TECH 646 Analysis of Research in Industry & Technology

A Core Course

Master of Science in Technology:
Industrial Technology/Manufacturing &
IT and Advanced Computer Applications Tracks

Purdue University Fort Wayne

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Lecture note based on (1) text book: Cooper, D.R., & Schindler, P.S., *Business Research Methods* (12th edition), McGraw-Hill/Irwin, (2) **Reference Text**: Applied Statistics and Probability for Engineers, 6th edition, by Montgomery and Runger, from Wiley, and (3) other online references

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TECH 646 Analysis of Research in Industry & Technology
Course Introduction

- **Core course for Master of Science in Technology (Industrial Tech/Manufacturing and IT/Advanced Computer App Tracks)**
- **Focuses on research process, methodologies**
- **Builds on IT 507 - Measurement and Evaluation in Industry & Technology**
- **Research methods, applied statistics**
- **A research project**
- **Real world data analysis project**

Course Objectives

- **Apply the scientific research approach to practitioner problems in business, industry and government.**
- **Select the appropriate data type and the scales for measuring the industry data.**
- **Enhance skills in performing analysis and interpreting the results of statistical methods such as: Hypothesis Testing, Regression and Correlation Analyses.**
- **Understand the application of multivariate analysis techniques such as cluster analysis and multiple regression models.**

Course Objectives (cont.)

- **Demonstrate systematic thought processes used in scientific thinking and knowledge development.**
- **Identify, describe and implement the key steps in the research process, including proposal generation, research design, methodology, data collection, analysis of findings, and written and oral presentation of results.**
- **Generate a draft proposal for an applied research project.**
- **Employ rigorous standards and conventions in formatting research documentation.**

Course Overview

- **Course is structured into three parts**
  - **Part A: Research methods, Research design, Proposal writing, Literature review, result presentation, and other issues in research methodologies**
  - **Part B: Statistical analysis, Hypothesis testing, goodness of fit test, Multiple regression analysis, Non-parametric test. And other possible application in Industrial contexts**
  - **Part C: Semester course project**

Text Book/Recommended Text

- **Required Text: Business research methods – Cooper and Schindler, 12th edition, from McGraw-Hill**
- **Reference Text: Applied Statistics and Probability for Engineers, 6th edition, by Montgomery and Runger, from Wiley**

Class Activities and Expectations

- The **class format**: 3 hour lecture and class discussion and/or presentation
- **Active student participations** in discussing questions, presenting/discussing case studies, articles and papers from the recent literature, and a team-based final project and presentation
- **Assignments**: Statistical problems solving, case studies, reading technical papers, and/or articles and writing short summary for each paper.
- **Mid-term and Final Projects**: project proposal, progress reports, project reports and presentations

Grading Policy

- **Questions** (short answer/essay/numerical problems), **Reading assignment** and summary reports - due one week from the assigned date, electronic submission; may require statistical software package such as Excel, Minitab, MATLAB, MAPLE, SPSS, etc – 30%
- **Case studies and presentations** – 25%
- **Mid-term project** – 15%
- **Term course project** (proposal, progress report and final report; and presentation) – 30%
- Grading Scale: A (90-100%), B (80 -89%), C (70-79%), D (60-69%), F (0-59%)

Week 1

- **Research in Industry/Business Request for Proposals –(from Business Research Methods text book)**

- **The Role of Statistics in Engineering (from Applied Statistics and Probability for Engineers)**

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Terms and Definitions

- **Analysis of Research in Industry & Technology**
- **Business Types and Sectors**
  - **Startup (Entrepreneur), Small and Midsize Enterprises, Corporations**
  - **For Profit, Non Profit**
- **Industry Sectors**
  - **Manufacturing, Technology, Services**

Ch. 1 Intro to Research in Business

- **Why Study Business Research?**
- **Information & Competitive Advantages**
- **Hierarchy of Information-Based Decision Makers**
- **The Research Process: A Preview**
- **A Glimpse at Four Research Studies**

