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Large Innovating Firms and Patent Management: Challenges for SMEs' Managers and IP Officials in Catching-up Economies

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Intellectual property management has become a centrepiece of global corporate strategy. A key characteristic of large innovating firms today is the diversified nature of their technology portfolio. Patents in new generic technologies such as information & communication technologies, drugs & biotechnology and new materials have soared since the early 1980s. This is also true for unrelated industries, a phenomenon known as technological diversification. This paper focuses on the evolution of empirical patterns in patenting by the largest industrial companies from Europe, Japan and the US. Implications of this multi-technology trend for IP offices and small and medium-sized firms from catching-up countries are explored.

Keywords: Large firms, technological diversification, patents, strategic IP management

Recently the Multi-Technology Corporation (MTC) concept has started to interest analysts and practitioners concerned with the economics and management of knowledge and innovation. This interest is motivated by the empirical observation that the largest innovating companies in the world are simultaneously active in several different technology fields. This spread of intellectual investment across distinct bodies of knowledge is empirically explicit, namely, through patent statistics. Therefore, technological diversification also reveals an evolving intellectual property (IP) strategy by these corporate giants. In particular, given that these global innovating players tend to protect knowledge assets that have no apparent direct relationship with the central technological requirements of the products they manufacture, the patenting trends indicate that the rationale behind IP management is increasingly showing relational and offensive purposes that contrast with the classic rationale of patents for defensive purposes and intangible investment appropriability.

Understanding the changing patenting behaviours of these core corporate institutions of contemporary capitalism could provide key information for IP officials as well as managers of small and medium sized enterprises (SMEs) that rely on global firms as buyers, research partners and suppliers of intellectual capital.

US Patent Data

Analysis uses patent counts and classifications based on the SPRU, University of Sussex, database for nearly 500 of the world's largest innovating industrial companies, as ranked by sales revenues. The data refers to US granted patents for 14 industries and 34 patent classes for the years 1980-85, 1986-90, and 1991-96. Patents for 463 of the largest European, Japanese and US firms are distributed according to their principal product group. 4500 subsidiaries and divisions under different assignee names, that had been kept or bought by the 463 largest companies up to 1992, were identified and attributed to their parent companies using the 'who owns whom' for 1992.

US data is a particularly rich source of information, qualifying as a basis for international and to a degree, inter-temporal comparisons.

The Key Characteristics of the Large Innovating Firm

The transition of the 1980s to the 1990s is marked by a sharp increase in patenting in all industries. Figure 1 shows the patenting performance in the

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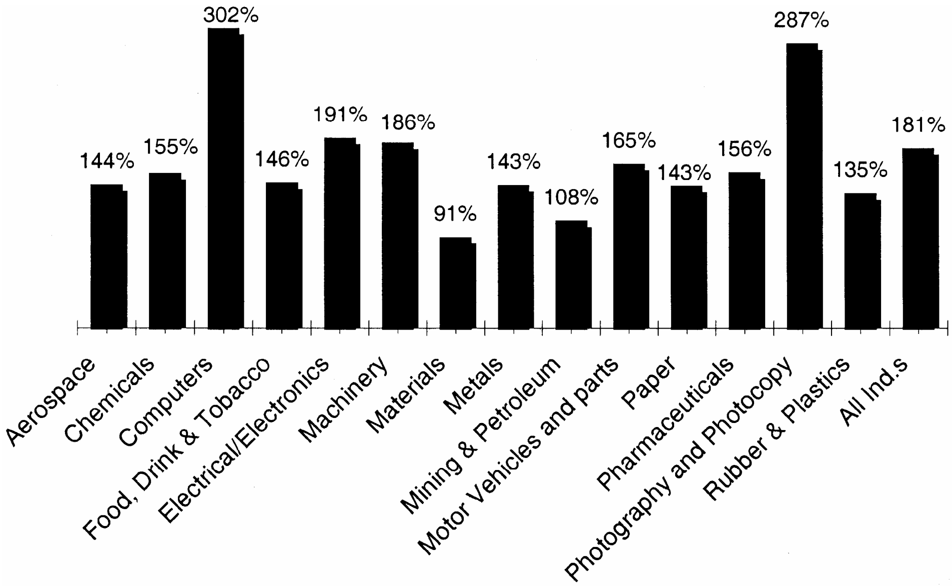

Fig. 1— Industries' increases in patenting between 1980-85 and 1991-96 *Source*: Elaborations on the SPRU-OTAF database

period 1991-96 of individual industries compared to their patenting performance in the early 1980s.

