TECH 646 Analysis of Research in Industry & Technology

A Core Course

M.S. in Technology
Industrial Technology/Manufacturing and IT/ Advanced Computer Applications Tracks
Purdue University Fort Wayne

Ch 3. Thinking Like a Researcher
Lecture note
based on the text book and supplemental materials from the text book:
Cooper, D.R., & Schindler, P.S., *Business Research Methods* (12th edition), 2014, McGraw-Hill/Irwin,
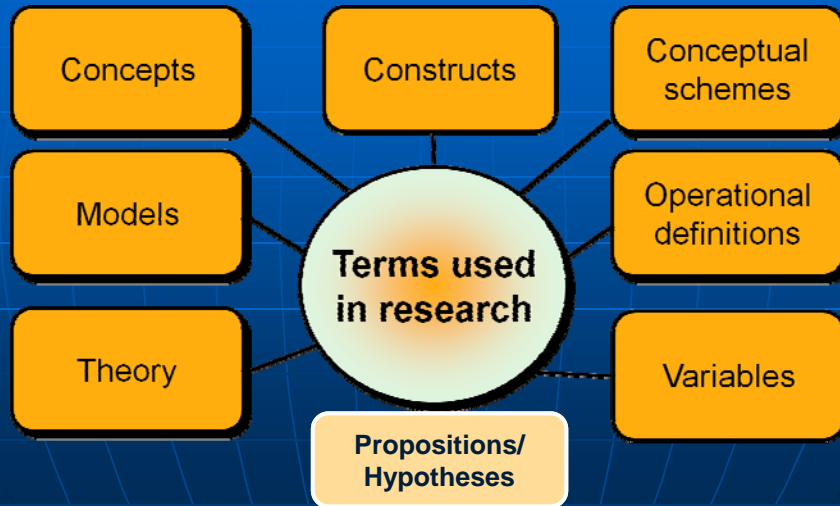
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http://www.etcs.pfw.edu/~lin

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Chapter 3

- **The Language of Research**
  - **Concepts, Constructs, Operational Definitions**
  - **Variables: IV, DV, MV, EV, CV, CFV, IVV**
  - **Propositions and Hypotheses: Descriptive hypotheses, Relational hypotheses**
  - **Theory**
  - **Models**
- **Research and the Scientific Methods**
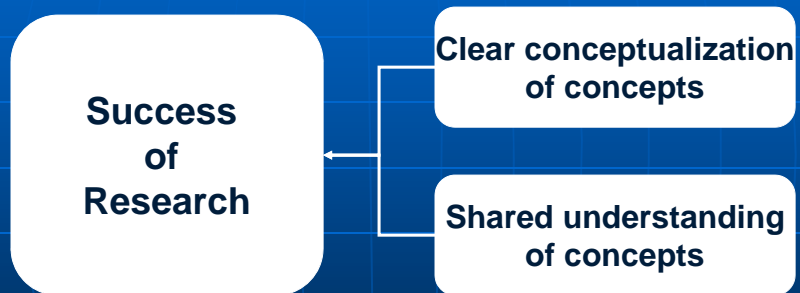 - **Deduction**
  - **Induction**
  - **Deduction + Induction**

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Language of Research

Concepts
Constructs
Conceptual schemes
Models
Operational definitions
Terms used in research
Theory
Variables
Propositions/ Hypotheses

Language of Research

Success of Research

Clear conceptualization of concepts

Shared understanding of concepts

Language of Research - Concepts

- **Concepts**
  - A generally accepted collection of meanings or characteristics associated with certain events, objects, conditions, situations, and behaviors
  - Ordinary Concepts; Uncommon Concepts (newly advanced ideas)
- **Examples of Concepts**
  - Distance – a concept, attitude measurement to describe degree of variability between the attitude of two or more persons
  - Threshold – describe a concept about the way we perceive

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Concepts and Research Problems

- **Concepts Precision and Inventiveness**
  - The need for concept precision and inventiveness => Special Problems
  - Design hypothesis using concepts
  - Devise measurement concepts => test hypothesis statement
  - Gather data using measurement concepts
- **The Success of Research hinges on**
  - How clearly we conceptualize
  - How well others understand the concepts we use
- **Concepts:** Concrete, Unambiguous, Measurable

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Language of Research - Concepts

