Vision of the Future of Manufacturing & Production (Visi-MAP)

18th November, 2013
Contents

- About Frost & Sullivan
- Age of Complexities
- Visi-MAP
- Evolving Paradigms
- Way Forward
About Frost & Sullivan

Emerging Research
1961-1990

Growth Partnership
1990-Today

Visionary Innovation
Today-Future

Aerospace & Defense
Measurement & Instrumentation
Consumer Technologies
Information & Communication Technologies

Automotive
Transportation & Logistics
Energy & Power Systems
Environment & Building Technologies
Healthcare

Minerals & Mining
Chemicals, Materials & Food
Electronics & Security
Industrial Automation & Process Control
Age of Complexities

How Are We Managing this Complexity??
Manufacturing Complexity Like Never Before

- Supply Chain Risk!
- Process Improvement & Innovation!
- Growth?
- Profitability?
- Green Manufacturing?
- Control Strategy
- Operational Excellence?

Central Warehouse
VP Production
Plant Manager
Plant Manager
Supervisor
Suppllier#1
Suppllier#2
Suppllier#3
CEO
CIO
COO
CFO
Suppllier-HQ
Suppllier-HQ
Suppllier-HQ
Visi-MAP: The 3-C Framework

- **Challenge Theme**
  - Competition
  - Collaboration
  - Compliance

- **Value Trend**
  - Resource Efficiency
  - Operational Excellence
  - Integration
  - Visualization
  - Risk Mitigation

- **Domains**
  - Manufacturing and Production Implication
  - Water/Waste Treatment & Distribution Management
  - Exploration, Processing & Distribution
  - Energy Portfolio Mix
  - Mining, Refining & Substitution
  - Human Capital Management
  - Climate Change Strategies and Sustainable Manufacturing Practices
  - Real-time Asset Effectiveness
  - Process Innovation & Technology Differentiation
  - Productivity, Quality by Design and Time to Market
  - Product Cost and Supply Chain Effectiveness
  - Real-time Process Visibility, Lifecycle Management
  - Digital Manufacturing, Virtual Simulation & Commissioning
  - Risk Management (Safety Systems, Cyber Security, Validation & Quality Management)

- **Value Trends**
  - Value Trend
  - Value Trend
  - Value Trend
  - Value Trend
  - Value Trend

- **Domains**
  - Water
  - Energy
  - Minerals
  - Human
  - Environment
  - Asset Excellence
  - Process Excellence
  - Plant Integration
  - Ecosystem Integration
  - Process Visualization
  - Product Visualization
  - People Risk
  - Process Risk
  - Technology Risk
## Key Focus: Continuous Innovation and Operational Efficiency Improvements

<table>
<thead>
<tr>
<th>Competition</th>
<th>Collaboration</th>
<th>Compliance</th>
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<tbody>
<tr>
<td><strong>Sustainable manufacturing</strong>: Adopting profitable and innovative manufacturing practices that allow optimal resource utilization with a continuously shrinking carbon footprint</td>
<td><strong>Risk-mitigation partnership</strong>: Mutual collaboration and co-operations to mitigate risk across the supply chain.</td>
<td><strong>Risk management</strong>: Enterprise-wide view of risk and consequent mitigation and control strategies</td>
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<td><strong>Energy and operational efficiency</strong>: Monitoring energy cost as a pivotal factor to boost profitability and asset effectiveness</td>
<td><strong>Supply-chain Optimization and Visibility</strong>: Real-time visibility of distinct supply-chain activities fostering process improvements.</td>
<td><strong>Safety and control</strong>: Co-existence of safety and control on a unified platform</td>
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<td><strong>Adaptive manufacturing</strong>: Fast response to changing market demands</td>
<td><strong>Digital manufacturing</strong>: Converging worlds of design, engineering and manufacturing leading to cost savings</td>
<td><strong>Business Continuity</strong>: Focus on disaster management and potential disruptions</td>
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<td><strong>Frugal Engineering</strong>: Adopting frugal design and manufacturing practices to reduce waste, and new product innovations to meet desired functionalities at lower cost</td>
<td><strong>Virtual simulation</strong>: Enhance first-time right commissioning and iterate process workflows using virtual simulation</td>
<td><strong>Cyber-security</strong>: Reducing vulnerability of connected devices and systems</td>
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<td><strong>Green Process Innovation</strong>: Using process-centric principles to reduce carbon footprint by using environment friendly processes and materials</td>
<td><strong>Partner Relationship Management</strong>: Including partners in the innovative process and treating them as internal customers to ultimately serve end-customers</td>
<td><strong>Migration strategy</strong>: Continuously current technology focused on maximizing manufacturing ROI</td>
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Competition – Asset Excellence Transformation

**Scenario Analysis**

- $65.00 billion worth of legacy automation systems
- 7% growth over next 10 years
- Intensive focus on return on assets to drive efficiency
- Top-down vision to drive operational strategies
- Change in nature of investments
- Incremental and disruptive approaches to drive manufacturing excellence

**Emerging Manufacturing Implications**

- Emergence of global monitoring centers of excellence – Real time view of operational metrics
- Asset management strategies: Shift from condition monitoring to predictive intelligence
- Remote monitoring services for wired, wireless and stranded assets
- Wireless technologies for transmission of critical process data; Increased unmanned remote sites
- Web-based technologies to promote comprehensive accessibility and availability to diverse end users

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**Dubai eGovernment deploys Enterprise Asset Management system at Dubai Municipality**

31 May 2010

System to reduce costs and ensure sustainability of services

Dubai eGovernment Department is to implement Enterprise Asset Management (EAM) at Dubai Municipality’s Public Transport Department, which oversees the maintenance of over 2,000 light to heavy vehicles and monitors and controls the movement of equipment and the supply of spare parts.

