Operations & Supply Chain Management

Prof. Tarun Sharma

Introduction

Learning Objectives

- Define
  - Operations Management & Supply Chain
- Identify
  - Similarities & Differences across Products and Services
  - Functional areas of organization and their inter relation
  - A typical ***archetype*** of a business organization
- Explain & Summarize
  - Importance of learning O&SCM
  - Aspects of process management
  - Current issues
  - Need to manage

Background

- What are (business) organizations?

  Productive activity = F(Land, labour, capital, entrepreneurship)

  Group of people working towards a goal

- Why do they exist?

- Are all business organizations the same?

- What is a good business organization?
  - Revenue, Profit
  - Customer Satisfaction
  - Quality

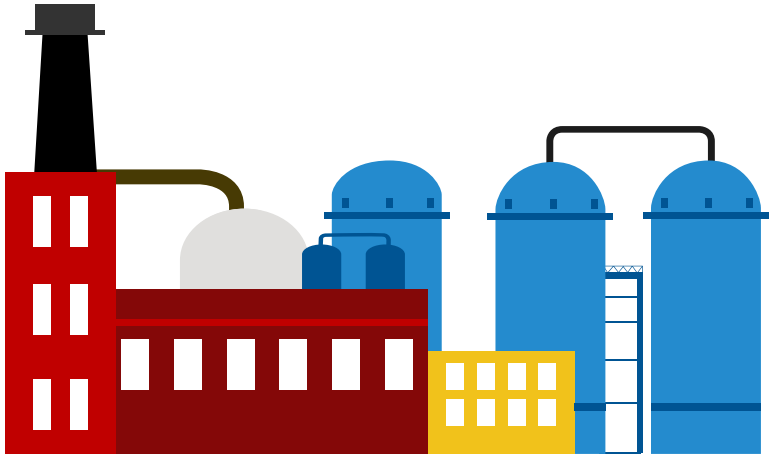
One of the fundamental problems:

- Demand and supply
  - Are not collocated in space
  - Are not coincidental in time

In resolving this problem:

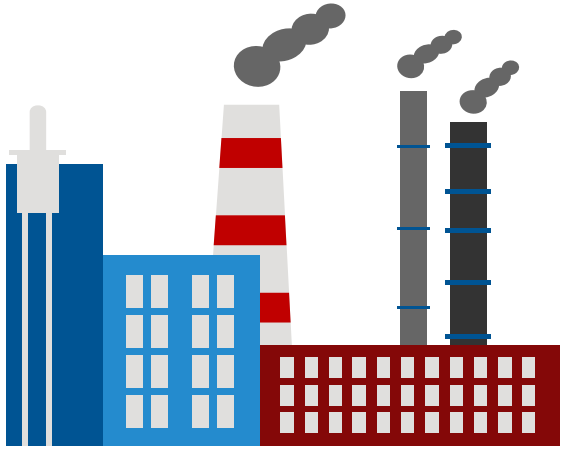
- Anticipate demand
- Control and manage a network of suppliers, production & storage facilities, inbound and outbound logistics
- For each of these decisions
  - Enumerate alternatives
  - Deal with Uncertainty
  - Assessment
  - Mapping of processes
  - Management & Control structures

Production

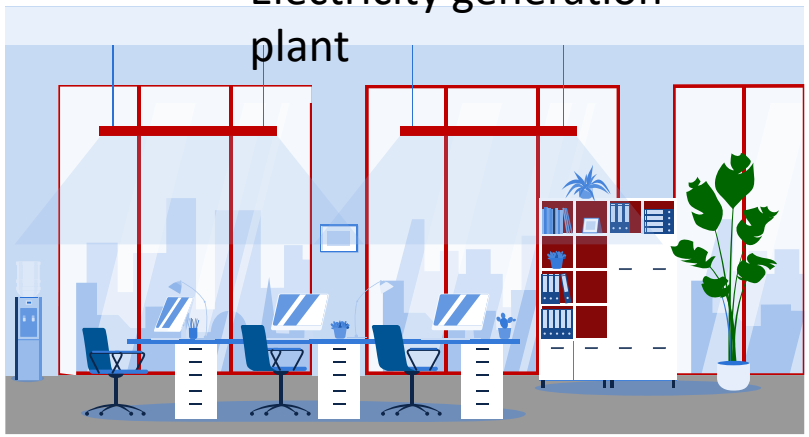


Dairy processing unit

Agriculture



Electricity generation plant



Office of an IT company

Characterizing a production activity

- Product vs service
  - Labour intensity
- Sectors:
  - Manufacturing
  - Agriculture
  - Service
- Some mix of factor inputs:
  - Capital intensive (Small scale vs Large scale)
  - Market structure
  - Demand location (Closer to source/Far away)
  - Availability of input resources,
  - Raw materials (availability, ownership)
  - Labour intensity
- Compliance, Confidentiality
- Innovative
- Marketing
  - advertisements

Capital Intensity -
This pertains to the degree to which production processes rely on capital, such as machinery, equipment, and technology. High capital intensity means that production heavily depends on physical assets, whereas low capital intensity indicates a greater reliance on human labor.

Labour Intensity -
This refers to the degree or level of human labor required in the production process. A high labor intensity indicates that a significant amount of human effort is involved in production, while low labor intensity suggests minimal human labor is needed.

Decision problems in organizing production

- Locate/Site
  - Closer to the raw materials or closer to markets
  - Environment
  - Laws and regulations: Fintech/regulatory sandboxes
  - Cost of factor inputs: Cost of labour
- Capacity
- Layout
- Technology choices
- Scheduling
- Financing
- Forecasting
  - Demand
  - Raw material/ Resources
- Quality
- Price determination
- Marketing
- Operations
  - Scheduling
  - Inventory
- Aggregate production planning

One of the fundamental problems:

- Demand and supply — this is the fundamental problem in O&SCM
  - Are not collocated in space
  - Are not coincidental in time

In resolving this problem:

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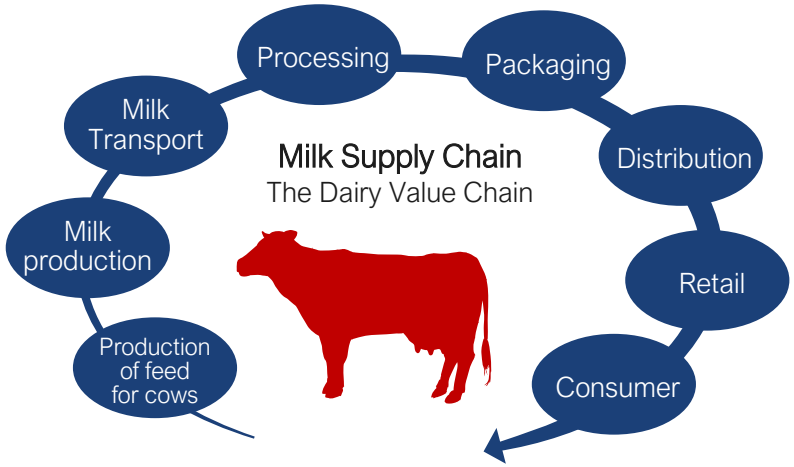
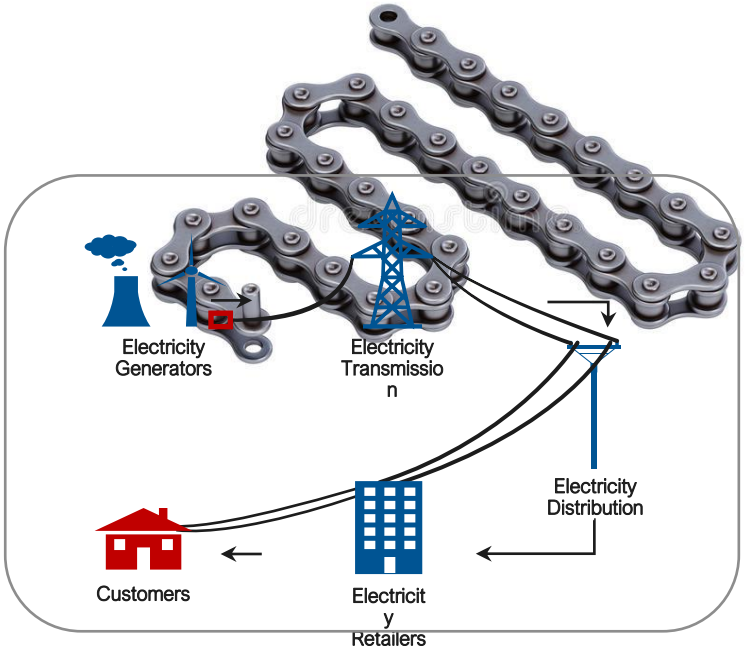
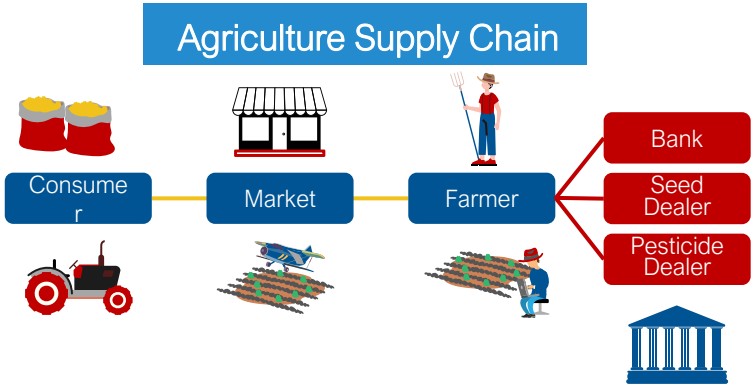
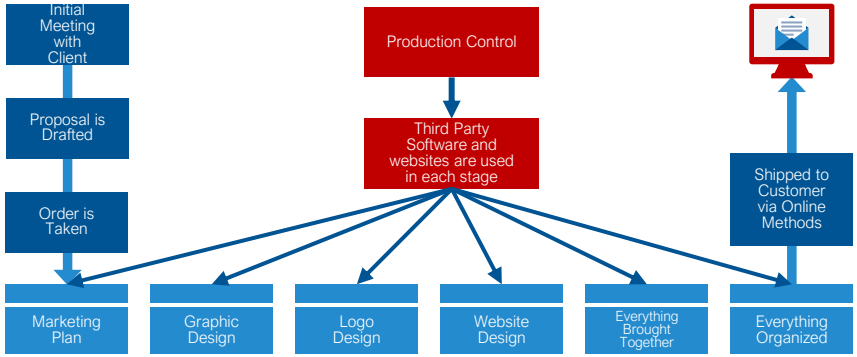
Supply Chain





