Industrial System Engineering

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What is 5M's of Manufacturing / Industry ?

MANPOWER

MATERIAL

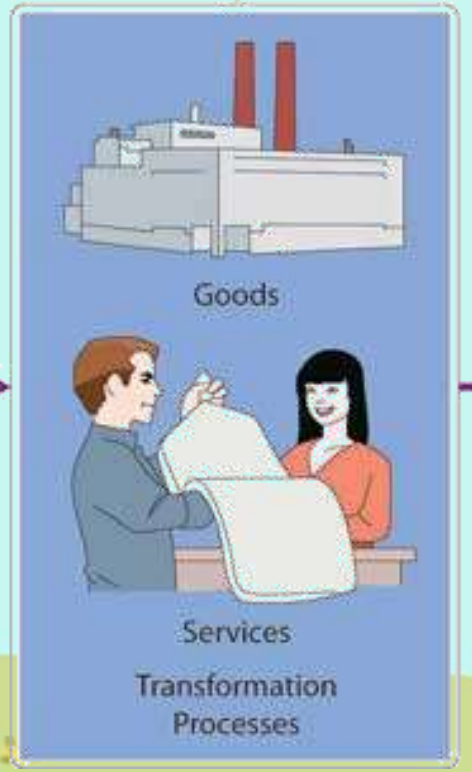
MACHINE

METHOD

MEASUREMENT

The Relationship of 5M's

Value

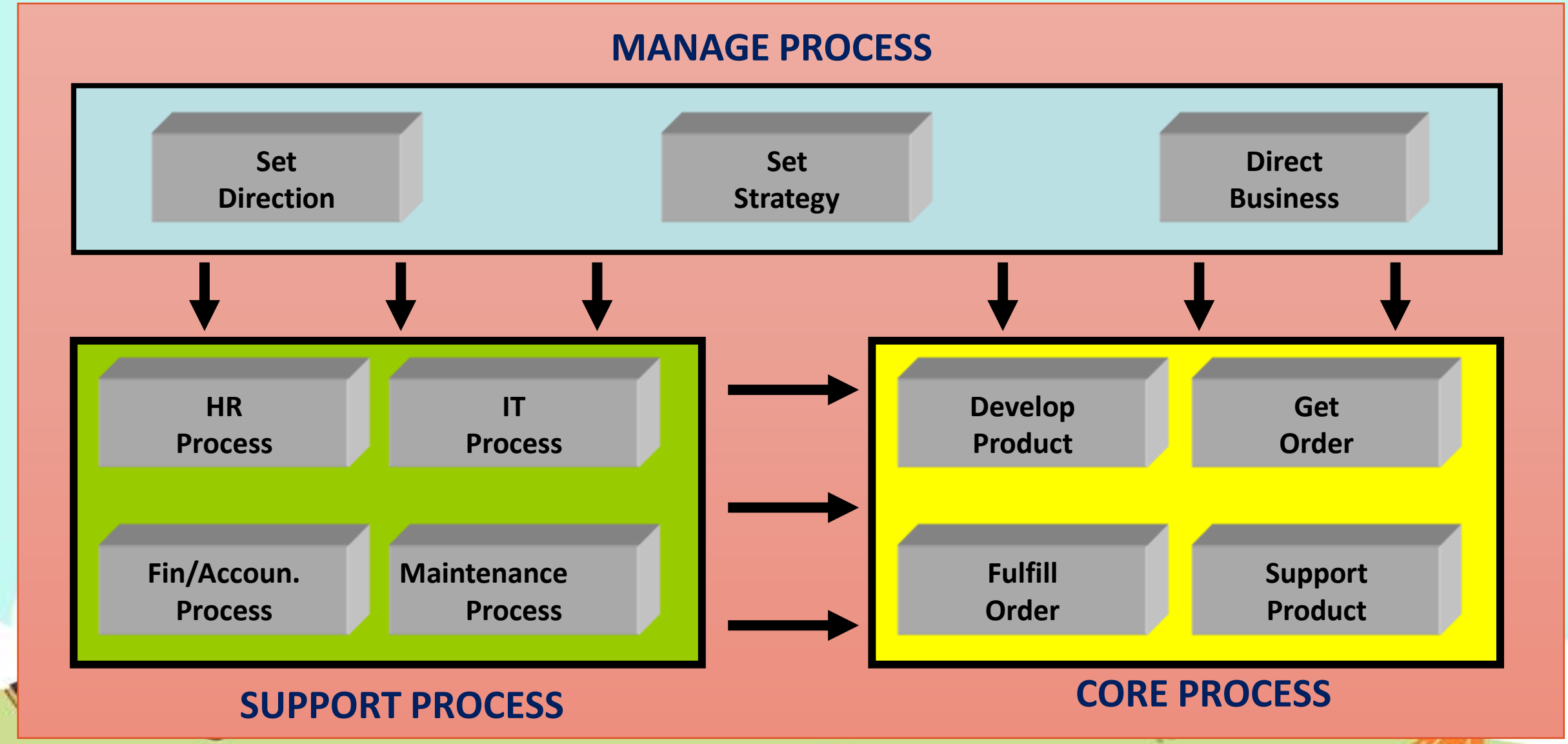


Value

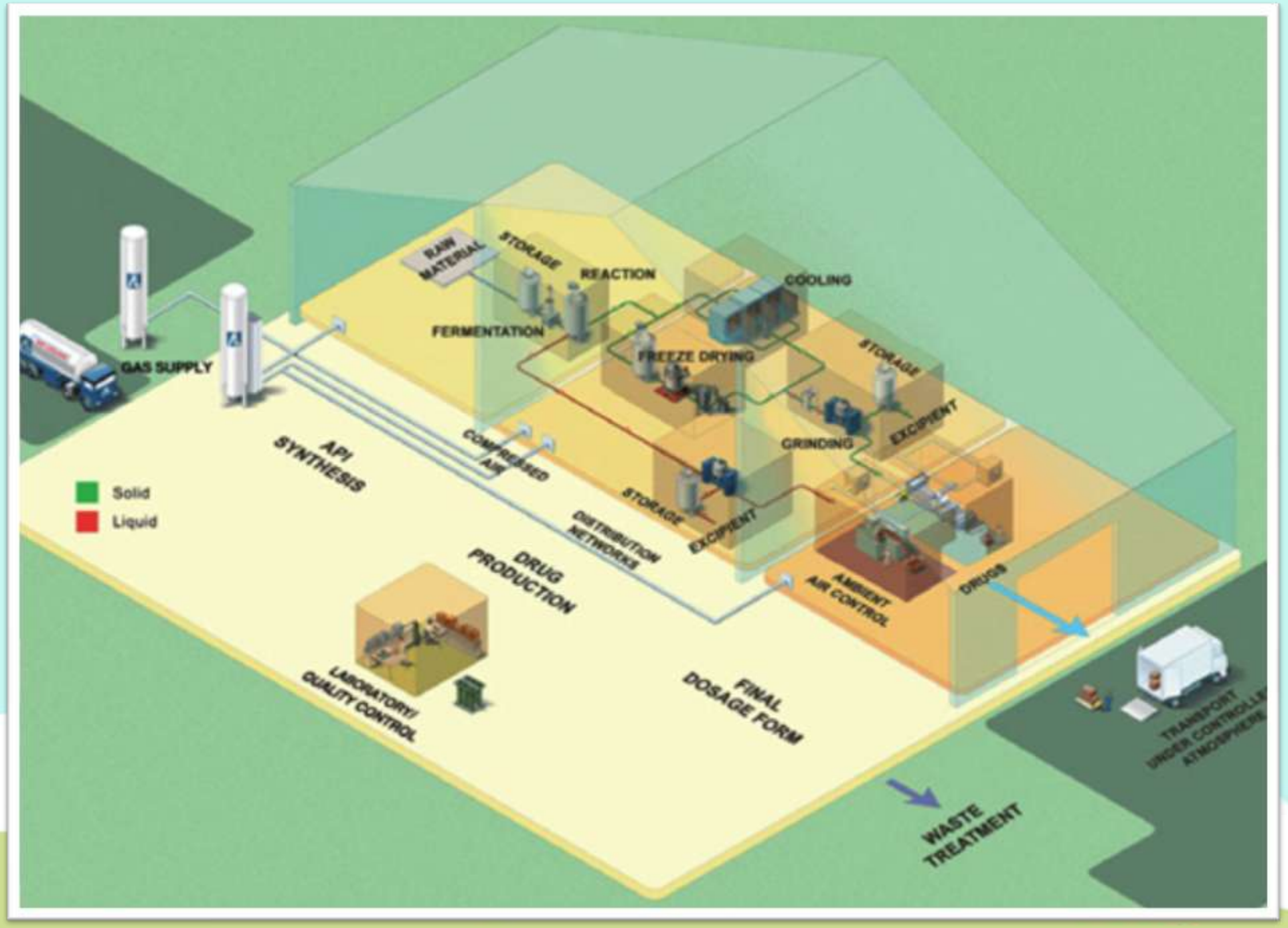
Business Process Management

