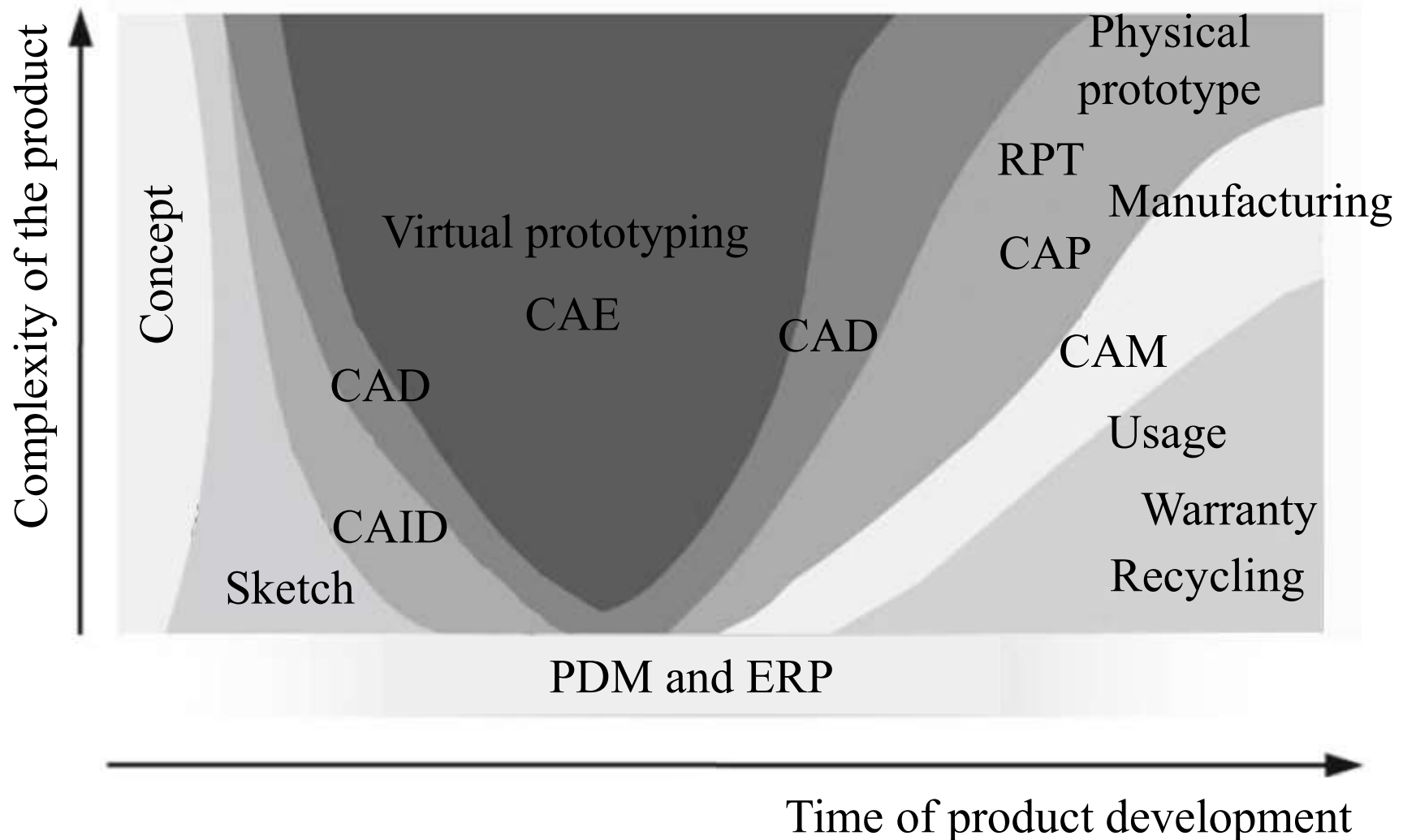


The subject matter

CAx – Computer-Aided X (Everything)



CAD - Computer-Aided Design

CAID - Computer-Aided Industrial Design (Styling)

CAE - Computer-Aided Engineering

FEM: Finite Element Method

CFD: Computational Fluid Dynamics

MBS: Multibody simulations

CAO - Computer-Aided Optimization

CAT - Computer-Aided Tolerancing (also refers to Computer-Aided Testing)

DMU - Digital MockUp

VR - Virtual Reality

KBE - Knowledge-based Engineering

RP, RT, RPT - Rapid Prototyping/Tooling

CAPP - Computer-Aided Process Planning

NC, CNC - Numerically Controlled, Computerized Numerical Control

MES - Manufacturing Execution System

CAM - Computer-Aided Manufacturing (CAPP + CNC + MES)

CAQ - Computer-Aided Quality Assurance

ERP - Enterprise Resource Planning

PDM - Product Data Management

PLM - Product Lifecycle Management

Computer-Aided Industrial Design (CAID) (Styling)

Computer-aided design (CAD) is a computer technology that designs a product and documents the design's process. CAD may facilitate the manufacturing process by transferring detailed diagrams of a product's materials, processes, tolerances and dimensions with specific conventions for the product in question.

Computer-aided engineering (CAE) is the broad usage of computer software to aid in engineering analysis tasks. It is done through the use of sophisticated, interactive graphical software. CAE allows for more computations than is possible by hand, especially when it is coupled with optimization systems.

