

Performance of National Innovation Systems

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- A national innovation system should have **strong research capabilities** in its **industrial sectors**.
- A national innovation system should have a **high - quality research – oriented university** sector.
- A national innovation system should have **at least one strong internationally competitive industrial or service sector**.
- A national innovation system should have a **culture of valuing high quality of performance**.
- A national innovation system should be **supported by government** policies that strongly fund appropriate R & D activities in universities and selected mission areas.
- A way to identify **cutting-edge science** (which can help surpass current technology) should be a national science and technology policy priority.
- Science and technology policy must support research for technology improvement in current industries, and research **to establish new internationally competitive industries** in new technologies.

Case Study: Innovation of Xerography

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- Good example for the importance of commercialization and management challenges
- The inventor of xerography was a technical person, Chester F. Carlson, and the commercialization of xerography was accomplished by a businessperson, Joseph Wilson.
- Carlson had backgrounds in physics and chemistry of carbon and understood the market need for copying.
- Like all new inventions, it was not commercially efficient, cost-effective, or easily usable.
- The development of a new technology usually costs a great deal of money, takes time, and requires skilled resources.
- From 1939 to 1944, he was turned down by twenty major companies.
- Wilson was looking for new technology for his company for new products. At the time, Wilson's main customer was Kodak, which could at any time eliminate his small business if it chose.
- Finally, all the innovative pieces for Carlson had fallen in place
— inventions, patents, R & D, commercialization. Wilson subsequently changed the name of his company to Xerox
- Take-home message: For technological innovation, two roles are always required: (1) an inventor (invention) and (2) an entrepreneur (commercialization).



Innovation Management

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- What made Carlson an outstanding inventor was that he had **two kinds of skills**
 - ▣ an understanding of a technical need
 - ▣ scientific background to invent a process to accomplish the technical goal
- What made Wilson an outstanding business leader was that he had two kinds of skills
 - ▣ Technical savviness
 - ▣ Business savviness
- A technically savvy manager needs to know how to manage the business process of innovation — planning and financing and assembling a good technical team for innovation strategy.
- Innovation management means management of innovation processes.
 - ▣ setting up the internal environment and conditions for innovation processes
 - ▣ designing a frame and a standard innovation process
 - ▣ carrying out the individual innovation projects

Innovation Management

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Two phases:

1. Idea management → To find the right product (project) (effectivity)
2. Project management → To develop the product efficiently (to achieve the goals, targeted costs and schedule)

Thus, to understand the whole of innovation, one needs to understand: (1) how engineers and scientists think and (2) how marketing, production, and financial managers think.

Effectivity and Efficiency

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- To be successful with innovations effectivity and efficiency have to be ensured.

Effectivity: To do the right things.

Efficiency: To do the right things in a good effort/result relation

- Efficiently organized innovation processes only pay out, when the strategically right topics and projects have been chosen (effectivity).

Departments at a business for commercialization of a radical innovation

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Within a business at this micro-level, there are several business functions for operating the business and innovating new products/services:

- Hard-good businesses require a **production function** for producing a hardware product; this is usually organized as a factory, or production unit.
- Businesses require a **marketing function** of selling their products/services; and this is usually organized as a marketing department.
- Businesses require a **finance function** of controlling the finances of the business operation; and this is usually organized as a finance department.
- Businesses require an **administration function** for managing the personnel and operations in a business; and this is usually organized as an administration department.
- Businesses now require an **information function** to acquire and manage information and communication technologies for business operations, and this is usually organized as an information technology (IT) department.
- Businesses require an **engineering function** for the capability to design new products and services; and this is usually organized as an engineering department.
- High-tech businesses also require a **research function** for the capability of inventing and developing new technology, and this is usually organized as a corporate research laboratory.

