e-Manufacturing
Requirements and Challenges

SEMI e-Manufacturing Workshop
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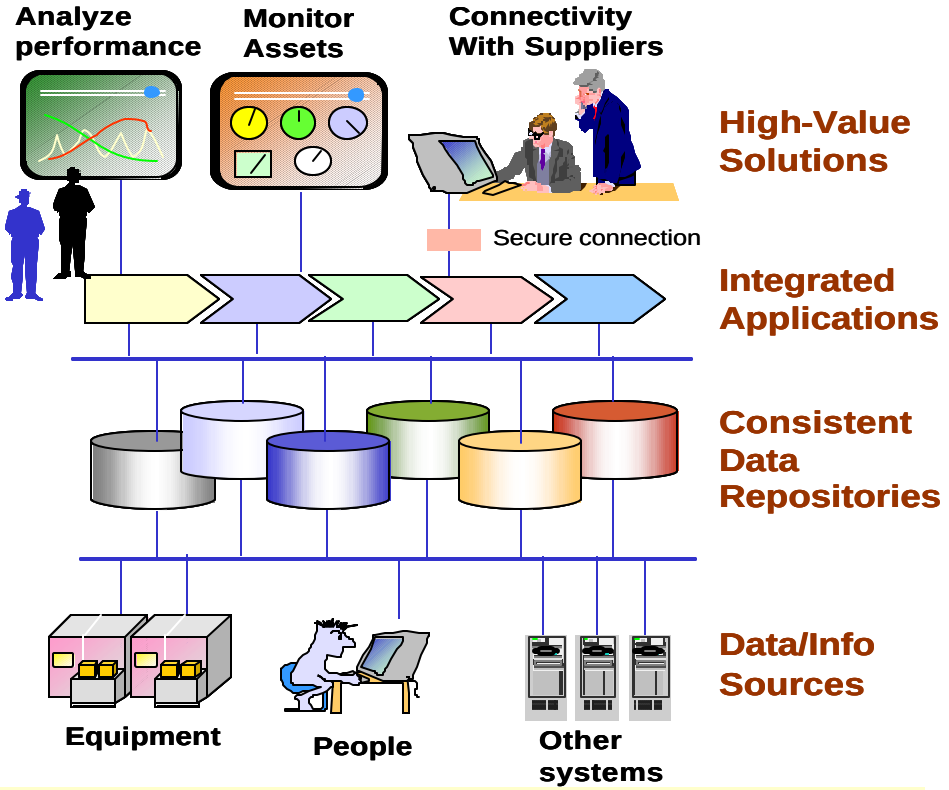
Dave Bloss / Intel (david.a.bloss@intel.com)

Motivation

- **The ability to rapidly share and use information has seen huge improvements in the last few years.**
- **Fueled by the Internet, information technology is quickly expanding and connecting multiple elements in the manufacturing supply chain.**
  - **This is due to significant increase in computational processing power and improvements in data collection, storage efficiencies, context-based information retrieval, data manipulation, ease of accessibility, connectivity, and data mining and analysis.**
- **The challenge for semiconductor manufacturers is how to seamlessly integrate their legacy manufacturing systems with new capabilities in order to keep up with increasing rate of change.**
- **Effective realization of efficiency improvements needed to survive in competitive environments will require utilization of many of these emerging information technology capabilities in manufacturing.**
  - **However, time is of the essence, and we must implement swiftly**

e-Manufacturing

- **This paradigm shift is called e-Manufacturing**
  - **Implies the linking of customers and suppliers via internet**
  - **Enables and provides operational flexibility to each element in the supply chain.**