Intra-firm change, however, has also been remarkable. As innovation researchers have demonstrated, the most striking feature of large innovating companies is the wide range of fields in which they command cutting-edge technical expertise[1]. There is considerable knowledge diversity within firms. The MTC refers to a corporation that operates in at least three different technologies[2]. Even though it is not feasible to rigorously measure capabilities, there are a number of ways and proxies that can be used to measure the degree of technology diversification. Since the early 1990s, the technology diversification phenomenon has been assessed through questionnaire surveys, interviews, human resources accounting and patent analysis. Patent statistics show this aspect of current innovation strategies very clearly.

The analysis is based on a correspondence between industries and their main bundles of technical fields found in Patel[3]. For example, information and communication technologies are at the core of the computer and the electrical/electronics industries' capabilities. The extent of technological diversity in each industry was calculated from the proportion of patents outside each industry's technological capabilities. Industries patenting 50% or more outside their core technological competencies are shown in Table 1. This information shows quite clearly that technological diversification is a common feature of 'higher-tech' sectors such as aerospace, as well as 'lower-tech' sectors such as rubber and plastics.

Table 1 — Industries with largest percentage of total patents outside their core technological fields

Industry	Total patents outside core capabilities (%)
Aerospace	74.0
Motor vehicles and components	62.4
Metals	62.1
Machinery	58.8
Paper	57.7
Materials	52.1
Rubber and plastics	50.0

Technological Complexity and Product Complexity

A crucial lesson that emerges from this insight is that the notion of MTC must not be confused with that of the multi-product corporation. In fact, "(t)he main analytical and policy conclusion is that technologies should not be confused with products."[4] The implication is that policy-makers and managers should be aware that contemporary big business institutions exhibit a much broader portfolio of technologies or competencies than of products.

These products and technological dimensions are related but autonomous. For example, technological diversification might coincide with product diversification, but not necessarily. The management of diversified corporate knowledge production systems is a very complex affair. Internal coordination problems coupled with rising R&D costs might therefore induce a strategy of greater product specialisation and market focusing[5].

However, although technological diversification has recently surpassed the classic strategy of product diversification (conglomerates fell out fashion in the 1980s), it is also an older trend than commonly acknowledged. The MTC predates multinational corporations as an industrial organisation phenomenon[6]. The pursuit of technological diversification for growth, even in highly specialised industries, is therefore a robust and persistent feature of industrial organisation.

Evidence derived from in-depth interviews and questionnaires of research and development (R&D) managers shows that technological diversification has been an increasing trend[7]. This research also showed that diversification was used in Swedish, Japanese and US companies to improve the degree of sophistication of certain types of products in very specific classes. Thus, the technology diversification trend has coincided and been reinforced by the tendency towards more complex products and systems.

The mobile phone is a paradigmatic example of product evolution towards technological complexity, given that it became the iconic artefact of the 1990s. The number of sub-technologies involved in one handset rose from 17 to 29 narrow patent classes from the early to the late 1980s.

It should be stressed again that multi-technological features are not exclusive of the so-called 'high-tech' sectors, i.e. industries with a high R&D to sales ratio[8]. For example, industries such as food processinghave been developing new technological fields alongside their extension of more traditional technologies. The food industry has added to its main technological fields (machinery and chemicals) with newer technological fields, such as advanced instrumentation (lasers), electronics, bioengineering, pharmaceuticals, advanced materials (especially in packaging), etc[9].

Technological diversification affects a broad spectrum of new and old, 'high-tech' and 'low-tech' industries. The conclusion is that one should not expect a linear relationship between patent classes and industry classification. But what are the hottest patent fields for technological diversifiers?

