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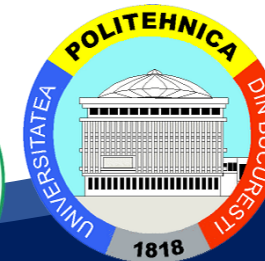


Collaborative Manufacturing Systems

I Collaborative Manufacturing Management

Collaborative Manufacturing Management

Fundamentals and Infrastructure (Cont.)



Curriculum Development
of Master's Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

2. CMM Infrastructure

CMM builds upon

- Collaborative infrastructure
- Business process management service
- Real-time strategic

Together with

- Critical applications
- Production systems
- Enterprise information

**Maximize the
Responsiveness,
Flexibility and Profitability
of the Manufacturing
Enterprise**

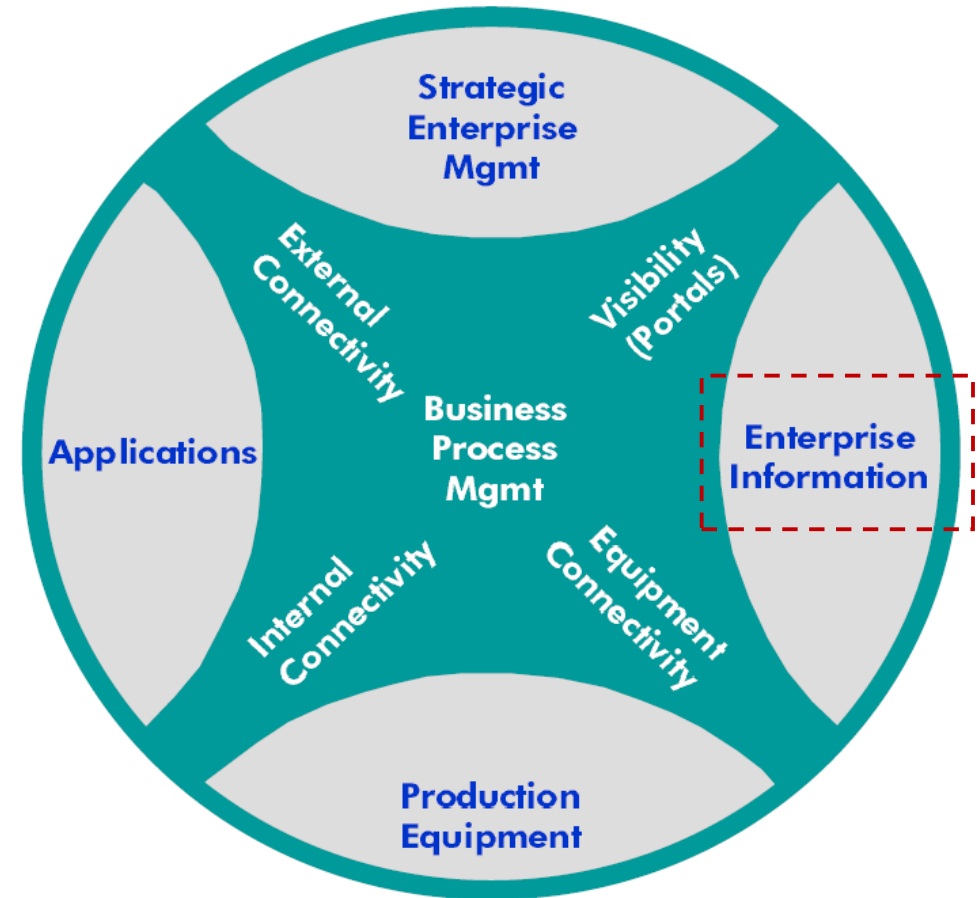
CMM Infrastructure considers enterprise information, production equipment, applications, strategic enterprise management, collaborative infrastructure, internal connectivity, equipment connectivity and external connectivity

Enterprise Information

Critical enterprise information can be found distributed around the enterprise in a **multitude of applications, databases**, internet, barcode and other devices and systems.

The *enterprise information* need be to available to people or systems that need it **when and where they need** it. It must be synchronized in multiple dimensions, across organizational and enterprise boundaries.

2. CMM Infrastructure





2. CMM Infrastructure

Production Equipment

CMM explicitly considers the **integration of all varieties** of production and material handling equipment.

Manufactures will be able to **collaborate more effectively** with digital and smarter production and material handling equipment as the **connection** to the rest of the plant and extended enterprise **are enable**.



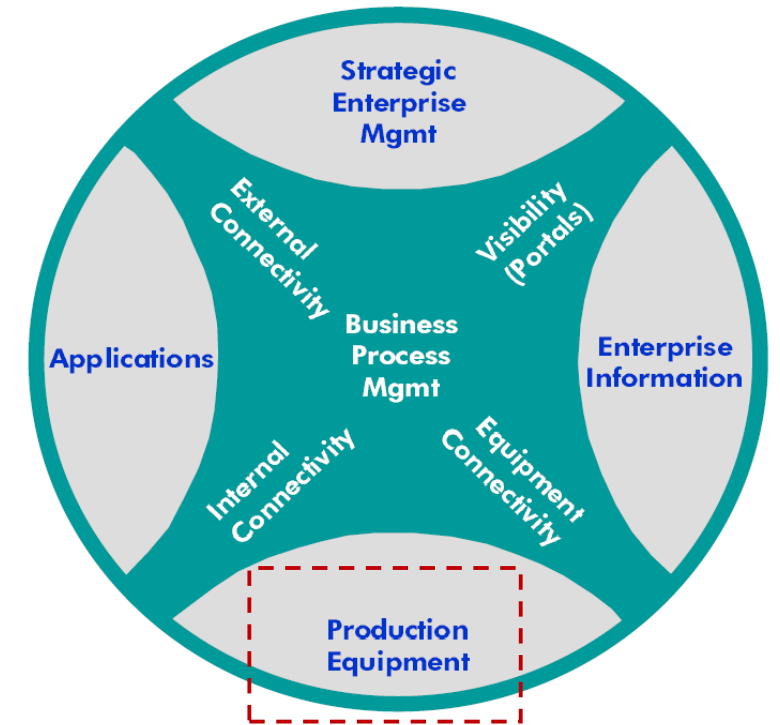
Automated Storage and Retrieval Systems (AS/RS)

