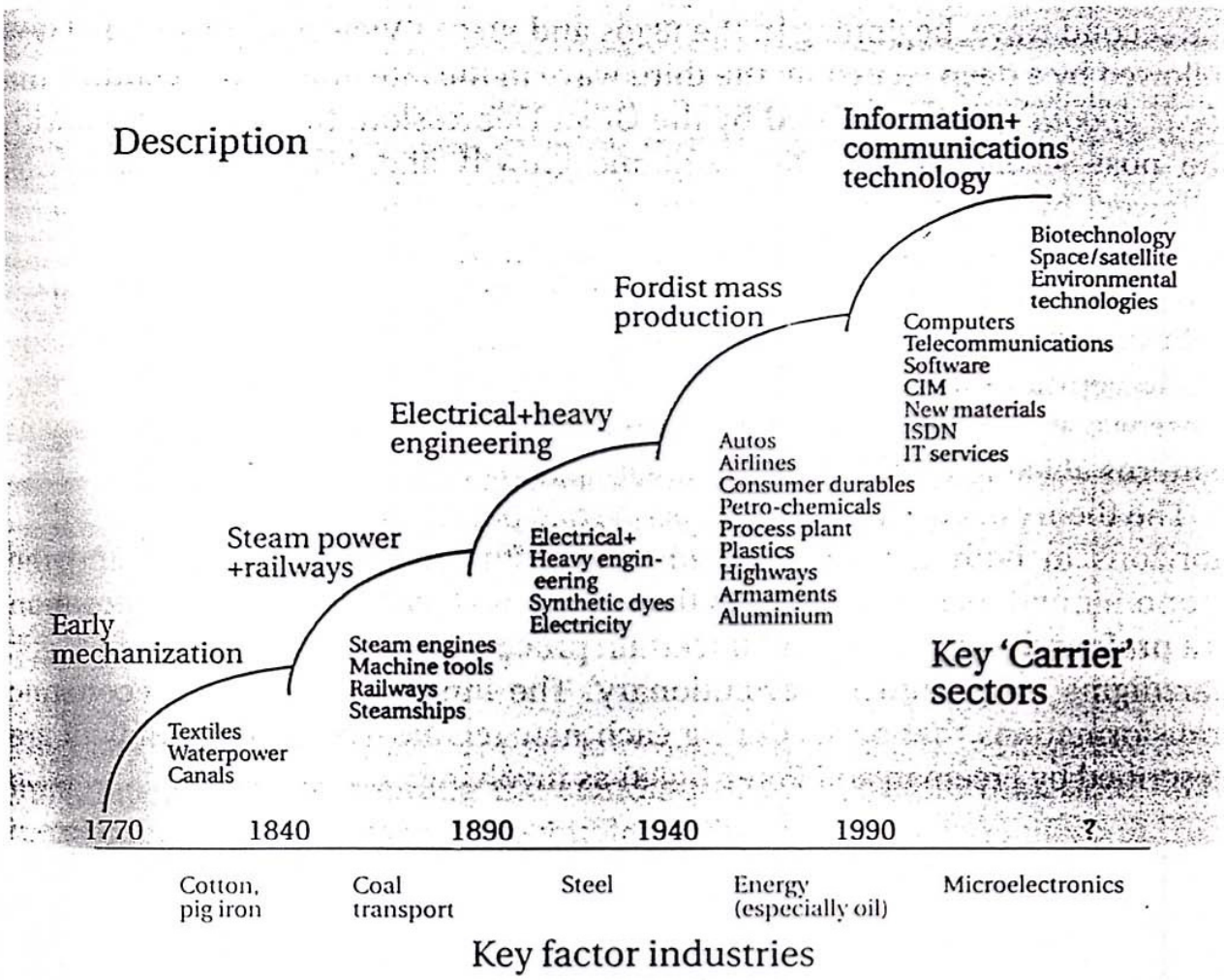
CAPÍTULO 2

PADRÕES DE MUDANÇA NAS TECNOLOGIAS E NOS MERCADOS

2.1. A CURVA S: EVOLUÇÃO E ADOPÇÃO DE TECNOLOGIAS



Waves of technological development, 1770–1990

Fonte: Dodgson (2000)

Box 2.1. ***Major features of industry, 1950s–1990s***

1950s and 1960s 'Convergence & aggregation' (the 4th wave?)	1990s onwards 'Divergence & disaggregation' (the 5th wave?)
Dominance of large-scale, vertically integrated firms	Decentralized, network-based, flexible firms
Mass production systems, dedicated machinery	Lean production systems, flexible machinery
Mass, stable, standardized markets	Niche, rapidly changing markets, customer sovereignty
Centralized management	Decentralized management
Monopoly and oligopoly	Intense competition
Strongly directive government, state-owned utilities and telecoms, protectionist industry policies, tri-partisanship between government, unions and employers	Non-interventionism, privatization and deregulation, government as regulator not provider, free-trade policies
Strong role of trade unions: from policy-making to demarcation decisions	Declining power of unions, employers' concern for 'employees', multiskilling
Separation of management and ownership	Share-owning incentives and management buy-outs
Full-time secure employment	Significant part-time, contractual employment
Some internationalization of industrial production	Globalization of business
Nationalism in trade and industry policies	Pan-nationalism in trade and industry (EU, NAFTA, APEC)
Predominance of Western models of management	Integration of international best practice in models of management
Science and research undertaken in universities and large firms	Substantial increase in scale and scope of science and research and diversity in provision ('the new production of knowledge')
Technology development a feature of individual firms; not-invented-here syndrome; anti-trust legislation	Technological collaboration a feature of government policies and corporate strategies
Clear distinction between manufacturing, services, and resources sectors	Blurred boundaries in the knowledge economy
Competitiveness derived from tangible assets: capital, land, and labour	Competitiveness derived from intangible assets: skills, capabilities, creativity.

Fonte: Dodgson (2000)