Technologies Targeted by Large Firms from All Industries

The consideration of technological diversification draws attention to the spread, composition and rates of change of corporate patenting activities. As measured by patent classes, the rate and direction of technological capabilities accumulation varies from firm to firm and from industry to industry. Nonetheless, the pattern of technological diversification is not random. In particular, large firms tend to direct their patenting efforts more to some fields than to others; the direction of technological accumulation is broadly consistent across industries.

To date, the literature has emphasised that the composition of technological competencies of companies is stable and that the direction of search is a function of the fields of knowledge involved in their product mix; i.e. industry influences the directions of diversification because there is path-dependence and localised technology search[10]. However, a closer look beneath the dispersion of corporate capabilities reveals that the new generic technologies of the third industrial revolution have been the highest attractors of knowledge investment[11].

Figure 2 shows the growth in patents obtained outside companies' traditional core capabilities by different groups of technologies. The transition of the early 1980s to the 1990s is marked by a significant expansion of Information and Communication Technologies (ICTs), new materials, drugs and biotechnology. Non-specialists have become contributors to these new fast moving technologies. Technological diversification is linked to this cluster of technologies that have become associated to what has been called the third industrial revolution[12].

The key insight is that technological diversification is an industrial organization phenomenon that is intertwined with the growth of specific technological opportunities at the end of the twentieth century. The increasing dispersion of expertise in ICT, drugs & biotechnology and new materials should not be underestimated. The new generic technologies are key for an increasing number of multi-technology companies[13].

> ICT is increasingly becoming ever more important for non-specialist industries such as photography and photocopy, motor vehicles and parts, aerospace, machinery and metals industries; Advances in drugs and bioengineering specialist sectors dominate the generation of this technology

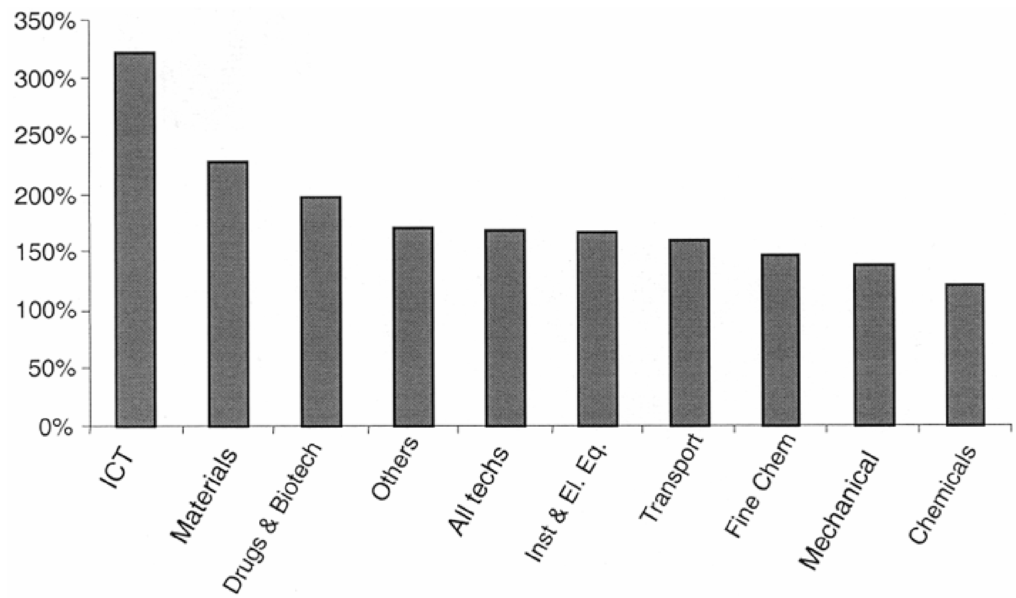

Fig. 2 — Increase in patenting outside core technological fields from 1980-85 to 1991-96 *Source*: elaborations on the SPRU database

set (pharmaceuticals, food, drink and tobacco and chemicals industry), but non-specialists' outperformed specialists in the growth of new patents in the transition to the 1990s (most dynamic non-specialists were photography & photocopy, mining and petroleum and the metals industries);

Among non-specialists, large contributors to patents in new materials were the chemicals, electrical/electronics and photography and photocopy industries.