<https://www.scglogistics.co.th/blog/detail/50?category=2>

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CMM Infrastructure



(ARC, advisory group, 2001)



2. CMM Infrastructure

Applications

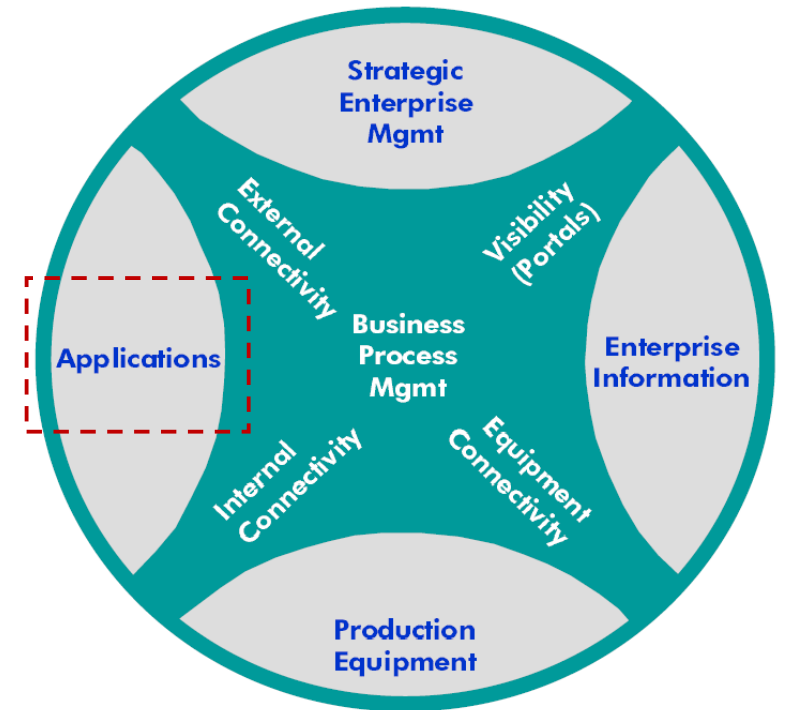
All applications in a collaborative system must be **collaboration-enabled**. This affects the way in which applications **manage data** and how they **support integration** within the overall system.

Collaboration-enable applications, therefore, **utilize open access** methods for maintaining and **accessing information** are responsible for.

Sharing information must be made **accessible through simple** browser interface to support all **levels of collaboration** that will occur in manufacturing.

Collaboration-enable applications should anticipate further support of **mobile device** that will become commonplace in future manufacturing system.

