An Industry-Academic Teaching Support Workshop
Supply Chain Operations, Strategy, and Infrastructure Development in a Global Economy

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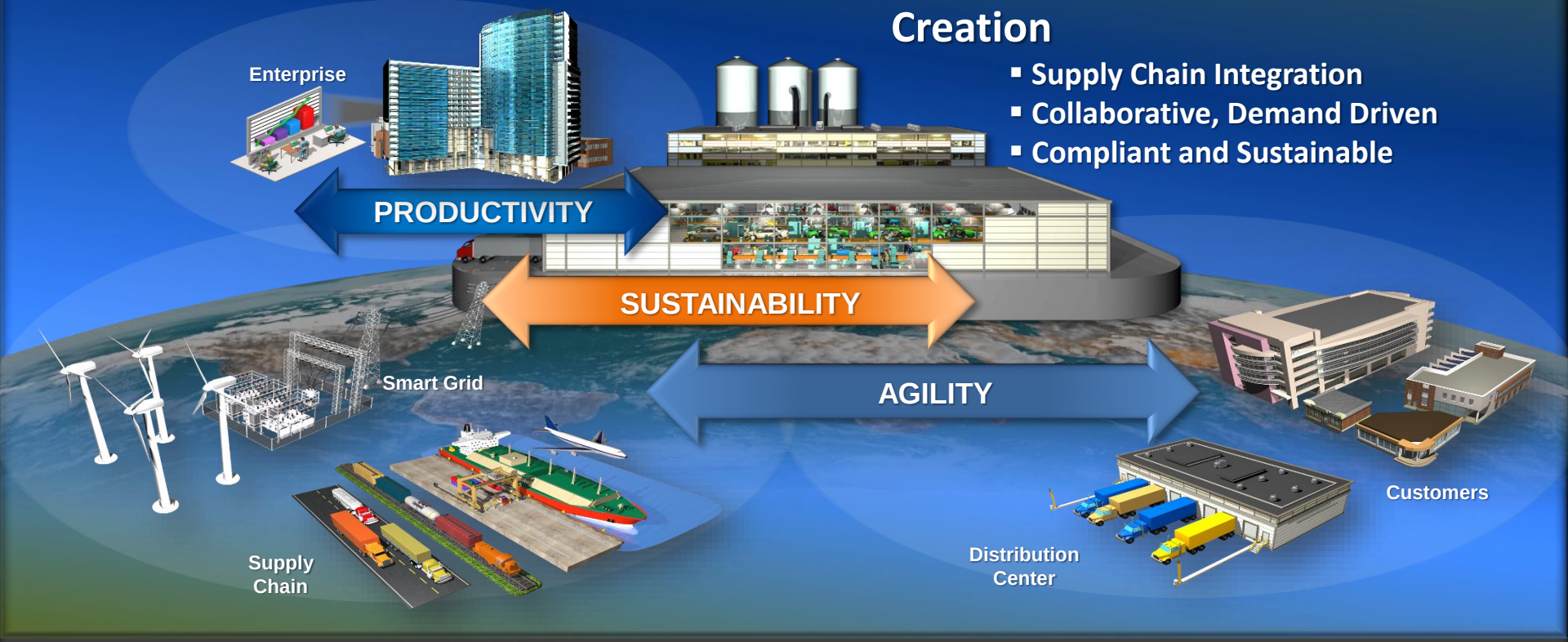
Activities Sponsored by Rockwell Automation and NEMA 1-IS Section

THE CONNECTED ENTERPRISE

Optimized for Rapid Value Creation

- Supply Chain Integration
- Collaborative, Demand Driven
- Compliant and Sustainable