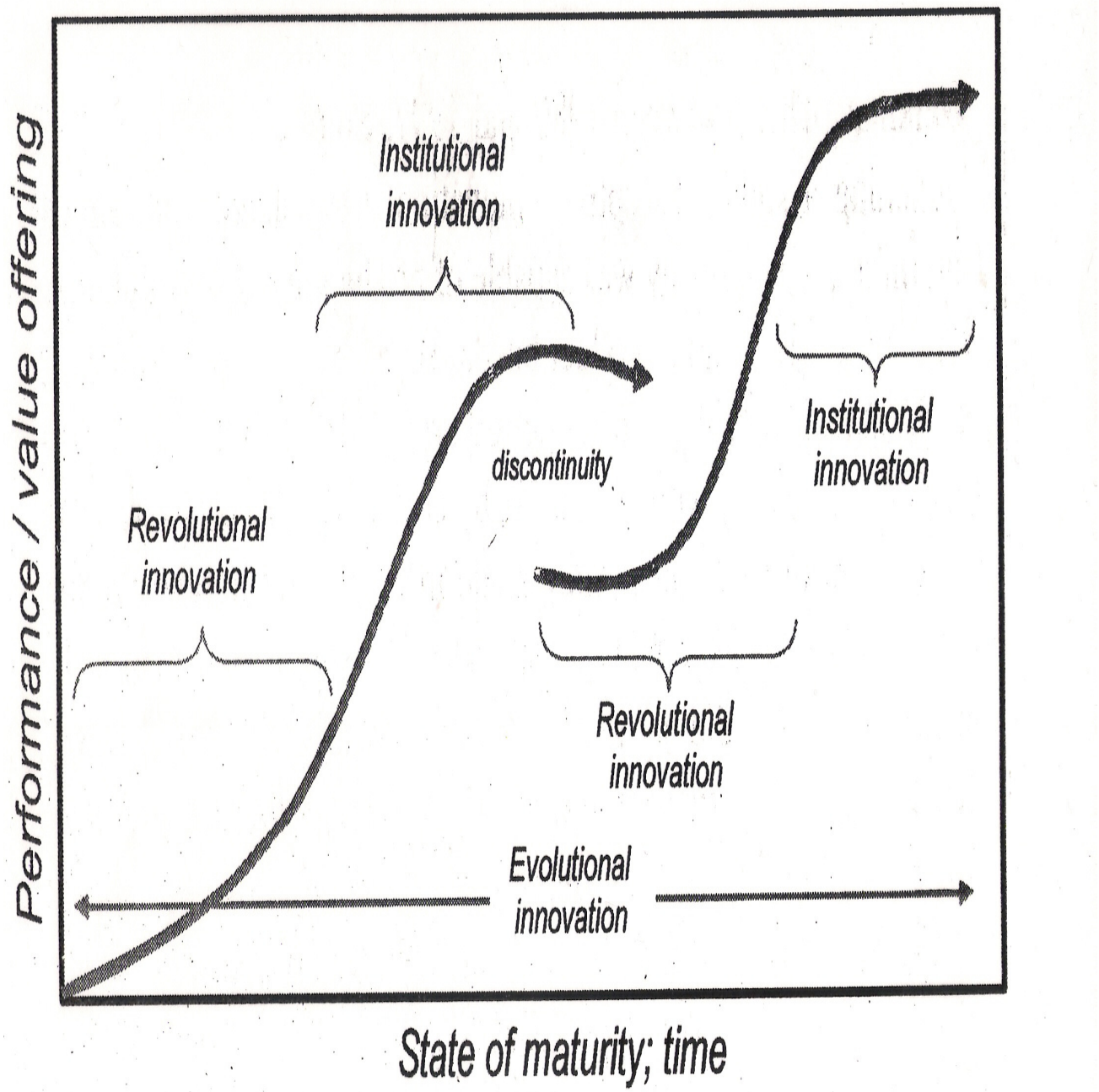
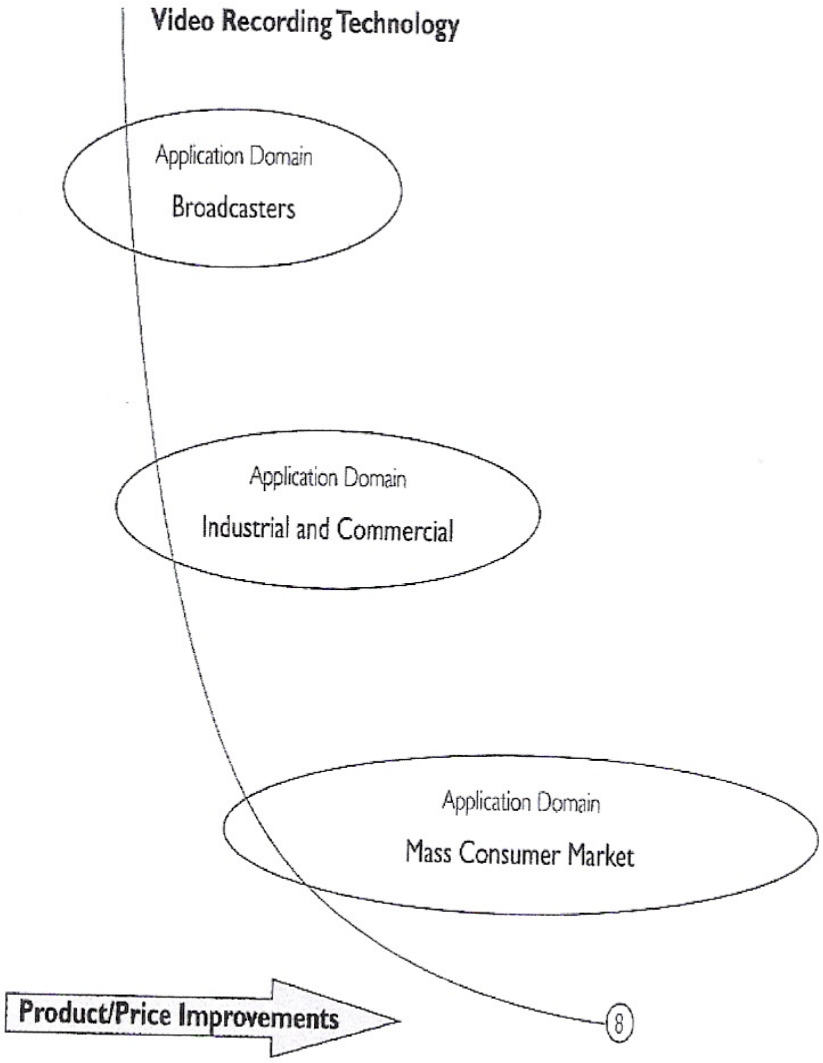


Figure 6.3 Innovation cycles and management implications for their strategic management

