



BUILD ELECTRONICS BETTER

Automotive electronics drives the electronics industry to accelerate towards intelligent manufacturing 汽车电子推动电子制造行业加速走向智能制造

September 12, 2023
@IPC WorksAsia



ipc.org →

> **成立于1957年**，IPC是全球电子制造业最有影响力的行业组织之一，最初由北美6家PCB制造商发起成立，全称为 Institute of Printed Circuits 印制电路协会。如今，IPC旨在帮助OEM原始设备制造商、EMS电子制造商、PCB印刷电路板制造商、线束线束制造商以及电子行业供应商更好地制造电子产品。



> **IPC 使命:** Furthering the competitive excellence and financial success of members. **提升会员竞争优势，使其获得财务成功。**

> **IPC 愿景:** Helping the World Build Electronics Better. **帮助世界更好地制造电子产品。**



1957-1966

IPC正式成立

出版《IPC-A-600印制电路板的可接受性》



1967-1976

IPC活跃于IEC

出版第一份《印制电路板市场调研报告》



1977-1986

接受ANSI认证

出版《IPC-A-610 电子组件的可接受性标准》



1987-1996

定义EMS行业

(电子制造服务业)
发起IPC印刷电路博览会
(IPC Expo)



1997-NOW

中国办事处成立

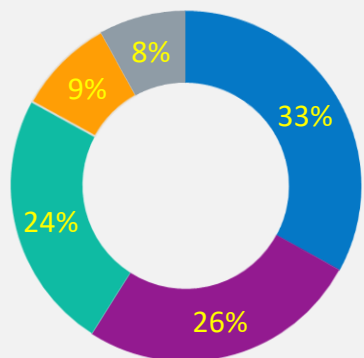
出版《IPC-A-620标准》
成立设备制造商、焊料、
无铅化等理事会、委员会

IPC会员构成



“ 作为会员驱动型的组织，IPC成立至今已有3000+集团会员分布在全球64个国家。结合中国“十四五”规划和2035年远景目标，IPC聚焦产业标准、高技能人才教育、科技创新解决方案等项目，集聚全球产业链资源，提高中国电子制造业的竞争优势，促进中国电子制造业的高质量发展。 ”

会员全球行业分布



- 原始设备制造商
- 电子制造服务商
- 供应商
- PCB制造商
- 政府、教育机构、非盈利机构



* 以上企业排位不分先后

IPC标准树



六大认证标准

IPC/WHMA-A-620
线缆线束的要求和验收

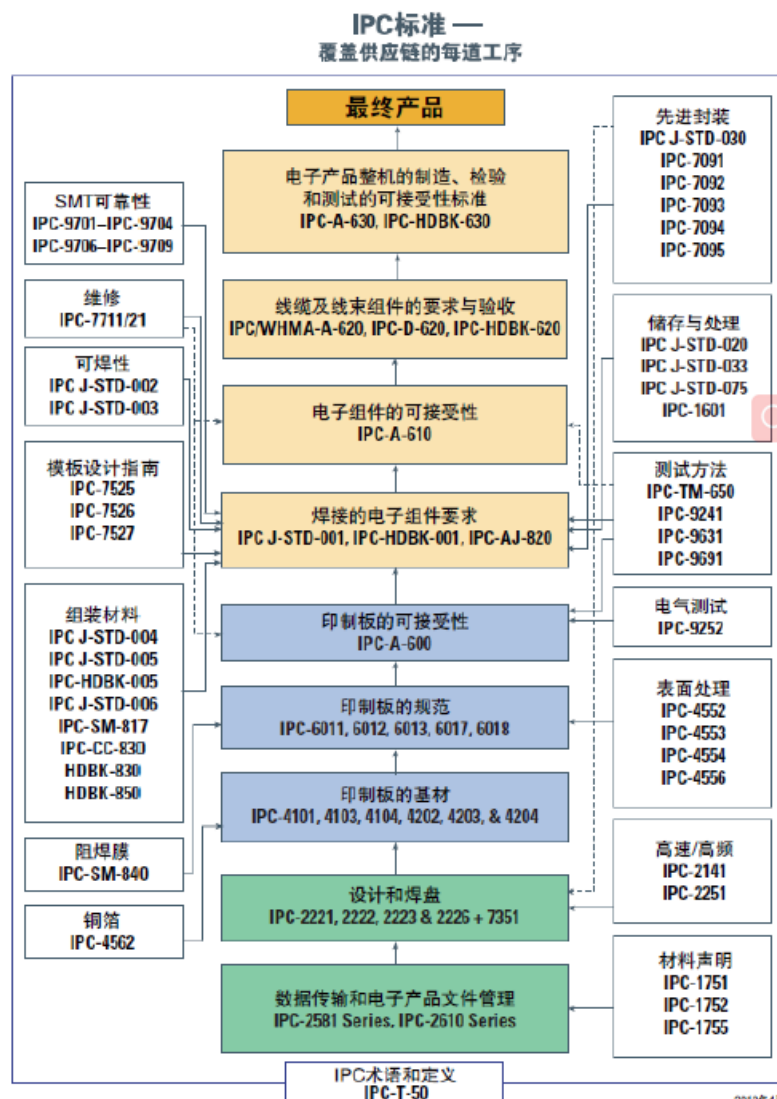
IPC-7711/7721
电子组件的返工、维修和修改

IPC-A-610
电子组件的可接受性

IPC-J-STD-001
焊接的电气和电子组件要求

IPC-A-600
印制电路板的可接受性

IPC-6012
刚性印制板的鉴定及性能规范



最终产品

清洗&涂覆

焊接&组装

PCB 制造

PCB 设计

> IPC标准与印制电路板生产和组装过程中的每一个步骤都息息相关。从设计到采购到组装，再到最终验收，IPC都有对应的系列标准，他们可以促进会员公司产品的所有电子组件都具备卓越的质量、可靠性和一致性。

380

全球共计380个标准
技术组

70

来自70多个国家地区的
各行业顶级企业
共同参与

5,000

全球活跃的志愿者人数
超5,000人



由企业担任IPC特定标准
的主席单位

五大核心裨益



72%
提升质量

53% 提升竞争力

43% 减少返工

39%
降低不必要的
报废

33% 减少现场失效

28% 提升产量

20% 提升盈利能力

您的公司如何通过使用全套
IPC 产品和服务而获益？

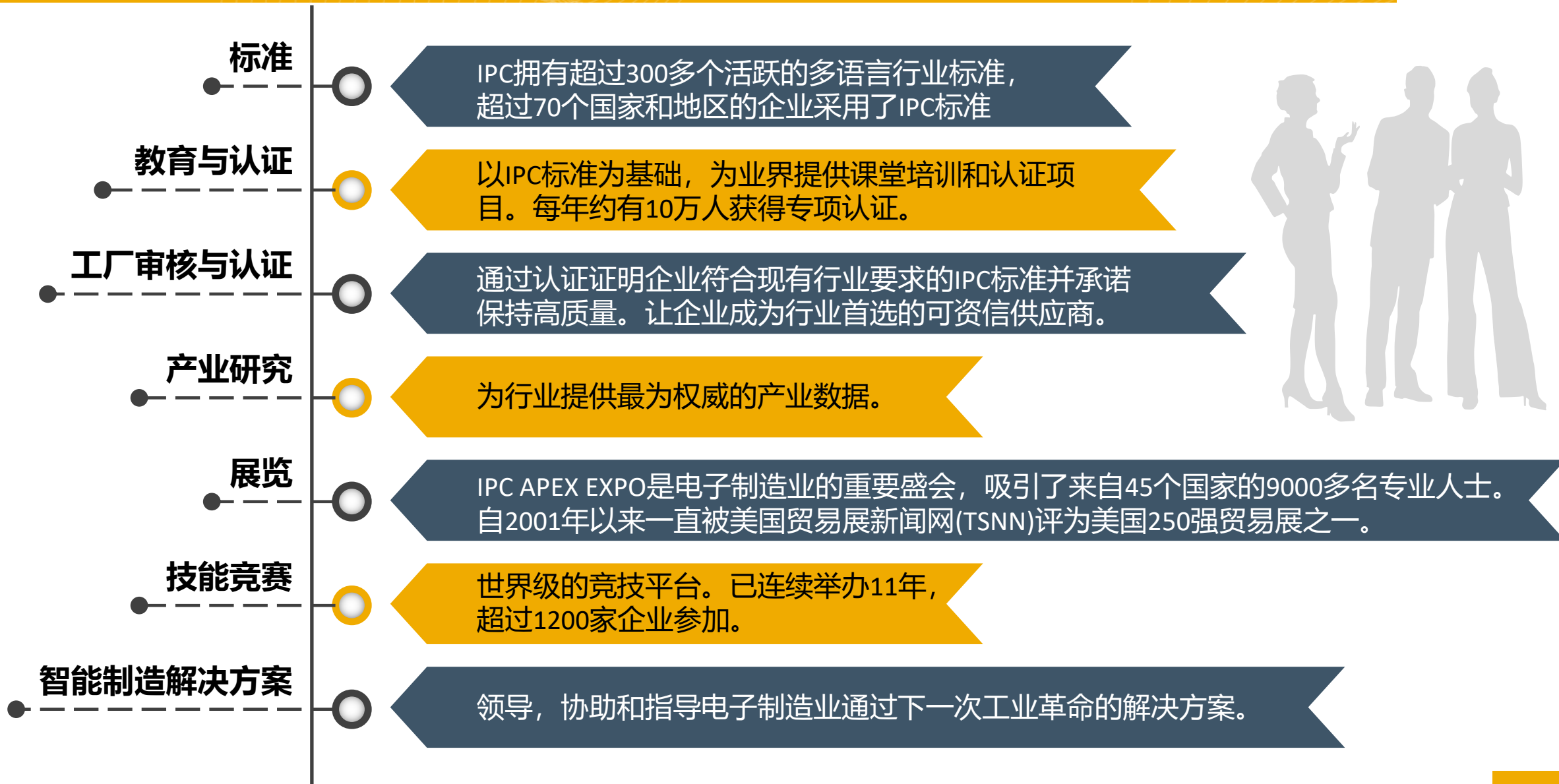
IPC 会员认为质量和竞争力的
提升是最大的收益

“中车参与IPC国际及行业标准化活动，极大助推了中国轨道交通产业的高速高质发展，有效促进了技术与产业的引进来和走出去，将继续为中车的开放创新、协同创新提供舞台，也将为轨道交通产业全球发展、企业转型升级提供源源不断的生机和动力。同时，期待未来双方在标准化作业、在职培训、在岗培训、校企合作及工匠培养等方面深入探讨及合作，开创更多新局面境界，坚强有力地支撑起高铁电子产品稳定、可靠、高速奔驰在世界各地，载着梦想和责任感，高质高效驶向未来。”

中国中车股份有限公司副总裁
王军

“我们在中国的供应商在全球范围内为通用汽车提供部件，而IPC标准在提高我们供应商的质量表现方面发挥了重要的作用。通过在供应链体系贯彻IPC标准，2019年一共有143家电子组供应商获得通用汽车中国质量优秀奖，占比20%，打破了往年的记录。未来，通用汽车中国将与IPC共同履行Build Electronics Better的承诺，推动电子行业的发展。”

通用汽车中国及上汽通用供应商质量与发展总监
顾明



Engine Control Unit

Chip resistors : RK73

Anti sulfuration : RK73_RT

High power chip resistors : WK73

Current detecting resistors : SL

Anti surge resistors : SG73/S/P

Anti sulfuration surge :

SG73_RT

Chip varistors : NV73DL

Thermal sensors : SDT73V

Air Flow Sensors

Platinum thermal sensors : SDT101B

Precision resistors : RN73H, KPC

Engine Ignition

Ceramic resistors : CPCN

Transmission Control

Current detecting resistors :

SL, TLR, WK73

Thermal sensors : SDT73V

Temperature Compensation For Various Sensors

Thermal sensors : SDT73V, LT73V*

Lamp Burn Out Detection Circuit

Current detecting resistors :

SL, LR, BPR

Precision chip resistors :

RN73H, KPC

Electric Power Steering

Precision chip resistors :

RN73H, KPC

Current detecting resistors :

PS, TLR, SL, LR

Anti sulfuration surge :

SG73/S/P

Hybrid Vehicle

Power resistors :

BGR, BWR, BSR

Car Audio

Current detecting resistors :

SR73, UR73

High quality sound : RK73A

Precision chip resistors : RN73H

Choke coils : LPC, LFC32

Chip fuses : CCF, CCP, TF

Surge absorber : SA

Chip varistors : NV73DL

Thermal sensors : LT73V*

Car Navigation

Choke coils : LPC, LFC32

High freq. Inductors : KL73, KQ, KQC

Chip fuses : CCF, CCP, TF

Chip varistors : NV73DL

Thermal sensors : LT73V*

Smart Key System

Current detecting resistors :

SL, TSL

High freq. Inductors :

KL73, KQ, KQC, LFC32

Transponder coils : KT

DC/DC Converter

Current detecting resistors :

SL, TLR, LR72, LR

Precision chip resistors : RN73H, KPC

High voltage chip resistors : HV73

Exhaust Emissions Sensor Control Circuit

Precision chip resistors : RN73H, KPC

Current detecting : SL

Thermal sensors : ST

Battery Management System

Precision chip resistors : RN73H, KPC

Current detecting resistors : SL, TLR, PS

4WD Control System

Current detecting resistors : SL

CAN-BUS

Varistors : NV73DL

ABS • Brake Control System

Current detecting : SL, SR73

Precision resistors : RN73H, KPC

Thermal sensors : SDT73V

Body Control, Motor Control for Power Window, Door and Mirror

Current detecting resistors :

SL, TSL, SR73, WK73

Anti surge resistors : SG73/P/S

Varistors : NV73DL

Air Conditioner Control System

Current detecting : SL, TLR

Thermal sensors : LT73V*

Varistors : NV73DL

Tire-Pressure Monitoring System

High freq. Inductors : KL73

Transponder coil (Receiver) : KT

Instrument Panel, Electronic Relay

Current detecting resistors :

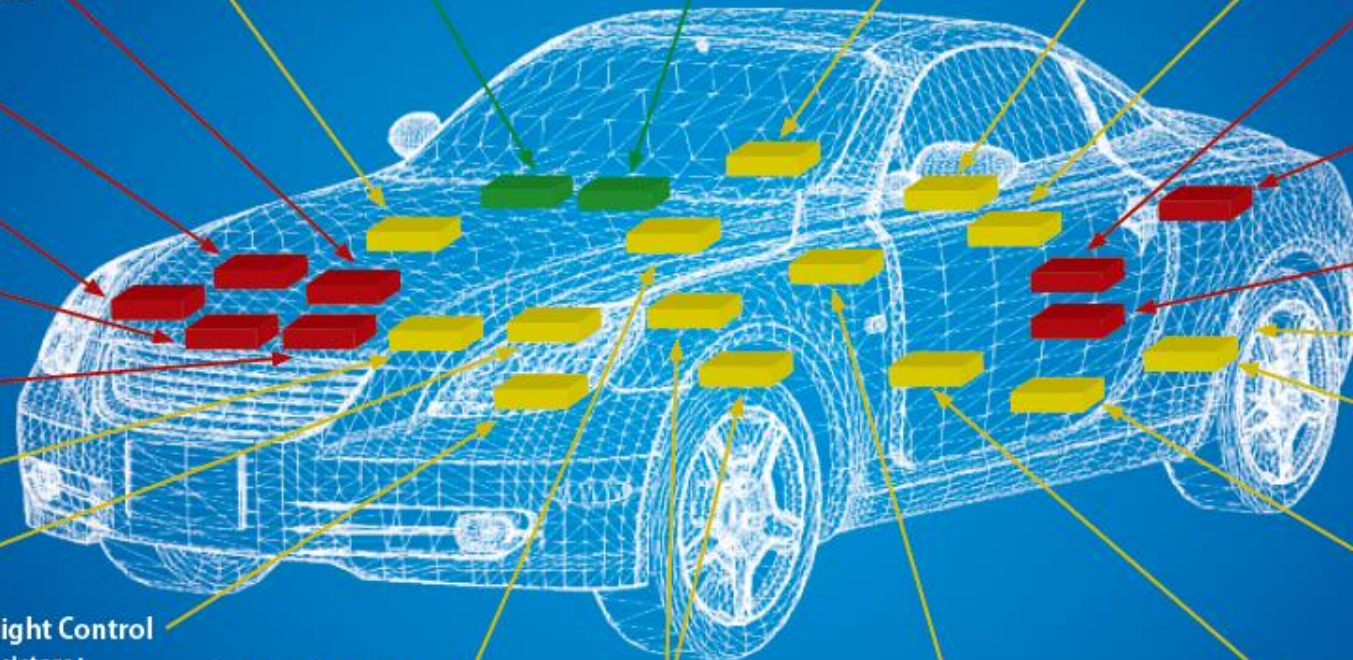
TSL, SL, TLR, SR73, WK73

Power Seat Control

Current detecting :

SL, TSL, BPR, SR73

Varistors : NV73DL





Collaborate. Modernize. Transform.
协作、现代化、转型

Vision

愿景

To harness the full potential of factory of the future / Ind4.0 technologies.

充分利用未来工厂/工业4.0技术的潜力

Collaborating with companies solving real business problems, delivering measured business value, and enabling a sustainable electronics manufacturing ecosystem.

