

## **UNDERSTANDING DYNAMICS IN SECTORAL SYSTEMS (from chapter 14)**

Over the past decades, **computers** have had major coevolutionary processes, quite different from one another. In mainframes, coevolution has been characterized by large systems requiring user–producer relationships, centralization of user information systems, and extensive sales and service efforts by large vendors. Market structure was highly concentrated and suppliers were vertically integrated. A dominant design (IBM/360) emerged in the growth phase of the segment and a market leader (IBM) dominated the industry early on, with a coordinating role over the platform and the ability to steer the direction of technical change. The US government played a role in early support for technological exploration and was a major buyer of early computers. In minicomputers and microcomputers, coevolution has been characterized by technological change focused on dedicated applications in the case of minicomputers or on systems that increased ease of use and a lower price/performance ratio (in the case of microcomputers). The relationships with customers have required much less post-sales effort and service. Market structure was characterized by high entry early on, and then by increasing concentration in platforms in both minicomputers and microcomputers. In computer networks, connectivity and compatibility led to modular, open, and multiform client/server platforms. Technical change follows a variety of directions with an upsurge in the number of potential technologies associated with the relevant platforms. Interdependencies and externalities have increased. Divided technical leadership has emerged, in that no single Firm has been able to govern change and coordinate platform standards. This example is quite different from coevolution in other sectoral systems.

In **pharmaceuticals**, the nature of the process of drug discovery had important consequences on the patterns of competition and on market structure. Until the molecular biology revolution, dominant Firms persisted as leaders. The molecular biology revolution induced deep changes in the incentive structures within Firms and universities, with the advent of university spin-offs and the emergence of the specialized new biotechnology Firms. In this process of adaptation and change, different dynamic processes led to different patterns of competition and performances (McKelvey, Orsenigo, and Pammolli 2004).

In **telecom equipment and services**, the early separation of the radio spectrum for use in one-way broadcasting and two-way telephony gave rise to an oligopolistic structure that persisted for quite a long time (Dalum and Villumsen 2001). The convergence within ICT and between ICT and broadcasting-audio-visual and the emergence of the Internet originated a more fluid market structure with a lot of

different actors with different specializations and capabilities, and new types of users. This in turn greatly expanded the boundaries of the sector by creating new segments and new opportunities, and also by creating national differences in the organization of innovation. Moreover, the emergence of the Internet has generated more pressure in favor of open standards and has led to the rise of new actors (such as ISP and content providers).

In **software**, since the early 1980s, the spread of networked computing, embedded software, the Internet, the development of open-system architecture and open source, and the growth of web-based network computing has led to the decline of large computer producers as developers of integrated hardware and software systems and to the emergence of a lot of specialized software companies. Also, software distribution has greatly changed, from licensing agreements in the early days, to the rise of independent software vendors, to price discounts for package software, and, with the diffusion of the CD-ROM and the Internet, to shareware and freeware (this last one particularly relevant with Linux) (D'Adderio 2001).

In **machine tools**, a major driving force for coevolutionary processes is the demand from advanced customer sectors, namely the automotive, aeronautics, and defense industries, and the increasing use of electronic devices. The emergence of new clusters that span several sectors, such as internet–software–telecom, biotechnology–pharmaceuticals, and new materials, is one of the most relevant current transformation processes in sectoral systems. Here a great role is played by the integration and fusion of previously separated knowledge and technologies and by the new relations involving users, consumers, Firms with different specializations and competences, and non-Firm organizations and institutions grounded in previously separated sectors.