A Biased Patent Pressure Boom

The number of patents granted in the US exploded in recent times. From a rate of growth of less than one percent per year between 1930 and 1982, it roughly trebled from 1983 to 2002[14]. As we have seen, this powerful surge in patents was not homogenous. On one hand, patents have soared as a result of corporate research encouraged by high opportunities and profit prospects in specific technologies[15]. On the other hand, this explosion is also linked to a change in IP strategy by large firms.

A major study on IP utilisation by US manufacturing firms (the Carnegie–Mellon study) reminds that firms still rely on a variety of means for appropriating the returns from innovation: patents, secrecy, lead times, etc. A survey questionnaire of 1478 R&D labs in the US manufacturing sector suggested that patent statistics have become more informative for the largest firms since the early 1980s[16]:

> "…results suggest that between 1983 and 1994 patents may have come to occupy a more central role in large firms' efforts to protect their product innovations in a growing number of industries."

Moreover, according to the same study, a new strategic rationale for patents emerged. Firms appear to use patents in an attempt to block the development of substitutes by rivals, and also to force rivals into negotiations (for example, this motivation is very acute when patents are taken in the telecommunications equipment and semiconductors industries).

Thus, strategic patenting is one of the major motivations behind IP management today. Preventing copying is not the only motivation for patenting. Using patents for blocking rivals to advance their technological trajectories, for avoiding law suits and for negotiation levering are increasing patenting rationales. Indeed, firms use their multi-technological capabilities and their IP portfolio to coordinate changes in their own products and processes, with changes made by their suppliers and co-developers of machinery, components and subsystems. As the range of potentially useful technologies is increasing over time, they need to nurture a wide array of competences to monitor and master them.

Challenges for SMEs' Managers and IP Officials in Catching-up Countries

Since global firms are pursuing widening and ever more sophisticated IP strategies, managers of firms from catching-up economies also face pressure to protect themselves from aggressive patent use, often embarking upon IP strategies themselves. These firms need to better understand the new strategies employed by large firms at the top of supply chains in order not to be bullied out of their share of the value added. The implication is that building technological competences is not enough for SMEs wanting to upgrade or keep their position in global supply chains. SMEs also need to develop socio-economic expertise such as IP management skills[17]. This implies that IP offices have an expanding local market for information services and IP-related skills. Failure to develop this new set of non-technological capabilities may constrain the innovating strategies of SMEs in catching-up economies trying to succeed in a fast moving global economic arena.

The global patenting pressure, led by large innovating multi-technology firms, means that IP offices have become overwhelmed, particularly, in the most critical technologies for corporate strategy and international trade. Endowed with scarce resources and facing an exponential rise in the leading science-based patent classes, IP offices are today under strain. IP officials need to find, train and retain qualified examiners in areas that are under continuous dramatic development. As patent litigation has become big business, firms demand both a timely and thorough response. Moreover, difficulties are only increasing with the new trends of widening the scope of patentability, for example, with business methods patents.

Operational pressures deriving from a developing IP-driven corporate competition have hit hard in large IP offices of catching-up economies, as well as in US and the EU. In particular, IP offices in catching-up countries will probably face new challenges given that IP-related service demand is likely to rise steadily as SMEs grow more sensitive to patent matters. More policy-oriented research of the role of developing countries' IP offices in the globalising learning economy is badly needed.

Conclusions

Corporate giants continue to be core institutions of the contemporary global economic system. An irreducible aspect of these players is that large innovating firms are active in several different technology fields and that they consistently diversify into technologies that are often of a generic nature (ICT, biotech, new materials), i.e., technologies that have great value in themselves and in combination with others.

Along with technological change, the strategic intents behind patenting behaviour are also evolving. Knowledge and patents are used by large firms to reorganise the business environment in which they operate. This means that SMEs that develop relationships with these supply-chain coordinators need to invest in new competencies. These capabilities should enable them to understand and respond to the new IP-based strategic interactions in global markets. Local IP offices in catching-up countries can have a role in upgrading SMEs' IP surveillance and management capabilities, thereby becoming a more explicit institutional actor in innovation policy.

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