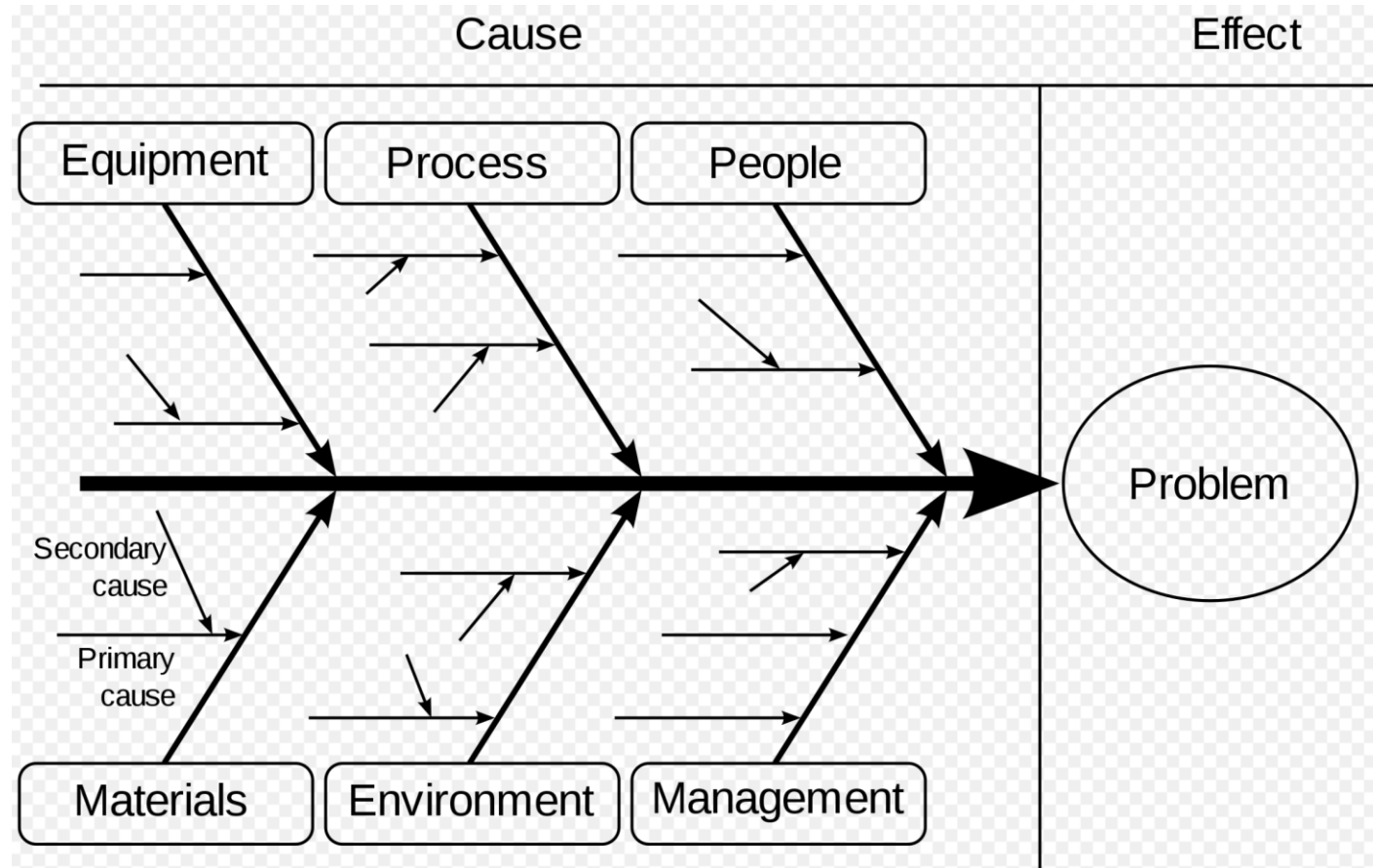


Ishikawa Diagram

Cause-Effect Diagram or Fishbone Diagram

Find Root Causes - Ishikawa Diagram

Cause-Effect Diagram or Fishbone Diagram



Find Root Causes – Root Cause Analysis (RCA)