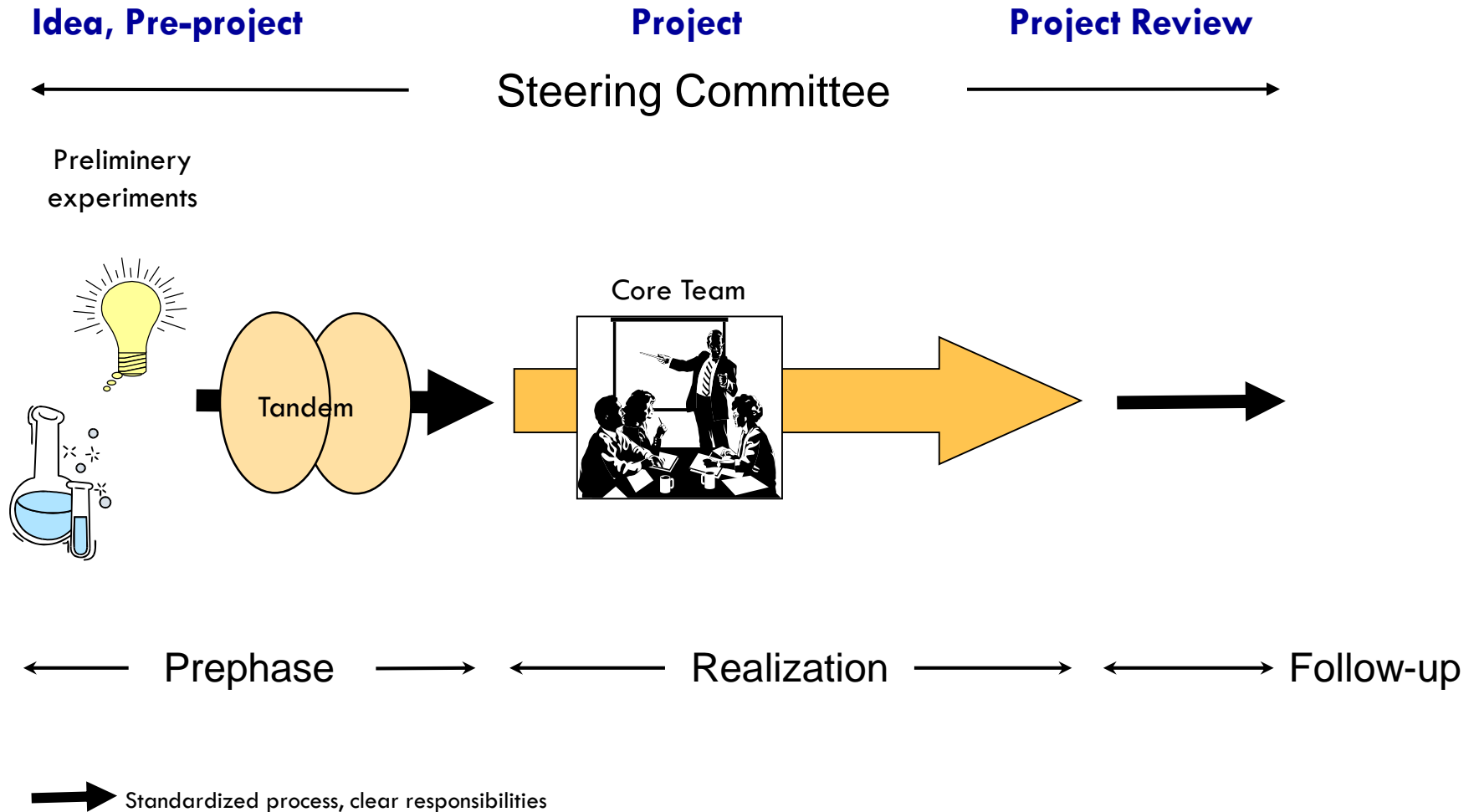
Case Study: How DuPont invented Nylon

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- **DuPont was a small explosives manufacturer and had in this century become a diversified chemical company.**
- Charles Stine listed four reasons why DuPont should spend its money on this new kind of industrial chemical research
 - The scientific prestige and public relations value to be gained through the presentation and publishing of papers.
 - Interesting scientific research would improve morale in the department and make the recruiting of Ph.D. chemists easier.
 - The results of DuPont's pure science work could be used to trade for information about research in other institutions.
 - Pure science might give rise to practical applications.
- Beginning in April 1927, fundamental research in DuPont's new research center was to receive \$25,000 a month. (Microsoft R&D budget in 2009: \$10 bln)
- Stine received \$115,000 to build a new laboratory for fundamental research.
- With the new building under construction, Stine began to look for twenty-five scientists.
- A central management responsibility of laboratory director is the establishment of proper procedures by which scientists are selected as research project leaders.
- Nylon= artificial silk: chaining smaller molecules into longer chains of molecules synthetically
- Finally, nylons went on sale nationally in May 1940, and the demand was overwhelming.
- Convinced that nylon would prove superior to silk, DuPont initially set its price 10% higher than that of silk

