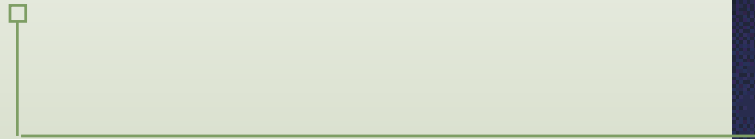


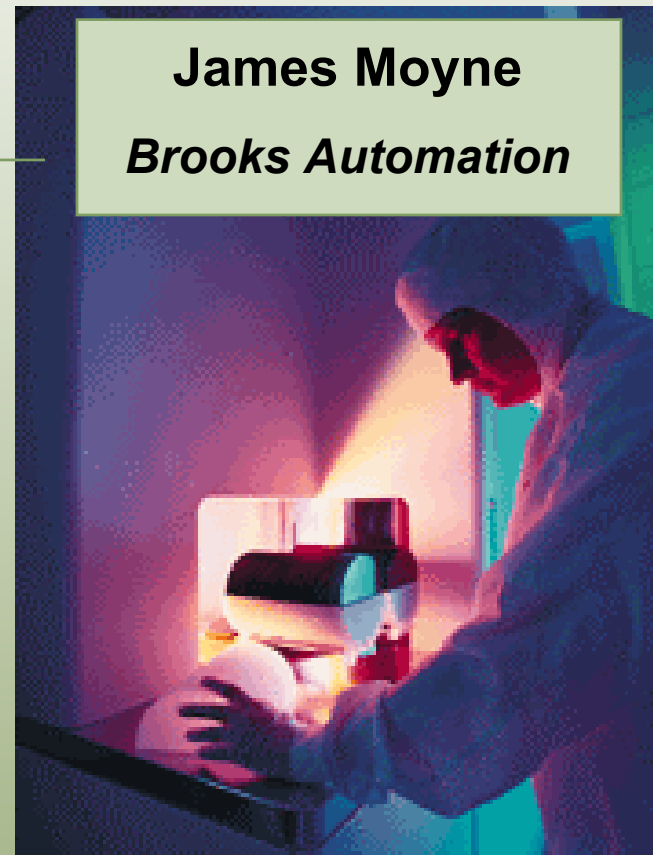


SEMI APC and IM Standards Update



*6th European Advanced Equipment Control/
Advanced Process Control (AEC/APC) Conference
April 6-8, 2005*

James Moyne
Brooks Automation





Area of Focus

- **I&CC:** Information and Control Committee (North America and Japan)
 - **PCS:** Process Control Systems Task Force (R2R)
 - **ECS:** Equipment Control Systems Task Force (R2R)
 - **DDA:** Diagnostic Data Acquisition Task Force (FDC)
 - **DQ-TM:** Data Quality Test Methods
 - **RAP:** Recipe and Parameters Task Force
 - **XML:** eXtensible Markup Language Task Force
 - **IM:** Integrated Metrology Task Force

APC Focus

IM Focus



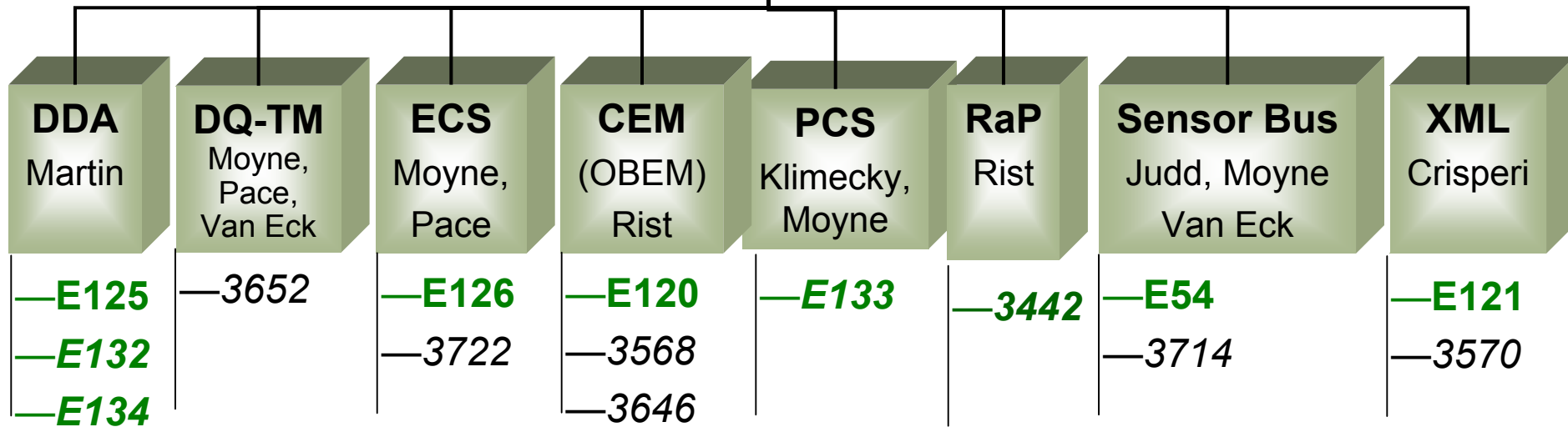
Current SEMI Standards Efforts Related to APC and IM

