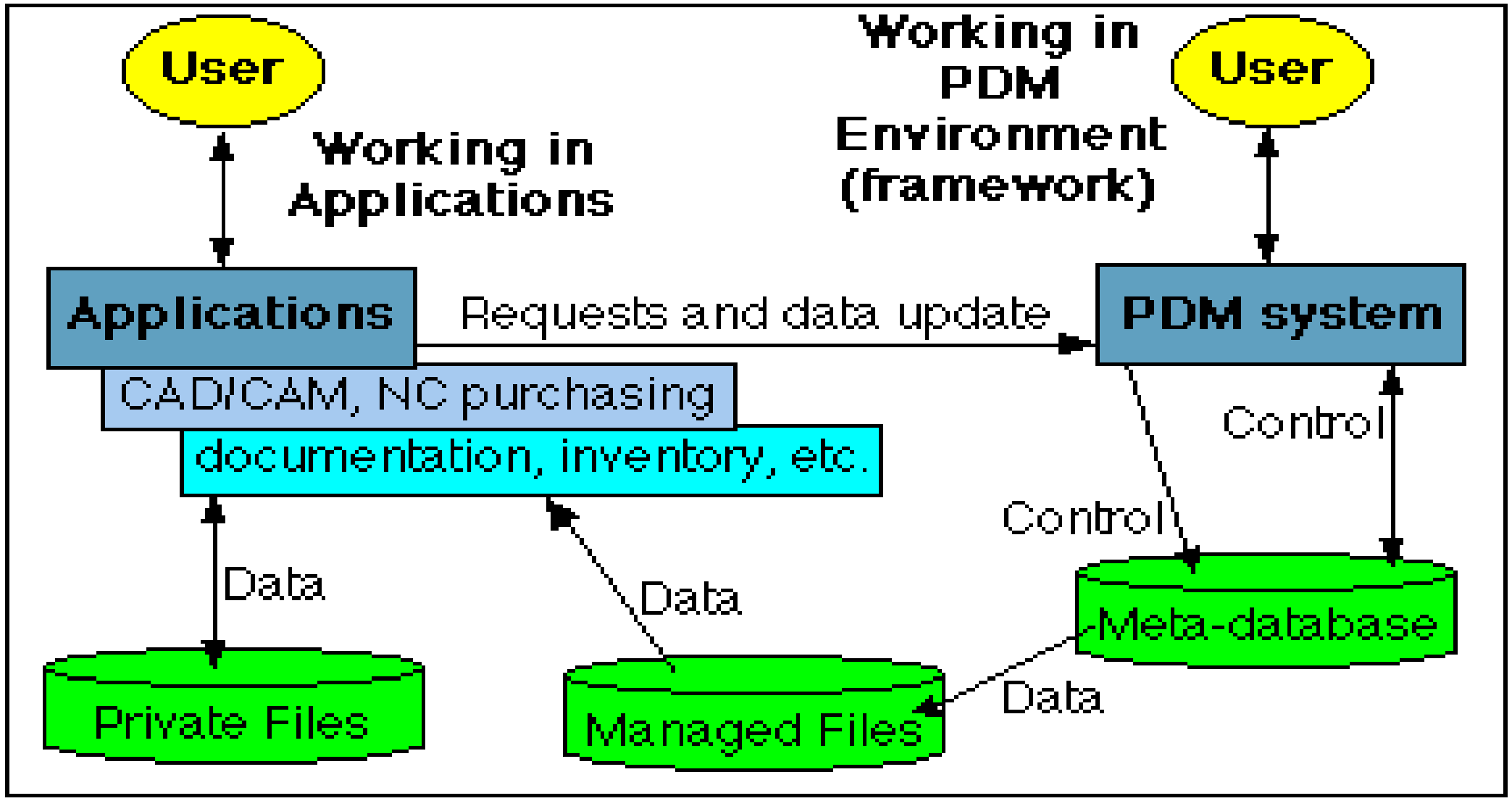
PRODUCT DATA MANAGEMENT(PDM)

- Product Data: includes all data related both to product and to the processes used to image it, to design it, to produce it, to use it, to support it and to dispose it.

- PDM: Its activity of managing product data, A PDM systems is the computer system, an application, which manage product data.


User
Working in Applications
Working in PDM Environment (framework)
User
Applications
Requests and data update
PDM system
CAD/CAM, NC purchasing
documentation, inventory, etc.
Control
Control
Data
Data
Meta-database
Private Files
Managed Files
Data

Benefits

A PDM or PLM system provides benefits in a number of areas:

- **Time-to-Market:** Data is instantly available to all with access. There is no waiting for paper documents to be distributed nor time wasted while documents sit in an in-basket waiting for review. Time spent searching for component and product data is reduced. Collaboration features also speed and improve the process.
- **Improved Productivity:** Studies have shown that engineers spend 25% to 35% of their time searching for, retrieving, handling, filing, and storing documents and information. This time can be reduced with a PDM system and its single repository, its classification and information structuring capabilities. The classification and search capabilities aid design retrieval, provide the opportunity to avoid “reinventing the wheel”, and, as a result, reduce the related development effort.
- **Improved Control:** Because PDM better manages configurations and assures that everyone is working from the most current data, it avoids problems of working with old data. Access control features assure that only authorized parties can access or change proprietary information. Control over engineering changes is improved with less manual effort.

#	*Benefit Category*	*Example of Benefit*
1	Information Management	provide a single, controlled vault for product information
		maintain different views of information structure
		provide faster access to data
		manage configurations
2	Re-use of Information	make available existing designs for use in new products
		reduce duplicate data entry
3	Workflow Management	make sure the most appropriate process is followed
		improve distribution of work
		ensure procedures are followed
4	Engineering Change Management	speed up Engineering Change distribution, review and approval
		provide status information on engineering changes
5	Business Performance Improvement	improve product quality
		reduce overhead costs
6	Business Problem Resolution	reduce scrap
		reduce product liability costs
7	Functional Performance Improvement	increase engineering productivity
		reduce inventory
		develop better cost estimates
8	Product Development Management	improve project co-ordination
		increase product development schedule reliability
		provide high-quality management information
9	Product Development Automation	automate the sign-off process
		automate the transfer of data between applications
10	IS Effectiveness Improvement	integrate Islands of Automation
		link data bases together
		remove unnecessary systems
11	Product Development Infrastructure	support product development practices and applications
		distribute data and documents electronically

Fig. 6.10 Eleven categories of benefits of PDM systems

Eight Components of a PDM Systems

- Information Warehouse
- Information Warehouse Manager
- Infrastructure
- System Administrator Manager
- Interface Module
- Product and Workflow structure definition Module
- Workflow control module
- Information management Module

The Information warehouse

The role of the Information warehouse module is to store engineering data. Other names for the warehouse are Electronic Library, Electronic Vault, Information Vault, and Data Repository.

The Information warehouse acts as a single source of all engineering information in the company. This does not mean that the information has to be physically centralized. In practice it will nearly always be physically distributed, with some of the information being in different departments of the company, and some with suppliers and customers.

The Information warehouse contains all sorts of engineering information describing the products and parts such as engineering drawings, CAD data, circuit layouts, flow charts, test results, Bills of Materials, field data and word-processed product specifications

Information Warehouse Manager

- The second component, the Information Warehouse Manager, controls and manages the data in the Information Warehouse.
- It’s responsible for such issues as data access, storage and recall, information security and integrity, concurrent use of data, and archival and recovery. It provides traceability of all actions taken on data.

Infrastucture

- The PDM system requires a basic infrastructure of a networked IT environment.

- This third component usually includes computer and communications hardware and software, a range of graphics terminals, printers, plotters, storage and other devices.

System Administration Manager

- The fourth component of the system is the System Administration Manager.

- This is used to set up and maintain the configuration of the PDM system, and to assign and modify access rights

Interface Module

- Users and other applications access the PDM system through the fifth component, the Interface Module.

- This supports user queries, menu-driven and forms driven input, and report generation. It also provides interfaces for applications such as CAD and ERP.

Product and Workflow Structure Definition Module

- The structure of the information and workflows to be managed by the PDM system is defined by the Product and Workflow Structure Definition Module

Workflow Control Module

- Once initiated, a workflow needs to be kept under control. This is the task of the seventh component, the Workflow Control Module.

- It controls and coordinates workflow steps. It can manage, for example, the engineering change workflow.

Information Management Module

- The exact structure of all products and information in the system is maintained by the Information Management Module.