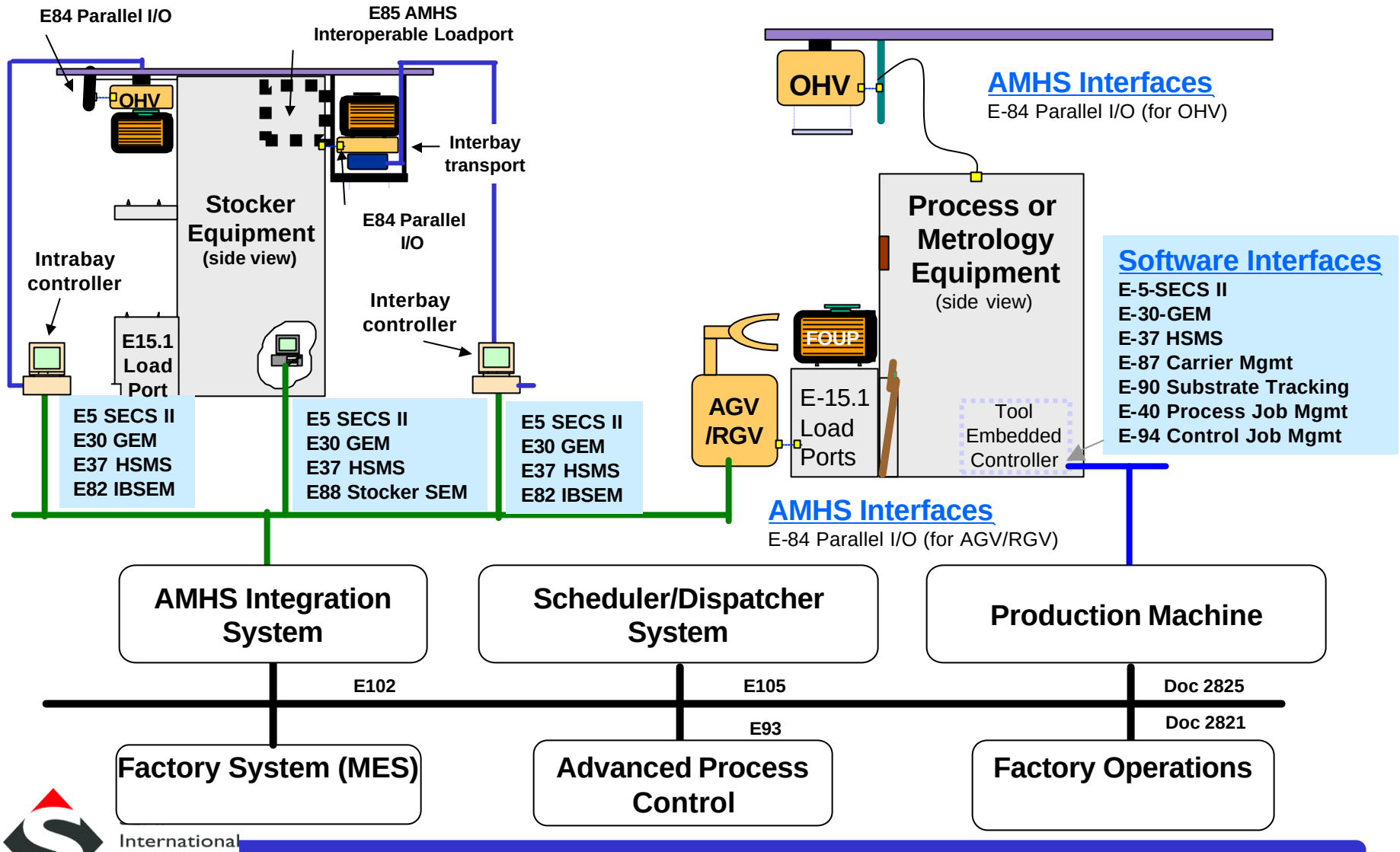


The end result is a reduction of overall manufacturing costs coupled with significant improvements in responsiveness to customer needs amidst changing priorities and operational conditions.

The Many Faces of e-Manufacturing

300mm Fab Automation Standards View

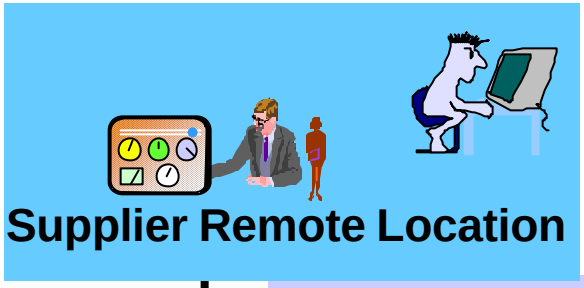
However, standards cycle time has taken far too long…



International Standards

Equipment Engineering Capability View

We have to do this much quicker!!



