半导体行业数字化、智能化的挑战与解决方案

西門子工業軟體全球半導體行業發展執行總監
申云勇 David Shen

Realize innovation.

最近的电子与半导体市场生态系统的驱动因子

智能接口 和 VR / AR 持续增长

- **Augmented Reality to reach $120B by 2020** (driven by hardware sales).

- **Nintendo's market value went up $9B in 5 days because of AR.**

将IoT理念设计运用到新产品中

- **Smart TV's include Smart Home hubs for connected products**

- **Amazon has over 1000 people working on Echo design team to add connected device capabilities**

IoT是未来3 - 5年主要驱动市场的发展力量

- **1/6 consumers currently own and use wearable tech.**

- **IoT: Over 50 billion internet-connected devices will exist worldwide by 2020.**

汽车电子和成像电子产品是一个崭新的领域

- **Electric vehicles Tesla Model 3 received 400,000 orders in 2 weeks**

- **US Government opened up $4.5B in loan guarantees to boost electric vehicle infrastructure**

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缩短技术创新采用的时间
Shorter technology Innovation Adoption Time Becomes Shorter.

更难实现跨越供应链的协同合作
More difficult to enable collaboration across and through the Supply Chain.

无法实现零缺陷将导致收入/市场份额的损失
Inability to achieve zero defect will cause loss of revenue/market share.

提供给制造环境需要的闭环、智能集成
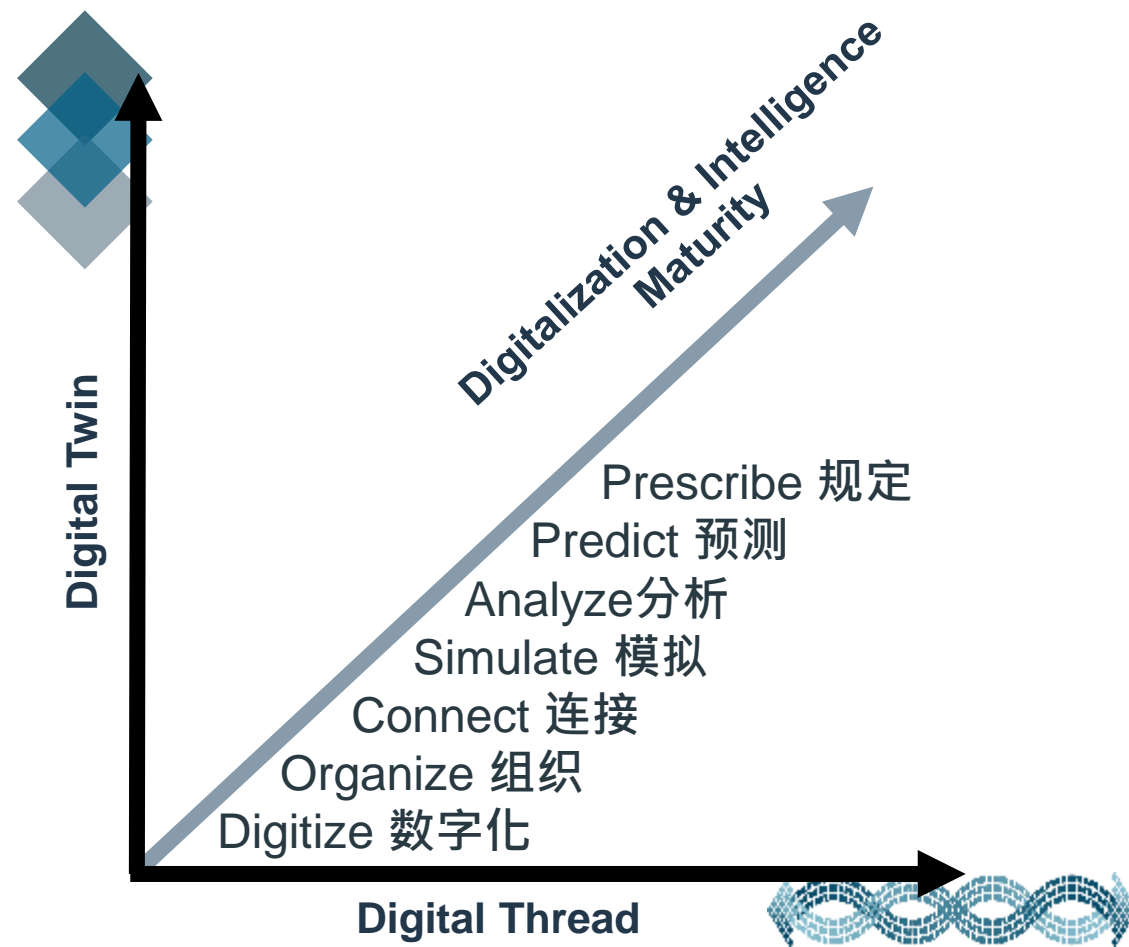**Manufacturing environment needs to be closed loop, intelligent and integrated.**