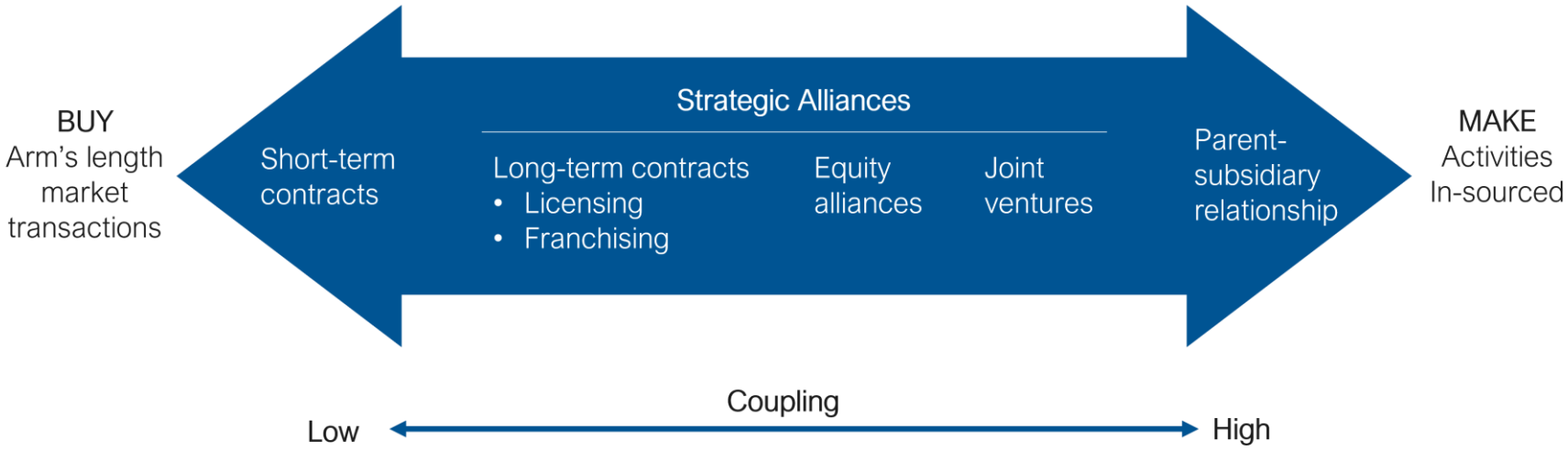




Observations

- Supply chains are usually organized into segments
  - Raw material supplier
  - Manufacturer/Producer
  - Wholesaler
  - Retailer
  - Inbound/Outbound logistics providers
- Different segments can be spread across vast regions.
- Each segment can have many business organizations.
- Strength of Coupling/Transaction (linkage) between organizations across different segments of supply chain varies.

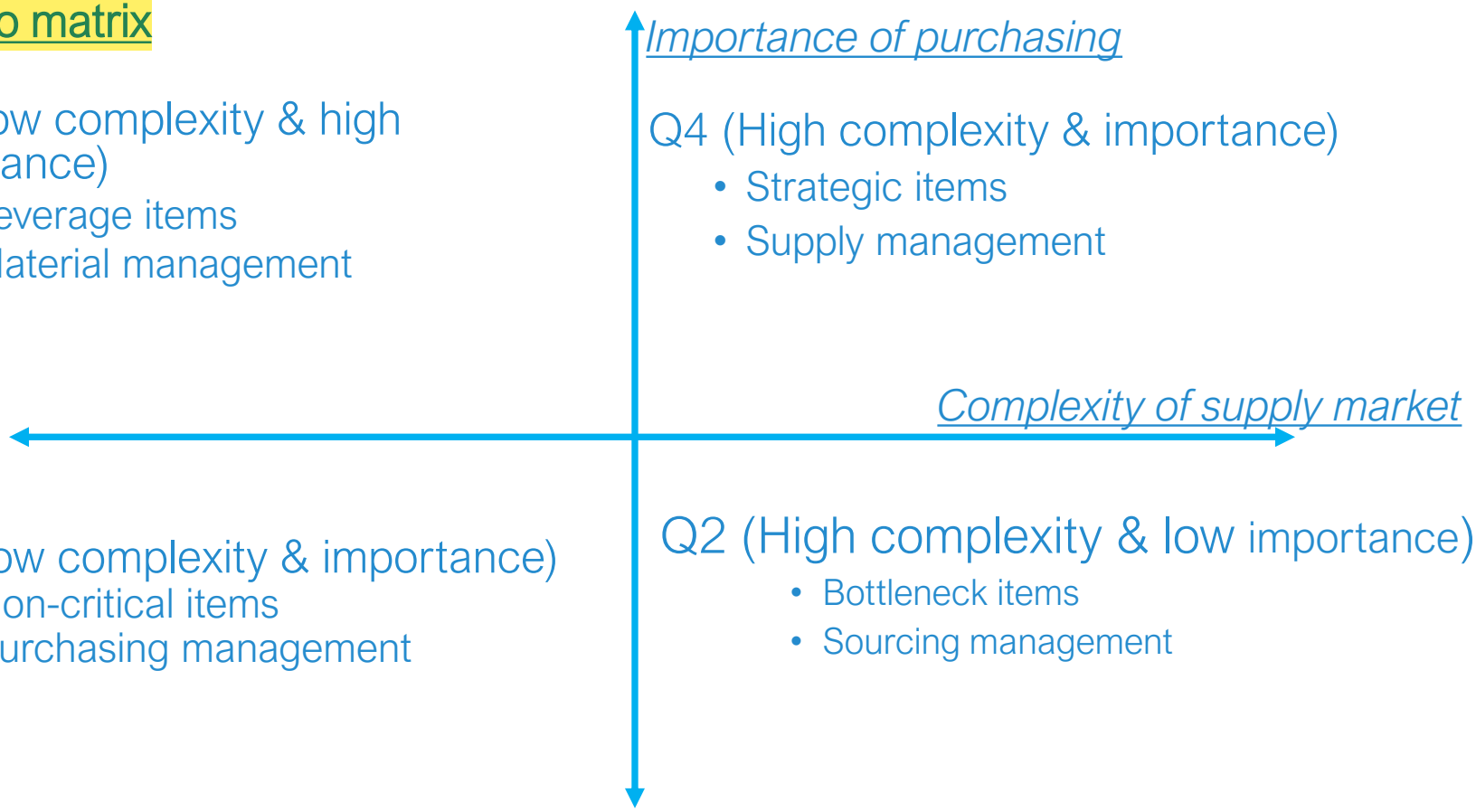
Coupling amongst organizations across different segments of a supply chain



- Organizations in different segments of the supply chain can be coupled tightly or loosely.
- Question: What determines the nature of coupling/transaction?

