

# TECH 646 Analysis of Research in Industry and Technology

## Research Design: An Overview

Based on the text book and supplemental materials from the text book:  
Cooper, D.R., & Schindler, P.S., *Business Research Methods* (12th edition), McGraw-Hill/Irwin

Paul I. Lin, PE (IN, CA)

Professor of Electrical and Computer Engineering Technology

<http://www.etcs.pfw.edu/~lin>

M.S. Technology Graduate Program: Industrial  
Technology/Manufacturing and IT and Advanced Computer  
Applications Tracks

School of Polytechnic

Purdue University Fort Wayne

TECH 646 Lecture 5: Ch 6

1

## Chapter 6

### Learning Objectives

- The **basic stages** of research design
- The **major descriptors** of research design
- The **major types** of research designs
- The **relationships** that exist between variables in research design and the steps for evaluating those relationships

TECH 646 Lecture 5: Ch 6

2

## What is Research Design

- **Research Design Definitions:**
  - **Blueprint:** Constitutes the blueprint for the collection, measurement, and analysis of data.
  - **Guide:** Aids the researcher in the allocation of limited resources by posing choices in methodology.
  - **Plan:** Is the plan and structure of investigation so conceived as to obtain answers to research questions.
  - **Framework:** Expresses both the structure of research problem—the framework, organization, or configuration of relationships among variables of a study—and the plan of investigation used to obtain empirical evidence on those relationships.

TECH 646 Lecture 5: Ch 6

3

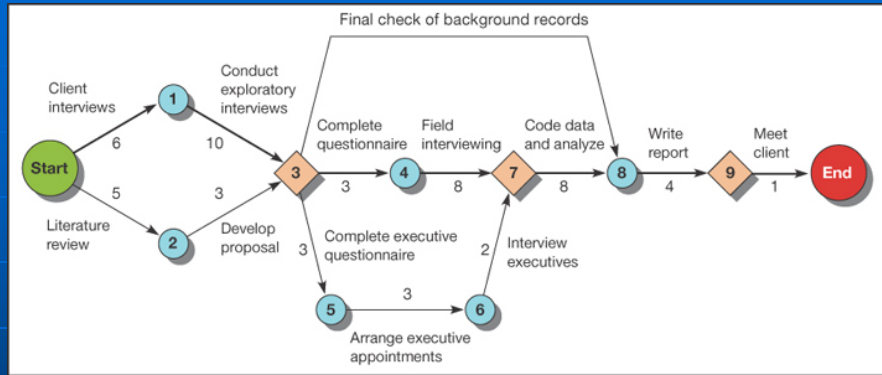
## What is Research Design

- **Research Design**
  - An activity- and time-based **plan**
  - A **plan** always based on the research question.
  - A **guide** for selecting sources and types of information
  - A **framework** for specifying the relationship among study's variables
  - A **procedure outline** for every research activity

TECH 646 Lecture 5: Ch 6

4

## What Tools are Used in Designing Research?



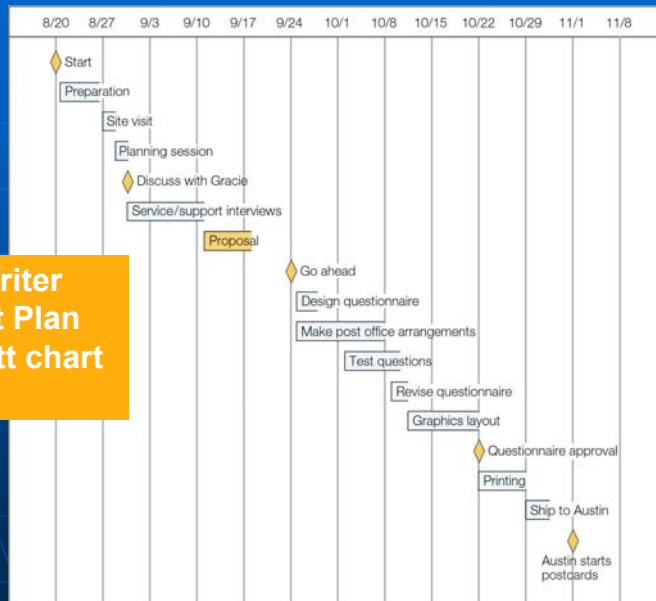
- Milestones:**  
 3 Proposal approval  
 7 Interviews completed  
 9 Final report completed
- Critical Path:**  
 S-1-3-4-7-8-9-E
- Time to Completion:**  
 40 working days