Research Should Help Respond to Changes

"**Enterprises** have long recognized the need to better sense and respond to business change. What's different today is that ubiquitous access to information and real-time communications have fostered an 'always on' business culture where decision making has become a 'just-in-time process.'"
Business Performance Management Forum

Business Research Defined

- A systematic inquiry process that provides information to guide managerial decisions
- A process of **planning**, **acquiring**, **analyzing**, and **disseminating** relevant business **data**, **information**, and **insights** to decision makers in ways that mobilize the organization to take appropriate business **actions** that, in turn, **maximize business performance.**

Data Sources

Some Data Sources: Government

- **U.S. Data and Statistics, https://www.usa.gov/statistics**
- **U.S. Bureau of Economics, www.bea.gov**
- **Bureau of Labor Statistics, https://www.bls.gov**
- **Census Bureau, https://www.census.gov**

Data Sources

Manufacturing Data

- **State Manufacturing Data, National Association of Manufacturers,** http://www.nam.org/Data-and-Reports/State-Manufacturing-Data/

- **Manufacturing Data, ISM (Institute for Supply Management),** https://www.instituteforsupplymanagement.org/ISMReport/content.cfm?ItemNumber=13130&SSO=1

- **How big data can improve manufacturing,** https://www.mckinsey.com/business-functions/operations/our-insights/how-big-data-can-improve-manufacturing

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Data Sources

Manufacturing Data

- **State Manufacturing Data, National Association of Manufacturers,** http://www.nam.org/Data-and-Reports/State-Manufacturing-Data/

- **Manufacturing Data, ISM (Institute for Supply Management),** https://www.instituteforsupplymanagement.org/ISMReport/content.cfm?ItemNumber=13130&SSO=1

- **How big data can improve manufacturing,** https://www.mckinsey.com/business-functions/operations/our-insights/how-big-data-can-improve-manufacturing

picProfile – Snausages Breakfast Bites

- **Need: New pet food**
- **Social media research**
  - **300 pet lovers**
  - **Web site**
  - **Questions**
    - **What does your dog eat breakfast?**
    - **Would you buy more treats for your dog if they contained vitamins and minerals?**
- www.snausages.com

Example - Research News

- **New research shows that owning an iPhone is the most common sign of wealth, Chance Miller, July 8th, 2018, https://9to5mac.com/2018/07/08/iphone-wealth-research/**
  - **Research areas: Consumer behavior and media consumption based on 2016 data**
  - **A paper from National Bureau of Economic Research, http://www.nber.org/papers/**
  - **Highlighted by Business Insider, https://www.businessinsider.com/apple-iphone-or-ipad-is-the-top-way-of-knowing-if-youre-rich-or-not-2018-7**
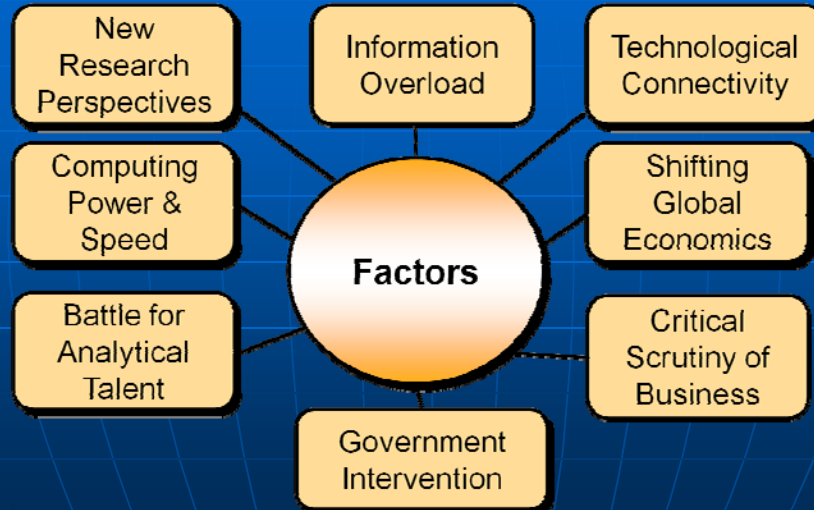
Example - Research News