BPM: the Framework that ensures the ongoing optimization of the enterprise level value chain and its enabling capabilities.

CIMOSA Integrating Infrastructure



Simple Layout Of An Industry

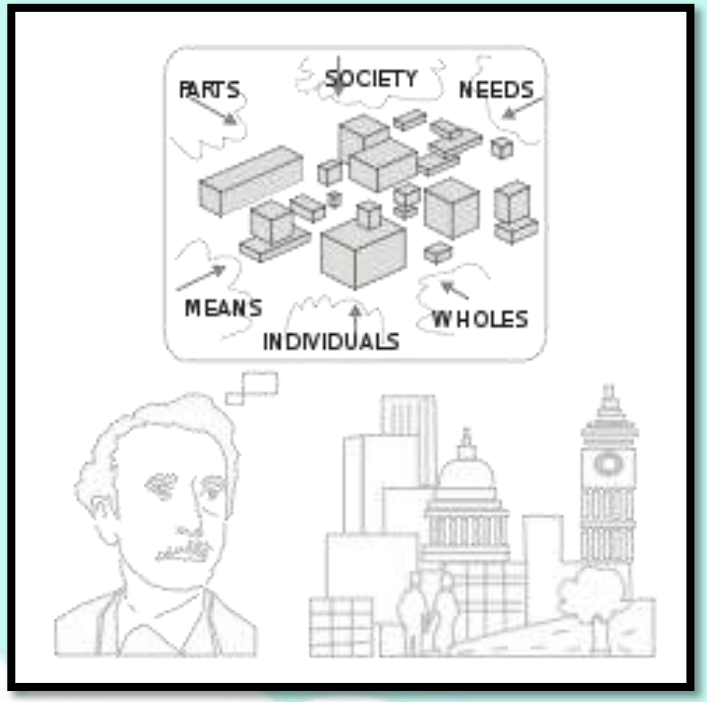


WHAT IS SYSTEM ?

“Systems Approach” In IE

- ***System :*** A set of components which are related by some form of interaction, and which act together to achieve some objective or purpose.
- ***Components :*** The individual parts, or elements, that collectively make up a system.
- ***Relationships :*** The cause-effect dependencies between components.
- ***Objective* or *Purpose :*** The desired state or outcome which the system is attempting to achieve.

“System Thinking” In IE



Systems thinking

is the process of understanding how things, regarded as systems, influence one another within a whole.