EES (Equipment Engineering System)

EE Data Sharing

Framework for EE Capabilities

EE Applications

APC App 1 | OEE App 1

APC App 2 | OEE App2

e-Diag App 1 | FDC App1

Relation between MES and EEC

MES

- Equipment Control
- WIP Tracking
- Factory Scheduling

Category & Level of EE Data

Global EE Data

EE Data Collection And Storage

Fire Wall

EE Access Control

EE Data On Demand

Equipment Engineering Network

Standardization of EE Data Interface

Standard EE Data Interface (Logically Separated)

Determination of EE Data

Continuous Monitoring

EE Data Sampling & Transmission

Equipment Performance Integrity

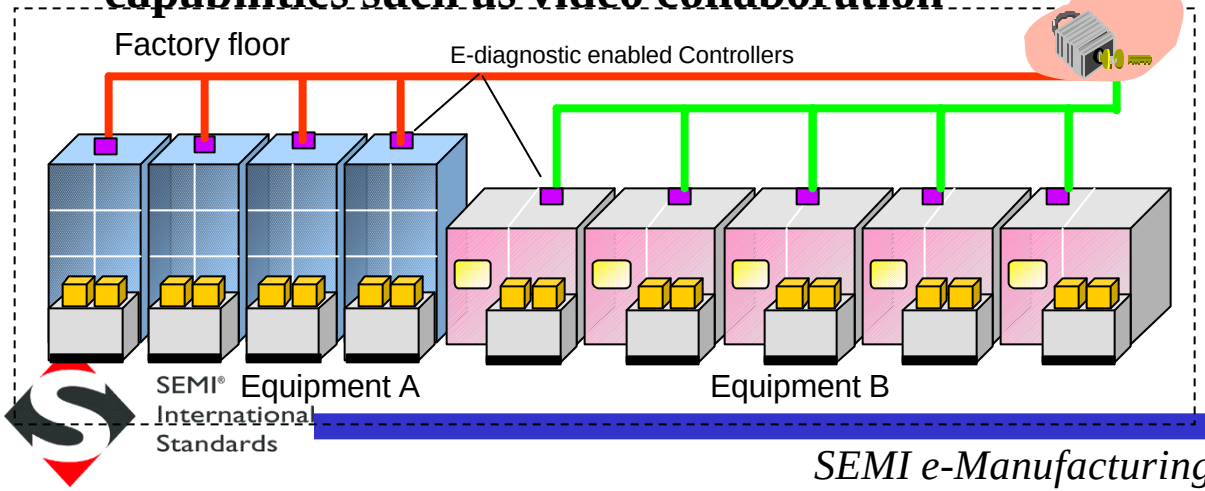
SECS/GEM Interface

Factory Network

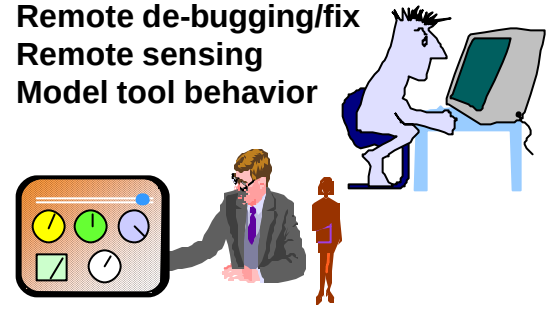
SEMI® International Standards

e-Diagnostics View

- **Equipment diagnostics data is available via remote access capability**
- **Equipment is remotely configurable for initial set-up or to resolve and debug issues**
- **PM utilities are available to fix issues in advance of problems**
- **Has built-in intelligence to determine whether to allow specific remote capabilities to be run**
- **Permit using enabling audio-visual capabilities such as video collaboration**



Remote monitoring
Remote diagnostics
Remote de-bugging/fix
Remote sensing
Model tool behavior