- **iPhone in Business (at Work) – Apple, https://www.apple.com/business/products-platform/**
  - **Products are built to be the best for business**
  - **Technology designed for all the ways your employee want to work**
    - **An intuitive, familiar interface**
    - **Powerful hardware, powerful results**
    - **Secure by design**
    - **Compatible with your existing systems**
    - **Streamlined deployment and management**
    - **Devices that are even better together**

Research Should Reduce Risk

- The **primary purpose of research** is to reduce the level of risks of a business decision
  - Financial/Economic risk
  - Social risks
  - Physical risks
  - Technological risks
  - Product recalls (industrial, medical, consumer, pharmaceutical, etc.,)
  - Environmental risks

What's Changing in Business that Influences Research

1. Information Overload
- **Internet & Search Engines**
- **Information quality and credibility**
- **Ubiquitous access to information**
- **Risk drowning in data**

2. Technological Connectivity, adapting to
- **Changes in work patterns: real-time, global**
- **Changes of formation of relationships and communities**

What's Changing in Business that Influences Research

3. Shifting global centers of economic activity and competition

- **Demographic shift: Asia, EU**
- **Global collaboration**
- **Knowledge of Consumers, Suppliers, Talent pools, Business models, Infrastructures**
- **Accommodate different Norms, Values, Technologies, and Languages**
- **Norms: ISO, ANSI, Japan, China standards**

What's Changing in Business that Influences Research

4. Increasing critical scrutiny of big business

- **Availability of information**
- **Business Financial Reports**
  - **Investor Relations: Financial Information, Quart reports**
- **Interconnected global systems of suppliers, producers and customers**

2008 Financial Crisis

- **Ben Bernanke: The 2008 Financial Crisis was Worse than the Great Depression, https://www.forbes.com/sites/timworstall/2014/08/27/ben-bernanke-the-2008-financial-crisis-was-worse-than-the-great-depression/**
- **https://en.wikipedia.org/wiki/Financial_crisis_of_2007%E2%80%932008**
- **2008 Financial Crisis: Causes, Costs, Could it Reoccur, https://www.thebalance.com/2008-financial-crisis-3305679**

What's Changing in Business that Influences Research

5. More Government Intervention

- **Social Impacts**
- **Do-Not-Call (National Do Not Call Registry), https://www.donotcall.gov/**
- **Spyware Act (H.R. 1525 – 110th Congress, 2007-2008), https://www.congress.gov/bill/110th-congress/house-bill/1525**
- **Spyware and Malware, Federal Trade Commission, https://www.ftc.gov/news-events/media-resources/identity-theft-and-data-security/spyware-and-malware**

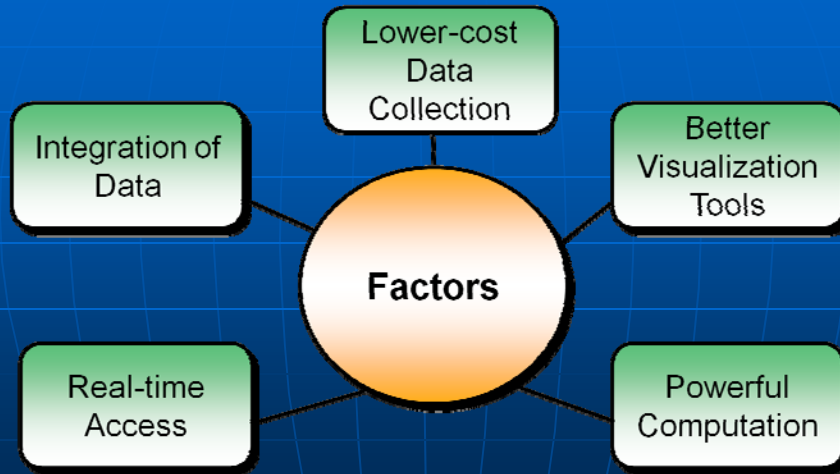**Public Companies: Financial Reporting Less Government Intervention**

