Chapter 1
Introduction to Operations Management

Operations Management

- What is operations?
  - The part of a business organization that is responsible for producing goods or services

- How can we define operations management?
  - The management of systems or processes that create goods or provide services

Goods or Services

Goods are physical items that include raw materials, parts, subassemblies, and final products.
- Automobile
- Computer
- Shampoo

Services are activities that provide some combination of time, location, form or psychological value.
- Air travel
- Education
- Legal counsel

Types of Operations

<table>
<thead>
<tr>
<th>Operations</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods Producing</td>
<td>Farming, mining, construction, manufacturing, power generation</td>
</tr>
<tr>
<td>Storage/Transportation</td>
<td>Warehousing, trucking, mail service, moving, taxis, buses, hotels, airlines</td>
</tr>
<tr>
<td>Exchange</td>
<td>Retailing, wholesaling, banking, renting, leasing, library, loans</td>
</tr>
<tr>
<td>Entertainment</td>
<td>Films, radio and television, concerts, recording</td>
</tr>
<tr>
<td>Communication</td>
<td>Newspapers, radio and television newscasts, telephone, satellites</td>
</tr>
</tbody>
</table>

The 3 basic functions of business organizations

Operations: the Transformation process

Value-Added

Feedback = measurements taken at various points in the transformation process
Supply Chain

Supply Chain – a sequence of activities and organizations involved in producing and delivering a good or service.

Fig. 1.2 A simple product supply chain

Note: the need to manage operations in the context of supply chains

Transformation: Food Processor

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Processing</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Vegetables</td>
<td>Cleaning</td>
<td>Canned vegetables</td>
</tr>
<tr>
<td>Metal Sheets</td>
<td>Making cans</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Cutting</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>Cooking</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>Packing</td>
<td></td>
</tr>
<tr>
<td>Building</td>
<td>Labeling</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
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</tbody>
</table>

Transformation: Hospital Process

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Processing</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctors, nurses</td>
<td>Examination</td>
<td>Healthy patients</td>
</tr>
<tr>
<td>Hospital</td>
<td>Surgery</td>
<td></td>
</tr>
<tr>
<td>Medical Supplies</td>
<td>Monitoring</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Medication</td>
<td></td>
</tr>
<tr>
<td>Laboratories</td>
<td>Therapy</td>
<td></td>
</tr>
</tbody>
</table>

Q. Is CSU an operation management system?

1.2 Production of Goods vs. Delivery of Services

- Production of goods – tangible output
- Delivery of services – an act
- Service job categories
  - Government
  - Wholesale/retail
  - Financial services
  - Healthcare
  - Personal services
  - Business services
  - Education

Goods-Service Continuum

Outputs are typically neither purely service nor purely goods based.

<table>
<thead>
<tr>
<th>Goods</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Songwriting</td>
<td>Software Development</td>
</tr>
<tr>
<td>Surgery, Teaching</td>
<td></td>
</tr>
<tr>
<td>Computer Repair, Restaurant Meal</td>
<td></td>
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<tr>
<td>Horse Remodeling, Retail Sales</td>
<td></td>
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<tr>
<td>Automobile Assembly, Steelmaking</td>
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</tbody>
</table>

Goods vs. Services

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Goods</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniformity of input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor content (intensity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniformity of output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement of productivity and quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity to correct quality problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can output be inventoried?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.3 Why Learn about Operations Management?

3 primary functions of business organizations overlap

- Marketing & Operations
  - Demand data
  - Product and service design
  - Competitor analysis
  - Lead time data
- Finance & Operations
  - Budgeting
  - Provision of funds
  - Economic analysis of investment proposals

1.4 Why study Operations Management?

Career Opportunities abound

- Operations manager
- Purchasing manager
- Supply chain manager
- Distribution manager
- Quality manager
- Etc.