Cause-Effect Diagram or Fishbone Diagram

- Root-cause analysis is intended to reveal key relationships among various variables, and the possible causes provide additional insight into process behavior. Each potential cause is traced back to find the root cause, often using the 5 Whys technique. Typical categories include:
 - **The 5 Ms / 8Ms (used in manufacturing)**
 - Man / mind power (physical or knowledge work)
 - Machine (equipment, technology)
 - Material (includes raw material, consumables, and information)
 - Method (process)
 - Measurement / medium (inspection, environment)
 - These have been expanded by some to include an additional three, and are referred to as the 8 Ms:
 - Mission / mother nature (purpose, environment)
 - Management / money power (leadership)
 - Maintenance

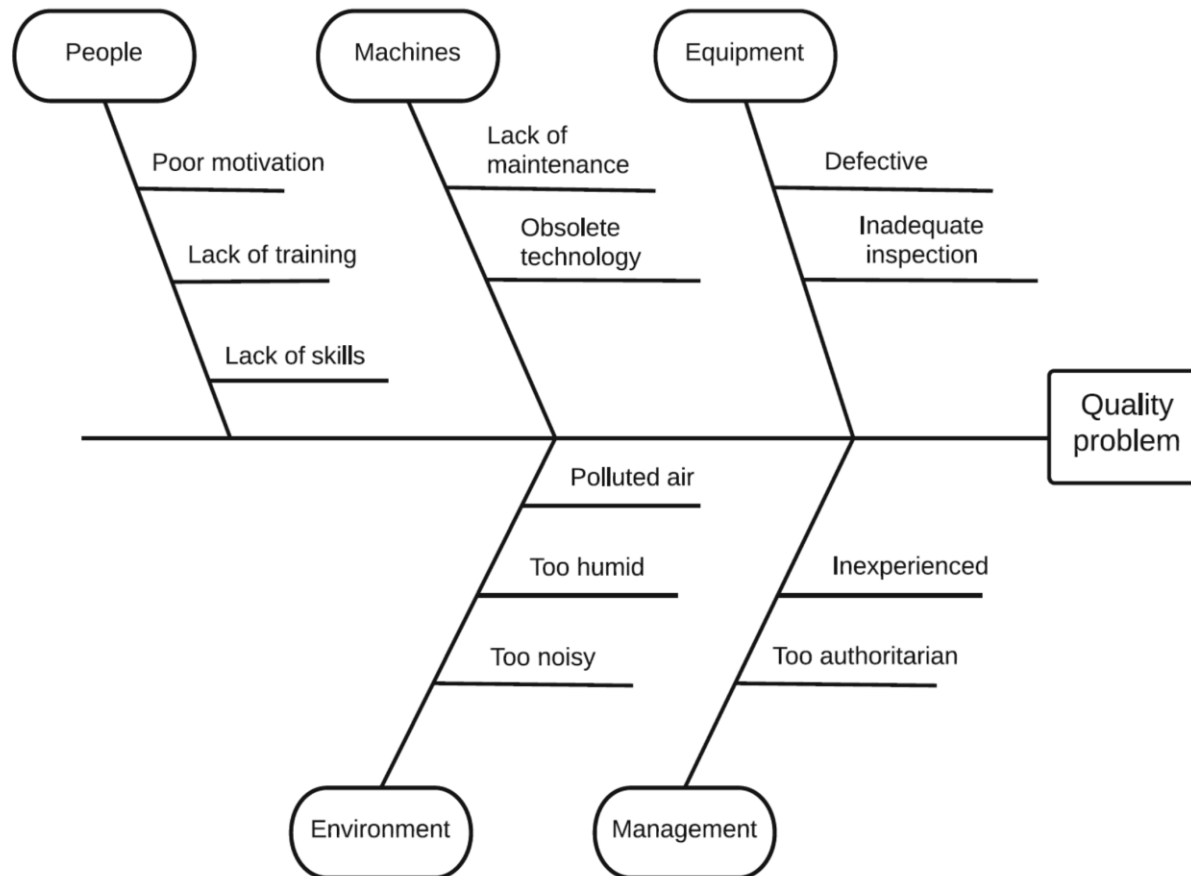
Find Root Causes – Root Cause Analysis

Cause-Effect Diagram or Fishbone Diagram

- **The 8 Ps (used in product marketing)** This common model for identifying crucial attributes for planning in product marketing is often also used in root-cause analysis as categories for the Ishikawa diagram:
 - Product (or service)
 - Price
 - Place
 - Promotion
 - People (personnel)
 - Process
 - Physical evidence
 - Performance
- **The 4 Ss (used in service industries)** - An alternative used for service industries, uses four categories of possible cause:
 - Surroundings
 - Suppliers
 - Systems
 - Skill