- **President Trump asks SEC to study abolishing quarterly earning report, https://money.cnn.com/2018/08/17/news/companies/trump-drop-quarterly-reports/index.html**

- **Trump Asks SEC to Study Six-Month Reporting for Public Companies, https://www.wsj.com/articles/trump-directs-sec-to-study-six-month-reporting-for-public-companies-1534507058**

What's Changing in Business that Influences Research

6. Battle for Analytic Talent
- **Data: Meaning, Knowledge**
- **Mathematical models**
- **Software tools**
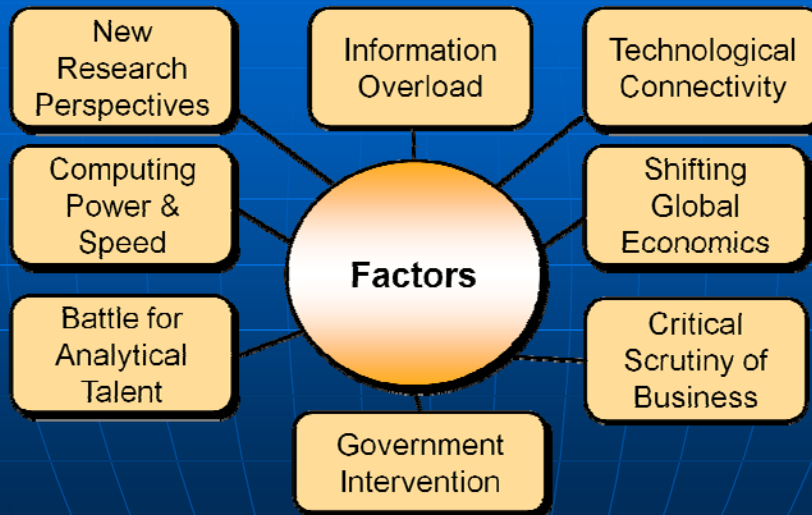- **Well-trained talent with advanced analytical skills**

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Computing Power and Speed

- Lower-cost Data Collection
- Integration of Data
- Better Visualization Tools
- Factors
- Real-time Access
- Powerful Computation

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What's Changing in Business that Influences Research

- New Research Perspectives
- Information Overload
- Technological Connectivity
- Computing Power & Speed
- Shifting Global Economics
- Factors
- Battle for Analytical Talent
- Critical Scrutiny of Business
- Government Intervention

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Business Planning Drives Business/Industry Research

Organizational Mission

Business Goals

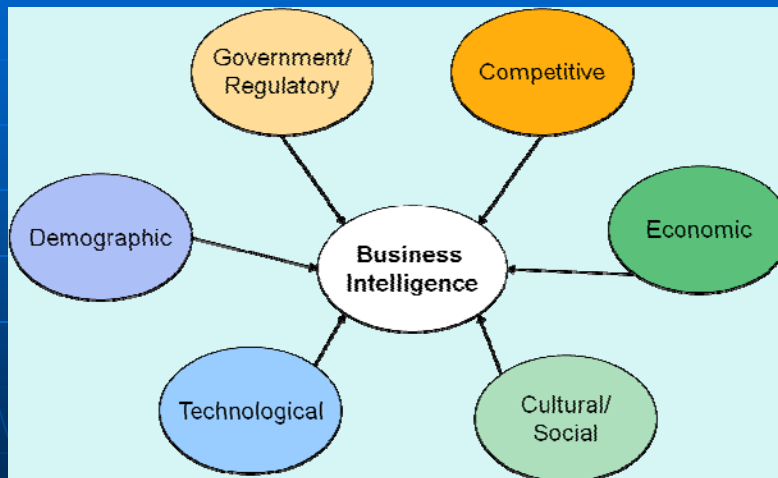**Business Strategies**

Business Tactics

Information Sources/Business Intelligence

- Decision Support Systems (DDS)
  - Numerous elements of data organized for retrieval and use in business decision making
  - Stored and Retrieved via
    - Intranets
    - Extranets

