



Ch. 3

Process of

Technological Change:

Innovation

Technical change consists of:

Two closely linked processes:

- 📊 Innovation, and
- 📊 Diffusion (penyebaran),



We will focus on

The process of
INNOVATION

Innovation,

Specifically, we will address such questions:

1. What are the different type of innovation?
2. What are the dynamics of technoloty evolution?
3. What are the characteristics of innovative firms?



The Dynamics of Technological Change



Technological change can thus be described at two level:

- ▶ At the level of the individual firm, or
- ▶ At the level of the technology

Innovation Dynamics at The Firm Level

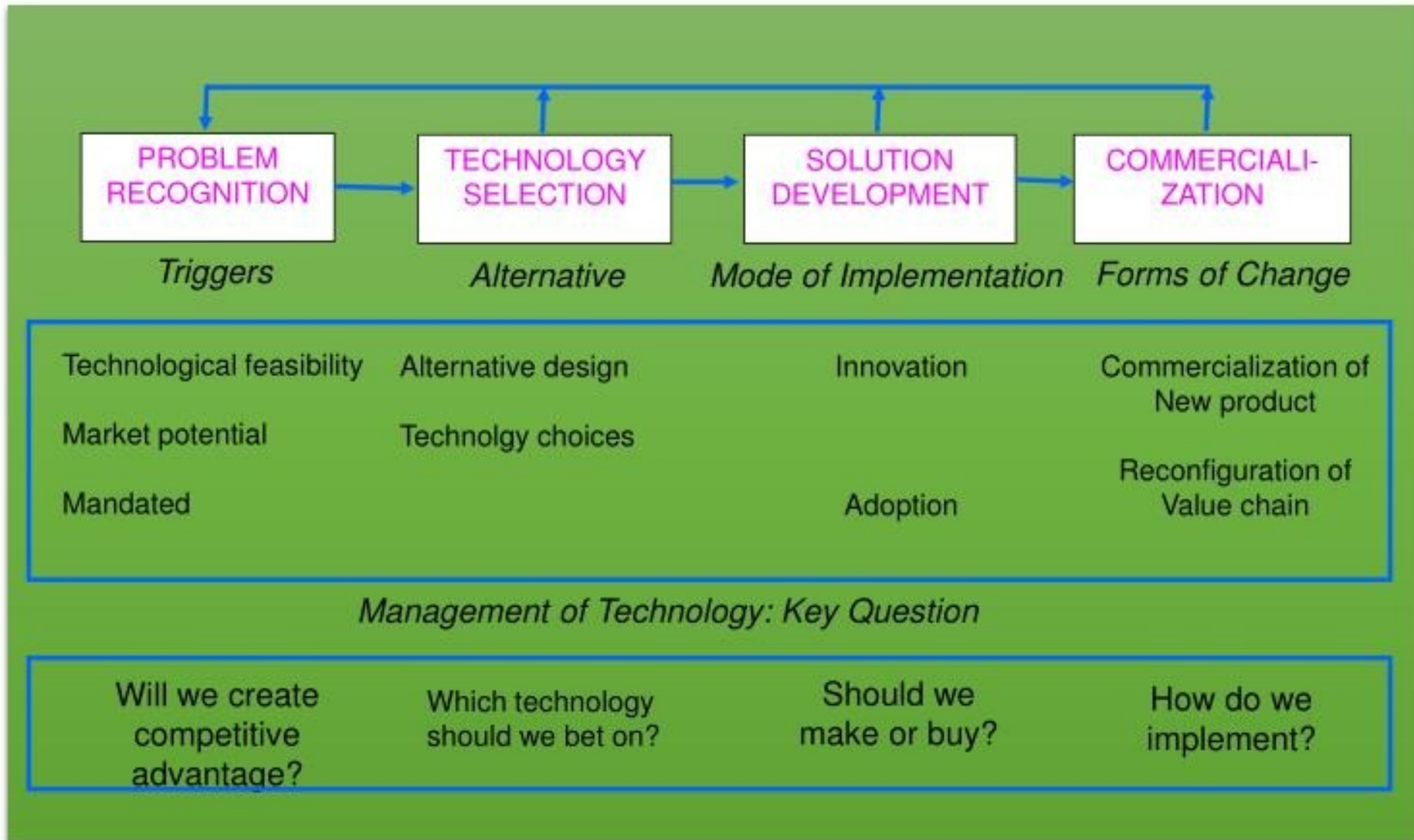
Firm Level

- ▶ At the level of an individual firm, technological change may be described as a process of problem solving.



We can identify four stages in
proces of problem solving.