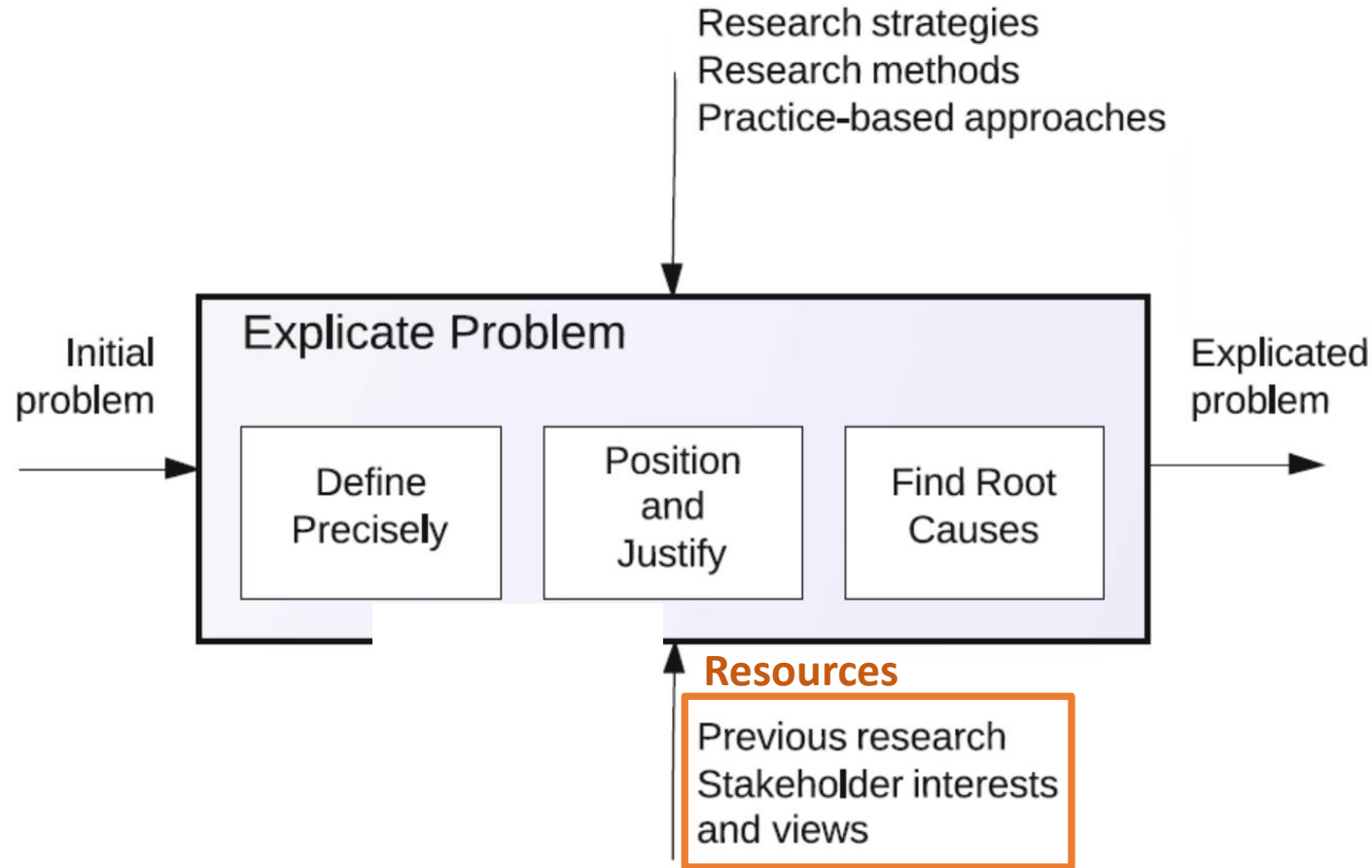
Find Root Causes - Ishikawa Diagram

Cause-Effect Diagram or Fishbone Diagram



- How likely is this cause to be the major source of the issue or variation?
 - V - Very Likely
 - S - Somewhat Likely
 - N - Not Likely
- How easy would it be to fix or control?
 - V - Very Easy
 - S - Somewhat Easy
 - N - Not Easy
- Put the answers of the two questions together. Work on the Causes that have a result of VV, VS, and SV.