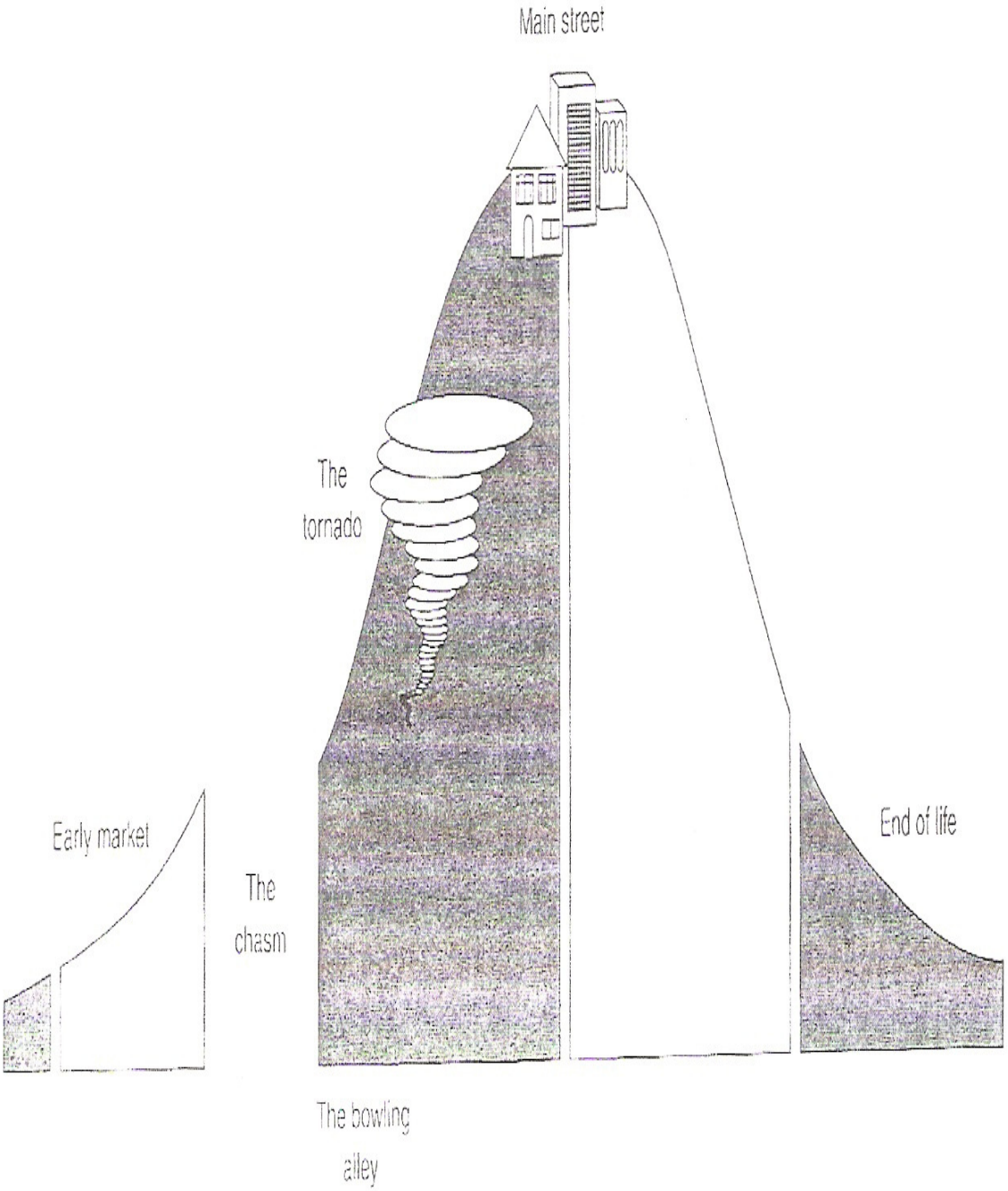
Fonte: Birchall & Tovstiga (2005)

FIGURE 3. Technology Evolution and Penetration of Application Domains by Video Recorders



Fonte: Ron Adner e Daniel Levinthal (2003), 'The emergence of emerging technologies', California Management Review, Vol. 45, n.º1, pp. 50-66.

EXHIBIT 4 The Landscape of the Technology Adoption Life Cycle.



Fonte: Moore (2000)

2.2. TRAJECTÓRIAS TECNOLÓGICAS

TRAJECTÓRIAS TECNOLÓGICAS

TRAJECTÓRIA TECNOLÓGICA é “a actividade de progresso tecnológico através dos trade-offs económios e tecnológicos definidos por um paradigma*” (Dosi e Orsenigo, 1988)

As trajectórias tecnológicas definem caminhos possíveis de evolução tecnológica

As estratégias de inovação empresarial são condicionadas pelos caminhos percorridos, nomeadamente em resultado de 2 tipos de restrições:

- Estado actual do conhecimento tecnológico
- Competências acumuladas (Base de Conhecimentos)

*Um paradigma tecnológico incorpora um conjunto de propriedades técnicas, heurísticas de solução de problemas e experiência acumulada. Cada paradigma envolve uma definição dos problemas a abordar, das tarefas a desempenhar, do padrão de investigação, da tecnologia material a ser utilizada, e dos tipos de artefactos básicos a serem desenvolvidos e melhorados (Dosi e Orsenigo, 1988: 16)

Table 5.1 Five major technological trajectories

	Supplier-dominated	Scale-intensive	Information-intensive	Science-based	Specialized suppliers
Typical core sectors	Agriculture Services Traditional manufacture	Bulk materials Automobiles Civil Engineering	Finance Retailing Publishing Travel	Electronics Chemicals	Machinery Instruments Software
Main sources of technology	Suppliers Production learning	Production engineering Production learning Design offices Specialised suppliers	Software and systems departments Specialised suppliers	R&D Basic research	Design Advanced users
Main tasks of technology strategy	Use technology from elsewhere to strengthen other competitive advantages	Incremental integration of changes in complex systems Diffusion of best design and production practice	Design and operation of complex information processing systems Development of related products	Exploit basic science Development of related products Obtain complementary assets Redraw divisional boundaries	Monitor advanced user needs Integrate new technology incrementally