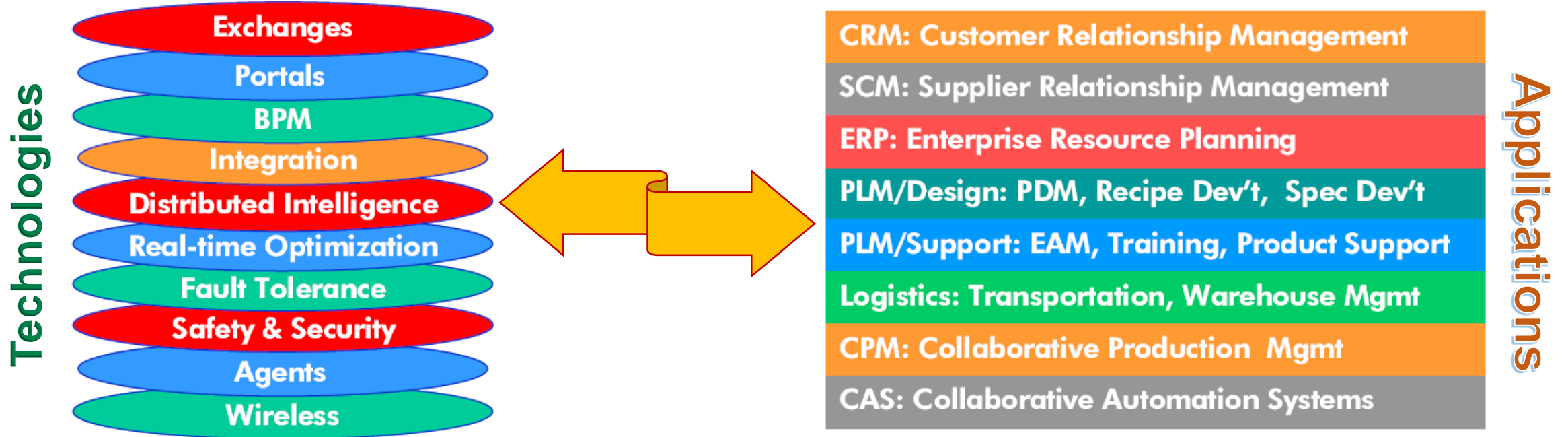
CMM Infrastructure





2. CMM Infrastructure

Relationship between CMM Technologies and Applications





2. CMM Infrastructure

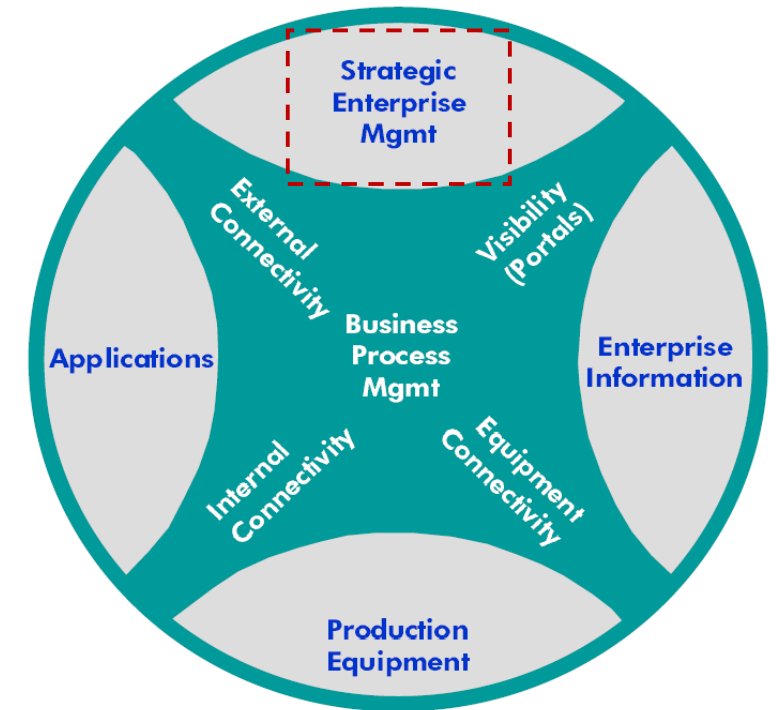
Strategic Enterprise Management

Manufacturers need to provide **executive management** with tools to **set target**, **measure performance** and **formulate strategy**.

To be effective, strategic enterprise management **tools** should provide for planning, creating, **managing** and **optimizing** the enterprise in the context of its **“value network”**, where intimate partner cooperate to pursue specific **business opportunities**.

The **management tools** should allow *managers* to **leverage technical capabilities** in a strategic way to **create competitive advantage** for the **value network** and individual companies within the network.

CMM Infrastructure



2. CMM Infrastructure

Collaborative Infrastructure

Collaborative infrastructure must support:

- **Internal connectivity** within the enterprise and among various sites, departments and locations
- **External connectivity** to partners and customers
- **Equipment connectivity**
- **Visibility** of necessary information

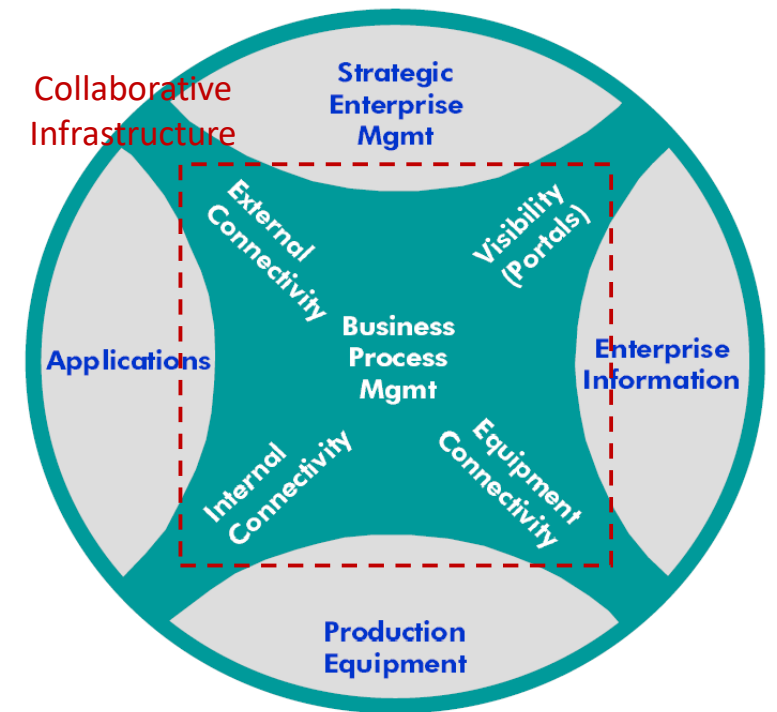
to users throughout all levels of the enterprise

As companies shift to collaborative manufacturing, the boundaries for information sharing will increase dramatically



Portal with single sign-on, role-based personalization capabilities offer a good solution for the collaborative manufacturing environment

CMM Infrastructure



(ARC, advisory group, 2001)