Information Warehouse	Interface Module
Information Warehouse Manager	Product And Workflow Structure Definition Module
Infrastructure	Workflow Control Module
System Administration Manager	Information Management Module

Fig. 5.7 Components of a PDM system

The PDM system in the enterprise world

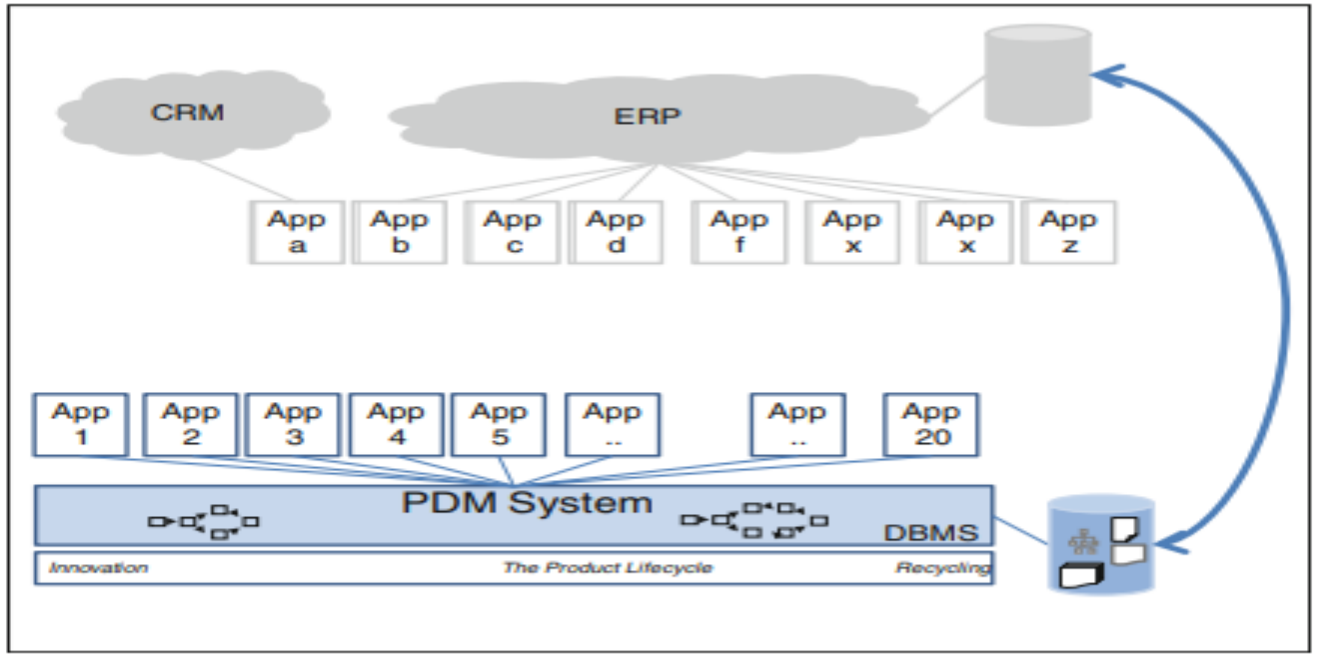


Fig. 5.11 The PDM system in the enterprise world

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Fig. 6.10 Eleven categories of benefits of PDM systems

Barriers to the implementation of PDM

Barriers to the implementation of PDM

- We know that PLM is in its infancy stage of development and just started about a decade ago. The pioneers have already seen much opposition to the concept and acts will be potential barriers. As PDM is the main foundation of PLM, we need to be aware of the potential barriers to its implementation.

  The potential barriers can be mainly classified as:

  1. System
  2. People
  3. Project Team
  4. Process
  5. Organizational structure
  6. Funding
  7. Information
  8. Installation
  9. Everyday use.

1. System

This is related to the PDM system and PDM vendor. It typically includes:

a) Incomplete System Functionality

b) System malfunction

c) Poor Response time

d) Unavailability of system on wide range of platforms

e) Limited customizability

f) Lack of up-grading

g) Limited interfacability

h) Problems from over sold functionality

i) Vendor going out of business

2. People

- All organizations are made of people and since PDM calls for a new work culture, people will naturally oppose the change. This group may include top management, middle management, PDM implementation team, PDM consultants and PDM users.
- Top management may be source of problems for reasons such as:
  - Lack of commitment
  - Lack of Leadership
  - Lack of support
  - And Lack of patience.
- Middle management may be source of problems for reasons such as:
  - Conflicts with personal goals
  - Empire building
  - Fear of loss of power
  - Ego clashes with users
  - Lack of motivation
  - Lack of team work
  - Poor project management skills

- PDM implementation team may be source of problems for reasons such as:
  - Wants to teach few concepts to remain Important
  - Ego clashes with users
  - Lack of motivation
  - Lack of team work
  - Poor project management skills
- PDM consultants may be source of problems for reasons such as:
  - Want to keep some areas ambiguous to remain in business
  - Lack of competency
  - Lack of time management
  - Lack of commitment
- PDM users may be source of problems for reasons such as:
  - Think PDM system may play the role of a Big brother watching over their shoulders
  - Thinks PDM system may eventually lead to their job loss.

3. Project Team

- The team greatly contributes in making or breaking of the PDM system from how they work together and produce a robust system. Some of the problems in team which may result into a potential barrier are:
  - Lack of team work – each individual have their own personal agenda
  - Project leader is not a good leader
  - Lack of clear objectives
  - Lack of willingness to learn
  - A fixed team till implementation is necessary – team disintegration will lead to poor quality or project failure.
  - If project team comprises of a consultant, he should bring with him working knowledge or rich experience from Industry

4. Process

- Process in PDM means the steps in workflow and making sure people have right information as and when they need it. Some of the limitations in process information can become a potential barrier to PDM such as:
  - Processes are not fully understood and clearly defined
  - Lack Clear idea about information flow
  - Team members have differences in opinion on process
  - Starting on PDM without improving on Process
  - Lack of consensus on one process.

5. Organizational structure

- We mentioned earlier that organizations are made of departments and departments are made of people.
- The structure of organization either tends be pyramidal creating islands or lean resulting in a homogenous unified force.
- Some of the limitations in structure will development to potential barriers for PDM as listed below:
  - Lack of agreement and cooperation between departments
  - Problems with cross functional team working
  - Departmental barriers preventing information flow
  - Departments using different definitions and standards.

6. Funding

- Funding is fundamental to any new system introduction and is planned and provided by the top management.
- Costs of PDM are very clear for all to see but the benefits are not. Potential benefits can only be estimated. Some time the team implementing may inflate their estimates of the benefits and it is dangerous as it may finally not achievable.
- Implementation will take a lot of money but it is necessary. Thus the following listed factors may develop into potential barriers for PDM:
  - Insufficient Funding
  - Inappropriate project cost justification costs leading to re examination
  - Wrong timing of funds
  - Benefits not fully explored leading to Budget beings withdrawn or cut
  - Lack of ownership from user departments

7. Information

- As we all know at the core of PLM or PDM is the information. This information is all about the product and its related threads such as material, processes, vendors, testing and validation, distribution, markets etc.
- The problems related to information flow , use and quality of product information are an important potential barrier to PDM and reasons may be listed as below:
  - Cost of entering data
  - System not able to handle all data types
  - Storage limitations
  - Incompatibility in data structures
  - Lost information
  - Knowledge is power – people who draw their power from information unwilling to part with information
  - Unorganized state of information

8. Installation

- PDM installation means not just the software installation but as a process installed in an organization with proper training imparted to the users. The so called system is likely to have a lot of initial teething problems.

The following listed factors may develop into potential problems:

- The implementing team disintegration
- New team lacking knowledge and motivation
- System Bugs
- Lack of service support from vendor
- Consultant not supporting post implementation hand holding
- Undocumented PDM procedures leading to confusions

9. Everyday use.

- PDM team should plan for everyday use of the tool at the beginning of the project. It should make sure all the resources are made available to support the system in an everyday use.
- PDM team should not bring the system into everyday use until it has been thoroughly **tested** and found to be capable of doing what has been promised. If not people will revert back to their earlier inefficient manual methods.
- PDM team should ensure proper training of the personnel with clearly drawn procedures to use the system. For this a Training budget should be planned beforehand.
- Some departments which may feel they are losing control or power due to PDM may block its everyday use. This needs some appropriate organizational changes & top management support.
- PDM system selection may be easy – challenge is to make it work effectively.