2.3. DESCONTINUIDADES TECNOLÓGICAS:

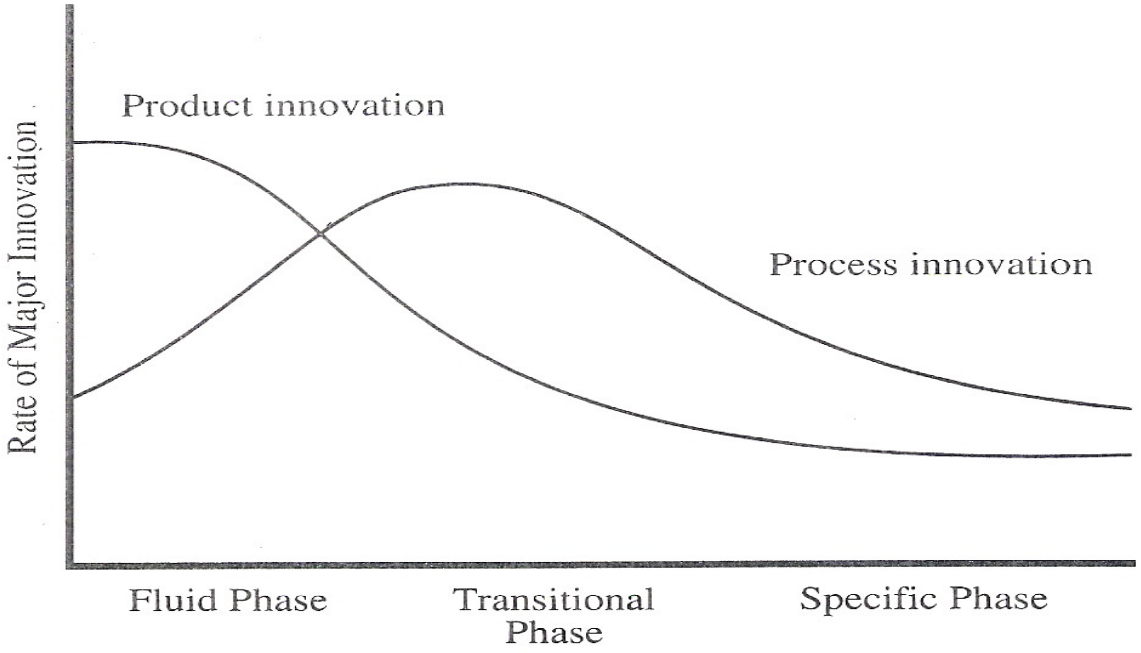
DOS NOVOS PARADIGMAS ÀS CONCEPÇÕES DOMINANTES E ÀS PLATAFORMAS

FIGURE 8–2. **Waves of Innovation and Change**

Industry	Waves of Innovation
Typewriters	• manual • electric • word processors • personal computers with word-processing software
Ice and refrigeration	• harvested ice • machine-made ice • electromechanical refrigeration • asceptic packaging
Lighting	• candles and oil lamps • distilled gas • incandescent electric lamps • fluorescent lamps
Plate glassmaking	• crown glass • cast glass • float glass
Photography	• daguerrotype • tin type • glass plates • dry plates • celluloid roll film • electronic imaging

Fonte: Utterback (1994)

IGURE 4–3. **The Dynamics of Innovation**



Product	From high variety, to dominant design, to incremental innovation on standardized products
Process	Manufacturing progresses from heavy reliance on skilled labor and general-purpose equipment to specialized equipment tended by low-skilled labor
Organization	From entrepreneurial *organic* firm to hierarchical *mechanistic* firm with defined tasks and procedures and few rewards for radical innovation
Market	From fragmented and unstable with diverse products and rapid feedback to commodity-like with largely undifferentiated products
Competition	From many small firms with unique products to an oligopoly of firms with similar products

FIGURE 4–4. **Significant Characteristics in the Three Phases of Industrial Innovation**

	Fluid phase	Transitional phase	Specific phase
Innovation	Frequent major product changes	Major process changes required by rising demand	Incremental for product and with cumulative improvements in productivity and quality
Source of innovation	Industry pioneers; product users	Manufacturers; users	Often suppliers
Products	Diverse designs, often customized	At least one product design, stable enough to have significant production volume	Mostly undifferentiated, standard products
Production processes	Flexible and inefficient, major changes easily accommodated	Becoming more rigid, with changes occurring in major steps	Efficient, capital intensive, and rigid; cost of change high
R&D	Focus unspecified because of high degree of technical uncertainty	Focus on specific product features once dominant design emerges	Focus on incremental product technologies; emphasis on process technology
Equipment	General-purpose, requiring skilled labor	Some subprocesses automated, creating islands of automation	Special-purpose, mostly automatic, with labor focused on tending and monitoring equipment
Plant	Small-scale, located near user or source of innovation	General-purpose with specialized sections	Large-scale, highly specific to particular products
Cost of process change	Low	Moderate	High
Competitors	Few, but growing in numbers with widely fluctuating market shares	Many, but declining in numbers after emergence of dominant design	Few; classic oligopoly with stable market shares
Basis of competition	Functional product performance	Product variation; fitness for use	Price
Organizational control	Informal and entrepreneurial	Through project and task groups	Structure, rules, and goals
Vulnerabilities of industry leaders	To imitators, and patent challenges; to successful product breakthroughs	To more efficient and higher-quality producers	To technological innovations that present superior product substitutes

FIGURE 9–3. **Competence-Destroying Product and Process Discontinuities**

Assembled/ Substitutes Photolithographic aligners (A) Radial tires (A) Diesel locomotive (A) Ballpoint pen (A) Jet aircraft engine (A) Refrigerators (A) Incandescent lamps (A) All-steel automobile (A)	**Assembled/ Market Broadening** Solid-state minicomputers (N) Integrated circuits minis (A) Transistor (A) Electronic calculator (A) Tufted carpet (A) Massively parallel supercomputers (A)
Nonassembled/ Substitutes Suspended preheating (D) Glass drawing (D) Continuous forming (D) Float glass process (D) Basic oxygen steel (A) Direct reduction of iron (A) Optical fibers (A)	**Nonassembled/ Broadening** Rotary kiln (A) Container machine (N) Owens process (A) Vinyl (E) Celluloid film (A) Manufactured ice (A) Synthetic gems (A) Small liquid oxygen plants (A)

(A) denotes an innovation originated predominantly from a new entrant or attacker; (D) denotes an innovation originated predominantly from an established firm or defender; (N) denotes that the origin of the innovation has not been classified, mainly cases in which no prior industry existed.

Fonte: Utterback (1994)

FIGURE 9–4. **Competence-Enhancing Product and Process Discontinuities**

Assembled/ Substitutes Nuclear steam supply (A) Air-cooled engines (D) Nylon tire cord (N) Hydrogen-cooled generator (D) Fluorescent lamps (N)	**Assembled/ Market Broadening** Semiconductor memory (D) Electric typewriter (A)
Nonassembled/ Substitutes Computerized kiln (D) Edison long kiln (D) Machine cylinder glass (D) Gob-fed bottle machine (D) Double gob machine (D) Continuous casting (D) Continuous drawn copper (D) Oriented strand board (D)	**Nonassembled/ Broadening** Integrated circuits (A) Continuous vertical kiln (A)

(A) denotes an innovation originated predominantly from a new entrant or attacker;
(D) denotes an innovation originated predominantly from an established firm or defender;
(N) denotes that the origin of the innovation has not been classified, mainly cases in which no prior industry existed.

Fonte: Utterback (1994)