Critical Path Method (CPM) – CPM chart, a project and project Management tool

TECH 646 Lecture 5: Ch 6

5

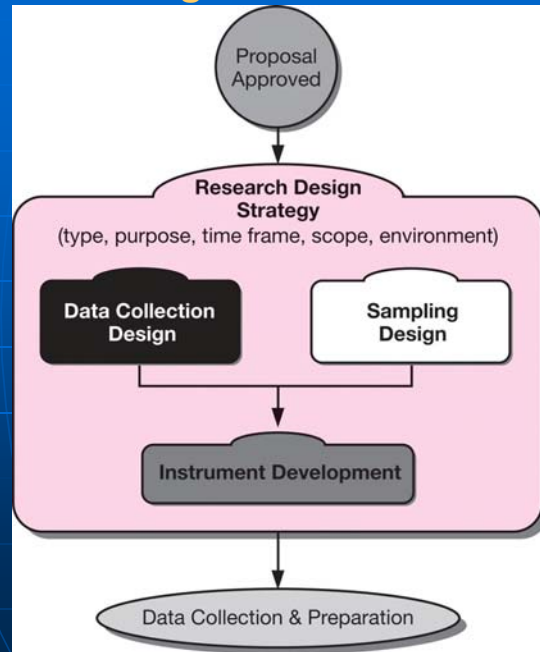
## Project Plan: Gantt chart



MindWriter  
Project Plan  
in Gantt chart  
format

6

## Exhibit 6-1 Design in the Research Process



7

## PulsePoint: Research Revelation

- Yankee Group, the global connectivity experts, <http://www.yankeegroup.com/home.do>
- 451 Research, Analyzing the Business of Enterprise IT Innovation, <https://451research.com/>

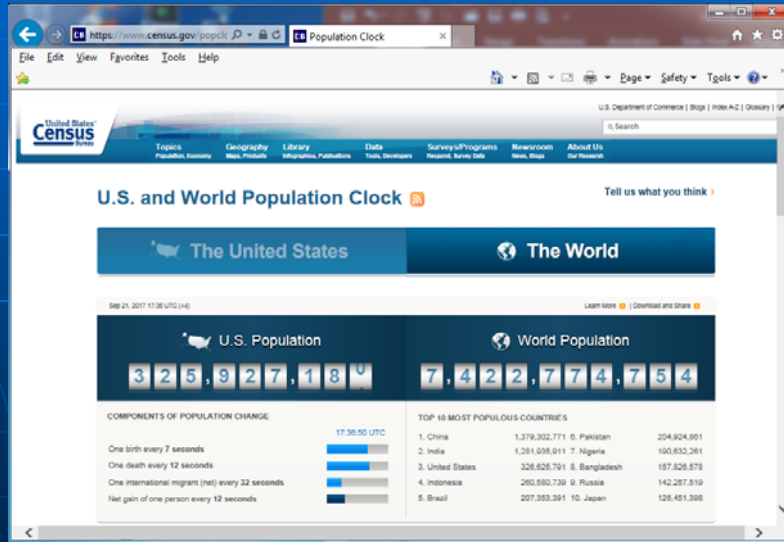
95

The millions of Americans actively text messaging, according to Yankee Group.

- United States Census Bureau, U.S. & World Population Clock: U.S. 310,405,822, World 6,872,965,029, <http://www.census.gov/main/www/popclock.html>, [accessed 10/4/2010]
- U.S. 312,350,562, World 6,966,047,919 [10/3/2011]
- United States Census Bureau, U.S. & World Population Clock: U.S. 324,54,991, World 7,340,962,377, <http://www.census.gov/main/www/popclock.html>, [accessed 9/22/2016]

## The newPulsePoint: Research Revelation

- United States Census Bureau, U.S. & World Population Clock: U.S. 325,9,27,180; The World 7,422,744,754,
- <https://www.census.gov/popclock/> [accessed 9/21/2017]



## PulsePoint: Research Revelation

76

The percent of mobile phone subscribers worldwide who use SMS text messaging.