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Supply Chains Are Complex

Real-Time demand information shared with supply chain

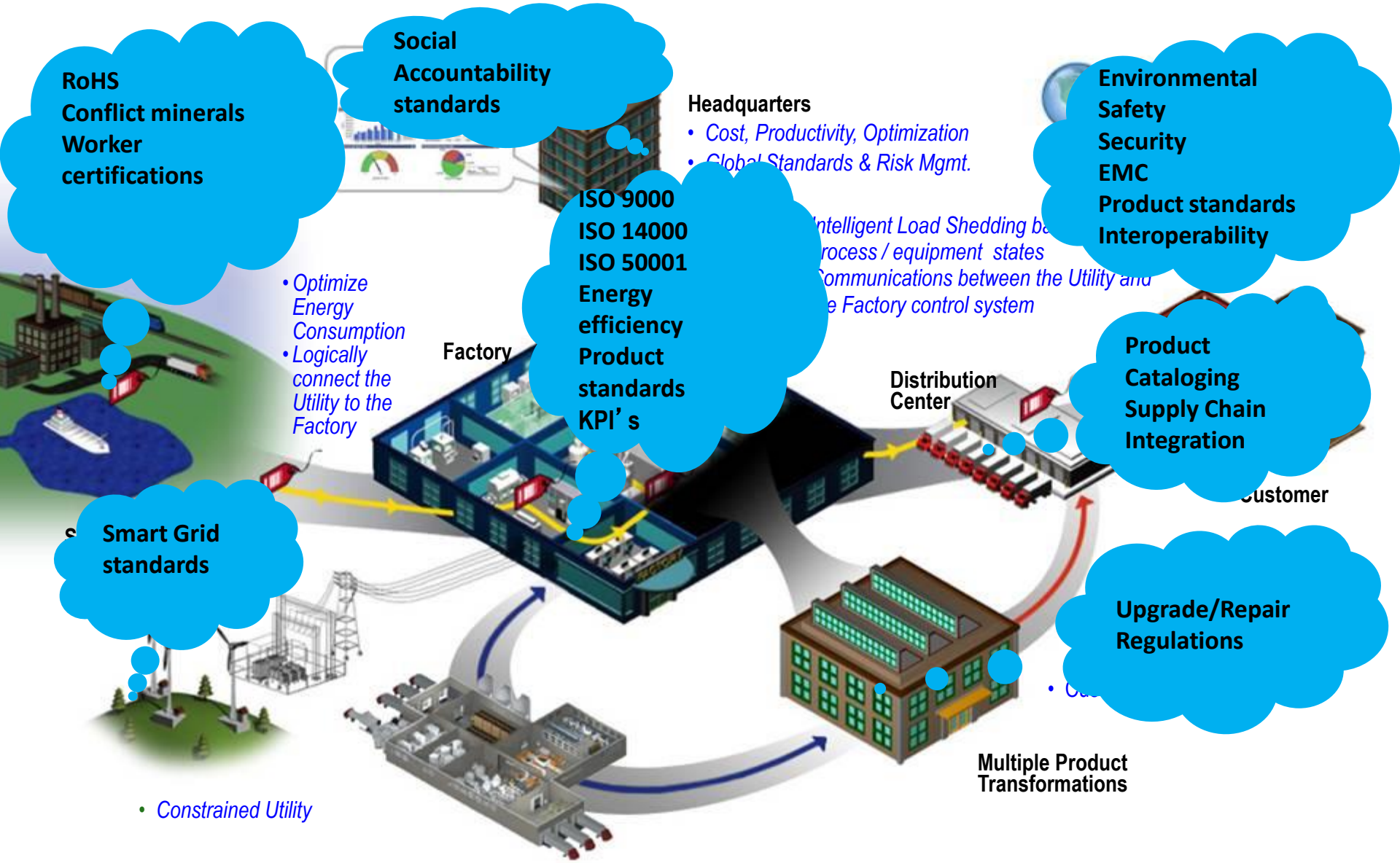
Rapid product and process design changes to capture opportunity

Operate factory to meet scheduled and exception orders in a cost-effective manner

Log changes in deliveries and shipments accurately and timely

Current demand and availability information to manage production schedules and reduce inventories