与公司合作处理现实商业问题、实现可量化的商业价值以及构建可持续的电子产品制造生态系统

Driving the industry to Build Electronics Better

驱动行业更好地制造电子产品

Approach

方法

- Intended to promote and accelerate modernization across the electronics manufacturing industry
- 完善和推动电子产品制造产业现代化
- Structured to foster industry-wide awareness, collaboration, and adoption
- 强化整个产业的意识、协作和适应能力

Value

价值

- **Implementation focused; 聚焦于可实施;**
- Help companies attain business value and ROI within their own operations
- 帮助公司在各自运营方式中获得商业价值和投资回报
- Utilize IPC network to drive collaboration, awareness, learning, sharing, and implement new solutions
- 提升产业内协作、意识、学习、共享以及执行新型解决方案
- Drive unified, standardized, and simplified industry transformation
- 推动统一化、标准化和便捷化的产业转型

IPC未来工厂是通过工业流程现代化、数字信息技术手段以领导、协助和引导电子制造业走向工业4.0和实现数字化战略升级转型的一个解决方案。

其中一些新的颠覆性技术已经存在，如人工智能检测、人工智能机器学习、CAD、3D设计、仿真、3D打印等。IPC与这些创新技术公司联系，整理这些技术，并为电子制造业现代化提供一个重点。

ipc.org →

IPC Factory of the Future Related Standards www.ipc.org/ipc-factory-future

IPC-2551 International Standard for **Digital Twins**
IPC-2551 数字孪生国际标准

IPC-HERMES-9852 The Global Standard for Machine-to-Machine Communication in SMT Assembly
IPC-HERMES-9852 表面贴装技术组装中机器对机器通信的全球标准

IPC-2552 General Electronic Components **Model Based Definition (MBD)** Standard
IPC-2552 通用电子元器件基于模型定义(MBD)标准

IPC-2581C Generic Requirements for Printed Board Assembly Products Manufacturing Description Data and **Transfer Methodology**
IPC-2581C 印制板组件产品制造描述数据和传输方法的通用要求标准

IPC-2591 Connected Factory Exchange (**CFX**)
IPC-2591 互联工厂数据交换 (CFX) 标准

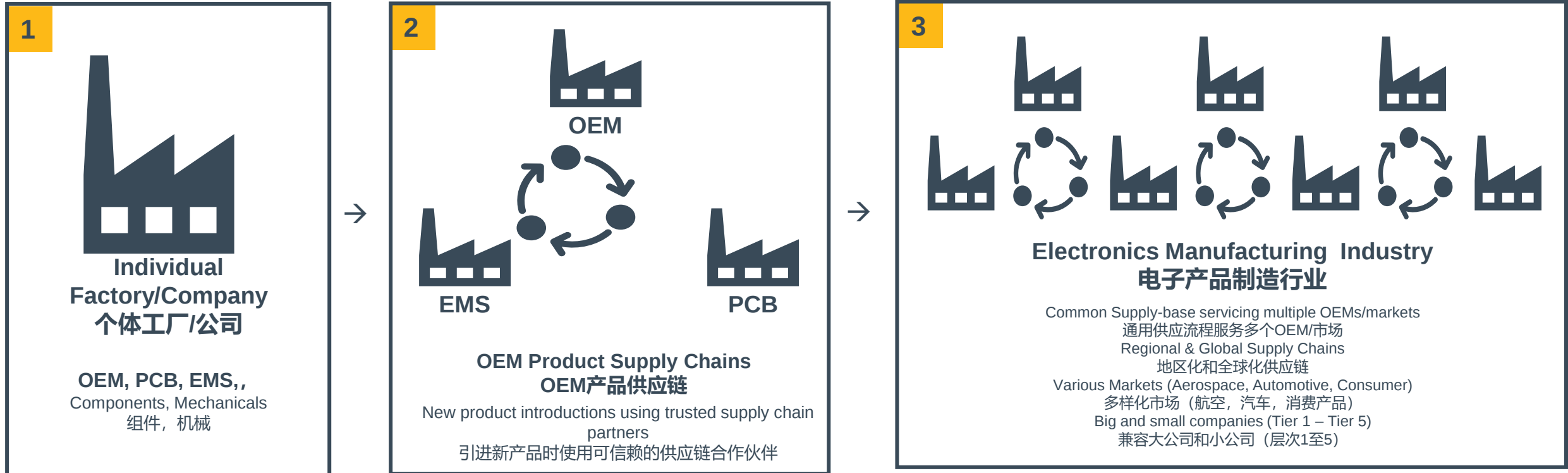
IPC-1782A Standard for Manufacturing / Supply Chain **Traceability** of Electronic Products
IPC-1782A 电子产品的制造和供应链可追溯性标准

IPC-1783 International Standard for Component-Level **Authentication** (CLA) (UNDERDEVELOPMENT)
IPC-1783 组件级认证国际标准

IPC-1792 Standard for the Management and Mitigation of **Cybersecurity** Incidents in the Manufacturing Industry Supply Chain
IPC-1792 制造业供应链网络安全事件的管理和缓解标准

F2 Modernization Integration Levels

F2现代化整合层级



★ Current adoption level across industry

★ Not many are thinking about or addressing this

Individual Company view
个体公司视角

New technologies & processes
新技术和流程,
Productivity, efficiency, ROI
生产力, 效率, ROI

OEM-defined ecosystems
OEM主导的生态系统

Faster cycle times, quality/reliability
更快的循环节奏, 质量/可靠性
Data driven supplier management
供应商管理通过数据驱动

Industry-wide view & transformation
整个产业的规模和转型

Modernized infrastructure for industry benefit
对行业有益的现代化基础设施
Excellent fit for IPC Industry leadership
完美适合IPC行业领军企业

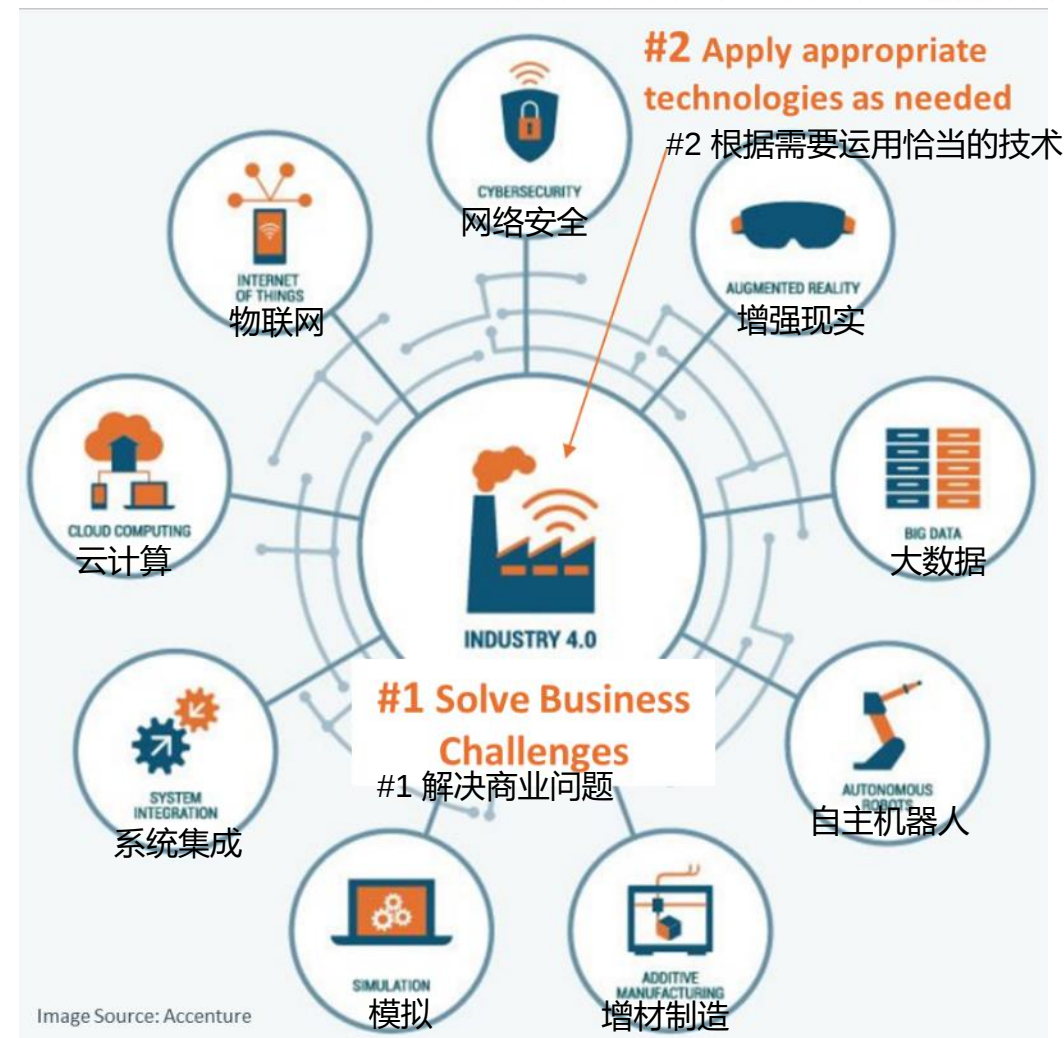
2013 - 2020

2025

2030

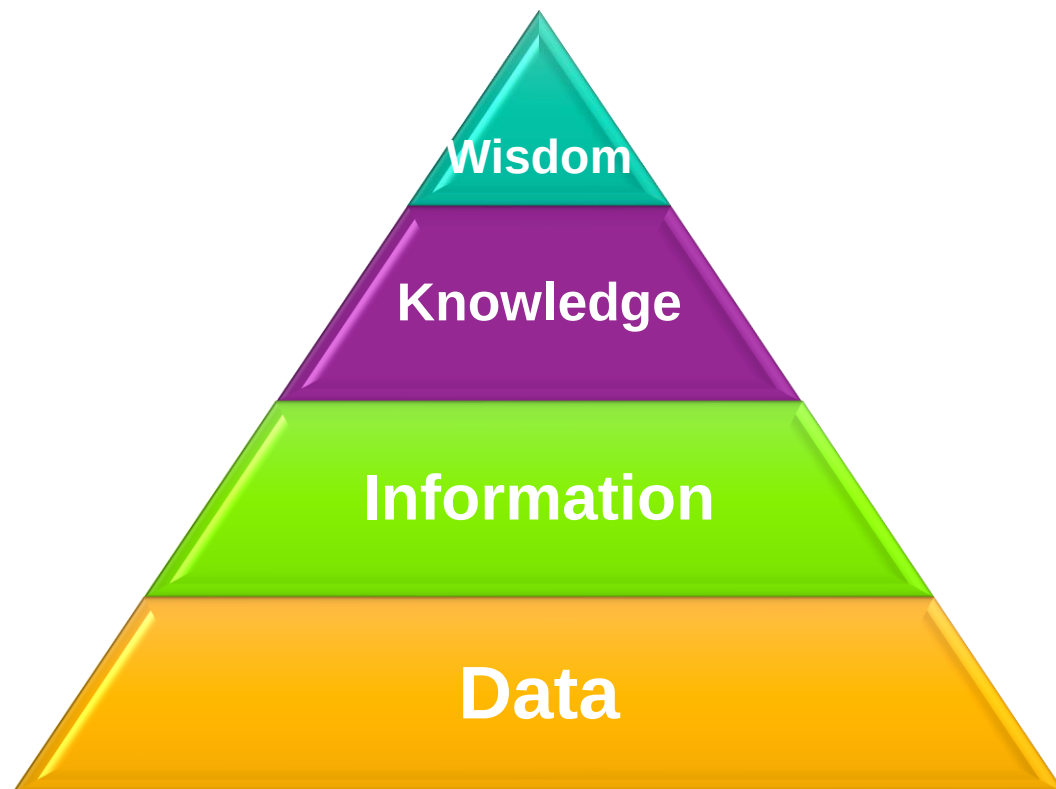
Complexity, coordination, industry standardization need increases
复杂性、协调性、行业标准化需求增加

Implement ROI Driven Solutions



Factory of the Future Disruptive Technology Stack

- Common design data protocol – Digital Product Model Exchange/通用的设计数据协议——产品模型交流实现数字化
- Common equipment data protocol - Connected Factory Exchange (CFX)/通用的设备数据协议——工厂间连接交流 (CFX)
- Data Analytics/Predictive Analytics, Big Data/Business Intelligence (BI)/数据分析/预测性分析, 大数据/商业智能 (BI)
- 3D Printing/Additive Manufacturing in Electronics/电子产品制造中的3D打印/增材制造
- Artificial Intelligence (AI) / Machine Learning/人工智能 (AI) /机器学习
- AI-Enabled Inspection/可运用AI的校验
- Automation/自动化
- Industrial Networks (IT/OT Convergence)/产业网络 (IT/OT融合)
- CAD, 3D Design/CAD, 3D设计
- Robotics/Cloud Robotics/ Cobots/机器人/云机器人/协作机器人
- Simulation and Modeling/仿真和建模
- AI Human Presence Detection/AI人员在场探测
- Cybersecurity/网络安全
- Industrial Internet of Things (IIoT)/工业物联网 (IIoT)
- Smart Sensor/Actuator Technologies/智能感应/执行器技术
- Cloud Computing/云计算
- Augmented Reality/Virtual Reality/增强现实/虚拟现实
- Digital Twin/Digital Thread/数字孪生/数字主线
- Digital Transformation of Operations and Supply Chain/运营和供应链的数字化转型
- Systems Integration/系统集成
- Cyber-Physical Production Systems (CPPSs)/信息物理产品系统 (CPPSs)
- Blockchain / Digital Supply Chain/区块链/数字化供应链



智慧是对知识运用的能力，知识是智慧的基础(NLP, LLM)

知识是对信息的总结和提炼

信息需要依托数据来表达, 数据是信息的载体
信息是用来消除不确定性

数据是可以被记录和识别的一组有意义的符号

Where is the data?
数据在哪里，从哪里来？



BUILD ELECTRONICS BETTER

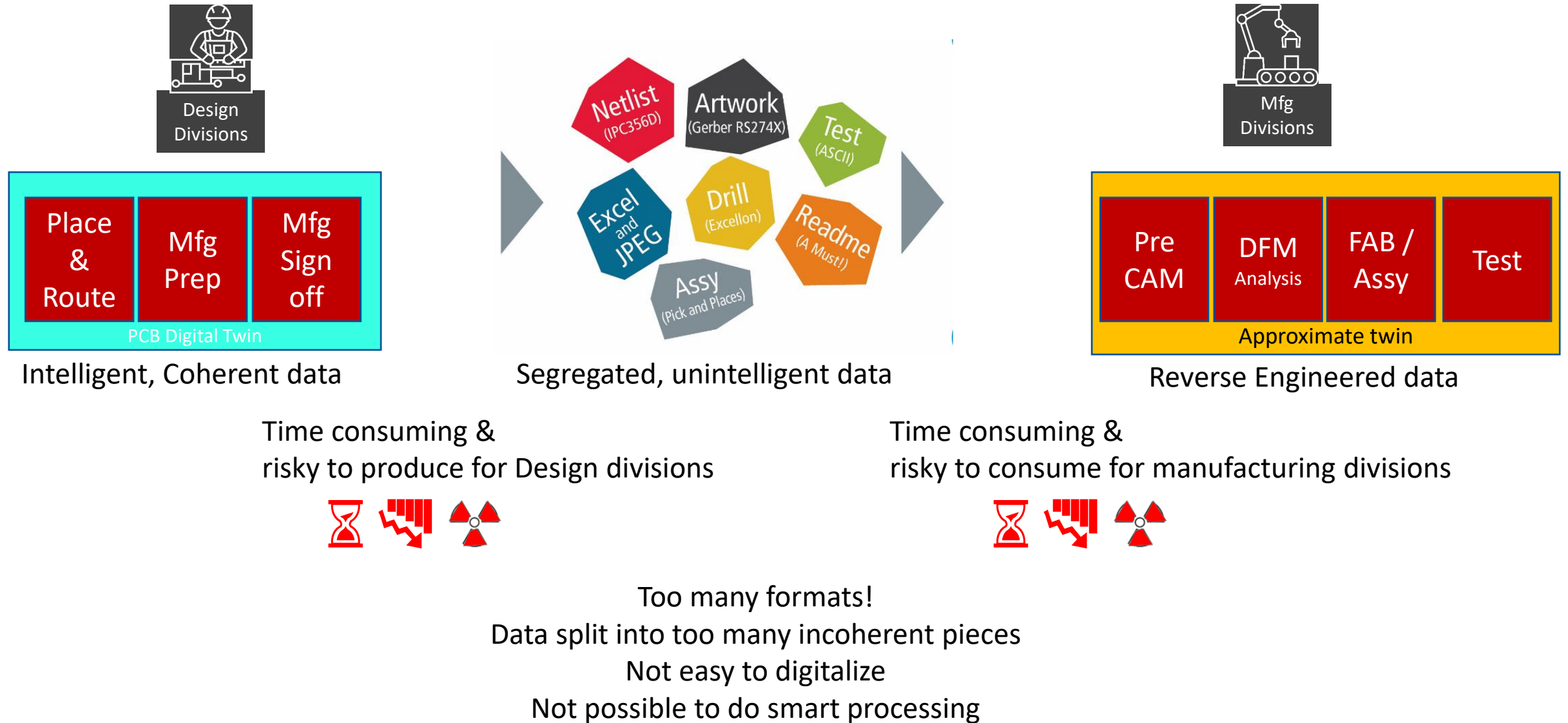
**IPC-2581C Generic Requirements for Printed Board
Assembly Products Manufacturing Description Data
and Transfer Methodology**