Mention the components, relationships, and purpose of the system beside!

Other Examples Of Systems

- Production system of a factory
- Information system of a business firm
- Computer system of an airlines company
- Circulatory system of the human body
- Nervous system of the human body

System Classifications

NATURAL SYSTEM

- Natural systems exist as a result of processes occurring in the natural world.

MAN-MADE SYSTEM

- Man-made systems owe their origin to human activity.

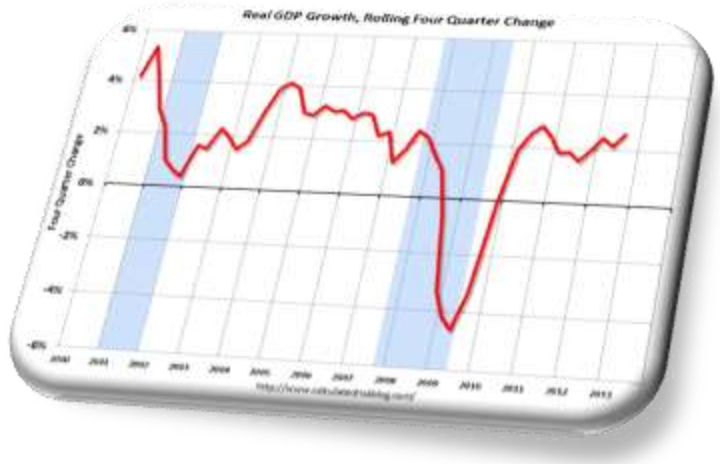
System Classifications

STATIC SYSTEM

- Static systems have structure, but no associated activity.

DYNAMIC SYSTEM

- Dynamic systems involve time-varying behavior.



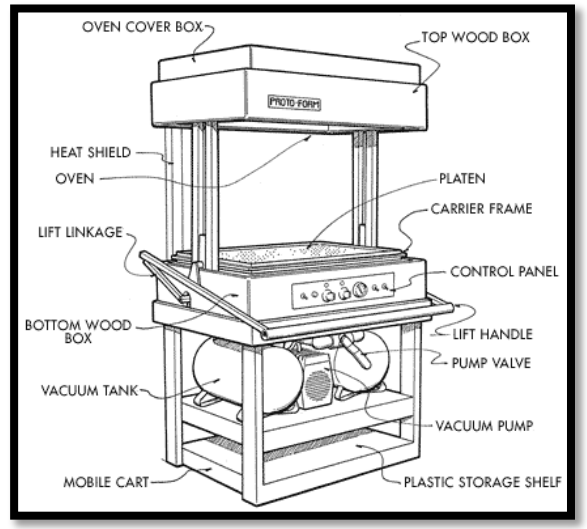
System Classifications

PHYSICAL SYSTEM

- Physical systems involve physically existing components.