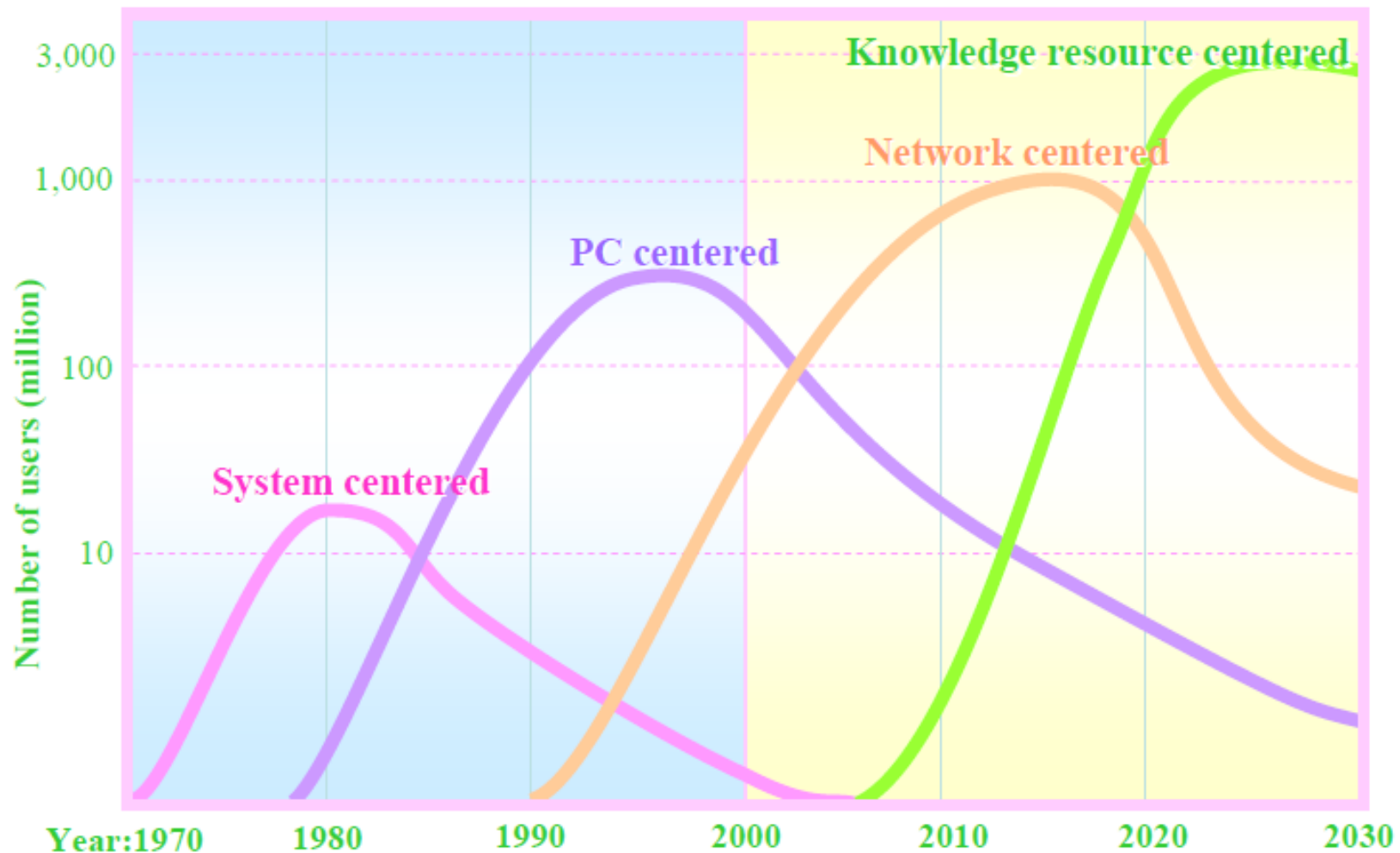
The Innovation Process

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Importance of reading the trends: the Paradigm shift in IT

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David C. Moschella: "Waves of Power"

Questions to be answered (by you)

- What are the potential fields for future innovations?

II. Empirical Findings: Success Factors

Results of "Old" Empirical Studies on Innovation Success – Still Relevant

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- Two third of all successful innovations come from market impulses (*Myers, Marquis 1968*).
- Successfully innovating companies understand the needs of customers better (*SAPPHO 1974*).
- They use more external sources and experts (*SAPPHO 1974*).
- Project responsibility lies higher in the hierarchy and project managers should have more competencies (*SAPPHO 1974*).
- When innovations fail this is mostly due to non-technical reasons (*Mansfield, Gerstenfeld 1970s*).

CHARACTERISTICS OF SUCCESSFUL INNOVATING COMPANIES - 1

- ❑ Systematic collection of all impulses that could lead to innovation
- ❑ Creativity of employees
- ❑ Ability to evaluate the possibility of the innovation idea
- ❑ Good team work
- ❑ Project-based approach and ability to manage projects

CHARACTERISTICS OF SUCCESSFUL INNOVATING COMPANIES - 2

- ❑ Cooperation with external experts (universities, research laboratories...)
- ❑ Proper rate of risk-taking
- ❑ Employees' motivation (the employees are willing to improve the product and the operation of the whole company)
- ❑ Continued education of employees
- ❑ Ability to finance the innovation activities

Success Factors of Innovation Performance

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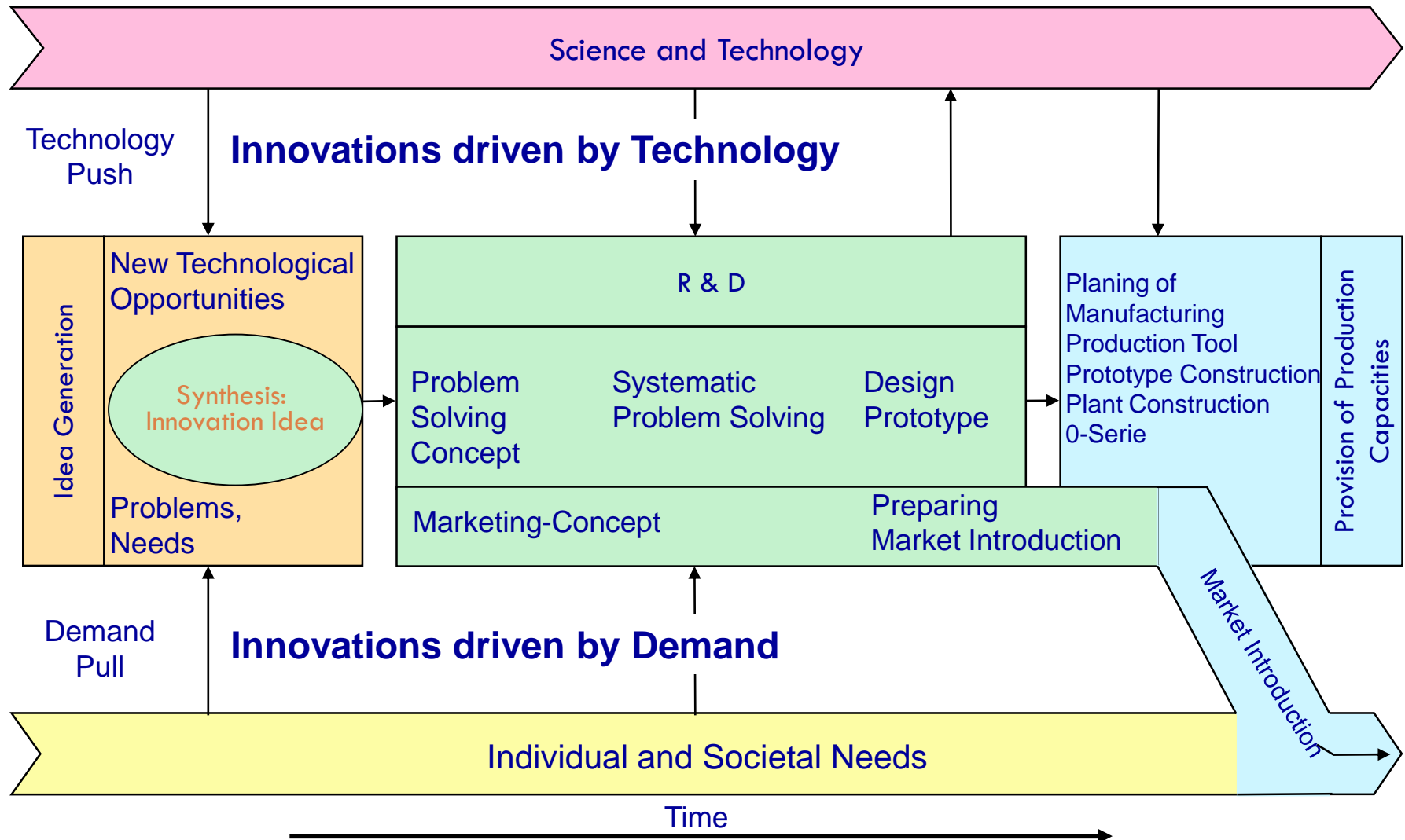
1. Efficient innovation process implemented
2. Clear and communicated innovation strategy
3. Sufficient resources for innovations
4. Commitment of higher management for innovations
5. Entrepreneurial climate for innovations
6. Strategic focus and realization of synergies
7. Cross-functional high-performance teams