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SIEMENS 愿景:

提供企业整体数字化、智能化软件解决方案 - 使新产品开发与实施更卓越。

Combining intelligence and connectivity

结合智能和连接

SMART INNOVATION

Ideation   Realization   Utilization

Digitalization & Intelligence Maturity

Digital Twin

Prescribe 规定
Predict 预测
Analyze分析
Simulate 模拟
Connect 连接
Organize 组织
Digitize 数字化

Digital Thread

西门子聚焦：帮助公司实现卓越的新产品开发与实施

实现卓越的新产品开发与实施

提供解决方案以跨多个领域来使用数据

帮助客户从PLM, MES, ALM, EDA中获得更多收益

进行战略收购和投资，以满足行业的具体需求

根据行业惯例，创建预配置的解决方案

提供具有竞争优势价值解决方案的半导体数字化平台

半导体数字化平台价值解决方案

新产品开发与实施项目管理和仪表板	IP管理与重用	集成验证与确认	设计规则手管理	芯片流片管理	设计与工程协作	闭环质量管理
IMPROVE NPI EXECUTION & VISIBILITY	**IMPROVE PRODUCTIVITY**	**IMPROVE DESIGN YIELD**	**IMPROVE WAFER MANUFACTURA-BILITY**	**IMPROVE DESIGN-TO-MASK QUALITY**	**EFFECTIVE SUPPLIER COLLABORATION**	**ENABLE CONTINUOUS IMPROVEMENT**
Provide a real-time objective dashboard for project / program status	**Enable Search, Catalog, Upload/Download, Security and reuse of Silicon IP**	**Enable end-to-end functional verification and physical test validation**	**Ensure compliance of design to Fab manufacturability rules**	**Enable a clear sign-off process from design to mask**	**Enable collaboration between Fabless and Foundry R&D and Operation teams**	**Provide PLM-MES Integrated solution for closed loop quality management**

新产品开发与引进项目管理和仪表板

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The Digitalization Platform provides an integrated solution for program, project, process and product data management.

Project Schedule

Status?

Product BOI

Product data Deliverables

Priority?

Availability?

Resources

Task List

Program Dashboard Scope Master Schedule Risk Assessment

Program Lifecycle Management

Project 1 Project 2 Project 3

Project Management (Stage Gate)

Business Processes

Product BOI 1 Product BOI 2 Product BOI 3

Product Data Management

TEAMCENTER
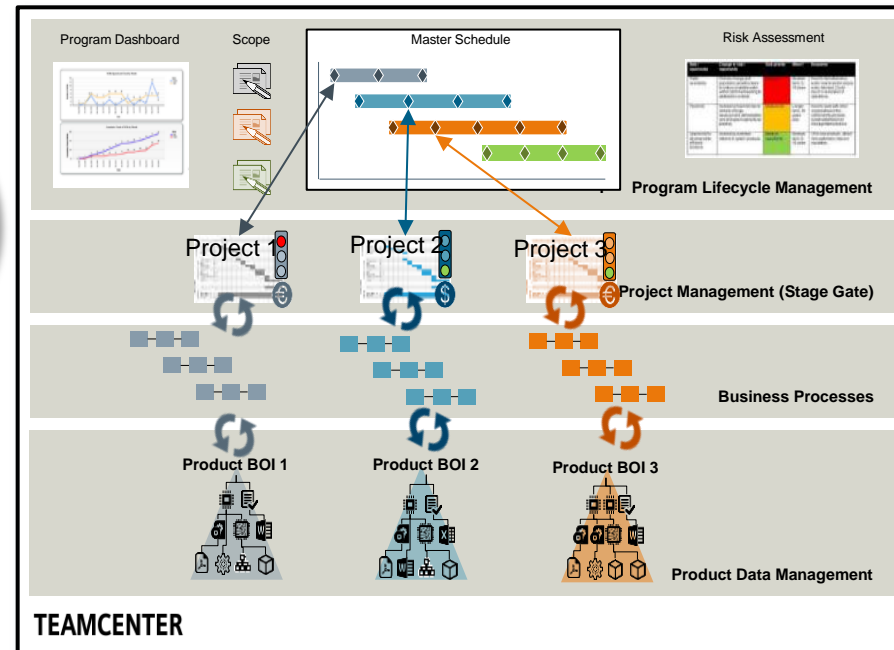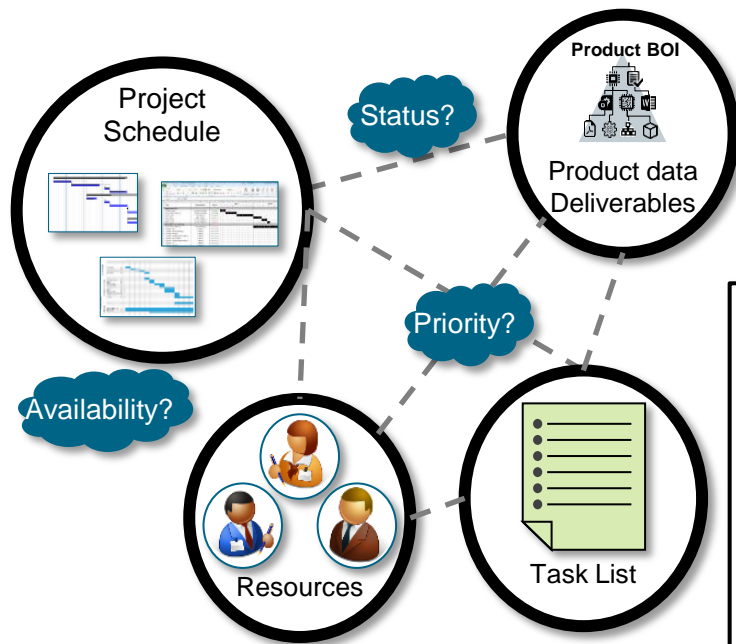
Challenges