Virtual product development (VPD) Tools

Virtual product development (VPD) Tools: Introduction

- In order to improve product development and reduce complexity, a new approach is being sought that represents a shift from traditional to Virtual Product Development (VPD).
- Virtual product development eliminates the design problem and gives a better understanding about attributes of productive performance.
- In the virtual product development, prototypes are being made virtually and the problems are detected early these problems can be solved before the actual development of product.
- Reducing time and money results the cost effective designs provides reliability in less time than the conventional process.
- Product development refers to the modelling of a product to virtually meaning is virtual prototyping with the use of advanced computer technology

Virtual product development (VPD)

- Virtual product development refers to the working and analysis techniques, processes and methods for product development in a virtual environment, which is created using advanced computer technology
- **Virtual product development** (**VPD**) is the practice of developing and prototyping products in a completely digital 2D/3D environment. VPD has four main components:
  - virtual product design
  - virtual product simulation
  - virtual product staging
  - digital manufacturing

Benefits of VPD are given as follows:

1. As we are not building any physical prototype it helps us to reduce the cost and time.

2. It helps us in evaluating the concept of design and test the product multiple times, without actually build the product.
3. With the help of virtual product development we can perform any task as in the development cycle.

4. Final product will be optimised and will be based on customer needs and wants

5. Manufacturing virtual product development helps us to provide information about potential safety issues

6. Product will be developed fast which in turn helps in the fast delivery of product in the market, in fact that it would lead the market competition.

VIRTUAL PRODUCT DEVELOPMENT TOOLS (MODELS)

- **Virtual product development** (**VPD**) is the practice of developing and prototyping products in a completely digital 2D/3D environment. VPD has four main components:
  - virtual product design (3D shape, 2D graphics)
  - virtual product simulation (drop test, crush test, etc.)
  - virtual product staging (retail space planning, consumer research and behavior analysis)
  - digital manufacturing (process planning, assembly/filling virtualization, plant design).

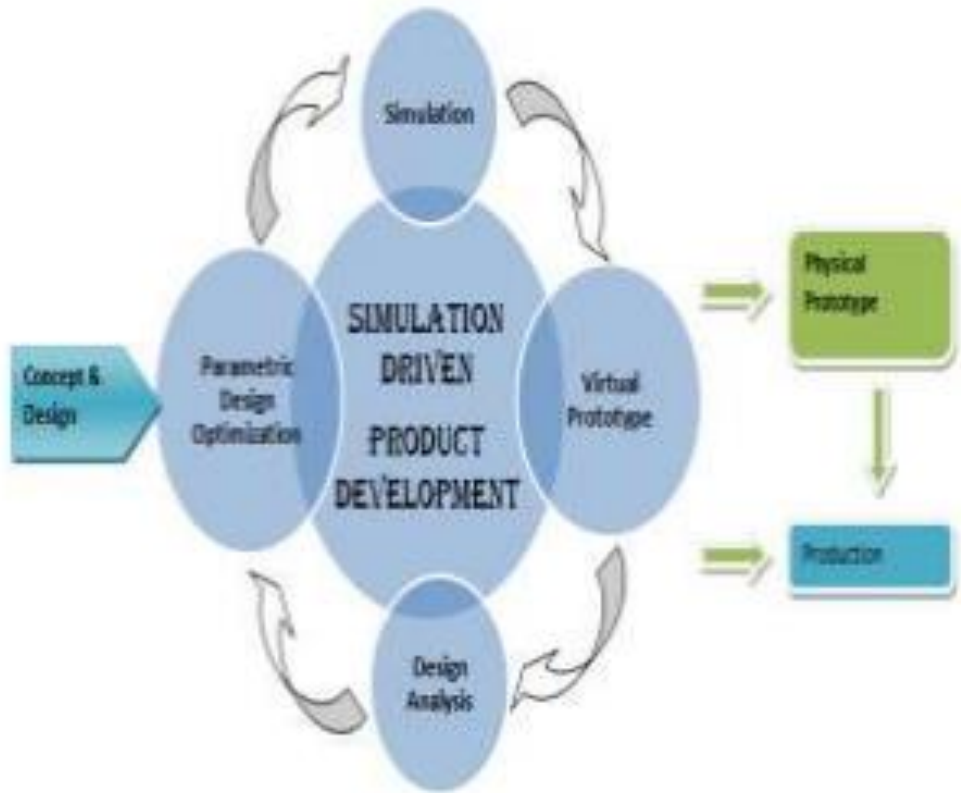
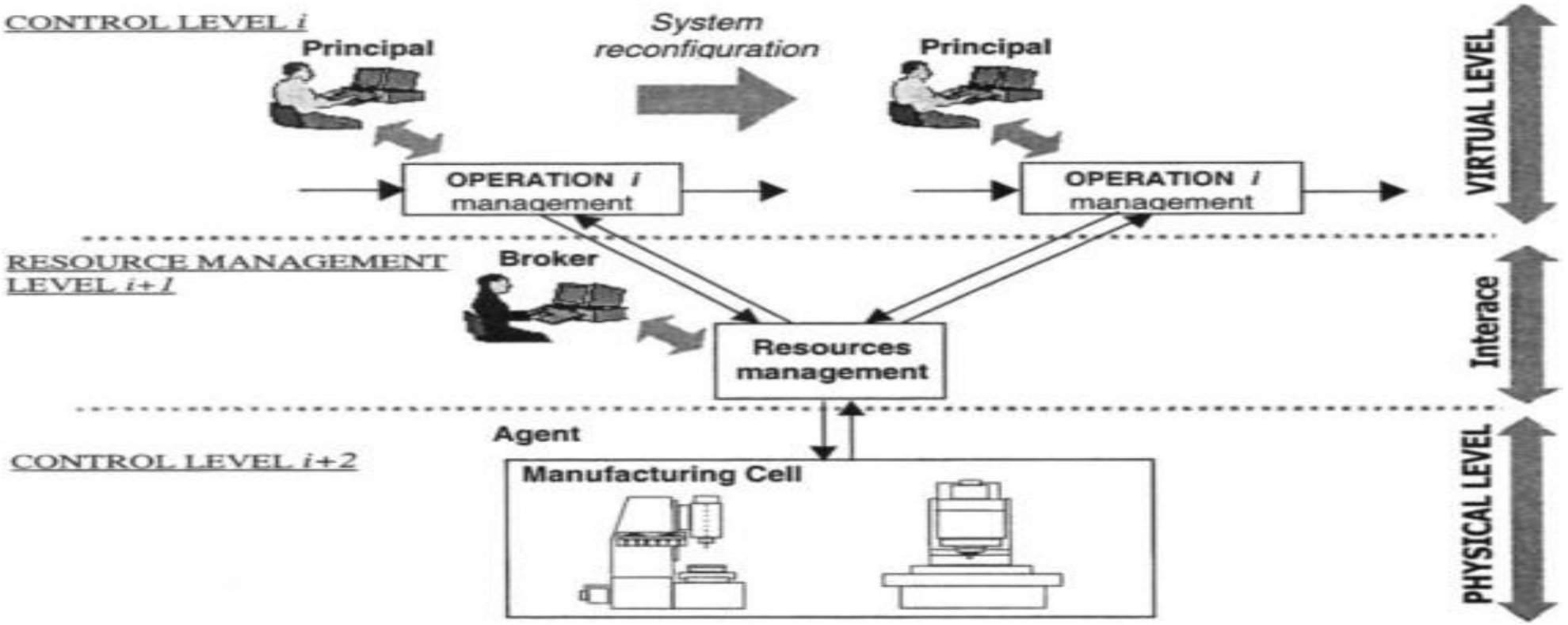


Fig. 1. Virtual Product Development

Virtual Manufacturing - an overview



3D CAD systems (software)

- Traditional or conventional way of designing a product was limited to the 2D drawing with the pen and paper. The product designers was not able to make 3D models. By the use of 3D CAD software, the product developers or designers are able to create the product in 3D model along with that the testing of the model can be done.
- Mostly used 3D CAD Software are Solidwork, Solid edge, Unigraphics, NX, Catia, etc. In the software system the model can be saved in different formats. Which can be used to exchange the models to different softwares.
- 3D CAD softwares provide the actual features to the model as of the actual product.

- **4.1.1 Benefits of 3D CAD software systems**

4.1.1.1 Time saving

The time which is used to produce or manufactured the product and 2 test on it in conventional way of manufacturing is saved by use of CAD system.

4.1.1.2 Increases productivity

The productivity will be increased by the use of saved time. the higher number of projects can be completed by the same time or we can say that the more number of products can be manufactured.