印制板组件产品制造描述数据和传输方法的通用要求标准



ipc.org →

Manufacturing Hand off Challenges



Current data formats are inefficient

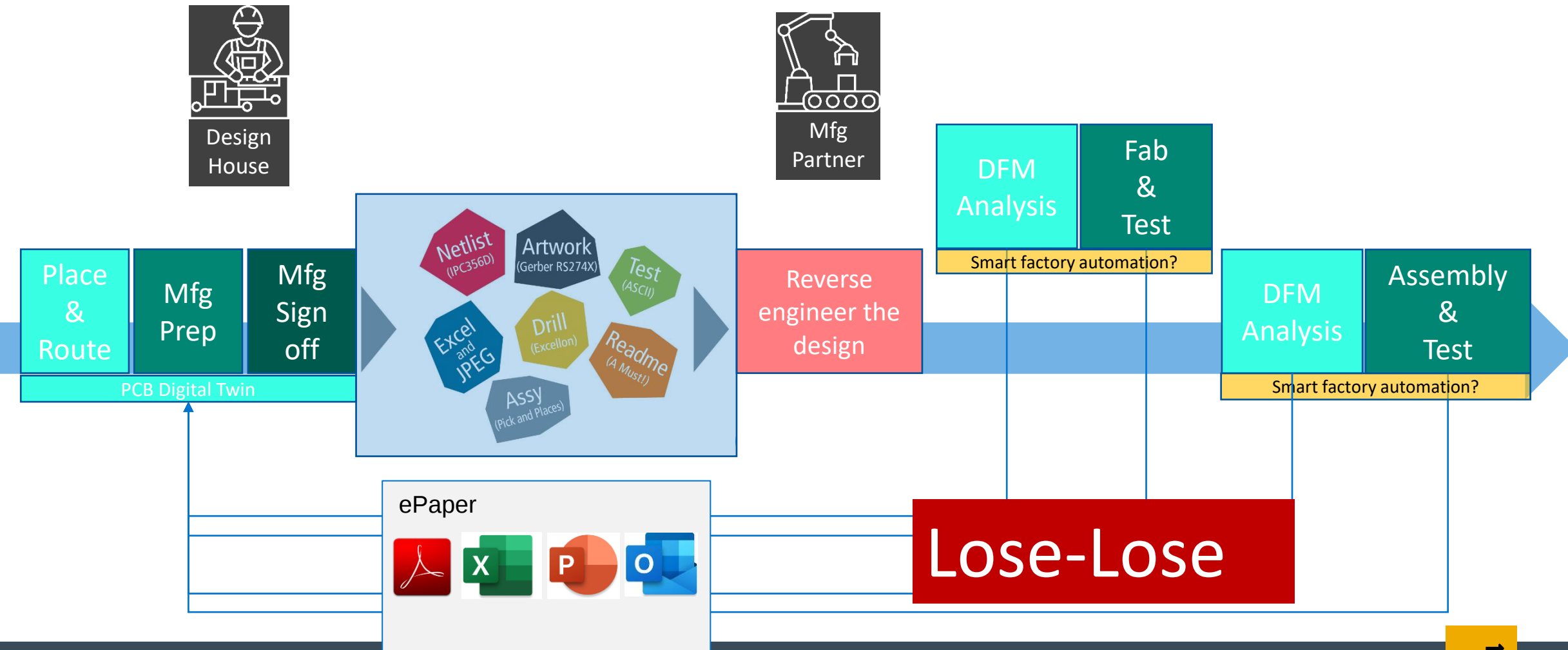
No digitalization; no smart processing



Format	Description	Business impact
Gerber	Graphic picture, unintelligent impossible for automatic processing	- Takes very long time to process - Business risk for stencil preparation - Difficult for digitalization   
GenCAD/FATF	Obsolete standard Nobody maintains this standard	- Business risk - No support 
ODB++	Proprietary standard Compatibility risk over time	Business risk if you are not a customer of owner of standard 
Centroid xy data (placement data)	Efficient content Can be out of sync with other data	- Takes time - Business risk for placement programming  

Blocks the possibility for smart processing & digitalization

Manufacturing Feedback Challenges



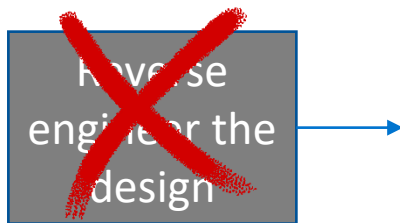
Hand-off from design house

From multiple formats to INTELLIGENT format



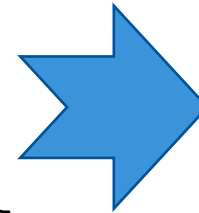
~~Why do we need to dump down the data?~~

~~Generation error – Design House pays for it~~

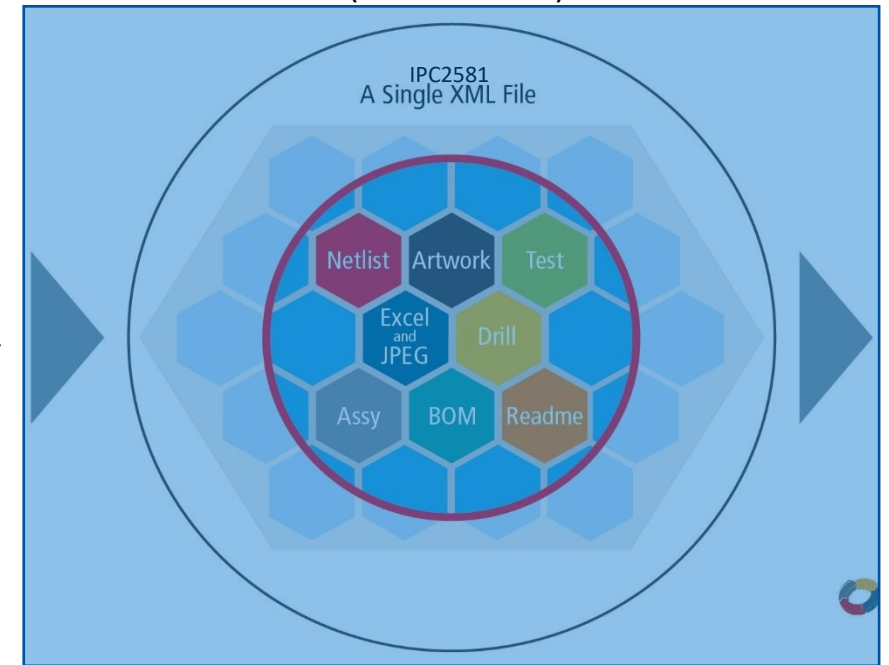


~~Why do we need to reverse engineer?~~

~~Reverse engineering error – Manufacturing House pays for it~~



IPC Digital Product Model eXchange (DPMX)
(aka IPC-2581)



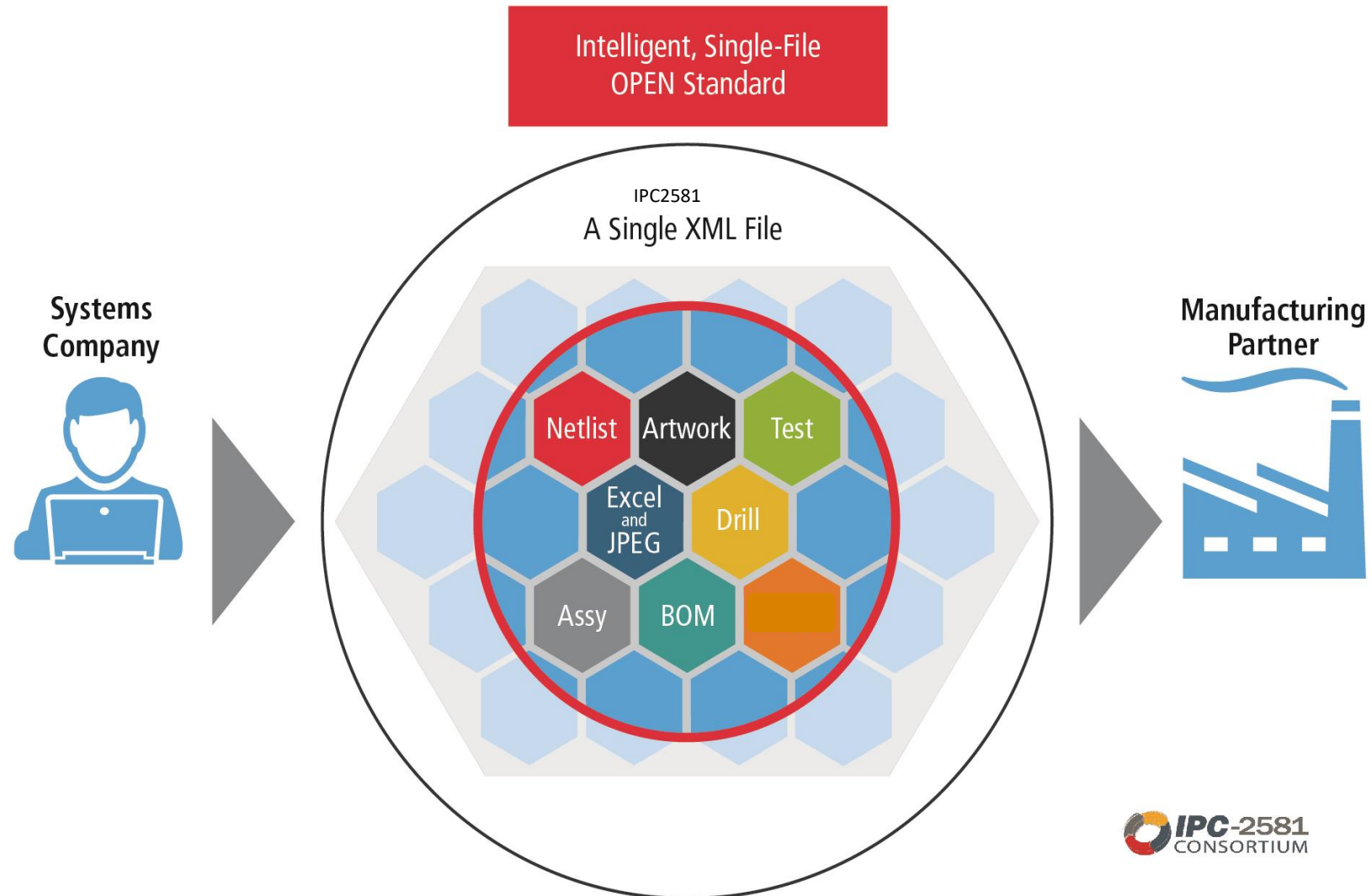
Hand-off based on 1980s based format

Intelligent design data hand-off
Enables industry 4.0
Go paperless with DPMX

Simple, intelligent hand-off to manufacturing



Single file that is MACHINE READABLE and enables Industry 4.0



IPC Digital Product Model Consortium

Over 100 Corporate Members



Mission:

- Establish Design Best Practices
- Provide guidance for adoption
- Track tool support & usage

Statistics:

- >100 corporate members
- In production use at many companies
 - *Since Jan 1, 2016!*





BUILD ELECTRONICS BETTER

IPC-2552 General Electronic Components Model Based Definition (MBD) Standard

IPC-2552 通用电子元器件基于模型定义(MBD)标准

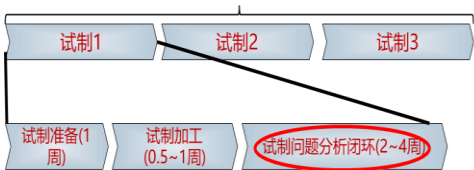
ipc.org →

MBD标准开发背景

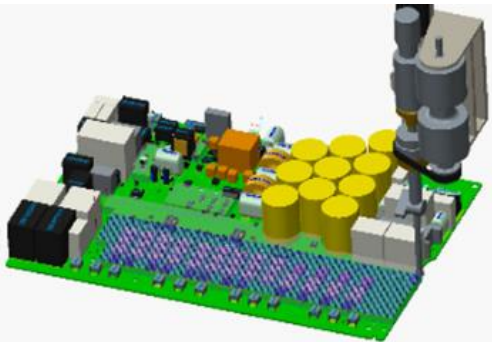


以实物验证为主，问题收敛慢，验证次数多，导入周期长

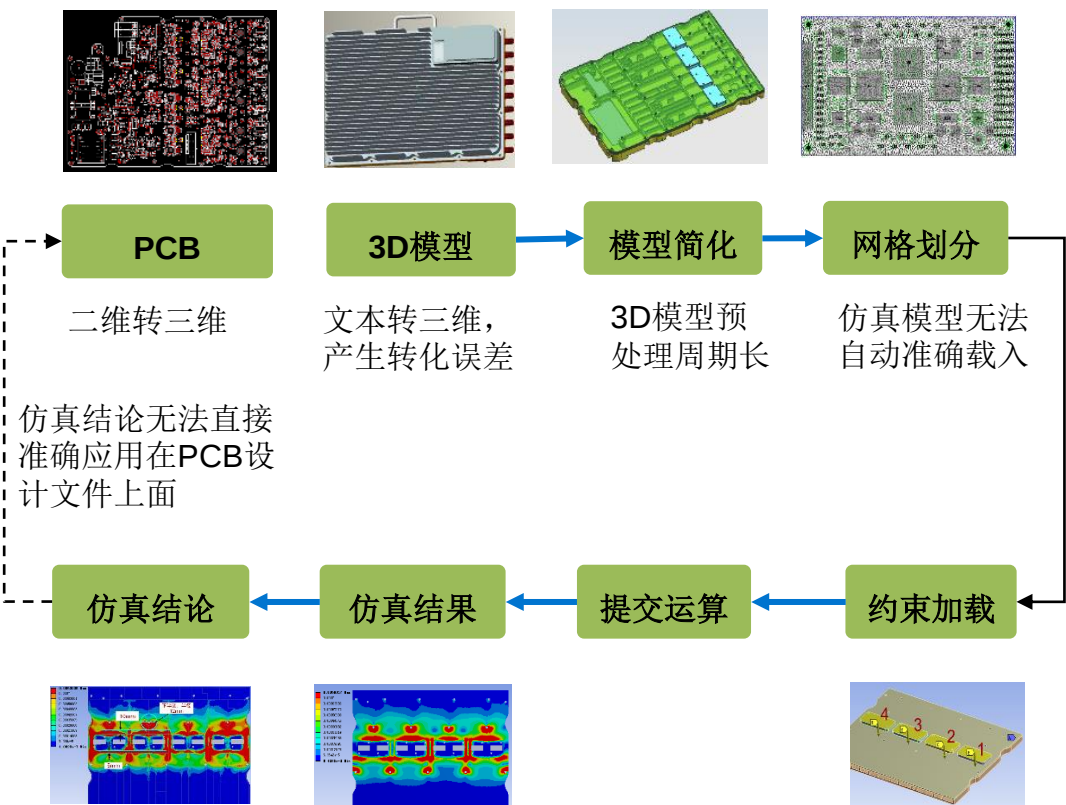
某终端产品试制周期占30%



某终端产品试制中结构装配设计问题5轮才清零，且收敛慢

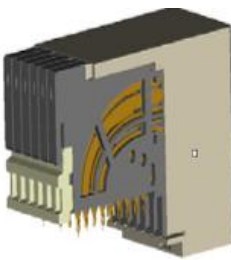


各专业领域“烟囱式”发展，文本信息传递，需要多次转化

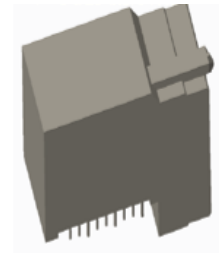


模型参数缺失，影响集成设计

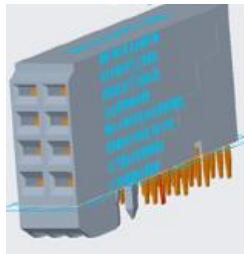
理想模型



实际模型



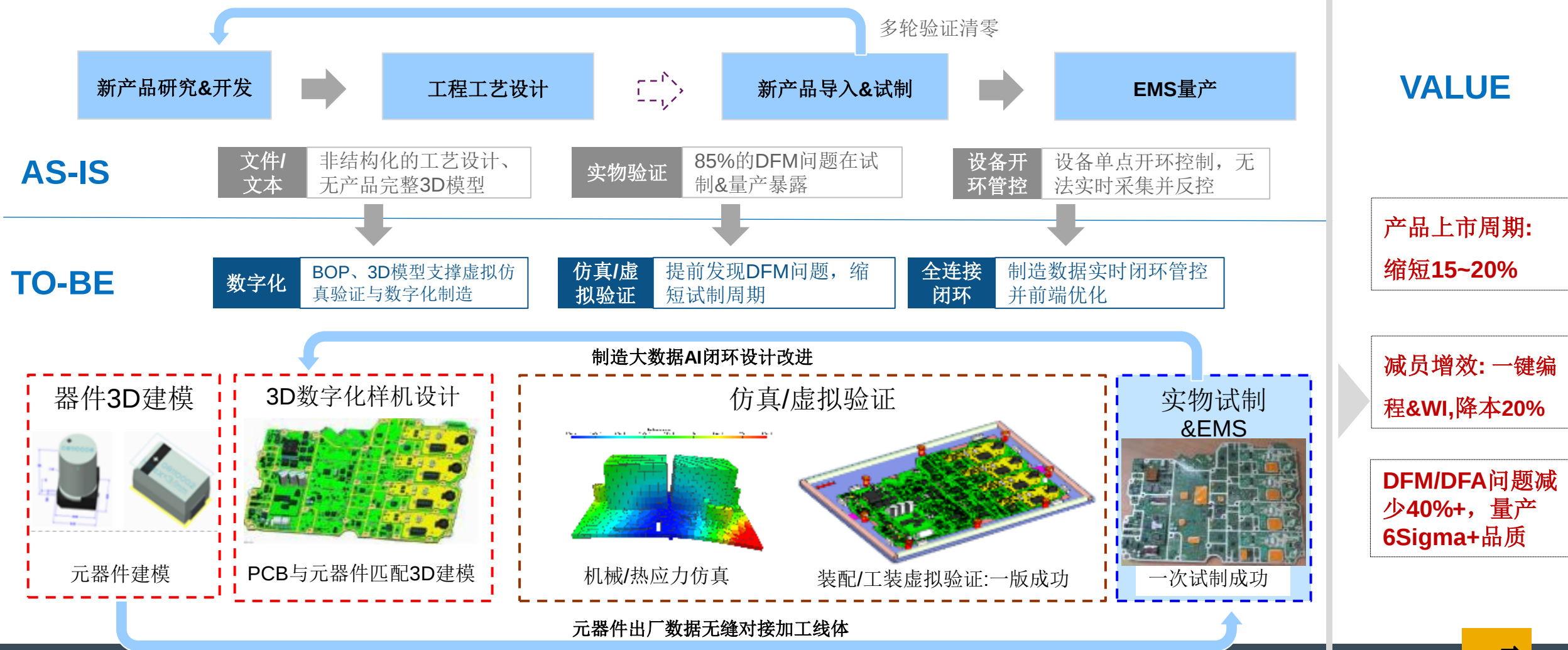
转化后的合规模型



愿景展望:产品3D数字化设计完成DFX论证和虚拟试制,达到提质降本的目标



以元器件MBD模型和单板3D数字化模型为基础交付件,并进行单板DFX仿真&虚拟验证,减少实物试制;通过闭环制造系统,进行端到端设计改进和质量闭环,提升产品竞争力。