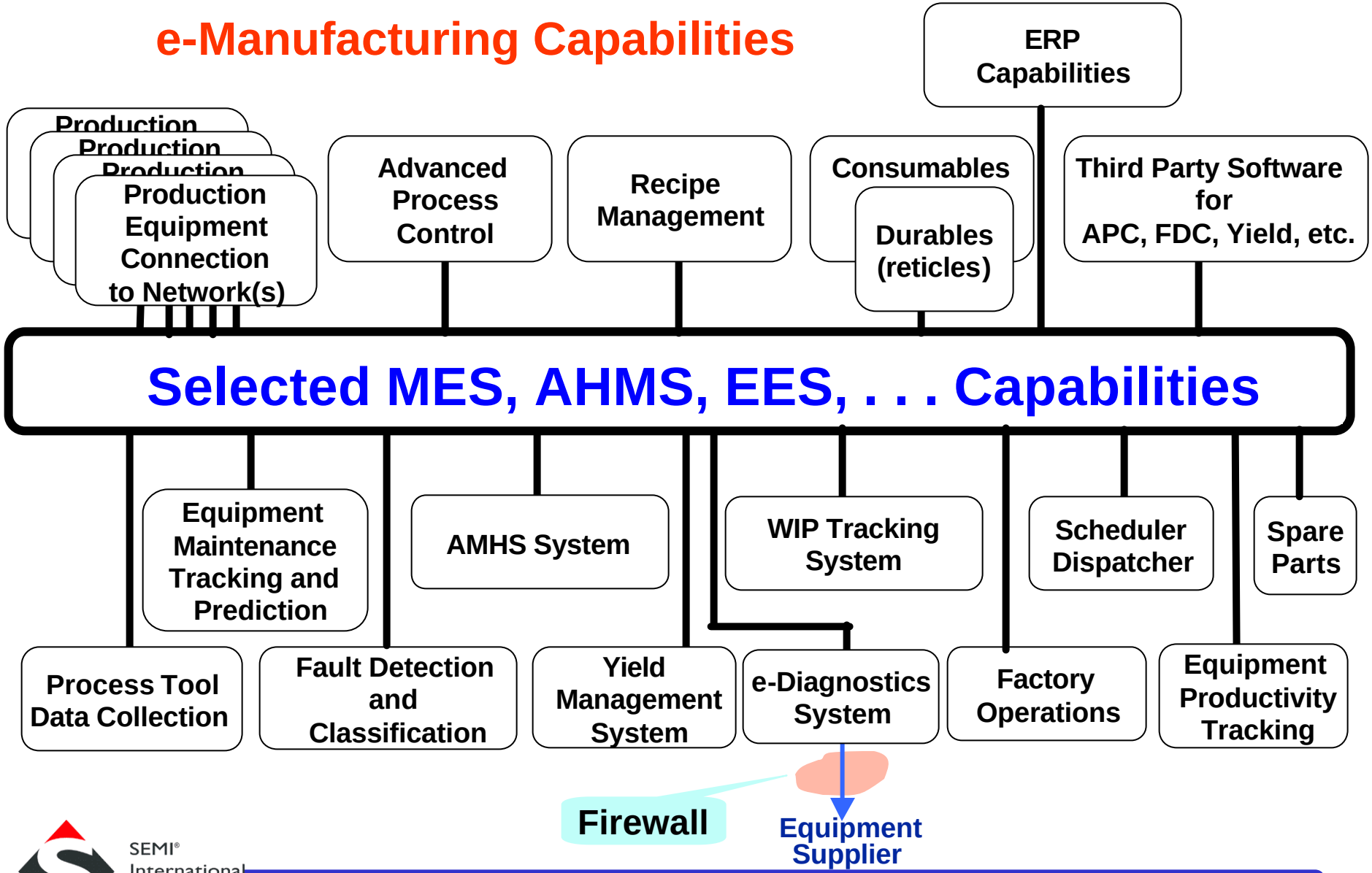
Supplier A Main Office

Remote monitoring
Remote diagnostics
Remote de-bugging/fix
Remote sensing
Model tool behavior