- **The Challenge of Developing Unambiguous Concepts**
- **Questions for an estimate of "Family's total income"**
- **Seeing unambiguous but not restricted if without additional constraints**
  - **Time period: weekly, monthly, or annually**
  - **Before or after Income Taxes**
  - **For Head of Family only or for all family members**
  - **Salary and wages; Dividends, Interests, Capital Gains**
  - **Income in kind: Free rent, Employee discount, Food stamps**

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Language of Research - Constructs

- **Constructs**
  - **A definition specifically invented to represent an abstract phenomena for a given research project**
  - **A group of concepts with a Label**
  - **Built by combining the simpler, more concrete concepts, especially when the idea or image we intend to convey is not subject to direct observation**
  - **Examples of Construct**
    - **Satisfied Service Customer**
    - **Technical Writer's job requirement**

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PicProfile: Shopping & Mobile Phones

Percent Shoppers Who Stop a Purchase Because of Their Mobile Phone

- Information
- Price

Reason	Value
Could not find information on the product being considered	11
Saw a negative review online	11
Found a better item online	21
Found a better price online	30
Found a better price at another store	38

(Axis: 0, 5, 10, 15, 20, 25, 30, 35, 40)

What are the constructs? What are the operational definition of these constructs?

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PicProfile: Shopping & Mobile Phones

- **What are the concepts and constructs involved in this study?**
- **What are the operational definitions of these constructs?**
- **What are the variables?**
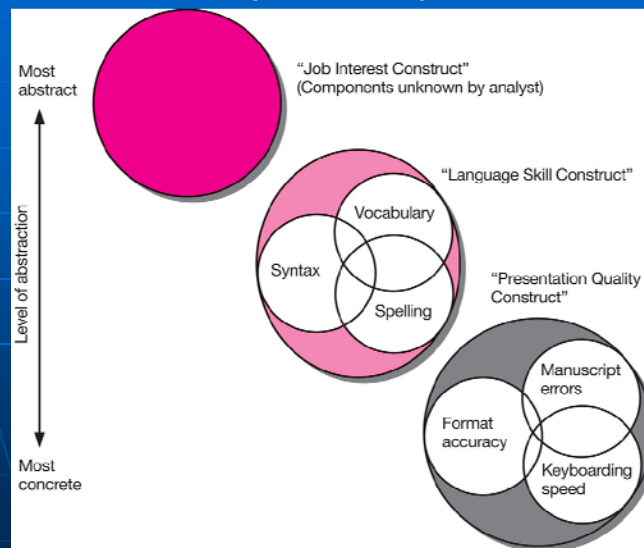- **What hypotheses would you propose about smart phone use and shopping behavior?**

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PicProfile: Shopping & Mobile Phones

What are the constructs? What are the operational definition of these constructs?

Concepts & Constructs – Job Redesign
(Exhibit 3-1)

Technical Writer's Job Design

- **Presentation Quality Construct**
  - Concepts:
    - Keyboarding Speed
    - Manuscript Errors
    - Format Accuracy
- **Language Skill Construct**
  - Concepts
    - Spelling
    - Vocabulary
    - Syntax

- **Job Interest Construct**
  - Hypothetical construct
  - Presumed to exist but no measure test whether such constructs actually exist
  - Inferred only from the data

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Language of Research - Constructs

- **Dictionary Definitions**
- **Operational Definitions**
  - A definition stated in terms of specific criteria for testing or measurement
  - Must refer to empirical standards, be able to
    - Count, or measures
    - Gather information through our senses
  - Must specify the characteristics
  - How they are to be observed
  - **Examples**
    - Undergraduate Student Classification
    - Dud Shell

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Operational Definitions – Class Standing

How can we define the variable "class level of students"?

• Freshman	• < 30 credit hours
• Sophomore	• 30-50 credit hours
• Junior	• 60-89 credit hours
• Senior	• > 90 credit hours

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Snapshot: Using Scientific Definition to Shape Political Debate Over BioMed

The National Academies advises on scientific issues.

Created voluntary guidelines for embryonic stem cell research.

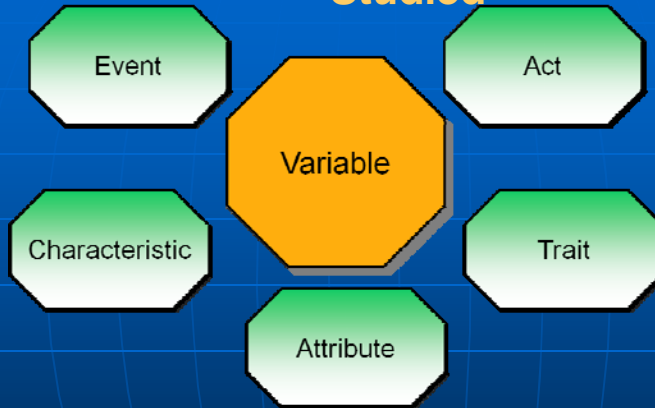Comprehensive definition of terms accepted by every researcher.

