

# IT and Business Organizations




Presented by  
Eldon Y. Li

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## Sharing Moment

- Does IT matter? 
- Why does a company computerize its business functions? 
- What is a disruptive innovation? 

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## Learning Objectives

- What is the framework of IT?
- What are the types (subsystems) of IT?  
How are they different?
- What are the stages of IT growth in organizations?
- What is the framework of MIS?
- What is the concise definition of MIS?

## What Is the Framework of Information Technology (IT)?

- *Computer technology* (hardware and software)
  - for processing and storing information
- *Communications technology* (voice and data networks)
  - for transmitting information.

# Long-Term IT Trend Is Hard to Predict

## Mispredictions by IT Industry Leaders

This "telephone" has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us.

—Western Union internal memo, 1876

I think there is a world market for maybe five computers.

—Thomas Watson, chairman of IBM, 1943

But what [is a microchip] good for?

Engineer at the Advanced Computing Systems Division of IBM, 1968

There is no reason anyone would want a computer in their home.

—Ken Olson, president, chairman, and founder of Digital Equipment Corp., 1977

640K ought to be enough for anybody.

—Attributed to Bill Gates, chairman of Microsoft, 1981

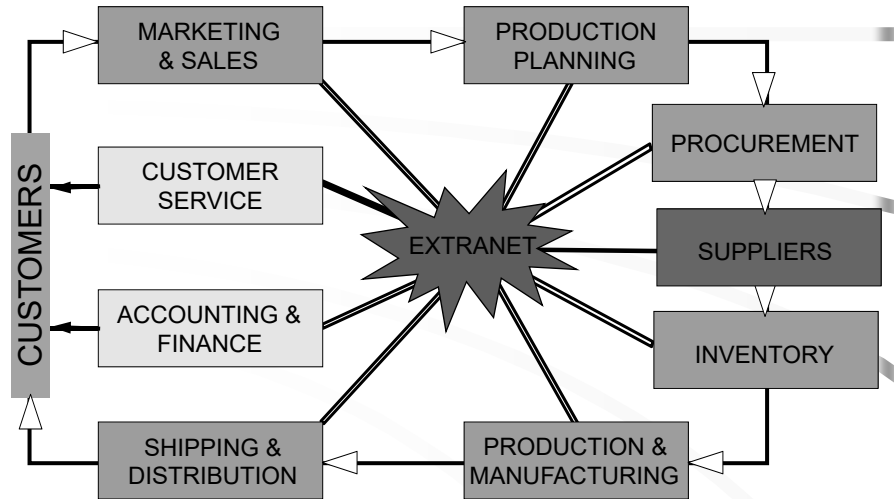
[Based on Kappelman, 2001; Jones, 2003]

## Types of Business Systems

Intraorganizational system

- Transaction processing systems (TPS)
- Electronic data processing systems (EDPS)
- Management information systems (MIS)
- Decision support systems (DSS)
- Executive information systems (EIS)
- Office automation systems (OAS)
- Artificial intelligence/Expert systems (AI/ES)
- Knowledge management systems (KMS)
- *Interorganizational systems (IOS)*

# IOS - Supply Chain Management



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# A Decision Support System

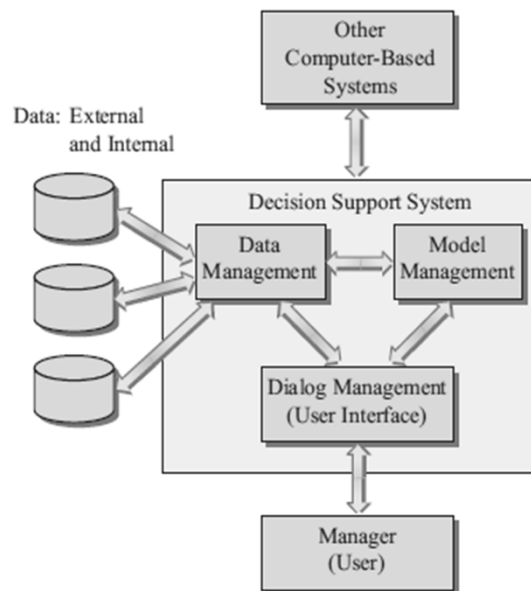


Figure 6.1 Decision Support Systems Components

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# Physical Neuron Structure

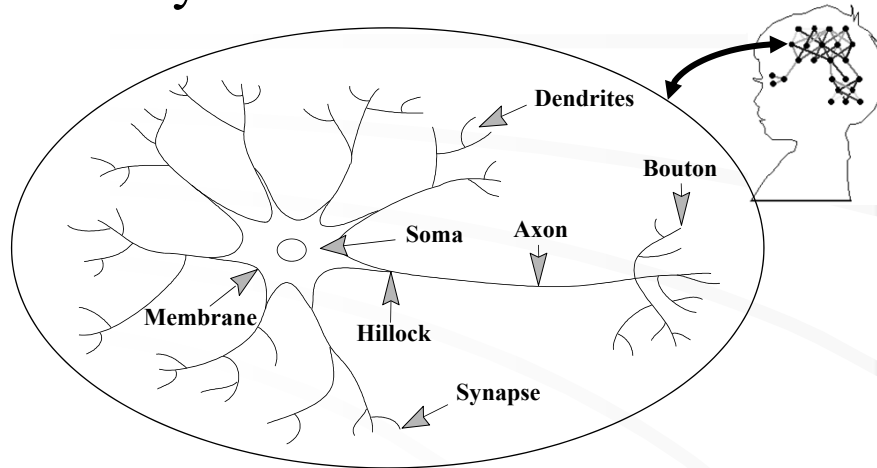
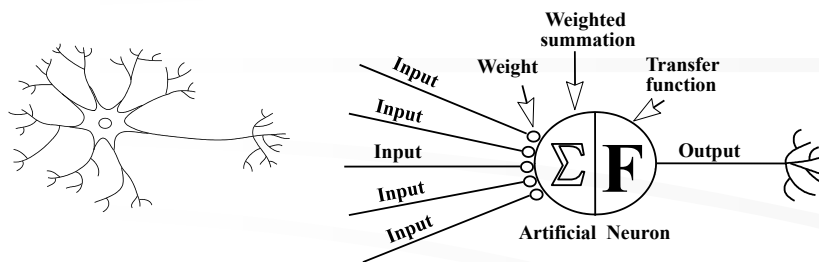