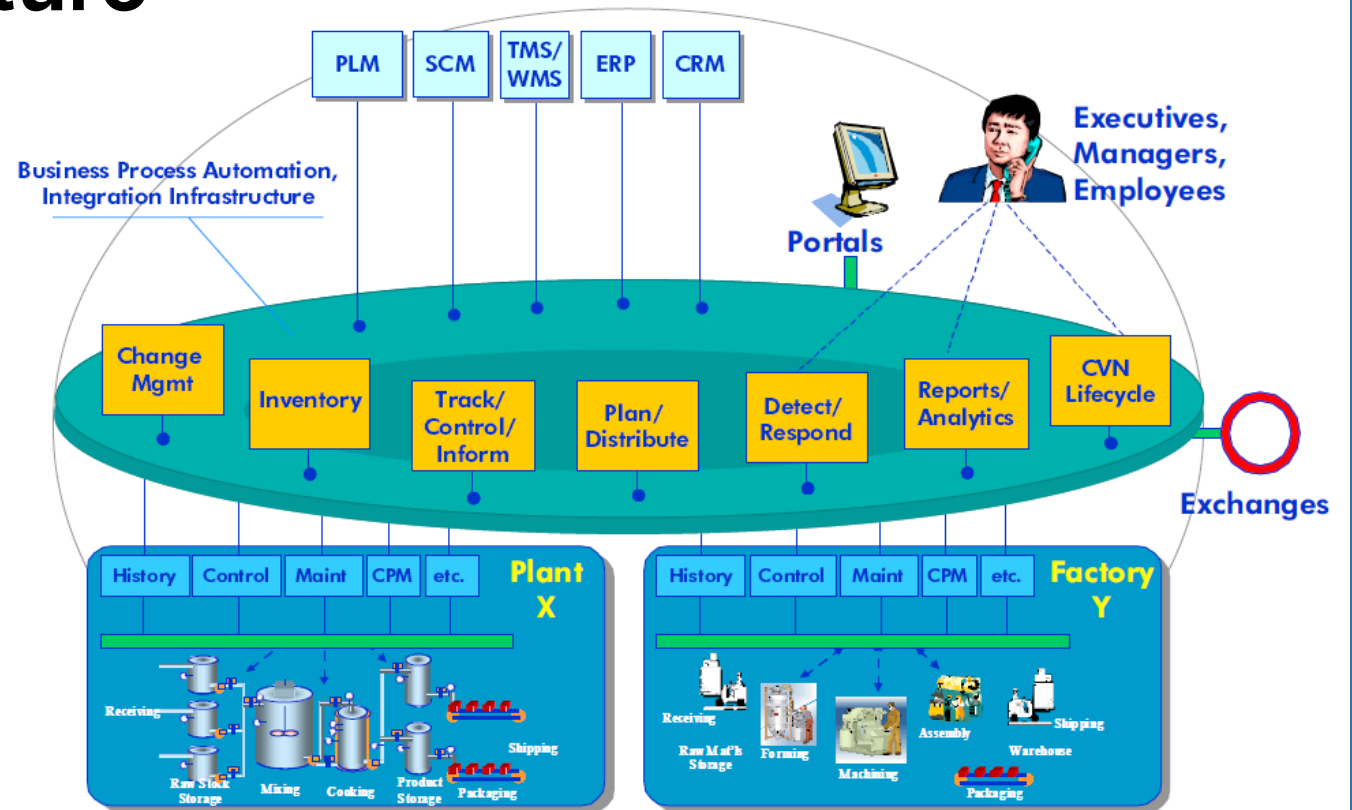
2. CMM Infrastructure

Multi-Site Management

Collaborative Infrastructure:

Internal connectivity

- Managing *multi-site production* is a **critical aspect** of internal connectivity.
- CMM systems must provide;
 - **Real-time visibility** and business process control **across distributed manufacturing facilities**.
 - **Centrally managing** manufacturing processes that are **distributed among physically remote plants**



Synchronizing production among multiple plants require **real-time bi-directional information sharing**, including: functionality for change management, work allocation, tracking, information visibility collaboration management and performance monitoring



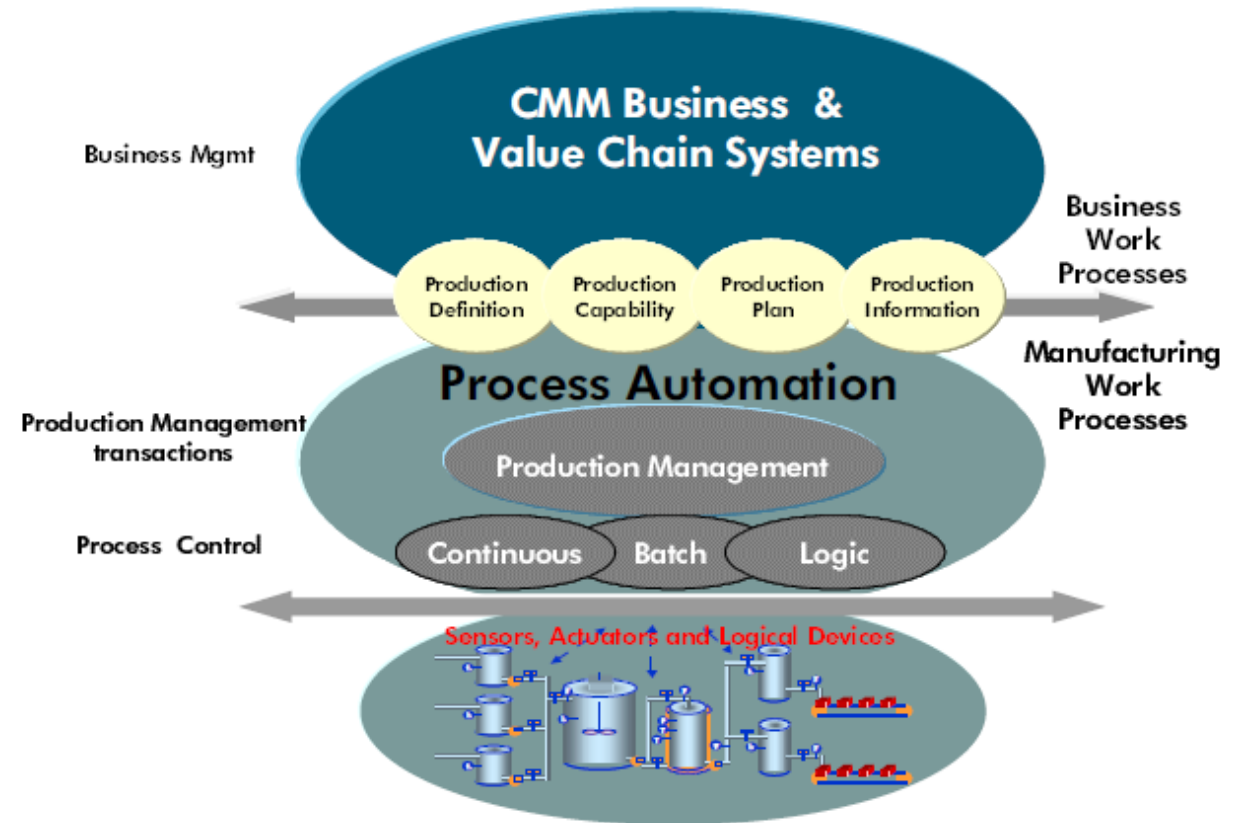


2. CMM Infrastructure

Collaborative Infrastructure: Equipment Connectivity

- **Manufacturing asset** coordinate and control is the domain of **Collaborative Automation system (CAS)**.
- **Process automation** system and **Distributed control** system are the *predecessors* of the **CAS**.
- The challenge of *equipment connectivity* is the **disparate data source** and **devices** manufacturers *need to integrate*.