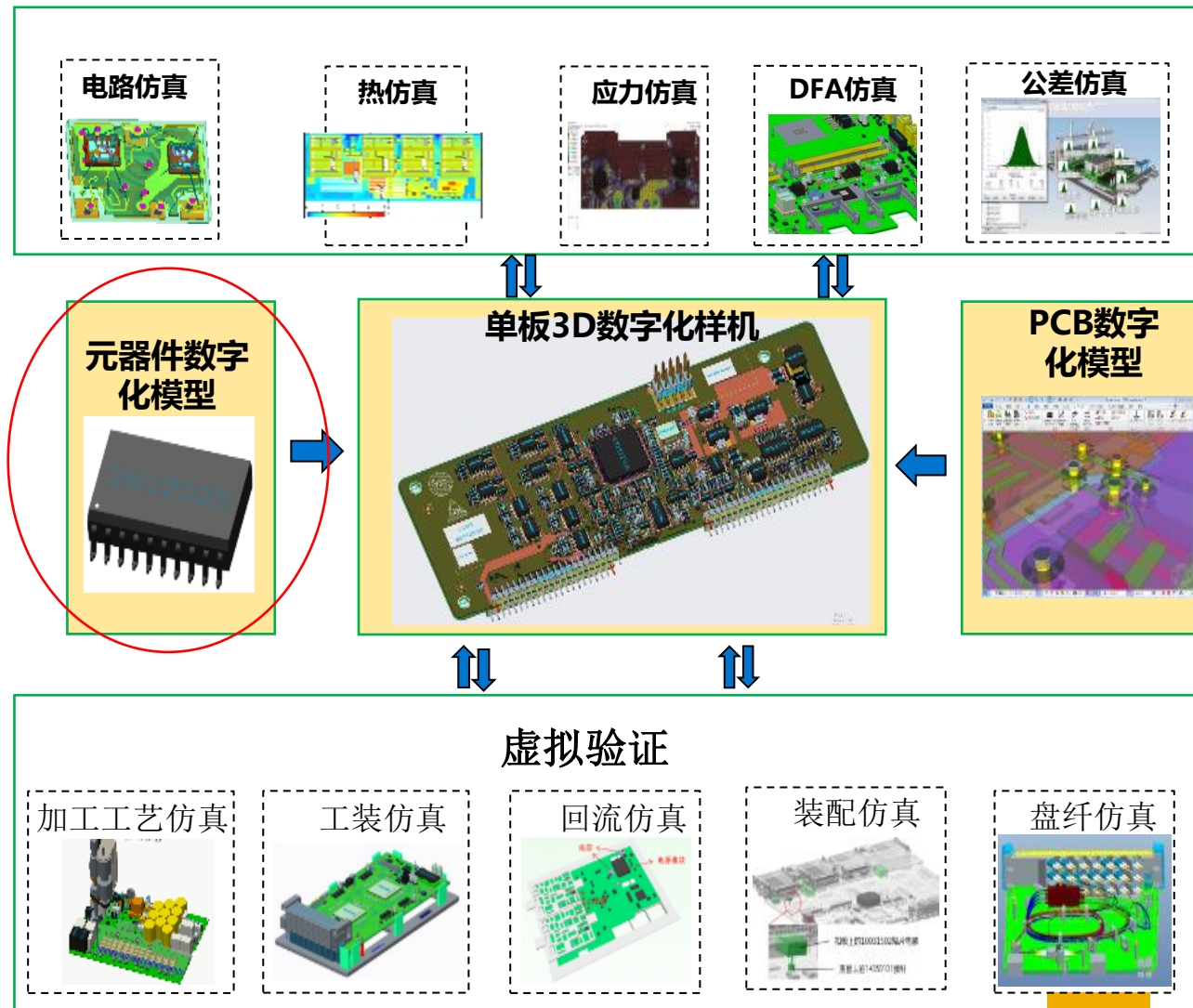
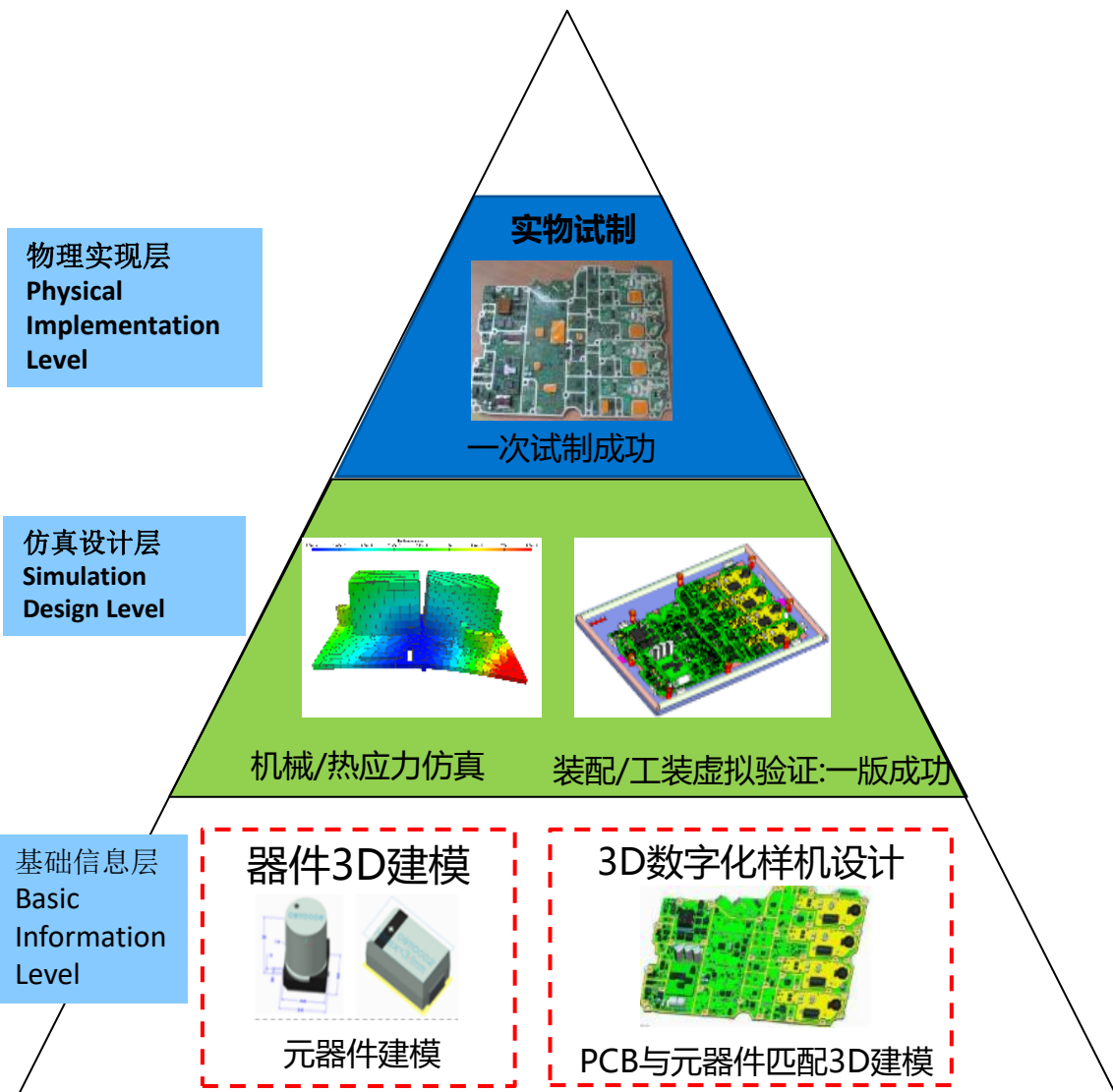


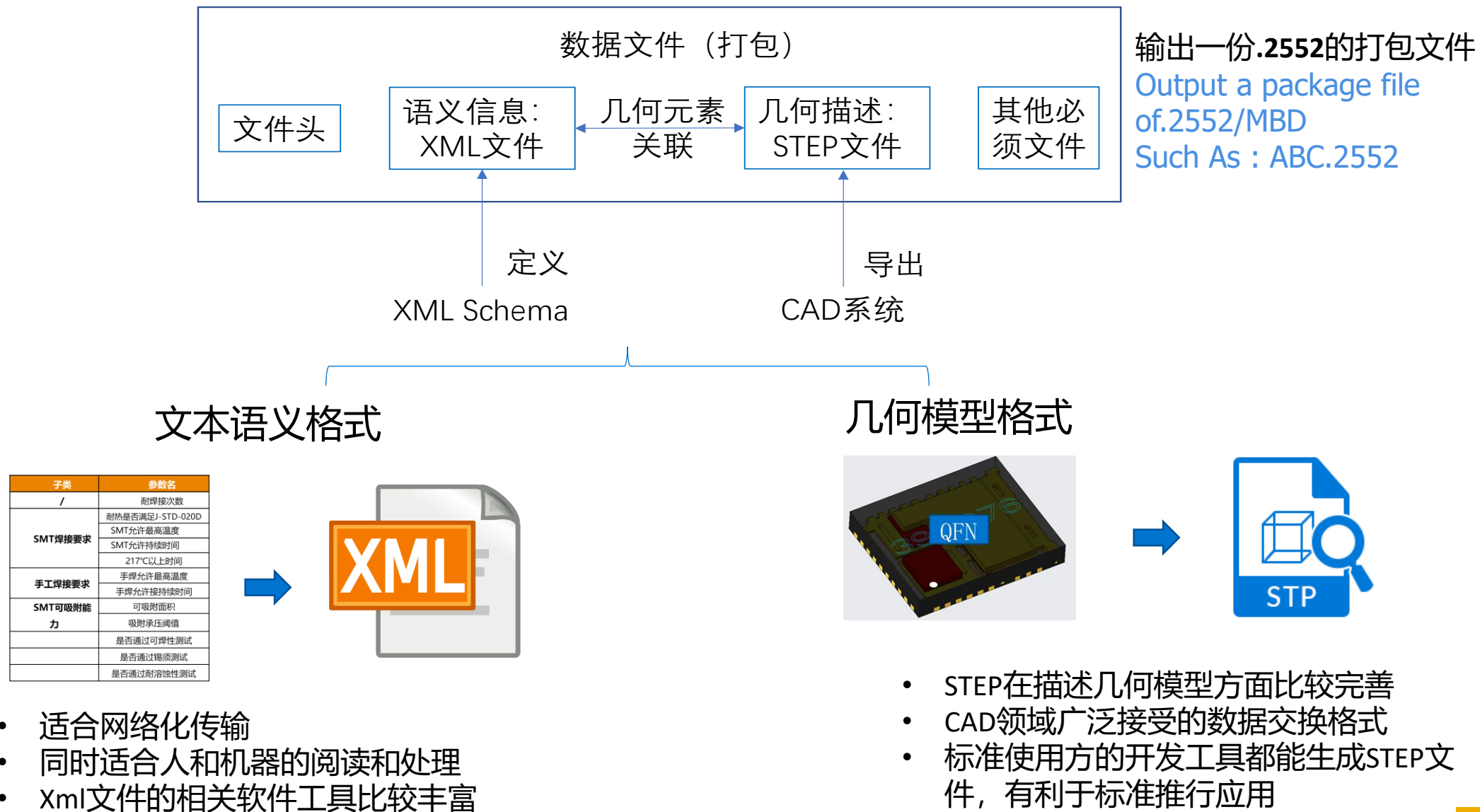
电子产品3D数字化设计目标



构建板级数字化仿真/制造底座基石，实现一个设计完成所有DFX的设计与验证

产品设计仿真(解决产品设计的尺寸、性能、容差等问题)







IPC/DAC-2552 Example Demo

IPC/DAC-2552 Team

ipc.org →

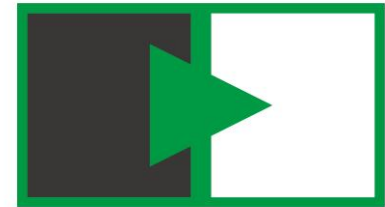


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IPC-HERMES-9852

The Global Standard for Machine-to-Machine
Communication in SMT Assembly

表面贴装技术组装中机器对机器通信的全球标准

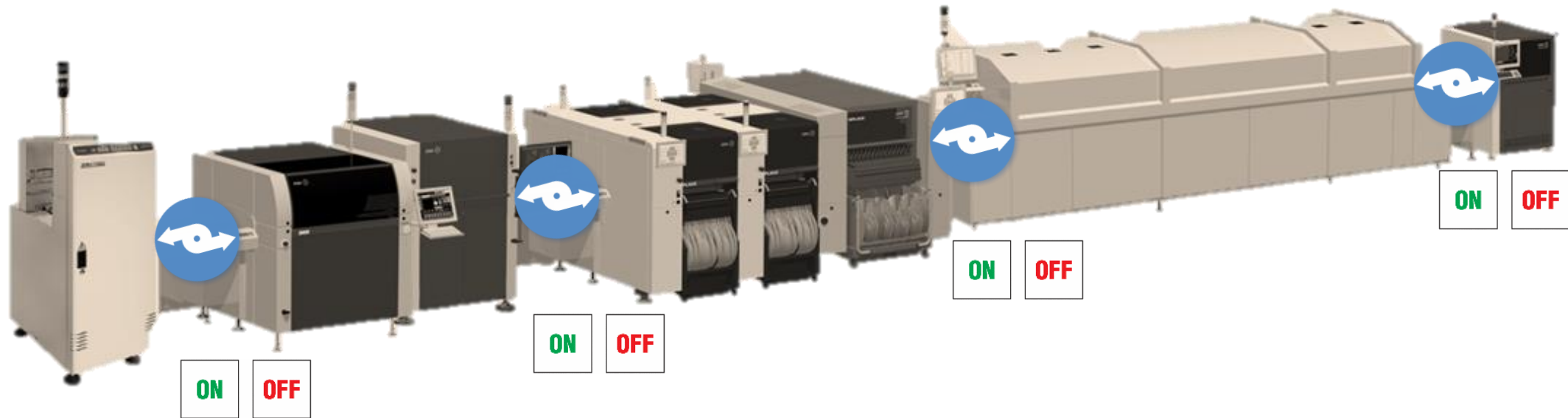


IPC-HERMES-9852

[ipc.org](https://www.ipc.org) →

Why a new interface?

Old Technology meets the Challenge of today



Challenges

- Highly automated / digitalized industry with more need of data
- Full integration of the equipment
- Need of direct machine-to-machine (M2M) communication
- Need of simple integration into high-level systems (MES, IoT...)

Old M2M Standard

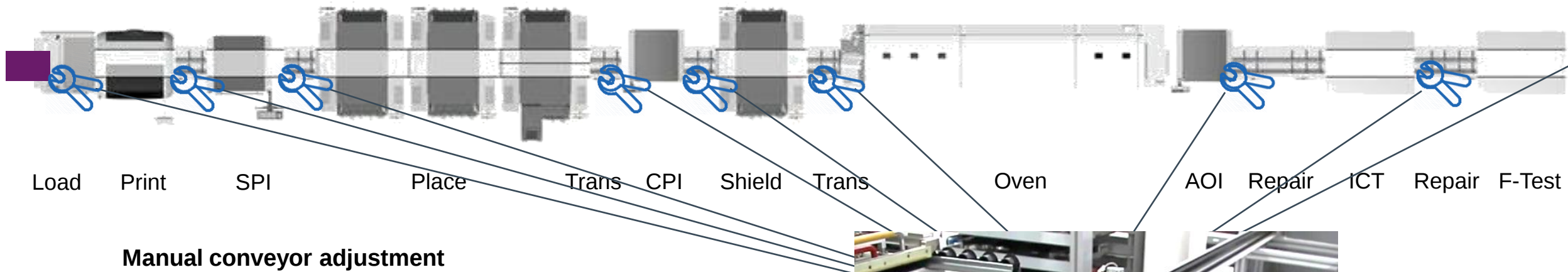
- Based on “signals”, no data at all
- Needs specific hardware
- Is expensive
- Restricts quick changes in line layout
- Can be hardly adapted to future needs

Why a new Interface...?

New Job Download = long Preparation Time

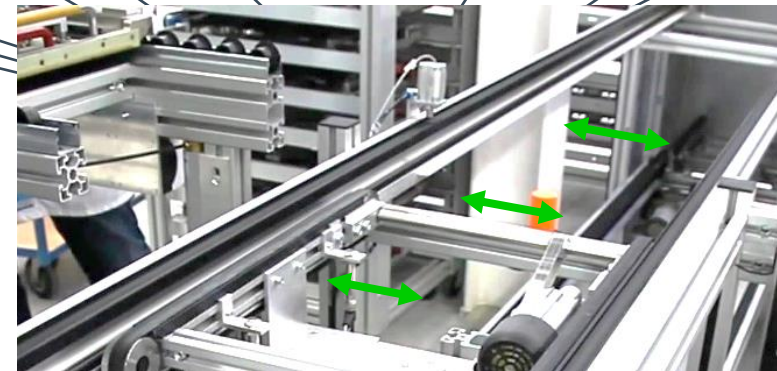


Example



Manual conveyor adjustment

- Manual intervention to different equipment
- Manual input of new parameters (error prone)

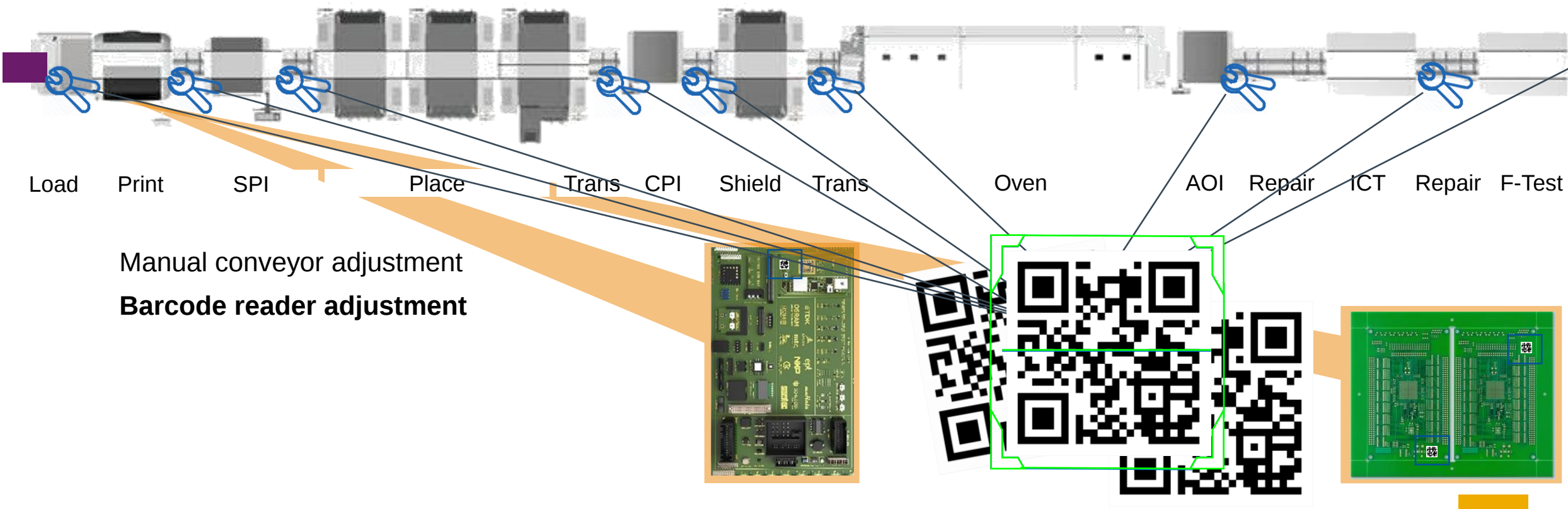


Why a new Interface...?