Figure 1. The Physical Structure of a Biological Neuron

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# Artificial Neuron Structure



Regression Model:

$$Y = b_1 X_1 + b_2 X_2 + \dots + b_5 X_5$$

$$= \sum b_j X_j$$

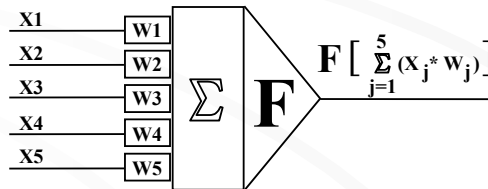
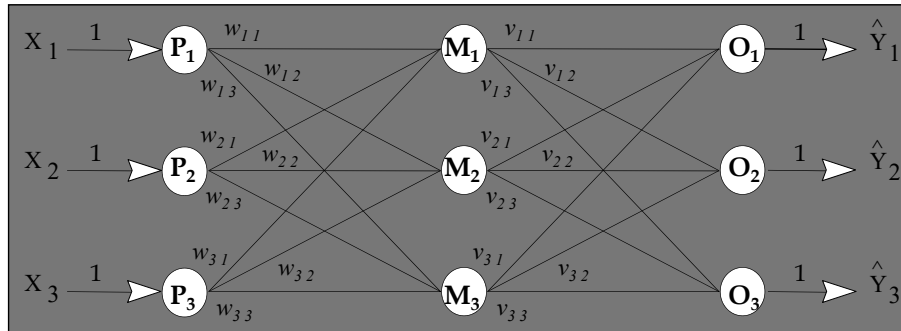


Figure 2. The Functions of an Artificial Neuron

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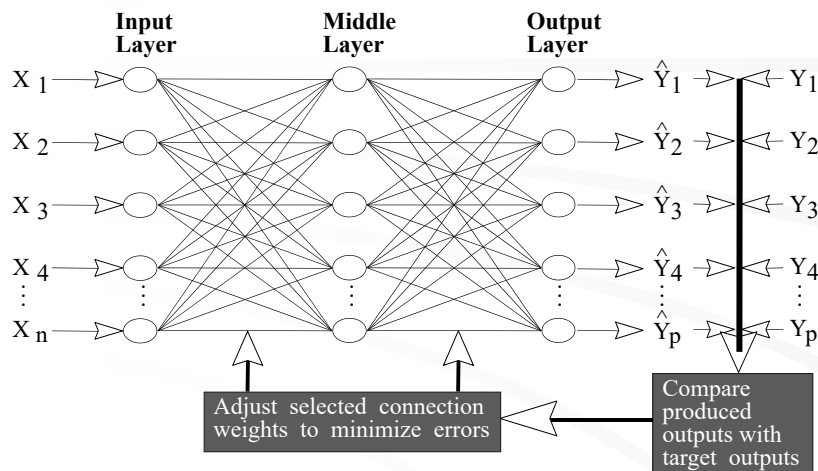
# Matrix Calculations in a One-Middle-Layer Neural Network



$$\begin{aligned}
 P_1 &= X_1 & M_1 &= w_{11}P_1 + w_{21}P_2 + w_{31}P_3 & O_1 &= v_{11}M_1 + v_{21}M_2 + v_{31}M_3 & \hat{Y}_1 &= O_1 \\
 P_2 &= X_2 & M_2 &= w_{12}P_1 + w_{22}P_2 + w_{32}P_3 & O_2 &= v_{12}M_1 + v_{22}M_2 + v_{32}M_3 & \hat{Y}_2 &= O_2 \\
 P_3 &= X_3 & M_3 &= w_{13}P_1 + w_{23}P_2 + w_{33}P_3 & O_3 &= v_{13}M_1 + v_{23}M_2 + v_{33}M_3 & \hat{Y}_3 &= O_3
 \end{aligned}$$

**Note: Assuming no transfer functions.**

# Learning Ability



**Figure 5. Supervised Learning in a Feed-Back Neural Network uses training pairs of  $(X_1, X_2, \dots, X_n; Y_1, Y_2, \dots, Y_p)$**

# Neuro-network Application

## Prediction of Thrift Failures

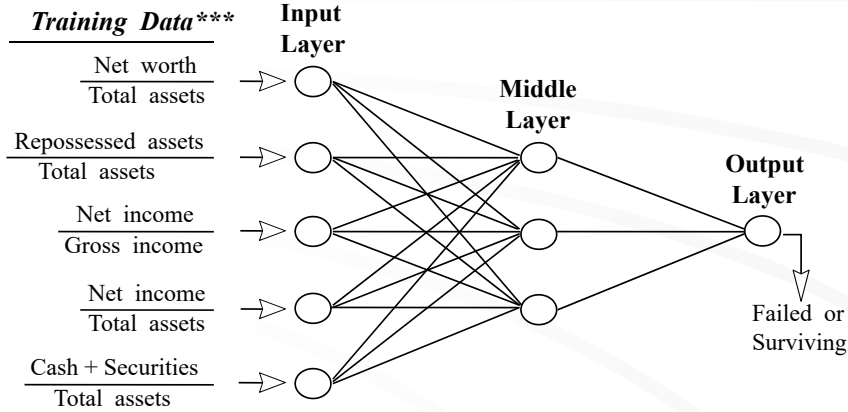


Figure 6. A Neural Network for Predicting Thrift Failures

\*\*\* Through stepwise regression, 5 significant input variables were identified (out of 29).