Volatile political issue = no nationwide guidelines

Politicians fill the void with own definitions to exploit personal agenda.
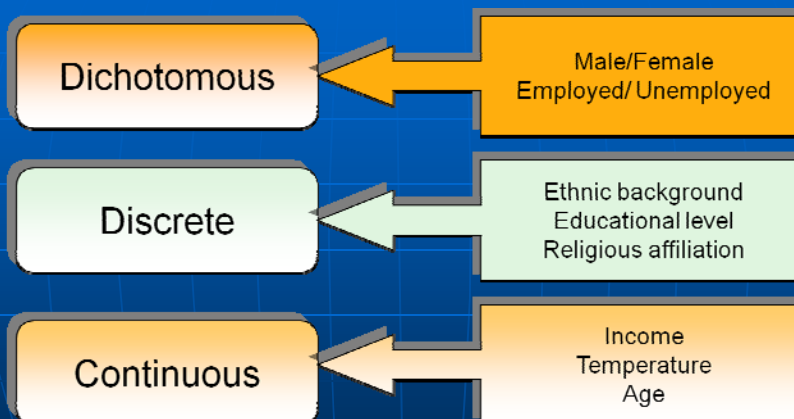
www.kumc.edu;
www.kslegislature.org

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A Variable – Construct or Property Being Studied

- **For data entry and analysis purposes**
- **A symbol, has types, can be measured and assigned values**

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Types of Variables

Dichotomous	Male/Female Employed/Unemployed
Discrete	Ethnic background Educational level Religious affiliation
Continuous	Income Temperature Age

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Language of Research - Variables

- **Types of Variables:**
  - **Dichotomous variable (binary values: 0, 1)**
    - **Yes, No**
    - **Present, Absence of a property**
    - **Male, Female**
    - **Employed, Unemployed**
  - **Discrete variable (Demographic)**
    - **Variables representing certain categories, ranges**
  - **Continuous variable**
    - **Variables within a certain range, or infinite set**

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Independent & Dependent Variables – Synonyms (Exhibit 3-2)

| Independent Variable (IV)	Dependent Variable (DV)
• Predictor	• Criterion
• Presumed cause	• Presumed effect
• Stimulus	• Response
• Predicted from…	• Predicted to….
• Antecedent	• Consequence
• Manipulated	• Measured outcome

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Language of Research - Variables

- **Variables and Relationships**
  - Independent Variable (IV)
  - Dependent Variable (DV)
    - IV => DV relationship
  - Moderating Variable (MV) or Interaction Variable
    - A second IV
    - Have a <u>significant contributory</u> or <u>contingent effect</u> of original IV-DV relationship

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Relationships Among Variables (Exhibit 3-3a)

(a)

IV: four-day working week

DV: productivity

MV: workers' age
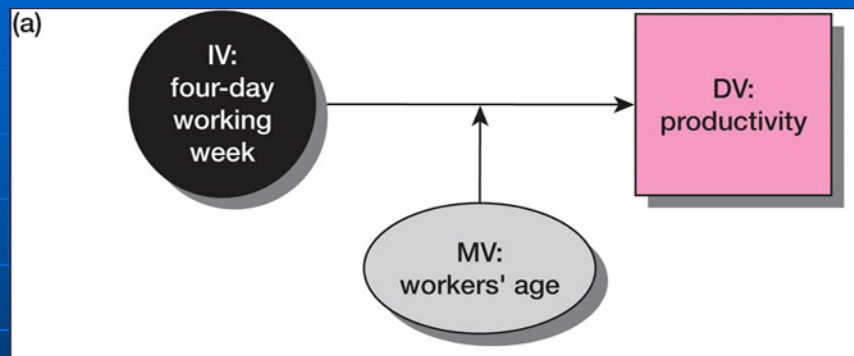
How about the case for Industrial/Factory Production Machines and Process => Productivity? 3 shift, 2 shift, 1 shift?

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Moderating Variables (MV)

- The introduction of a 4-day week (IV) will lead to higher productivity (DV), especially among younger workers (MV).