Source: Cooper, Kleinschmidt 1995

III. Basic Concepts of Innovation Management

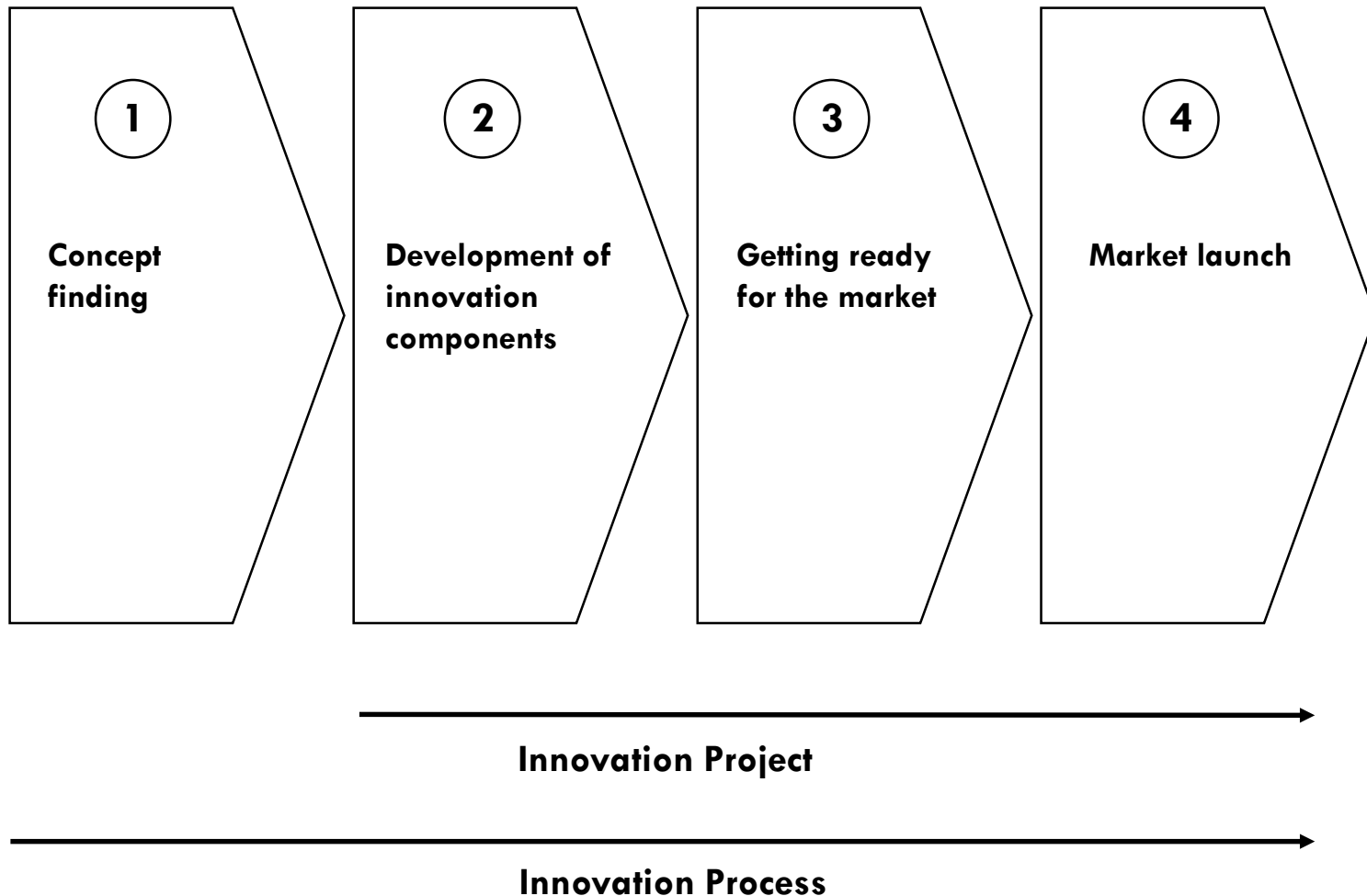
The Process of Technological Innovation

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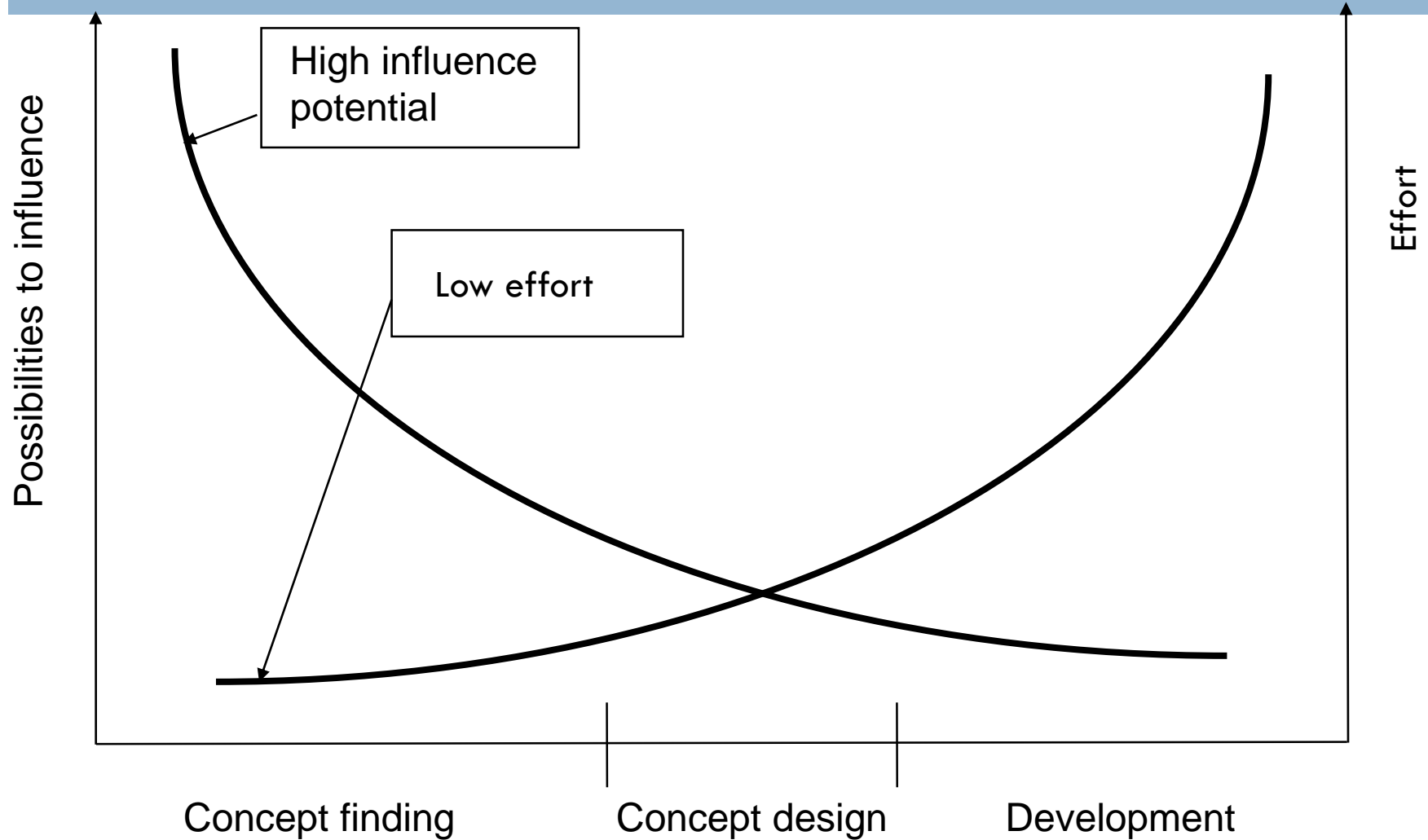