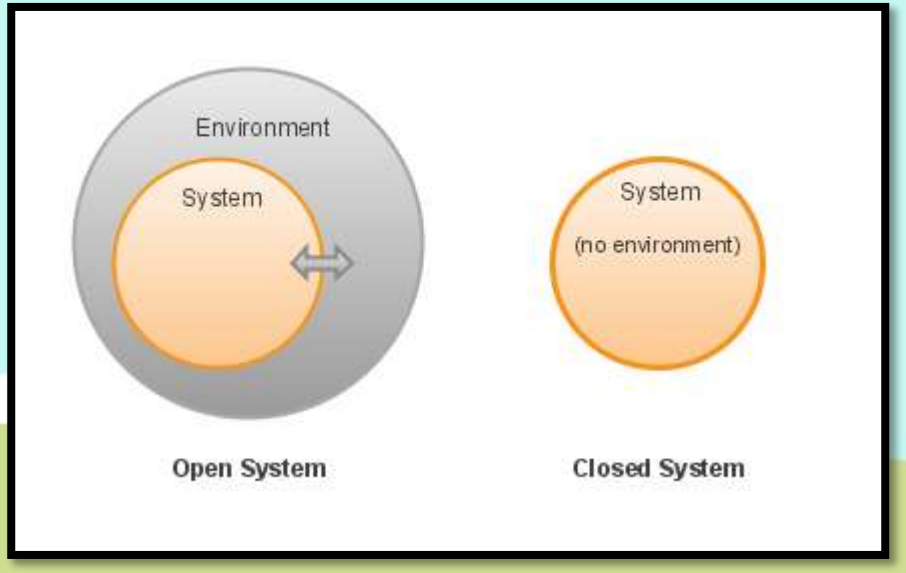
ABSTRACT SYSTEM

- Abstract systems involve symbols representing the system components.



System Classifications

OPEN-SYSTEM	CLOSED-SYSTEM
▪ Open systems interact with their environment, allowing materials (matter), information, and energy to cross their boundaries.	▪ Closed systems operate with very little interchange with its environment.



"Systems approach" attempts to resolve the conflicts of interest among the components of the system in a way that is best for the system as a whole.

Industrial & System Engineering
Industrial Management

What is Industrial Engineering?

- Electrical Engineering – to engineer an electrical product or system.
- Computer Engineering – to engineer a computer or a system of networked computers.
- Industrial Engineering?
  - To engineer an industry?? NO
  - To engineer an industrial product or system (efficiently and effectively): for manufactured goods or services, originally
  - To engineer a product or system for industry, the military, government, education, etc.
  - **Efficiency** and **Quality** Engineering!!

What is Systems Engineering?

- To engineer a system, with efficiency and quality
- All Types of Systems:
  - Aviation Systems, including Air Traffic Control Systems
  - Telecommunication and Computer Systems
  - Airline Reservation Systems
  - Software and Database systems
  - Highway Systems
  - Manufacturing Systems, e.g., the Toyota Production System (TPS)

An Early and Modern Example About Manufacturing: Car Assembly

- The original “work cell” assembly method.
- Henry Ford’s idea of assembly line, following the efficiency innovations in cattle slaughtering.
- Many innovations for higher efficiency and better quality, including robotics.
- The Toyota Production System (TPS), practiced at The New United Motor Manufacturing Incorporated (NUMMI) in Fremont, California (and elsewhere).