- **Inconsistent practices** for project management across the organization
- **Time consuming** reporting and status update activities.
- **No program view.**
- Project Schedule / Tasks **isolated** from Document and Product Data Management applications
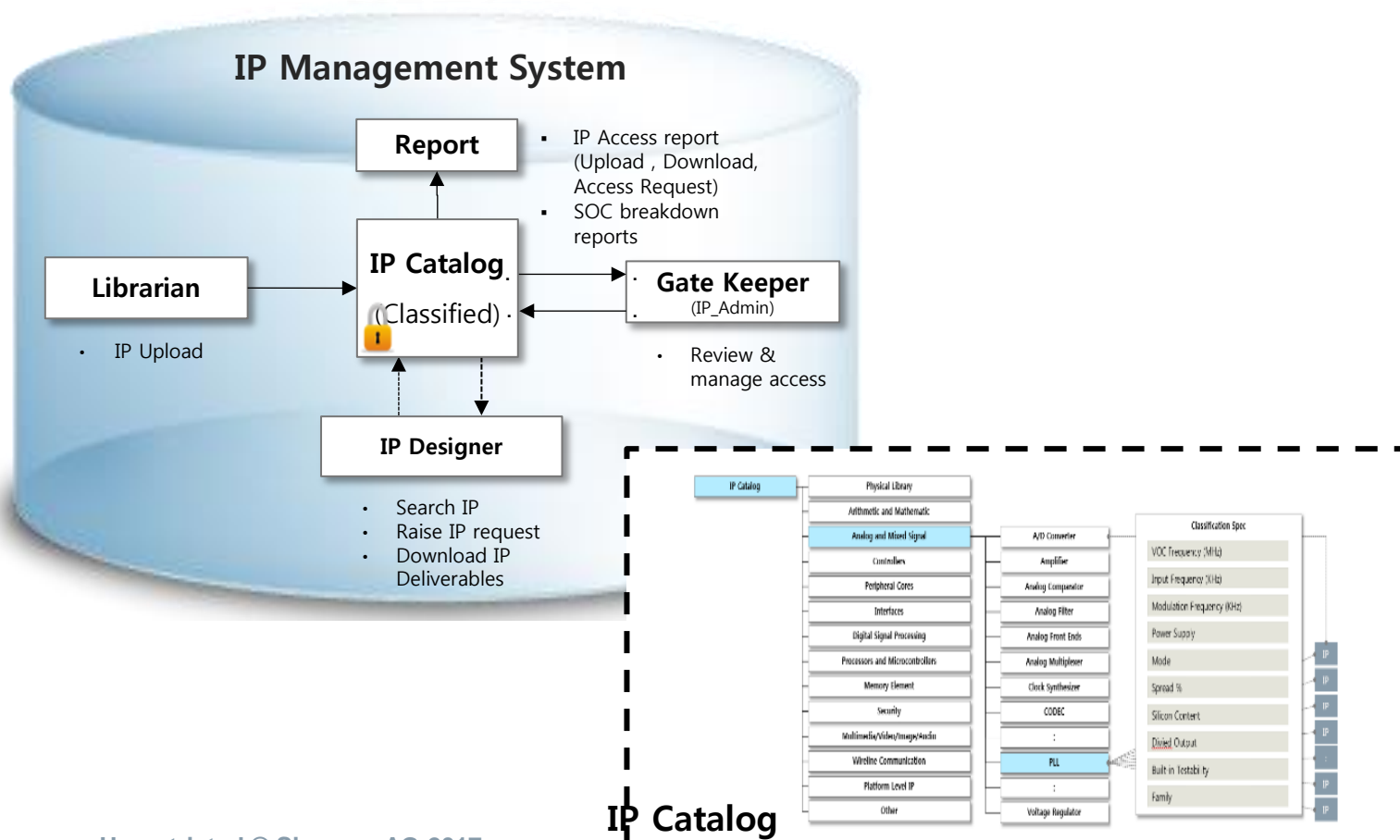- **Ad hoc communication**

Capabilities

- Master Schedule View
- Program Dashboards
- Risks Management
- Resources Management
- Embedded Gantt Chart
- Timesheet, Baseline, Notification
- Workflows synchronized with project tasks
- Project deliverables based on preassigned templates

The Digitalization Platform provides a global IP repository, enabling IP Protection on 4 dimensions: Group/Role/User, Project, IP License and DRM.