Information and Control Committee (NA)

International Equipment Engineering
Rist

KEY

- Standards
- Ballots



IM - Kamlet — E127

A significant, but ongoing effort



APC and IM Standards Efforts:

Brief Descriptions

- Diagnostic Data Acquisition (DDA)
 - **Specifying “Interface A” (EDA—Equipment Data Acquisition); 2nd (Ethernet-based) interface to the tool to support e-diagnostics and health monitoring**

- Data Quality (DQ)
 - **Specifying definitions, attributes and test procedures for verifying data quality capabilities**

- Equipment Control Systems (ECS)
 - **Specifying equipment quality information parameters (EQIPs) and their links to tunable process parameters to enable R2R control**

- Common Equipment Model (CEM)
 - **Specifying a common, extensible object oriented equipment model that other modeling standards may link to (extend) for consistent modeling throughout the tool**



APC and IM Standards Efforts:

Brief Descriptions

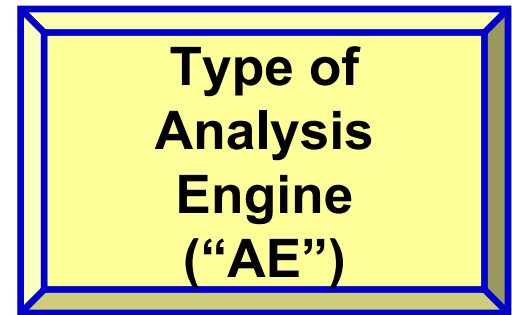
- **Process Control Systems (PCS)**
 - **Specifying “Interface B”; interface to PCS applications such as R2R control and FDC**
- **Recipe and Adjustable Parameters (RaP)**
 - **Specifies management of multi-part recipe specifications (e.g., including APC recipes); supports tunable recipe parameters (e.g., for R2R control)**
- **Sensor Bus Sub-committee**
 - **Specifying communication and device model standards for devices interoperating over a sensor bus network**
- **eXtensible Markup Language (XML)**
 - **Specifying general practices for utilizing XML in semiconductor Information and Control standards**
- **Integrated Metrology (IM)**
 - **Specifying object model and communication integration mechanism for and integrated measurement module (e.g., metrology)**



Process Control Systems Standard (E133)

Status (1)

- ✓ Define PCS and each PCS **Functional Groups and Group Capabilities**
 - Run-to-Run Control (R2R)
 - Fault Detection (FD)
 - Fault Classification (FC)
 - Fault Prediction (FP)
 - Statistical Process Control (SPC)
- ✓ Define Input/Output **Interface Data Model** (approved this year)
- ✓ Define **R2R control** required data elements (approved this year)





Process Control Systems Standard (E133) Status (2)

- ❖ Current Activities
 - ❖ Define XML message format (yellow ballot)
 - ❖ Define SPC required data elements (blue ballot)
 - ❖ Define FD required data elements (in development)