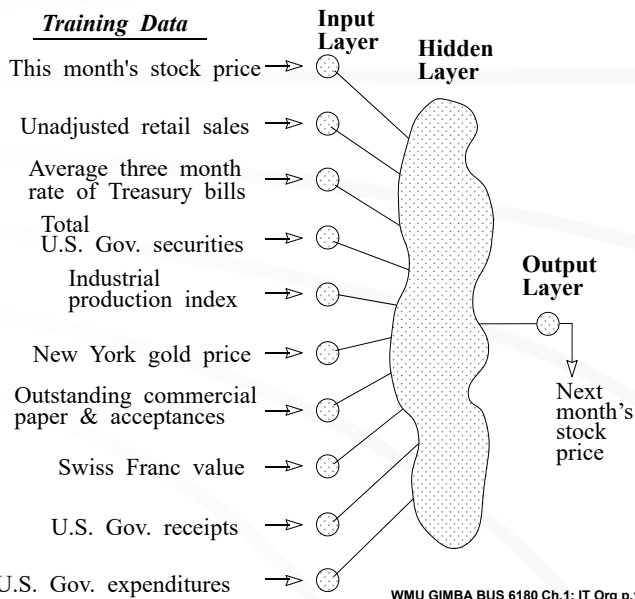
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# Neuro-network Application

## Prediction of Stock Price Index

RESULT: Such neural system can produce the first 8-month predictions with less than 3.2% average absolute error and the entire 12-month predictions with only 4% average error.



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# Intraorganizational Systems

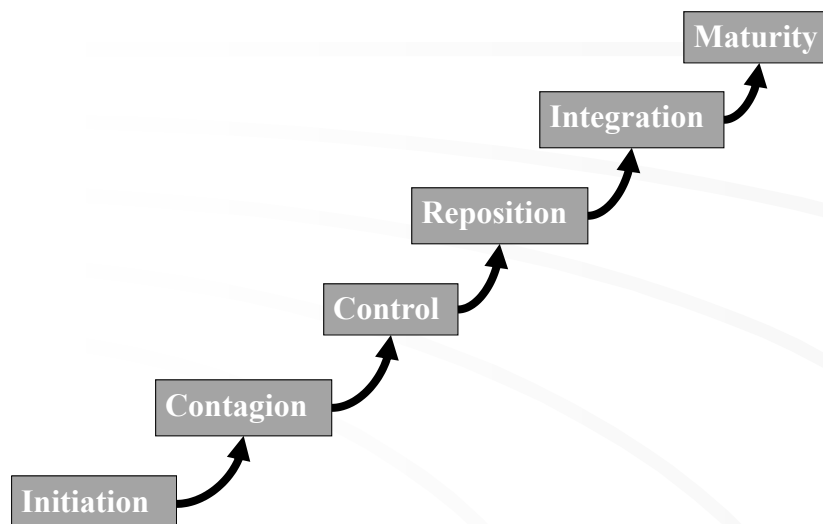
## Managerial Support Systems

- Electronic data processing systems
- Management information systems
- Decision support systems
- Data/Text mining systems
- Group support systems
- Geographic information systems
- Executive information systems
- Business intelligence systems
- Knowledge management systems
- AI/Expert systems
- Neural networks
- Virtual reality systems

## Enterprise Systems

- Transaction processing systems
- Enterprise resource planning systems
- Data warehousing
- Customer relationship management systems
- Office automation
- Groupware and collaborative work
- Intranets and portals
- Factory automation and controls
- Supply chain management systems

# Nolan's IT Growth Model





# Nolan's IT Growth Model

Nolan's model concerns the general approach to IT in business. The model proposes that evolution of IT in organizations begins slowly in Stage I, the "initiation" stage. This stage is marked by "hands off" user awareness and an emphasis on functional applications to reduce costs. Stage I is followed by further growth of IT in the "contagion" stage. In this stage there is a proliferation of applications as well as the potential for more problems to arise. During Stage III a need for "control" arises. Centralized controls are put in place and a shift occurs from management of computers to management of data resources. Next, in Stage IV, "integration" of diverse technological solutions evolves. Management of data allows development without increasing IT expenditures in Stage V. Finally, in Stage VI, "maturity", high control is exercised by using all the information from the previous stages.

[https://en.wikipedia.org/wiki/Stages\\_of\\_growth\\_model](https://en.wikipedia.org/wiki/Stages_of_growth_model)

# Nolan's IT Growth Model

## **Initiation**

- User awareness is "hands off".
- IT personnel are "specialized for technological learning".
- IT planning and control is not extensive.
- Emphasize functional applications to reduce costs.

## **Contagion**

- Proliferation of applications.
- Users are superficially enthusiastic.
- Management control is even more relaxed.
- Rapid growth of budgets and usage in functional areas.
- Treatment of the computer by management is primarily as just a machine.
- Computer use is plagued by crisis after crisis.