IP Management System

- Report
  - IP Access report (Upload , Download, Access Request)
  - SOC breakdown reports

- Librarian
  - IP Upload

- IP Catalog (Classified)

- Gate Keeper (IP_Admin)
  - Review & manage access

- IP Designer
  - Search IP
  - Raise IP request
  - Download IP Deliverables

IP Catalog

Challenges

- Access to IP data is needed from many **different internal and external roles located in different places**.
- **Access control** is critical to preserve IP knowledge
- IP data is authored with **various EDA tools, managed in multiple repositories**
- **IP catalog classification** is complex

Capabilities

- IP Registration
- Designers can Request Access to some or all Deliverables for an IP Design
- Gatekeeper review request and provide Access Control
- If the Designer receives access, he can access deliverables and download to local workstation. (Data Share Manger)
- Audit trails show who received access   and downloaded IP. (IP Data Cube)
- IP usage can be traced (Where Used)

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The Digitalization Platform supports the end-to-end process for SoC/SoC-BLOCK/IP Verification & Validation processes, and bridges the gap between Pre-silicon verification and Post-silicone validation.
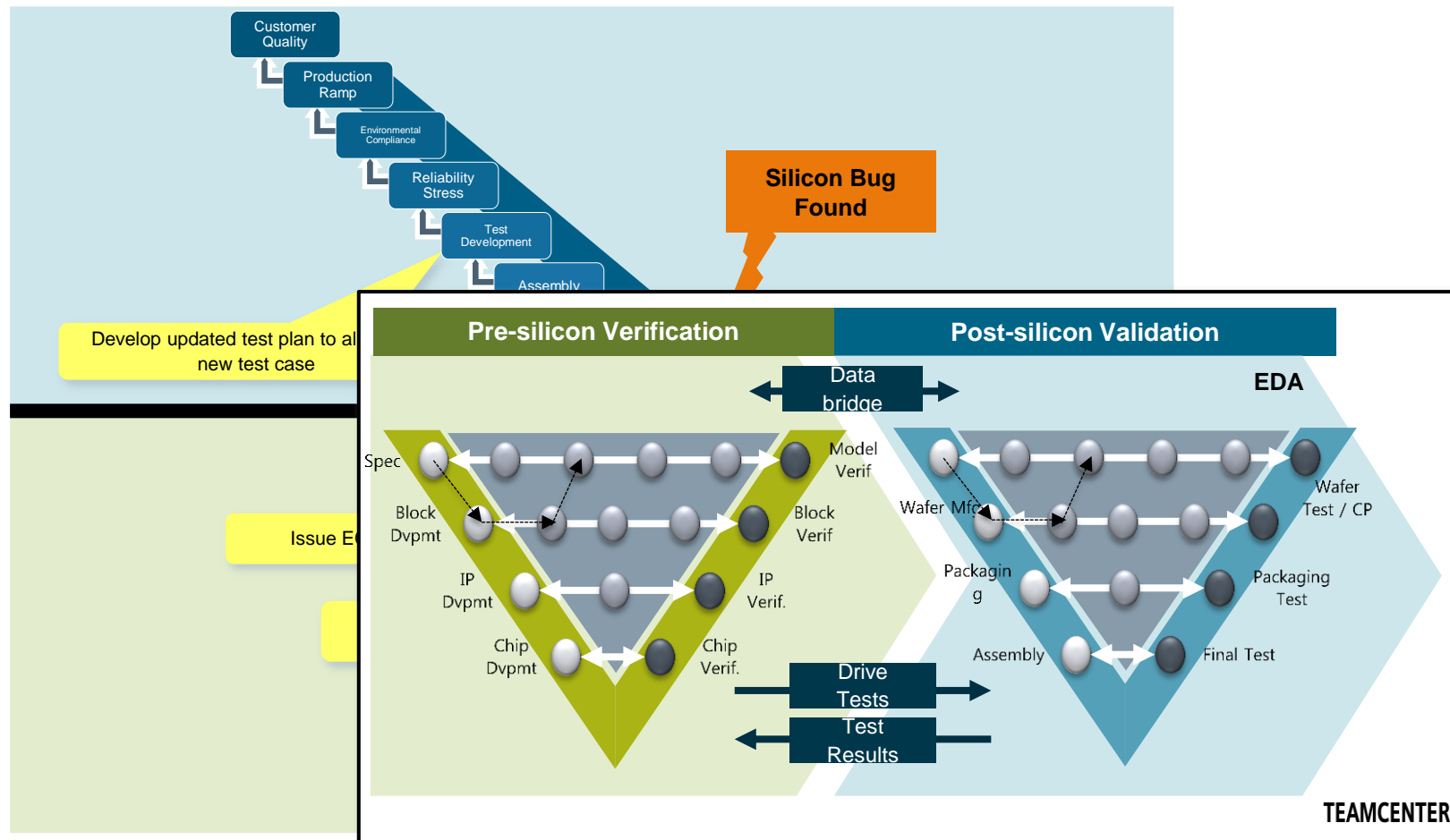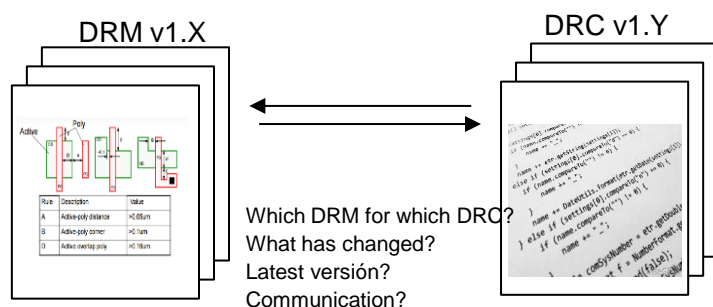