- The switch to commission from a salary compensation system (IV) will lead to increase sales (DV) per sales staff, especially more experience sales staff (MV).

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Language of Research - Variables

- **Variables and Relationships**
  - **Independent Variable (IV)**
  - **Dependent Variable (DV)**
  - **Moderating Variable (MV) or Interaction Variable**
  - **Extraneous Variable (EV)**
    - **Control Variable (CV)**
    - **Confounding Variables (CFV)**
  - **Intervening Variable (IVV)**

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Language of Research - Variables

- **Variables and Relationships**
  - **Independent Variable (IV)**
  - **Dependent Variable (DV)**
  - **Moderating Variable (MV) or Interaction Variable**
  - **Extraneous Variable (EV)**
    - **Control Variable (CV)**
    - **Confounding Variables (CFV)**
  - **Intervening Variable (IVV)**
    - **Variables that theoretically affect DV**
    - **But cannot be observed, or**
    - **Has not been measured**
   - **Effects must be inferred from the effects of IV and MV on the observed phenomenon**

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Extraneous Variables (EV)

- With new customers (EV-control), a switch to commission from a salary compensation system (IV) will lead to increased sales productivity (DV) per staff, especially among younger staff (MV).
- Among residents with less than a high school education (EV-control), the loss of jobs (IV) leads to high-risk behaviors (DV), especially due to the proximity of the firing range (MV).
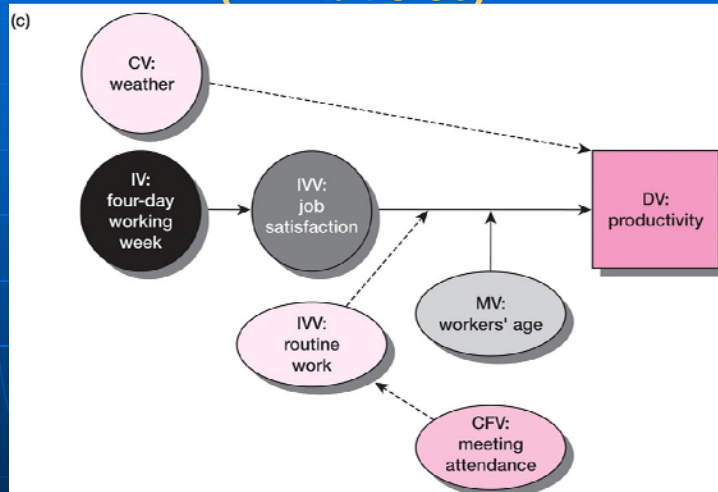
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Relationships Among Variables (Exhibit 3-3b)
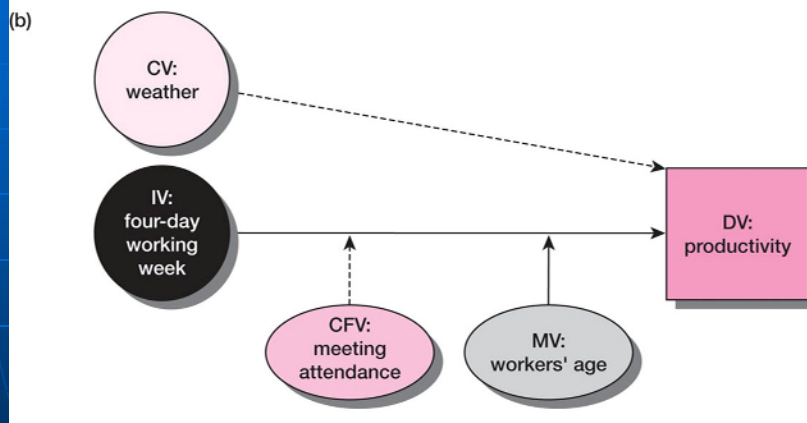
CFV (Confounding Variables):
Attending group (quality circle) meeting with different intensity

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Relationships Among Variables (Exhibit 3-3c)

IVV – Intervening Variables

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Propositions and Hypotheses

- Proposition – a statement about observable phenomena (concepts) that may be judged as true or false
- Hypotheses - a proposition formulated for empirical testing
  - Descriptive Hypotheses
  - Relational Hypotheses
- Case - the entity or thing the hypothesis talks about

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Descriptive Hypotheses Examples

- Brand Manager Jones (case) has a higher-than-average achievement motivation (variable).

  Generalization

- Brand managers in Company Z (cases) have a higher-than-average achievement motivation (variable).

  State the existence, size, form or distribution of some variables.