New Job Download = long Preparation Time



Example



Why a new Interface...?



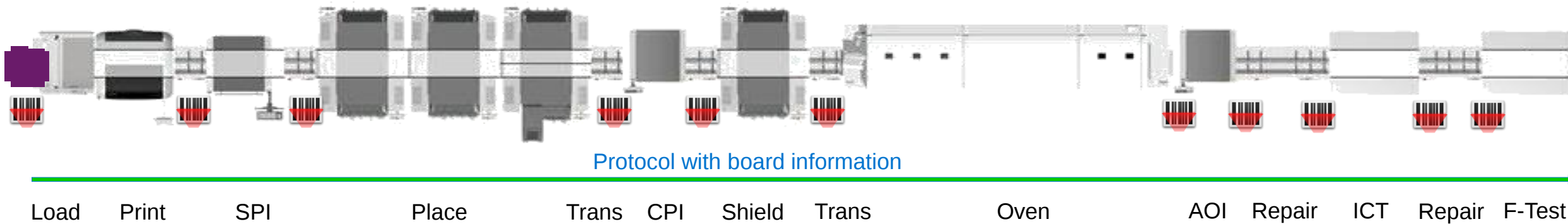
IPC-HERMES-9852 represents THE next generation horizontal communication standard and replaces IPC-SMEMA-9851

Why IPC-HERMES-9852?

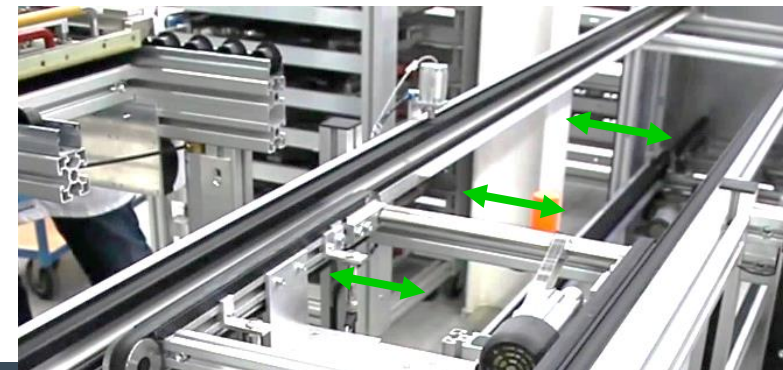
Automated Data Transfer



 Different boards widths in one line, at the same time and without operator intervention

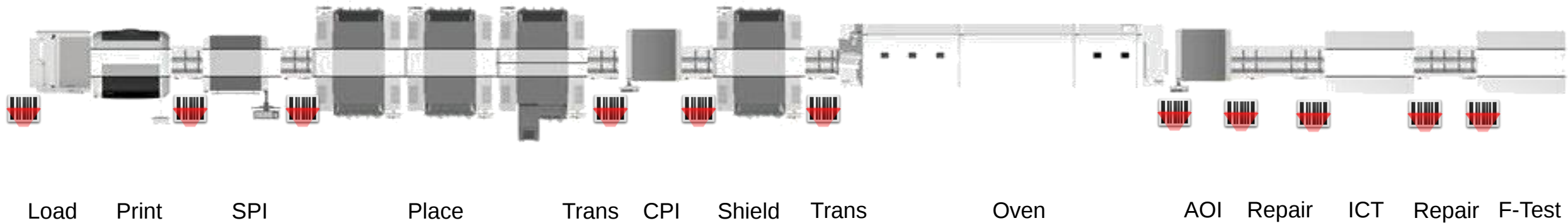


- ~~Manual eye adjustment~~
- Barcode reader adjustment
- High number of barcode readers



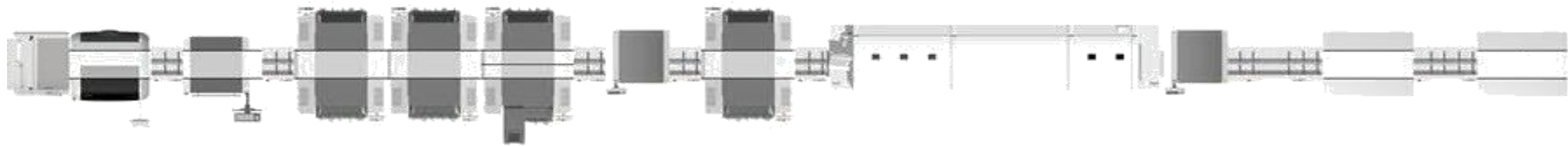
Why IPC-HERMES-9852?

Full Data Availability



- Automated conveyor adjustment
- Barcode reader adjustment (code / RFID...) needed only once per line
- Speed optimization (code reader) needed

Why IPC-HERMES-9852? Full Data Availability



Load

Print

SPI

Place

Trans

CPI

Shield

Trans

Oven

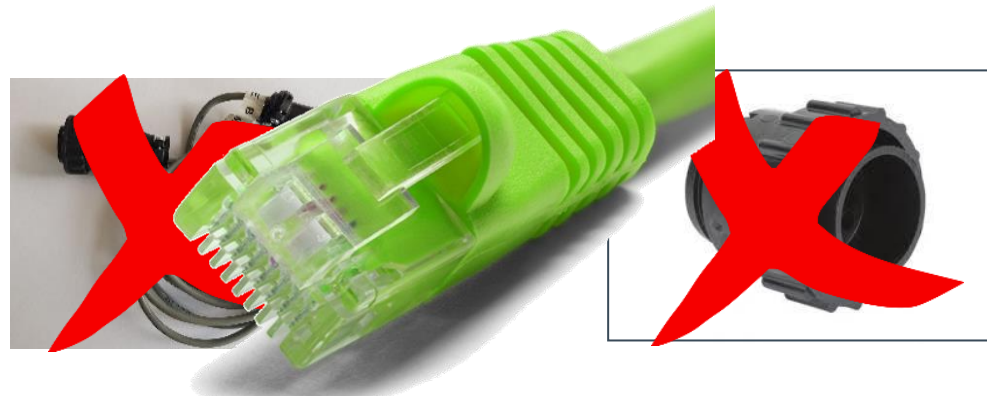
AOI

Repair

ICT

Repair

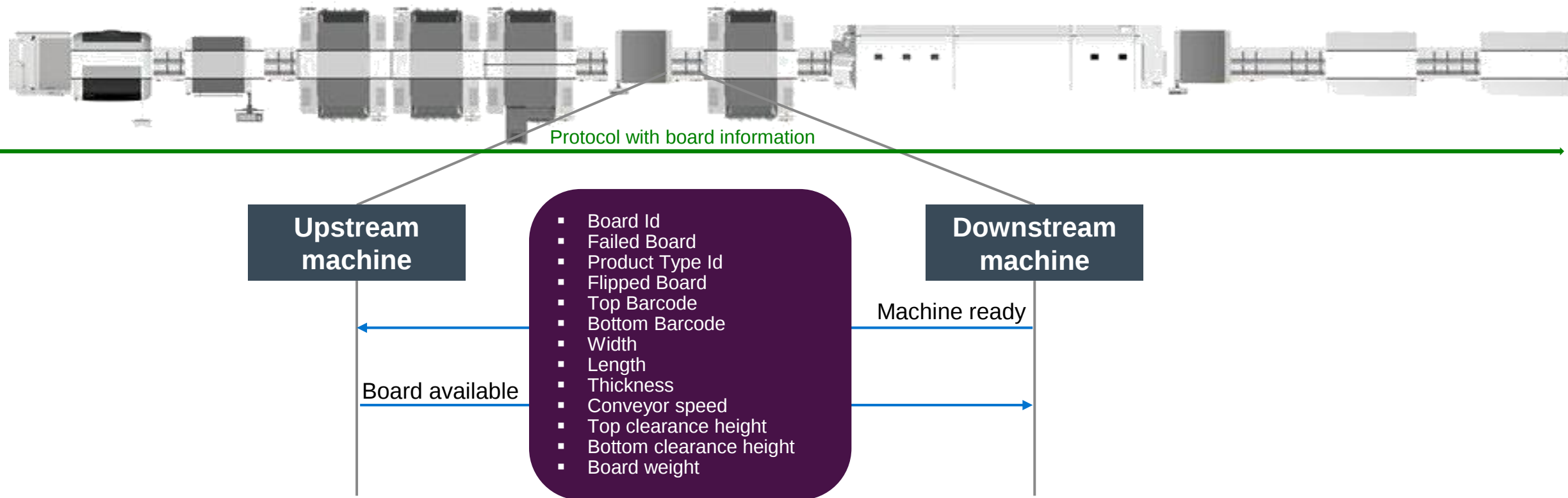
F-Test



> Proven Ethernet. ONE Interface, ONE Standard!

Why IPC-HERMES-9852?

Protocol based

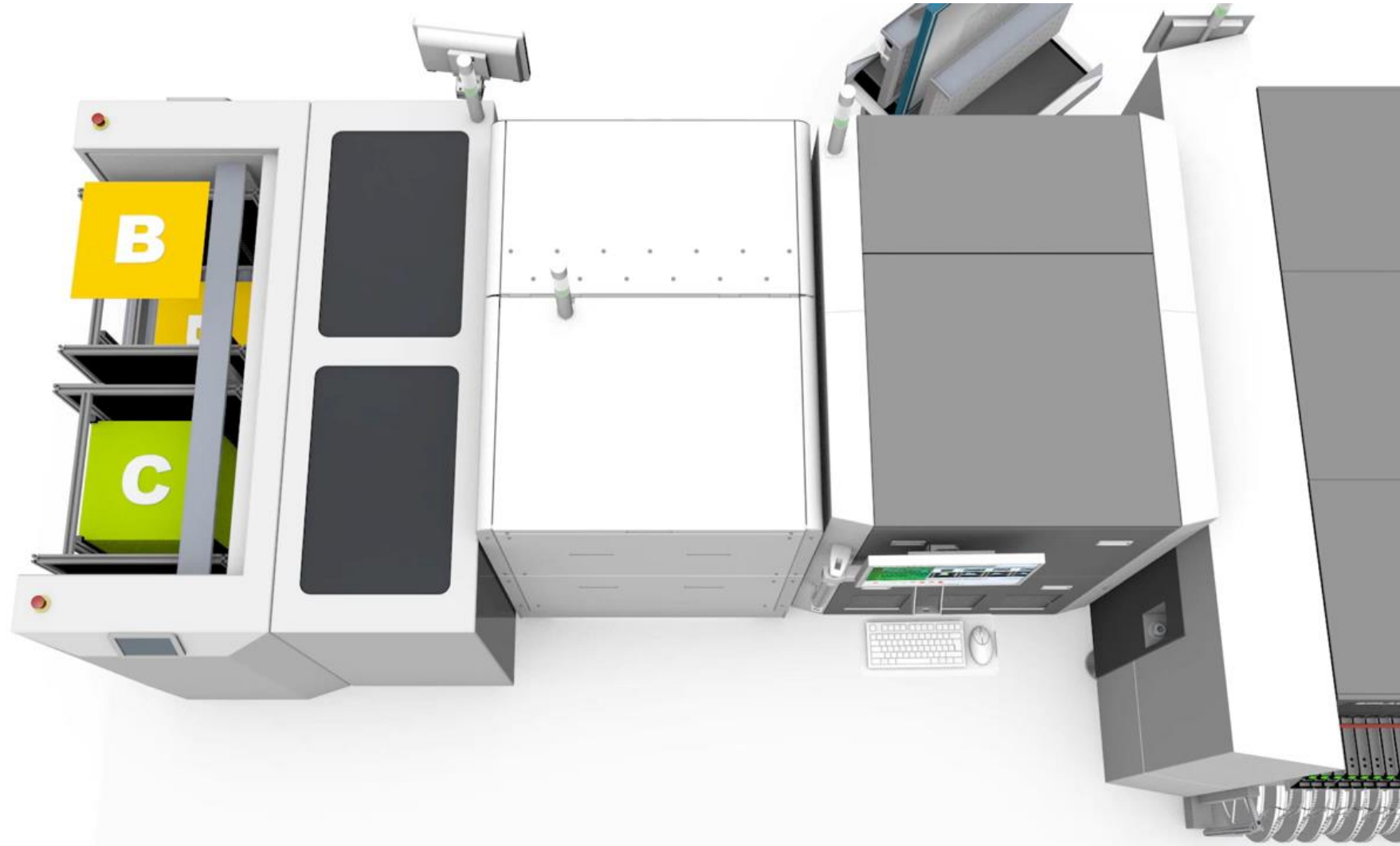


IPC-HERMES-9852 Remote Changeover



From ASMPT

IPC-HERMES-9852 Remote Changeover



From ASMPT



 **SunSDA** 昇士達科技股份有限公司
SUNSDA TECHNOLOGY CO., LTD.



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IPC-CFX-2591

Connected Factory Exchange

互联工厂数据交换标准

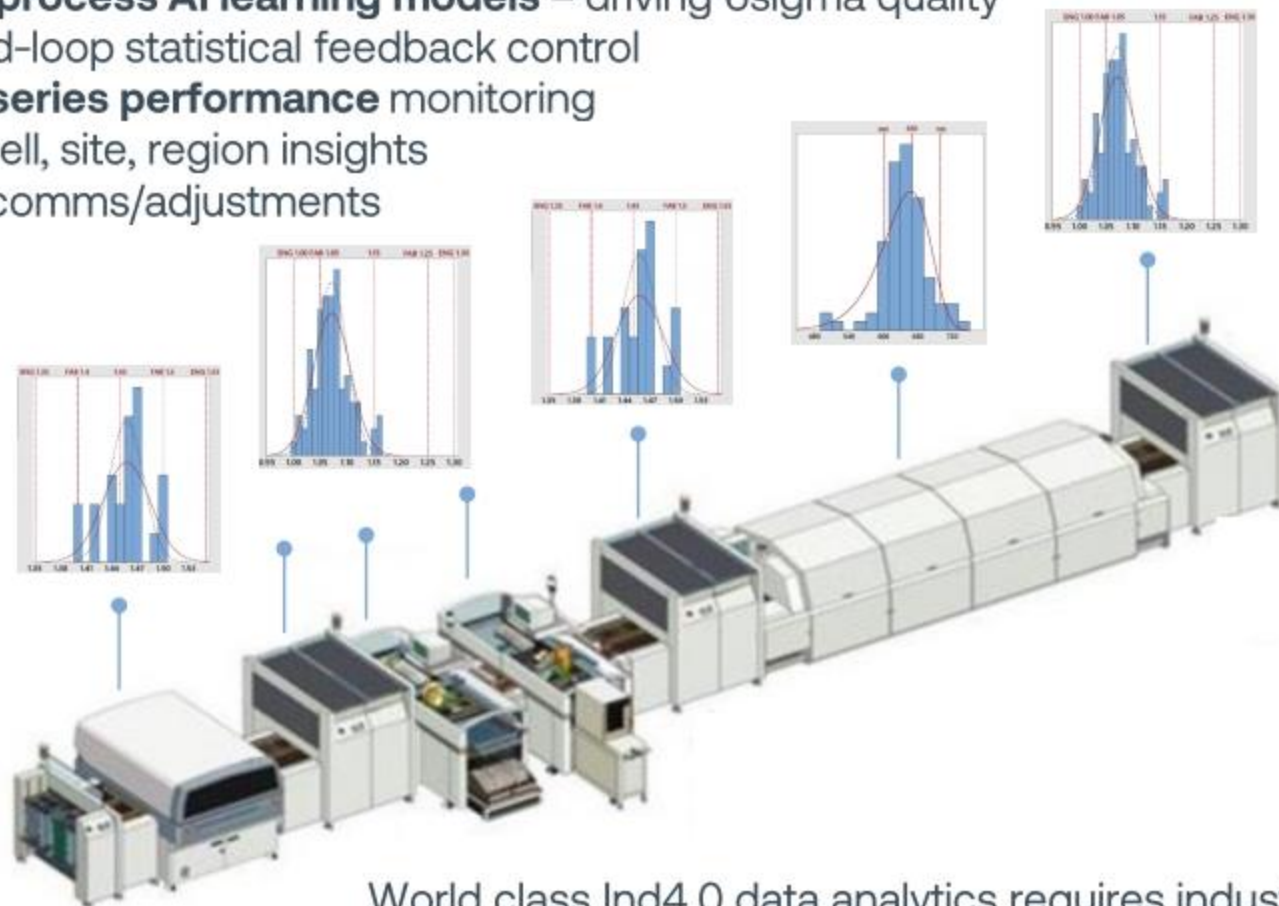


ipc.org →

Challenge: Achieve high quality, yield, throughput – Data Analytics

Manufacturing line – secure, real-time, big data sets (FEOL, BEOL)

- Individual process control, reports, Cp, Cpk, dashboards
- Multi-process AI learning models – driving 6sigma quality
- Closed-loop statistical feedback control
- Time series performance monitoring
- Line, cell, site, region insights
- M2M comms/adjustments



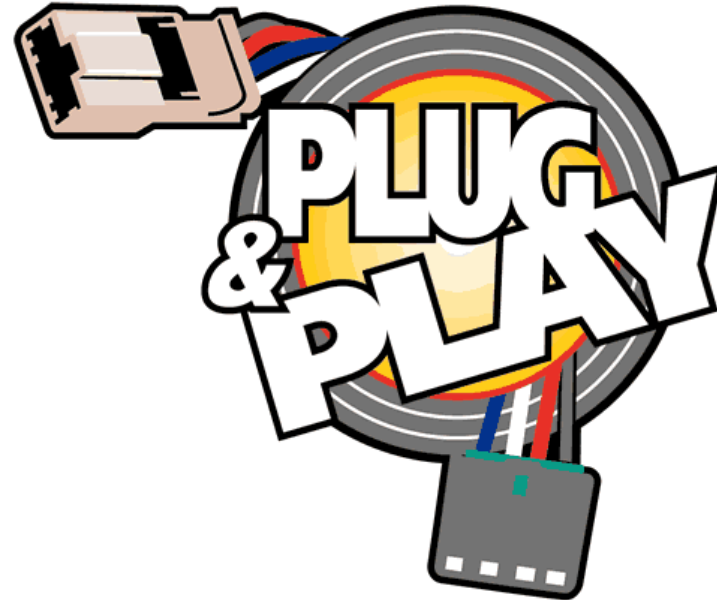
World class Ind4.0 data analytics requires industry-wide, open-source machine data communication protocol eg) IPC-2591 CFX



When it doesn't work.....