- ❖ STEP planned for SEMICON/West
 - ❖ SEMI Technical Education Program

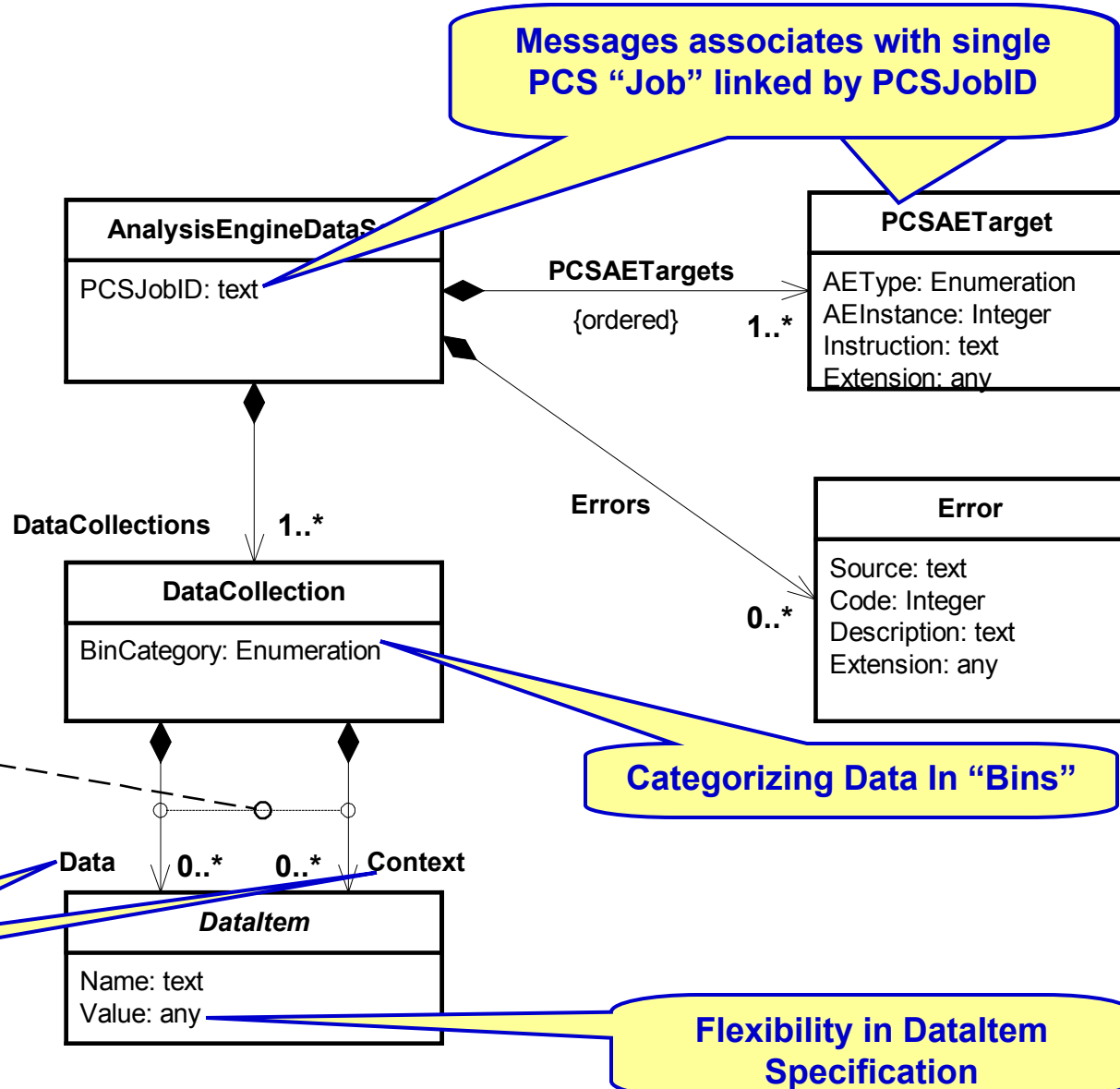
- For Additional Information Contact
 - Pete Klimecky (pete.i.klimecky@intel.com)
 - James Moyne (james.moyne@brooks.com)



Process Control Systems Standard (E133)

Implementation: UML and XML

- UML model provides **data structure**
- Standard additionally specifies **ordering rules** for I/O messaging
- Ordering & Nesting of data reduces the parsing requirements for each AE





