1 *Global outsourcing and offshoring*

In search of the optimal configuration for a company

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Introduction

The activities of any enterprise can be broken down into a large number of discrete steps along its value chain, from research and design, to production, marketing and distribution, to customer service. Even these are but broad categories which can be micro-dissected into their component pieces. For instance, the "research" function can include creative design, requiring high technical skills and intelligent market feedback into the design process. But research also entails several mundane activities such as field testing, patent applications, and data compilation.

This chapter deals with three broad trends affecting the reconfiguration of company functions, for which we propose an integrated approach for theory and strategy:

(a) The increasingly finer micro-dissection of company functions all along the value chain. This enables a finer-grained evaluation of which of the micro-activities are best performed within the company, and which may be outsourced – in short, the *organizational relocation* of functions which previously may have been performed in-house.
(b) *Geographical relocation* and the choice of foreign country and partner.
(c) The greater outsourcing and offshoring of activities that used to be considered "core," proprietary, or strategically crucial, such as Research and Development vital to the continued competitiveness of the firm.

The chapter addresses a crucial global strategy question, "What is the optimal global and organizational configuration for each micro-activity or function for a company?"

Although the driving forces of outsourcing and offshoring have recently escalated, the roots of geographical and organizational restructuring of economic activity can be traced back into prehistory. Along the central spine of Italy, in the Abruzzo province, are a series of caves carved into mountainsides amidst picturesque deep valleys and gorges. One such cave is the Grotta Sant'Angelo which used to be visited by pilgrims hoping to have their sins purged, ever since the year 490 CE when the Archangel Michael appeared to Saint Lawrence Maiorano and proclaimed absolution for all who visited such grottos thereafter. The tourists, hikers, or penitents who climb up the hillside into the cave are oblivious to its much longer history. Excavations by the University of Michigan into the floor of the cave reveal an entire workshop for making flint tools, as early as 25,000 years ago.[1] Early hominids as well as *homo sapiens sapiens* made flint tools, such as spear heads for hunting, or scrapers for skinning and de-boning. Initially, these were made by each hunter or family for their own uses. However, the raw material, flint, is not ubiquitous. Quarries can be many miles apart. Flint knapping is a skilled art requiring much experience in the worker. Otherwise there is considerable wastage, and the end product is misshapen or useless. In the best of hands, tool-making is a significantly weight-reducing process. As human history progressed, later in the Chalcolithic era, it made economic sense to concentrate production preferably near the raw material sources in skilled workshops, under an organized hierarchy, and then distribute the finished product over the entire region by trading arrangements. This chapter is a story of separation and disaggregation that began over 25,000 years ago – separation between producer and consumer, organizational separation between specialized producers over a fragmented value chain that could be hundreds, and later thousands, of miles apart. Ochre of various colors (brown from Roussillon, France, and yellow from Cyprus) was used to paint dwellings, bodies, and murals such as the famous Lascaux cave paintings. The ores were transported across a continent to specialist workshops which would add proprietary adhesives and grind the mixtures to desired consistencies, before selling them to customers for their rituals, tribal markings, cosmetic embellishments, or art. The benefits of specialization, economies of scale and learning, technological innovation, weight-reduction criteria for the location of production, and inter-regional trade all have their seeds in human prehistory.

Today, this organizational and geographical fragmentation has progressed to an unparalleled extent – global in scope and scale. An automobile made by a major producer has more than twelve thousand parts. Components are typically sourced from hundreds of major suppliers in a dozen or more nations worldwide, in addition to making key parts in the car company's own factories. In theory, for each of the twelve thousand parts, the firm may decide to make it internally, or outsource. If the decision is to make it within the company, the question is where, and in which nation. If the decision is to outsource the production of that component, then the question arises as to choice of supplier and country.

The maximum number of combinations amount to 12,000 parts, times 193 nations, times 2 (for the "make" vs. "buy" decision) – which comes to 4,632,000 configurations. For the minimum number, at the other end of the organizational spectrum, the answer is 1.0 – all production being in-house, under one organization, in one country. In practice, of course, the answer is neither 1.0 nor 4,632,000, but some optimum solution in between these two extremes. A typical automobile major has direct relationships with at most a few hundred suppliers and development partners, located in fewer than twenty nations.[2]

What constitutes the optimal configuration for a firm? What is the optimum degree of outsourcing (versus internal production)? What are the best geographical or country locations for adding value along the value chain? The answer depends on how finely the firm wishes to slice its product or service. Clearly, dissecting an automobile into all its more than twelve thousand individual parts is too detailed, and too fine grained. Outsourcing all of them would be impossibly complex and inefficient, even in an information technology (IT)-enabled world. On the other hand, since a century ago when Ford produced everything from its own steel to the finished automobile, no producer has been that vertically integrated. The fact is that no company is able to produce every piece of the product itself. They all rely on outsourcing to some extent. The question amounts to what the optimal level of outsourcing should be.

The answer also depends on the sector. IBM, which is today better understood as an IT services consulting company, rather than a hardware producer, claims "90,000 business partners worldwide, including consultants, integrators, software vendors, value-added resellers, and distributors" who act as suppliers, buyers, as well as strategic or tactical allies to IBM (IBM, 2009). The large number is a reflection of the multiplicity of the end-applications of information technology in very diverse business arenas in thousands of industries. It is also a reflection of the fact that no company today – not even a giant like IBM – has the internal knowledge or capability to put together a service "bundle" or solution for all its clients. The totality of the knowledge inputs required to produce or design efficiently, or to meet the diverse needs of customers, has today grown beyond the ken of most companies.