4.1.1.3 Improve accuracy

Use of 3D CAD system is advantageous than the manual designing. There can be a lot of mistakes or errors in a manual design. CAD design are error-free that led to the higher accuracy.

4.1.1.4 Complex shapes

Complex shapes can be produced with CAD systems. However it is difficult to produce a the complex design manually And also perfect results are obtained by cad system tools.

4.1.1.5 Decreases error

Unique advantage of CAD systems for 3D model provides interference checking feature. This feature helps the designed check for interferences between one or more parts.

- **4.1.1.6 Improved quality**
- The quality of the product is improved as cad system produce the product as error free, with high accuracy etc.
- **4.1.1.7 Easily understandable**
- 3D models in CAD software are simple to understand rather than in the manual drawings. At least 3 sketches are required to get the idea of the product in manual drawings (plan, elevation , and side view).
- **4.1.1.8 Quick Sharing**
- The model of product will be saved in different formats so that it can be shared to different software's. Sharing is instantaneous.

DMU (Digital Mock Up)

- The **DMU** (**Digital Mock Up**) is a virtual representation of the product and its parts, which organizes and aggregates the components according to the logic design or production.
- The **DMU** allows to simulate the shape and spatial arrangement of the components of the product or subsystem, and parts of the production equipment.

digital mockup of XM1202 Mounted Combat System

- **4.2 Digital Mock-Up (DMU)**
- Digital Mock-up is our overall product evaluation of 3D development and maintenance. The DMU contains all the information about the product geometry and configuration.
- The DMU process is used for packaging research, accident detection, assembly and assembly simulation, and other 3D CAD-based analysis. For example, in the automotive industry, DMU handles the creation of assemblies with components

- The concept Of DMU originated in late 1980s shortly after the adoption of 3D CAD system.
- It was typically provided as an add-on application to CAD systems, i.e., DMU applications are provided as standalone application that are not integrated with CAD authoring tools or with the overall PLM solution, product data management (PDM) OR computer aided manufacturing (CAM) applications.

Benefits of Digital Mock-Up

- The main benefits of digital mock-up process are as follows;
- 1. The time to the market is reduced.
- 2. Improvement of quality of the product and optimization of design.

From Sustainable Development to Design for Environment

From Sustainable Development to Design for Environment

- **Sustainable Development**
- “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

Key Factors in Sustainable Development and the Role of Environmental Protection

- Establish environmental goals, regulations, incentives, and standards
- Make more effective use of economic instruments
- Broaden environmental assessment
- Encourage action by industry
- Increase capacity to deal with industrial hazards
- Strengthen international efforts to help developing countries

Brundtland Report

- The three main pillars of sustainable development include **economic growth, environmental protection, and social equality**.

Role of Science and Technology

- In seeking a schematic vision, the sociocultural, economic, and environmental elements representing the principal factors involved in the process of sustainable development, can be imagined as ideally placed at the vertices of an equilateral triangle (Munasinghe, 1993).

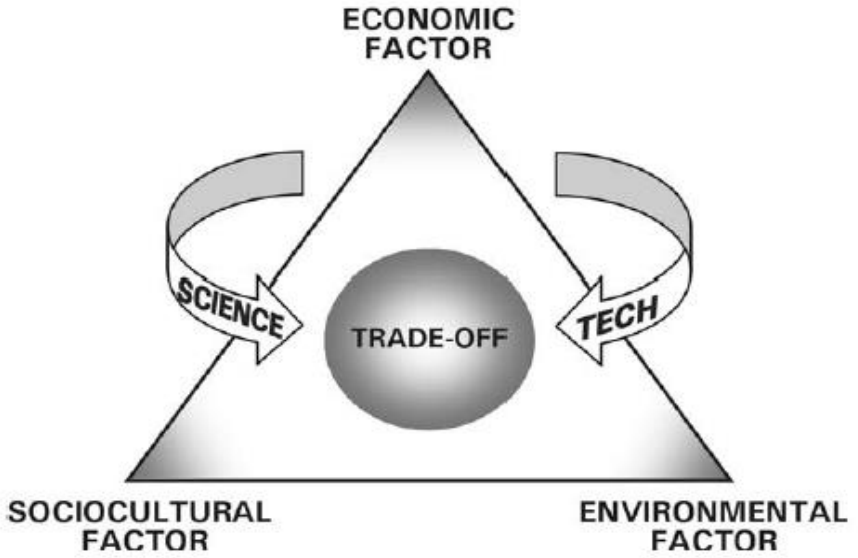


FIGURE 1.1 Triangle of sustainable development and the role of science and technology.

Elements of an Effective S&T Strategy

- A sufficient base for science and technology for sustainable development must be assembled from a variety of key activities. We believe that an overall strategy to this end entails 5 specific elements where science and technology are intimately involved.

These are:

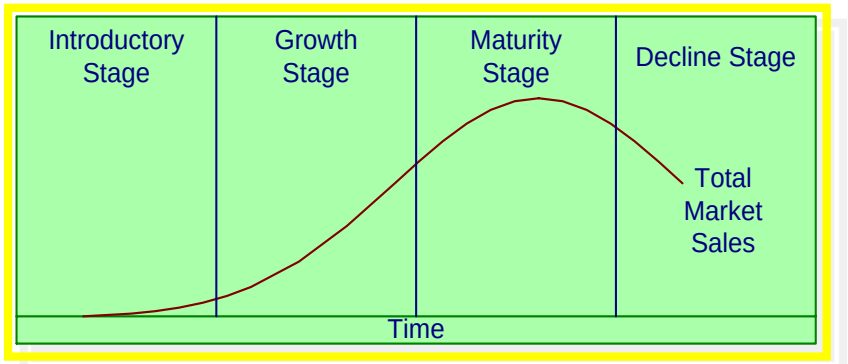
- Building Capacity for Sustainable Development
- Investing in Training the Next Generation
- Ensuring Access to Information
- Strengthening the Scientific Basis of Decision-Making
- Informing the Public

Elements of an Effective S&T Strategy

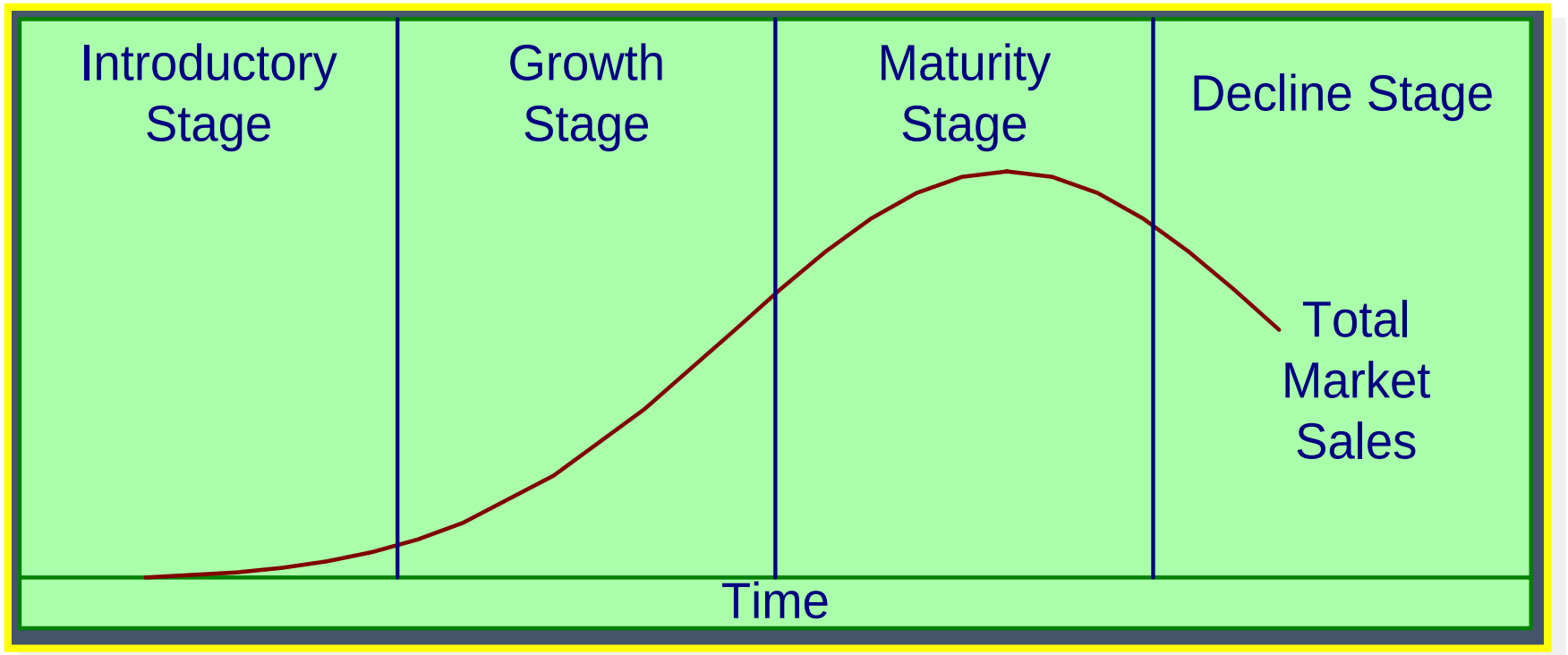
- **Building Capacity for Sustainable Development.** This includes investment in the human and institutional resources to understand the challenges to sustainable development.
- **Investing in training the next generation.** This is an imperative for all countries. Education in mathematics, science and technology is crucial for the long term economic development of a nation, and for the future of its scientific enterprise,
- **Ensuring access to information.** Information can be made more readily accessible and convenient to all users.
- **Strengthening the scientific basis of decision-making.** Many research themes related to sustainable development are the focus of ongoing international research programs.
- **Informing the public.** One of the greatest challenges for sustainable development is the long time horizon of both the problems and the solutions. Governments and policymakers must support the communication of scientific findings to the public thereby enabling a dialogue.