1. Problem Recognition.
2. Technology Selection.
3. Solution Development.
4. Commercialization/implementation.



Model Of Problem Solving

The four-stage problem solving model serves three purposes:

1. It provides a unifying framework within which we will be discussing the twin processes of innovation and diffusion.
2. It provides a normative framework for key management of technology decisions, such as new product introduction or value chain configurations; and
3. It helps us to focus on the key questions that need to be answered during management of technology.

Technology Level

- ▶ Although each firm is trying to seek competitive advantage through its own problem solving efforts, in most cases technological change is driven by numerous firms and organizations involved in technology development.
- ▶ As a result, at the level of a specific technology (product of process), technology change displays evolutionary dynamics that are not controlled by a single firm.
- ▶ Although breakthroughs are difficult to forecast, once a technology has emerged, the evolutionary dynamics display predictable patterns that enable us to discern the direction of technological change.

Just what drives these changes?

We can identify five sets of actors that participate in the evolutionary dynamics:

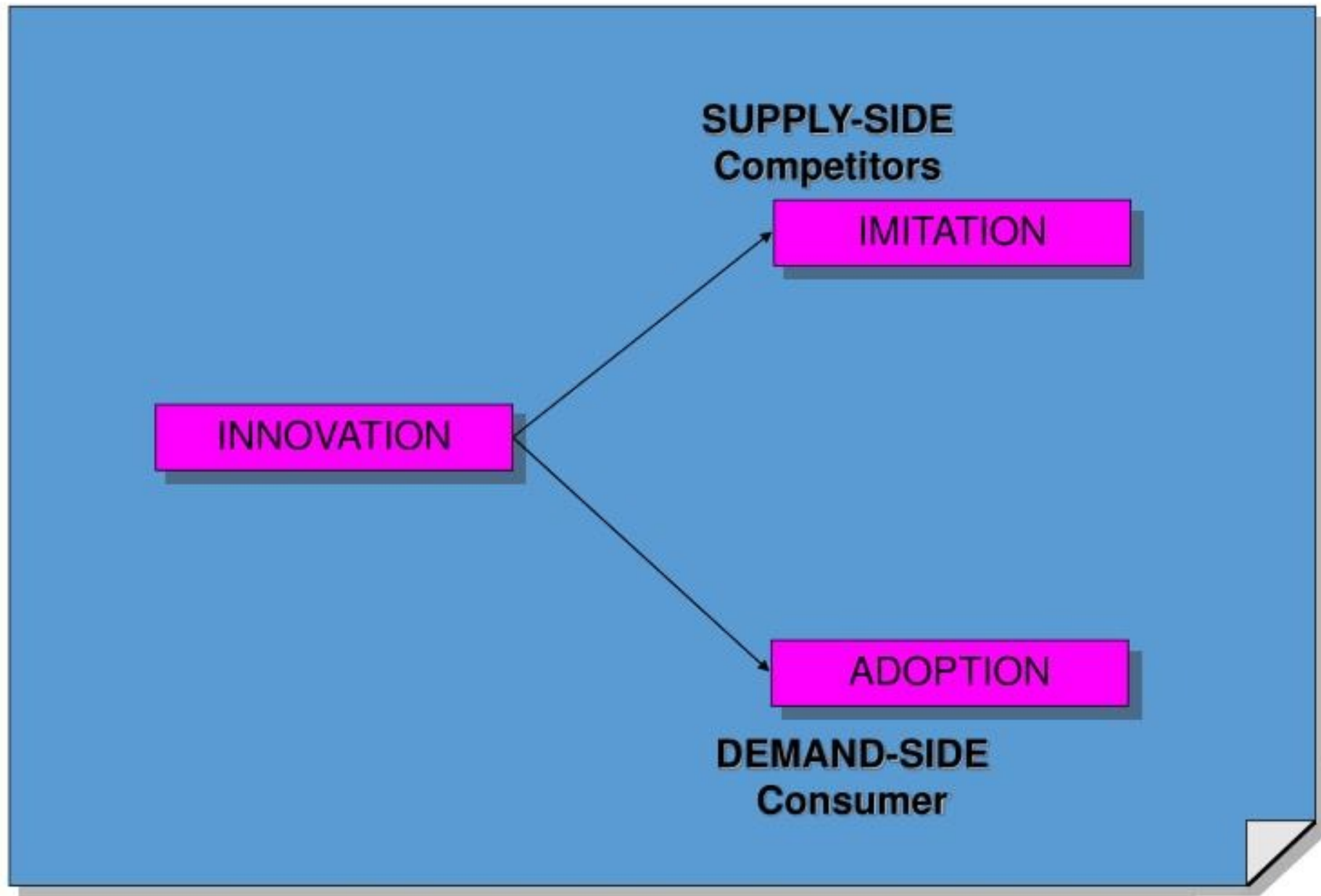
1. **Technology Developer** which typically are firms involved in innovations in their pursuit of competitive advantage;
2. **Technology Facilitators**, yang menghasilkan/menyediakan sumberdaya dalam pendanaan dan pelaksanaan usaha inovasi.
3. **Customers (Pelanggan)** yang tertarik pada buah pengembangan teknologi dan siapa yang menggambarkan arah dari pengembangan.
4. **Regulatory agents** (lembaga regulator), pemerintah dan pihak lain yang menggambarkan bentuk dari produk dan proses dengan membuat standar atau spesifikasi.
5. **Other stakeholders**, yang menerima keuntungan (seperti supplier yang memasok pada perusahaan yang melakukan inovasi) atau victim (sasaran) perubahan teknologi (contoh: industri seperti yang menjadi ketinggalan dengan adanya perubahan teknologi).