IPC CFX Committee's Vision



What is "CFX"



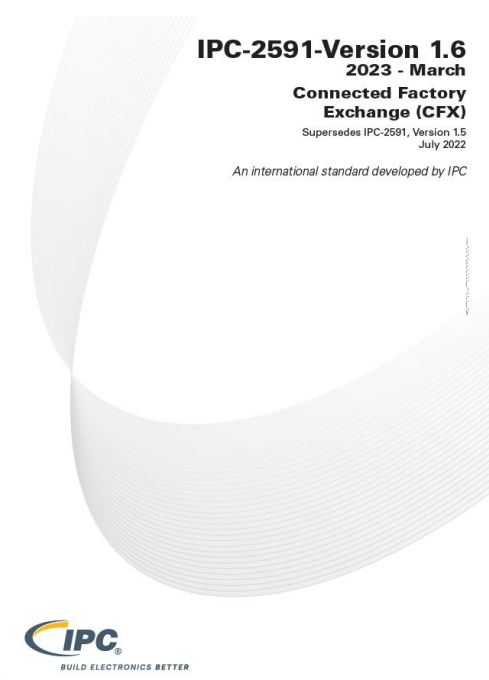
- > Standard Name: "Connected Factory Exchange" (CFX) 互联工厂数据交换
- > Developed by IPC 2-17 & 2-17CN Subcommittee
- > 120+ companies participated

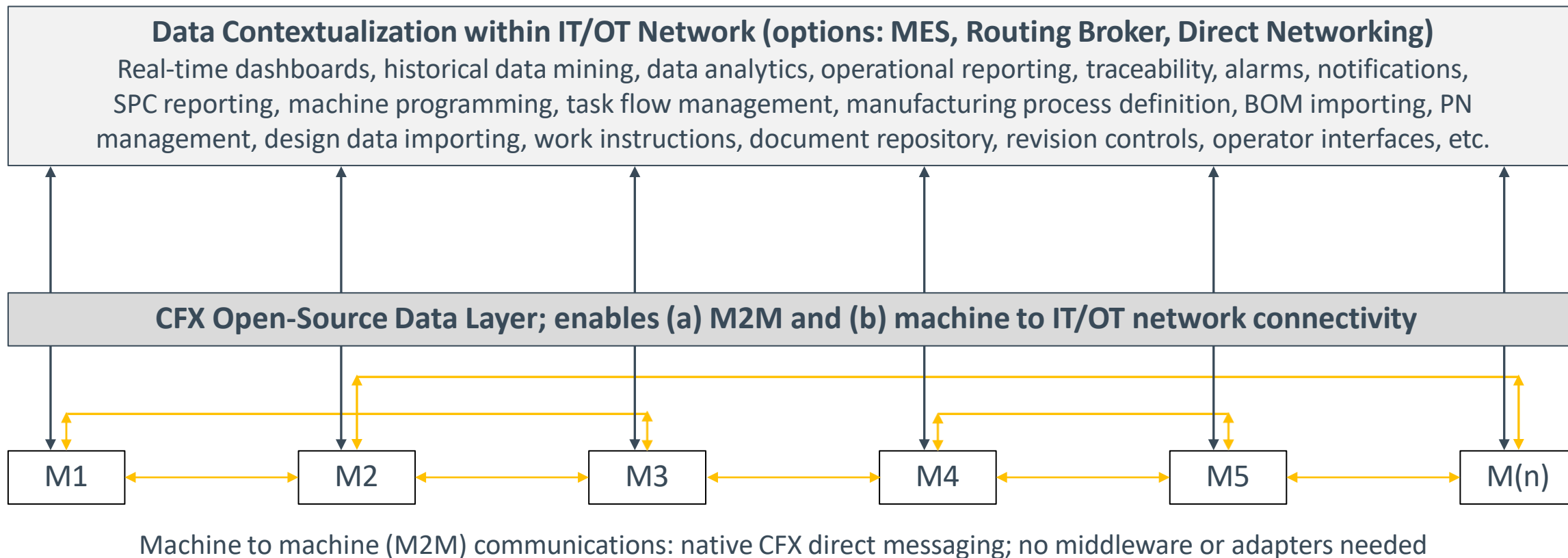
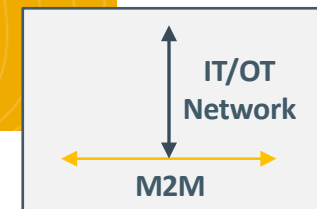
CFX Version History:

- v1.0 March 2019
- v1.1 January 2020
- v1.2 October 2020
- v1.3 March 2021
- v1.4 December 2021
- v1.5 July 2022
- v1.6 February 2023
- v1.7 August 2023

All CFX versions are backward compatible:

- *Solutions with mixed CFX support work together on the same network*
- *CFX version is communicated during connection, newer content is ignored by older instances*
- *Standard & SDK Documentation shows additions / changes to each version*





Physical Equipment – Connected Machine to Machine / Assembly Line

- CFX M2M communication (any combination)
- CFX Machine to IT/OT network



A Common Manufacturing Language



Data Is Sent using



- As secure as a bank
- Data encryption at source
- Broadcast & point to point



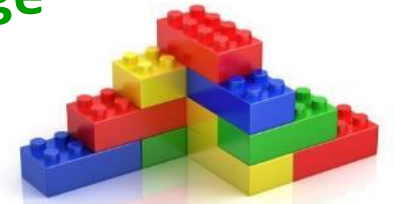
Ah! Now I understand!

Data is Encoded using



```
{
  "source": "CFX.Production.Work",
  "timestamp": "2017-08-29T10:34:11.6757089",
  "messageID": "346be717-6421-4832-877b643",
  "source": "MACHINE12345",
  "requestID": null,
  "messageBody": {
    "ID": "db6e6191-515d-44b7-a092-cc94021d9f5e",
    "UnitCount": 2,
    "UnitLocations": [
      {
        "UnitIdentifier": "UNIT1112245",
        "LocationIdentifier": "1"
      },
      {
        "UnitIdentifier": "UNIT1112246",
        "LocationIdentifier": "2"
      }
    ]
  }
}
```

Data has Defined Language



- Modular topics and messages
- Specific message content
- The basis on which to build context

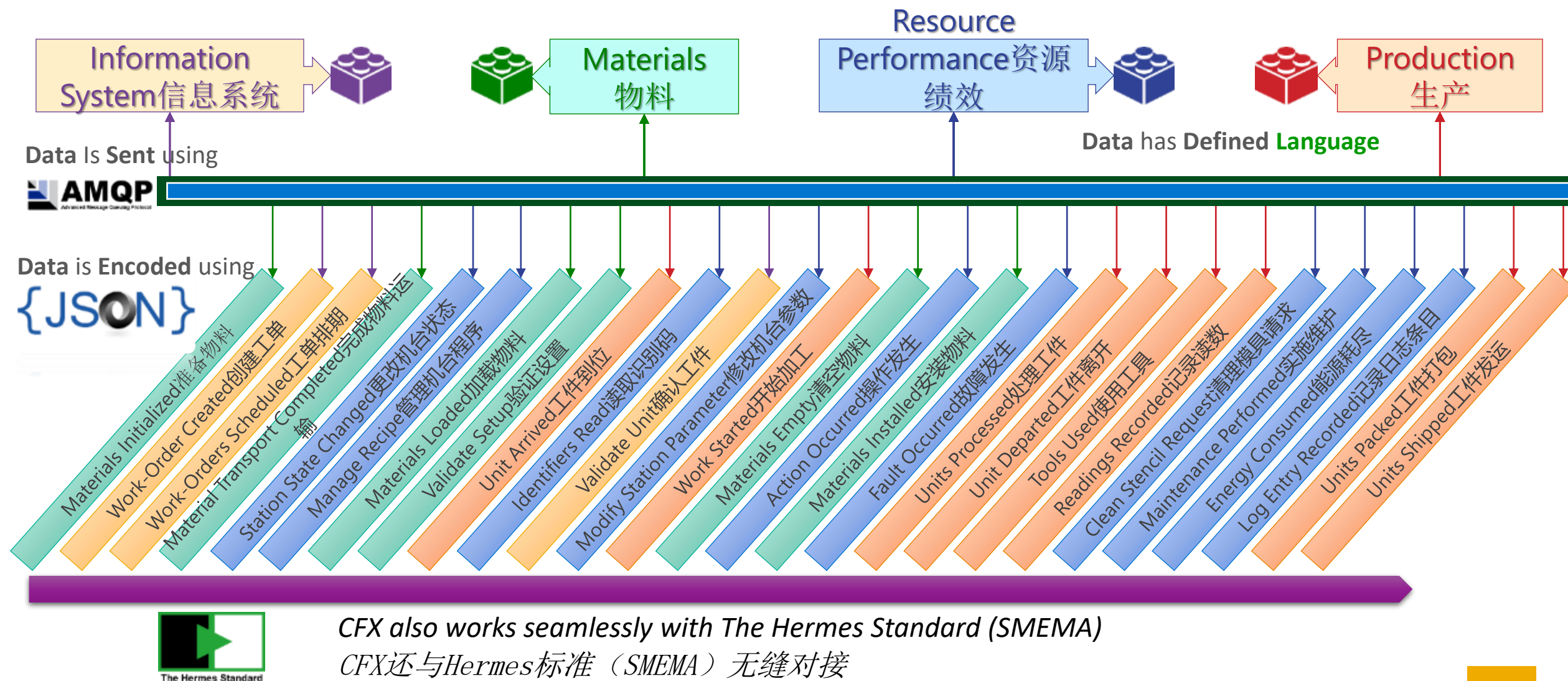
All 3 Critical Components Needed For “Plug & Play”实现 “即插即用” 的3个关键要素

Digital Manufacturing IoT Standard

数字制造物联网标准



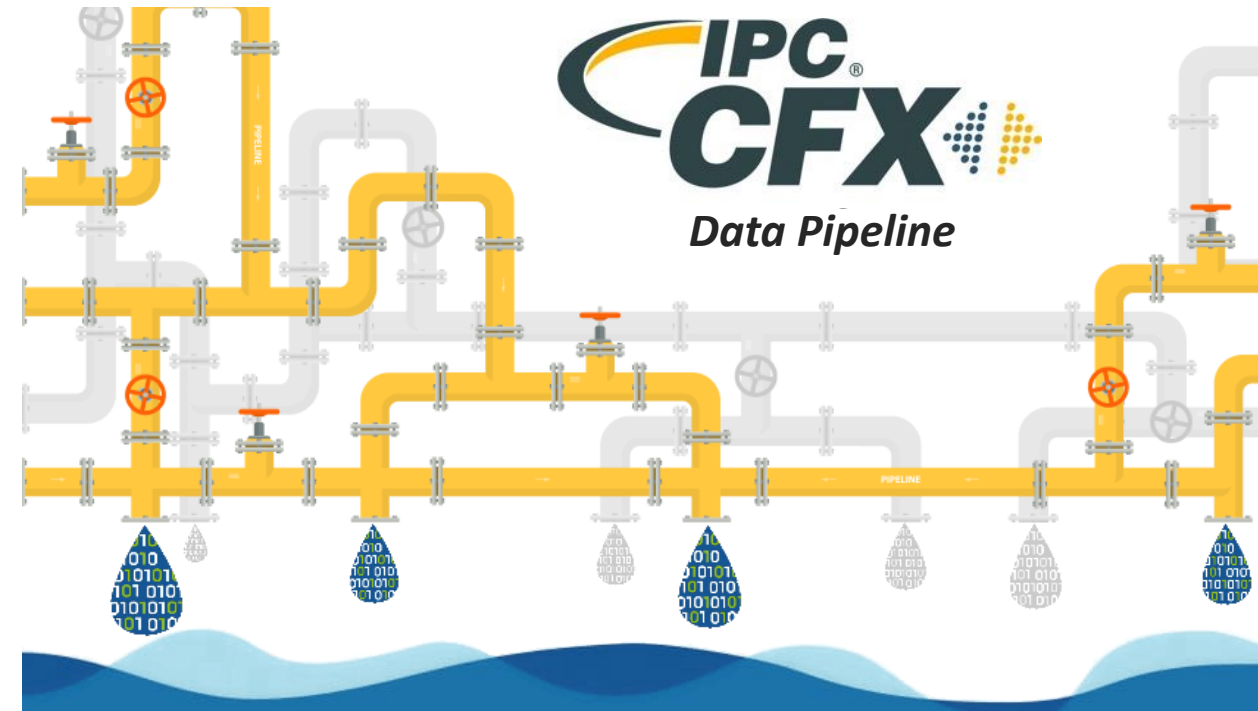
CFX Topics, Messages & Flow Concept



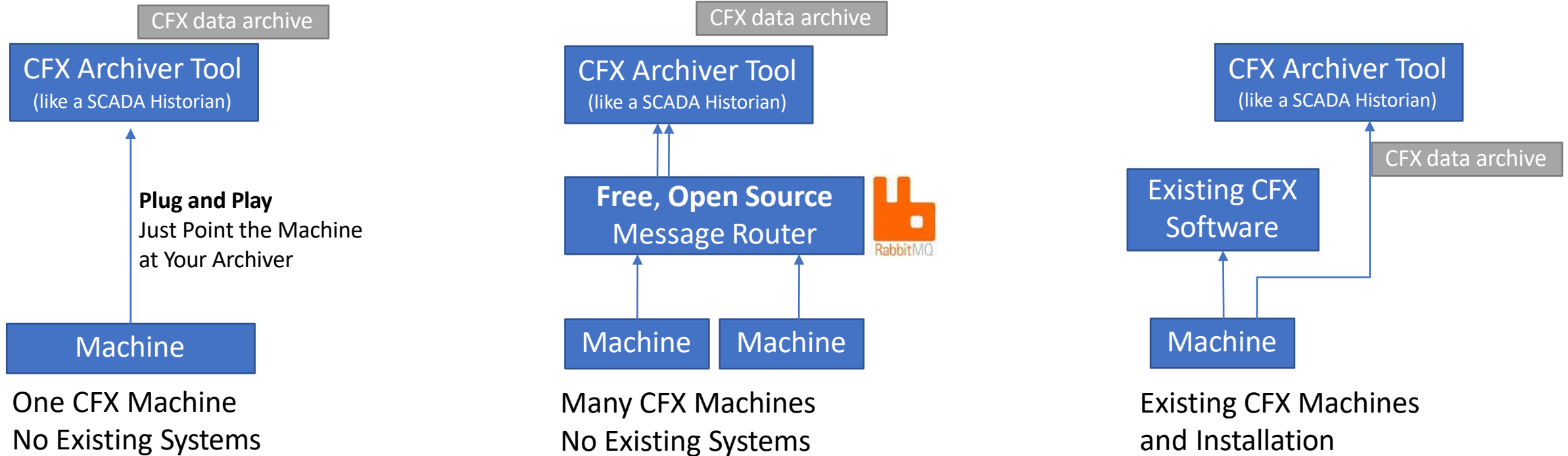
IPC-CFX Is A Clean Pipeline of Data



- > IPC-CFX standardizes the message content *and* the communication protocol
- > Standardized messages have the same format across all machines
 - Any machine can talk with any other machine without translation (middleware)
- > EMS and OEM can interpret data the same regardless of machine vendor
 - Essential for mixed-equipment lines
 - It is a single way to report performance
- > Sets IPC-CFX apart from other protocols
 - For instance, SECS-GEM only specifies how data are sent, not “what” is sent
 - Each machine decides for itself how to pack its information into SECS/GEM reports
 - Not plug and play
 - Integration nightmare
- > **IPC-CFX is 100% plug and play**

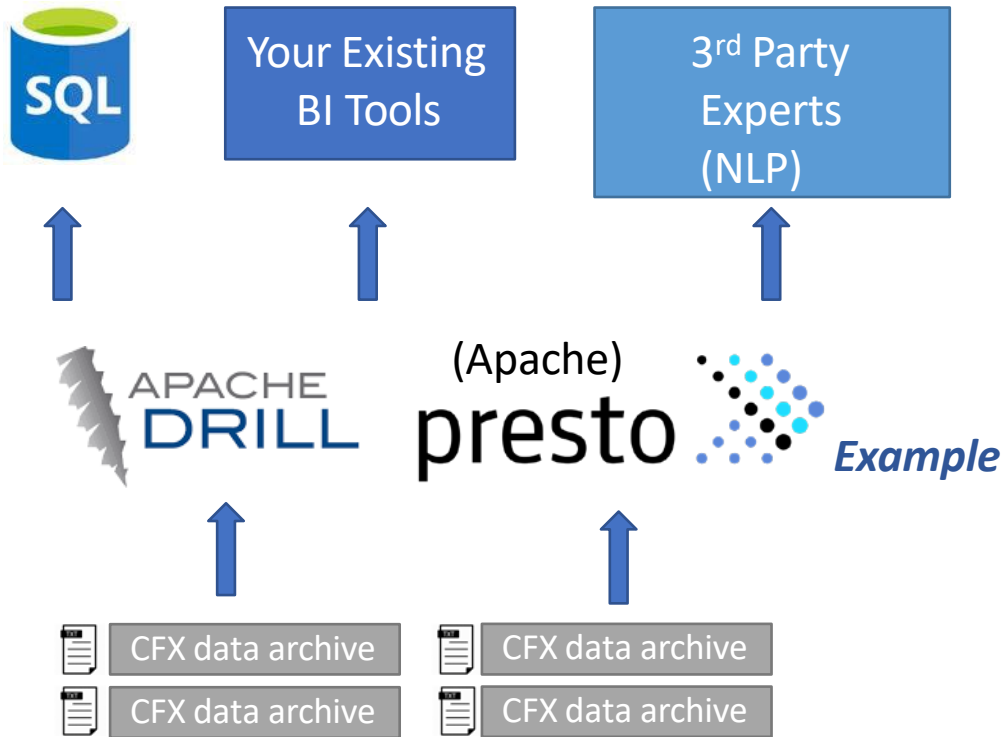


How to Start Collecting CFX Data



The first step is to start recording the rich CFX data your machines are producing so you have it when you need it