# Nolan's IT Growth Model

## Control

- No reduction in computer use. End user are often frustrated.
- IT position has greater importance to the organization.
- Centralized controls are put in place.
- Applications are often incompatible or inadequate.
- Using database and communications, often with negative general management reaction.

## Reposition

- Rise of control by the users. Large growth of IT budget.
- Greater demand for on-line database facilities.
- IT department now operates like a computer utility.
- Formal IT planning and control.
- Users are more accountable for their applications.
- Use of steering committees, applications financial planning becomes important.
- IT has better management controls and set standards.

# Nolan's IT Growth Model

## Integration

- Data administration is introduced.
- Identification of data similarities, its usage, and its meanings within the whole organization.
- Integrating applications portfolio into the organization.
- IT department now serves as an administrator of data resources than of machines.
- IT supports more than data processing.

## Maturity

- Systems now reflect the real information needs of the organization.
- Greater use of data resources to develop competitive and opportunistic applications.
- IT department is viewed solely as a data resource function.
- IT now emphasizes data resource strategic planning.
- Users and IT department jointly are responsible for the use of data resources within the organization.
- Manager of IT system takes on the same importance in the organizational hierarchy as say the director of finance or director of HR.

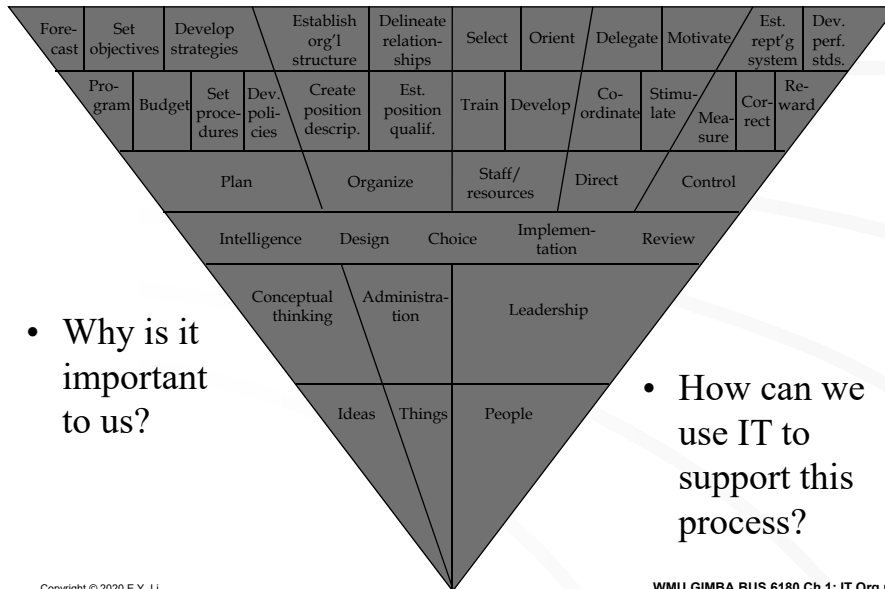
## Back to Basic Questions

- Why use IT?
  - To assist management in decision-making
- What is the decision making process?
- What are the management functions?
- What is the framework of MIS?

## The Decision Making Process

- Intelligence:
  - Identify areas of improvement;
  - Analyze the areas;
- Design:
  - Develop alternate solutions;
  - Evaluate the solutions;
- Choice:
  - Make a decision;
  - Communicate the decision;
- Implementation:
  - Implement the decision;
  - Manage the implementation;
- Review:
  - Review the results
  - Feedback the results
- Why is this process important to us?
- How can we use IT to support this process?

# The Management Process



- Why is it important to us?

- How can we use IT to support this process?

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# Top Manager's Characteristics

- **Multitasking**
- **Time management**
- **Short time span on a task (<50% last >9 min.)**
- **Lots of meetings (70% of time)**
- **Lots of interruptions (0% worked >20 min.)**
- **Verbal communications**
- **Intuitive judgment**
- **Holistic vs. parochial view**
- **Strategic vs. technical thinking**
- **Sensitivity analysis**
- **Different decision styles**
- **Different leadership styles**
- **Different management styles**

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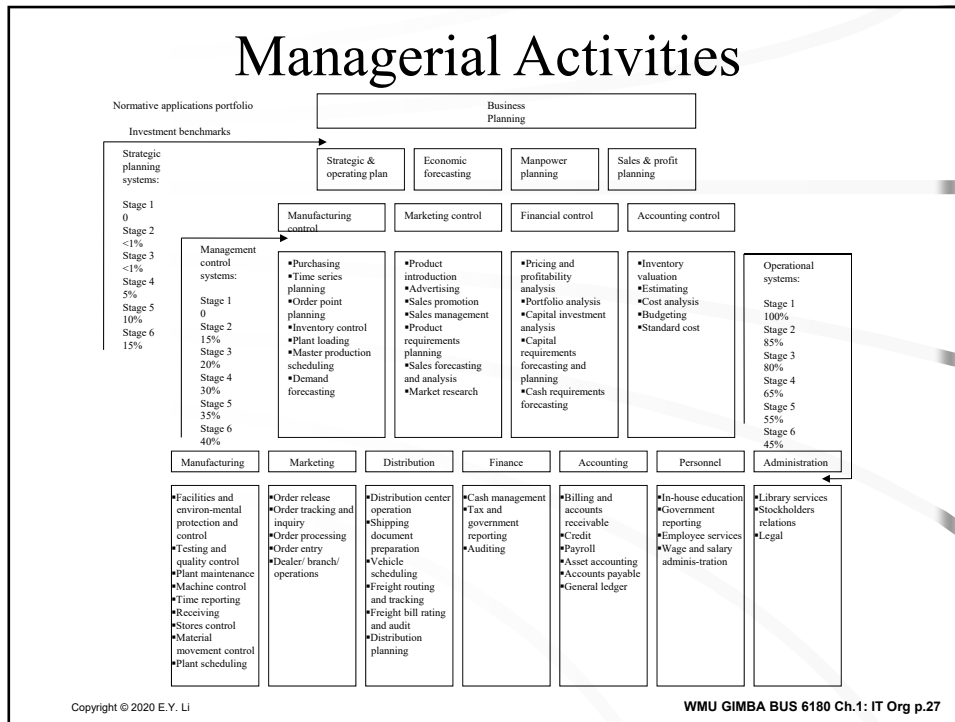
# Management Responsibilities