Evaluating potential suppliers=> Nature of coupling

Portfolio matrix



Q3 (Low complexity & high importance)
- Leverage items
- Material management

Q4 (High complexity & importance)
- Strategic items
- Supply management

Q1 (Low complexity & importance)
- Non-critical items
- Purchasing management

Q2 (High complexity & low importance)
- Bottleneck items
- Sourcing management

Characterizing supply chains

- How many **segments** are there in the supply chain?
- How many **organizations** are present in any segment of the supply chain?
- How tightly **coupled** are the organizations in the different segments of the supply chain?
- A desirable supply chain is:
  - Efficient
  - Responsive
  - Traceable
  - Resilient
  - Sustainable
  - Agile & Flexible

  - Nike has a manufacturing network consisting of over **780 factories** in **50 countries** and **57 distribution centers** that feed **140,000 retail outlets**.
  - Adidas has over **800 total suppliers** and its shoes are made at over **100 manufacturing facilities** worldwide.
  - https://www.gartner.com/en/newsroom/press-releases/2023-05-24-gartner-announces-rankings-of-the-2023-global-supply-chain-top-25

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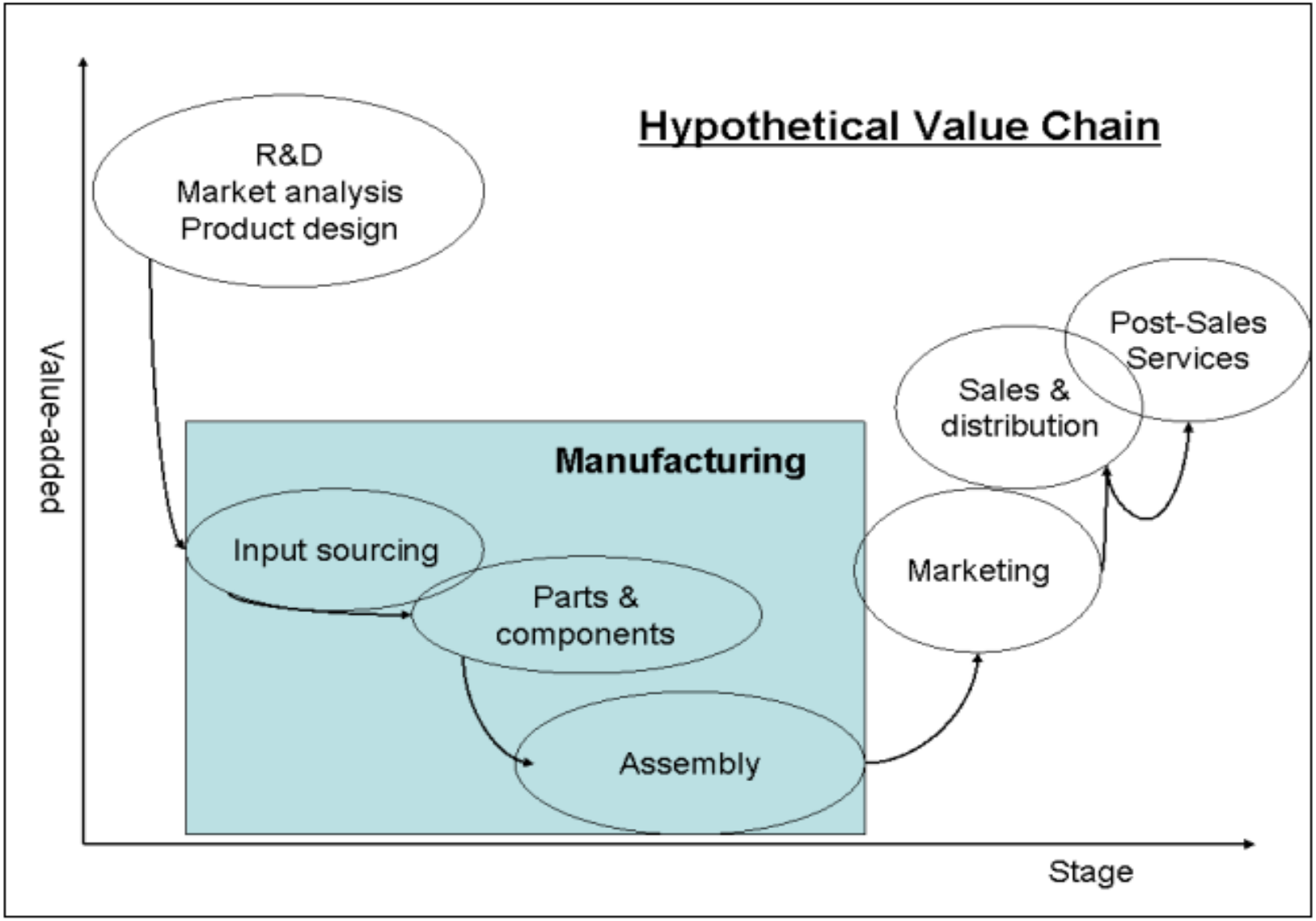
Questions

Value accrual:
Value of the
(Output – Input)

Which segment is doing the most value addition/accrual?



Value addition in Global Supply Chains

Lessons

- Some activities in the supply/value chain add more value than the other.
- Organizations engaged in high value addition activities can lead and command the entire/substantial parts of the supply chain.
- A new entrant organization - if capable - would like to enter and occupy the high value adding part of the supply chain.
- The relative position of organizations in a supply chain depends on:
  - Competition
  - Technical know how
  - Barriers to entry

Decision problems in Supply Management

- Any single organization/agent in the supply chain makes procurement decisions:
  - What to **buy** and what to **make**?
  - In what quantity?
  - From whom?
  - At what price?
  - In what condition?

General Nature of decisions problems

- Number of alternatives is large
- Uncertainty
- Constraints on the availability of resources

Other things to deal with:

- Market Competition
- Technology advancement
- Consumer sophistication
- Legal aspects

Operation and Supply Chain Management

Introduction to O&SCM

Topic: History of Purchasing

Question: Can supply management be a source of competitive advantage?

Assertion

- Supply Chain Management can be a source competitive advantage.

History of Purchasing

- Before 19th Century: Procurement mostly not a different department
- Early 19th Century: Considered a clerical job
- WW I & II: Became a critical function to ensure continuity of operations
- 1950-70: Gained importance, MRP introduced, Procurement tended towards a strategic activity
- 1970: Oil embargo and shortages of critical materials shifted the focus to purchasing

History of Supply Management

- 1980: **Quality** of suppliers; **Dependability**; **Inventory control**; JIT; SM became cornerstone of competitive advantage

- 1990: Enhanced value proposition of SM; Evolution of SM into **Strategic sourcing**; Supplier relationship building and relationship management

- 2000: Low cost country sourcing; ERP; Data mining; Benchmarking

Relationship of Supply Management with other functions

- Purchasing and Engineering/Manufacturing
- Purchasing and Marketing
- Purchasing and Finance
- Purchasing and Logistics
- Purchasing and Legal
- Purchasing and Risk Management
  - Financial Risks
  - Reputational Risk
  - Operational Risk

Operations and Supply Chain Management

Introduction to O&SCM

Topic: Supply Management

Types of purchases

- Raw materials
- Semi-finished products and components
- Finished products
- Maintenance, repair and operating items
- Production support items
- Services
- Capital equipment
- Transportation and third party purchasing

Goals

- Supply continuity
- Efficiency and effectiveness in sourcing
- Supply base management
- Develop aligned goals with internal stakeholders
- Develop integrated purchasing strategies that support organizational goals and objectives

Strategic sourcing process

- Discover potential suppliers
- Evaluate potential suppliers
- Select suppliers
- Develop suppliers
- Manage supplier relationships