How To Start Using CFX Data



Notes

1. CFX Data is in **JSON format** with a **fixed schema**
2. This means it is **compatible with modern software**
3. Literally just copy your CFX archive files onto a computer running **free, open-source tools** and query anything you want to know about your machines
4. It **works for 1 machine** and it **works for 1000** machines
5. Easily sharable if you want help solving problems

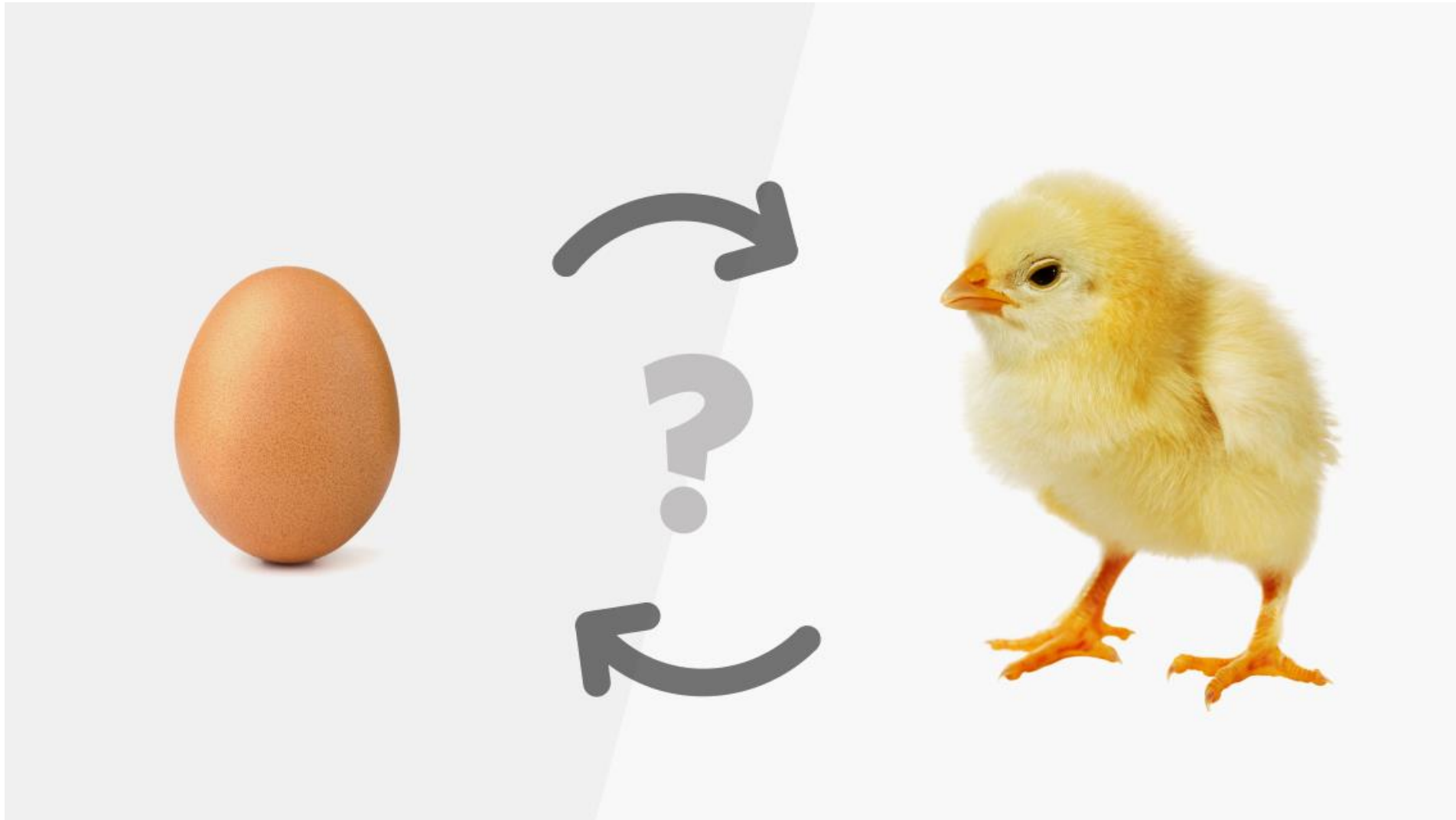


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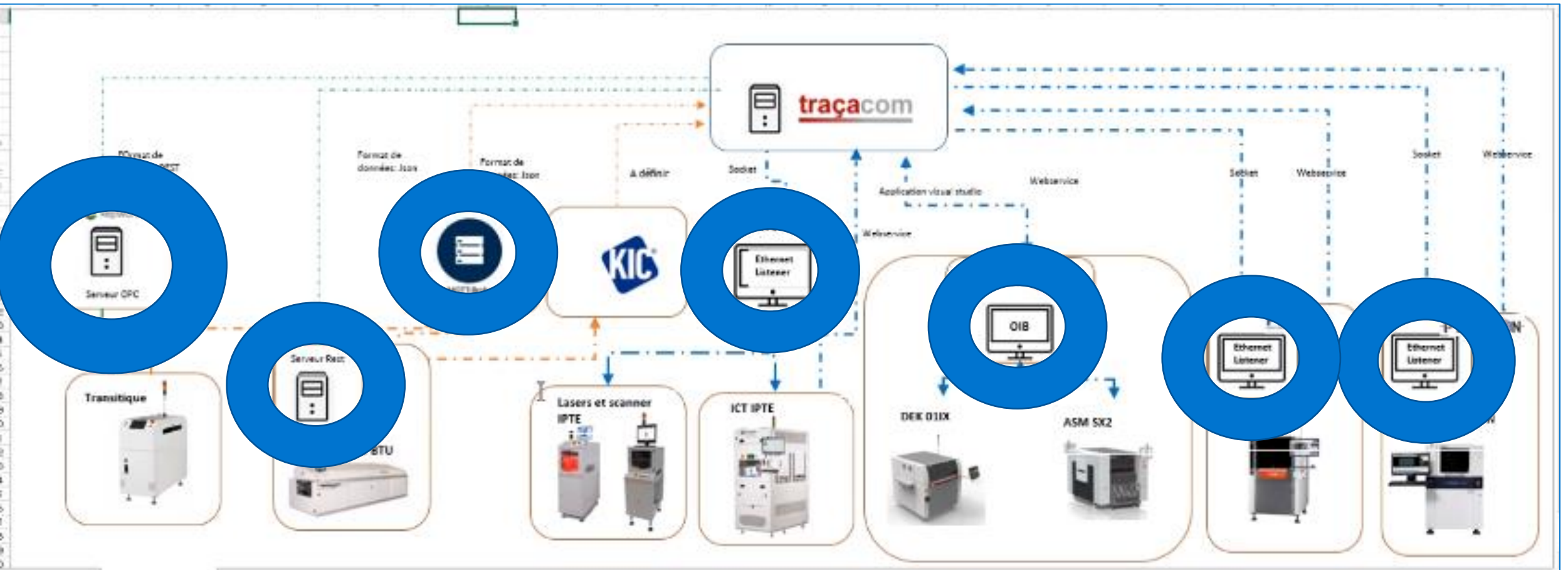
Industry Support

[ipc.org](https://www.ipc.org) →

Chicken or Egg?



Remember all those adapters???

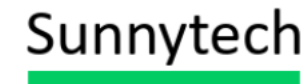


Equipment Suppliers - 82

Software Suppliers - 26



Electronic Manufacturing Services Supporters of CFX - 32



How to participate: [Join IPC-CFX as a Committee Member, Supporter, or Partner](#)

CFX Capability Requirements by Equipment Type



July 2022

IPC-2591-Version 1.5

Table 6-1 CFX Capability Requirements by Equipment Type

Category	Capability	Endpoint Class												
		Generic Equipment Endpoint	Automated Labeler/Laser Marker	Stencil Printer	Solder Paste Inspection (SPI)	SMT Mounter (Pick and Place)	Automated Optical Inspection (AOI/AXI)	Solder Reflow Oven	Reflow Profiling	Selective Solder	Through-Hole Component Insertion (THT)	Test Equipment	Conformal Coating	Cleaning
CFX Core	Core Communications	M	M	M	M	M	M	M	M	M	M	M	M	M
Track and Trace	WIP Tracking	M	M	M	M	M	M	M	M	M	M	M	M	M
	WIP Identification	MR	M	MR	MR	MR	MR	MR	MR	MR	MR	MR	MR	MR
	Unit Initialization	O	M	O	O	O	O	O	O	O	O	O	O	O
	Panelized Unit Initialization	O	M	O	O	O	O	O	O	O	O	O	O	O
	Operator Tracking	O	O	O	O	O	O	O	O	O	O	O	O	O
	Equipment Data Tracking	O	O	O	O	O	O	O	O	O	O	O	O	O
	Unit Disqualification/Scrapping	O	O											
	Detailed Activity Tracking	O	O	O	O	O	O	O	O	O	O	O	O	O
	Material Trace with Internal Setup	O	O	O		O		O	O	O	O	O	O	O
	Exact Material Trace with Internal Setup	O				MR					MR			
	Exact Material Trace with External Setup	O				M					M			
	Tool Trace	MR	O	MR		O			O	O	O	O	O	O
Process Interlocking	Process Route Validation	O	O	O	O	O	O	O	O	O	O	O	O	O
	Unit Status Validation	O	O	O	O	O	O	O	O	O	O	O	O	O
	Unit Trace Validation	O	O	O	O	O	O	O	O	O	O	O	O	O

Recipes	Basic Recipe Visibility	M	M	M	M	M	M	M	M	M	M	M	M	M
	Recipe Recipe Selection	O	O	O	O	O	O	O	O	O	O	O	O	O
	Recipe Recipe Management	O	O	O	O	O	O	O	O	O	O	O	O	O
Setup Validation	Internal Setup Validation	O	O	O	O	O	O	O	O	O	O	O	O	O
	Offline Setup						O					O		
	External Setup Validation	O	O	O			O					O		
Blocking and Locking	Material Blocking for External Setup	O	O	O			O					O		
	Material Blocking for Internal Setup	O	O	O			O					O		
	Station Locking	O	O	O	O	O	O	O	O	O	O	O	O	O
Personalization	Unit Personalization						O					O	O	
Station Information	Station Performance Reporting	M	M	M	M	M	M	M	M	M	M	M	M	M
	Advanced Station Performance Reporting	O	O	O	O	O	O	O	O	O	O	O	O	O
	Station Configuration Management	O	O	O	O	O	O	O	O	O	O	O	O	O
	Station Maintenance Tracking	O	O	O	O	O	O	O	O	O	O	O	O	O
	Energy Consumption Tracking	O	O	O	O	O	O	O	O	O	O	O	O	O

Table 6-1 CFX Capability Requirements by Equipment Type (cont.)

Category	Capability	Endpoint Class												
		Generic Equipment Endpoint	Automated Labeler/Laser Marker	Stencil Printer	Solder Paste Inspection (SPI)	SMT Mounter (Pick and Place)	Automated Optical Inspection (AOI/AXI)	Solder Reflow Oven	Reflow Profiling	Selective Solder	Through-Hole Component Insertion (THT)	Test Equipment	Conformal Coating	Cleaning
Test and Inspection	Production Unit Inspection				M		M							
	Automated Optical Inspection (AOI/AXI)						M							
	AOI Component Critical Measurement						O							
	Solder Paste Inspection				M									
	Production Unit Test											M		
Specialized Processing	Solder Paste Reflow Processing							M						
	Solder Paste Reflow Profiling								M					
	Selective Solder Processing									M				
	Solder Paste Preheating			M										
	Conformal Coating												M	
	Cleaning													M



Manufacturers with Qualified Listing on the QPL




enabling the digital world




Technology Leadership. Global Solutions.



A NANODIMENSION DIVISION



Surface Mount Intelligence



a coesia company



innovative spirit



欧菲特
GENERALTEST




Enjoy Testing




Electronic Assembly Equipment



Making Ovens Smarter




WORLDWIDE HIGH-PRECISION CLEANING SYSTEMS







innovation



vision technology





振華興

Qualifications in progress



Let's Test



Revs Your Heart

AOI/AXI	SPI	Pick & Place	Stencil Printer	Automated Labeler/ Laser Marker	Test Equipment	Solder Reflow Oven	Reflow Profiling
							
							
							
							
							
							
							
							
							
							
							
							



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IPC-CFX Industry Adoption

[ipc.org](https://www.ipc.org) →

IPC-CFX Supporters and Industry Growth



- > Over 100 global companies have publicly indicated their support for IPC-CFX
 - > EMS/OEM manufacturing partners
 - > Software support services
 - > Equipment vendors
 - > Industry partners
- > Lockheed Martin announced Smart Factory supported by IPC-CFX in January
- > Lacroix in France implemented CFX in new factory
- > Many other EMS and OEM companies working IPC-CFX without public announcements
- > One vendor on IPC-CFX team indicates 90% of new equipment orders require IPC-CFX
- > Expect to see more announcements in the days ahead

ASSEMBLY

eMAGAZINE EXCLUSIVES INDUSTRIES TECHNOLOGIES COLUMNS MORE MEDIA

Lockheed Assembly Plant Adopts IPC-CFX Standard, Creates 'Smart Factory'



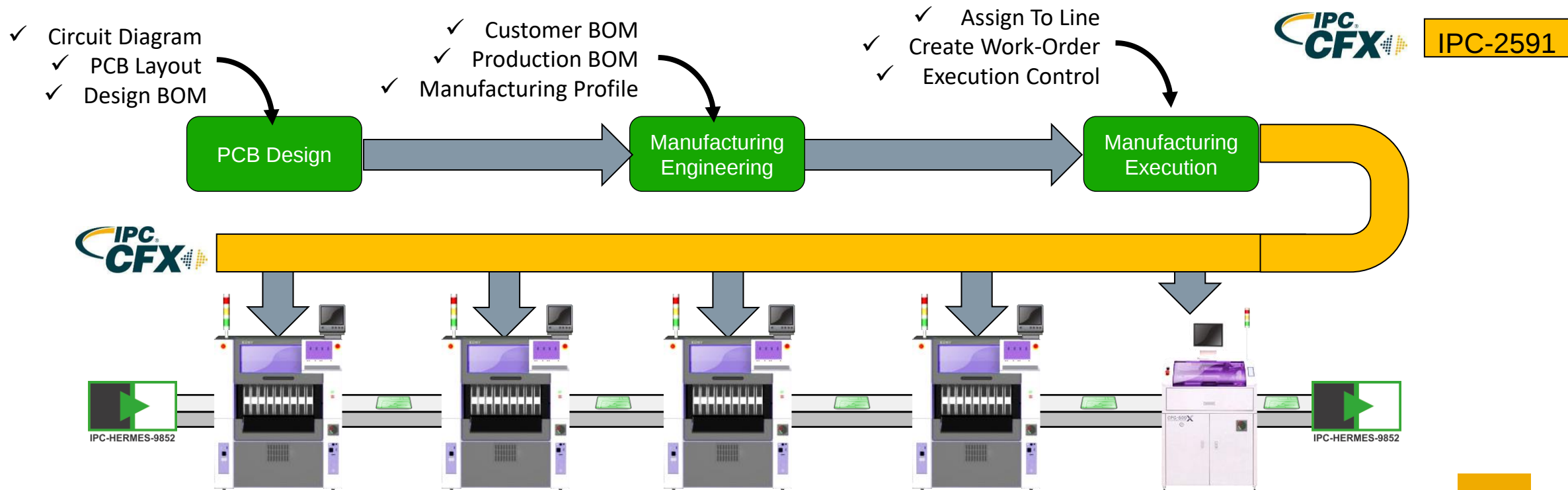
January 14, 2022

BY WENDY K. HARRIS /

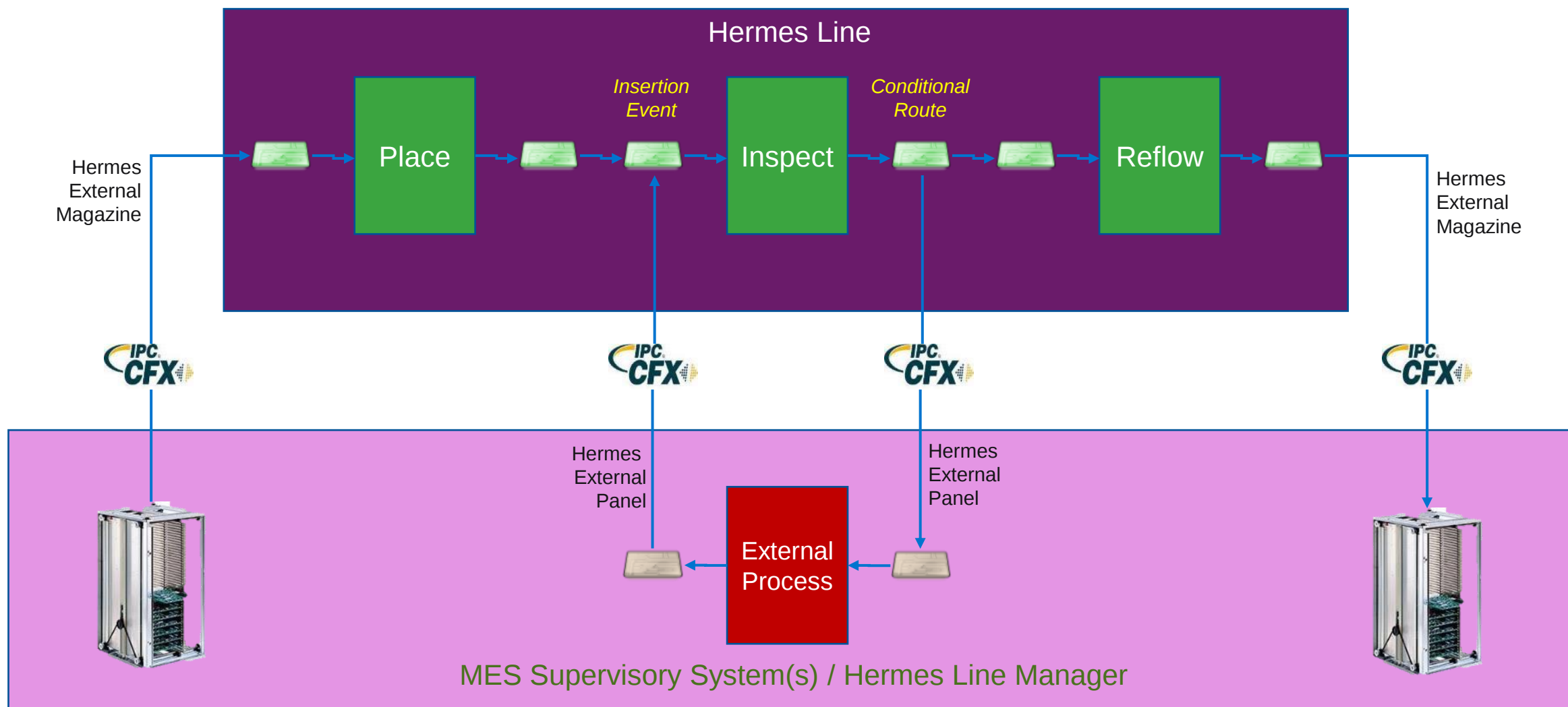
LUFKIN, TX—Lockheed Martin's electronics assembly plant here has adopted the IPC-CFX standard for its surface-mount production lines, enabling the defense contractor to turn the facility into a smart factory.