- **Top level:**
  - sets policies, budgets, goals, objectives, priorities, strategies.
- **Middle level:**
  - manages profit, ROI, revenues, costs, scheduling, allocates resources, sets performance standards.
- **Operating level:**
  - manages daily work schedule, quality control, measures performance, quota, or deadlines.

# Management Job Content

Characteristic	Top management	Middle management	Operating management
<b>Focus on planning</b>	Heavy	Moderate	Minimum
<b>Focus on control</b>	Moderate	Heavy	Heavy
<b>Time frame</b>	One year or longer	Up to a year	Day to day
<b>Scope of activity</b>	Extremely broad	Entire functional area	Single subfunction or subtask
<b>Nature of activity</b>	Relatively unstructured	Moderately structured	Highly structured
<b>Level of complexity</b>	Very complex, many variables	Less complex, better defined variables	Straightforward
<b>Job measurement</b>	Difficult	Less difficult	Relatively easy
<b>Result of activity</b>	Plans, policies and strategies	Implementation schedules, performance yardsticks	End product
<b>Type of information utilized</b>	External	Internal, reasonable accuracy	Internal historical, high level of accuracy
<b>Mental attributes</b>	Creative, innovative	Responsible, persuasive, administrative	Efficient, effective
<b>No. of people involved</b>	Few	Moderate number	Many
<b>Department/divisional interaction</b>	Inter-division	Inter-department	Intra-department

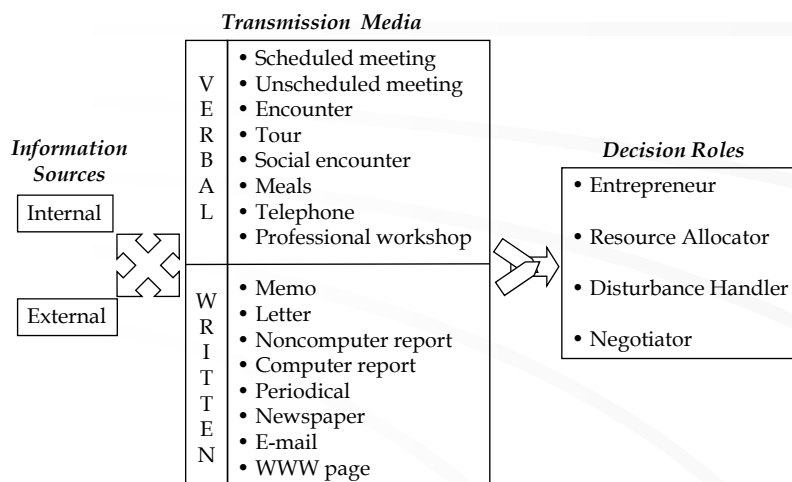
# Managerial Activities



# Information Transmission Model

INTELLIGENCE

DESIGN & CHOICE



- How can we use IT to support information gathering?

## System Support of Decision Activities

Member:	At single location	At multiple locations
Not all present	Sequential brainstorming Electronic bulletin board E-mail	Sequential brainstorming Networked bulletin board E-mail
All present	Direct brainstorming Groupware/Group decision system	Direct brainstorming Multimedia tele-conference Computer conference

## Groupware Features (e.g., ZOOM)

Common Groupware Features	
• Electronic mail	• Meeting support systems
• Electronic bulletin boards	• Workflow routing
• Computer conferencing	• Electronic forms
• Electronic calendaring	• Internet telephony
• Group scheduling	• Sharing documents
• Desktop videoconferencing	• Learning management systems
• Electronic whiteboards	• Instant messaging
• Shared workspace	

# The Framework of MIS

## MANAGEMENT:

- Management process/functions:
- Decision making process: Simon's phases
- Problem types:
- Levels of management:
- Time frames of activities:

## INFORMATION:

- Data  $\Rightarrow$  Information
- Computer System
- Hardware
  - Computing
  - Communications
- Software
  - Computing
  - Communications
- Database
- Modelbase
- Procedures
- People
  - Users
  - IS professionals

## SYSTEMS:

- I-P-O-F
- Multiple subsystems
- Common goals & standards
- Procedures & policies
- Integration & coordination

# The Framework of MIS

## • MANAGEMENT:

- Management process/functions:
- Decision making process: Simon's phases
- Problem types:
- Levels of management:
- Time frames of activities:



# The Framework of MIS

- INFORMATION:
  - Data vs. information:
    - Relevancy, timeliness, accuracy, verifiability, completeness, usefulness.
  - Computer system: hardware, software, people, data, models, procedures
  - Three information processing technologies:
    - procedural/non-procedural languages
    - (macroscopic/black-box:) AI/logic programming/expert systems shells
    - (microscopic/white-box:) neural network processors