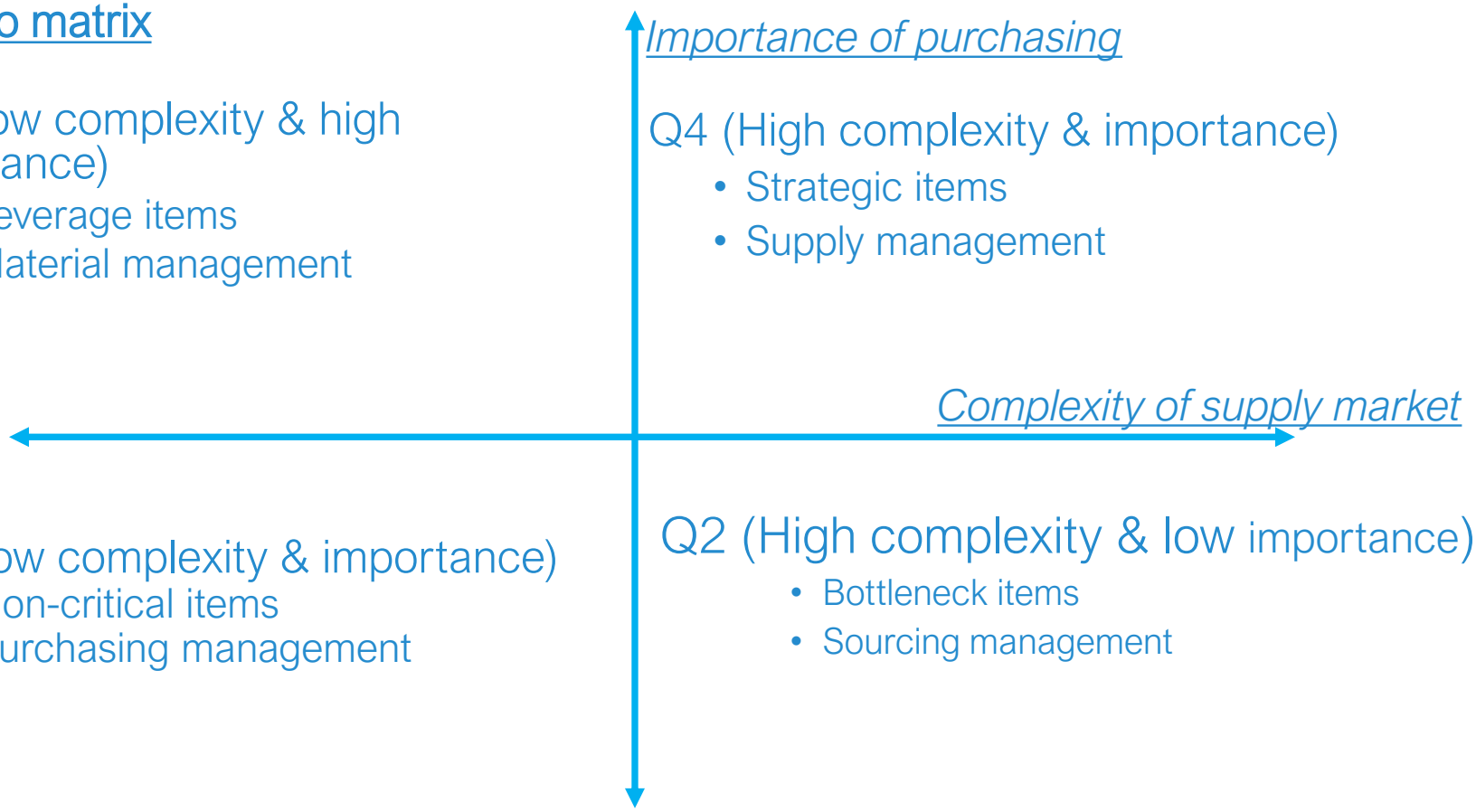
Discovering potential suppliers

- Supplier websites
- Supplier catalogues
- Trade registers and directories
- Trade journals
- Phone directories
- Sales personnel
- Trade shows

- Company policy on single vs. multiple sourcing
- Company policy and buyers share of supplier's capacity
- Company policy and ESG

Evaluating potential suppliers=> Nature of coupling

Portfolio matrix



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Evaluating Potential suppliers

- Supplier surveys
- Financial condition analysis
- Third-party evaluators
- Evaluation conference
- Facility visits
- Quality capability analysis

Supplier selection

- Bidding (Reverse auctions)
- Negotiation

Developing and managing Suppliers

- Performance metrics
- Growth plans
- Design capabilities
- Future production capacity

Roles of purchasing

Strategic

- Spend analysis
- Demand Management & Specifications
- Category management
- Contract management
- Cost management
- Managing and improving Procure to Pay process
- Supplier relationship management
- Establishing a supply management strategy

Tactical

- Supplier identification/Evaluation/Selection
- Forecast and plan requirements
- Needs clarification: Requisitioning
- Purchase requisitions
- Review forecasts and customer orders
- Establish a reorder point system
- Stock checks

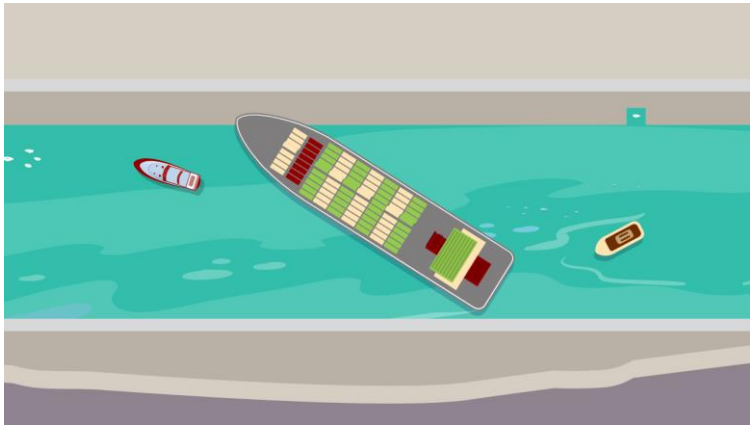
Operations and Supply Chain Management

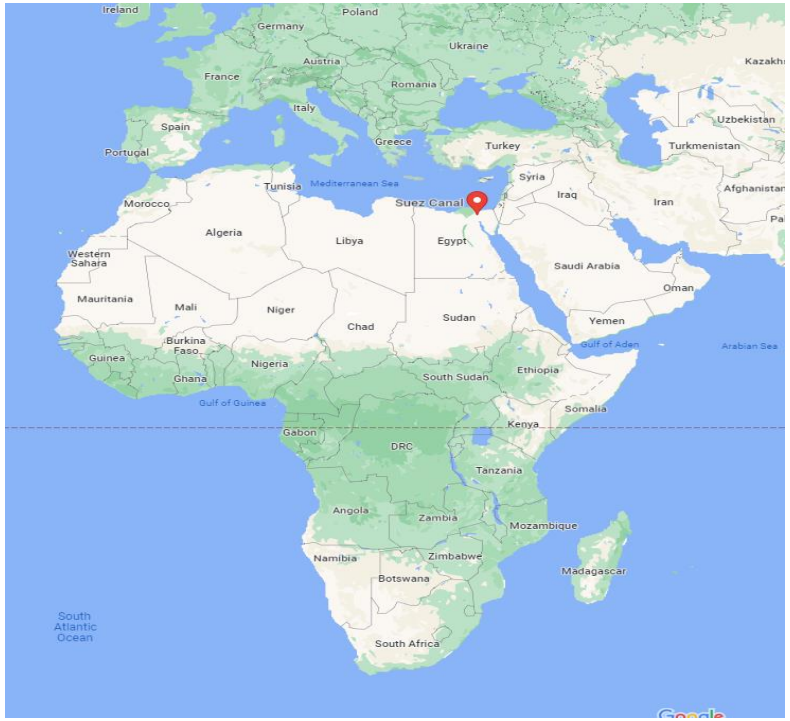
Intro to O&SCM

Topic: Supply Chain Anecdotes

Suez Canal Blockade

- For six days in March 2021
- More than 10 percent of global trade passes every year





Source: Google Maps

Accumulation of Ships

https://www.esa.int/ESA_Multimedia/Images/2021/03/Suez_Canal_traffic_jam_seen_from_space

Implications of the Blockade

- Hike in shipping rates
- Curtailment of key manufacturing supplies
- Delay in outgoing shipments
- Increased fuel prices

Chip Shortage

- Large number of products across an increasing number of industries depend on chips
  - New demand from additional sectors
- Complaints of shortage from several companies
- Why the shortage?

Chip Shortage

Causes

- Technology development (5G)
- Geopolitical considerations (trade wars, protectionism, economic recession)
- Extreme natural events in Japan and Texas
- Cost of shipping and freight increased tenfold
- Shortage of labor at ports
- Capacity expansion is expensive (capital intensive) and requires a trained workforce

Consequence

- Rebalancing of demand and supply will take years

Demand During Pandemic

Demand Surge

- Toilet papers
- Sanitizers
- Oxygen cylinders
- Concentrators
- Medicines

Demand Contraction

- Airlines
- Electricity
- Petroleum

Retailing Practices

	Company A	Company B
Retailer's margin	Low	High
Unsold stock	Retailer's responsibility	Taken back by company
Expired stock/out of trend	Retailer's responsibility	Taken back by company

Who do the practices favor?