Standards & Regulations are found within aspects of a supply chain…



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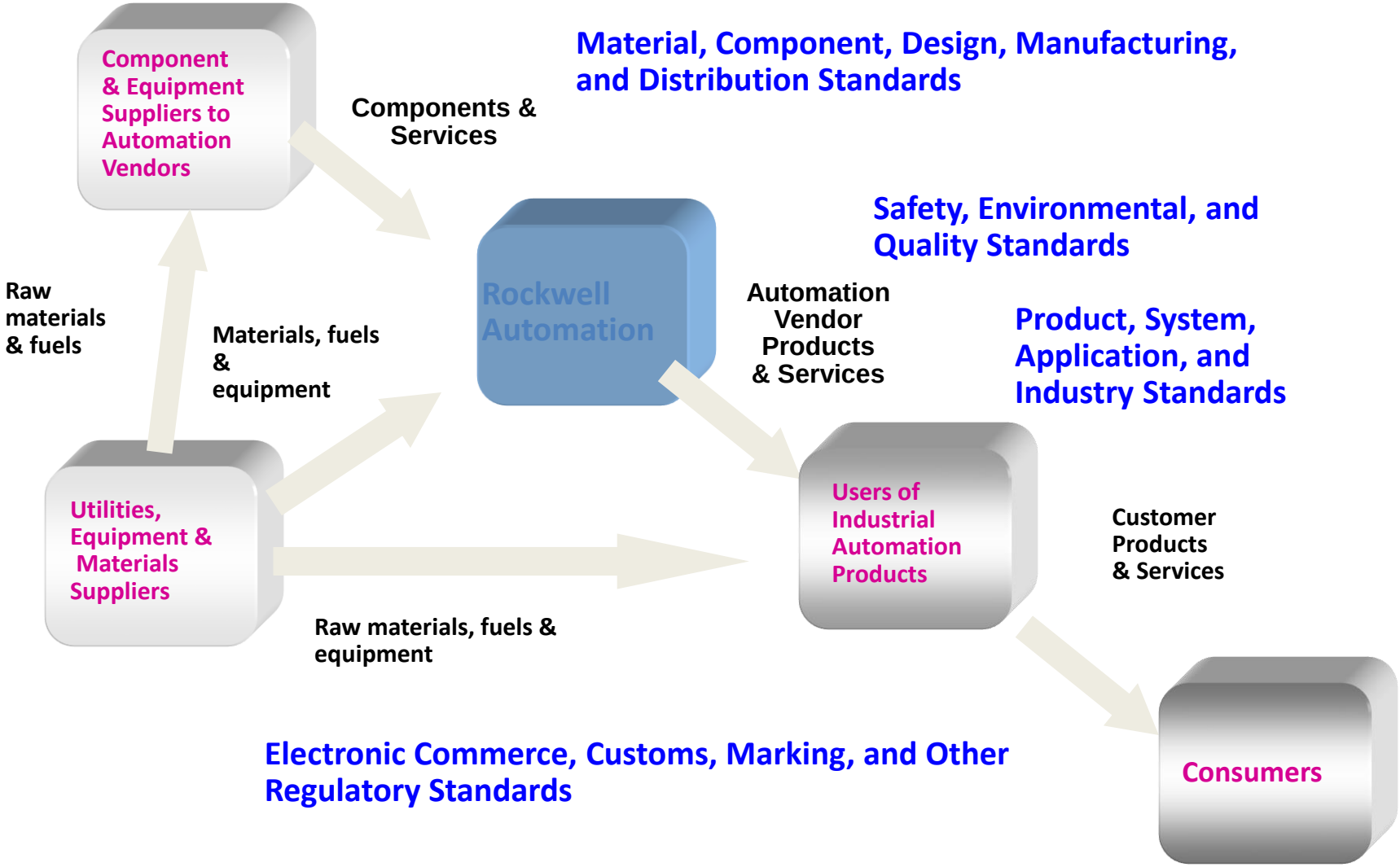
Standards Impact Product Supply Chain



Standards Collaboration is Commencing Earlier in The Supply Chain

Innovation Collaboration & Data Protection is KEY

Rockwell Automation

Functional Hierarchy – S95

Business Planning & Logistics
Plant Scheduling, Capability Management,
Performance Management…

Level F4 - Establishing demand for production, material use, delivery, and shipping. Determining enterprise wide inventory levels.
Time Frame - Months, weeks, days

Manufacturing Operations Management
Detailed Scheduling, Dispatching,
Resource Management, ...