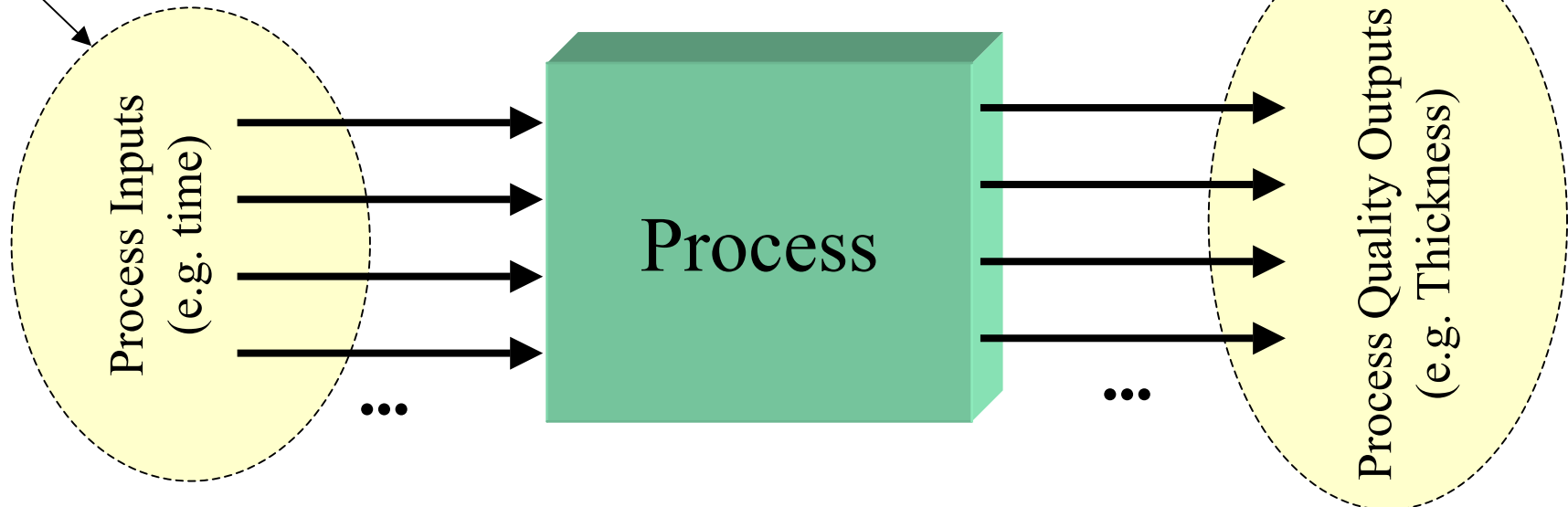
EQIP Standard (E126)

for R2R Control Enabling

1. *EQIPs* requires OEM to specify “Tunable Parameter” sets that affect each “Process Quality Output”
2. *EQIPs* requires that OEM provide access to tune these parameters using SEMI standard methods

EQIPs defined for process types

Tunable Parameter
(in GEM Recipe)





EQIP Standard (E126)

Status → Now a Full Standard

- ✓ Standard provides EQIPs for **CMP**, **Lithography**, **Etch**, **CVD**, **Diffusion** and **Deposition**
 - ✓ Standard includes compliance specification
- ❖ EQIP tutorial as part of PCS STEP during Semicon/West 2005
 - ❖ SEMI Technical Education Program
- ❖ Survey currently in circulation to see if industry would like to add EQIPs to the specification
 - ❖ Additional EQIPs added as necessary by end of 2005
- ✓ For Additional Information Contact
 - ✓ James Moyne (james.moyne@brooks.com)
 - ✓ John Pace (j.pace@siautomation.com)



SEMI E127 (IMM) – An Overview

- This is a specification for a module capable of receiving and sending a substrate (e.g., wafer) and providing measurement data, and optionally data conversion, to a semiconductor process tool.
 - “raw” signal intensity data can be converted to layer thickness

- Multiple ports
 - One Control Client, usually the integrated tool
 - One or more for other Data Clients
 - APC applications running on or off the tool
 - Host post-analysis and archiving



IMM Standard: E127

Status

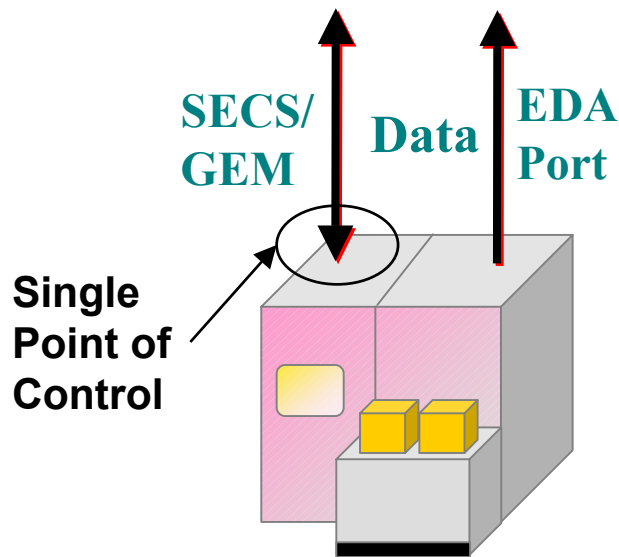
- E127 is fully approved and released.
 - E127.1 is addition of SECS-II mapping (mappings to SECS-II error codes (ERRCODE) and text)
- It is available from SEMI for implementers NOW!
- What is left to do?
 - Complete E127.1 with Add a mapping to XML as E127.2
- For more information contact
 - Len Kamlet, leonard_kamlet@mksinst.com



