Understanding Operations

Operations in an Organization
Section 1, Sub-section 1.2
Operations Management

Definition

• An operations system is defined as one in which:
  – several **activities** are performed
  – to **transform a set of inputs into useful output**
  – using a **transformation process**
  – involving **multiple stakeholders**

• Operations Management is a **systematic approach** to address **all the issues** pertaining to an Operations System.
Introduction to Operations Management - I
B Mahadevan
Week 1

Customer Layer
- Ultimate Customer
- Dealers
- Retailers

Core Operations Layer
- Testing
- Assembly
- Fabrication
- Machining
- Service Delivery system

Operations Support Layer
- Marketing
- Maintenance
- Quality
- Costing
- Planning
- Tooling
- Material
- IT
- Design
- IE

Layer of Innovation
- Innovation Strategy
- Research & Development

Supplier Layer
- Sub-contractors
- Suppliers
- Other service providers

Operations Management

Issues to address...

• Do we have the **right capacity** to address the demand on hand?
• How should one look at the issues pertaining to **the supply chain**?
• Can we deploy some methods to **improve the productivity** of the processes and people in our organizations?
• How do I put a **quality assurance system** in place so that there is some predictability of the quality of products and services offered?
Understanding Operations

Alternative Configurations in Operations
(Streamlined Flow Systems)
Section 1, Sub-section 1.3
Flow Patterns in Streamlined Flow Systems
Automobile Assembly & Restaurant Examples

- Chassis
  - Parts Assembly
  - Doors Assembly
  - Painting
  - QC
  - Cars roll out

- Cash Counter
  - Delivery Counter
  - Dining Area
  - Dispose
  - Depart

100 – 200 work stations

- Continuous Flow
- Splitting work into several stages
- Low variety/high volume
- Flow Streamlined
- Work Stations
- Need to balance them
Issues in Streamlined Flow Systems

• Ensuring continuous flow
• Work/Capacity Balancing
• Importance of Maintenance Management
• Good Quality Assurance System
Understanding Operations

Alternative Configurations in Operations
(Intermittent Flow Systems)
Section 1, Sub-section 1.3
Why Intermittent Flow Systems?

• The quest for variety is leading organizations to create more versions in products and services.

• Some examples:
  – Travel agency: Adventure tourism, eco/nature tourism, personal vacations etc.
  – Number of tariffs and plans offered by mobile telephone providers or satellite based DTH entertainment services is on the increase
  – Product variations: Do it yourself products and services
  – PET bottles (industrial, medical, food grade)
Intermittent Flow System

Salient Features

- Characterized by mid-volume, mid-variety products/services
- Increases the flow complexities
- Flow and capacity balancing are difficult but important
  - Batch Processing
  - Alternative methods of work organization
- Capacity Estimation is hard
- Production Planning & Control is complex
Interruption Flow System

Sources of Problems

- Inappropriate Choice on Structure & People Issues
- Complex Material & Information Flows
- Complex Operations Planning & Control
Intermittent Flow System

Sources of Problems

- Too much Paper Work
- High Overhead/Cost
- Excess Inventory
- Poor Delivery Reliability
- Long Lead Times
- Excessive Coordination
- Enormous Supervision

Series of Problems
Intermittent Flow System
Role of Operations Management

• What happens when you try to offer these variations to the customers?
  – Delivering variety without compromising on quality and delivery schedule is a challenge.
  – Focus shifts to how we organize the operations.
Intermittent Flow System

Role of Operations Management

• Manage the offering
  – Variety Management – modular designs – delayed differentiation

• Design an appropriate Operating System
  – Divide & Rule

• Manage operations
  – Changeover from one mode to another
Understanding Operations

Alternative Configurations in Operations
(Jumbled Flow Systems)
Section 1, Sub-section 1.3
Jumbled Flows

Examples

• Construction of a flyover, the metro train network or a new airport terminal.
• Manufacturing and Assembly of Boeing or Airbus Aircraft.
• A large multi-specialty hospital located on a 10-storey building.

In these examples if we watch operations we will see a jumbled flow.
Jumbled Process Flow

Resource 1 → Resource 2
Resource 2 → Resource 3
Resource 3 → Resource 4
Resource 4 → Resource 5
Resource 5 → Resource 6
Resource 6 → Resource 7
Resource 7 → Job 1
Resource 1 → Job 2
Job 1 → Job 2
Job 2 → Job 3

Jumbled Process Flow

Issues to address

• Non-standard, complex flow patterns (Highly customized items, customer orders for one or a few)
• Very High Variety, Low volumes
• No benefits arising out of volume or scale of operations
• Large uncertainty, Too many entities involved
• Longer time span
• Difficult to dedicate resources exclusively for requirements
  – Sharing of common resources is a reality
Jumbled Process Flow
How to handle this?