Implication of the Technology Management

1. Innovation, Imitation, and Adoption.
2. The Role of Technology and Market Factor.
3. The Centrality of Learning

1. Innovation, Imitation, and Adoption.

- ▶ Ketika sebuah perusahaan melakukan inovasi (misal: mengembangkan produk baru), dua kelompok pemain yang berbeda akan merespon inovasi tersebut.
- ▶ Kelompok pertama, *pelanggan* (baik individual maupun perusahaan lain), membuat keputusan untuk mengadopsi atau tidak mengadopsi inovasi tersebut.
- ▶ Kelompok kedua adalah *pesaing*, yang mungkin menentukan untuk meniru (mencopy) inovasi dan membuat produk baru miliknya bersaing dengan perusahaan yang melakukan inovasi. Kita sebut hal ini sebagai *imitasi* (*imitation*).

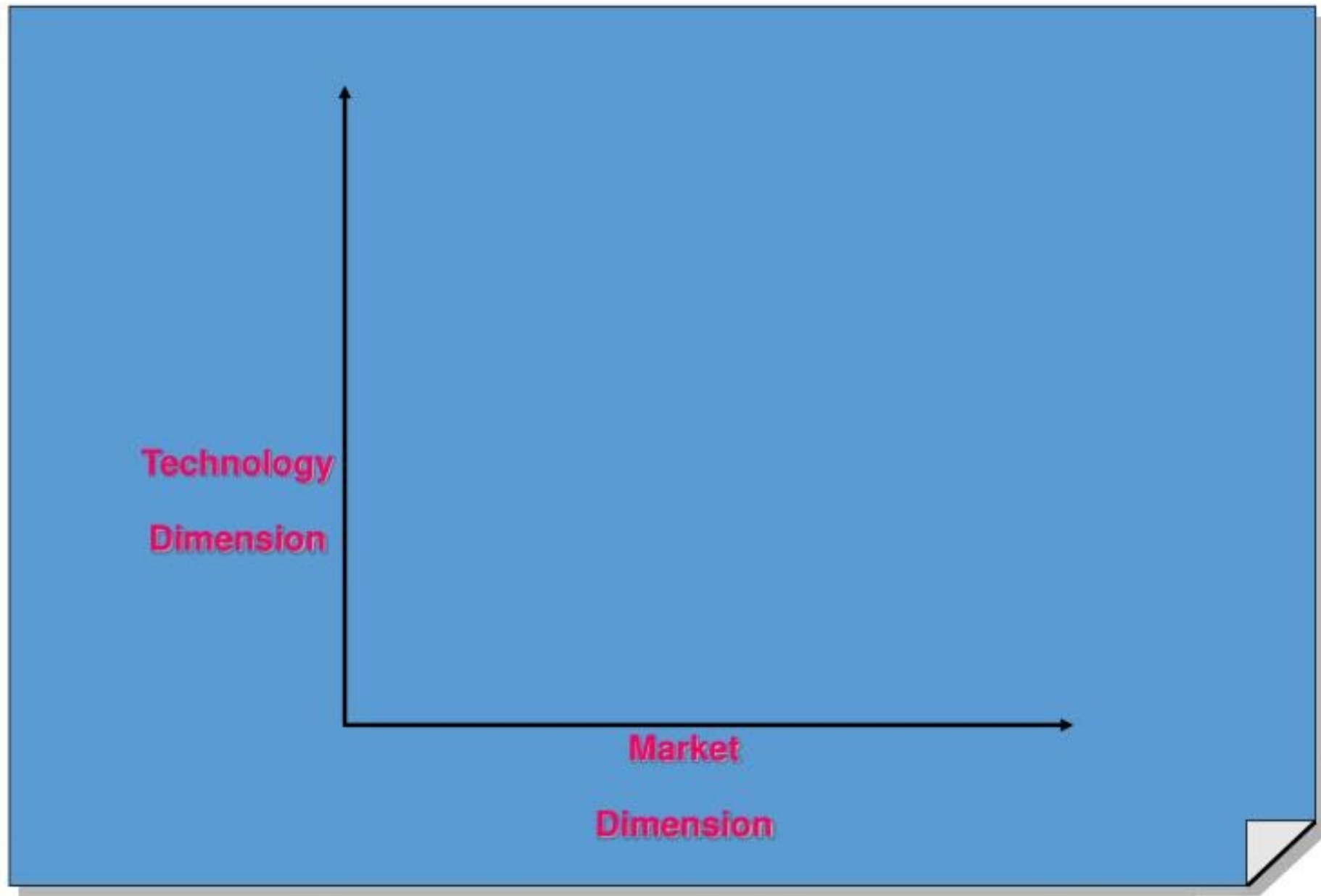


INNOVATION, IMITATION, AND ADOPTION

2. The Role of Technology and Market Factor

To be succesful, a firm has to manage two related processes:

1. Finding effective solution to a problem, and
2. Gaining acceptance of the solution in the marketplace..



TECHNOLOGY-MARKET (T-M) MATRIX

2. The Centrality of Learning

Many ways to learn, we identify three major mechanisms of learning:

1. Environmental surveillance through technical and market intelligence
2. Experimentation within firms whereby firms can learn problem solving by simulations and by trial and error.
3. Imitation through competitive intelligence.

“

**What is
Innovation?**

”

Definition of innovation