FEM: Finite Element Method

CFD: Computational Fluid Dynamics

MBS: Multibody simulations

Computer-Aided Optimization (CAO)

Virtual Prototyping is a concept that allows the description of a product for its entire life cycle. DMU is enriched by all the activities that contribute to describing the product. The product design engineers, the manufacturing engineers, and the support engineers work together to create and manage the DMU. One of the objectives is to have an important knowledge of the future or the supported product to replace any physical prototypes with virtual ones, using 3D computer graphics techniques. **As an extension it is also frequently referred to as Digital Prototyping or Digital MockUp (DMU). VP allows engineers to design and configure complex products and validate their designs without ever needing to build a physical model (?).**

Computer-aided manufacturing (CAM) is an application technology that uses computer software and machinery to facilitate and automate manufacturing processes. CAM is the successor of computer-aided engineering (CAE) and is often used in tandem with computer-aided design (CAD)

CAPP - Computer-Aided Process Planning

NC, CNC - Numerically Controlled, Computerized Numerical Control

MES - Manufacturing Execution System

Computer-Aided Tolerancing (CAT)

Computer-Aided Quality Assurance (CAQ)

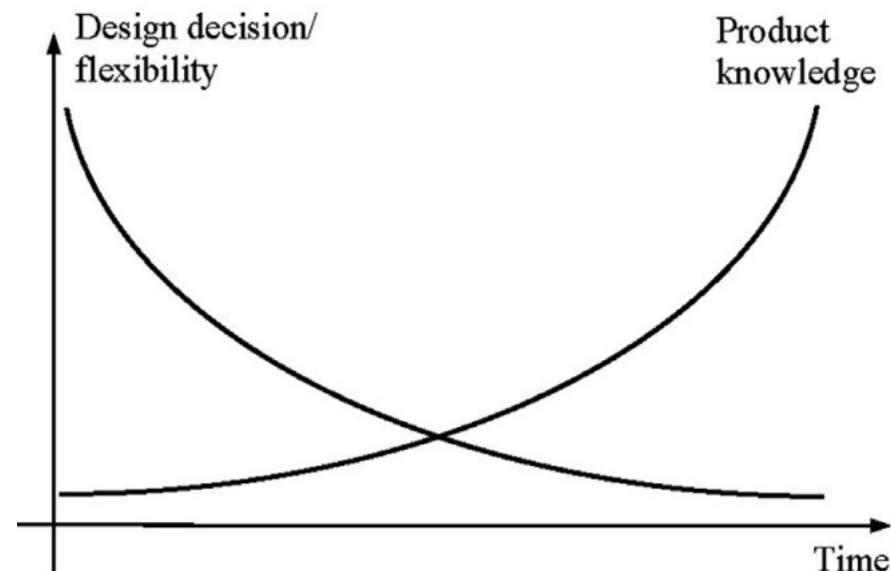
Product data management (PDM) is the process of using IT resources and services to store, manage, monitor and share data pertaining to a particular product. PDM incorporates tools and techniques to centrally store and manage all the data associated with a product's life cycle. PDM is a bundled processing hardware, software, storage and networking solution that works to store and maintain each type of product data from product launch to deployment. It is connected directly to the production system and receives, stores, shares and collaborates product data over a network/Internet. PDM may include data such as product diagrams, technical specification sheets, project plans, images and any related data.

Enterprise resource planning (ERP) is a method of efficiently utilizing people, hardware and software to increase productivity and profit, thus simplifying a company's business processes. ERP may include many software applications or a single (but more complex) software package that smoothly disseminates data required by two or more unique business departments.

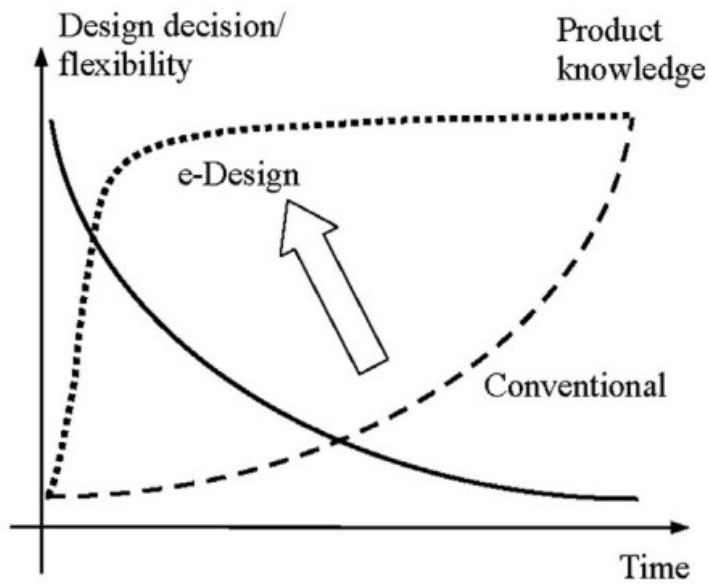
Product Lifecycle Management (PLM) is a systematic approach to managing a product's lifecycle from inception to disposal. PLM serves as a product backbone by integrating human skills, data and business processes, e.g., enterprise resource planning (ERP) and manufacturing execution systems (MES).

The design paradox

A conventional product development process that is usually conducted sequentially suffers the problem of the design paradox. This refers to the dichotomy or mismatch between the design engineer's knowledge about the product and the number of decisions to be made (flexibility) throughout the product development cycle. **Major design decisions are usually made in the early design stage** when the product is not very well understood. Consequently, **engineering changes are frequently requested in later product development stages**, when product design evolves and is better understood, to correct decisions made earlier.



Product development



With intensive knowledge of the product gained from simulations, better design decisions can be made, breaking the aforementioned design paradox. With the advancement of computer simulations, more hardware tests can be replaced by computer simulations, thus reducing cost and shortening product development time.