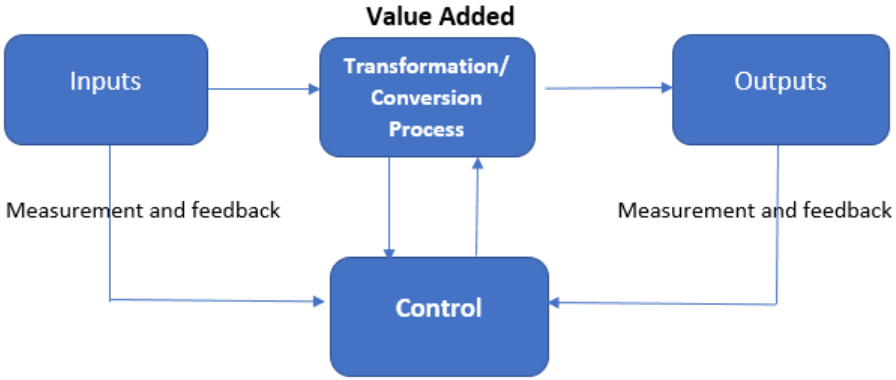
Which is the best practice?

Operations and Supply Chain Management

Introduction to O&SCM

Topic: Process Taxonomies

Operations/Processes



Types of operations:

- Physical
- Chemical
- Physiological
- Transactional

Process taxonomies

- Upper management
- Operational
- Supporting

- Plan
- Source
- Make
- Supply
- Conversion
- Distribution

Supply & Demand

Interfaces across functions

Finance:

- Pays workers and suppliers
- Performs cost analysis
- Approves capital investment
- Communicates requirements of shareholders and financial markets

- Operations:
  - Production and inventory data (Product and service availability, lead time estimates, order status, delivery schedules)
  - Capital budgeting requests
  - Capacity expansion and technology plans

- Marketing:
  - Sales forecasts
  - Customer orders
  - Customer feedback on promotions and product development

Process variation

- Varieties of offered goods or services
- Variation in demand
- Random variation
- Assignable variation

Operations and Supply Chain Management

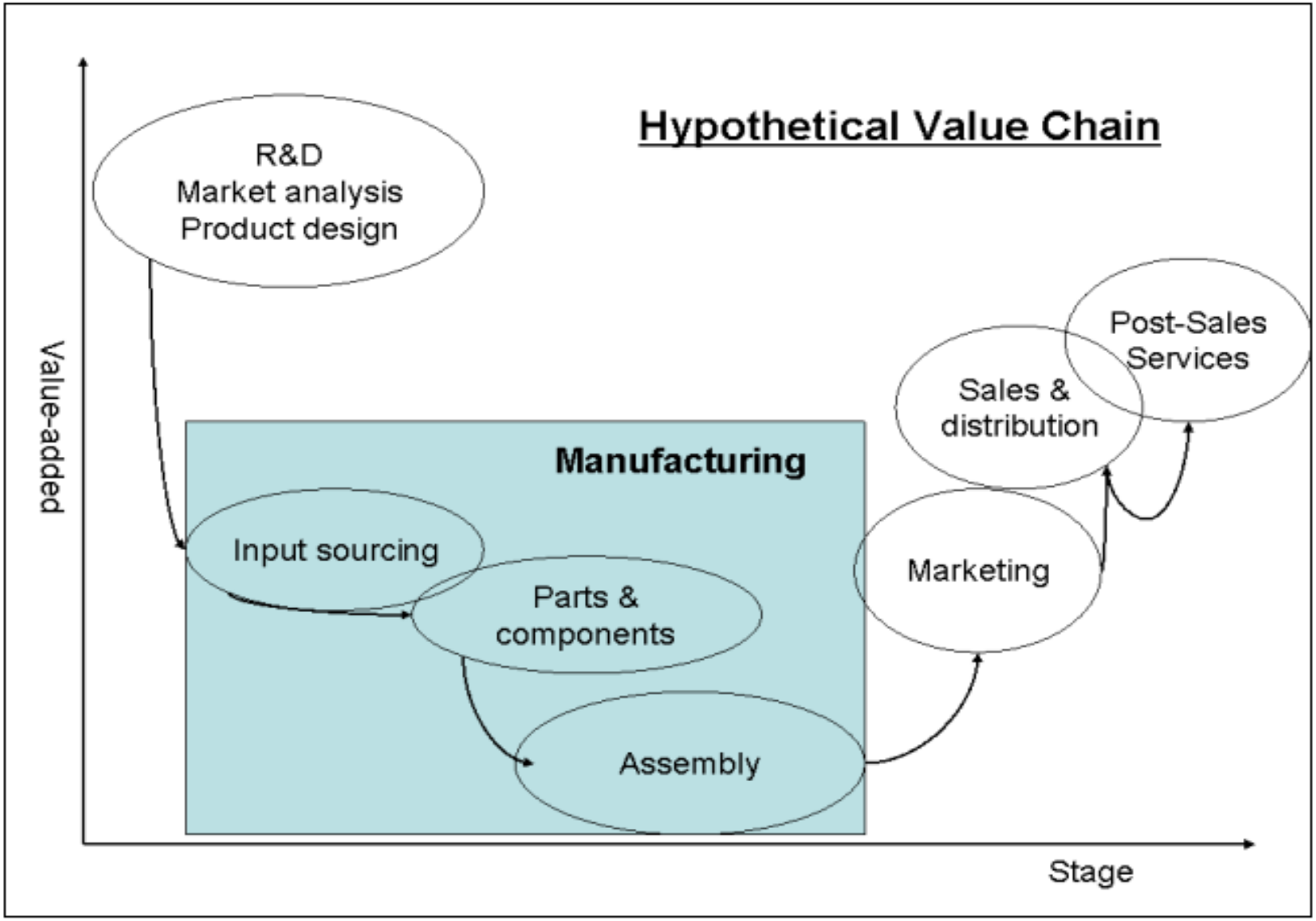
Intro to O&SCM

Topic: Middle Income Trap and the Supply Chain

Middle income trap

- A country's inability to continue the process of moving from low-value-added to high-value-added industries or activities in a supply chain.

- It is a situation in which a country attains a certain income (Medium income countries) and gets stuck there.



Value addition in Global Supply Chains

Box 1. Buyer-supplier relational linkage strength of global supply chains

	(Weak) Market-based arm's length relationship	"Sticky" relationship	(Strong) Vertical integration
Ownership structure	Lead firm (buyer) does not own any of the suppliers	Lead firm (buyer) maintain some degree of relational linkage with suppliers	Lead firm (maker) directly or indirectly owns suppliers
Industry characteristics	Low-tech requirement, labour-intensive, low design specification economy of scale	Low-tech requirement, labour-intensive, high design specification economy of scope	High-tech requirement and design specification, labour intensive or capital-intensive economy of scale and scope
Product sectors	Consumer non-durables	Consumer non-durables	Consumer durables
Product characteristics	Standard, non-differentiated products (e.g. standard apparel, electronics, toys) long or short life cycle	Design-, process- or other requirement-specific products (e.g. designer apparel, footwear, electronics) short life cycle	Quality-sensitive (e.g. auto parts and components, assembly) long life cycle
Buyer characteristics	Mega (low-price) retailers International buyers (i.e. triangular production network)	Brand owners International buyers (i.e. triangular production network)	Makers Brand owners
Supplier location	Low-income developing countries	Low- or middle-income developing countries	Middle- or higher-income developing countries
Buyer-supplier transfer of technology	Unlikely	Likely	Necessary

Adopted from Kaplinsky (2005) and Milberg (2004).

The market-based arm's length buyer-supplier linkage is common in industries whose manufacturing requires low-tech, labour-intensive standard technique and where products are standardized. As production and process requirements increase, or as final products become more differentiated, buyers' or the lead firms' chain management needs increase as well, thus the buyer-supplier linkage tends to become stronger. In general, the trend observed is that there are more low-income countries among low-cost suppliers of non-differentiated products and higher- to middle-income developing countries among suppliers of more differentiated products.

Lessons

- The market-based arms-length buyer-supplier linkage is common in industries whose manufacturing requires low-tech, labor-intensive, standard technique and where products are standardized.

- As product and process requirements increase or as products become more differentiated, buyer or lead firm's chain management needs increase as well, and the linkages tend to become stronger.