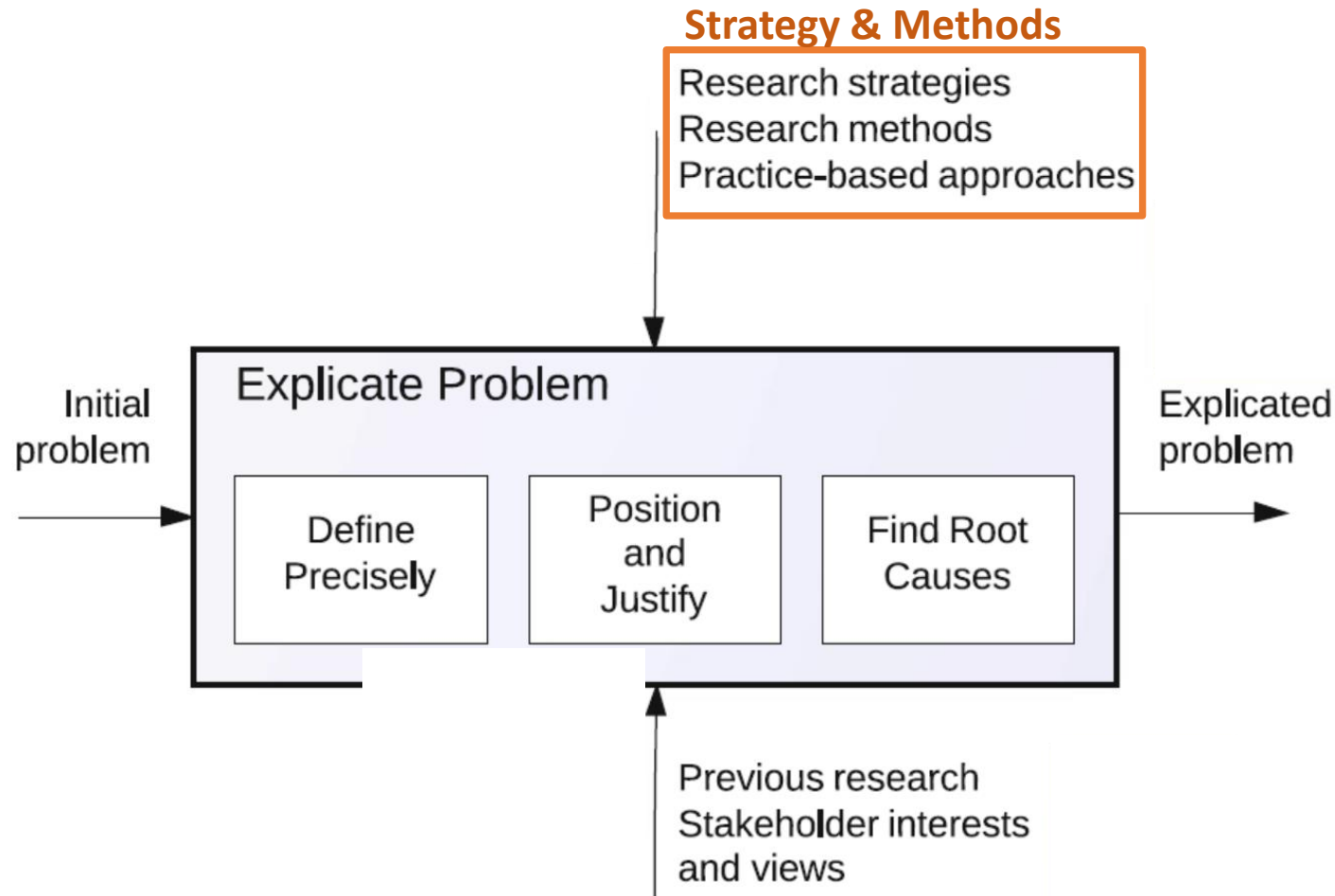
Explicate Problem – Resources



Resources for Explicate Problem

- **Previous Research** - Researchers need to investigate previous research that has addressed similar problems and existing solutions.
- **Stakeholders Opinions** - Stakeholders in the practices may express views and opinions about a problem themselves, which then are to be interpreted by the researchers.
- **Observations** - Researchers can also gain a better understanding of the practices by observing participants in their daily activities.