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Descriptive Hypothesis Format

Descriptive Hypothesis	Research Question
• In Detroit, our potato chip market share stands at 13.7%. • American cities are experiencing budget difficulties.	• What is the market share for our potato chips in Detroit? • Are American cities experiencing budget difficulties?

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Descriptive Hypotheses

- Descriptive Hypotheses
  - A statement about the existence, size, form, or distribution of a variable
- Advantages of Descriptive Hypotheses vs. Research Question: Encourage researchers
  - Crystalize thinking about the likely relationships
  - Think about the implications of a supported or rejected findings
  - Useful for testing statistical significance

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Relational Hypotheses

- A statement about the relationship between two variables with respect to some case
- May be correlational or explanatory (casual)
- A Correlational Hypotheses
  - A statement indicating that variables occur together in some specified manner without implying one causes the other
- A Casual Hypotheses
  - A statement that describes a relationship between two variables in which one variable leads to a specific effect on the other variable

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Relational Hypotheses

- An Example
  - "Foreign (variable) cars are perceived by American consumers (case) to be of better quality (variable) than domestic cars."
  - Two variables
    - Country Of Origin
    - Perceived Quality
  - The relationship between two variables – not specified

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Relational Hypotheses

Correlational

- Young women (under 35) purchase fewer units of our product than women who are older than 35.

- The number of suits sold varies directly with the level of the business cycle.

Causal /Explanatory

- An increase in family income leads to an increase in the percentage of income saved.

- Loyalty to a grocery store increases the probability of purchasing that store's private brand products.

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The Role of Hypotheses
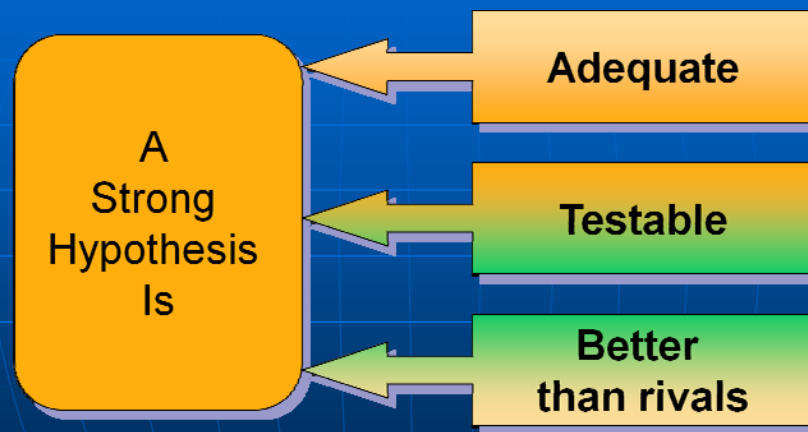
Guide the direction of the study

Identify relevant facts

Suggest most appropriate research design

Provide framework for organizing resulting conclusions

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Characteristics of Strong Hypotheses

A Strong Hypothesis Is

Adequate

Testable

Better than rivals

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The Difference between Theories & Hypotheses

- **Hypotheses**
  - Tends to be simple, limited-variable statements involving concrete instances
- **Theories**
  - Tends to be complex, abstract, and involve multiple variables
  - A theory - a set of systematically interrelated concepts, definitions, and propositions that are advanced to explain or predict phenomena
  - To the degree – theories are sound and fit the situation, we are successful in our explanation and prediction; an example – The Product Life Cycle

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Theory within Research:
Traditional Product Life Cycle
An Example of a Theory (Exhibit 3-5)
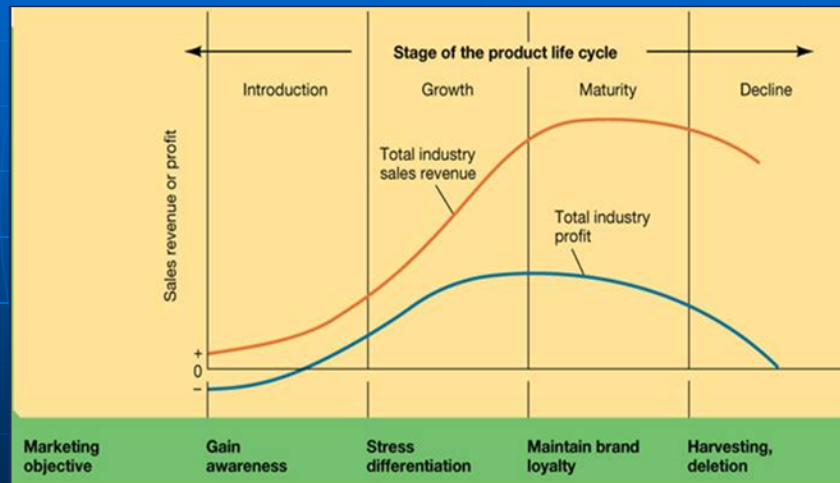
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Product Life Cycle