Level F3 - Work flow / recipe control, schedule, assign and managed the jobs to produce the desired end products. Maintaining records and optimizing the production process.
Time Frame - Days, Shifts, hours, minutes

Manufacturing Operations & Control
Batch control, Discrete control
Continuous control, ...

Level F2 - Monitoring, supervisory control and automated control of the production process
Level F1 - Sensing and manipulating the production process
Level F0 - Actual physical processes
Time Frame – Hours, minutes, seconds, fractions of a second

The Results Of ISA - 88

Opportunity	Benefit
Batch Cycle Time	10 to 50% reduction
Engineering Cost	60% Reduction over 3 projects
Recipe Development	30% Faster
Re-validation	50% Faster
Throughput	3 to 20% Increase
Commissioning time	33% Reduction

PRODUCTIVITY ↑ QUALITY ↑ COSTS ↓ TIME ↓

ARC Advisory Group, Oct 2006

The Results Of ISA - 95

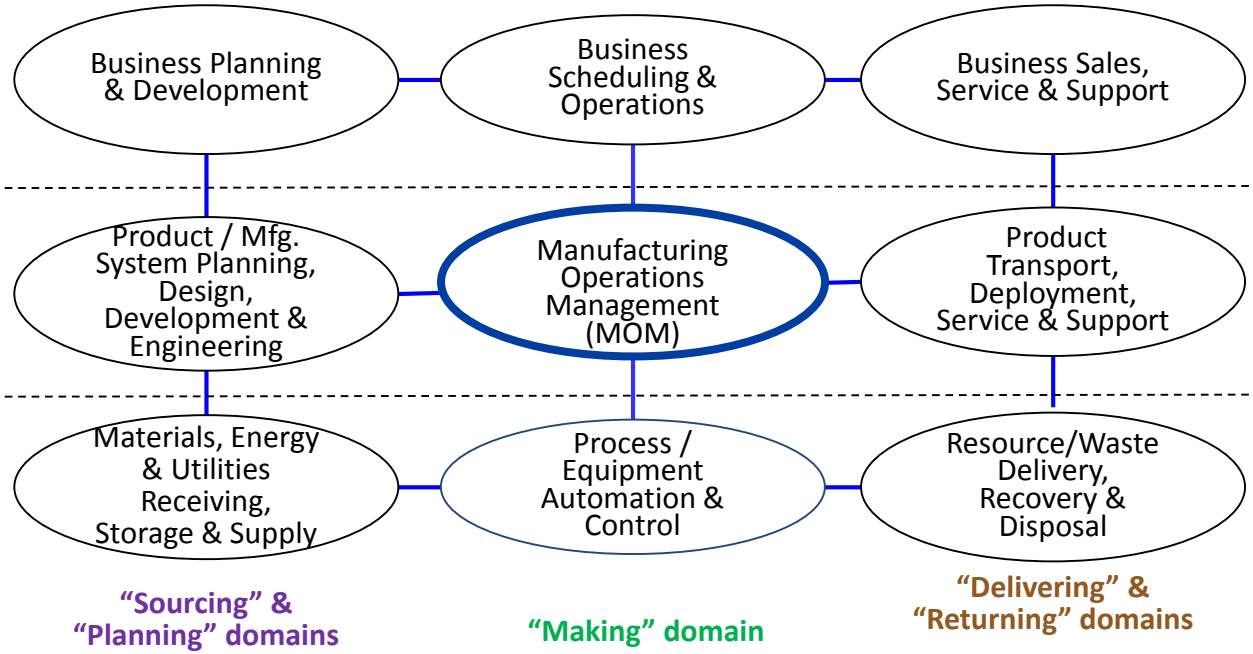
Opportunity	Benefit
Manufacturing Cycle Time	10 to 45% reduction
Data Entry Time	Reduction by 75%
Work In Process	Reduced by up to 24%
Product Defects	Average reduction of 18%
Lead Time	Reduced by up to 27%
Paper Work	Average reduction of 56%