Collaborative Automation system (CAS)



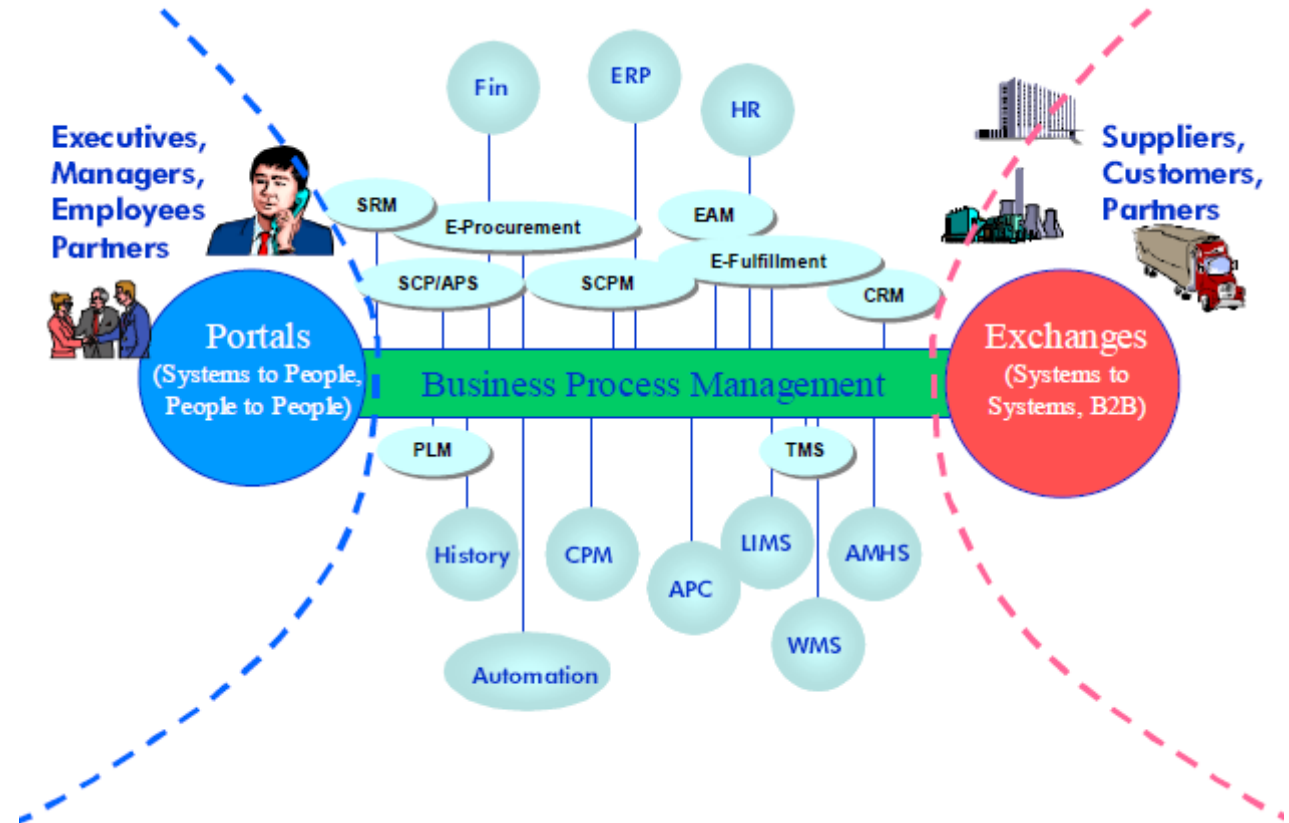


2. CMM Infrastructure

Collaborative Infrastructure: **Visibility**

- **Portals** provide a *convenient* way to establish an **efficient desktop work centre** that can drive **information flow** and **problem solving**.
- Many portal suppliers provide **role-based templates** that **organize user interfaces** for efficiency while allowing **personalization** that can **address individual differences**.
- **Effective portals should;**
 - **Display data in one place** or assembling collections of related data for **Key Performance Indicator (KPI)** or other analysis.
 - **Allow users to verify facts**, make and pursue the logical connections and to **take immediate action**.

Portals and Exchanges Lie at the Core of a Collaborative Enterprise



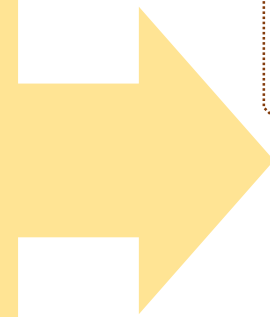


2. CMM Infrastructure

Collaborative Infrastructure: External connectivity

Exchanges come in two flavors, **public** and **private**

- **Public exchange** focused on **streamlining transaction processes** and **supply chains**, and **lower landed costs** within the vertical for **non-strategic goods**.
- **Private exchanges** offer **secure connectivity** between **businesses** or systems **providing a focal point** for **strategic collaboration** between a manufacturer and its strategic partners.



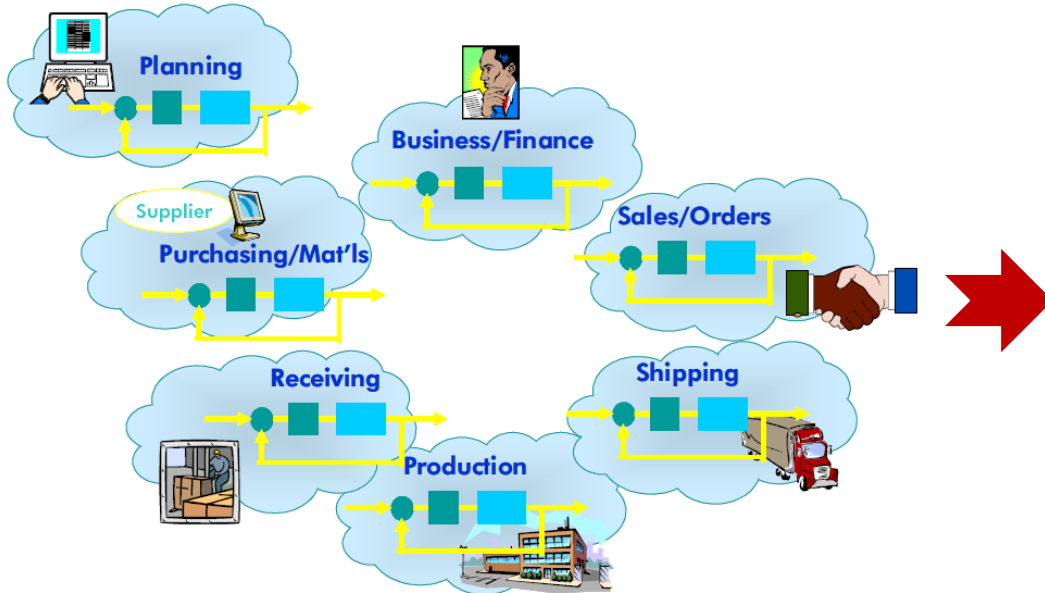
Integration with **public exchanges** will be **dynamic**, and **collaborative manufacturers** will use **private exchanges** internally to **manage their own extended enterprise** and **supply chains**.