The Phases of the Innovation Process

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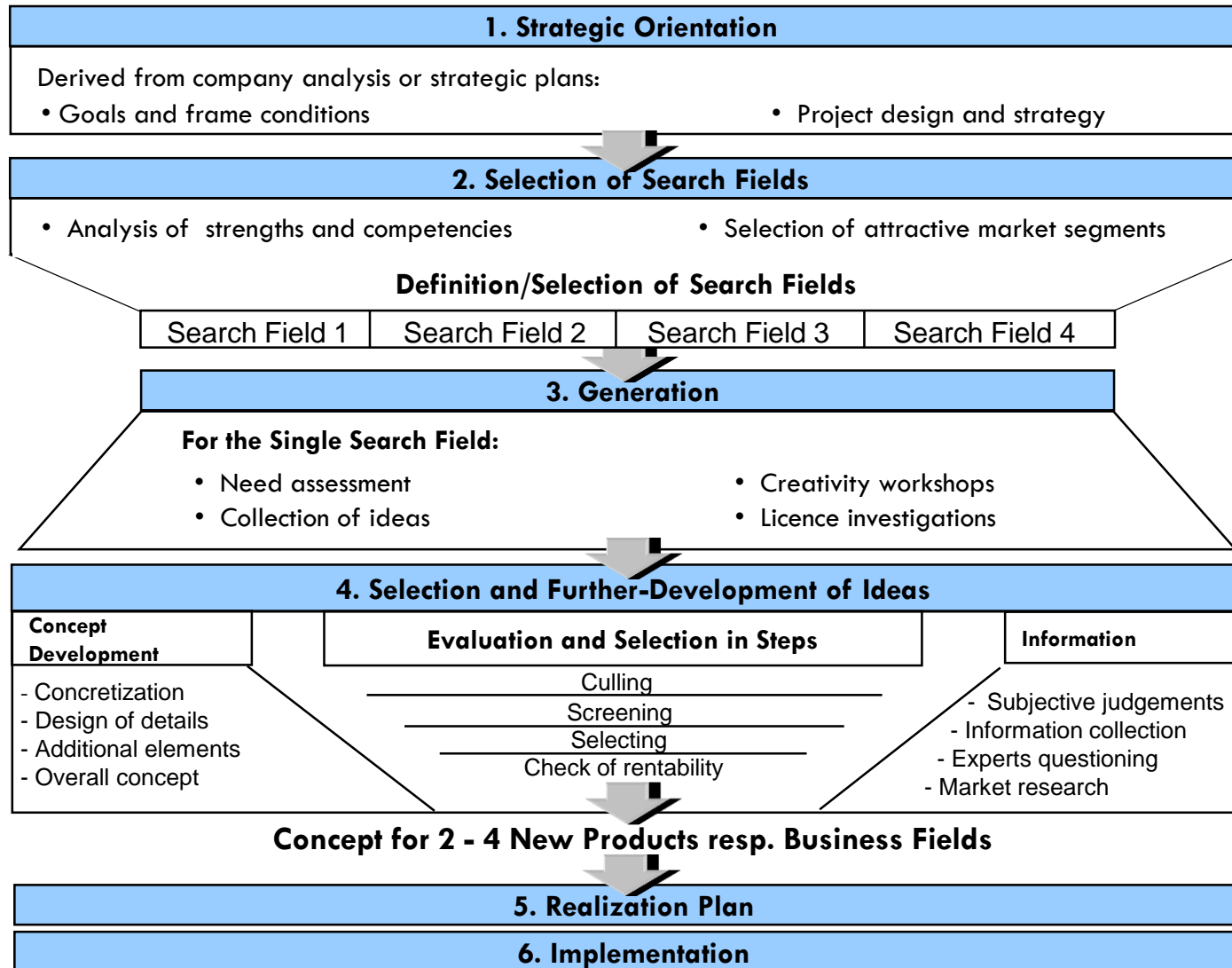
Frontloading: Intensive Analysis and Concept Development in the „Prephase“