DPMX and CFX - Design Through Manufacturing 4.0 Flow

- No human “touch” of data
- Manufacturing attributes added to DPMX file
- DPMX delivered to machines by CFX Message
- Machine vendors parse DPMX file



Hermes – CFX Interoperability

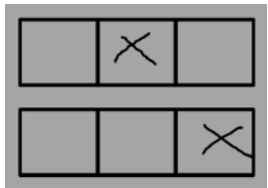


Hermes - Managing “Bad Marks”

Objective:

Transfer known bad mark information between MES and machine, so that no or only one machine must detect it by itself

Board with 6 subpanel, 2 bad marks



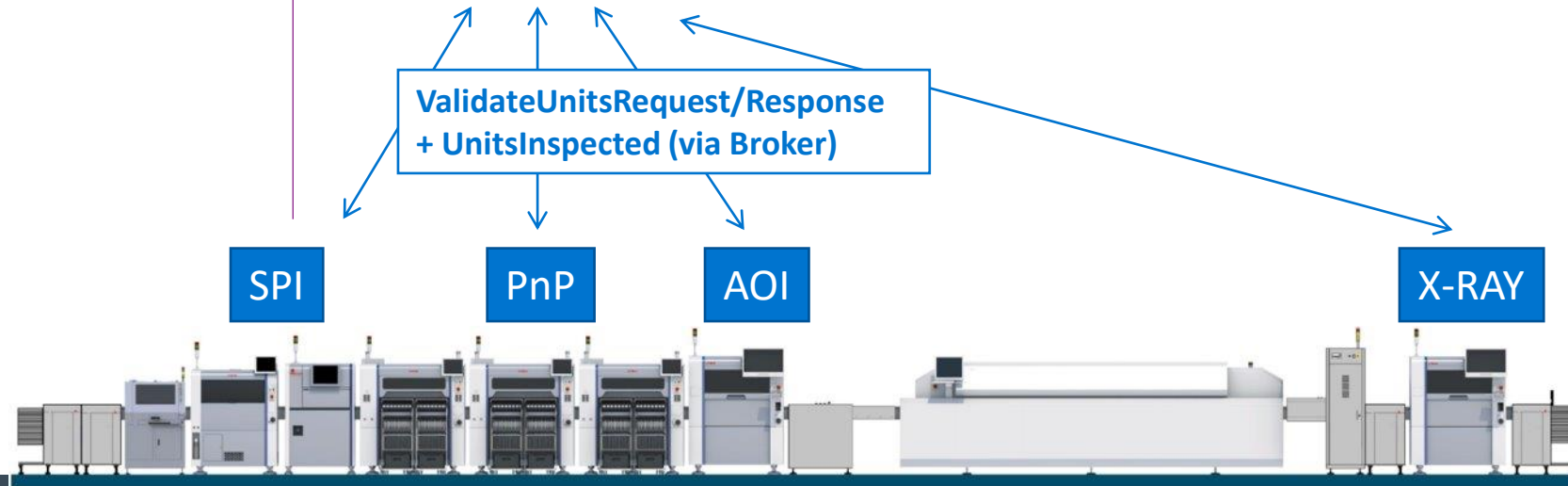
MES	
SubPanel1	OK
SubPanel2	XOUT
SubPanel3	OK
SubPanel4	OK
SubPanel5	OK
SubPanel6	XOUT

Multiple situations:

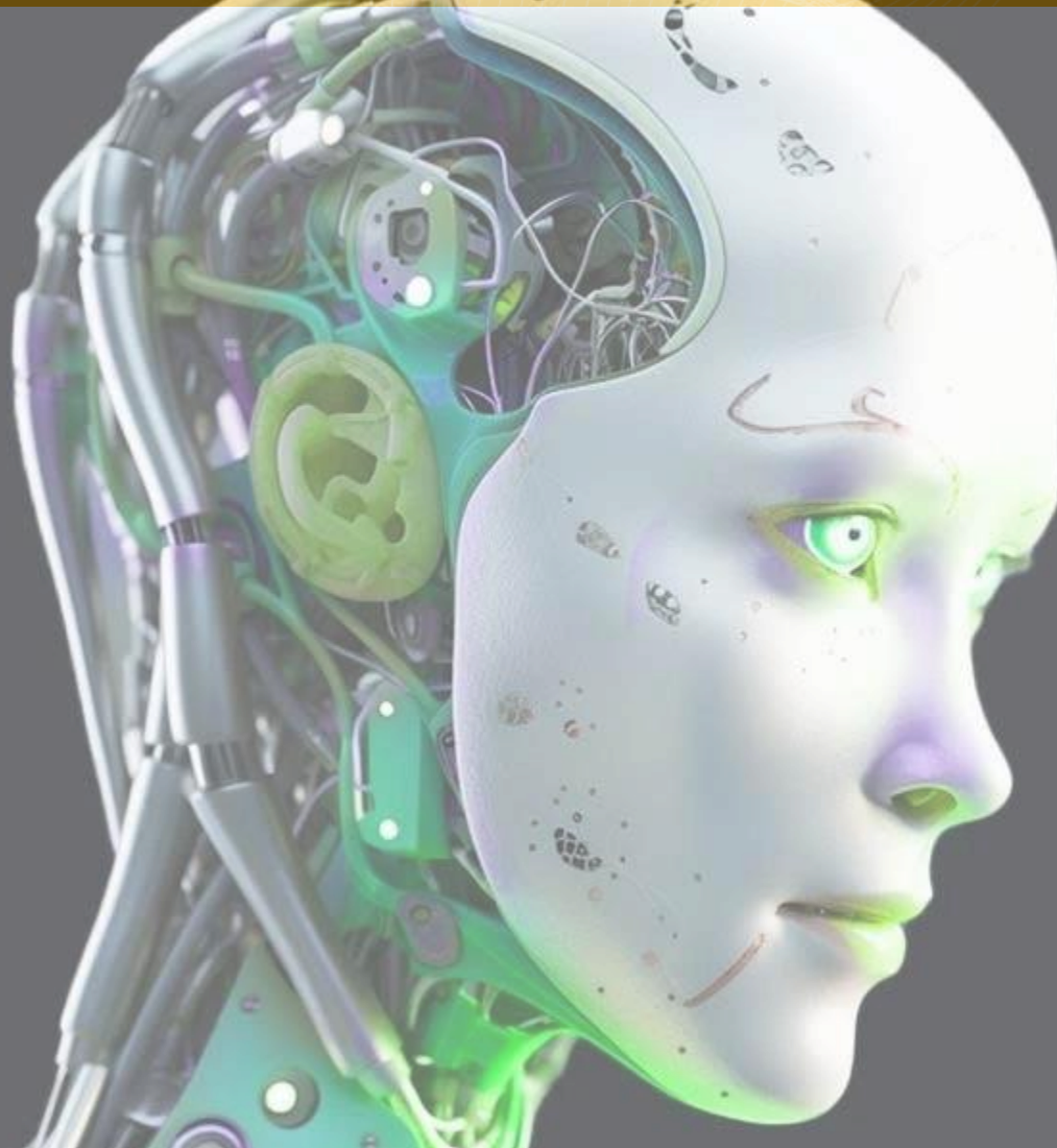
- Bad marks known before SMT process (data from supplier/previous process)
- Bad marks detected by first inspection process (SPI)

Proposal

Simply add **Skipped** status to ValidationResult (MES -> Machine) and TestResult (Machine -> MES)



Looking Forward to the Future of EMS



- **Primary goals** - reduce, eliminate false calls
- **Key points** - training / learning **AI algorithms** applied to SPI, AOI, AXI tools and software
- **Intent** - reduce, eliminate false calls and escapes

 OpenAI

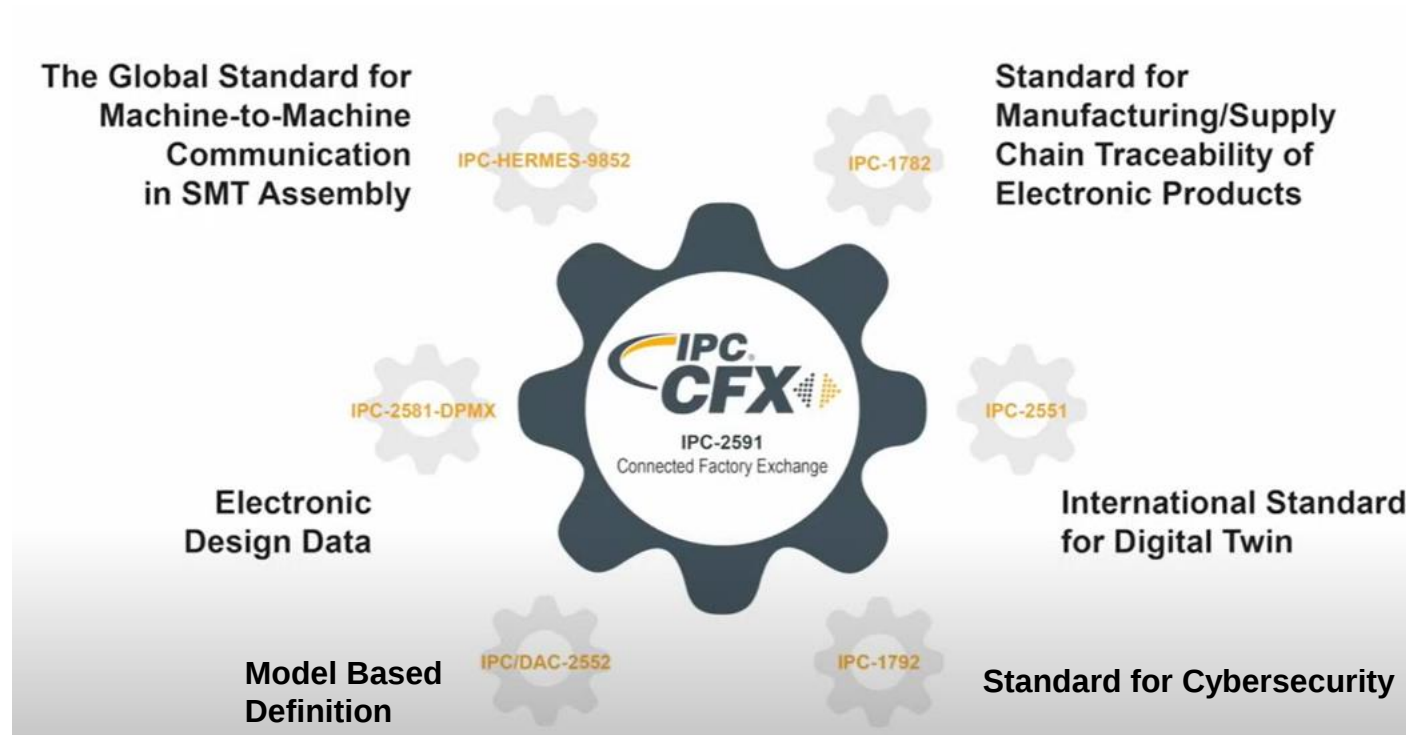
- Currently, when defect found by machine, OPERATORS are making the call to clear or confirm the defect. THIS IS BAD!!!!

- **Instead** - move the decision point from operators to and AI-based tool

- **Opportunity** - next gen SPI, AOI, AXI tools need to have AI-base decision capability. This will be a big step to improve quality and reliability at SMT manufacturing.

- Now think all this data!!!!

- **Data needs to come from the equipment to make this happen - CFX do this.**
- allows multiple equipment suppliers to participate.



Foundational to enable Factory of the Future & Digital Transformation of Electronics Manufacturing

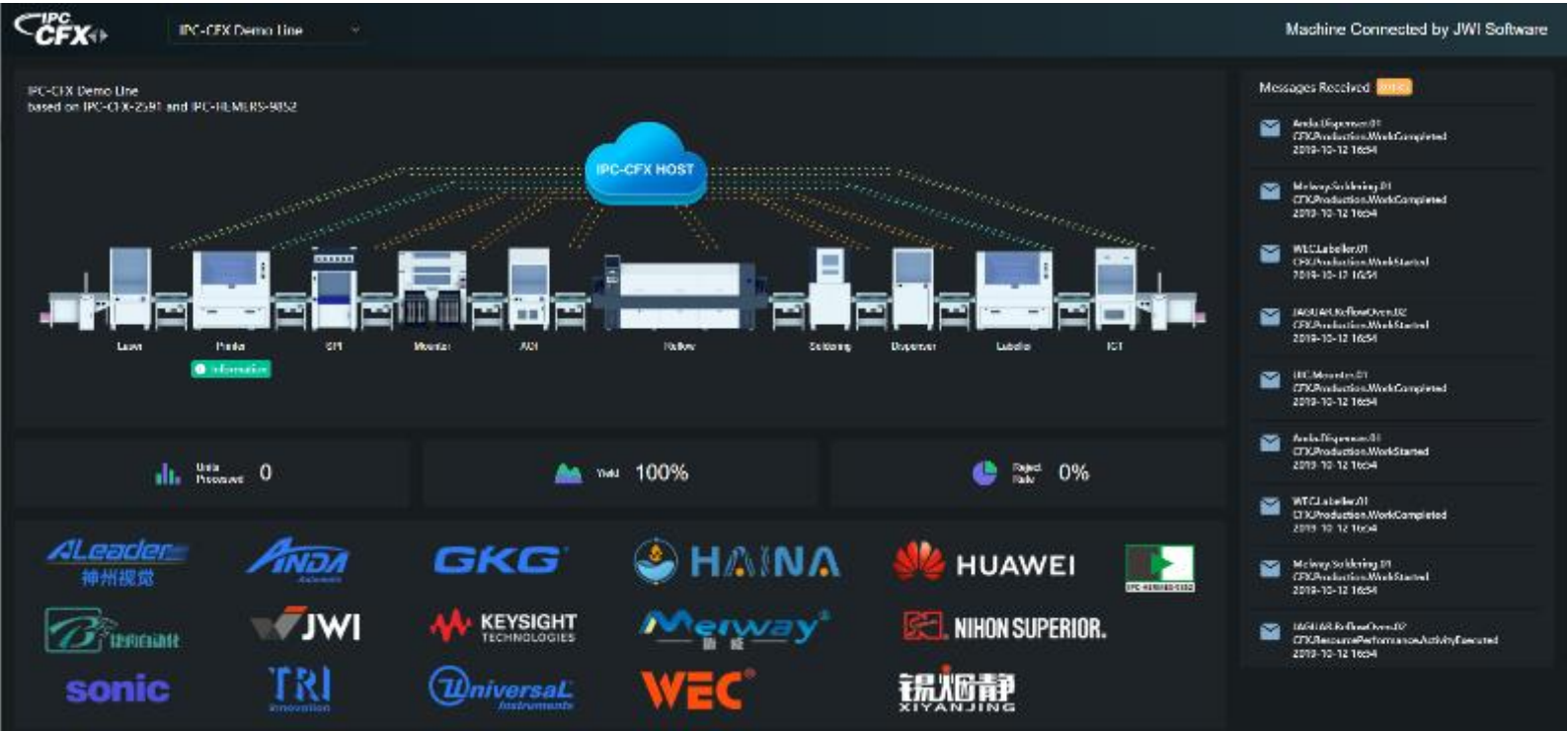
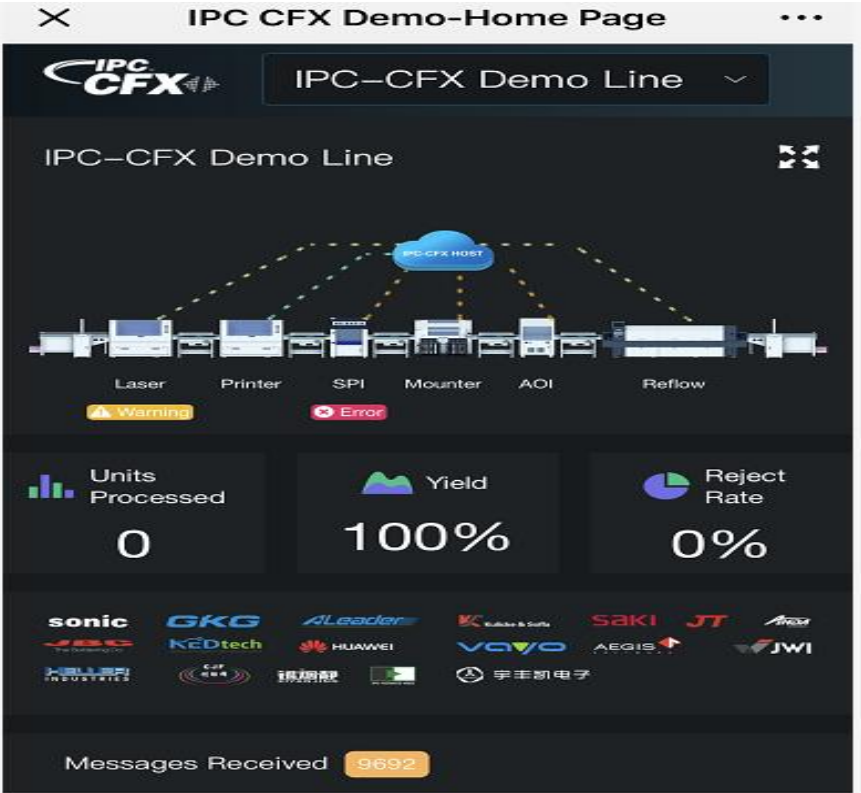
IPC CFX Demo Line



IPC CFX Demo Line Application



<http://ipc.devicemate.cn>





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Thank you. Questions?

Chuck Li IPC Standards Manager

Mobile : +86 181 2993 1518 (WeChat)

Email: ChuckLi@ipc.org