Source: Public Transport Department of Dubai Municipality
Competition – Process Excellence Transformation

Scenario Analysis

- Focus on driving waste reduction and process innovation
- Operational frugality – Making more with less
- Product strategy to service-centric strategy
- Green chemistry – Re-engineering process to drive efficiency at reduced carbon footprint

Emerging Manufacturing Implications

- Simulation lifecycle management to drive understanding of future implications of the product
- Nanotechnology and Biotechnological disruptions expected to revolutionize future approaches
- PAT & QbD are set to drive process excellence
- Innovation management systems are vital to keep the product development engines primed to deliver consistently
- Waste elimination, cloud computing and virtualization are key to success
- Value-added services and migration to advanced automation systems
- Mobile decision support systems to enable faster time to intelligence and autonomous corrective action

“The art of war teaches us to rely not on the likelihood of the enemy's not coming, but on our own readiness to receive him; not on the chance of his not attacking, but rather on the fact that we have made our position unassailable”.

– Sun Tzu, Chinese Thinker and Philosopher

Source: Science Daily
Evolving Paradigms for Manufacturing

Productivity Enhancement

- Manufacturing Execution Systems
- Advanced Process Control
- Distributed Control Systems
- HMI/SCADA
- Cloud Computing
- SaaS
- MEMS Based Sensors & Actuators
- Traditional Transducers
- Smart Sensors
- Wireless Sensors
- Supply Chain Mgmt
- Licensed Software
- RFID Enabled Devices
- Energy Management
- Energy & Emissions Dashboard
- Integrated Energy Management
- Smart Meters
- Digital Field Buses
- Web Based Data Transfer
- Ethernet Based Networks
- Analog Wiring
- Industrial Networks
- 2010
- 2020

Wireless Systems

Manufacturing Intelligence

Project Lifecycle Mgmt

DMS

Digital Manufacturing Systems

SaaS

Distributed Control Systems

Manufacturing Execution Systems

RFID Enabled Devices

Cloud Computing

Licensed Software

Supply Chain Mgmt

MEMS Based Sensors & Actuators

Traditional Transducers

Smart Sensors

Wireless Sensors

Integrated Energy Management

Energy & Emissions Dashboard

Smart Meters

Digital Field Buses

Web Based Data Transfer

Ethernet Based Networks

Analog Wiring

Industrial Networks

2010

2020

FROST & SULLIVAN
Smart Factory 2020

Product and process simulation resulting in reduced design costs

Premium efficiency class motors, pumps and compressors

Quality Management System and Non-destructive testing

Use of Smart Meters enables real-time energy consumption monitoring

Dashboard with real-time information fed through the Manufacturing Intelligence platform

Material Handling conveyor

Mixing & Processing Plant

LV and MV drives coupled with energy efficient products

Waste Water Processing Plant

Drying Chamber

Wireless and MEMS Sensors & Virtual Instrumentation

Heating Plant

Batching & Blending Plant

Chilling Plant

Remote diagnosis and support of production equipment; Virtual Reality based maintenance and planning

Quality Plant

Packaging Shop

Manufacturing Execution System controlling plant operations

Use of Smart Meters enables real-time energy consumption monitoring
Smart Factory Will be Built on Greater Intelligence

2010
REACTIVE

2020
PREDICTIVE

MEMS
Smart Field Devices

Measure

Implement

Analyze

Model Based Performance
Predictive Analytics

Design

Predict

Real-Time Simulation
Optimization

F R O S T & S U L L I V A N

2010 to 2020
Collapse the Invisible Ceiling

Interfaced Connectivity

Integrated Connectivity

Enterprise Level

Supervisory Level

Control Level

Device Level

Supervisory

Device

Control

Enterprise

F R O S T & S U L L I V A N
Smart Data Management for Business Performance Optimization

PAST
- Data in Silo
- Centralized Management
- Operational Silo’s
- Reactive

FUTURE
- Integrated Data Management
- Distributed Management
- Cloud + Centralized Operations
- Predictive and Preventive

Analytics and Visualization

F R O S T  &  S U L L I V A N
Analytics to Define and Manage Data

- Temperature data
- Volumetric flow data
- Level data
- Pressure data
- Emission data

Dispersed Wells

- SCADA MTU 1
- SCADA MTU 2
- SCADA MTU 3

Centralized maintenance, requirements for business performance optimization, display of relational data requires use of analytics.

1-way reporting and control

Strategic Data

Tactical Data
Combination of Technologies

Remote Asset + Innovative Asset Management → Improved Operational Efficiency

User Voice Authentication + Control Loop → Future State of Control
Future: Manufacturing Driven Business

**2010**
- Produce & Sell
  - Single-Silo Decision Making
- Product Defined Market
- Competition between Companies
- Compete on Product and Price
- Need Based
- Stand Alone Equipments & Processes
- In-house Licensed Software with High Maintenance & Up-gradation Costs

**2020**
- Focus
- Markets
- Competitiveness
- Differentiation
- Innovation
- Integration
- IT Infrastructure

- Sense & Respond
- Collaborative Decision Making
- Customer Defined Markets
- Competition between Supply Chains
- Compete on Responsiveness, Product Delivery and Value Addition
- Part of a Continuous Process Optimization
- Seamless Integration Between All Systems
- Cloud Computing and Software as a Service (SaaS) Based IT Applications

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Thank You