- In general, the trend observed is that: there are more low-income countries among low-cost suppliers of non-differentiated products, and middle to higher-income developing countries among suppliers of more differentiated products.

Foundations of Supply Chain Management – Week 2

Prof. Tarun Sharma

Evolution of operations and supply chain management

From artisans and craftsman to Industry 4.0

Topic : History of O&SCM

Process evolution

Demands on processes

- Efficiency
- Effectiveness
- Minimum variance

- Existing processes
  - Incremental
  - Disruptive
- New processes

Evolution of Production Paradigms

Period	Concepts/Events	Contributor
1750 - 1800	Harnessing Steam	James Watt
	Division of Labor	Adam Smith
	Interchangeable parts	Eli Whitney
Early 20th Century	Scientific Management	Taylor
	Time and Motion Studies	Gilbreth
	Scheduling charts	Henry Gantt
	Assembly line	Henry Ford
Mid 20th Century	Operations research	OR groups
	Linear Programming	Dantzig
	MRP, CIM	IBM and others

Evolution of Production Paradigms

Period	Concepts/Events	Contributor
1970-1990	JIT	Toyota
	Quality Management	Deming, Juran
	Six Sigma	Motorola, GE
Late 20th Century	IT, Internet, ERP, SCM	ARPANET, ORACLE, Dell
	E commerce	Amazon, Yahoo
	Outsourcing, Global supply chains	China, India, SEZs, Emerging Economies
	Assembly line	Henry Ford
21st Century	Sustainability, Climate change, Circular Economy, Green Products	Numerous companies, National governments, COP, IPCC
	CSR, UN Global Compact	
	Industry 4.0, CPS	

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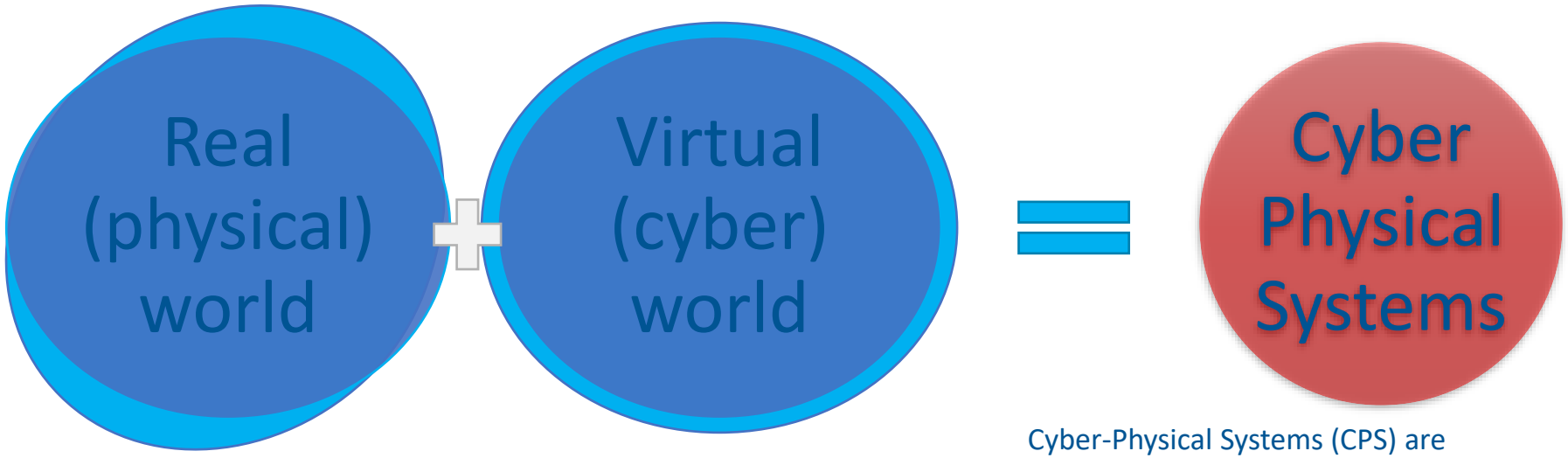
Evolution of operations and supply chain management

From artisans and craftsman to Industry 4.0

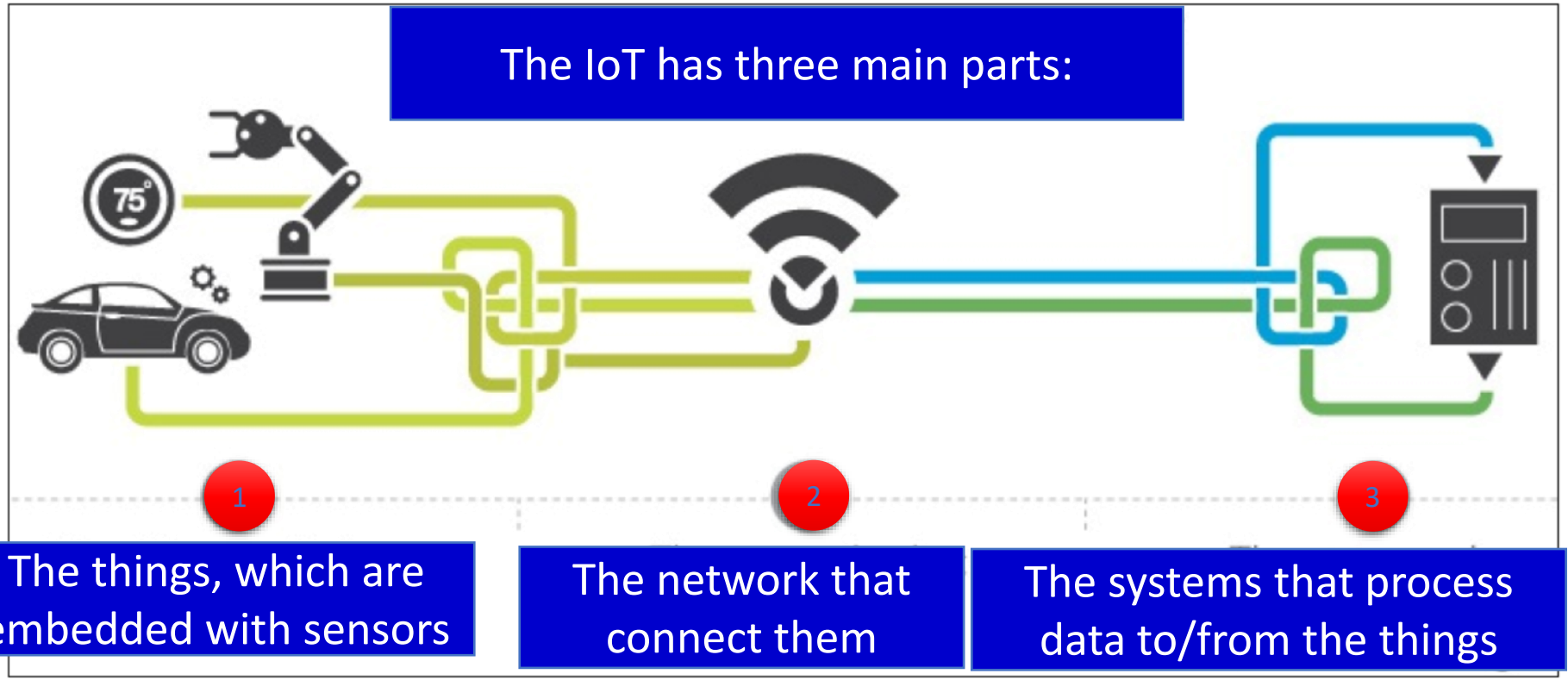
Topic : Contemporary trends in O&SCM

Industry 4.0- Cyber Physical Systems



Cyber-Physical Systems (CPS) are integrations of computation with physical processes.