<http://www.smartinsights.com/mobile-marketing/mobile-marketing-analytics/mobile-marketing-statistics/>

Worldwide Text Statistics,  
<https://www.textrequest.com/blog/texting-statistics-answer-questions/>

## Descriptors of Research Design Issues



11

## Degree of Research Question Crystallization

- **Exploratory Study**
  - Loose structure
  - Expand understanding
  - Provide insight
  - Develop hypotheses
  - May be qualitative and quantitative techniques
  - Rely more heavily on qualitative (meaning, definition, analogy, model, or metaphor characterizing something)
- **Formal Study**
  - Precise procedures
  - Begin with **Hypotheses**
  - Answer **Research Questions**

TECH 646 Lecture 5: Ch 6

12

## Exhibit 6-3 Descriptors of Research Design



## Descriptors of Research Design Issues

### ■ Data Collection Method

- **Monitoring** - Inspect the activities of a subject or the nature of some material without attempting to elicit responses from anyone
  - Traffic counts
  - License plates recording (a specific location)
  - A search of library collection
  - An observation of the actions of a group of decision makers
  - WindWriter case: "following a computer through the repair process, documenting each activity ..."
- **Communication Study**

## Exhibit 6-3 Descriptors of Research Design

- Data Collection Method
  - Monitoring
  - Communication Study
    1. **Interview** or **Telephone** Conversation
    2. **Self-administered or self-reported instruments** sent through the mail, left in convenient locations, or transmitted electronically or by other means
    3. **Instruments presented before and/or** after a treatment or stimulus conditions in an experiment

TECH 646 Lecture 5: Ch 6

15

## Descriptors of Research Design Issues



16



## Descriptors of Research Design

- Time Dimension
  - **Cross-sectional studies**
    - Carry out once and represent a snapshot of one point in time
  - **Longitudinal studies**
    - Repeated over an extended period
    - Can track change over an extended period



TECH 646 Lecture 5: Ch 6

17

## Exhibit 6-3 Descriptors of Research Design



18

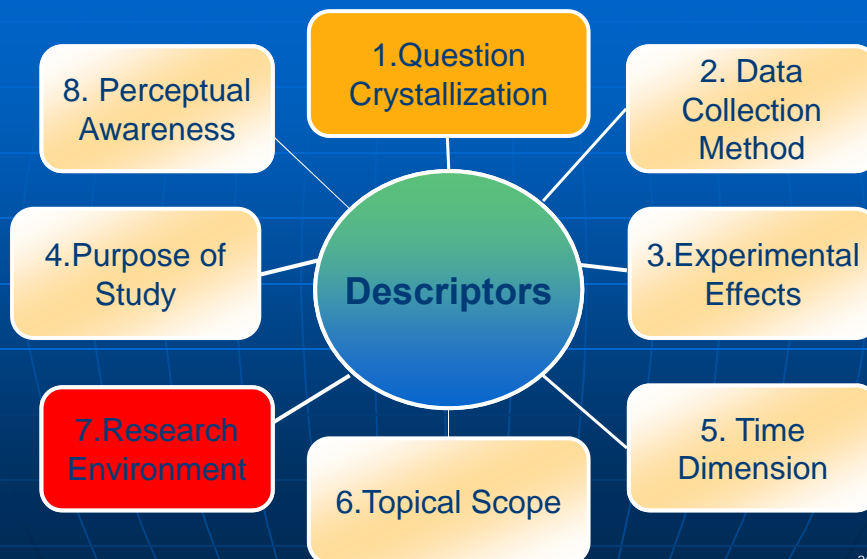
## Descriptors of Research Design

- **The Topical Scope**
  - **Statistical studies**
    - Breadth
    - Population inferences
    - Hypotheses are tested quantitatively
    - Generalization about findings are presented based on sample and the validity of the design
  - **Case Studies**
    - Collect information from multiple sources
    - Depth
    - Detail
    - Qualitative