Challenges

- Any ECO change has **multiple impacts** up and down the value chain.

- Verification, Validation & ECO change activities happen **multiple time at multiple points** of the process

- Verification and Validation processes are traditionally **disconnected**, with **inefficient coverage, observability, data exchange, communication and information traceability**

Capabilities

- Integrated data bridge between pre-silicon verification and post-silicon validation

- Integrated PLM , ALM, DevOps with EDA for continuing integration and delivery
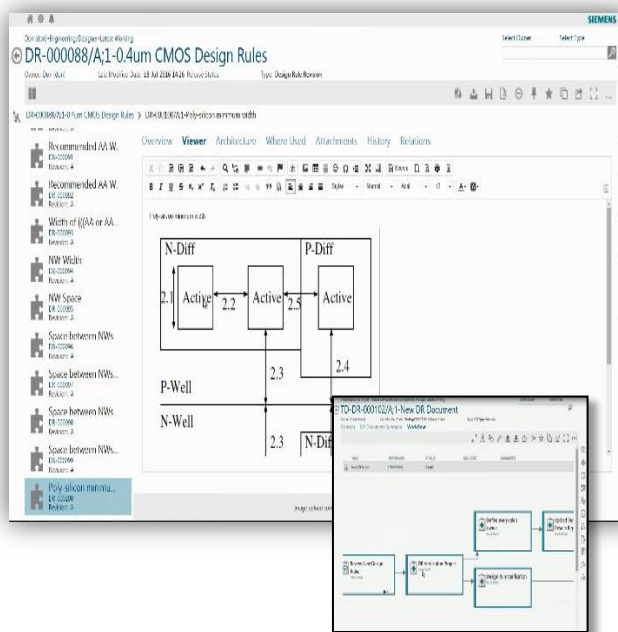
The Digitalization Platform provides rich capabilities to enable electronic DRM.

Validation Problem between
Process/DRM/DRC and impact on Design

DRM v1.X

DRC v1.Y

Which DRM for which DRC?
What has changed?
Latest versión?
Communication?

Complexity of DRC deck vs. Process node
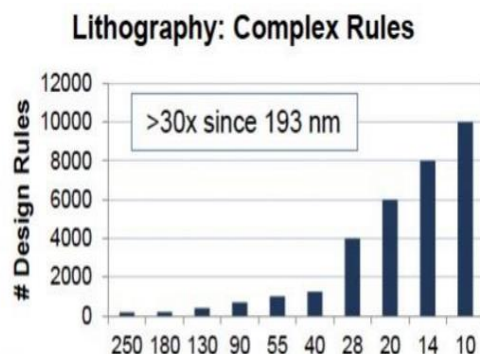
Source: SemiWiki.com

Challenges

- DRM specification and the DRC runset are **separated in time and space   with many revisions** over the lifetime of a chip

- **Single mistake** in the design flow from DRM to DRC **can be fatal**

- **One DRM is the source of multiple DRC runsets** but development and maintenance of every new DRC runset is expensive and introduces both risk and delays

Capabilities

- Import Design Rules (Word/Excel)

- Intuitive web based editor

- Manage Rich content

- Manage Design Rules Revisions

- Manage Workflows & Assignments

- Compare Design Rules

- Check List Management: Pool Management, Configurable list, Results management

芯片流片管理

The Digitalization Platform drives the Tape-out release process by managing deliverables, checklists and workflows.