- ▶ *Rogers defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption"*

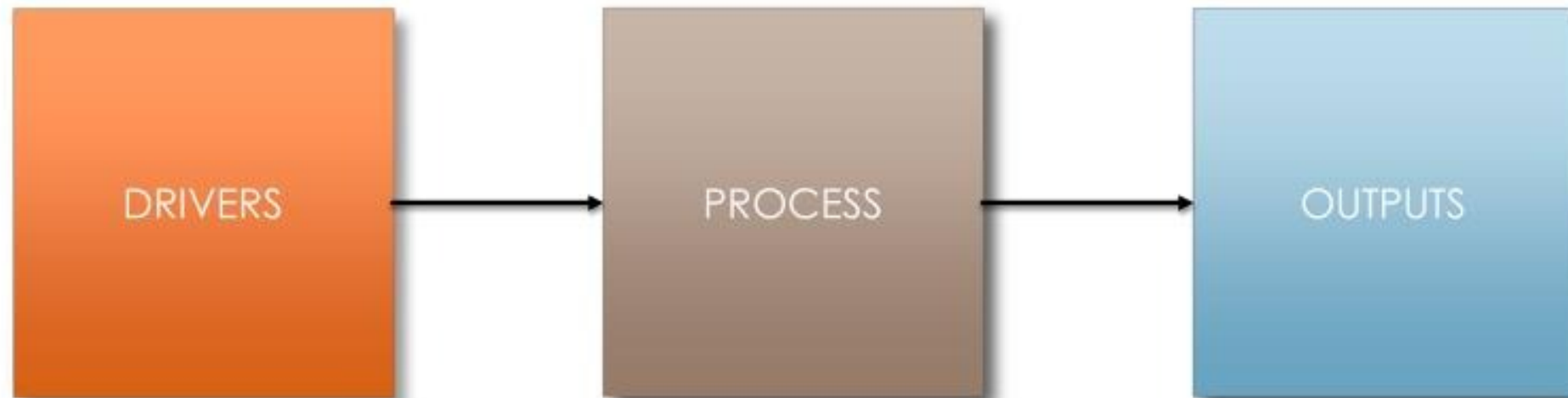
Definition of innovation

- **Innovation is** *the process whereby new and improved products, processes, materials, and services are developed and transferred to a plant and/ or market where they are appropriate (Rubenstein).*

Definition of Technology

- ▶ **Technology** *is the practical implementation of learning and knowledge by individuals and organizations to aid human endeavor. Technology is the knowledge, products, processes, tools, and systems used in the creation of goods or in the provision of services.*

Drivers of Innovation



Two environmental factors very frequently stimulate innovation

- ▶ **Market Factor.** Appear to have a primary influence on innovation.
- ▶ **Input Factors.** Especially rising costs of inputs, trigger innovations aimed at reducing the use of the expensive inputs.

PROCESS OF INNOVATION

- ▶ **Market Pull**, is the advancement of technology oriented primarily toward a specific market need, and only secondarily toward increased technical performance.
- ▶ **Technology-push**, is the advancement of technology oriented primarily toward increased technical performance, and only secondarily toward specific market needs.

Market-Pull Innovation

Dalam hal ini, ide inovasi berasal dari komunikasi tentang kebutuhan pelanggan., diikuti oleh pencarian solusi teknis untuk memenuhi kebutuhan tadi.