- Business Intelligence Systems
  - Ongoing information collection
  - Focused on events, trends in micro and macro-environments

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Sources of Business Intelligence

Sources of Business Intelligence

Competitive
- Press releases or press events
- Syndicated industry studies
- Records of public proceedings
- Web sites
- Business research
- Clipping services
- Presentation at conferences
- Literature searches

Economic
- Economic outlook and forecasts
- Literature searches
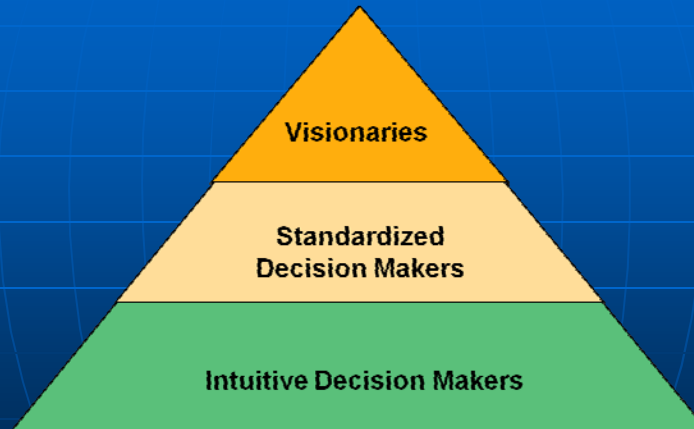- Government reports

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Sources of Business Intelligence

- **Government/Regulatory**
  - Press releases or press events
  - Recordings of public proceedings
  - Speeches by elected officials
  - Website of agency or department

- **Cultural & Social**
  - Syndicated studies
  - Public opinion organizations
  - Business research
  - Government reports

Sources of Business Intelligence

- **Technological**
  - Press releases or press events
  - Clipping services
  - Literature search
  - Presentations at conferences
  - Syndicated industry studies
  - Patent filings
  - Websites

- **Demographic**
  - Syndicated studies
  - Business research
  - Government report

Hierarchy of Business/Industry Decision Makers

Visionaries

Standardized Decision Makers

Intuitive Decision Makers

Pattern Thinking at Yum! Brands

PepsiCo Spun off Its Restaurant Division into a Separate Corporation: Yum! Brand, Inc

- PepsiCo – Global Good & Beverage Company, http://www.pepsico.com/
  - Pepsi, lays, Tropicana, Quaker, etc
- "**Pattern Thinking**" – what working for someone else and apply it to your own situation.
- Yum! – Feed the World, http://www.yum.com/
  - KFC, Pizza Hut, Taco bell, Restaurants in China
  - Borrow the lessons and ideas from GE, Walmart, Home Depot, Southwest Airlines, Target, Coke, and UPS
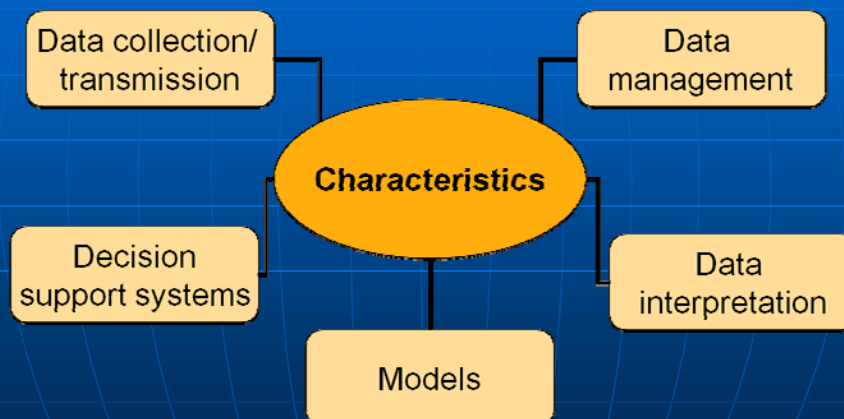
Pattern Thinking at Yum! Brand