Tape-Out Form

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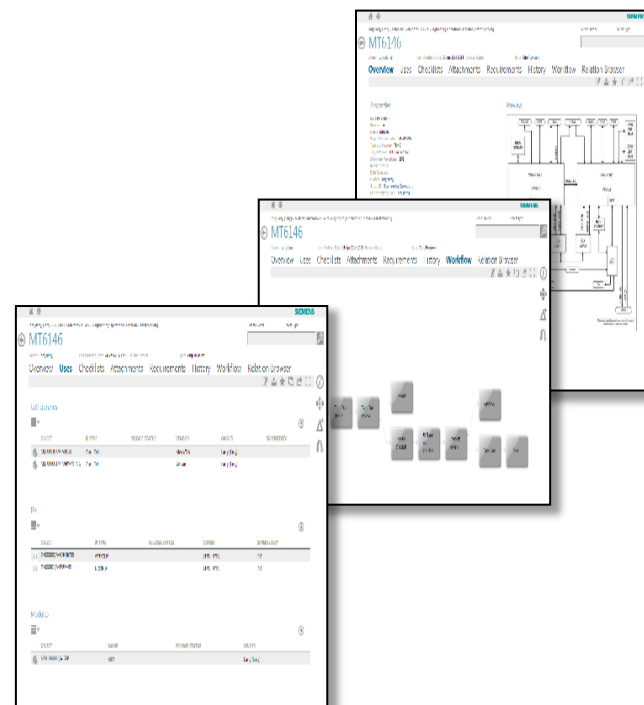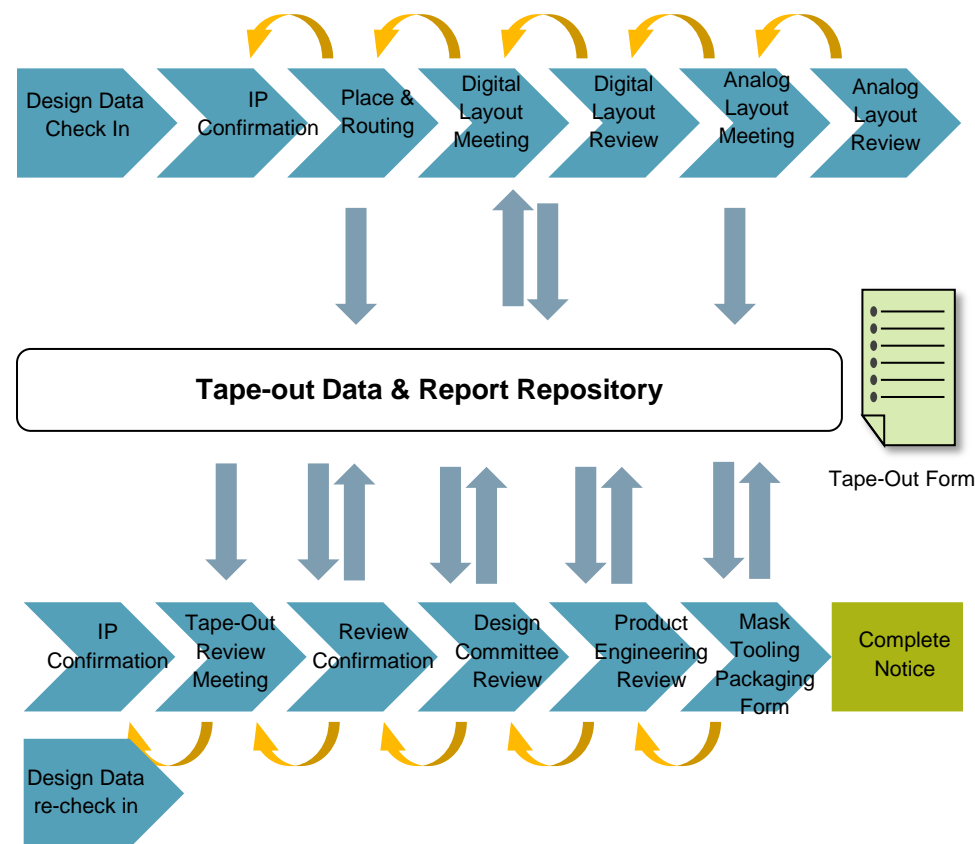
Challenges

- Tape-out process involves many **different internal and external stakeholders**

- **Tape-out process is complex**, with many steps and branches

- Every step consume and generate data

- The **information required to perform the Tape-out, is very diverse** and evolving over time.

- Effective Tape-out process is key to **avoid late error discovery, and significant costs**

Capabilities

- **Preconfigured workflows** supporting the business process

- Tape-Out **specific data model** to efficiently managed the deliverables from the BOI.