TECH 646 Lecture 5: Ch 6

19

## Descriptors of Research Design Issues



20

## Exhibit 6-3 Descriptors of Research Design

- **Research Environment**
  - **Field Conditions** - actual environment conditions
  - **Lab Conditions** - staged or manipulated conditions
  - **Simulations**

## Descriptors of Research Design Issues



## Purpose of Study

- Reporting Study
- Descriptive Study
- Casual-Explanatory Study
- Causal-Predictive Study

## The Purpose of Study

- Reporting study
  - A summation of data, often recasting data to achieve a deeper understanding, or
  - Generate statistics for comparison
  - Examples
- Descriptive study
  - Concerned with finding population characteristics
  - WHO, WHAT, WHERE, WHEN, HOW MUCH
- Causal-explanatory study
  - How one variable produces change in another
  - Relationships among variables
- Causal-predictive study
  - Predict an effect on one variable by manipulating another variable while holding all other variables constant

## Purpose of Study

- **Causal-explanatory study**
  - How one variable produces change in another
  - Relationships among variables
- **Causal-predictive study**
  - Predict an effect on one variable by manipulating another variable while holding all other variables constant

## Exploratory Studies

- **Qualitative Techniques**
- **Secondary Data Analysis**
- **Experience Survey**
- **Focus Group**
- **Two-Stage Design**

## Approaches for Exploratory Studies/Investigations

- Participant observation
- Film, photographs
- Case studies
- Expert interviews
- Document analysis
- etc

TECH 646 Lecture 5: Ch 6

27

## Desired Outcomes of Exploratory Studies

- An Exploratory Study is Completed when the researcher has
  - Established **range and scope** of possible management decisions
  - Established major dimensions of **research tasks**
  - Defined a set of **subsidiary questions** that can guide research design
  - Developed **hypotheses** about possible causes of management dilemma
  - Learned which **hypotheses** can be **safely ignored**
  - Concluded **additional research** is not needed or not feasible

TECH 646 Lecture 5: Ch 6

28

## Commonly Used Exploratory Techniques

Secondary  
Data Analysis

Experience  
Surveys



Focus  
Groups

TECH 646 Lecture 5: Ch 6

29

## Experience Surveys

(Open-ended Expert Interviews/Key Info Surveys)

Or called Expert Interviews, Key Information Surveys

- **What** is being **done**?
- **What** has been **tried** in the past with or without success?
- **How** have **things changed**?
- **Who** is involved in the decisions?
- **What problems areas** can be seen?
- **Whom** can we count on to assist or participate in the research?

TECH 646 Lecture 5: Ch 6

30

## Secondary Data Analysis

- An organization's own data archives
- Published documents
- Special catalog
- Subject guides
- Electronics indexes

## Secondary Data Analysis

- Examples
  - Copper Industry Association is interested in establishing the outlook for the copper industry over the next 10 years
  - We could search the literatures under the headings: "copper production", "copper consumption"
  - Useful information:
    - Mines and minerals; nonferrous metals, forecasting, planning, econometrics, consuming industries such as automotive and communications; countries where copper is produced, etc



## Experience Surveys (Open-ended Expert Interviews/Key Info Surveys) Or called Expert Interviews, Key Information Surveys

- **What** is being **done**?
- **What** has been **tried** in the past with or without success?
- **How** have **things changed**?
- **Who** is involved in the decisions?
- **What problems areas** can be seen?
- **Whom** can we count on to assist or participate in the research?

TECH 646 Lecture 5: Ch 6

33

## Experience Surveys – An Example

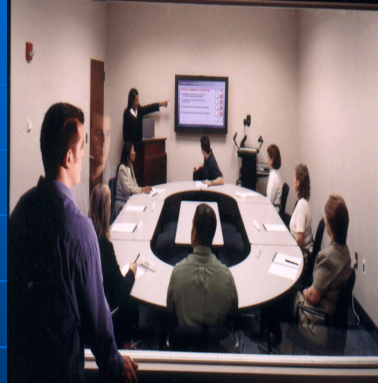
- Study StartAuto's automobile assembly plant. It has a history of declining productivity, increasing costs, and growing number of quality defects.
- People who might provide insightful information:
  - Newcomers to the scene
  - Marginal or peripheral individuals
  - Individuals in transition
  - Deviants and isolates
  - Pure cases or cases
  - Those who fit well and those who do not
  - Those who present different positions in the system