Early Moving Assembly Line in Ford

Recent Assembly Line in Ford

Assembly Line with Robotic

Assembly Line VW in Dresden

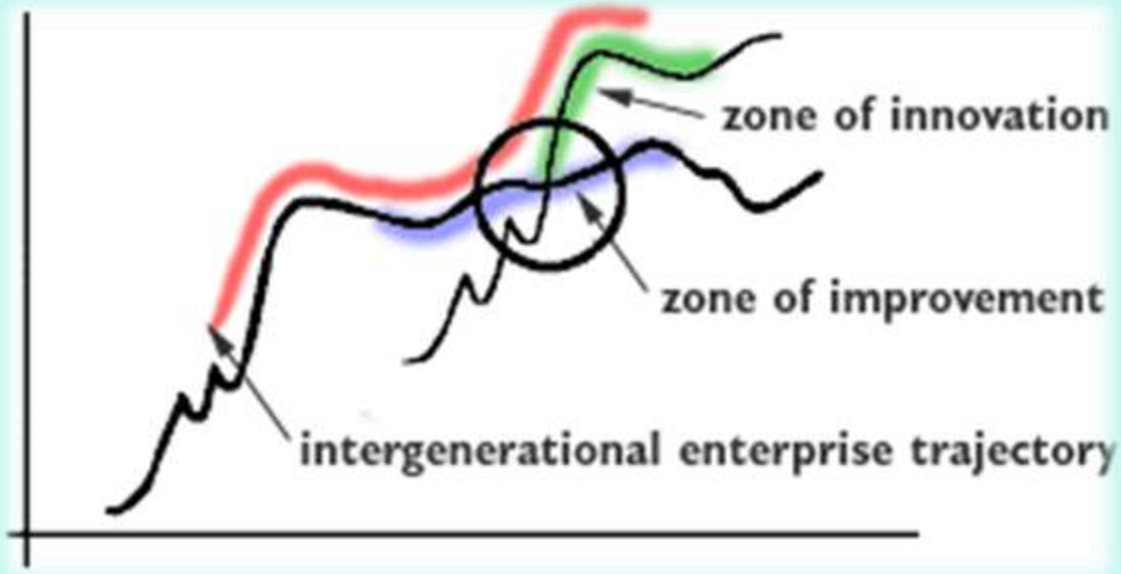
Evolution Vs Innovation

- **Evolutionary/Improvement Change:**

- A product is allowed to evolve over a period of time with only slight improvement. This is done when there is no competition. The creative capabilities of the designer are limited.

- **Innovation Change:**

- Rapid scientific growth and technological discoveries as well as competition among companies for their slice of the market have placed a great deal of emphasis on new products, which draw heavily on innovation. The creative skills and analytical ability of the design engineer play an important role.



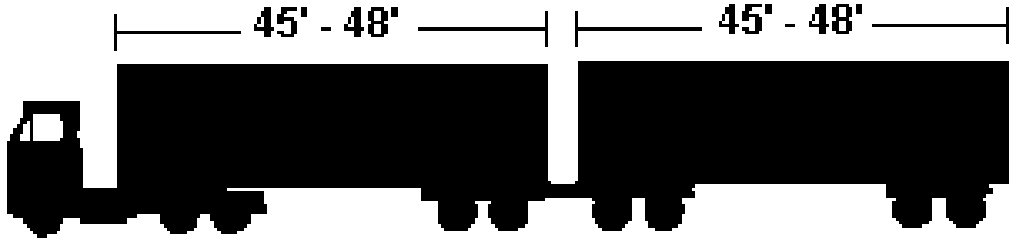
Multidisciplinary Research: Efficient and Safer Large-truck Operations

- Proven US oil reserve: 22 billion barrels
- Daily US consumption: 21 million barrels
- “Desperate” need for fuel efficiency
- Public transportation for passengers, but how about freight transportation?
- Longer Combination Vehicles (LCVs) for higher fuel efficiency : 5.4 MPG for a 40,000-lb “straight truck” and 4.6 MPG for a 140,000-lb “turnpike double”

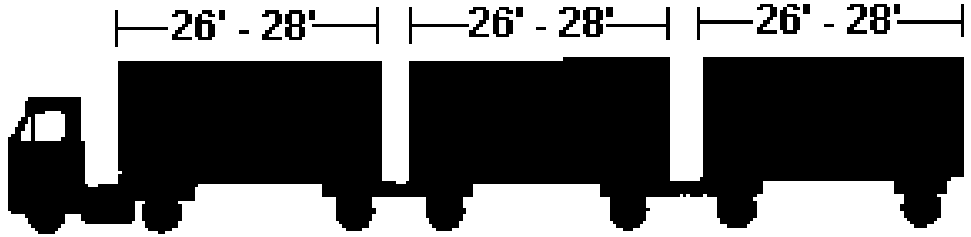
Common LCVs

Rocky Mountain Double

Turnpike Double



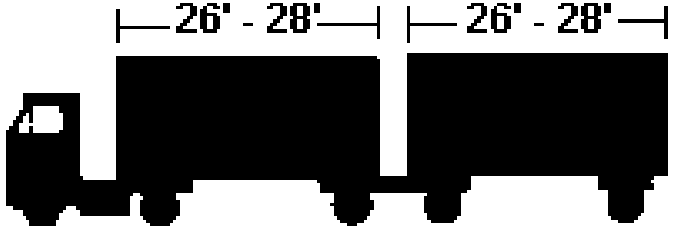
Triple



Common Non-LCV Trucks

Combination With Single Trailer

Combination With Twin Trailers



Straight Truck With Trailer Connected With Draw Bar (Lengths Vary)