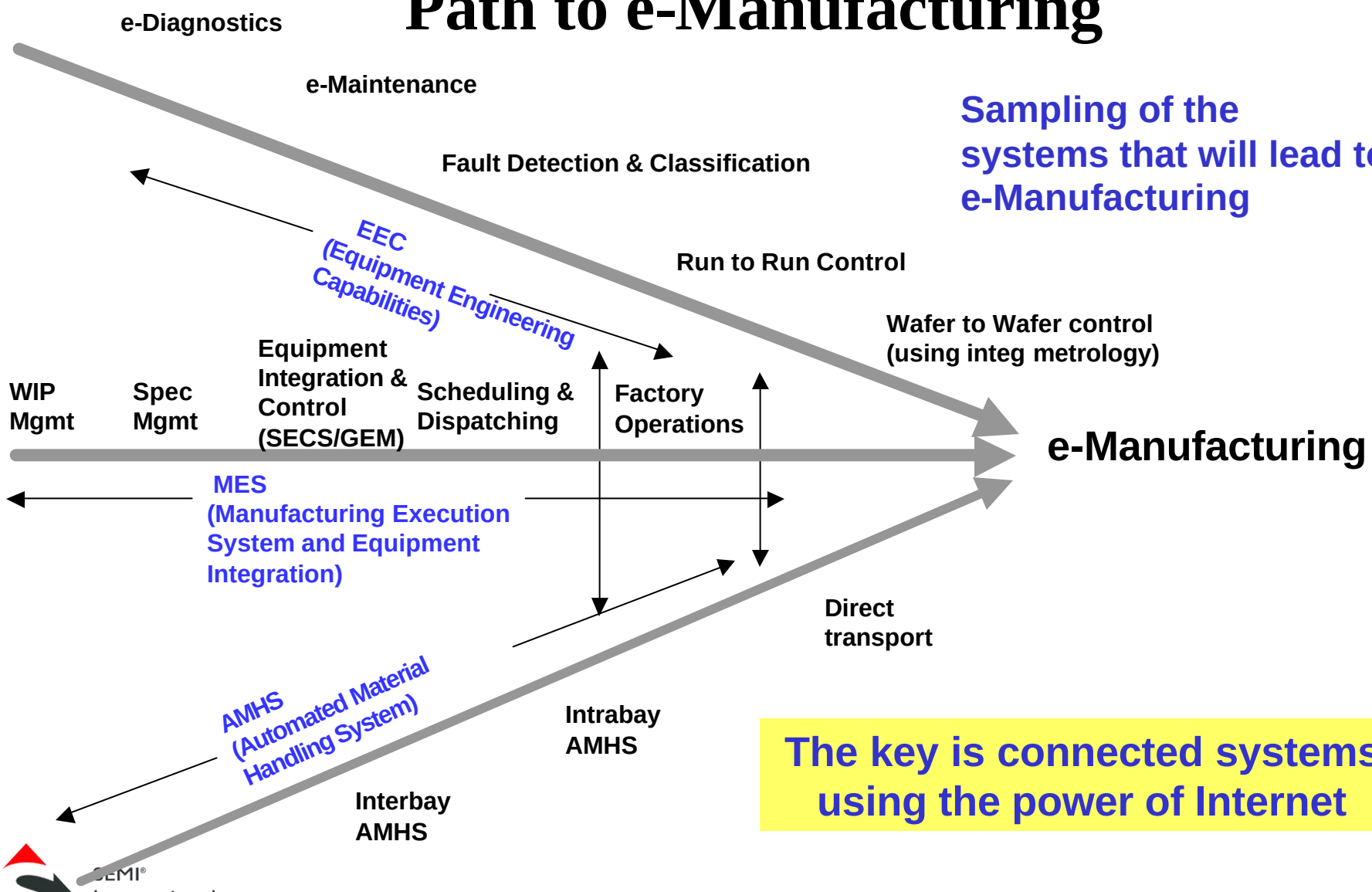
Supplier B Main Office

SEMI® International Standards

e-Manufacturing Capabilities



Path to e-Manufacturing



Sampling of the systems that will lead to e-Manufacturing

The key is connected systems using the power of Internet

Key e-Manufacturing Capabilities

- **Connected Information and Data Sources**
  - **The factory's existing (MES, AMHS, equipment control, factory scheduling, etc.) must be connected with information that is originating from other relevant data sources (people, equipment or other systems).**
- **Consistent Data Repositories**
  - **Reference data, current data, historical data, external data, and raw detailed data are all required for decision making.**
  - **To eliminate data redundancy and inaccuracies, every data element in the infrastructure must have one data source.**
- **Integrated Applications**
  - **Secure and integrated environment of application databases and web-enabled user interfaces based on consistent sources of data.**
- **High Value Solutions**
  - **On-line reporting and data retrieval capabilities targeted at making this data available in an integrated, flexible manor.**

Key e-Manufacturing Challenges (1/2)

- **Obtaining relevant, accurate data from the equipment in an automated manner which can be easily integrated with other factory systems.**
  - **Today the accuracy of equipment data is dependent on each specific equipment model.**
  - **This leads to inaccurate data being propagated throughout the factory systems, which in turn, leads to poor decisions**
  - **Process, metrology, and facilities equipment must generate accurate performance data related to both equipment and 'process' health in order to feed supplier links, monitoring, and analysis tools.**
- **Integration of process, metrology, and facilities data with factory systems.**
  - **Today equipment and process data is provided in non-standard, rigid implementations that are dependent upon each specific equipment model.**
  - **This leads to expensive, custom integration with factory systems and manual data collection in cases where automated integration is not feasible.**
  - **Factory equipment must provide standardized automated interfaces based on mainstream computing technologies to reduce cost, reduce risk, and increase integration efficiency.**
  - **Often times, these systems are standalone islands – no connectivity today**

Key e-Manufacturing Challenges (2/2)

- **Integration of 3rd party applications into traditional factory systems.**
  - **Today integration of 3rd party applications is cost-prohibitive due to the use of proprietary interfaces and closed architectures – High risk/takes too long.**