Visit APICS, ISM, ASQ, CSCMP websites

1.5 Process Management

Managing a Process to Meet Demand

Supply > Demand
Supply < Demand
Supply = Demand

1.6 The Scope of OM

Operations Management includes:

- Forecasting (3)
- Capacity planning (5)
- Scheduling (16)
- Managing inventories (13, 15)
- Assuring quality (9, 10)
- Motivating employees
- Deciding where to locate facilities
- And more . . .
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**: product/service planning, capacity, location, layout,
- **System Operation**: quality, inventory, scheduling, supply management (purchasing/sourcing)

U.S. Manufacturing vs. Service Employment

Manufacturing vs. service employment

Manufacturing vs. Services

“Since the 1970s the US economy has been driven by consumer credit and a misguided notion of building a service economy.

-- Jeffery Immelt, CEO

The Decline in Manufacturing Employment

Productivity
- Increasing productivity allows companies to maintain or increase their output using fewer workers

Outsourcing
- Some manufacturing work has been outsourced to more productive companies (in other countries)

A Statistical Artifact
- Manufacturers are increasingly using contract and temporary labor which no longer show up in the statistics as manufacturing employment

Why Manufacturing Matters?

Myth #1: advanced economy like the U.S. no longer needs to manufacture and can thrive exclusively as a hub for high-value-added design and innovation.

Reality:
Product and process innovation are intertwined. Once manufacturing is outsourced, process-engineering expertise can’t be maintained, since it depends on daily interactions with manufacturing. e.g., Lithium-ion battery

Without the ability to develop such new processes, they can no longer develop new products.

Myth #2: the migration of mature manufacturing industries away from developed countries like the U.S. is just part of a healthy, natural process of economic evolution that allows resources to be redeployed to new, higher-potential businesses.

Reality:
Example 1: The migration of semiconductor foundries to Asia, which caused a sharp decline in silicon-processing and thin-film-deposition capabilities in the U.S., greatly reducing, if not eliminating, its chances of becoming a major player in solar panels.
Why Manufacturing Matters?

Example 2: GM Chevy Volt’s lithium-ion battery—the highest value-added component in the car—will be made by South Korea’s LG.

GM had no choice but look abroad, since rechargeable-battery manufacturing left the U.S. long ago. Why?

Most innovation in batteries in recent decades has been driven by the increasing demands of consumer electronics products for more and more power in smaller and smaller packages. When the U.S. companies largely abandoned the “mature” consumer electronics business, the locus of R&D and manufacturing—not just for the laptops, cell phones, and such but also for the batteries that power them—shifted to Asia.

"...manufacturing no longer only encompasses the work of 'making things.'

"Today, rather, the work of making things cannot be separated from the work of inventing them...and improving them...and developing the next generation of them. Companies cannot, anymore, invent a product in one country — and build it in another. Innovation and production — the lab and the plant — must be linked."

— Andrew N. Liveris, CEO

The State of U.S. Manufacturing

Fact #1: U.S. manufacturing workforce peaked at 19.5 million in 1979. It has declined about 40% since then, to 11.7 million.


Reason #1:

Reason #2:

Fact #3: After decades of decline, manufacturing jobs are returning to the U.S. (i.e., Re-Shoring)

Fact #4: The U.S. remains a global manufacturing leader, churning out 17% of the world’s goods, only slightly behind China.

Fact #5: Innovation is the key to productivity and productivity is the key to higher living standards. Three-fourths of private R&D derives from manufacturers. Goods exports account for about 65-70% of total U.S. exports.

Reasons for the Return:

1. Wages. Climbing wages in China (17% per year) makes offshoring less compelling.

2. Transportation. Rising fuel prices make global shipping less cost-effective.

3. Security. Supply chain disruptions following the 3/11/11 tsunami in Japan have companies reconsidering local or regional supply chains. Thailand flood.
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**Does America Need Manufacturing?**

**Myth:** It is a curiosity of modern life that information companies can create extraordinary social disruptions and vast shareholder wealth but relatively few jobs.

**Case:** Facebook has about 2,000 employees worldwide. Even the slimmed-down General Motors, a decidedly less valuable (?) company, has about 200,000 employees.