# The Framework of MIS

- INFORMATION:
  - Types of users:
    - nonprogramming end-users
    - command level end-users
    - end-user programmers
    - functional-support IS pro as user's personnel
    - end-user-computing-support IS personnel
    - programming IS personnel

## The Framework of MIS

- SYSTEMS:
  - "a system is a set or arrangement of things so related or connected to form a unity or organization." (Webster's definition).
  - Fundamental structure of a system (IPO model):
    - Open-loop system vs. Closed-looped system:
    - Open system vs. Closed system:
  - CBIS subsystems: (see below)

## Concise Definition of MIS

- MIS is an integrated system
- Consists of Hw, Sw, P, D, M, P
- Transforms data into information
- Supports decision making
- Supports all levels of management

# Q & A



## IT Doesn't Matter

- <http://eli.johogo.com/Class/CCU/ITDoesntMatter.pdf>

## Why Is This Article Important?

- it causes us to consider the importance of the strategic, tactical, and operational importance of IT
  - strategic - changing the course/objectives of the business -- causing it to be distinguished from other businesses
  - tactical - changing how the business accomplishes its objectives
  - operational - changing how the business performs tasks

## Article Premise

"As information technology's power and ubiquity have grown, its strategic importance has diminished"

**Power?** Moore's law, doubling of computer power every 18 months for a constant cost

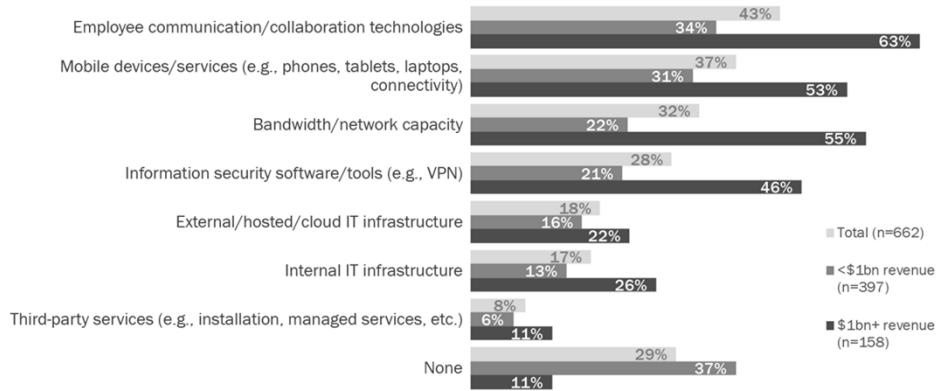
**Ubiquity?** By 2000, about 50% of capital expenditures by US companies are for information technology

**Worldwide IT Spending Forecast (Millions of U.S. Dollars)**

	2019 Spending	2019 Growth (%)	2020 Spending	2020 Growth (%)	2021 Spending	2021 Growth (%)
Data Center Systems	210,053	0.6	188,365	-10.3	200,094	6.2
Enterprise Software	476,687	11.7	449,506	-5.7	482,666	7.4
Devices	711,525	-0.3	596,914	-16.1	611,303	2.4
IT Services	1,040,263	4.8	969,438	-6.8	1,023,179	5.5
Communications Services	1,372,236	-0.6	1,326,492	-3.3	1,366,419	3.0
<b>Overall IT</b>	<b>3,810,764</b>	<b>2.3</b>	<b>3,530,714</b>	<b>-7.3</b>	<b>3,683,661</b>	<b>4.3</b>

Source: Gartner (July 2020)

**PLANS TO SPEND MORE ON TECHNOLOGY TOOLS – REVENUE SPLIT**



Q. Which, if any, of the following technology products or services do you expect your organization to spend more on as a result of the circumstances surrounding the coronavirus outbreak? Please select all that apply.

Base: All respondents

## Carr Says

- "Today, no one would dispute that information technology has become the backbone of commerce. It underpins the operations of individual companies, ties together far-flung supply chains, and, increasingly, links businesses to the customers they serve."

## IT Changes Management Thinking

- Why?
  - Faster, more possibilities, less cost, etc.
- When did this happen?
  - Mid 1960s was a massive change because of database technology
- How?
  - It is the question of whether we master the technology or be controlled by the technology -- if you have a hammer, does every problem look like a nail?

## What Is 'Vanishing Advantage'?

- "When a resource becomes essential to competition but inconsequential to strategy, the risks it creates become more important than the advantage it provides."
- Carr creates a conundrum -- both theory and practice teach management to eliminate risks yet you cannot eliminate something "essential to competition"

## Different Technologies

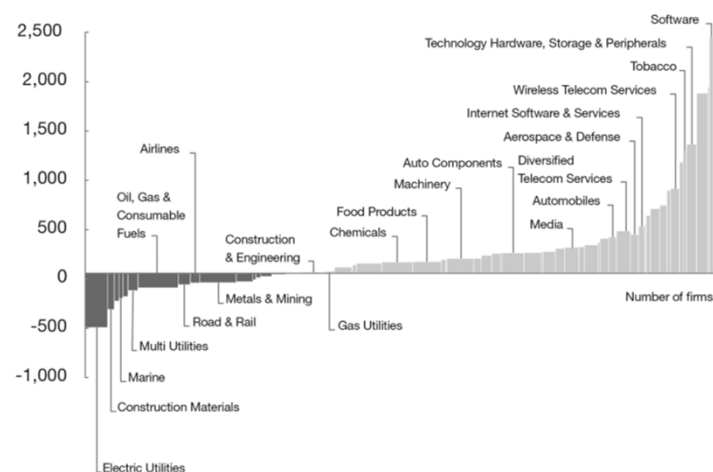
- Proprietary
  - can be owned by a single company (for example a copyright or patent)
  - present a barrier to other businesses that might compete against you
  - these are strategic as long as the proprietary characteristic is held
- Infrastructural
  - offer value in the sharing -- remember that IT is at its best when standardization is adopted
  - most proprietary technologies, by time or by regulatory intervention, become infrastructural after some length of time

## The Broader Impact

- Infrastructural technologies lead to broader impacts, impacts that affect markets instead of businesses and industries
- Knowing that eventually most proprietary technologies become infrastructural, managers need to plan for the passing of the advantage of a specific technology -- the passing from a microeconomic level to a macroeconomic level
- Think of the ‘power curve’ of industries. Companies in the top quintile capture nearly 90% of the economic profit created.