What is the “Internet of Things“?



https://www.linkedin.com/pulse/internet-things-iot-dummies-rajat-kochhar

Operations and Supply Chain Management

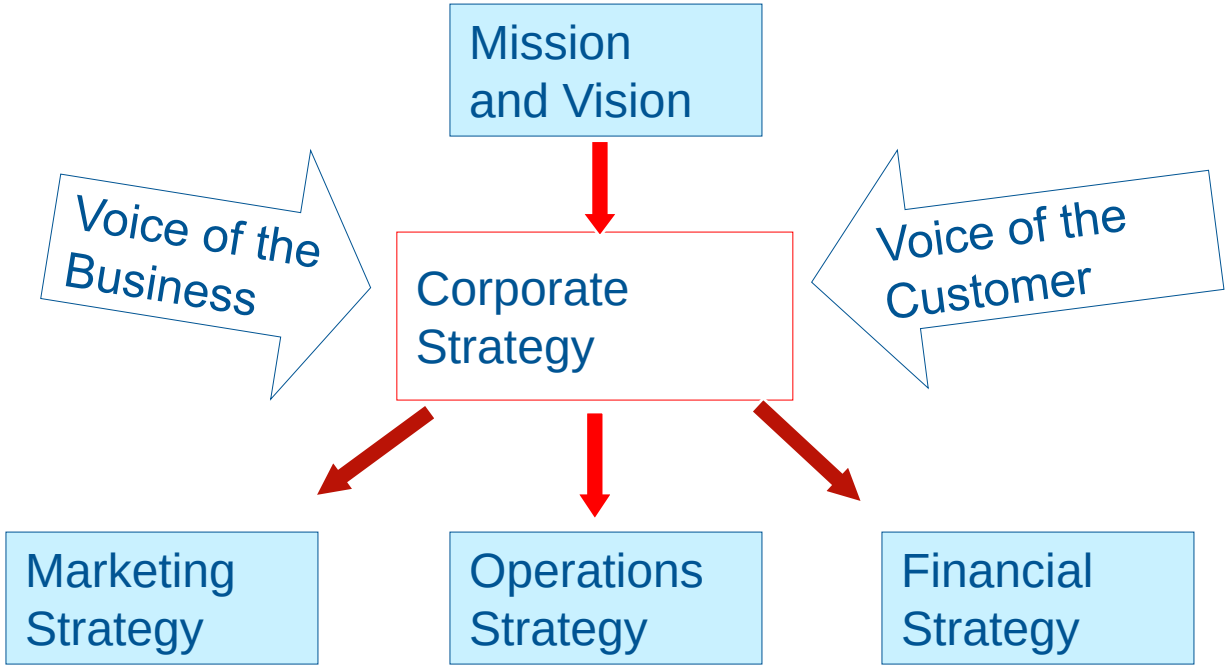
Intro to O&SCM

Topic: Strategy formulation

Strategy Formulation

1. Defining a primary task
   - What is the firm in the business of doing?
2. Assessing core competencies
   - What does the firm do better than anyone else?
3. Determining order winners and order qualifiers
   - What qualifies an item to be considered for purchase?
   - What wins the order?
4. Positioning the firm
   - How will the firm compete?
5. Deploying the strategy

Strategic Planning



IIT Roorkee

Vision

To attain global level of excellence in education and to create a sustainable and equitable society through innovative research in science and technology.

Mission

To create an environment that shall foster the growth of intellectually capable, innovative and entrepreneurial professionals, who shall contribute to the growth of Science and Technology in partnership with industry and develop and harness it for the welfare of the nation and mankind.

NTPC

Vision

To Be The World's Leading Power Company, Energizing India's Growth.

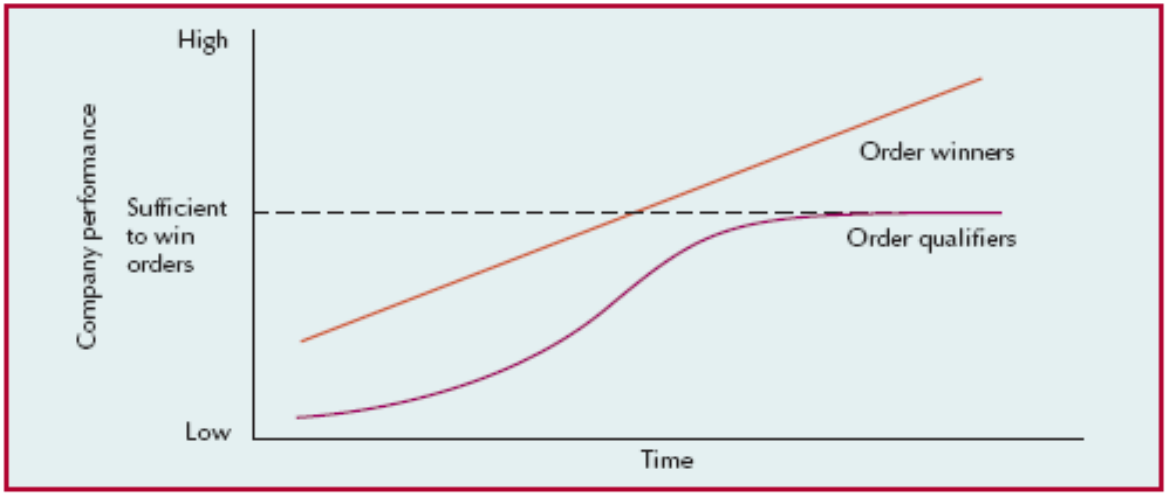
Mission

Provide Reliable Power and Related Solutions in an Economical, Efficient and Environment Friendly Manner, Driven by Innovation and Agility.

Flying Geese Illustration

- The formation provides additional lift and reduces air resistance
- Drop out is hard
- Rotate leadership
- Honk at each other
- Help each other

Order Winners and Order Qualifiers



Source: Adapted from Nigel Slack, Stuart Chambers, Robert Johnston, and Alan Betts, *Operations and Process Management*, Prentice Hall, 2006, p. 47

Operations and Supply Chain Management

Intro to O&SCM

Topic: Positioning the firm

Positioning the Firm

- Cost
- Speed
- Quality
- Flexibility

Positioning the Firm: Cost

- Waste elimination
  - relentlessly pursuing the removal of all waste
- Examination of cost structure
  - looking at the entire cost structure for reduction potential
- Lean production
  - providing low costs through disciplined operations

Positioning the Firm: Speed

- Fast moves, Fast adaptations, Tight linkages
- Internet
  - Customers expect immediate responses
- Service organizations
  - always competed on speed (McDonald's, LensCrafters, and Federal Express)
- Manufacturers
  - time-based competition: build-to-order production and efficient supply chains
- Fashion industry
  - two-week design-to-rack lead time of Spanish retailer, Zara

Positioning the Firm: Flexibility

- Ability to adjust to changes in product mix, production volume, or design
- Mass customization
  - mass production of customized parts
- National Bicycle Industrial Company
  - offers 11,231,862 variations
  - delivers within two weeks at costs only 10% above standard models

Competing on Innovation

Questions

- Why is it difficult to match supply and demand?
- How do firms position themselves?
- What goes into making a strategic plan for an organization?
- What is the difference between order qualifiers, order winners and core competencies?

Operations and Supply Chain Management

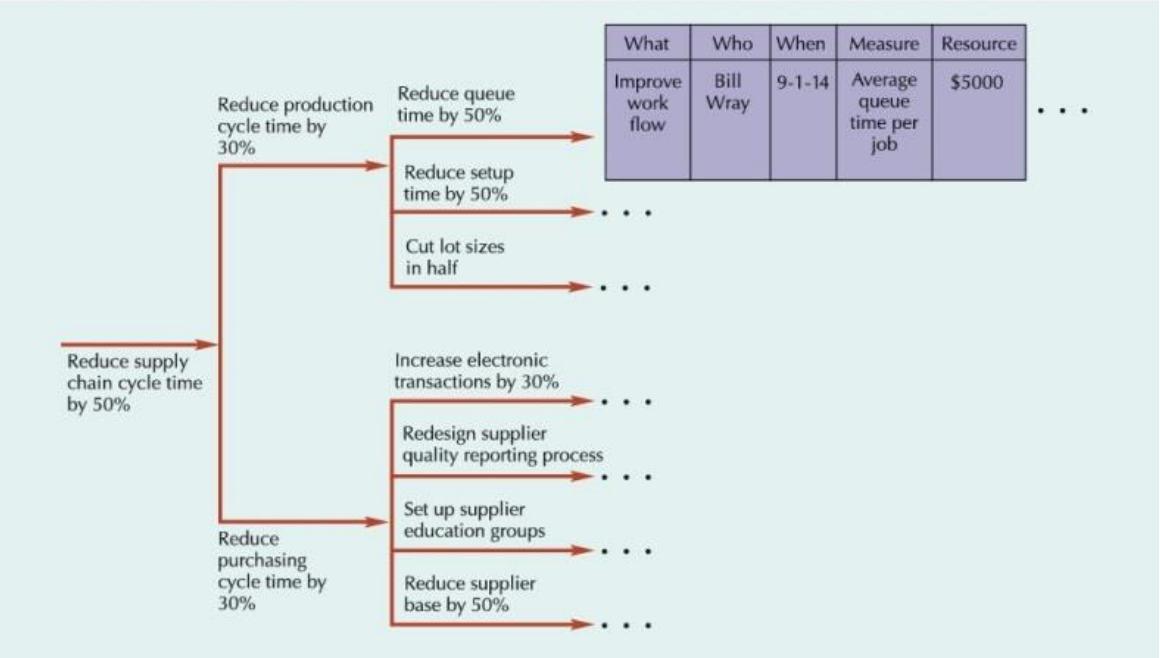
Introduction to O&SCM

Topic: Policy deployment

Policy Deployment

- Policy deployment
  - translates corporate strategy into measurable objectives
- Hoshins
  - action plans generated from the policy deployment process