To be effective, the **collaborative manufacturer** must ensure that **exchanges** are **fully integrated into workflows** of the manufacturing enterprise.

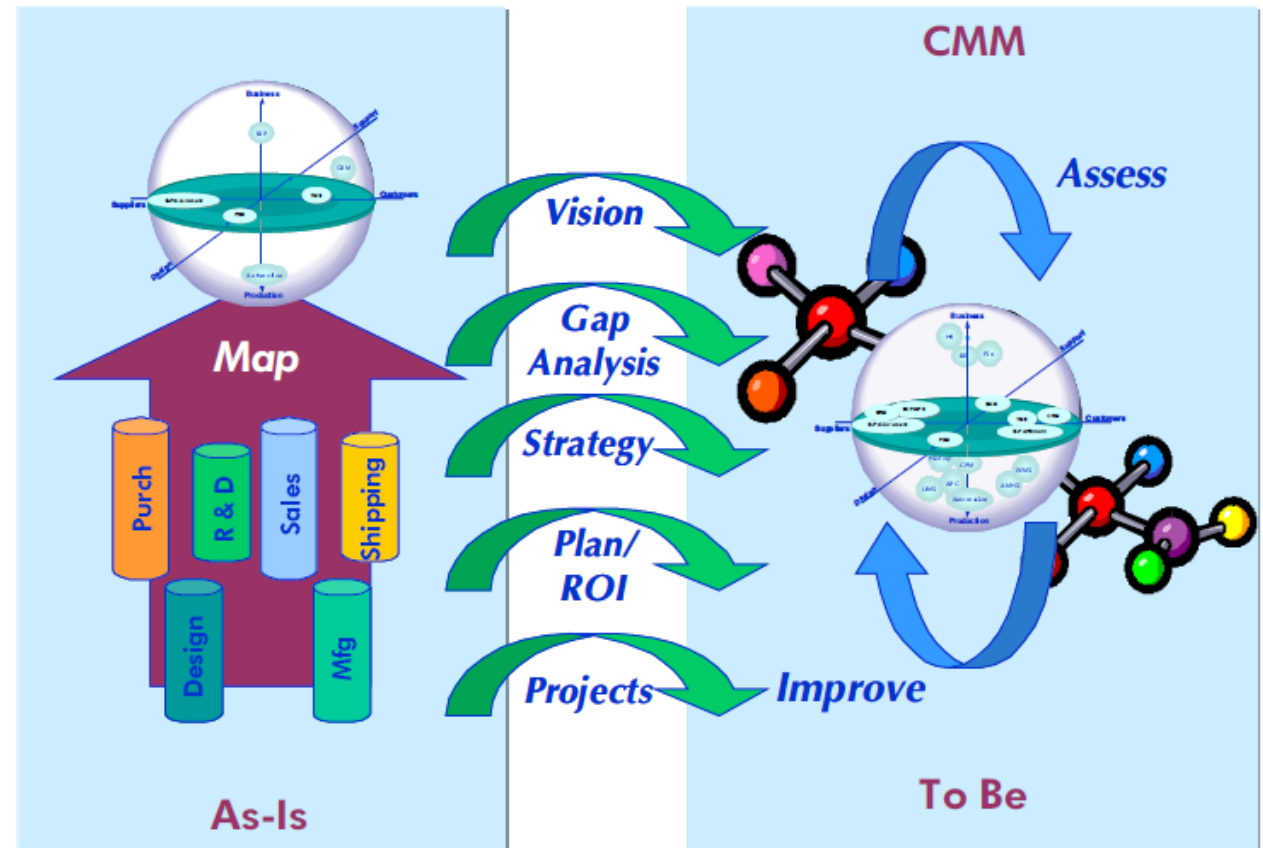


Implementing CMM

Prior to CMM, Manufacturers operate as independent centers of control



Moving to Collaborative Manufacturing Management



To implement CMM, manufacturers should consider

- Vision and strategies
- Assessment of existing collaborative initiatives
- Ideal solution and strategic solution