Technology-push Innovation

Dalam hal ini peuang ditunjukkan oleh keunggulan teknologi baru memicu perusahaan mencari sebuah aplikasi. Inovasi ini, cenderung digerakkan oleh pabrik. Sebagai contoh, selama periode dari 1944 sampai 1962, manufaktur mendominasi inovasi dalam bidang komputer.

TYPE OF INNOVATION OUTPUTS

- ▶ Innovations differs in terms of the degree to which they introduce practices that depart in a significant way from past practices.
- ▶ Some innovations introduce relatively marginal changes to an existing product or process, whereas others are based on different scientific and engineering principles and thus open up new markets and applications.



To classify an innovation we employ two dimensions:

1. The degree to which **specific technologies** in an innovation depart from earlier ones, or what we will call ***component knowledge***.
2. The degree to which **configurations among technologies** in an innovation depart from earlier ones, or what we will call ***component configuration***.



This Classification leads to four major types of innovation:

- (1) Incremental innovation,
- (2) Modular innovation,
- (3) Architectural innovation,
- (4) Radical innovation.

Characteristics of
Elements: Component Knowledge

Minor
Change

Incremental

Architectural

Novel
Change

Modular

Radical

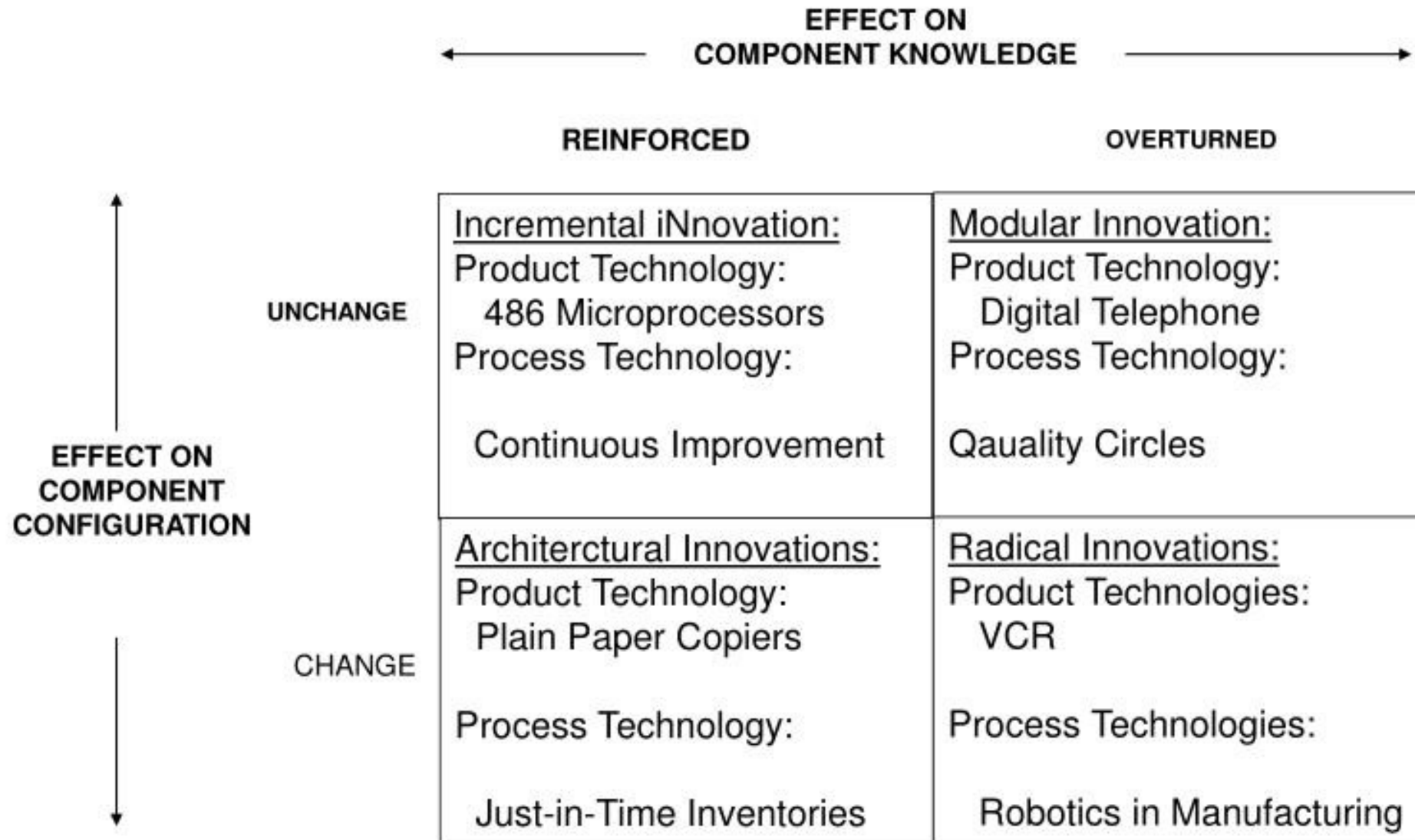
Existing

Novel

Characteristics of

Lingage Among Elements: Component Configuration

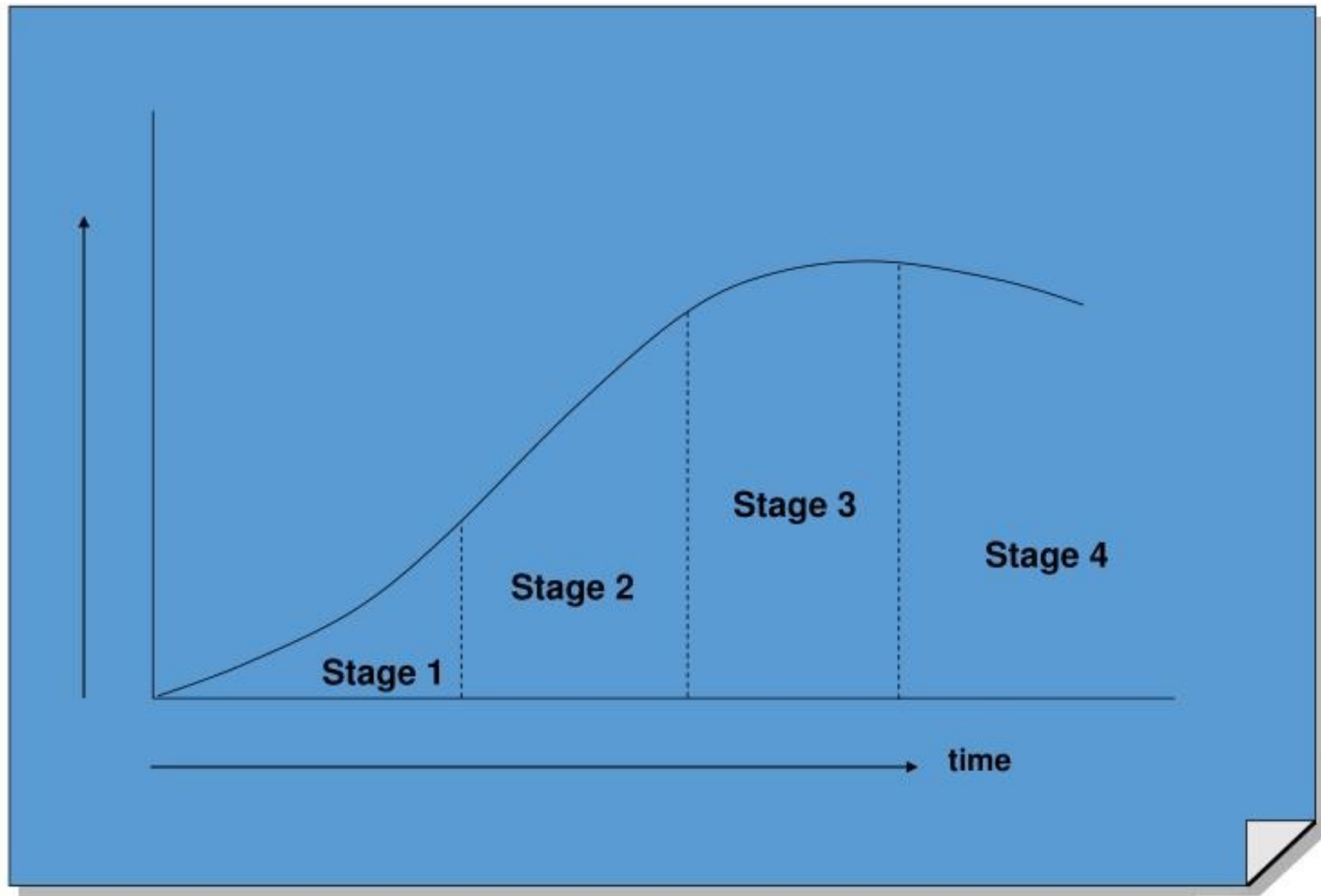
CLASSIFICTION OF INNOVATION



CLASSIFICATIONS OF INNOVATIONS FOR PRODUCTS, PROCESSES, AND SERVICES



TECHNOLOGY EVOLUTION



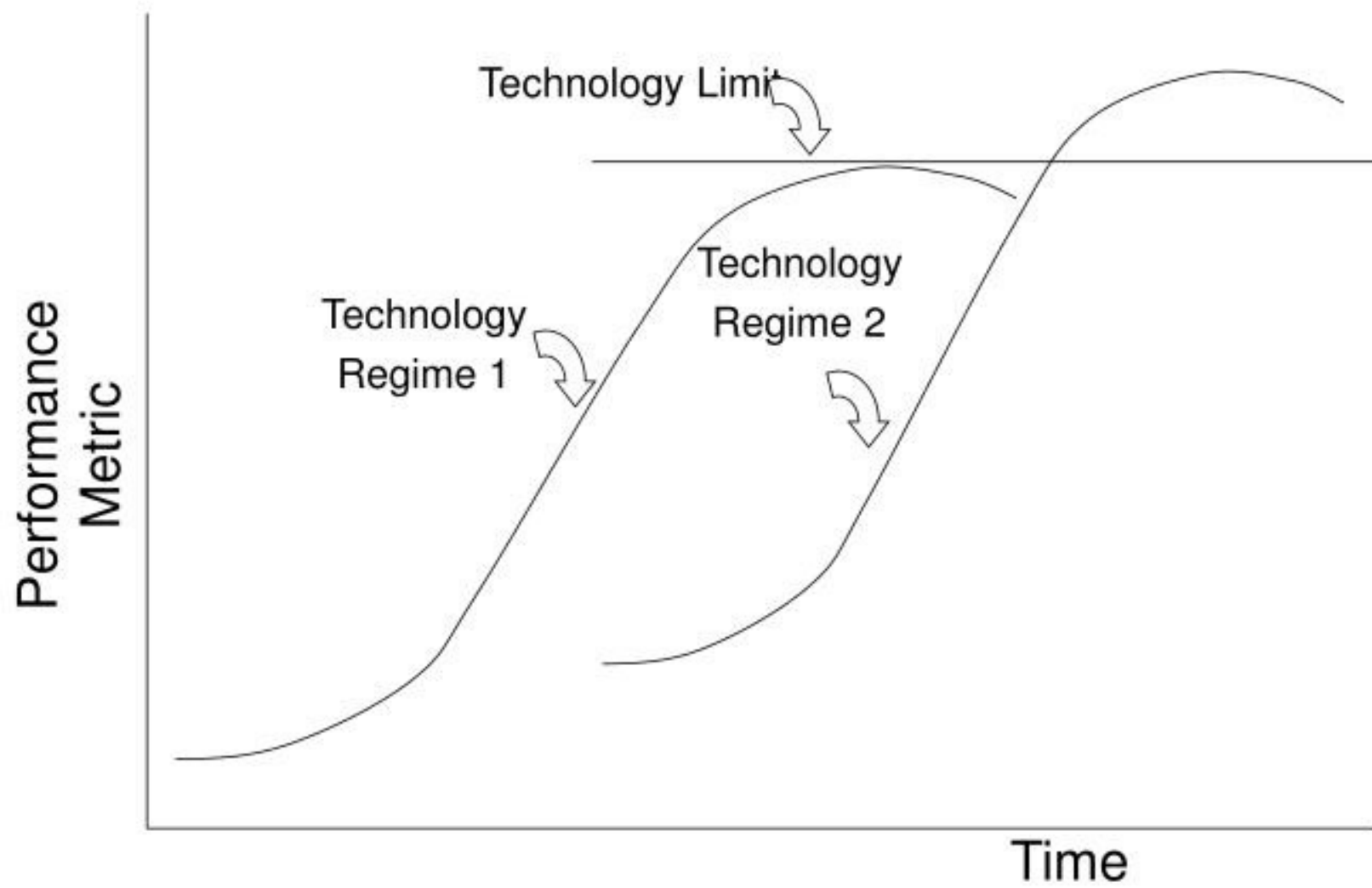
S-CURVE OF TECHNOLOGY EVOLUTION

FOUR MAJOR STAGES IN THE EVOLUTION OF A PERFORMANCE CHARACTERISTICS

- Stage 1 Emergence, when the technology has come into existence but shows little improvement in its performance characteristic;
- Stage 2 Rapid improvement, when the performance characteristic improves at an accelerating pace;
- Stage 3 Declining improvement, when the pace of improvement declines, and
- Stage 4 Maturity, when further improvements become very difficult to achieve.



LEARNING PROCESS AND TECHNOLOGY LIMITS



**TECHNOLOGY
PROGRSSION**



Characteristics of Innovative Firms

Four major classes of internal organizational characteristics:

- (1) ORGANIZATION STRUCTURE,
- (2) RESOURCES,
- (3) OPENNESS TO EXTERNAL INFORMATION,
AND
- (4) INFORMAL INTERNAL COMMUNICATIONS.

ORGANIZATION STRUCTURE

The two organization structure variable that have been found to stifle innovation are formalization and centralization:

1. *Formalization* refers to the degree of relevant rule, written documentation, and operating procedures within an organization. It represent the degree of bureaucracy that exiswts in an organization.
2. *Centralization*, on the other hand, refers to the locus of deciswion making. The more centralized an organization is, the more likely it is that decisions are made at the top levels of the organization.