TECH 646 Lecture 5: Ch 6

34

## Focus Groups

- Group discussion
- 6-10 participants
- Moderator-led
- 90 minutes-2 hours



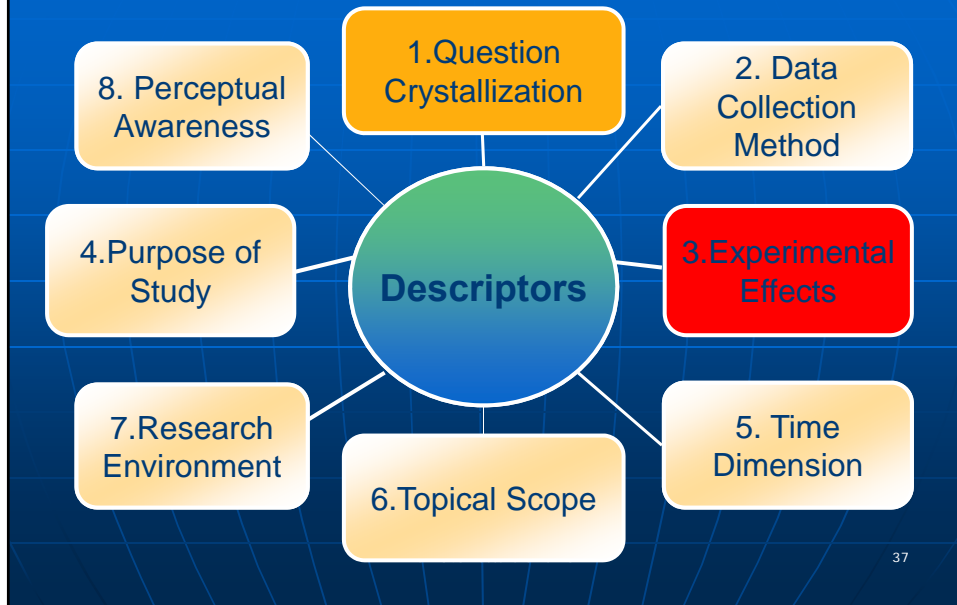
## Descriptive Studies

Descriptions of  
population characteristics

Estimates of frequency of  
characteristics

Discovery of associations  
among variables

## Exhibit 6-3 Descriptors of Research Design



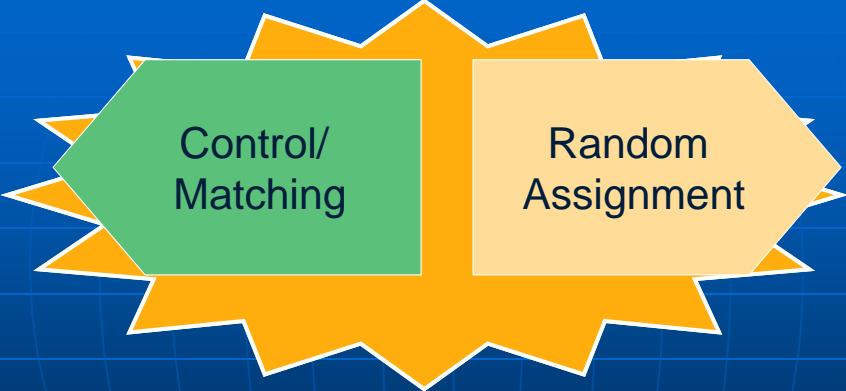
## Experimental Effects

- **Ex Post Facto Study**
    - After-the-fact report on what happened to the measured variable
  - **Experiment**
    - Study involving the manipulation or control of one or more variables to determine the effect on another variable
- **Example: WindWriter – planning an Ex Post Facto design**

# Ex Post Facto Design

	Fishing Club Member		Non-Fishing-Club Member	
Age	High Absentee	Low Absentee	High Absentee	Low Absentee
Under 30 years	36	6	30	48
30 to 45	4	4	35	117
45 and over	0	0	5	115