- **Growth Stage**
  - **$$Advertising & Promotion** => Product Awareness => Primary Demands (Construct), Improving Product Class awareness
  - Higher pricing => Skimming (Concept) to help recover development costs
  - Alternative Lower pricing strategy or Penetration Pricing (Concept) => capture & build Unit Volume
  - Repeat Purchasers (Concept) => Consumers tries, satisfied, and bought again => Sales increased rapidly
  - Death for the product (Proposition), if the company is unable to attract repeat purchasers

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Product Life Cycle

- **Maturity Stage**
  - A good time for generating cash flow (Proposition)
  - The cost of developing the product and establishing its position in the market place are paid and it tends to be profitable
  - Product Extend Strategies (Construct)
   - Introduce New Version of the product => delay the "Decline Stage"

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Product Life Cycle

- **Decline Stage**
  - Product Extend Strategies (Construct)
    - Introduce New Version of the product => delay the "Decline Stage"
  - Hypotheses: "Product will consume a disproportionate share of management time and financial resources relative to their potential future worth."
  - Need Operational Definitions
    - Disproportionate Share, Time
    - Resources, Future Growth

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Snapshot: Radio Chip vs. Retinal Scans
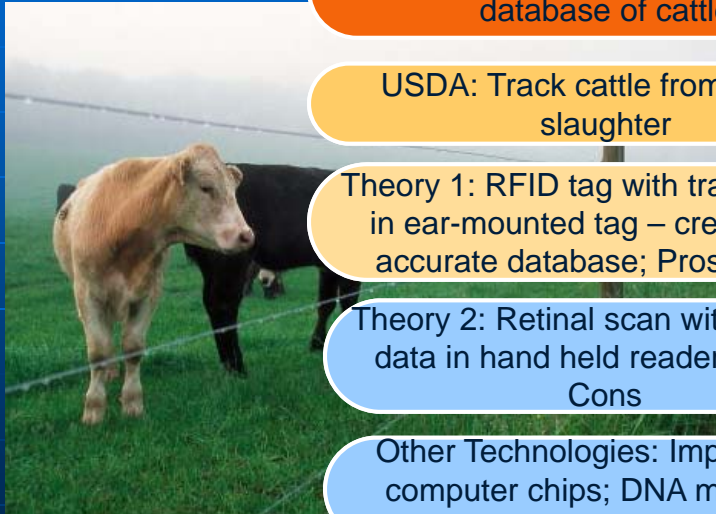
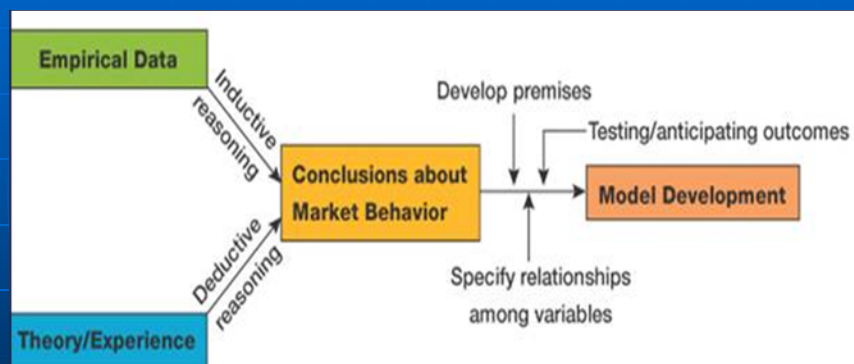Prevent cattle-born disease with database of cattle

USDA: Track cattle from birth to slaughter

Theory 1: RFID tag with tracking data in ear-mounted tag – create most accurate database; Pros & Cons

Theory 2: Retinal scan with tracking data in hand held reader; Pros & Cons

Other Technologies: Implantable computer chips; DNA matching systems

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The Role of Reasoning (Exhibit 3-7)
Business Model Development