Explicate Problem – Strategies and Methods



Strategies and Methods

1. Surveys
2. Case Studies
3. Action Research
4. Grounded Theory
5. Ethnography
6. Interviews
7. Focus Groups
8. Questionnaires
9. Observation
10. Documents

Strategies and Methods – **Surveys (1/10)**

- **Survey (Definition)** - A survey is a list of questions aimed at extracting specific data from a particular group of people.
- **Advantages**
 - **Eliciting problem statements** - Eliciting problem statements from a large group of stakeholders.
 - **Overview of the problems** - Provide an overview of the problems experienced by, for example, managers, employees, end users, and customers.
 - **Different views of the problem** - Different stakeholders have different views of the problem at hand, and a survey can make these differences explicit.
- **Disadvantages**
 - **Lack of Depth** - Ineffective instrument for eliciting a deep and elaborated analysis of a problem from stakeholders.



Survey

Better User Research Through Surveys

Strategies and Methods –

Case Studies (2/10)

- **Case Study (Definition)** - A case study is a research method involving an up-close, in-depth, and detailed examination of a particular case. For example, a case study in medicine may examine a specific patient a doctor treated, and a case study in business might study a particular business's strategy. Generally, a case can be nearly any unit of analysis, including individuals, organizations, events, or actions.
- **Advantages**
 - **Identifying an Initial Problem** - Provide a deep understanding of the practice in which an initial problem emerged.
 - **Root causes of the problem / Stakeholders' views** - Establishes a firm grasp of the root causes of the problem, as well as the stakeholders' views on the problem.
- **Disadvantages**
 - **Rely on the skills /experiences of the researchers** - Complex undertakings that rely heavily on the skills and experiences of the researchers performing them.
 - **Subjectivity / bias the research work** - Dependency on the individual researchers may be a drawback, as they may have interests and preconceptions that can bias the research work.

Strategies and Methods – **Action Research (3/10)**

- **Action Research (Definition)** - Action research is an interactive inquiry process that balances problem-solving actions implemented in a collaborative context with data-driven collaborative analysis or research to understand underlying causes enabling future predictions about personal and organizational change.
- **Advantages**
 - **Engaging Research** - Action research requires the active engagement of both researchers and practitioners in a practice.
 - **The Researcher Provides Fresh Perspective to Stakeholders** - The competence and experiences of the researchers may offer fresh perspectives on the problem that are not obvious to the stakeholders of the practice.
 - **Identify New Problems** - Furthermore, new and more important problems can emerge when the researchers are investigating opportunities and solutions with the stakeholders.
- **Disadvantages**
 - **Dependency on Researchers** - The dependency on the researchers is strong due to their active participation in the practice. Therefore, there is a risk that their interests and preconceptions will have too much influence on the problem explication.
 - **Participant Lack of Time** - A risk that the practitioners do not have the necessary time to be active in the research project
 - **Lack of Collaboration** - A risk that the collaboration between researchers and practitioners does not work as expected.

Strategies and Methods –

Grounded Theory (4/10)

- **Grounded Theory (definition)** - Grounded theory is a research strategy in which pure empirical facts have a strong impact on the explication of a problem. The researchers start by gathering facts about the domain under consideration. Based on these facts, they suggest a first problem explication, which is tested against further empirical facts from the domain, resulting in a refined problem explication. The iterations between fact gathering and problem explication refinement continue until further empirical facts have no effect on the problem explication.
- **Advantages**
 - **Objective / Experimental** - It is not restricted by any specific theoretical view that may limit the researchers.
- **Disadvantage**
 - **Theoretical Bias** - as a theoretical lens can support the researchers in finding new perspectives on the problem.