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Innovation Planning Process

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The Concept Finding Phase

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The prephase of the innovation process starts with „Strategic Orientation“ and lasts till the decision to start a project of technical development:

= concept finding phase

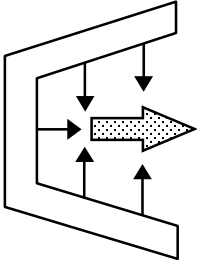

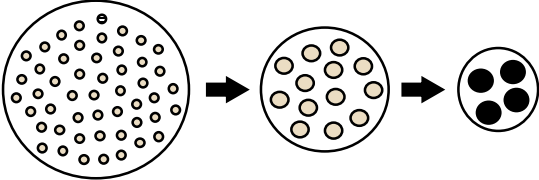
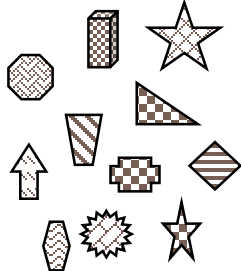
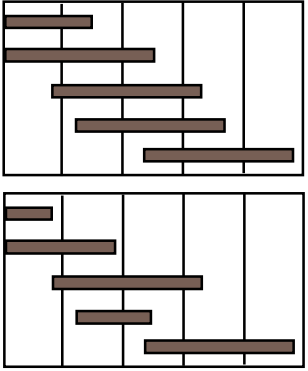
= fuzzy front end

= predevelopment phase

Range, volume and professionalism of these activities and structuredness of procedures in the concept finding phase are success factors for innovations.

Concept Finding Phase of the Innovation Process

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Strategic Orientation	Idea Generation	Idea Selection and Conceptual Further-Development	Pre-Projects	Projects
				
Technology Monitoring Technology Roadmaps Scenarios Laying down directions and fields for innovation	Need assessment Creativity-workshops Creative climate of the company	Screening Evaluation criteria Idea assessment Idea further-development Idea management system	Inquiries Analyses of requirements Quality Function Deployment (QFD) Specifications	Project management Multi-project-management R&D-controlling

IV. Strategic Orientation; Scenario Technique

Strategic Orientation

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- Innovations are an important part of a company's strategy.
- That means: Strategic orientation is necessary for defining and conceptualizing innovation.
- **Strategic planning** is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy, including its capital and people.
- The outcome is normally a **strategic plan**, which is used as guidance to define functional and divisional plans, including Technology, Marketing, etc.

Methods Supporting Strategic Orientation

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- Long-range demand trends
- Competition analysis
- SWOT-Analysis
- Gap-Analysis
- Product-market-matrix (Ansoff-matrix)
- Search-field matrices
- Scenarios

Competitor Analysis

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- **Competitor analysis** in marketing and strategic management is an assessment of the strengths and weaknesses of current and potential competitors.
- This analysis provides both an offensive and defensive strategic context to identify opportunities and threats.
- Competitor analysis is an essential component of corporate strategy.
- It is argued that most firms do not conduct this type of analysis systematically enough. Instead, many enterprises operate on what is called “informal impressions, conjectures, and intuition gained through the tidbits of information about competitors every manager continually receives.”
- As a result, traditional environmental scanning places many firms at risk of **dangerous competitive blindspots** due to a lack of robust competitor analysis.

Competitor array

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One common and useful technique is constructing a *competitor array*. The steps include:

- Define your industry - scope and nature of the industry
- Determine who your competitors are
- Determine who your customers are and what benefits they expect
- Determine what the key success factors are in your industry
- Rank the key success factors by giving each one a weighting - The sum of all the weightings must add up to one.
- Rate each competitor on each of the key success factors
- Multiply each cell in the matrix by the factor weighting.