• Operations Planning and Control too complex
• Needs sub-system oriented thinking
• Taking uncertainty into consideration is important
• Project Management tools and techniques are critical
Alternative Configurations in Operations

Some observations

• We have seen three different patterns of operating systems – both in manufacturing and service settings – what is it pointing to in terms of understanding operations?
  – Volume & Variety always trade off with one another
  – There is a trend towards mid-volume mid-variety situation
  – Flow is always related to the volume – variety interactions
    • High Volume – Low Variety: Continuous Flow
    • Low Volume – High Variety: Jumbled Flow
    • Mid Volume – Mid Variety: Intermittent Flow
Making Sense of Operating Systems

- Variety: High
  - Continuous Flow Systems
  - Intermittent Flow Systems
  - Jumbled Flow Systems
- Volume: High
  - Continuous Flow Systems
  - Intermittent Flow Systems
  - Jumbled Flow Systems
- Low
Complexity of Operations Management

• The Notion of variety is to be understood
  – Products, Models, Processes, Routing, Technology Choices

• Factors Affecting Operations Management Complexity
  – Volume – Variety Interactions leading to flow
  – Number of Stages in Operations
Complexity of Operations Management

<table>
<thead>
<tr>
<th>Type of Flow</th>
<th>Continuous Flow</th>
<th>Intermittent Flow</th>
<th>Jumbled Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Stages</td>
<td>Few</td>
<td>Some</td>
<td>Many</td>
</tr>
<tr>
<td>Complexity</td>
<td>Less Complex</td>
<td>More Complex</td>
<td>Less Complex</td>
</tr>
</tbody>
</table>
Complexity of Operations Management

<table>
<thead>
<tr>
<th>Type of Flow</th>
<th>No. of Stages</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Flow</td>
<td>Many</td>
<td>Petro-chemicals</td>
</tr>
<tr>
<td></td>
<td>Some</td>
<td>Automobile</td>
</tr>
<tr>
<td></td>
<td>Few</td>
<td>Fast Food</td>
</tr>
<tr>
<td>Intermittent Flow</td>
<td>Many</td>
<td>Multi-specialty Hospital</td>
</tr>
<tr>
<td></td>
<td>Some</td>
<td>Computer</td>
</tr>
<tr>
<td></td>
<td>Few</td>
<td>Restaurant</td>
</tr>
<tr>
<td>Jumbled Flow</td>
<td>Many</td>
<td>Eye Hospital</td>
</tr>
<tr>
<td></td>
<td>Some</td>
<td>Full fare Airline</td>
</tr>
<tr>
<td></td>
<td>Few</td>
<td>Garments</td>
</tr>
</tbody>
</table>
Understanding Operations

Performance Measures for Operations

Section 1, Sub-section 1.4
Performance Metrics
An example (Indigo Airlines)

- The number of employees per aircraft in Indigo is 96
- Four handlers stack bags in hold

Capacity Decisions

Performance Metrics
An example (Indigo Airlines)

Operational Choices

- Check-in staff also doubles as baggage handler
- Ground crew takes 20 minutes to prepare the aircraft for the next flight
- Indigo planes fly about 12 hours a day

Cost

Responsiveness

Flexibility

## Performance Metrics
### Comparison of Two Manufacturers

<table>
<thead>
<tr>
<th>Criteria for Comparison</th>
<th>Manufacturer A</th>
<th>Manufacturer B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Volume (million)</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>No. of Employees</td>
<td>35,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Design to customer delivery</td>
<td>27 months</td>
<td>36 months</td>
</tr>
<tr>
<td>No. of models offered</td>
<td>45</td>
<td>28</td>
</tr>
<tr>
<td>Defects at Assembly Line (ppm)</td>
<td>1,400</td>
<td>8,900</td>
</tr>
<tr>
<td>Inventory (Days)</td>
<td>23</td>
<td>39</td>
</tr>
<tr>
<td>Order to Delivery Time (Days)</td>
<td>11</td>
<td>24</td>
</tr>
</tbody>
</table>

- **Quality**: 
  - Manufacturer A: 1,400 ppm
  - Manufacturer B: 8,900 ppm

- **Cost**: 
  - Manufacturer A: 120,000 employees
  - Manufacturer B: 35,000 employees

- **Delivery**: 
  - Manufacturer A: 27 months
  - Manufacturer B: 36 months

- **Flexibility**: 
  - Manufacturer A: 45 models
  - Manufacturer B: 28 models
What do we infer from these examples?