Source MESA International

The IEC SMB SG8 Smart Manufacturing Goal

- Identify which functions, domains are within the IEC scope.
- Identify which functions, areas are being standardized in other organizations.
- Identify the interfaces, overlaps and gaps within and between domains and functions that need to be addressed by the standards communities.
- Create a standards roadmap for smart safe secure sustainable enterprise standards activities and create a portfolio of deliverables to form a cohesive set of standards to sustain smart manufacturing system implementation.
- Incorporate new technology e.g. Internet of Things, Cloud, Big Data Analytics, new sensor technologies , and new materials in generation of the required standards portfolio.

Activity domains within an enterprise



Level F4
Establishing demand for production, material use, delivery, and shipping. Determining enterprise wide inventory levels.
Time Frame **-** Months, weeks, days

Level F3
Work flow / recipe control, schedule, assign and managed the jobs to produce the desired end products. Maintaining records and optimizing the production process.
Time Frame **-** Days, Shifts, hours, minutes

Level F2 - Monitoring, supervisory control and automated control of the production process
Level F1 - Sensing and manipulating the production process
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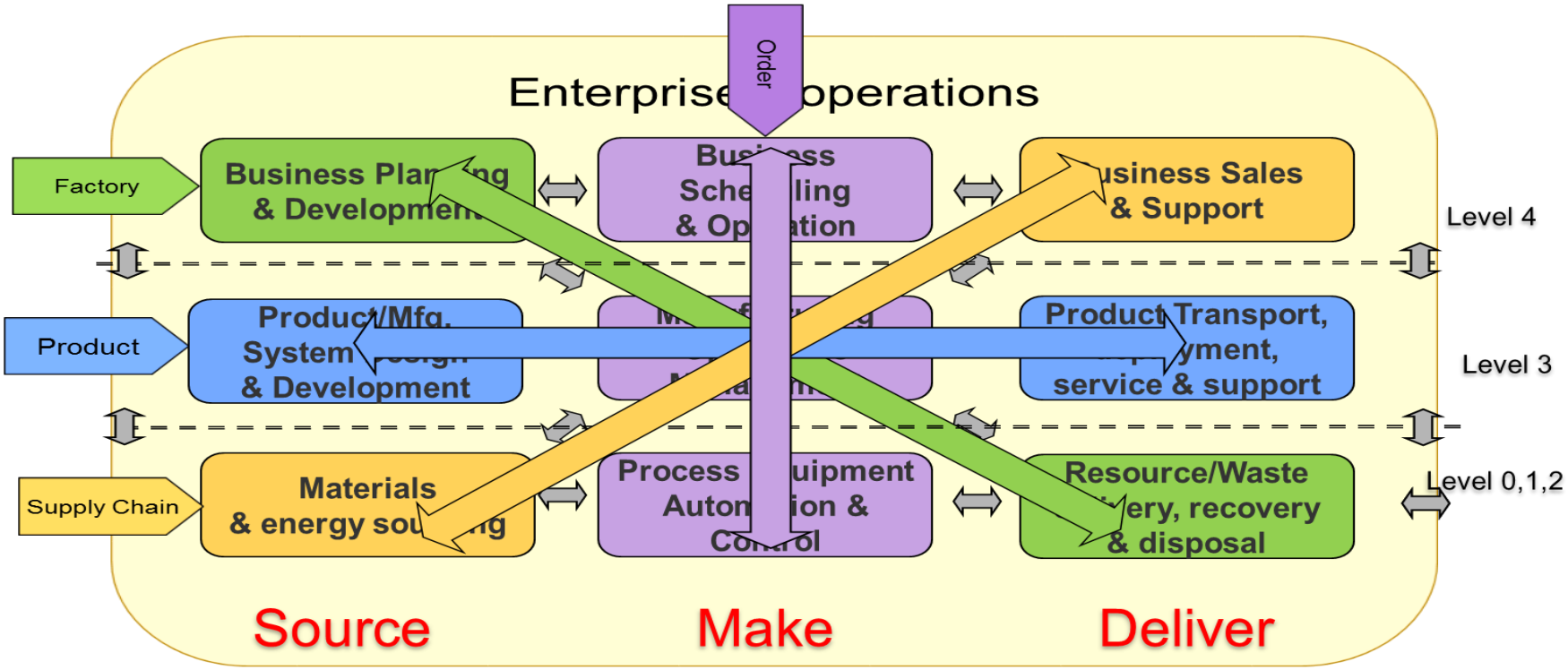
Activity domains differ by functional clusters and decision horizons