Empirical Data

Inductive reasoning

Develop premises

Testing/anticipating outcomes

Conclusions about Market Behavior

Model Development

Deductive reasoning

Specify relationships among variables

Theory/Experience

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A Model within Research
Exhibit 3-6 – A Distribution Network Model (descriptive)
Maximum Flow Network Model
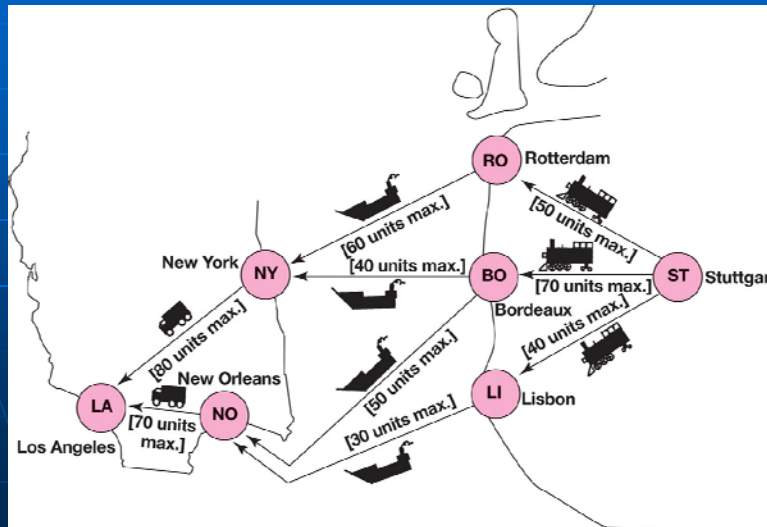
Matrix Representation of Model

| From/To	Stuttgart(ST)	Lisbon(LI)	Bordeaux(BO)	Rotterdam(RO)	New Orland(NO)	New York(NY)	Los Angeles(LA)
Stutgart(ST)	x	80/NO	70/NY	50/NY	x	x	x
Lisbon(LI)	x	x	x	x	30/LA	40/LA	x
Bordeaux(BO)	x	x	x	x	50/LA	40/LA	x
Rotterdam(RO)	x	x	x	x	x	60/LA	x
New Orlands(NO)	x	x	x	x	x	x	70/LA
New York(NY)	x	x	x	x	x	x	80/LA
Los Angeles(LA)	x	x	x	x	x	x	x

Roles of Models vs. Theory

- **Theory**
  - **To explain**
- **Models**
  - **Static or Dynamic**
  - **To represent or describe a system for study**
  - **In Business Research**
    - Descriptive models – used for complex system, visualization of numerous variables and relationships
    - Predictive models – forecast events and facilitate business planning
    - Normative models – with necessary actions; used for control

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Sound Reasoning

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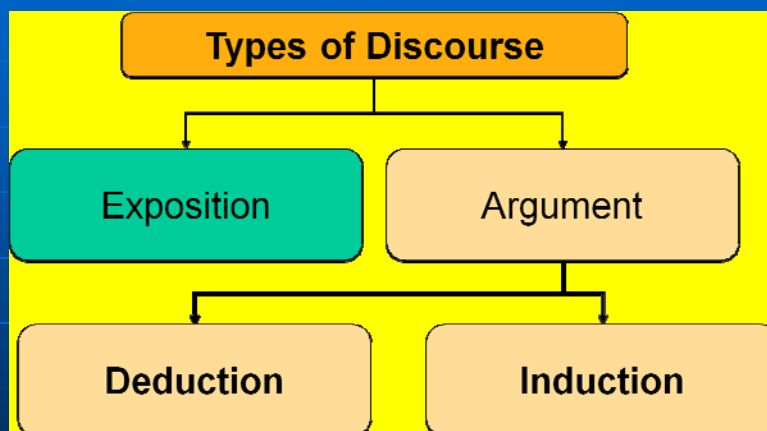
Sound Reasoning
Two Types of Discourse

- **Exposition**
  - Consists of statements that describe without attempting to explain
- **Argument**
  - Allows us to explain, interpret, defend, challenge, and explore meaning
  - Two types of arguments:
    - Deduction
    - Induction

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Deductive Reasoning

Inner-city household interviewing is especially difficult and expensive

Premises (reasons)