Individual Product Strategies

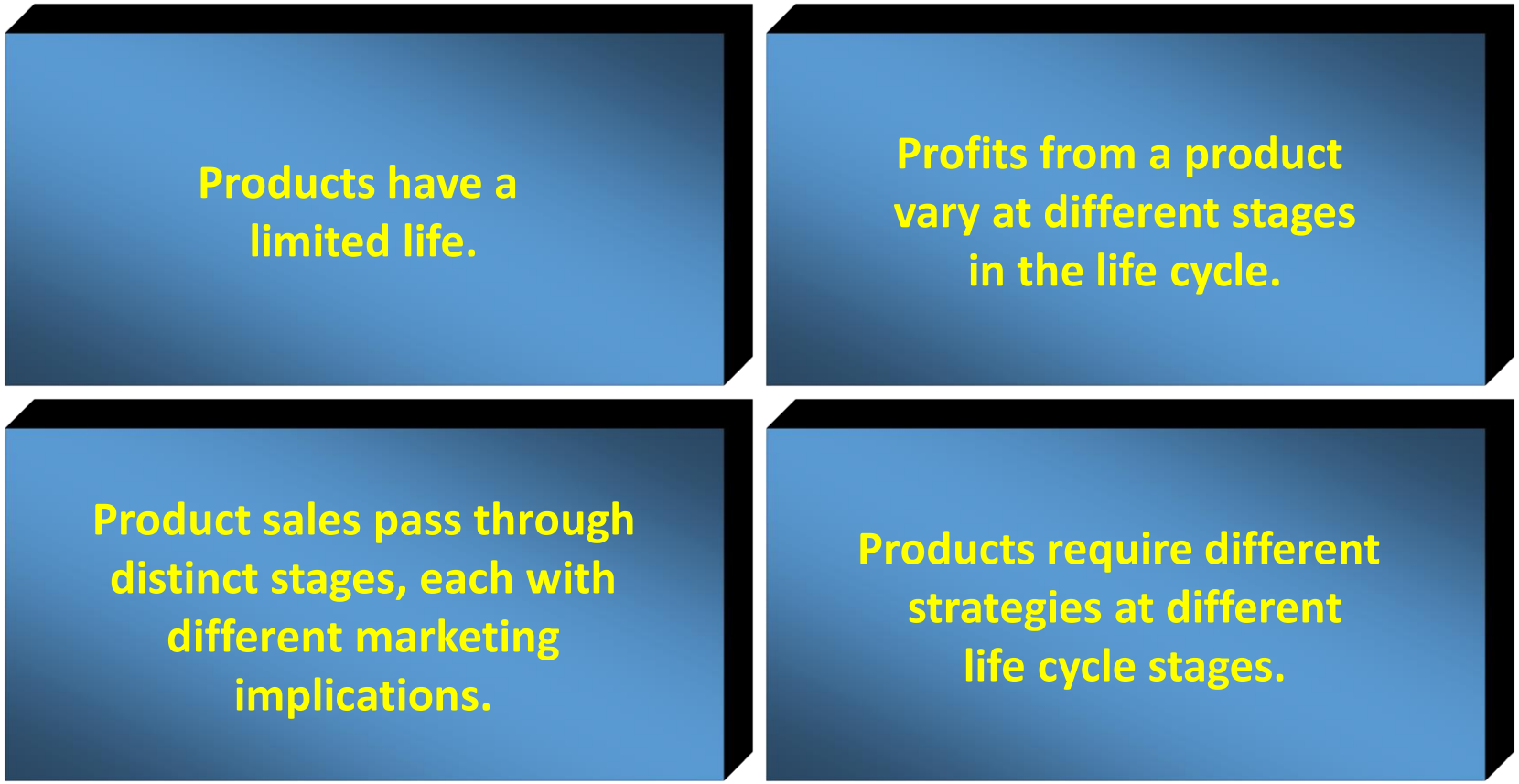
- **Product Life Cycle (PLC):**
  - *Describes the advancement of products through identifiable stages of their existence.*