ROBERT
ROBERT

Efficient And Safer Large-truck Operations

- LCV for higher productivity : tractor utilization, driver utilization and speed of freight movement. But, only 20 states allow such operations.
- California does not allow them. WHY?
  - Safety hazard and damage to roadway
  - A major source: “off-tracking”
- Innovative concept : Automated Trailer Steering, for virtual elimination of off-tracking [Rangavajhula & Tsao]
- Multidisciplinary research : mechanical engineering, electrical engineering, electrical engineering, industrial engineering, economics, public policy, etc.

What Do Industrial Engineers Do?

- Industrial Engineers work to make things better, be they processes, products or systems.
- Typical focus areas include:
  - Project Management
  - Manufacturing, Production and Distribution
  - Supply Chain Management
  - Productivity, Methods and Process Engineering
  - Quality Measurement and Improvement
  - Program Management
  - Ergonomics/Human Factors
  - Technology Development and Transfer
  - Strategic Planning
  - Financial Engineering

Project Management

- Develop the detailed work breakdown structure of complex activities and form them into an integrated plan
- Provide time based schedules and resource allocations for complex plans or implementations
- Use project management techniques to perform Industrial Engineering analyses and investigations
- Conduct facility planning and facility layout development of new and revised production plants and office buildings
- Form and direct both small and large teams that work towards a defined objective, scope & deliverables
- Perform risk analysis of various project options and outcomes

Manufacturing, Production & Distribution

- Participate in design reviews to ensure manufacturability of the product
- Determine methods and procedures for production distribution activity
- Create documentation and work instructions for production and distribution
- Manage resources and maintain schedule requirements to meet required production and distribution schedules
- Process Optimization utilizing Simulation tools (Arena, etc)
- Facilitate and Lead process improvement teams

Supply Chain Management

- Manage Supplier relationships
- Managing and report on company Supplier Cost / Performance Indices to management
- Audit Suppliers and ensure supplier processes and procedures are being followed
- Travel to suppliers to resolve issues Coordinate first article Inspections
- Work with Outsource Manufacturers to ensure product quality, delivery and cost, is maintained

Productivity, Methods & Process Engineering

- Define proper work methods for tasks
- Define appropriate processes for work flow activities
- Define key production measures
- Define goals and data capture/analysis for key measures
- Perform root cause analysis to improve poor performing processes
- Develop appropriate incentive plans for work tasks
- Determine capacity requirements and subsequent investment options

Quality Measurement And Improvement

- Determine quality-related issues in all aspects of the business
- Work with design and production teams and outsource manufacturers to ensure product quality is maintained during the design and production phases
- Audit defined processes and procedures to ensure that they are being followed
- Coordinate and Facilitate 3rd Party Quality Audits
- Provide refresher training on procedures for company personnel on Quality and process-related issues, including the use of analytical tools and techniques
- Manage and determine issues with incoming material through the Receiving process

Program Management

- Develop proposals for new programs
- Manage program/project teams to ensure program stays on schedule, on budget, and meets performance expectations
- Coordinate a matrix of team member across departments within an organization to ensure completion of project tasks

Ergonomics/Human Factors

- Ensure Human Factors Engineering is utilized in New Product Design
- Ensure Human Factors Engineering disciplines are utilized in production setup and configuration
- Ensure company Ergonomics policies are defined to minimize causes of employee injury and discomfort

Technology Development And Transfer

- Identify basic business problems requiring analysis
- Determine if technology or process based solution best
- Characterize problem, identify prospective providers/ bidders and submit requests for proposals
- Evaluate bid responses, select successful bidder and establish technical feasibility
- Conduct small scale/medium scale tests to determine operational feasibility, implementation methods and training requirements
- Conduct enterprise wide implementation