Competitor Analysis

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Key Industry Success Factors	Weighting	Competitor #1 rating	Competitor #1 weighted	Competitor #2 rating	Competitor #2 weighted
1 - Extensive distribution	.4	6	2.4	3	1.2
2 - Customer focus	.3	4	1.2	5	1.5
3 - Economies of scale	.2	3	.6	3	.6
4 - Product innovation	.1	7	.7	4	.4
Totals	1.0	20	4.9	15	3.7

SWOT ANALYSIS

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	Helpful to achieving the objective	Harmful to achieving the objective
Internal origin (attributes of the organization)	S Strengths	W Weaknesses
External origin (attributes of the environment)	O Opportunities	T Threats

SWOT Analysis is a strategic planning tool used to evaluate the **Strengths**, **Weaknesses**, **Opportunities**, and **Threats** involved in a project or in a business venture or in any other situation of an organization or individual requiring a decision in pursuit of an objective. It involves monitoring the marketing environment internal and external to the organization or individual.

The technique is credited to Albert Humphrey, who led a research project at Stanford University in the 1960s and 1970s using data from the Fortune 500 companies.

- **Weaknesses:** are characteristics that place the team at a disadvantage relative to others
- **Opportunities:** elements that the project could exploit to its advantage
- **Threats:** elements in the environment that could cause trouble for the business or project
- **Strengths:** characteristics of the business or project that give it an advantage over others

SWOT ANALYSIS

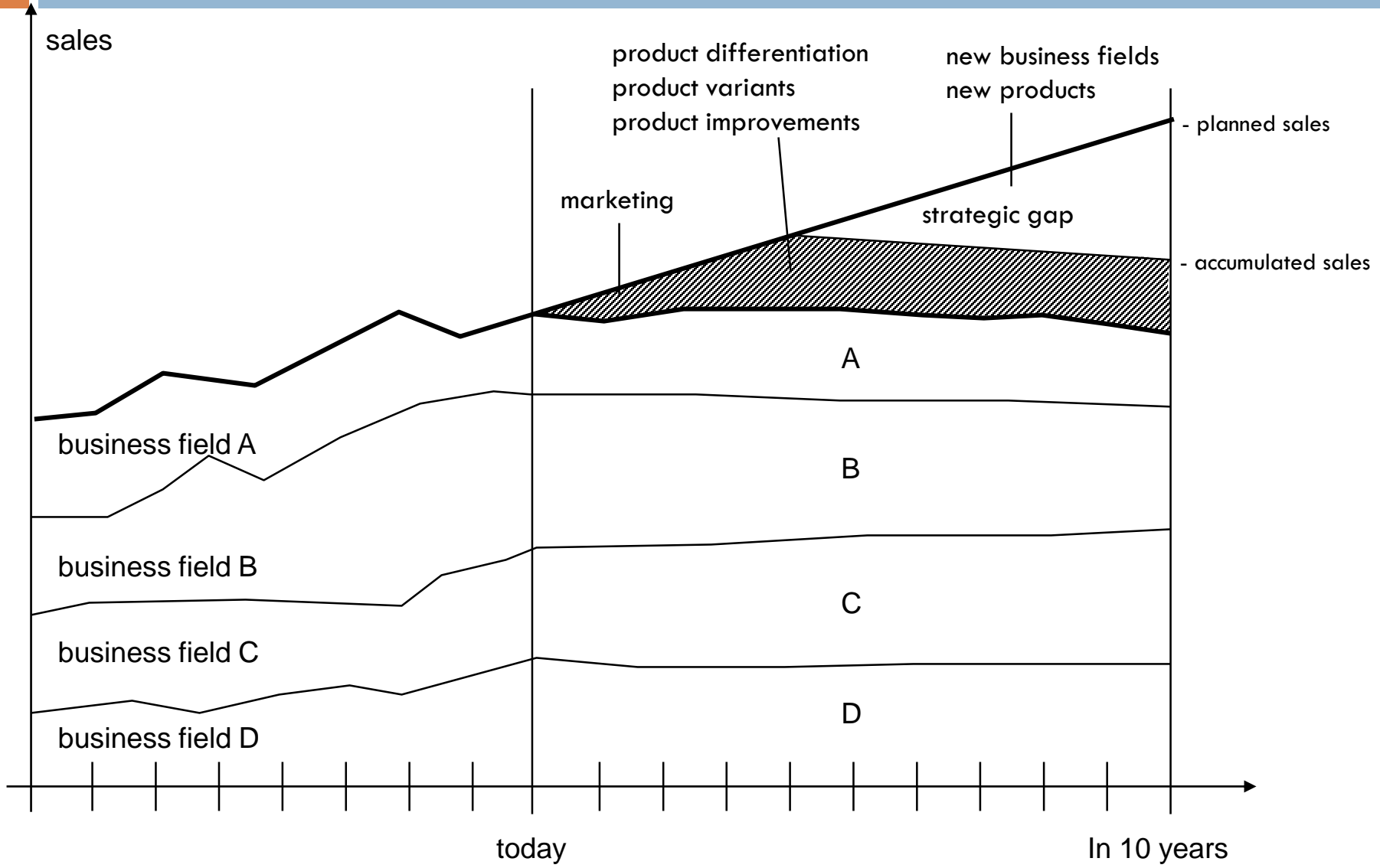
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- Below is an example SWOT analysis of a market position of a small management consultancy with specialism in HRM.