### The industry Power Curve

Industries also have a Power Curve—where you play really matters  
Average annual economic profit of firms within each industry, 2010–14  
\$ Millions, N=2,393



McKinsey&Company | Source: McKinsey Corporate Performance Analytics™



## Commoditization of IT

- The cost of an application is the cost of development since the cost to replicate the code approaches \$0.
- IT is the very essence of standardization.
- The price per unit of IT (millions of instructions per second is the standard measure) continues to fall.

## From Offense To Defense

- Since IT is critical to many businesses, even a minor and brief lose can be devastating -  
be defensive
- New rules for IT management according to Carr
  - spend less
  - follow, don't lead
  - focus on vulnerabilities, not opportunities

## Spend Less

- Carr states "Studies show that the companies with the biggest IT investments rarely post the best financial results."
  - The "rarely post the best financial results" is based on the fact that the biggest IT investments are generally in transaction processing businesses (such as mailing out bills) and those types of companies would not be "best financial" whether they used computers or monkeys.

## Follow, Don't Lead

- Carr states that "Moore's Law guarantees that the longer you wait to make an IT purchase, the more you'll get for your money."
  - If you wait three years you can buy used IT equipment for about 25 cents on the dollar - why don't people wait?
  - What is the cost of lost opportunity or the cost of a competitor using new IT for years while you wait for the price to drop?

## Focus On Vulnerabilities, Not Opportunities

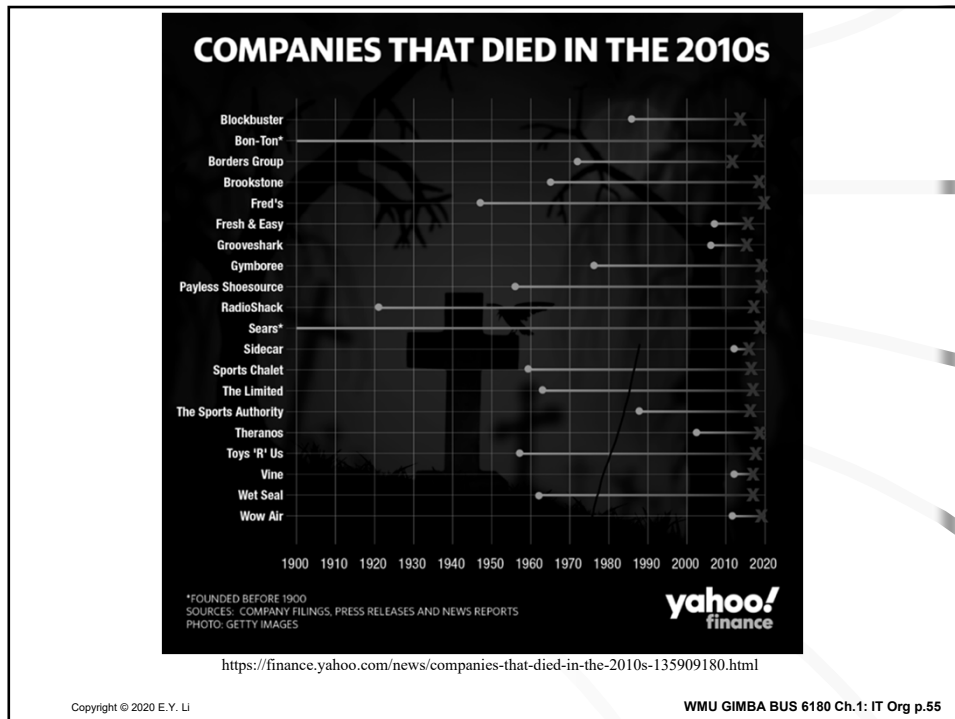
- It is unusual for a business to gain competitive advantage through the distinctive use of mature infrastructure technology
  - Be prepared for dangers - can be caused by employee misconduct and wrongdoing, electrical loss, obsolescence of hardware or software, etc.
  - Outsourcing IT to third parties has benefits and some decided dangers



## Disruptive Innovation

Further readings: IS7-6



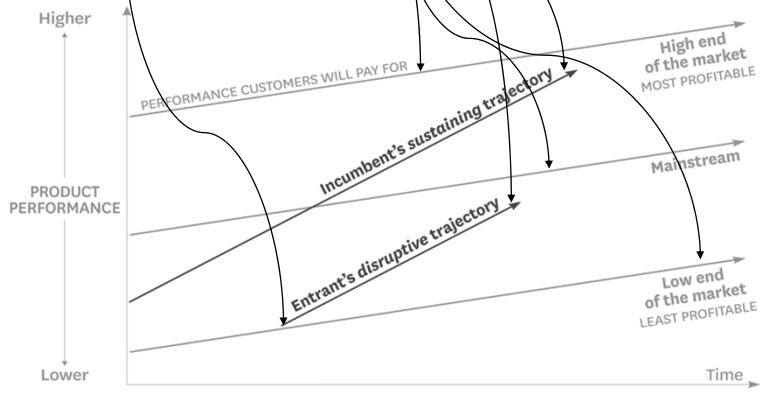


## What is Disruptive Innovation?

- In business theory, a **disruptive innovation** is an **innovation** that creates a new market and value network and eventually disrupts an existing market and value network, displacing established market-leading firms, products, and alliances. The term was defined and first analyzed by the American scholar Clayton M. Christensen.