  - **Future solutions must use open architectures and mainstream computing technology in order to reduce the cost of integration and long term support.**
- **Security**
  - **Data is a valuable asset to both IC makers and suppliers, and requires creation of new business processes and security measures in order to protect the intellectual property of all involved.**
  - **Data must be classifying relative to its intellectual property value in order to determine the level of protection required.**
  - **Future solutions must make use of technologies such as encryption, firewalls, proxy servers, hardened operating systems, user identification / authentication, and detailed logging are required to ensure that only authorized users have access to specific functions, equipment, and data.**
  - **Business procedures must also be in place to complement technology use.**

Summary

- **e-Manufacturing can be characterized as providing the right data to the right people at the right time by leveraging the power of the internet**
  - **Coupled with decision support systems that act upon this information with or without people intervention.**
- **The overall goal of this effort is to synchronize the planning, procurement, ramping and operations of a factory.**
  - **And its support functions at significantly faster (at Internet) speeds and greatly reduced costs.**
- **This synchronization is enabled by efficient information flows between the factory, its suppliers, its customers and the factory's internal support groups.**

Next Steps

- Up to this point, these significant changes in factory systems and operational paradigms have been focused on solving specific issues
  - Resulting largely in expensive point solutions.
- In order to achieve widespread benefits across the supply chain, IC makers must now define a common roadmap of capabilities, and work together with suppliers to define solutions for IC industry customers.
  - Mainstream computing technologies developed outside of the semiconductor industry must be utilized to significantly reduce risk, development cost and implementation costs.
- As a first step, IC makers are analyzing these basic building blocks in the area of production equipment productivity enhancement programs.
  - Prioritization in this area is only natural because of its high upfront capital cost and high depreciation costs.
- There is a tremendous urgency to achieve benefits in the areas of overall equipment efficiency, increased availability and uptime, process improvement, and overall manufacturing cost reduction.
  - The definition and standardization of these building blocks will enable cost effective implementations to occur at a rapid pace throughout the industry.
  - The standardization process must also reduce its cycle time significantly.