**Market capitalization:**

**Insights:** The 200,000 employees represents only a fraction of the people behind the production of a GM car.

“When you’re manufacturing anything, even if the work is done by robots and machines, there’s an incredible value chain involved,” Susan Hockfield, the president of M.I.T., says. “Manufacturing is simply this huge engine of job creation.”

The value chain also include scientists, contractors, suppliers, designers, engineers, and many more service employees.

By some estimates, manufacturing employs about 65% of America’s scientists and engineers.

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**Does America Need Manufacturing?**

**Government (industrial) policy debates:**

2. 1980s: assist U.S. companies in gaining ground on the Japanese in the semiconductor industry.
3. When George H. W. Bush became the president in 1988, the move away from industrial policy was clear.
4. It’s naïve to believe that we can just let the market work and we’ll have a strong manufacturing base in America.

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**Does America Need a clear Policy?**

**1.7 Key Decisions of Operations Managers**

- What
  - What resources/what amounts
- When
  - Needed/scheduled/ordered
- Where
  - Work to be done
- How
  - Designed
- Who
  - To do the work
Operations Management & Decision Making

- Models
- Quantitative approaches
- Analysis of trade-offs
- Systems approach

Systems Approach

“The whole is greater than the sum of the parts.”

Suboptimization

1.8 Historical Evolution of OM

- Industrial revolution (1770’s)
- Scientific management (1911)
- Mass production
- Interchangeable parts
- Division of labor
- Human relations movement (1920-60)
- Decision models (1915, 1960-70’s)
- Influence of Japanese manufacturers, JIT, lean

1.9 Trends in Business (Operations Today)

- Major trends
  - The Internet, e-commerce, e-business
  - Management of technology (product, process, IT, RFID, etc.)
  - Globalization or Localization?
  - Agility
  - Lean (JIT)

1.10 Key Issues for Today’s Business Operations

- Environmental Concerns
  - Sustainability: Using resources in ways that do not harm ecological systems that support human existence.
  - All areas of business have an impact on sustainability.
  - Individual choice makes a big difference too (e.g., livestock accounts for 18% of greenhouse gas emissions because non-vegetarian diet requires 2.9 times more water, 2.5 times more energy, and 13 times more fertilizer)
- Ethical Conduct
  - Meeting all economic, social, and environmental criteria (e.g., Fair Trade Certified agri-product, Forest Stewardship Council certified paper and furniture)

The need to manage the supply chain

- In the past, organizations did little to manage the supply chain beyond their own operations and immediate suppliers which led to numerous problems:
  - Oscillating inventory levels
  - Inventory stockouts
  - Late deliveries
  - Quality problems
The need for managing supply chain

- Supply Chain Management is essential to business success because of:
  - The need to improve operations
  - Increasing level of outsourcing
  - Increasing transportation cost
  - Competitive pressures (e.g., shorter product life cycle)
  - Increasing globalization length of supply chain
  - Increasing importance of e-business
  - Increased complexity of supply chains
  - The need to manage inventories

Simple Product Supply Chain

Supply Chain: A sequence of activities and organizations involved in producing and delivering a good or service.

The Bullwhip Effect: Forecasts, additions of safety stock, and their corresponding orders to suppliers become amplified as they move up to the supply chain.

Elements of Supply Chain Management

- **Customers** – what products/services do customers want (3, 4)
- **Forecasting** – predicting timing and volume of customer demand (3)
- **Design** – incorporating customer wants, manufacturability, and time to market (2, 4)
- **Capacity planning** – matching supply and demand (5, 11)
- **Processing** – controlling quality, scheduling work (9, 10, 16)

- **Inventory** – meeting demand requirements while managing costs (12, 13, 14)
- **Purchasing** – evaluating potential suppliers, supporting the needs of operations on purchased goods and services (15)
- **Suppliers** – monitoring supplier quality, on-time delivery, and flexibility; maintaining supplier relations (15)
- **Location** – determining the location of facilities (8)
- **Logistics** – deciding how to best move information and materials (15)