Strategies and Methods – **Ethnography (5/10)**

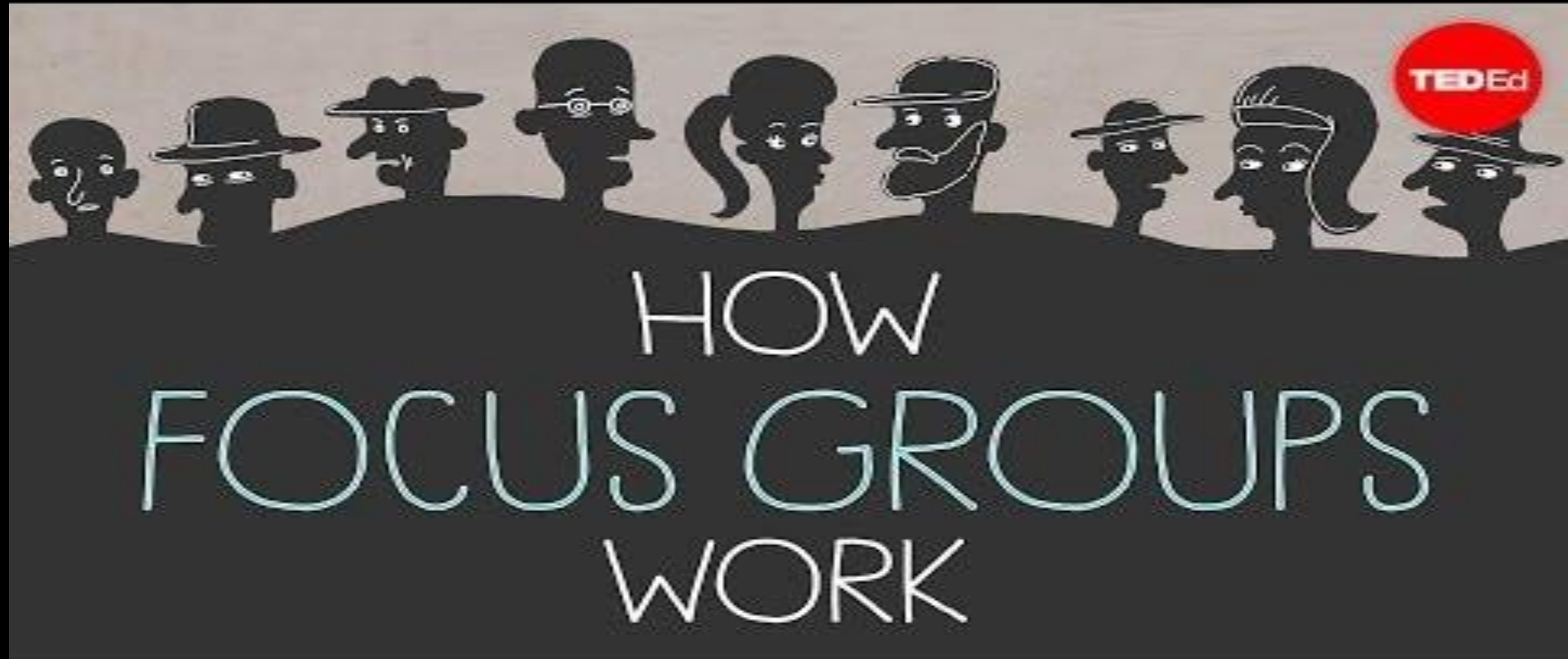
- **Ethnography (Definition)** - Ethnography is the branch of anthropology that involves trying to understand how people live their lives. Unlike traditional market researchers, who ask specific, highly practical questions, anthropological researchers visit consumers in their homes or offices to observe and listen in a nondirected way.
- **Advantages**
 - **Depth** – Ethnography research Allows researchers to understand the culture of a practice in depth. Thereby, they are able to see a problem not only as outsiders but also from the stakeholders' point of view.
 - **Hidden Structure** - The researchers may understand the structures behind the stakeholders' views and actions, which they themselves might not recognize.
 - **Depth** - This knowledge can allow the researchers to arrive at a deep and rich explication of a problem.
- **Disadvantages**
 - **Time Consuming / limited access to Stakeholders** – Since Ethnographical studies are time-consuming, they may only be able to understand a limited number of stakeholders, while other stakeholders may not be considered.
 - **Researchers' Experience Biased** - The outcome of this research strategy also relies heavily on the competence and experience of the researchers.