- **Flexible check lists** to drive the review activities

设计与工程协作

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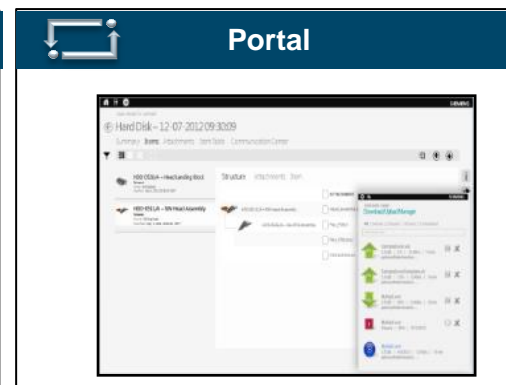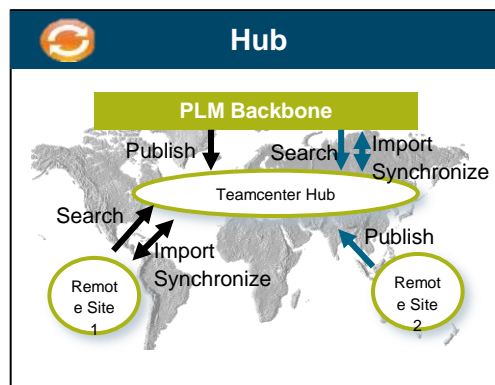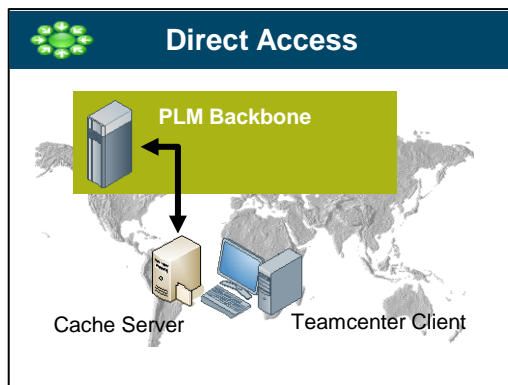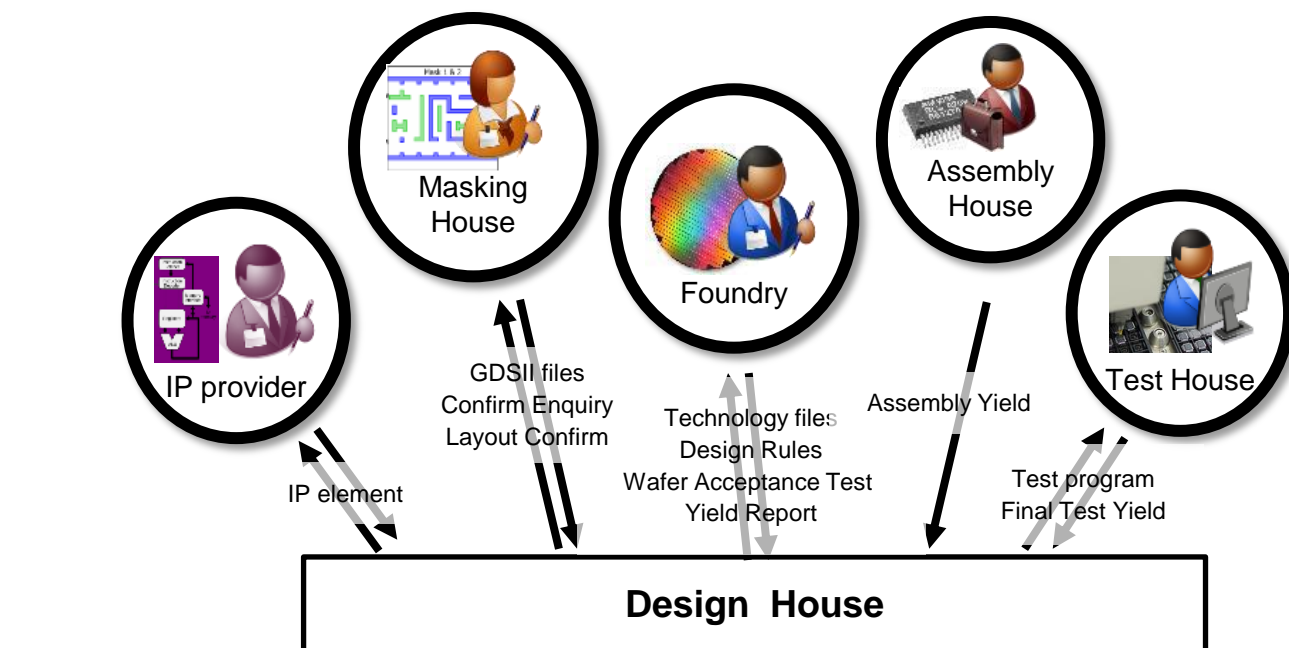
Challenges

- Design and Engineering have to **exchange information and data at multiple points** of the NPI process

- Data exchange is **bi-directional**

- **Tight Design – Engineering collaboration** is needed to avoid errors and therefore to reduce NPI time

Capabilities

- Asynchronous data exchange via web portal

- Synchronized data exchange via system integration

- Data exchange traceability and audit

- Immersive data sharing, enabling direct access with fine-grain security access control, and advanced File Management System (FMS)

IP provider

Masking House

Foundry

Assembly House

Test House

GDSII files
Confirm Enquiry
Layout Confirm

Technology files
Design Rules
Wafer Acceptance Test
Yield Report

Assembly Yield

Test program
Final Test Yield

IP element

Design House

Direct Access

PLM Backbone

Cache Server   Teamcenter Client

Hub

PLM Backbone

Publish   Search   Import Synchronize

Teamcenter Hub

Search   Import Synchronize   Publish

Remote Site 1   Remote Site 2

Portal

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闭环质量管理

The Digitalization Platform provides an integrated solution for Quality Management, including Non Conformance, CAPA, FMEA, Changes and audit.