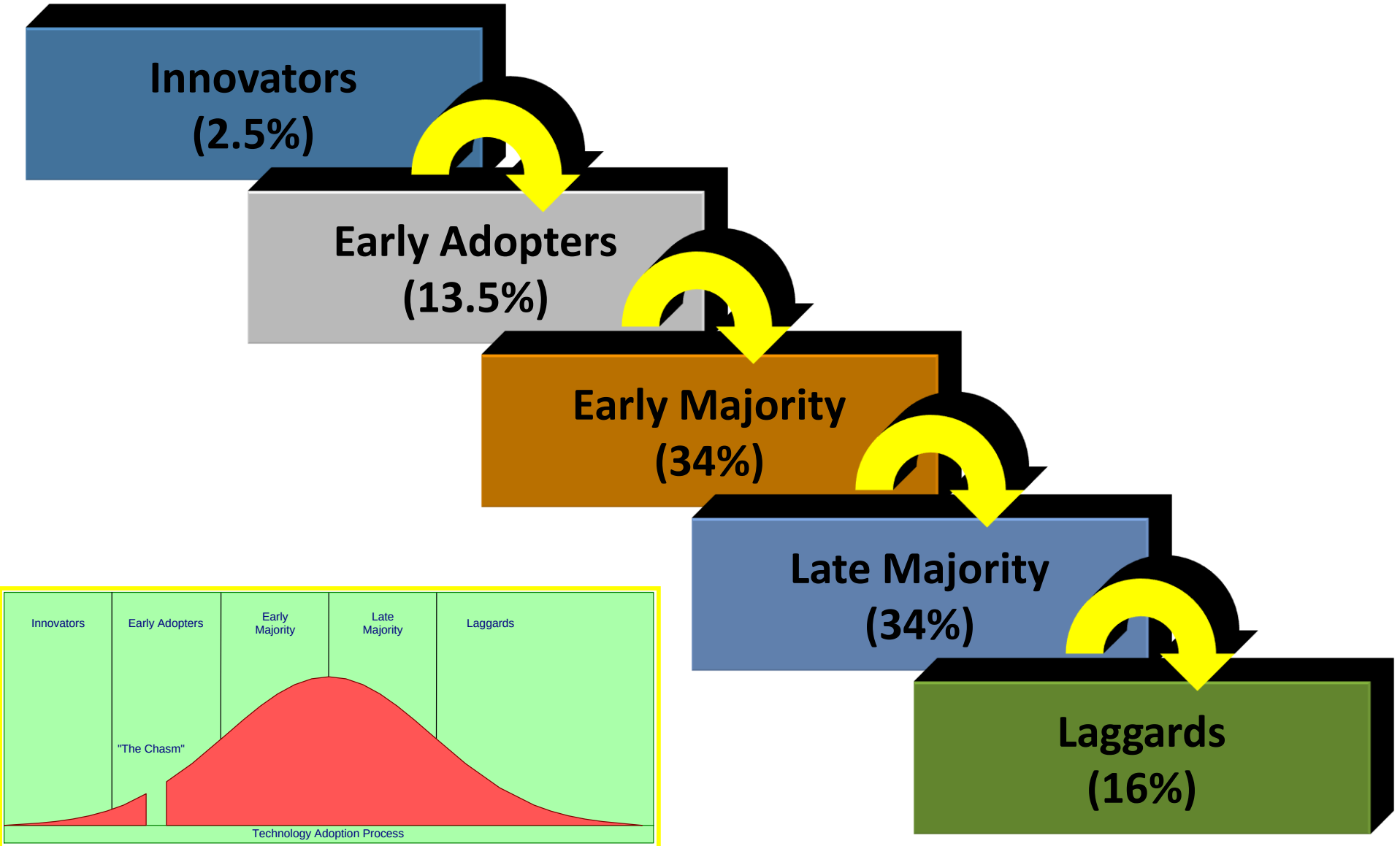
The Product Life Cycle



The Product Life Cycle Concept is Based on Four Premises



The Diffusion Process



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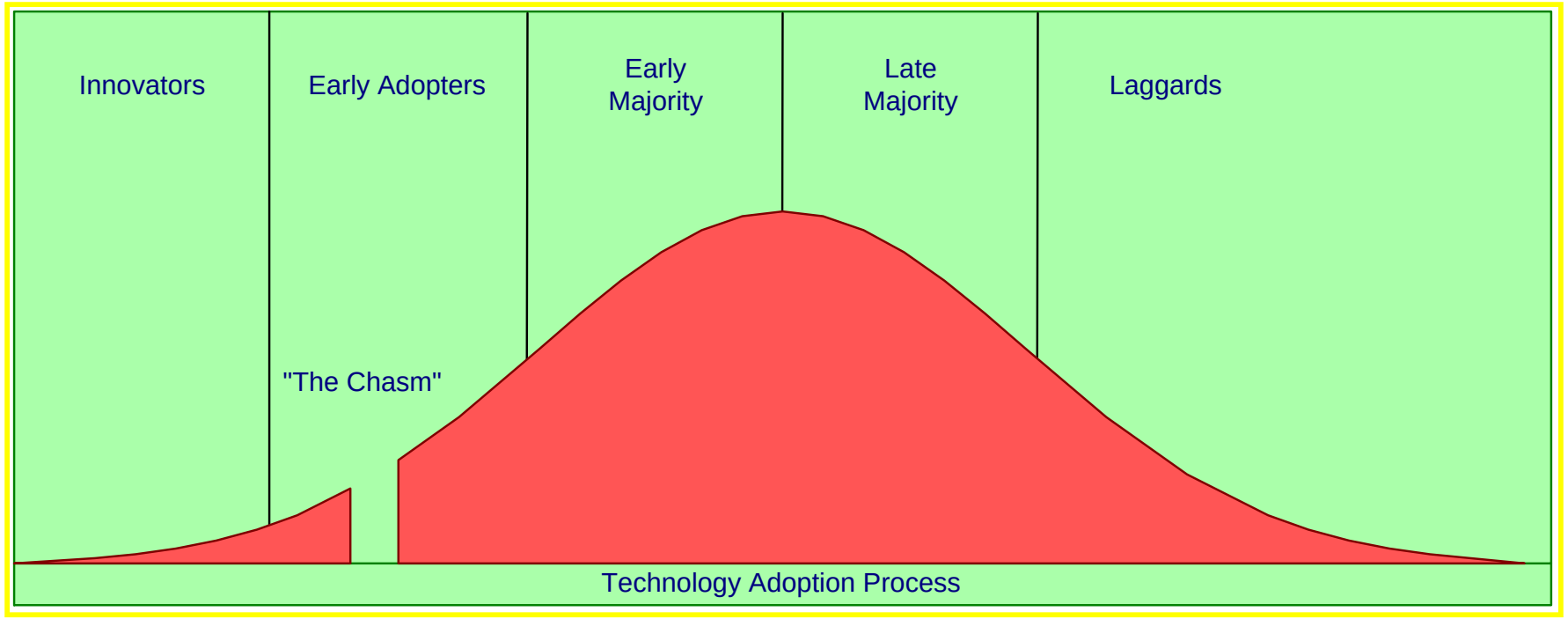
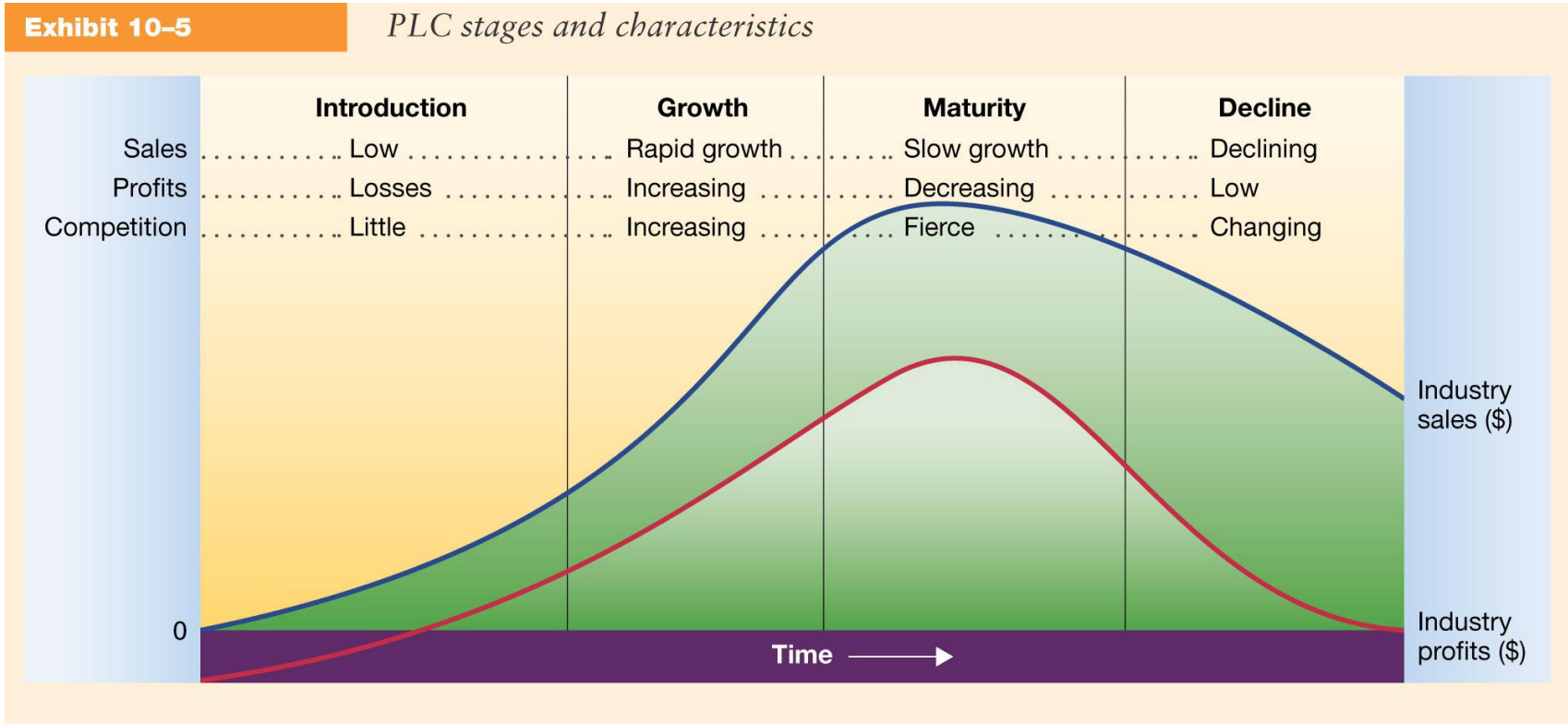
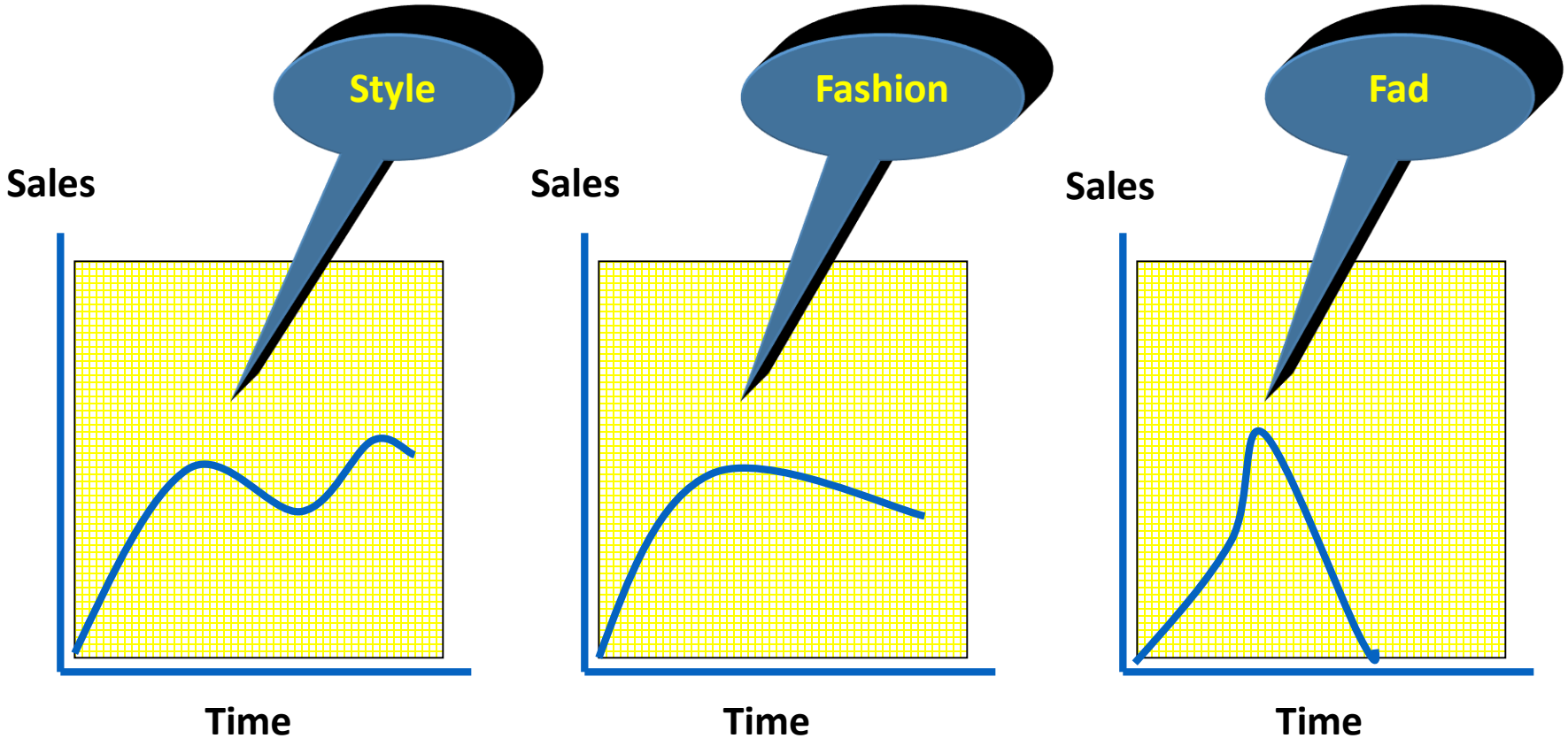