FIGURE 3-3

Sources of Complexity in the Empirical Environments

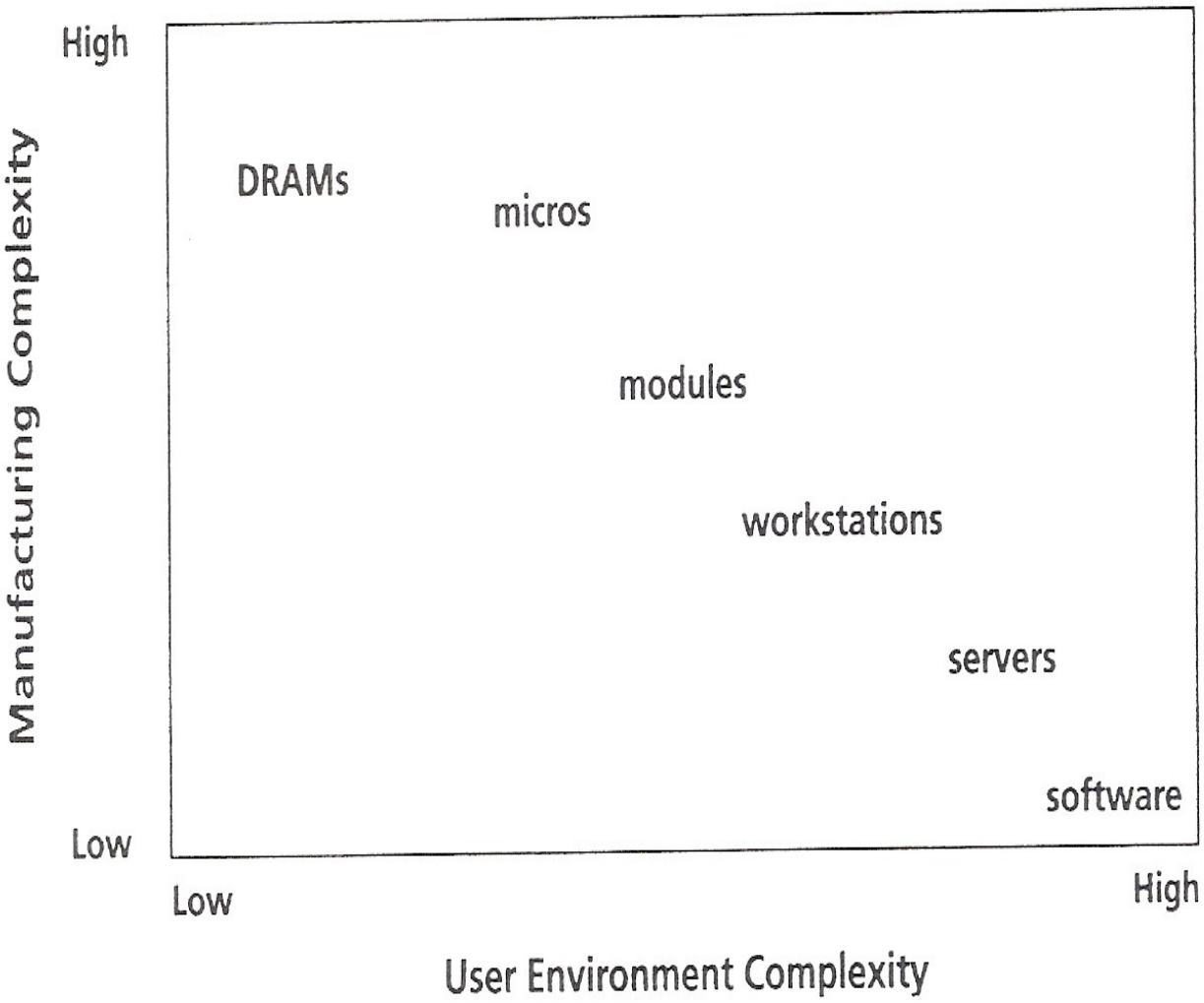
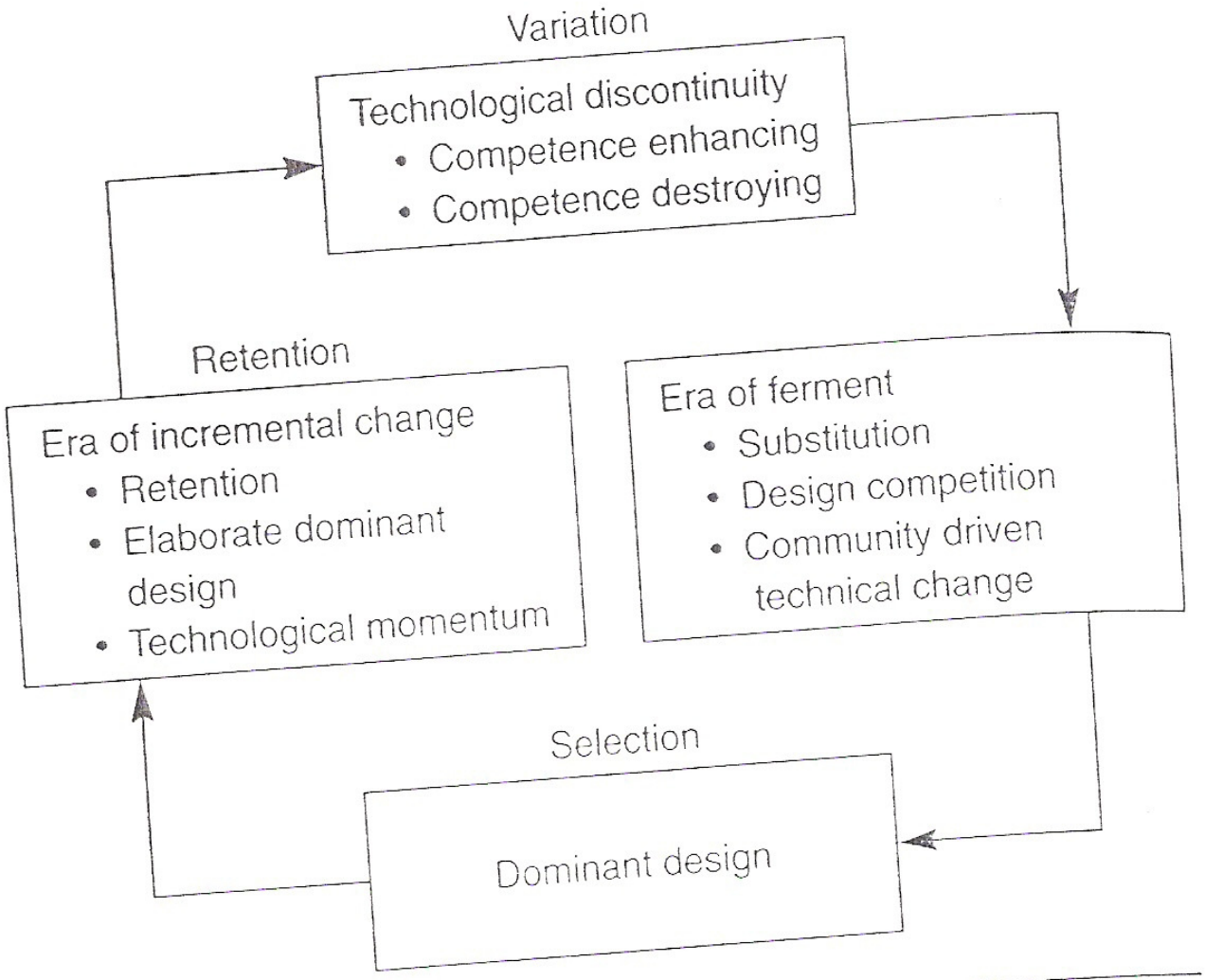


EXHIBIT 1 A Technology Cycle



PLATAFORMAS:

- A PLATAFORMA
  como base orientadora do desenvolvimento de novas aplicações/modelos e como base de redução de custos de produção