- **Observation + individual depth Interviews:** gain insights-patterns
- **Pattern Thinking** technique/approach
- **Identified 5 Dynasty Drivers for Yum! Brand**:
  - A company where everyone makes a difference
  - Customer and Sales Mania
  - Competitive brand differentiation
  - Continuity in people and process, and
  - Consistency in results
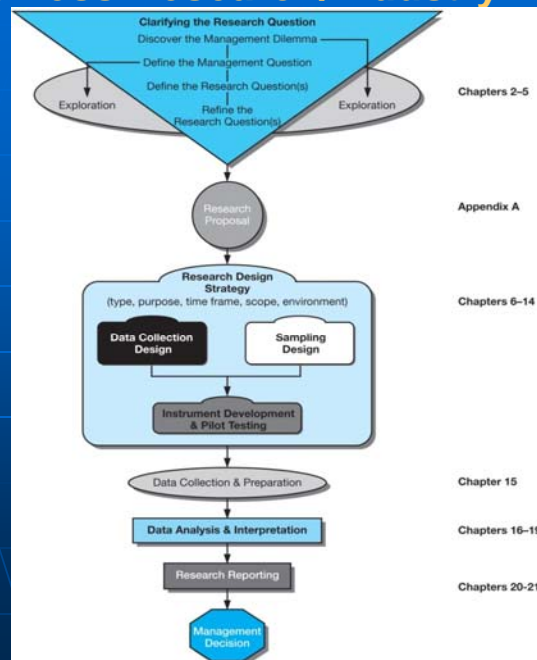
Information Value Chain

Research May Not Be Necessary

Can it Pass These Tests?

- Can information be applied to a critical decision?
- Will the information improve managerial decision making?
- Are sufficient resources available?

The Business Research/Industry Process

Characteristics of Good Research

1. Clearly defined purpose

2. Detailed research process

3. Thoroughly planned design

4. High ethical standards

5. Limitations addressed

6. Adequate analysis

7. Unambiguous presentation

8. Conclusions justified

9. Credentials

Two Categories of Research

Applied

Basic (Pure)

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Four Types of Studies

Reporting

Descriptive

Explanatory

Predictive

Four Types of Research Studies

- **Reporting studies** provide a summation of data, often recasting data to achieve a deeper understanding or to generate statistics for comparison.
- Carefully gather Data/Information which are readily available
- Data/Information re-evaluation is needed

Four Types of Research Studies

- **Descriptive Study**: tries to discover answers to the questions who, what, when, where, and, sometimes, how.
- **Colleting data and the creation of a distribution**
  - Number of times a single event or characteristics (a research variable), or
  - Relating the interaction of two or more variables
- **Addressing questions and issues** involving: quantity, cost, efficiency, effectiveness, and adequacy

Four Types of Research Studies

- **Explanatory study:** attempts to explain the reasons for the phenomenon that the descriptive study only observed.
- **Theory** is created to answer why and how questions.
  - Correlational Study – study the relationship between two or more variables
  - Hypotheses, Cause-effect proving

Four Types of Research Studies

- **Predictive study**: attempts to predict when and in what situations an event will occur. Studies may also be described as applied research or basic research.

- NATA (National Air Transportation Association, www.nata.org)

- FAA Reports on Radiation Exposure During Air Travel, 2015, https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/reports/

A Glimpse of Research Study

A. ClassicToys – Reporting Study

- Considering the **acquisition of a toy manufacturer**

- The Senior VP for Development asks you to head a Task Force to investigate 6 companies that are potential candidates.