Strengths	Weaknesses	Opportunities	Threats
Reputation in marketplace	Shortage of consultants at operating level rather than partner level	Well established position with a well defined market niche	Large consultancies operating at a minor level
Expertise at partner level in HRM consultancy	Unable to deal with multi-disciplinary assignments because of size or lack of ability	Identified market for consultancy in areas other than HRM	Other small consultancies looking to invade the marketplace

Strategic Gap Analysis

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Product-Market-Matrix (Ansoff-matrix)

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Markets Products	Present customer groups	New customer groups
Present product program	Market penetration P:75%	Market development P:25%
New products	Product development P:50%	Diversification P:5%

Source: Booz, Allen & Hamilton 1982

P = probability of success

Product-Market-Matrix (Ansoff-matrix)

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Ansoff, Igor, Strategies for Diversification, *Harvard Business Review*, Vol. 35, Sep-Oct 1957, pp.113-124

- **Market Penetration** (existing markets, existing products): Market penetration occurs when a company enters/penetrates a market with current products. The best way to achieve this is by gaining competitors' customers (part of their market share). Other ways include attracting non-users of your product or convincing current clients to use more of your product/service, with advertising or other promotions.
- **Product Development** (existing markets, new products): A firm with a market for its current products might embark on a strategy of developing other products catering to the same market. *For example, McDonalds is always within the fast-food industry, but frequently markets new burgers.* Frequently, when a firm creates new products, it can gain new customers for these products. Hence, new product development can be a crucial business development strategy for firms to stay competitive.
- **Market Development** (new markets, existing products): An established product in the marketplace can be tweaked or targeted to a different customer segment, as a strategy to earn more revenue for the firm. *For example, Lucozade (energy drink) was first marketed for sick children and then rebranded to target athletes. It is a good example developing a new market for an existing product.*
- **Diversification** (new markets, new products): *Virgin Cola, Virgin Megastores, Virgin Airlines, Virgin Telecommunications are examples of new products created by the Virgin Group of UK, to leverage the Virgin brand. This resulted in the company entering new markets where it had no presence before.*

Search-Field-Matrix

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Technological Strengths → ↓ Attractive Market Segments	• • •	Sensor technology	System simulation	Precision manufacturing	• • •	• • •	
• • •							
Security systems							
Office automation							
CIM							
Waste treatment							
Maintenance							
• • •							

The search-field-matrix supports the process of identifying new business fields. It is formed by crossing the technological or functional strengths with attractive market segments in a matrix.

Search-Field-Matrix

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Attractive Market Segments	Technological Strengths						
	• • •	Sensor technology	System simulation	Precision manufacturing	• • •	• • •	
• • •							
Security systems		a		c			
Office automation							
CIM		b	b				
Waste treatment		a		c			
Maintenance		a	d				
• • •							

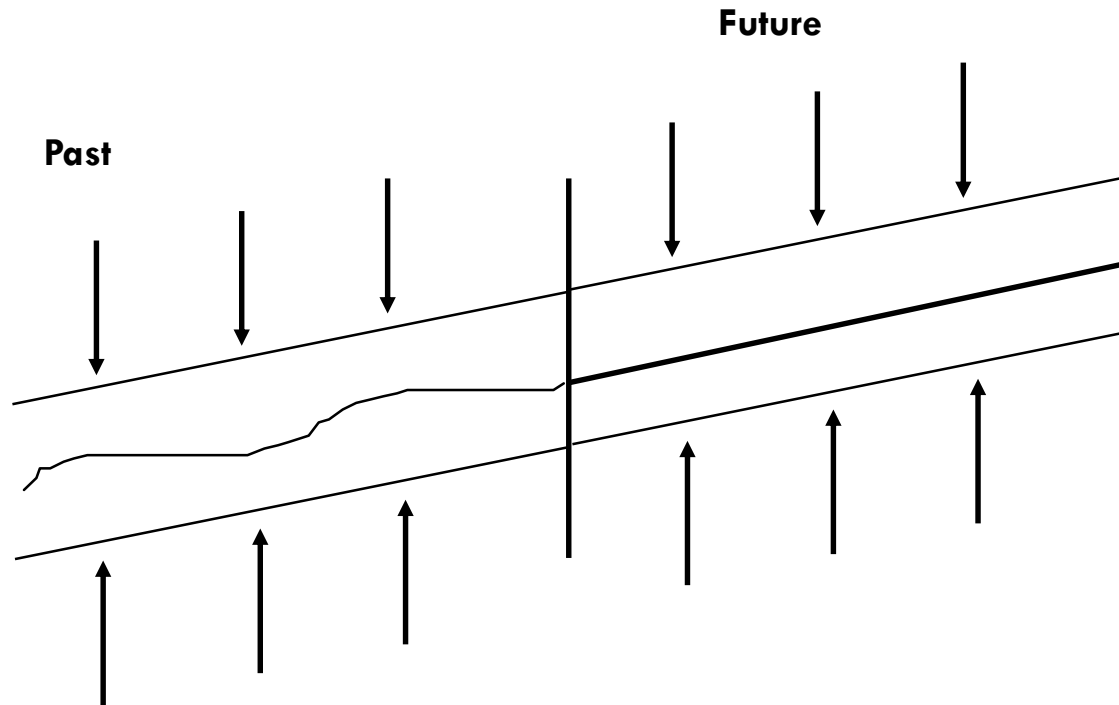
A search-field is formed by one (or more) technology-market-combination(s). It is supposed to be promising as it combines company strengths with attractive markets. A search-field is a potential new business line.

Search-field a: advanced warning systems
 Search-field b: flexible manufacturing systems
 Search-field c: special locking systems
 Search-field d: forecasting machine lifetimes

Forecasts in a stable Environment

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Conventional forecast methods assume that correlations between the impacting factors (independent variables) and the topic factors (dependent variables) detected for the past are also valid for the future.



Forecasts in a Turbulent Environment

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When the influencing environment on a topic is changing, forecasts cannot be based on correlations valid for the past. The influencing factors of the future have to be identified and characterized with respect to strength and direction; then the impacts on the topic have to be deducted.