# Causation and Experimental Design



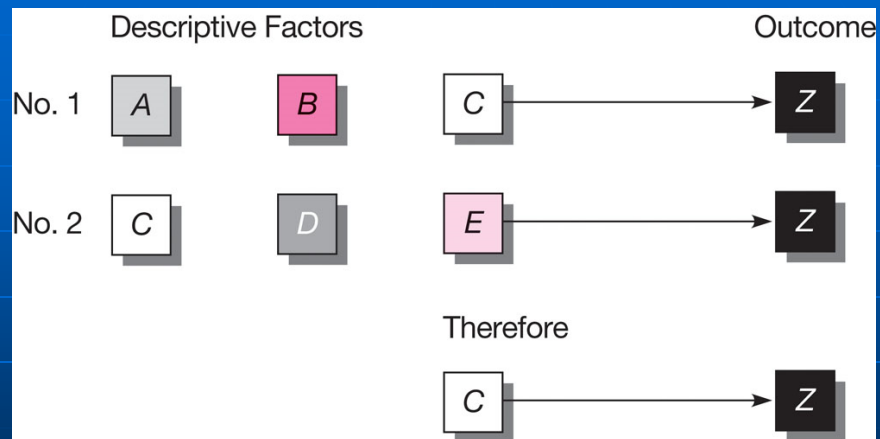
## Exhibit 6-4 Mills Method of Agreement

- The Method of Agreement, proposed by John Stuart Mill in 19<sup>th</sup> century states:  
“When two or more cases of a given phenomenon have one and only one conditions in common, then that condition may be regarded as the cause (or effect) of the condition.”

TECH 646 Lecture 5: Ch 6

41

## Exhibit 6-4 Mills Method of Agreement



- We find Z and only Z in every case where we find C, and no other (A,B, D, or E) are found with Z, then we can conclude that C and Z are causally related

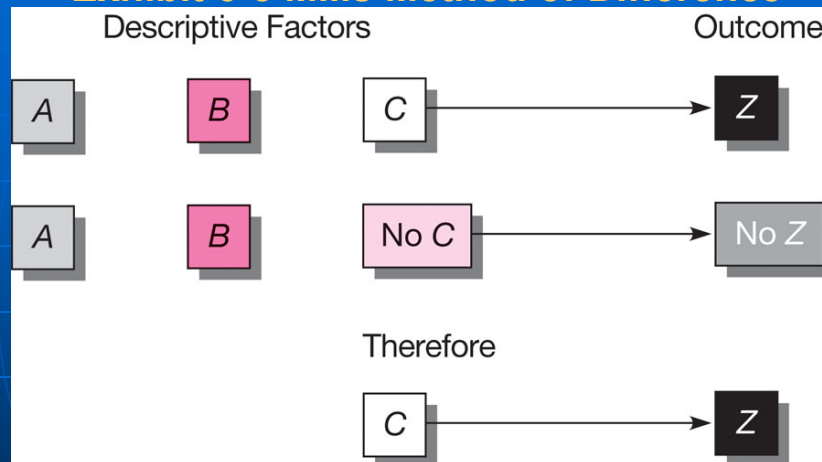
TECH 646 Lecture 5: Ch 6

42

## Exhibit 6-5 Mills Method of Difference

- “If there are two or more cases, and in one of them observation Z can be made, while in the other it cannot; and if variable C occurs when observation Z is made, and does not occur when observation Z is not made; then it can be asserted that there is a causal relationship between C and Z.”

## Exhibit 6-5 Mills Method of Difference



## Causal Studies

Symmetrical

Reciprocal

Asymmetrical

TECH 646 Lecture 5: Ch 6

45

## Causal Studies

- **Correlation  $\neq$  Causation**
- **Does not imply a Cause-and-Effect relationship**
- **Three possible relationships between 2 variables**
  - **Symmetrical Relationship**
    - Two variables vary together, but not due to changes in the other
  - **Reciprocal Relationship**
    - Mutual influence or reinforce each other
  - **Asymmetrical Relationship**
    - One variable (IV) is responsible for changes in another Dependent Variables