Policy Deployment



Derivation of an Action Plan Using Policy Deployment

Operations and Supply Chain Management

Intro to O&SCM

Topic: Assessment and Navigation

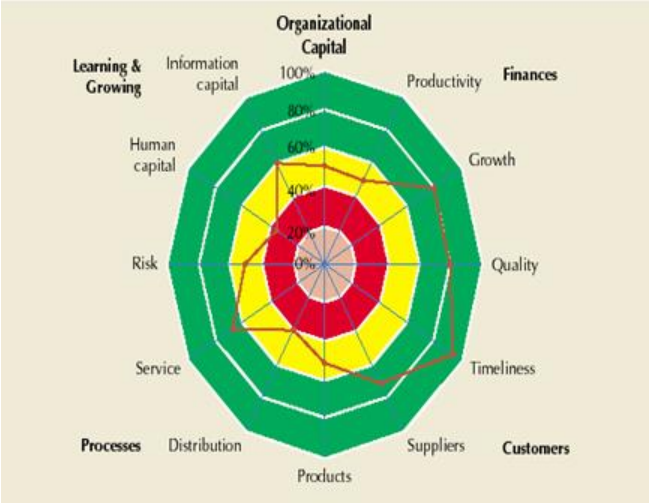
Is the organization performing well?

What makes for a good business organization?

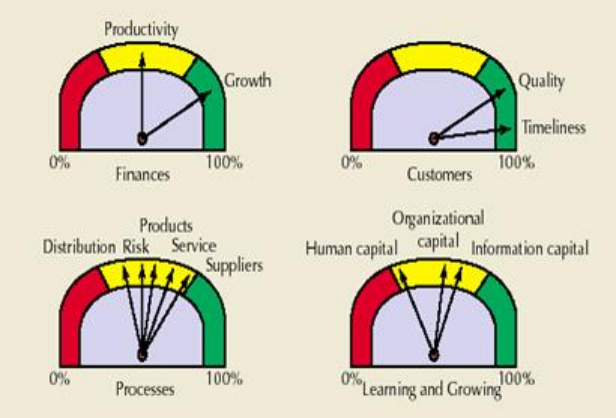
Assessing an organization

- Balanced scorecard
  - measuring more than financial performance
    - finances
    - customers
    - processes
    - learning and growing
- Key performance indicators
  - set of measures to help managers evaluate performance in critical areas

Balanced Scorecard

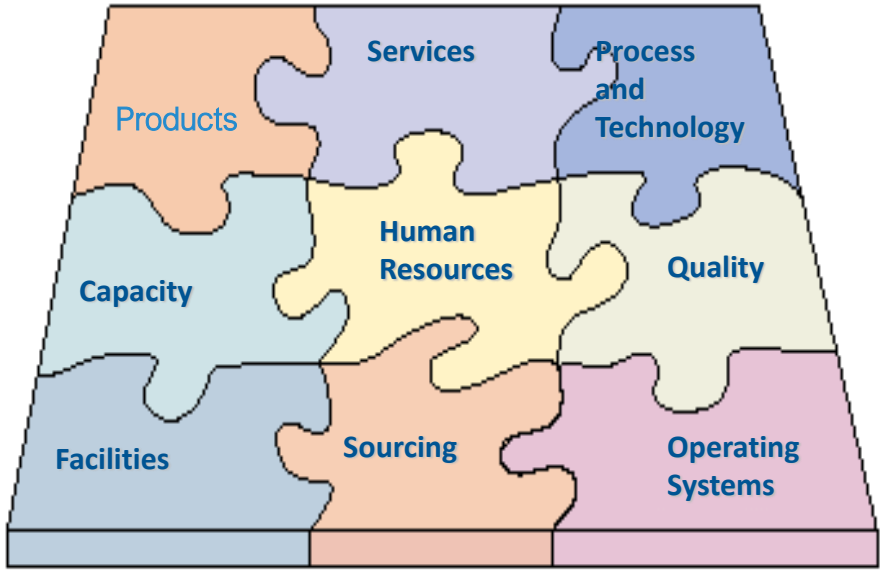


Radar Chart



Dashboard

Design/Strategy



Role of the operations manager

Role of the Operations Manager

The Operations Function consists of all activities *directly* related to producing goods or providing services.

A primary function of the operations manager is to guide the system by decision making.

- System Design Decisions
- System Operation Decisions

System Design Decisions

- **System Design**
  - Capacity
  - Facility location
  - Facility layout
  - Product and service planning
  - Acquisition and placement of equipment
- These are typically strategic decisions that
  - usually require long-term commitment of resources
  - determine parameters of system operation

System Operation Decisions

- **System Operation**
  - These are generally tactical and operational decisions
    - Management of personnel
    - Inventory management and control
    - Scheduling
    - Project management
    - Quality assurance
- Operations managers spend more time on system operation decision than any other decision area
  - **They still have a vital stake in system design**

OM Decision Making

- Most operations decisions involve many alternatives that can have quite different impacts on costs or profits
- Typical operations decisions include:
  - *What:* What resources are needed, and in what amounts?
  - *When:* When will each resource be needed? When should the work be scheduled? When should materials and other supplies be ordered?
  - *Where:* Where will the work be done?
  - *How:* How will he product or service be designed? How will the work be done? How will resources be allocated?
  - *Who:* Who will do the work?

Approach to decision making

General Approach to Decision Making

- Modeling is a key tool used by all decision makers
  - *Model* - an abstraction of reality; a simplification of something.
  - Common features of models:
    - They are simplifications of real-life phenomena
    - They omit unimportant details of the real-life systems they mimic so that attention can be focused on the most important aspects of the real-life system

Understanding Models

- Keys to successfully using a model in decision making
  - What is its purpose?
  - How is it used to generate results?
  - How are the results interpreted and used?
  - What are the model's assumptions and limitations?

Benefits of Models

1. Models are generally easier to use and less expensive than dealing with the real system
2. Require users to organize and sometimes quantify information
3. Increase understanding of the problem
4. Enable managers to analyze “What if?” questions
5. Serve as a consistent tool for evaluation and provide a standardized format for analyzing a problem
6. Enable users to bring the power of mathematics to bear on a problem

Model Limitations

- Quantitative information may be emphasized at the expense of qualitative information
- Models may be incorrectly applied and the results misinterpreted
  - This is a real risk with the widespread availability of sophisticated, computerized models are placed in the hands of uninformed users.
- The use of models does not guarantee good decisions.

Quantitative Approaches

- A decision making approach that frequently seeks to obtain a mathematically optimal solution
  - Linear programming
  - Queuing techniques
  - Inventory models
  - Project models
  - Forecasting techniques
  - Statistical models

Metrics and Trade-Offs

- Performance Metrics
  - All managers use metrics to manage and control operations
    - Profits
    - Costs
    - Quality
    - Productivity
    - Flexibility
    - Inventories
    - Schedules
    - Forecast accuracy

- Analysis of Trade-Offs
  - A trade-off is giving up one thing in return for something else
    - Carrying more inventory (an expense) in order to achieve a greater level of customer service

Systems Approach

- *System* - a set of interrelated parts that must work together
  - The business organization is a system composed of subsystems
    - marketing subsystem
    - operations subsystem
    - finance subsystem
- The systems approach
  - Emphasizes *interrelationships among subsystems*
  - Main theme is that *the whole is greater than the sum of its parts*
  - The output and objectives of the organization take precedence over those of any one subsystem

Establishing Priorities

- In nearly all cases, certain issues or items are more important than others
- Recognizing this allows managers to focus their attention to those efforts that will do the most good
  - Pareto Phenomenon - a few factors account for a high percentage of occurrence of some event(s)
    - The critical few factors should receive the highest priority
    - This is a concept that is appropriately applied to all areas and levels of management

Learning Objectives of this Course

- Gain an appreciation of strategic importance of operations and supply chain management in a global business environment
- Understand how operations relates to other business functions
- Develop a working knowledge of concepts and methods related to designing and managing operations and creating value along the supply chains
- Develop a skill set for continuous improvement