- PLATAFORMAS E DESENHOS ROBUSTOS

  Exemplos

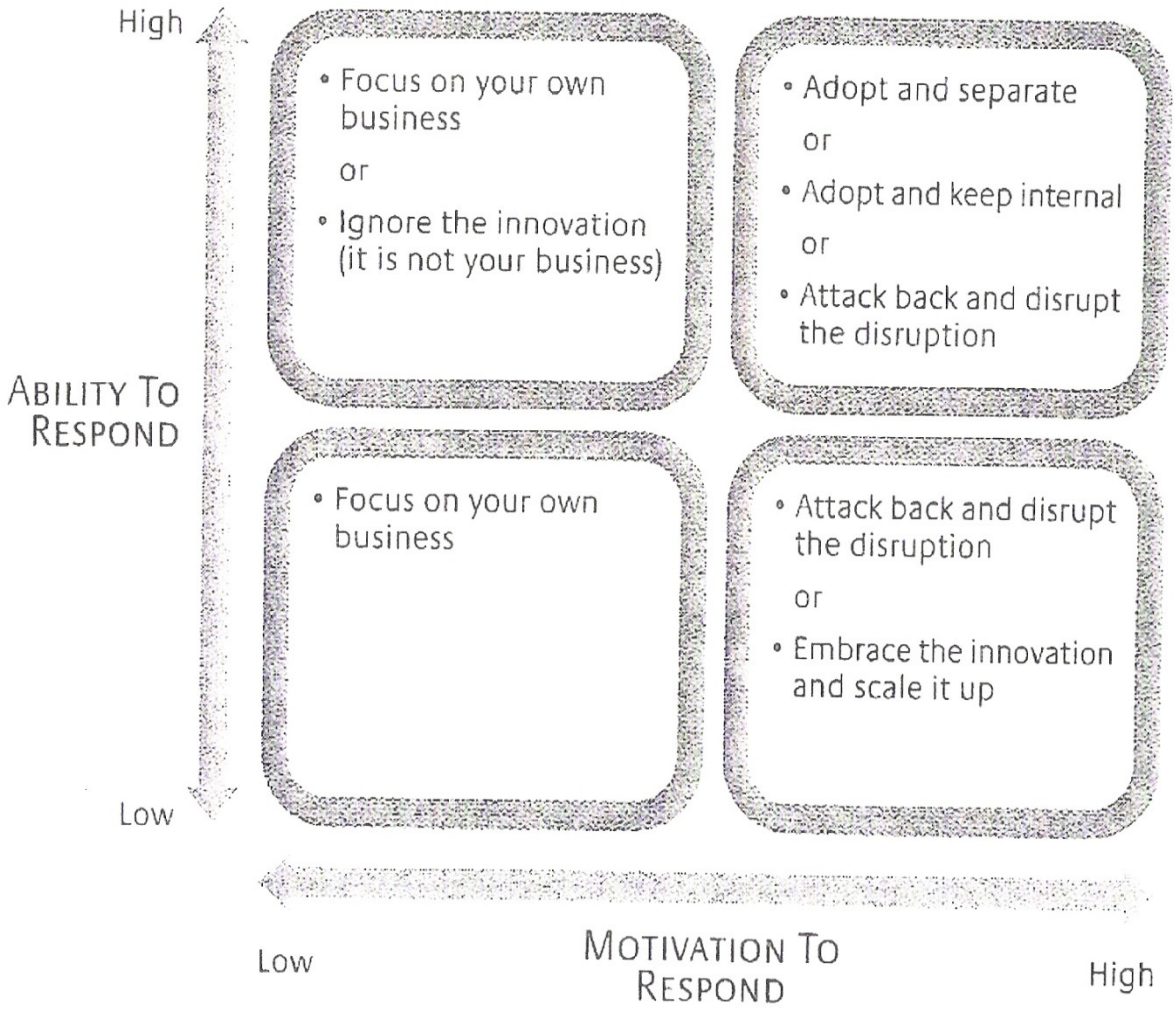
SONY: 200 modelos diferentes do Walkman baseados em 3 plataformas

INDÚSTRIA AUTOMÓVEL: A plataforma como base de concepção e produção de diversos modelos

EXPLORATION EM EMPRESAS INCUMBENTES

- Como conciliar *Exploring* e *Exploiting* em Empresas Estabelecidas?
- Será possível ter o melhor de 2 mundos?
- *Internal Corporate Venturing* como Solução?
- Duas perspectivas: Charitou & Markides (2003); e Lerner (2012)

CHARITOU & MARKIDES (2003)



Fonte: Constantinos Charitou e Constantinos Markides (2003), 'Response to disruptive strategic innovation', Sloan Management Review, Winter, p. 55-63

LERNER (2012): CONDIÇÕES PARA *CORPORATE VENTURING*

- *Corporate venturing*: Trazer o capital de risco para dentro da empresa
- Vantagens: Resposta rápida à mudança tecnológica (acesso a competências); induzir mudança no sentido desejado (caso da Intel); alavancar fundos externos; e flexibilidade.
- Problemas: Indefinição de objectivos; falta de consistência e sustentabilidade; inércia; e domínio da estrutura estabelecida.

Fonte: Josh Lerner (2012), *The Architecture of Innovation*

ESTRATÉGIAS DE COMERCIALIZAÇÃO DA TECNOLOGIA: DE TEECE (1986) A GANS & STERN (2003)