RESOURCES

- ▶ Resources include financial resources and technical resources. Financial resources take the form of research and development expenditures; technical resources refer to the number of individuals who work on research and development or, in general, the task of innovation within an organization.

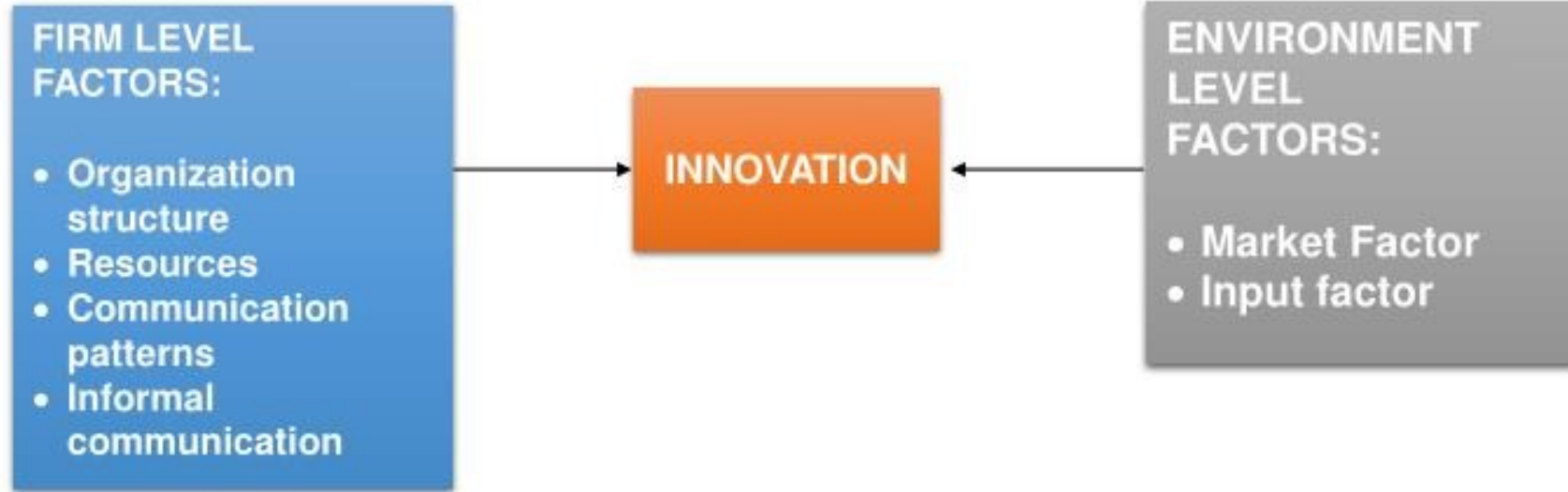
OPENNESS TO EXTERNAL INFORMATION

- ▶ This refers to the patterns of information exchange a firm establishes with its environments, including customers as well as the technical experts outside the firm.

INFORMAL COMMUNICATION

- ▶ The nature of informal communication that exists within an organization also influences innovation. More open climates tend to allow free exchange of ideas within an organization, and thus help the process of innovation.

FACTORS INFLUENCING THE PROCESS OF INNOVATION IN ORGANIZATION



INFLUENCE OF ENVIRONMENTAL TRENDS ON INNOVATION

- ▶ GLOBALIZATION
- ▶ TIME COMPRESSION
- ▶ TECHNOLOGY INTEGRATION

GLOBALIZATION

- ▶ Different nations tend to develop specialized technology-based assets

TIME COMPRESSION

- ▶ The pressures of time compression are driving firms to shorten their problem-solving time, in turn, forcing them to learn smarter and faster

TECHNOLOGY INTEGRATION

- ▶ Firm increasingly understand two major implications of technology integration for innovation. First, competitive advantage may be effectively sought by deploying architectural innovations that incorporate known technologies in novel ways. Second, during product and process innovations, alliances with other firms or adoption from external sources is sometimes more economically prudent and faster than in house development



MANAGERIAL IMPLICATION

Although we have already discussed several managerial implications of the dynamics of technological change, we will reiterate three key themes for emphasis:

1. Successful management of technology requires that the problem solving within the firm should take into account both technical and market considerations. Thus, both technology-push and market-pull innovations can succeed if they are augmented respectively by market and technical consideration.
2. Learning through environmental intelligence, innovation, and imitation are central to effective problem solving. Globalization, time compression, and technology integration are heightening the need for faster and more effective problem solving than in the past.
3. Development of problem solutions can be accomplished either in-house, in collaboration with others, or simply by adopting innovations from outside. The mode of development should be a deliberate managerial choice.