DESIGN / ENGINEERING OFFICES

FMEA — Change Trigger — Change Request — Change Implementation — Change Effectivity??

PLANT 1
Material Deviation — CAPA
MES — Lot & Wafer/Strip — Failure Catalogue

PLANT 2
Material Deviation — CAPA
MES — Lot & Wafer/Strip — Failure Catalogue

MD-000037/A;1-Discoloration on Wafers

Owner: Rana (rana)   Last Modified Date: 24-Oct-2015 13:10   Release Status: Type: Material Deviation Revision

Overview   Affected Items   Documentation   Workflow   Signoffs   **Relations**   Participants   Analytics

Relations Legend

Quality

Objects
- File (0)
- Failure (1)
- Lot (1)
- Wafer (3)
- CAPA (1)
- MaterialChangeRequest (1)
- Deviation (1)
- Other (0)

Relations
- Attach (0)
- ImplementedBy (2)
- Impact (2)
- Structure (3)

Ports

Challenges

- Each plant has **isolated deviation management processes**, not connected to the Enterprise Change process.

- **Lack of enterprise visibility and auditability** of deviations and Non Conformances

- Change and deviation management processes are **not related to the FMEA process**

Capabilities

- FMEA analysis for system, product and process

- Flexible Change Process, including "fast track"

- Embedded Change Planning

- Change execution tacking, with effectivity per manufacturing site

- Deviation / Non Conformance retrieval

- Corrective and preventive actions management

- End-to-end audit

进行战略收购 (近三年)

ALM	MES	Product Analytics	Electronic Design Automation
Polarion ALM	CAMSTAR	omneo	Mentor Graphics (Not Yet Approved)
Polarion Acquisition	Camstar Acquisition	Cloud Based Solutions	Mentor Graphics Acquisition
PLM – ALM integration	PLM – MES Integration	Product Performance Intelligence	PLM – EDA integration
Continuous Delivery			
2015 / 12	**2014 / 12**	**2014 / 12**	**2016 / 11**

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总结：
提供数字化、智能化清楚的半导体行业方向蓝图与完整的解决方案

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半导体数字化平台价值解决方案

NPI Project Management & Dashboard	IP Management & Reuse	Integrated Verification & Validation	Design Rule Check Management	Tape-out Management	Design & Eng'g Collaboration	Closed-Loop Quality Management 闭环质量管理
IMPROVE NPI EXECUTION & VISIBILITY	IMPROVE PRODUCTIVITY & COMPLIANCE	IMPROVE YIELD	IMPROVE WAFER MANUFACTURA-BILITY	IMPROVE DESIGN-TO-MASK QUALITY	EFFECTIVE SUPPLIER COLLABORATION	ENABLE CONTINUOUS IMPROVEMENT
Provide a real-time objective dashboard for project / program status	Enable Search, Catalog, Upload/Download, Security and reuse of Silicon IP	Enable end-to-end functional verification and physical test validation	Ensure compliance of design to Fab manufacturability rules	Enable a clear sign-off process from design to mask	Enable collaboration between Fabless and Foundry R&D and Operation teams	Provide PLM-MES Integrated solution for closed loop quality management

ALM	MES	Product Analytics	Electronic Design Automation
Polarion ALM	CAMSTAR	omneo	Mentor Graphics
Polarion Acquisition PLM – ALM integration Continuous Delivery	Camstar Acquisition PLM – MES Integration	Cloud Based Solutions Product Performance Intelligence	Mentor Graphics Acquisition PLM – EDA integration
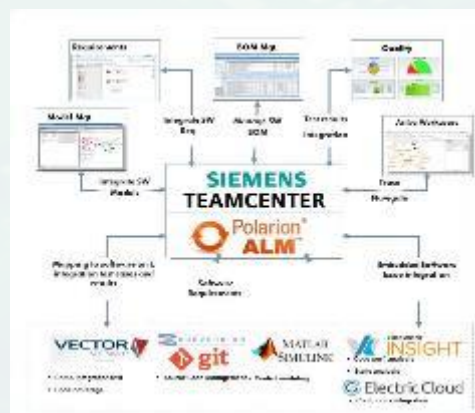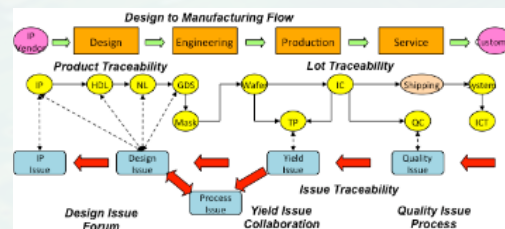
Not Yet Approved

Siemens PLM Software