Strategies and Methods – **Interviews (6/10)**

- **Interviews (Definition)** - Interviews allow a researcher to engage in a dialogue with a respondent in order to explicate a problem in an interactive and creative way.
- **Advantages**
 - **Follow-up Questions** - The researcher, based on the respondent's initial answers, can ask follow-up questions.
- **Disadvantages**
 - **Dependency on the perspective and interests of the respondent** - A drawback of interviews is the dependency on the perspective and interests of the respondent, but this problem can be mitigated by interviewing several respondents.
 - **Researcher Bias** - Another disadvantage is that the researcher's personal attributes can affect the outcome of an interview.

Strategies and Methods – **Focus Groups (7/10)**

- **Focus Groups (Definition)** - A focus group is a research method in which several respondents in conversations may inspire each other to identify and define problems in a domain.
- **Advantages**
 - **Brainstorming / Group Dynamics**
- **Disadvantage**
 - **Dominant Individual** - Dominant individuals in such a group have too great an impact so that other opinions are not voiced. To some extent, this problem can be handled by a skillful moderator.



Focus Group

Better User Research Through Surveys

Strategies and Methods – **Questionnaires - (8/10)**

- **Questionnaires (Definition)** - A questionnaire is a form that contains predefined written questions.
- **Advantages**
 - **Large Distribution / Low Cost** - An important benefit of using questionnaires for data collection is that they can be distributed to a large number of respondents easily and with low cost.
- **Disadvantages**
 - **Lack of Discussion / Superficial Answers** - A researcher and a respondent cannot discuss a problem situation informally and creatively. Therefore, the answers can be superficial. There is no time or inclination to provide detailed answers to the questions.
 - **Researcher Interoperation** - Respondents can interpret the written questions of a questionnaire in different ways.
 - **Multiple Choices Bias** - If the questionnaire is a multiple choice form the respondents' answers will be biased to the views of the researchers, since the researchers have decided the available answer options.

Strategies and Methods – **Observation (9/10)**

- **Observation (Definition)** - Observation is the active acquisition of information from a primary source. In living beings, observation employs the senses. In science, observation can also involve the perception and recording of data via the use of scientific instruments. The term may also refer to any data collected during the scientific activity. Observations can be qualitative, that is, only the absence or presence of a property is noted, or quantitative if a numerical value is attached to the observed phenomenon by counting or measuring.
- **Advantages**
 - **Identify Problems Invisible to People Under Observation** - the Researchers, based on their competence and experience, can identify problems and circumstances that are not apparent to the people under observation.
- **Disadvantages**
 - **Highly Skilled Researchers / Interpretation** - The method requires highly skilled researchers to interpret the actions and interactions of the people investigated.
 - **Researcher Bias (Interests / Preconceptions)** - The interests and preconceptions of the researchers may influence their interpretations in undesirable ways.



Observation

Selective Attention Test



The Monkey Business Illusion

Selective Attention Test



Seeing the world as it isn't | Daniel Simons | TEDxUIUC

| Daniel Simons | TEDxUIUC

Strategies and Methods – **Documents (10/10)**

- **Documents (Definitions)** - A document study is a form of observation study, but the focus is on written documents, not actions.
- **Advantages**
 - **Expose contradictions in a practice** - Written documents can expose contradictions in a practice and, therefore, be a valuable source for identifying and defining problems.
- **Disengages**
 - **Skilled Researcher** - The method requires skilled researchers for the interpretation of the documents.
 - **Official View / Not Practice** - A risk that some documents only show the official view of some actor and may hide existing problems.

Guidelines for Explicate Problem – Summary

- **Position the Problem** - Clarify in which practice the problem appears.
- **Formulate the Problem Precisely** - Describe the problem in a precise but also concise, easily understandable manner.
- **Justify the Problem** - Explain why the problem is important and to whom.
- **Ensure the Problem Is of General Interest** - Make clear that the problem is of interest not only to a local practice.
- **Ensure the Problem Is Solvable** - Define and analyze the problem so that it becomes small enough to be solved.
- **Specify the Sources of the Problem** - Describe the literature and the stakeholders that have previously identified, studied, and experienced the problem.
- **Describe How the Problem Has Been Explicated** - Explain what has been done to explicate the problem, in particular, how the stakeholders have been involved and how the research literature has been reviewed.

References

- Books
 - Chapter 5 - Explicate Problem
[An Introduction to Design Science](#)
Authors: Johannesson, Paul, Perjons, Erik
- Websites
- Videos
 - [Seeing the world as it isn't | Daniel Simons | TEDxUIUC](#)