Strategic Planning

- Develop long range planning models, typically 5-10 years in scope
- Model all areas affected by operation
- Identify anticipated investment in plant, capacity, network, etc
- Tie to preliminary production cost, operational cost, sales forecasts
- Develop preliminary financial impacts, including profitability and ROI

Financial Engineering

- Determine production costs using specific cost based methodology
- Develop budgets, forecasts for operating cost centers
- Measure actual performance versus budget goals and investigate difference
- Develop capital and expense budgets for capacity expansion
- Perform cost analysis/justification for capital and expense expenditures
- Perform make versus buy versus lease analyses

Industrial Engineers Work in Many Types of Industries

- Aerospace & Airplanes
- Aluminum & Steel
- Banking
- Ceramics
- Construction
- Consulting
- Electronics Assembly
- Energy
- Entertainment
- Forestry & Logging
- Insurance
- Materials Testing
- Medical Services
- Military
- Mining
- Oil & Gas
- Plastics & Forming
- Retail
- Shipbuilding
- State & Federal
- Government
- Transportation

Some Techniques Utilized By Industrial Engineers

- Benchmarking
- Design of Experiments
- Employee Involvement
- Equipment Utilization
- Flow Diagramming
- Information & Data Flow
- Diagramming
- Interviewing for
- Information
- Lean Manufacturing
- Modeling & Testing
- Operations Auditing
- Organizational Analysis
- Pilot Programs
- Plant & Equipment
- Layout
- Project Management
- Simulation
- Six Sigma projects
- Statistical Analysis
- Strategic Planning
- Theory of Constraints
- Time Studies
- Work Sampling

10 Best World Company (Fortune Magazine, 2013)

1. **Royal Dutch Shell** → oil and gas, Netherlands
2. **Wal-Mart Stores** → retail, USA
3. **Exxon Mobil** → oil and gas, USA
4. **Sinopec Group** → oil and gas, China
5. **China National Petroleum** → oil and gas, China
6. **British Petroleum** → oil and gas, England
7. **State Grid** → electricity, China
8. **Toyota Motor** → automotive, Japan
9. **Volkswagen** → automotive, Germany
10. **Total** → oil and gas, France

25 Best Indonesia Company (Fortune Magazine, 2013)

1. Astra International
2. Telekomunikasi Indonesia (Persero)
3. HM Sampoerna
4. Bank Rakyat Indonesia (Persero)
5. Bank Mandiri (Persero)
6. United Tractors
7. Indofood Sukses Makmur
8. Gudang Garam
9. Bumi Resources
10. Bank Central Asia
11. Adaro Energy
12. Garuda Indonesia (Persero)
13. Bank Negara Indonesia (Persero)
14. Smart
15. Unilever Indonesia
16. Perusahaan Gas Negara (Persero)
17. Bank Danamon Indonesia
18. Indah Kiat Pulp & Paper
19. Sumber Alfaria Trijaya
20. Indo Tambangraya Megah
21. Indosat
22. Akr Corporindo
23. Indofood Cbp Sukses Makmur
24. Barito Pacific
25. Chandra Asri Petrochemical

Homework

- Read our Industrial Engineering Syllabus .
- Classify the course subjects according to CIMOSA Integrating Infrastructure!
- Collect the task on next week!


systems
Industrial
Engineers
Engineering
Business
design
operations
control
processes
planning
knowledge
engineering
production
manufacturing
analyze
program
scheduling
system
college
large
skills
complex
individual
Offered
allows
quality
pursue
flexibility
disciplines
inventory
particular
equipment
mathematics
management
facilities
Entrepreneuership
interpersonal
communication
simulation
information
perspective
customize
allocation
problem
methods
degrees
resource
group


KEEP
CALM
YOU'RE AN
INDUSTRIAL
ENGINEER