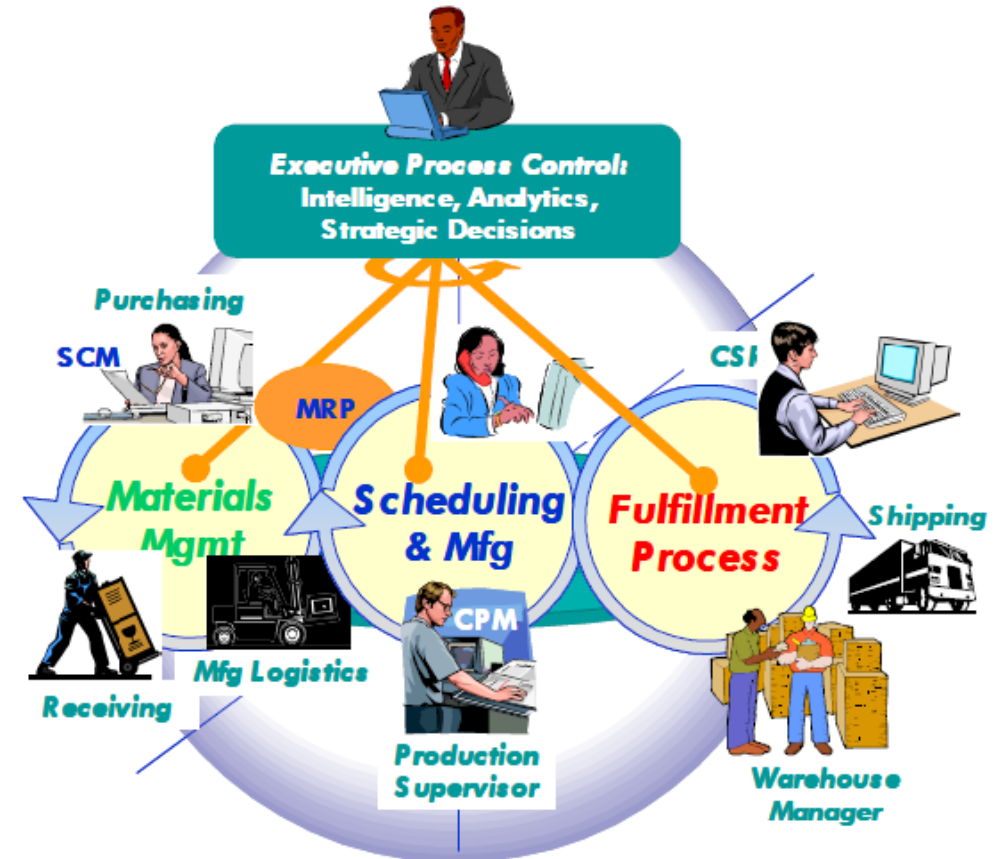


Implementing CMM

Adaptive real-time collaboration

Business process management (BPM) systems

- BPM allows managers to design process improvement that move beyond the limitations of standalone or legacy applications.
- BPM include 3 interacting loops in the value chain:
 - Order/Fulfilment: process of reaching out to customer, accepting ordering and ensuring goods delivery
 - Material management: process of connecting with suppliers, procuring the materials and ensuring arrival of materials needed by production
 - Scheduling/Manufacturing: process of interaction with both fulfilment and material management process
- BPM solutions can orchestrate, manage, refine and optimize for complex processes or workflows.

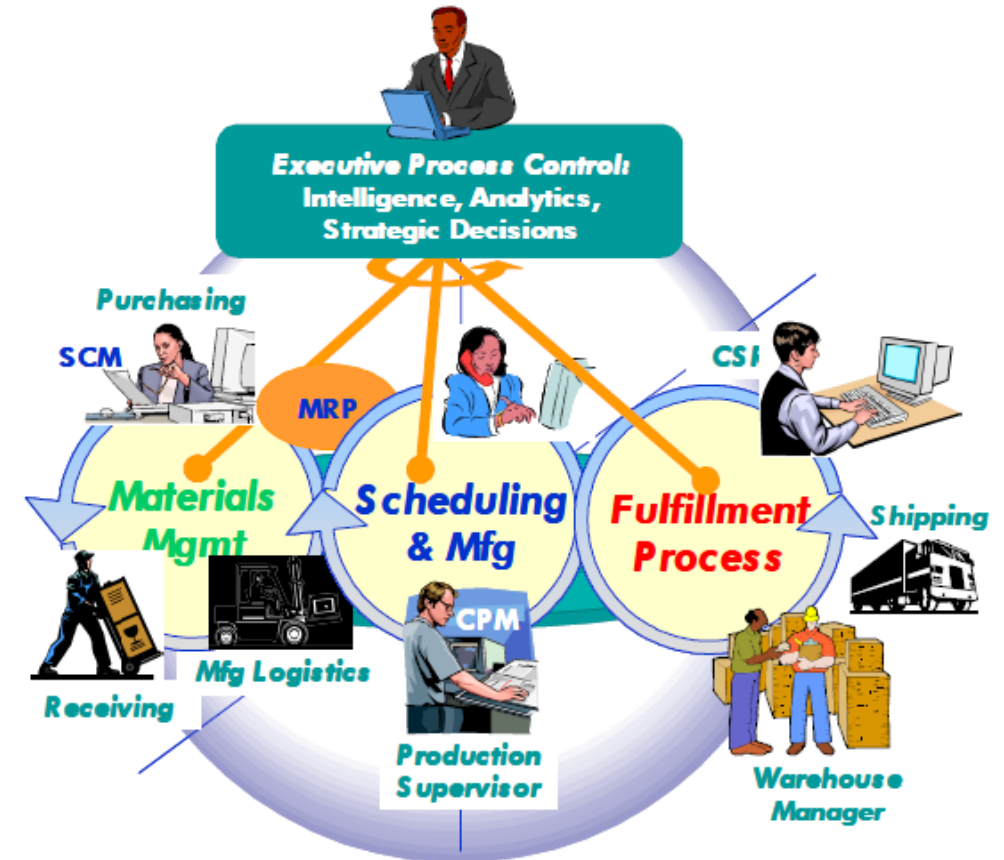


Implementing CMM

Adaptive real-time collaboration

Collaborative systems can provide

- **Easy access** to shop reference materials
- **Lower** the **required skill** level for users
- **Facilitate** moving employees between **jobs and product lines**
- **Adding new jobs** or changing rate to use less skilled employees
- **Speed the hunt** for information in time-critical situations
- **Cut dependency** on job knowledge and informal information sources

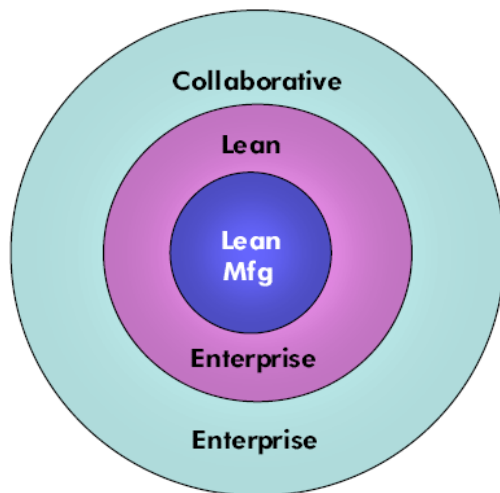


Lean manufacturing benefit from CMM

CMM and Lean: The elimination of waste (muda)

- A **collaborative manufacturing strategy** allows a **Lean enterprise** to **achieve its full potential** by **optimizing the value stream**.
- The **value stream** describes the total set of **activities necessary to produce** the product **from design** through **production, delivery and product support**.
- **Development of collaborative enterprise** requires **examining processes** both **inside and outside** the factory floor and **optimizes** the principles of truly **Lean enterprise**.