This survey involves substantial inner-city household interviewing

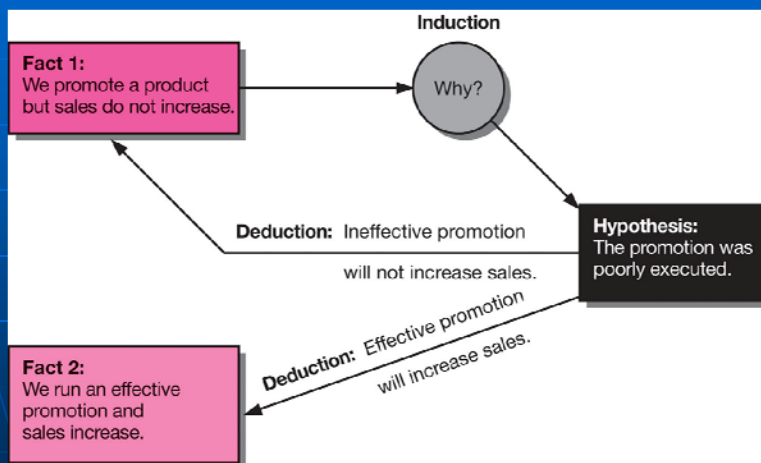The interviewing in this survey will be especially difficult and expensive

Conclusion

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Inductive Reasoning

- **Why didn't sales increase during our promotional event?**
  - Regional retailers **did not have sufficient stock** to fill customer requests during the promotional period
  - A **strike by employees** prevented stock from arriving in time for promotion to be effective
  - A **hurricane closed retail outlets** in the region for 10 days during the promotion

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Why Didn't Sales Increase
Uses Inductive and Deductive Reasoning

Induction

Fact 1:
We promote a product but sales do not increase.

Why?

Hypothesis:
The promotion was poorly executed.

Deduction: Ineffective promotion will not increase sales.

Deduction: Effective promotion will increase sales.

Fact 2:
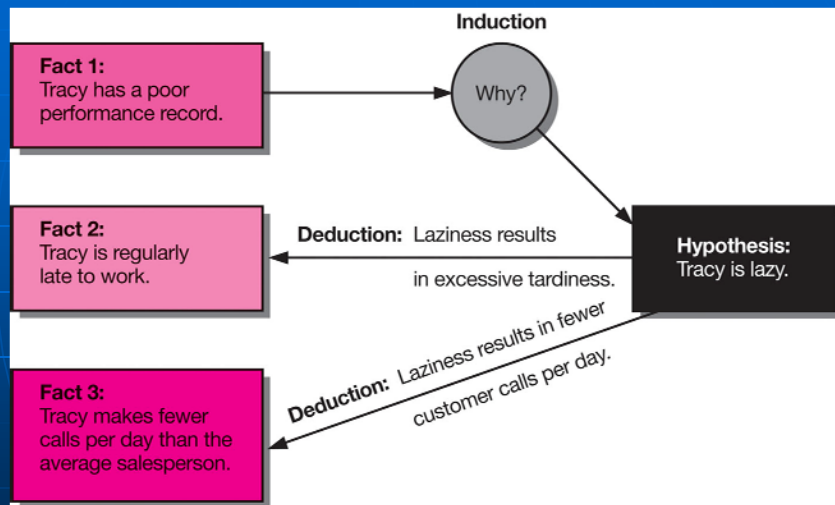We run an effective promotion and sales increase.

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Snapshot: Business and Battlefield: Scientific Evidence Supports "Gut-Hunches"

"People usually experience true intuition when they are under severe time pressure or in a situation of information overload or acute danger, where conscious analysis of the situation may be difficult or impossible."

Tracy's Performance

Induction

Fact 1:
Tracy has a poor performance record.

Why?

Hypothesis:
Tracy is lazy.

Deduction: Laziness results in excessive tardiness.

Fact 2:
Tracy is regularly late to work.

Deduction: Laziness results in fewer customer calls per day.

Fact 3:
Tracy makes fewer calls per day than the average salesperson.

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Pull Quotes: Research Thought Leaders

"<u>Brand communities</u> play a pivotal role for a brand connecting with its consumers, and as one of our Never Ending Friending focus group respondent notes: "I want brands to be my friends," which means that consumers would like to have common ideas, conversations and benefits delivered to them on their own terms."

Judit Nagy
vice president, consumer insights
MySpace/Fox Interactive Media

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PulsePoint: Research Revelations

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The percent of executives who admitted that their companies do not have an official policy for social networks.

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Formulating a Hypothesis

Wal-Mart recently decided not to share its unit sales information with IRI, a large syndicated research distributor. After studying the data, Wal-Mart didn't think it was getting enough value from competitor information in the syndicate. What hypothesis might have driven its research?

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Summary

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