References: ISO 15704, IEC 62264, ISO 18435

Value Chains Relative to Enterprise Operations



Manufacturing Value Chain Examples

- MATERIAL: Sourcing of material and its passage through many process stages resulting in the disposal or delivery of material in a product form to a customer
- ENERGY: Sourcing of energy in the form of Labor , Water, Air, Gas, Electricity, Steam , to the consumption and generation of energy of individual processes to the delivery of re-useable energy (e.g. heat , steam) or waste products for recycle purposes.
- PRODUCT LIFE CYCLE: defines the process steps from the creation of the product idea, through the design, prototype, build, assembly, test, delivery, application, use and service of the product.
- FACTORY LIFE CYCLE: addresses the investment, process and automation planning, modeling and simulation of the designed plant, acquisition of plant resources, build and commissioning , production operation, maintenance and the ultimate tear down and disposal of the plant assets.
- SUPPLY CHAIN : addresses the Purchasing and Quality Management of incoming materials and resources, together with the sales, and delivery logistics of the completed products.
- ORDER to ENTRY: addresses order entry, production planning, manufacturing execution systems, production operation including equipment monitoring and control, order status reporting, order delivery, installation, service and invoicing.
- HUMAN RESOURCE MANAGEMENT: organizes the acquisition, training, deployment, development, and maintenance of skilled employees with required capabilities to perform needed functions
- ACCOUNTANCY : collects cost and utilization data from each of the functions within the organization to manage the ultimate productivity and profitability of the enterprise

Smart Manufacturing Standards

- Today Manufacturing Automation standards currently address the **planned**
  - Safety of plant, equipment and personnel
  - Security of data, and equipment
  - Sustainability and Environmental Regulation Compliance
  - Quality of Product
  - Energy Efficiency of Equipment
  - Lean / Just In Time Material Utilization
  - Machine / Process Diagnostics and Preventive Maintenance
- Smart Manufacturing implementation **requires** the collection of real time data that can improve decision making in manufacturing value chains which enhances the efficiency and performance of the individual plants and increases overall productivity
- Real time data is embedded in shop floor equipment and software applications throughout the extended enterprise
- What data can be shared with the public? What data is proprietary to the owner ? What data can be shared on a license to use basis with defined partners ?
- How is the quality data to be acquired , managed and protected ?

Smart Manufacturing Enterprise Challenge

- Actionable, accurate validated data delivered to the right place and right time within the extended enterprise to facilitate improved decision making
- Consistent terminology, definitions and data representation within the industry
- A high level of security and safety integrated within the smart systems deployed
- Ability for the installed base to evolve and adapt to changing production requirements
- Complete Life Cycle Management to be addressed across the enterprise
  - For the Product from Concept to Market to Obsolescence
  - For the Production facility from Concept to Installation, Commission and end of life
  - For the Supply Chain from Initial offer to obsolescence of the product – Asset, Resource and Supply management
  - For the sales order to product delivery and after sales support
  - For Finance from Customer Quote to Cash
- Move from a sequential model to that of a concurrent iterative process.

A Smart Manufacturing Standardization Stakeholder Challenge

- A modern international standardization infrastructure that facilitates fast development and publishing of quality standards which are of value to the global community
- A generation of employees that see the value of new system and information standards to the community at large, are motivated to participate, and have developed the cross cutting skills to be able to participate in such an infrastructure
- Standardization is a process that should take into account regulatory requirements (government), market requirements (customers), and business opportunity (suppliers) and then seeks through consensus negotiation to deliver a performance level specification that all suppliers of product, systems and services should meet .