EDA Standards

Status

- **Standardize a 2nd port to the tool, for data only (not control)**
- Standards are fairly mature
 - Ballots for updating and fine tuning
 - Simplified data model being discussed (NIST)
- Adoption has yet to occur
 - Many OEMs are considering
- ✓ For Additional Information Contact
 - ✓ Luo, Xian [xian.luo@intel.com]



- *Process Control and Equipment Operational Data*
- *Host-Independent Data Collection*
- *Data Collection Plans → E134*
- *Equipment Self-Description → E125*
- *Authentication and Authorization → E132*



Sensor/Actuator Network Standard (E54)

Status

- ✓ Very active over past 18 months
- ✓ New “dot” standards
 - ✓ SafetyBus p (control networks that also support safety)
 - ✓ ProfiNet (Europe)
 - ✓ A-link (Japan)
 - ✓ LonWorks (significant update to align with current E54)
- ❖ Current Activities
 - ❖ Vacuum Pump specific device model
 - ❖ Active effort driven by efforts to reduce power consumption of these devices
 - ❖ Define an “IDLE” state and associated behavior
- ✓ For Additional Information Contact
 - ✓ James Moyne (james.moyne@brooks.com)
 - ✓ Brad Van Eck (brad.van.eck@ismi.sematech.org)
 - ✓ Dan Judd (danjudd@alum.mit.edu)



Data Quality Task Force

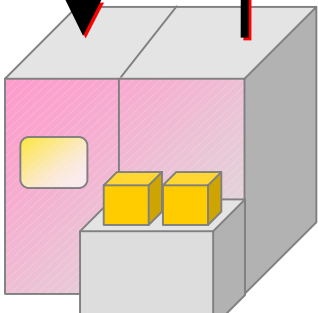
Status

- Specifying **Definitions**, **Attributes** and **Test Procedures** for communicating and verifying quality of data coming out of the tool
- Effort currently on hold
 - Concerns expressed by ISMI on approach, but no alternative offered and no resourcing from ISMI
 - Frustration of volunteer authors of first document
 - **Do not expect a data quality standard any time soon**
 - Current effort is a survey
- For additional information contact brad.van.eck@ismisematech.org

SECS/
GEM

Data

EDA
Port



(1) Quality of Protocol

- Reply to Request
- Well-formed Reply
- Proper Events Reported
- No Duplicate Data
- No Out-of-order Data
- ...

Focus Area

(2) Quality of Data

- Accuracy and Precision
- Resolution
- Correct Data
- Correct time-stamping
- Sufficient Context with Data
- Data Freshness
- ...



RAP Standard

Status

- SEMI E139 (RaP) approved Oct. 2004
 - Minor fixes approved Mar. 2005

- RaP Needs Implementation Mappings
 - E139.1 (XML Schema for PDE's) approved Mar. 2005
 - SECS-II Messaging (139.2) *ballot for Cycle 4 2005*
 - XML/SOAP Messaging – Web Services (139.3) **2005**

- Some Additional Improvements In Discussion

- For additional information contact:
 - Lance Rist, lance.rist@ismi.sematech.org
 - Refer to Rist presentation, this conference