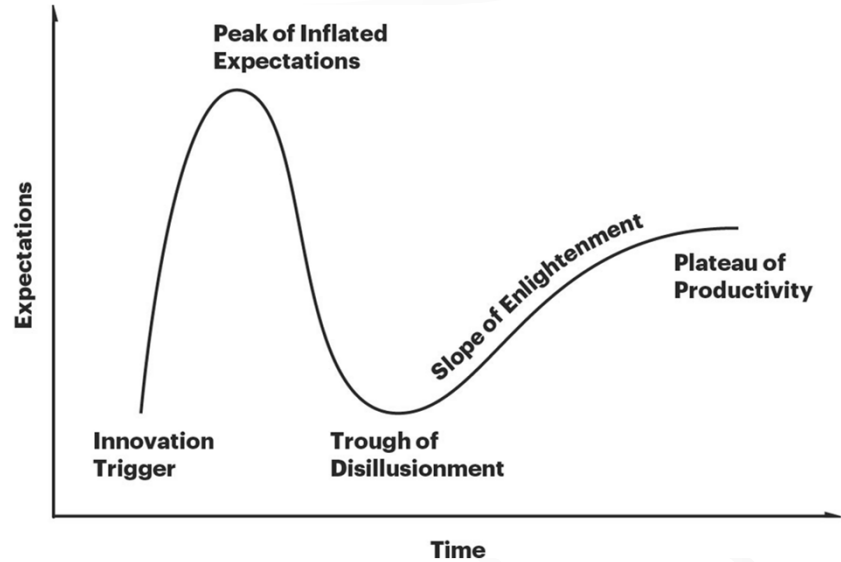
### The Disruptive Innovation Model

This diagram contrasts *product performance trajectories* (the red lines showing how products or services improve over time) with *customer demand trajectories* (the blue lines showing customers' willingness to pay for performance). As incumbent companies introduce higher-quality products or services (upper red line) to satisfy the high end of the market (where profitability is highest), they overshoot the needs of low-end customers and many mainstream customers. This leaves an opening for entrants to find footholds in the less-profitable segments that incumbents are neglecting. Entrants on a disruptive trajectory (lower red line) improve the performance of their offerings and move upmarket (where profitability is highest for them, too) and challenge the dominance of the incumbents.



SOURCE CLAYTON M. CHRISTENSEN, MICHAEL RAYNOR, AND RORY MCDONALD  
 FROM "WHAT IS DISRUPTIVE INNOVATION?" DECEMBER 2015 © HBR.ORG  
[https://www.innosight.com/wp-content/uploads/2018/01/Innosight\\_HBR\\_What-is-Disruptive-Innovation.pdf](https://www.innosight.com/wp-content/uploads/2018/01/Innosight_HBR_What-is-Disruptive-Innovation.pdf)

### Gartner Hype Cycle



<https://www.gartner.com/en/research/methodologies/gartner-hype-cycle/>

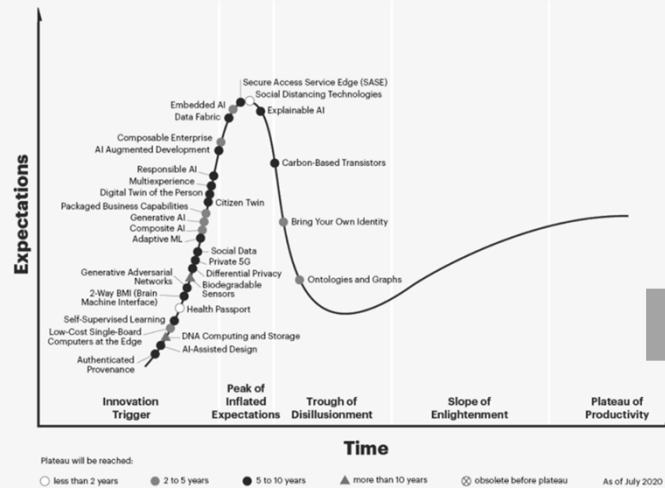
# Gartner Hype Cycle

- **Innovation Trigger:** A potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven.
- **Peak of Inflated Expectations:** Early publicity produces a number of success stories — often accompanied by scores of failures. Some companies take action; many do not.
- **Trough of Disillusionment:** Interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.
- **Slope of Enlightenment:** More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers. More enterprises fund pilots; conservative companies remain cautious.
- **Plateau of Productivity:** Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability and relevance are clearly paying off.

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## Hype Cycle for Emerging Technologies, 2020



[gartner.com/SmarterWithGartner](https://www.gartner.com/SmarterWithGartner)

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**Gartner.**

<https://www.gartner.com/smarterwithgartner/5-trends-drive-the-gartner-hype-cycle-for-emerging-technologies-2020/>

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## Objectives of Computerized Business Functions

- To store data efficiently
- To reduce the need for human record keeping
- To reduce the number of errors produced in record-keeping operations
- To assist management in decision-making
- To provide government with detailed reports