A Glimpse of Research Study

A. ClassicToys

- **Assembly a team** composed of representatives from the relevant functional areas
- **Collect data** – public sources (sensitive nature)
- **Examine** all of the following:
  - Company annual reports
  - Articles in business journals
  - Trade magazines
  - News papers
  - Financial analysts' assessments
  - Company advertisements

A Glimpse of Research Study

A. ClassicToys

- **Develop summary profile** of candidate firms based on the characteristics gleaned from the sources
- The **Final Report** highlights the **Opportunities and Problems** that **acquisition of the target firm would bring to all areas of the business.**

A Glimpse of Research Study

B. Medimage

- As **a manager** for MedImage, a large group of Physicians specializing in **diagnostic imaging** (MRI, nuclear, tomography, and ultrasound)
- A prominent **health insurance organization** has contacted you to promote a "**New Cost-Containment Program**".
- The <u>doctor's committee</u> to which you will make recommendation will have narrow enrollment window for their decision.

A Glimpse of Research Study

B. Medimage

- If they **choose to join**, they will agree to
  - A **reduced fee schedule** in exchange for easier filling procedure, quick reimbursement, and listing on a physicians' referral network
- If they **decline** , they will continue to deal with their patients and the insurance carrier in the current manner.

A Glimpse of Research Study

B. Medimage

- **Research on Data**
  - You begin your Investigation by **Mining Data from Patient Files** to learn
    - How many are using this insurance carrier
    - Frequency of care visits
    - Complexity of filing, etc

A Glimpse of Research Study

B. Medimage

- Research on Data
  - **Consult Insurance Industry Data**
    - How many potential patients in your area use this Care Plan, or
    - Similar care plans with alternative insurance carriers, and
    - The likelihood of a patient choosing or switching doctors to find one that subscribes to the proposed program.

A Glimpse of Research Study

B. Medimage

- **Data Validation**
  - You attempt to **confirm your data** with information from professional and association journals
- **Develop a profile** that details
  - Number of patients
  - Overhead, and
  - Potential revenue realized by choosing to join the plan.

A Glimpse of Research Study

C. MoreCoatings

- A **paint manufacturer**, is having trouble maintaining profits.
- The owner believes **Inventory Management** is a week area of the company's operation.
- **Industry nature:**
  - Large inventory: many pain color, types of paint, and container size
  - Still unable to fill customer orders.

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A Glimpse of Research Study

C. MoreCoatings

- You look into (Data Gathering)
    - Present warehousing and shipping operation
    - Find excessive sales losses and delivery delay
    - Because of "Out-of-Stock" conditions
- Poll customers – confirm your impression

A Glimpse of Research Study

C. MoreCoatings

- You suspect
    - Present inventory system database and reporting system do not provide prompt, usable information needed for appropriate production decisions.

A Glimpse of Research Study

C. MoreCoatings

- Research Methods
  - **You familiar yourself with latest "Inventory Management Techniques"**
  - **You asks "Warehouse Manager" to take an inventory**
    - **Review the incoming orders from last year**
  - **You ask owner to show you the "Production Runs" of the last year and his method for assessing the need for a particular color or paint type**

A Glimpse of Research Study

C. MoreCoatings

- Research Methods
  - **Modeling the last year of business using**
    - **Production**
    - **Order**
    - **Inventory Management Techniques**

A Glimpse of Research Study

C. MoreCoatings

- Research Methods
  - **Choose the method that provides the best theoretical profit.**
  - **Run a pilot line using the new control methodology**
    - **After 2 months, the data shows a much lower inventory and higher order fulfillment rate**
  - **You recommend that the owner adopt the new inventory method.**

Summary/Key Terms

- Applied research
- Business Intelligence System (BSS)
- Business research
- Control
- Decision Support System (DSS)
- Descriptive studies
- Explanatory study

- Management dilemma
- Predictive studies
- Pure research
- Reporting studies
- Return on Investment (ROI)
- Scientific method
- Strategy
- Tactics