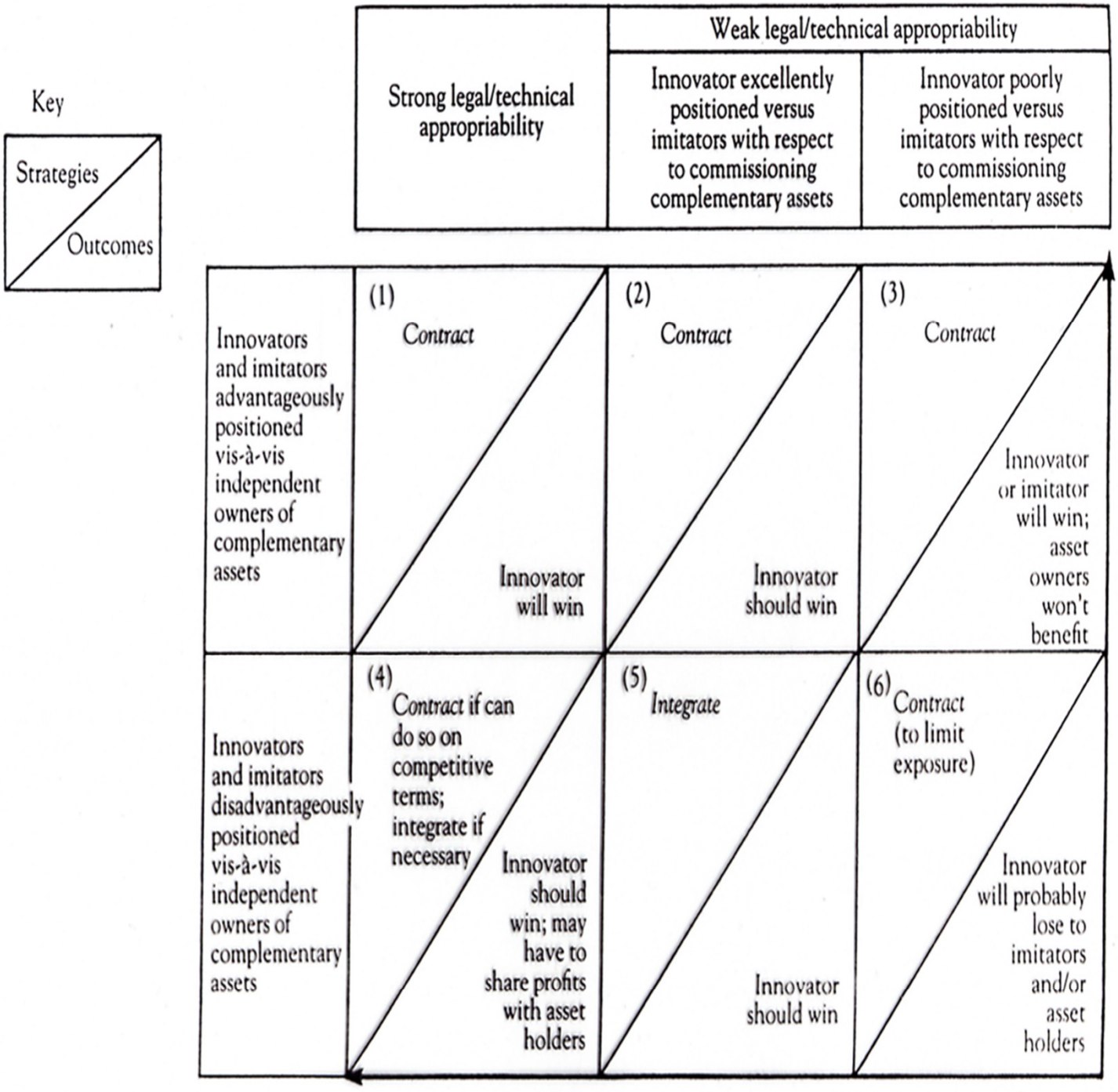


Figure 9–11. Contract and Integration Strategies and Outcomes for Innovators: Specialized Asset Case.

Fonte: Teece (1988)

Table 2
The impact of the commercialization environment of strategy and competitive

	Overturns Incumbent Asset Value		Reinforces Incumbent Complementary Assets	
Non-Excludable Technology	**ATTACKER'S ADVANTAGE**		**REPUTATION-BASED IDEAS TRADING**	
	Start-Up Strategies • Few opportunities for effective contracting • Opportunity to exploit technical leadership to capture market leadership • Performance depends on 'stealth' product market entry	*Incumbent Strategies* • Competitive advantage in products not competencies • Sustained market position requires continual reinvention and preemption • Constant monitoring and tight integration of value chain	*Start-Up Strategies* • May be few opportunities for contracting • Product market entry risky due to high costs and imitation risk • Performance depends on existence of incumbent commitment to ideas trading	*Incumbent Strategies* • Competitive advantages in both competencies and products • Opportunity for sustainable positioning by developing reputation for ideas trading • Often results in internal R&D focus
	Expected Competitive Dynamics • Market leadership determined by technological leadership • Established firms face competition from entrants in 'niche' markets • Start-ups will make new investments in complementary assets as part of establishing a novel value proposition		*Expected Competitive Dynamics* • Relative market and technological stability • Established firms face few competitive threats from start-up firms • Start-ups may play a greater role if incumbent chooses reputation strategy	
Excludable Technology	**GREENFIELD COMPETITION**		**IDEAS FACTORY**	
	Start-Up Strategies • Ideal opportunity to choose between contracting and product market entry • Opportunity to use temporary monopoly power to build future positioning • Performance depends on strength of technological competition	*Incumbent Strategies* • Competitive advantage is based on products not competencies • Sustained market position requires continual innovation and ceding profits to upstream providers • Develop reputation from strong innovative performance	*Start-Up Strategies* • Contracting with established firms • Product market entry is very costly and perhaps impossible • Performance depends on securing bargaining power	*Incumbent Strategies* • Competitive advantage is in competencies not products • Sustained market position requires securing start-up partners • Find balance between internal development and use of external start-up innovation
	Expected Competitive Dynamics • Technological leadership drives rent distribution along the value chain • Start-ups and incumbents compete for technological priority • Substantial investments in new platforms and complementary assets		*Expected Competitive Dynamics* • Frequent changes in technological but not market leadership • Start-ups compete with one another for priority in negotiations with incumbents • Start-up innovation will reinforce existing platforms	

Fonte: *J.S. Gans, S. Stern / Research Policy 32 (2003) 333–35*

ESTRATÉGIAS DE ENTRADA PARA START-UPS:
ILUSTRAÇÃO NA ENERGIA EM PORTUGAL
(Fontes, Sousa & Pimenta, 2013)

		WIND-TECH	WAVE TECH	OCEAN	WIND-SERV
		R&D *(technology)*	**Prototype** (*product)*	**Services & products** (customised)	**Services** (plant optimisation)
Background	**Maturity of technology** **Industrial structure of energy segment** **Opportunities for research-based entrants**	Emerging field: niche characteristics No dominant design: Experimental projects. Demonstration projects. *Opportunities to propose services / new technologies* to companies involved in such experiments.			Stabilised sector with efficiency and reliability problems: *Scope for suppliers of solutions* (wind plant optimisation)
Commercialisation environment	**Firm capacity to protect technology**	**Patented**	**Patented**	**Patented** (+ firm specific knowledge)	**Firm-specific & experiencial knowledge**
	Relevance of incumbents' CAs	Knowledge distributed by several organisations (R&D consortia)	Idem: but new technology design may not require same degree of integration with incumbents assets	Complex infrastructures & financial resources required (integration in large systems): *CAs controlled by incumbents*	Specialised supplier of services that improve incumbent performance: but *no dependence on specialised incumbent CAs*
	Incumbents attitude to firms' technology	Incumbents follow-up the new technology through participation in R&D project led by firm	Incumbents interested to closely watch technology development (support prototype development)	Incumbents interested in technology: demonstration projects as test-bed & market	Incumbents interested in using technology (process); Scope for project-based relations in foreign market entry
Types of incumbents and their actual involvement with firm		**Ex-Utility** & **Foreign firms:** watchers	**Ex-Utility:** watcher *(Firms is prospecting foreign markets)*	**Ex-Utility** & **equipment producer; Foreign firms:** partners & clients	**Ex-Utility, new players, foreign firms**: clients
Strategy adopted by new firm		**Sell technology**	**Alliances may be required to enter market**	**Alliances required to enter market**	**Enter market directly with service:** arms-length market relations, some long-standing associations