PLC Stages and Characteristics



PLC Length and Shape



PLC Marketing Strategies

Stage	Objective	Marketing Strategy
Introduction	Awareness & trial	Communicate benefits
Growth	Usage of firm's brand	Specific brand communication, lower prices, expand distribution
Maturity	Maintain market share Extend life cycle	Sales promotion, drop price, expand distribution, new uses & new versions of product
Decline	Decide what to do with product	Maintain, harvest, or divest

Limitations of the PLC

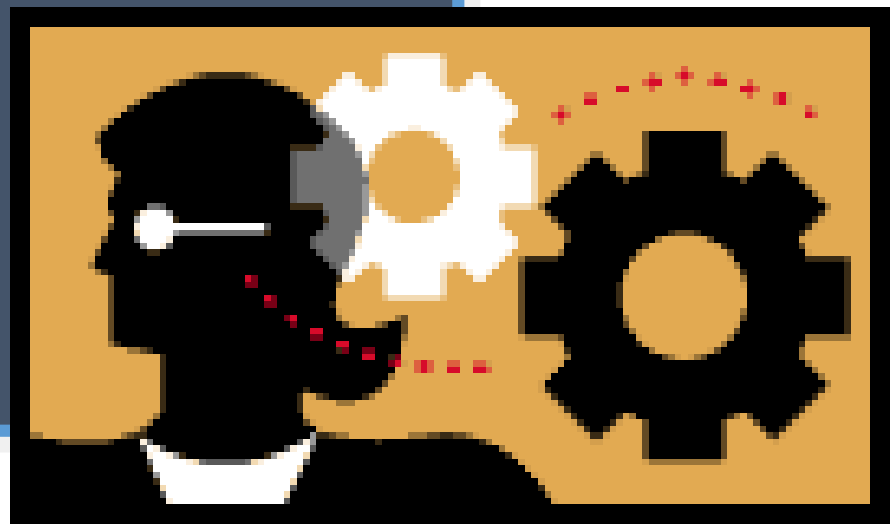
1. The life cycle concept applies best to product forms rather than to classes of products or specific brands.

2. The life cycle concept may lead marketers to think that a product has a predetermined life, which may produce problems in interpreting sales and profits.

3. It is only a descriptive way of looking at the behavior of a product and the life cycle can not predict the behavior of a product.

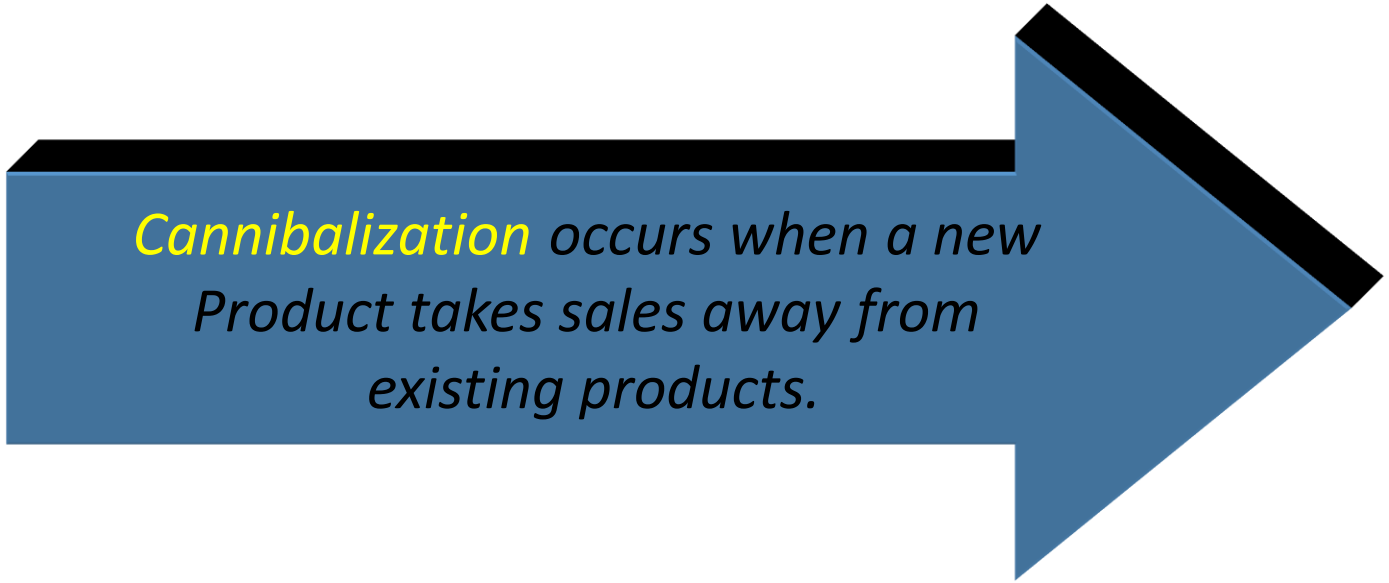
Product-Line Strategies

- **Strategic Alternatives:**
  1. **To increase the length of a product line.**
  2. **To decrease the length of a product line.**



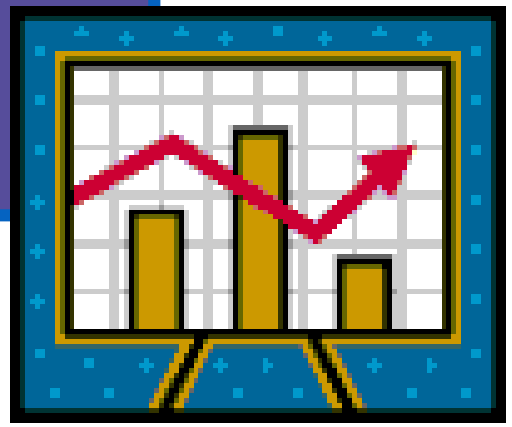
Increasing the Product Line

- Downward-stretch Strategy
- Upward-stretch Strategy
- Two-way-stretch Strategy
- Line-filling Strategy