Waste (Muda)	CMM
Overproduction	CMM strengthens relationship with customers and synchronizes production with demand
Waiting	CMM strengthens relationship with suppliers and synchronizes materials with production
Transport	CMM synchronizes transport with production and demand
Overprocessing	Collaboration in the design phase can reduce manufacturing complexity
Inventories	Increasing agility, manufacturers can produce the right products in the shortest time
Movement	Opportunities to reduce unnecessary worker movement by electronically delivering necessary information
Defects	Extensive collaboration in the design phase can reduce defective and unmarketable products



Collaboration extends the Lean enterprise



Siemens PLM Software's Strategy for Collaborative Manufacturing

Siemens PLM Software's Collaborative Manufacturing solutions are built on their Smart Innovation Portfolio. Characteristics of this platform are particularly pertinent to *collaborative manufacturing*. They are:

Engaged Users

- Right information, right time, right context

Realized Products

- Virtual product definition, real production environment, closed loop between product development and production

Intelligent Models

- Accurately represent what is real, understand connectedness, always up to date

Open System

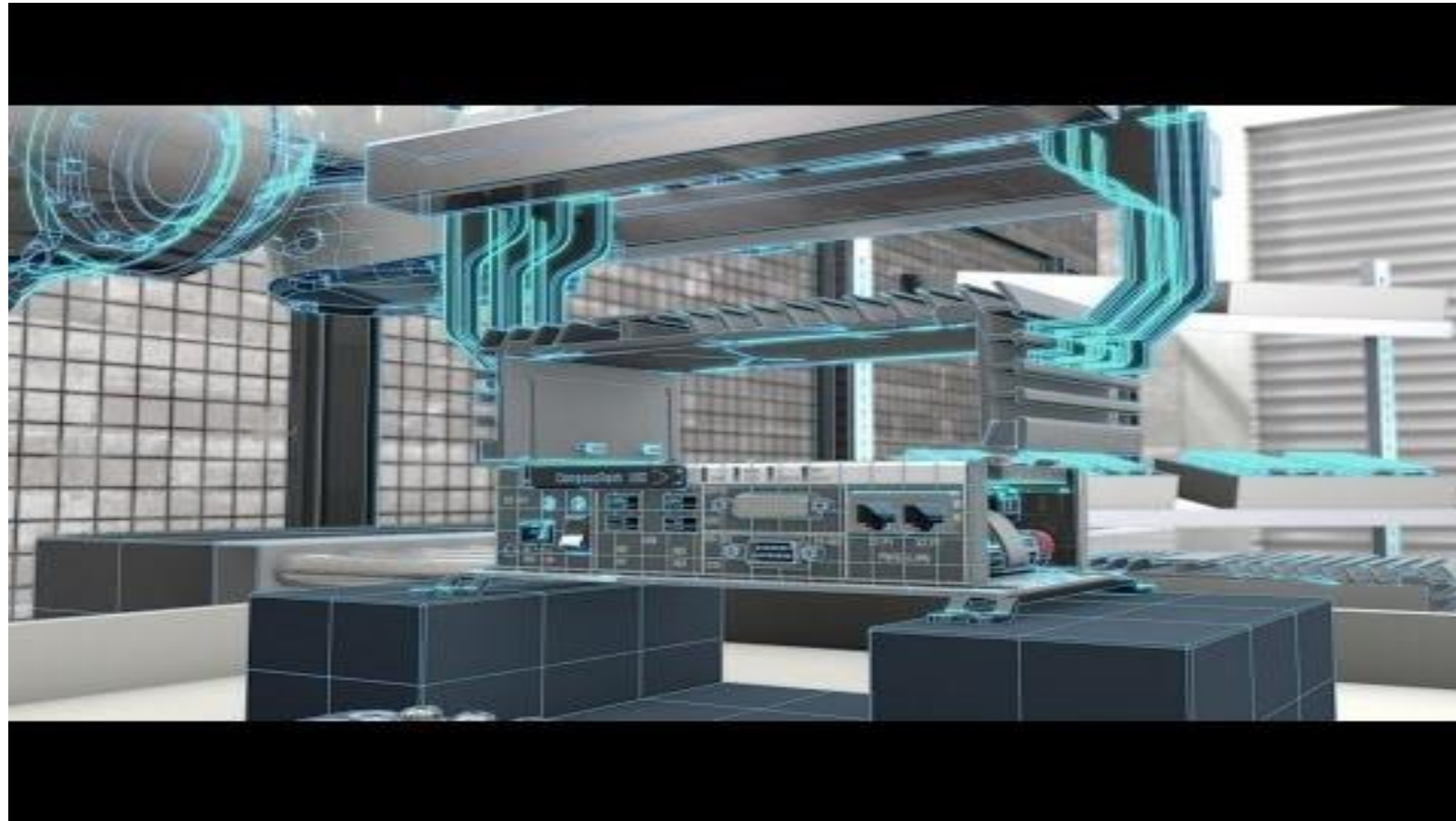
- Optimize the value of business investments, easy deployment, future flexibility

https://www.plm.automation.siemens.com/media/global/ru/CIMdata-Collaborative-Manufacturing_tcm1023-238760_tcm52-76280.pdf

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Siemens PLM Overview



https://www.youtube.com/watch?v=ePZheUvsH0w&ab_channel=SiemensSoftware



Siemens PLM Software: Teamcenter Supplier Collaboration



https://www.youtube.com/watch?v=Y3WVRtu0hog&ab_channel=SiemensSoftware

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Activity: Self Study (Collaborative Design)

After reading the article: *“Agile Process Engineering to support Collaborative Design” (Baschin et.al, 2019)*

Discussion:

What is Agile process engineering in collaborative design to anticipate potentials of digitalization?





Key references

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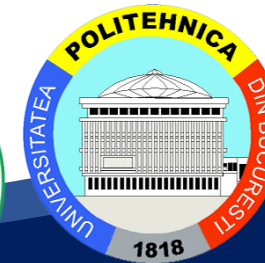
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