2.4. AS BATALHAS PELA DOMINÂNCIA TECNOLÓGICA

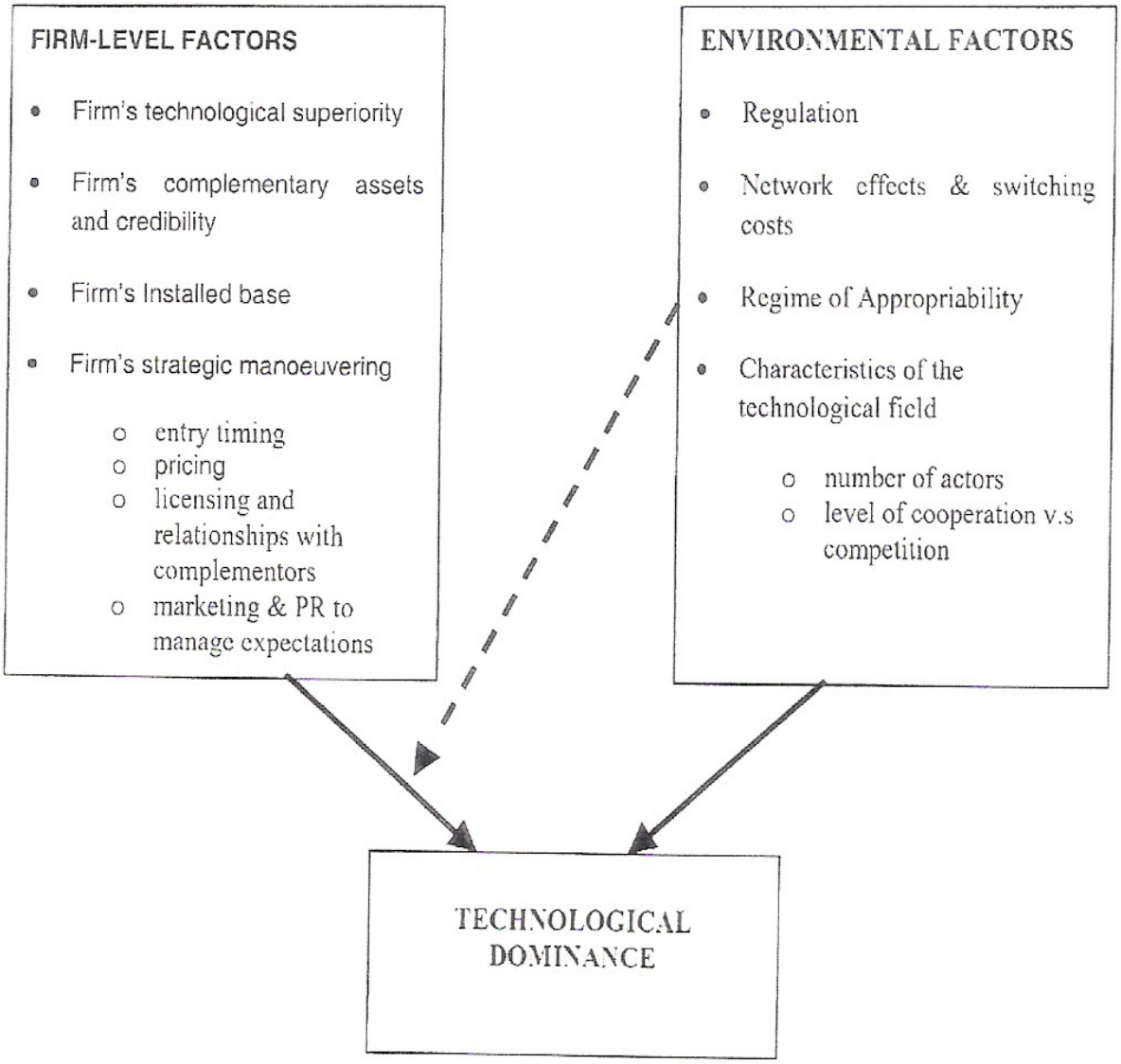
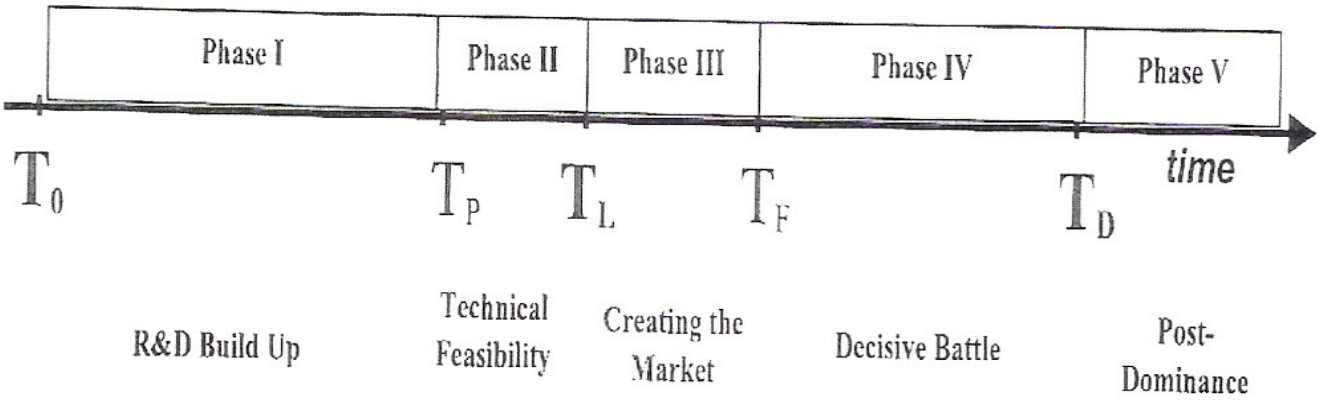


Fig. 1. Firm- and environment-level factors influencing the outcome of technology battles.

Fonte: Fernando Suarez (2004), 'Battles for technological dominance: an integrative framework', Research Policy, Vol. 33, pp. 271-286



Factor Type	Dominance Factor	Phase I	Phase II	Phase III	Phase IV	Phase V
Firm-level	Technological superiority		***			
	Credibility/complementary Assets	***			***	
	Installed base				***	***
	Strategic manoeuvering			***		
Environ-mental level	Regulation		***			
	Network effects and switching costs				***	***
	Regime of Appropriability	***				
	Characteristics of the technological field	***				

Fig. 3. Key factors of success at each stage of the dominance process.

Fonte: Fernando Suarez (2004), 'Battles for technological dominance: an integrative framework', Research Policy, Vol. 33, pp. 271-286

O CASO KODAK

O CASO KODAK

- Quais as razões que estiveram na base da ascensão da Kodak?
- Quais os factores que conduziram à sua queda?
- Como podemos interpretar o declínio da Kodak com base no que estudámos neste Capítulo?