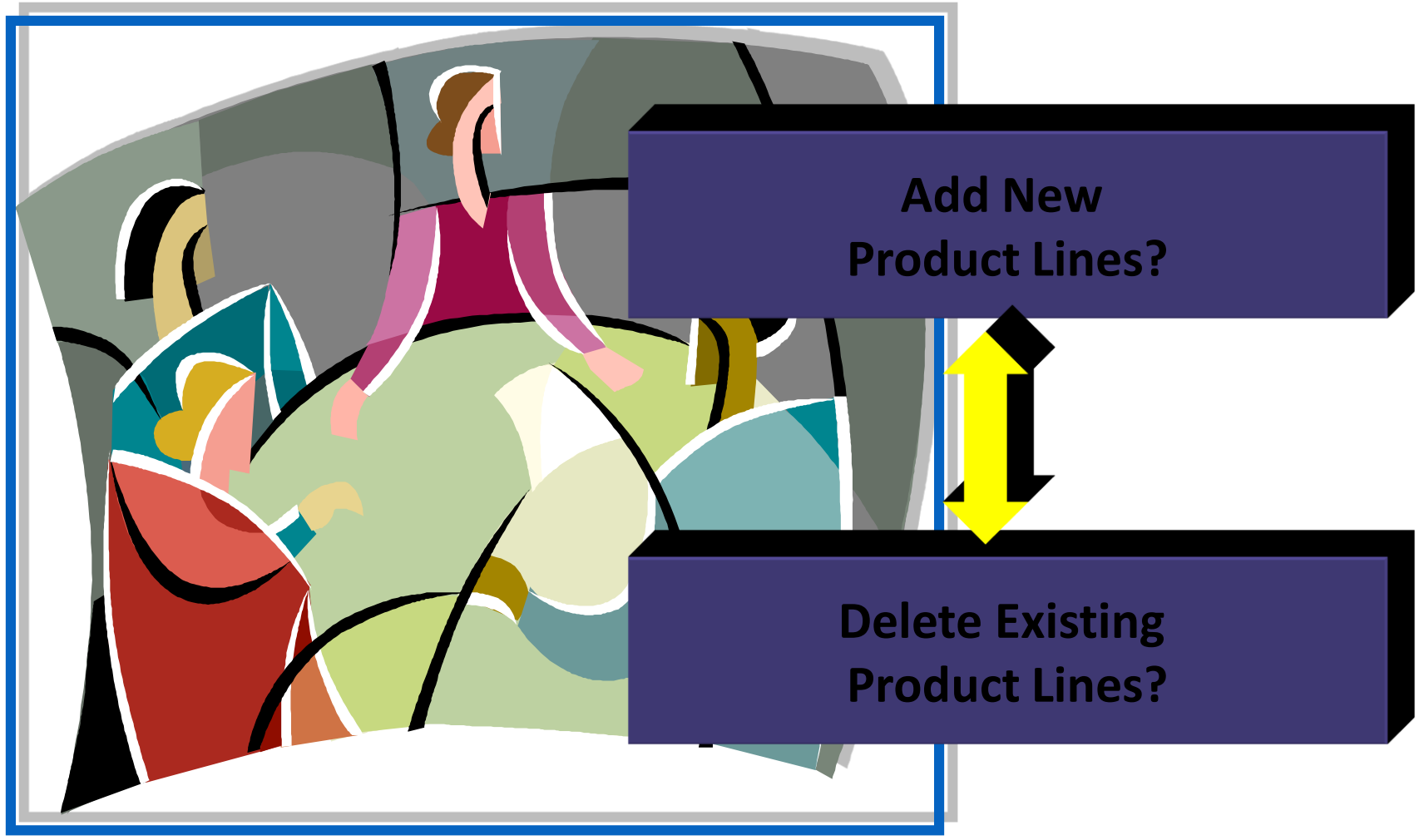
Decreasing the Product Line

- **Product Line Contraction:**
  - Firms must consider deleting products when:
    - *They are not successful.*
    - *They reach the decline stage of PLC.*
    - *Long product line marketing costs are too high.*

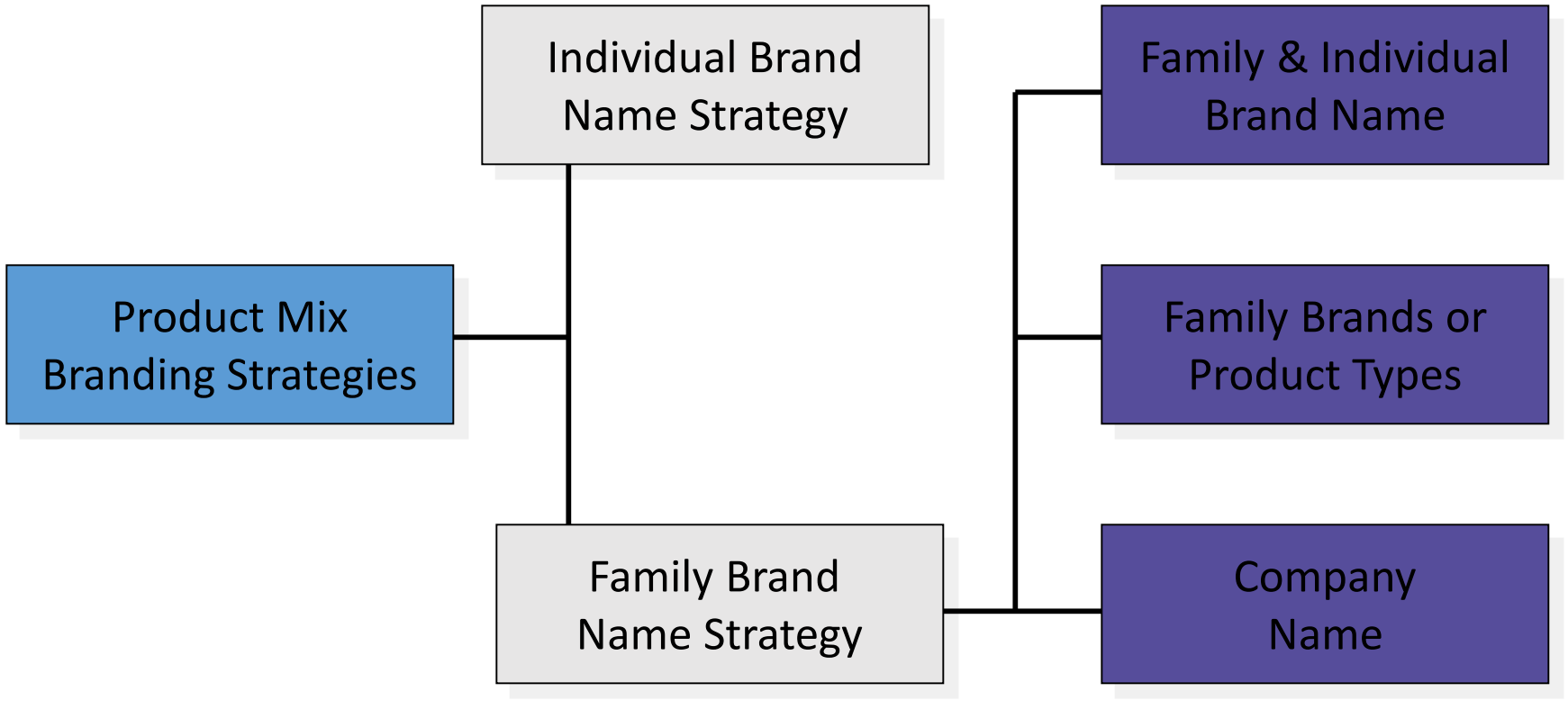


Product-Mix Strategies

Strategic Alternatives



Branding Strategies



Ethical Issues in Product and Service Strategies

- Is the product safe when used as intended?
- Is the product safe when misused in a way that is foreseeable?
- Have any competitors' patents or copyrights been violated?

Ethical Issues in Product and Service Strategies

- Is the product compatible with the physical environment?
- Is the product environmentally compatible when disposed of?
- Do any organizational stakeholders object to the product?