• Operational choices will eventually affect the performance of an organization.
• Performance Metrics help us assess the impact of these choices.
Performance Metrics for Operations

- Quality – PPM, DPMO, Quality Costs, FPY
- Cost – Inventory (days), Procurement, Production
- Delivery – Order Fulfillment time, OTD Index, Schedule Adherence
- Flexibility – No. of models,
- Responsiveness – Waiting Time, Delivery Quote
- Innovation – No. of new models, Patents,
- Learning – Training time, Suggestions per employee
- Improvement – NVA Content
Identifying appropriate Performance Metrics

An example

• An insurance service provider wants to know which performance metrics are important to stay competitive.
  – Is it cost, time or responsiveness?
• If he/she has a good understanding of this, he/she can accordingly plan operations and make appropriate operational choices.
## Reasons for not having insurance

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not so important</td>
<td>24.1%</td>
<td>25.6%</td>
</tr>
<tr>
<td>Too Expensive</td>
<td>54.9%</td>
<td>57.1%</td>
</tr>
<tr>
<td>Limited Range of Products</td>
<td>30.5%</td>
<td>28.0%</td>
</tr>
<tr>
<td>Poor Services</td>
<td>10.7%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Complex Policies</td>
<td>10.4%</td>
<td>12.1%</td>
</tr>
<tr>
<td>Accessibility Problem</td>
<td>17.0%</td>
<td>12.6%</td>
</tr>
<tr>
<td>Difficult Procedure</td>
<td>10.5%</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

### Identifying appropriate Performance Metrics

**Comparison of Offerings among competitors**

<table>
<thead>
<tr>
<th>Criteria for Comparison</th>
<th>Firm</th>
<th>Best</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Passenger Car (in the segment)</td>
<td>INR 700,000</td>
<td>INR 540,000</td>
<td>INR 670,000</td>
</tr>
<tr>
<td>No. of Variations offered</td>
<td>30</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>Order Delivery Time</td>
<td>2 weeks</td>
<td>3 days</td>
<td>6 days</td>
</tr>
<tr>
<td>Kilometers per Litre (Fuel Efficiency)</td>
<td>12.5</td>
<td>12.8</td>
<td>10.4</td>
</tr>
<tr>
<td>Average Maintenance Cost per year</td>
<td>INR 18,000</td>
<td>INR 11,000</td>
<td>INR 17,000</td>
</tr>
</tbody>
</table>
Identifying appropriate Performance Metrics

Emerging Challenges & Concerns

• Growing customer expectations
  – Customers tend to demand more and refine their expectations.
  – Manufacturing & Service organizations must learn to respond to these expectations.
  – Need to develop capabilities to bring newer products and services faster and yet profitably.
• Today’s businesses are constantly challenged by the rapid technological advancements.
  – ATMs & Internet Banking, Procurement of goods & services, New Product Development
• Environmental Issues
  – Growing industrialization raises concerns regarding the depletion of natural resources and the waste generated from production systems and end-of-life products.
  – Increasingly, firms are under pressure to take responsibility of restoring, sustaining and expanding the planet’s ecosystem instead of merely exploiting it.
Priorities for Operations Today

• Relate operations system to Customer/Market.
• Acquire Capabilities to tolerate product proliferation.
• Develop systems and procedures that promote learning.
• Develop Green Manufacturing Practices.
How do we identify the important metrics?

• Get to know what the customers want.
• Analyze the existing offerings in the market.
• Understand the emerging trend in business & society.
Order Qualifiers & Order Winners

• **Order qualifying attributes** are the set of attributes that customers expect in the product or service they consider for buying.

• **Order winning attributes** are other attributes that have the potential to sufficiently motivate the customer to buy the product or service.
Understanding Operations

Highlights
Section 1
Summary

• Operations is a basic requirement in all organizations.
• Decisions regarding Capacity, Supply Chain, Productivity, Quality and other operational choices are part of Operations Management.
  – These create the competitive advantage for firms from operations.
• First step in this process is understanding operations, configurations, and patterns in organizations.
Summary (cont.)

• Volume and Variety in offerings determine:
  – Flow patterns in organizations.
  – Complexity of managing the operations.

• We need performance measures for operation:
  – To prioritize efforts and choices we need to make.
  – Assess the impact of various operational choices we make.

• With this understanding of operations, we may be in a position to:
  – Develop an overall sense.
  – Focus on specific aspects of operations in some detail.