TECH 646 Lecture 5: Ch 6

46

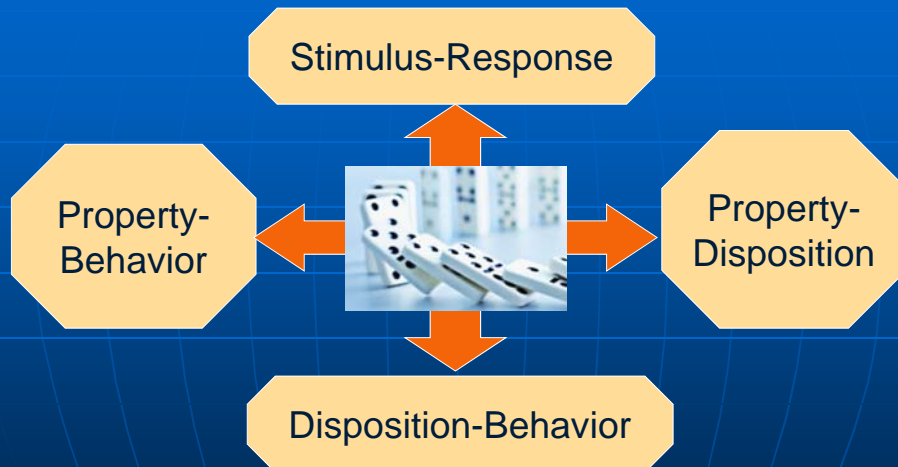
## Understanding Casual Relationships



TECH 646 Lecture 5: Ch 6

47

## Four Types of Asymmetrical Casual Relationships



TECH 646 Lecture 5: Ch 6

48



## Exhibit 6-6 Asymmetrical Casual Relationships

Relationship Type	Nature of Relationship	Examples
<b>Stimulus-response</b>	An event or change results in a response from some object.	<ul style="list-style-type: none"> <li>A change in work rules leads to a higher level of worker output.</li> <li>A change in government economic policy restricts corporate financial decisions.</li> <li>A price increase results in fewer unit sales.</li> </ul>
<b>Property-disposition</b>	An existing property causes a disposition.	<ul style="list-style-type: none"> <li>Age and attitudes about saving.</li> <li>Gender attitudes toward social issues.</li> <li>Social class and opinions about taxation.</li> </ul>
<b>Disposition-behavior</b>	A disposition causes a specific behavior.	<ul style="list-style-type: none"> <li>Opinions about a brand and its purchase.</li> <li>Job satisfaction and work output.</li> <li>Moral values and tax cheating.</li> </ul>
<b>Property-behavior</b>	An existing property causes a specific behavior.	<ul style="list-style-type: none"> <li>Stage of the family life cycle and purchases of furniture.</li> <li>Social class and family savings patterns.</li> <li>Age and sports participation.</li> </ul>

## Evidence of Causality

Covariation between A and B

Time order of events

No other possible causes of B



## Exhibit 6-3 Descriptors of Research Design



## Participants' Perceptual Awareness

No deviation perceived

Deviations perceived  
as unrelated

Deviations perceived as  
researcher-induced

## Descriptors of Research Design

Category	Options
The degree to which the research question has been crystallized	<ul style="list-style-type: none"> <li>• Exploratory study</li> <li>• Formal study</li> </ul>
The method of data collection	<ul style="list-style-type: none"> <li>• Monitoring</li> <li>• Communication Study</li> </ul>
The power of the researcher to produce effects in the variables under study	<ul style="list-style-type: none"> <li>• Experimental</li> <li>• Ex post facto</li> </ul>
The purpose of the study	<ul style="list-style-type: none"> <li>• Reporting</li> <li>• Descriptive</li> <li>• Causal-Explanatory</li> <li>• Causal-Predictive</li> </ul>
The time dimension	<ul style="list-style-type: none"> <li>• Cross-sectional</li> <li>• Longitudinal</li> </ul>
The topical scope—breadth and depth—of the study	<ul style="list-style-type: none"> <li>• Case</li> <li>• Statistical study</li> </ul>
The research environment	<ul style="list-style-type: none"> <li>• Field setting</li> <li>• Laboratory research</li> <li>• Simulation</li> </ul>
The participants' perceptual awareness of the research activity	<ul style="list-style-type: none"> <li>• Actual routine</li> <li>• Modified routine</li> </ul>