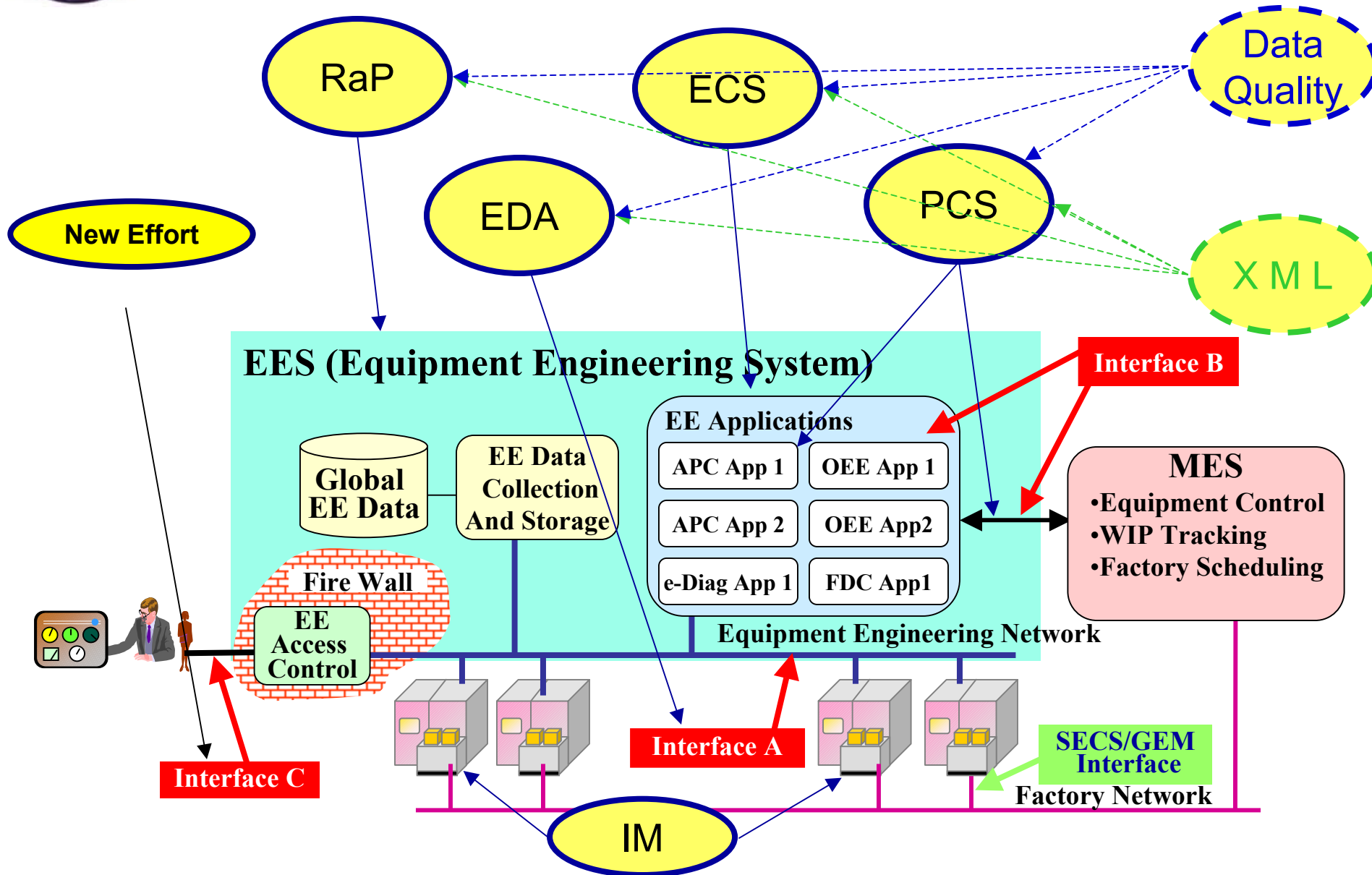
CEM Standard (E120)

Status

- CEM is complete
- Developments in EDA (and its implementation) are driving some changes
 - Equipment Component identification will be modified (using locator over uid)
 - Modeling advice is needed to obtain consistency
- XML TF is driving some simplification of the XML schema
- Adding MaterialLocation types (esp. for discrete consumables) and subtypes of OBEM TF (owner of CEM)
- Planning to sunset as soon as the above are complete. CEM will move to DDA TF.
- For additional information contact:
 - Lance Rist, lance.rist@ismi.sematech.org



Summary: Using APC and IM Standards in Fab-wide Deployment





Summary

- IMA membership supports and is fully engaged with SEMI APC and IM standards
 - E.g., facilitating the E54 Vacuum Pumps SDM standard development

- We hope you had time to check out our poster on standards at this conference
 - Identifying the consensus level of interoperability via SEMI standards (co-authored by suppliers and users)