In 2007, out of IBM's 375,000 employees worldwide, some 125,000 were in the US. The second-biggest contingent was 73,000 employees in its Indian affiliates, with 177,000 in other countries (Associated Press, 2007). It is ironic that IBM's Indian employees today comprise almost 20 percent of the global total, and that in India alone IBM has alliance and supplier relationships with well over a thousand companies – when one recalls that in 1977, rather than accept the Indian government's mandate to share some technology and accept local partners, IBM shut down its entire operation in India. Vertically integrated, internally controlled hierarchy was then the operating business model for IBM and most companies.

Besides IBM, companies in 2006 that had more than 15 percent of their global employees in India included Accenture, Oracle, EDS, and Cap Gemini, to name just a few.

The spatial and organizational fragmentation of economic activity

Today, the vertical integration or internalization model of business is in retreat. Most major companies are in the process of fragmenting themselves by examining each piece of their operations and asking how it may be deconstructed (Zaheer and Zaheer, 2001). And if deconstructed, in which nation the fragmented function can best be performed.

Traditionally most companies added value "in-house" and in their "home nation" – Cell A in Figure 1.1. Today, the firm adds value

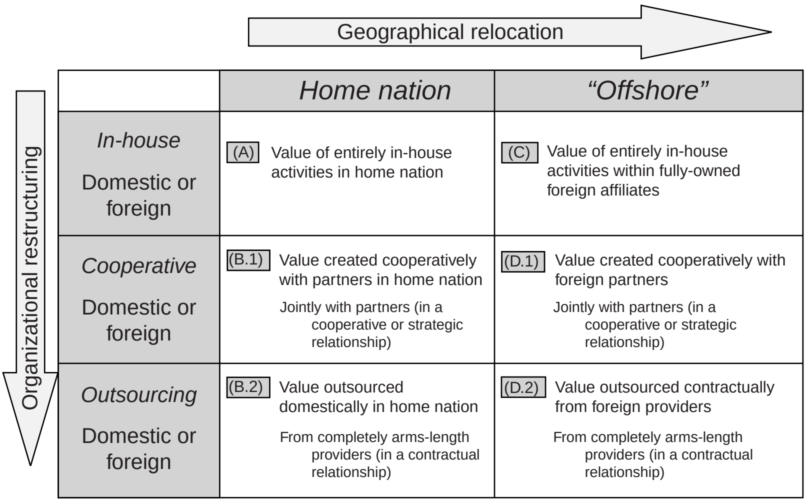

Figure 1.1. The spatial and organizational choices available for each piece of the value chain.

internally (in the home nation [Cell A] or in fully owned foreign subsidiaries [Cell C]) only to selected portions of its value chain where it determines it has "core competence" (Prahalad and Hamel, 1990) while leaving other selected bits of the value chain (and support services) to external providers or in other nations. The latter, in turn, are linked to the focal firm in a spectrum of organizational relationships, ranging from highly "cooperative" or "relational" to mostly contractual or arms-length over the other four categories B.1, B.2, D.1, and D.2 in Figure 1.1.

- **"Offshoring":** [Cells (C) + (D.1) + (D.2)] refers to the geographical relocation of activities outside the home nation of the firm under any organizational arrangement, including foreign subsidiaries of the company (Cell C), foreign alliance partners (D.1) or foreign contract providers (D.2).
- **"Outsourcing"**: [Cells (B.2) + (D.2)] refers to value added by contractual external providers, whether in the home nation of the firm (B.2) or foreign nation (D.2).

Incidentally, Cell (D.2) is the only one which constitutes *both* offshoring as well as outsourcing. By contrast, Cells [(B.1) + (D.1)] comprise cooperative relationships in one case with strategic partners or cooperative vendors in the home country, and in the latter case in a foreign nation. Cooperative alliance relationships are "half way" in organizational terms, between completely in-house operations and completely contract-based outsourcing where the relationship is arms-length.

The offshoring and outsourcing phenomenon is, in a way, the logical outcome of the strategic focus on "core competence" which implies that a firm should abandon functions it cannot best perform in-house or at home, to external vendors, or partners, or foreign countries.

The scale of this devolution or deconstruction of the firm is enormous. But exact data are unavailable. While we have (imperfect) figures on international trade in goods and services, as well as some estimates of the internal value-added by sector, it is impossible to distinguish, in the aggregate, between, say, the purchase of raw materials or components from the relocation of the job or production based on *conscious strategic intent*. For example, we know from the World Trade Organization (WTO, 2009) that the sum total of merchandise exports of all countries in 2008 amounted to $16.13 trillion. But we do not know what portion of that total was formerly carried out in the home nation of the firm and subsequently offshored by a conscious decision made by the firm.

We do know that the outsourcing of manufactured goods is far more advanced than in services. Trade in manufactures began millennia ago.[3] In comparison with the $16.13 trillion in goods, the total of world trade in services was only $3.7 trillion (WTO, 2009). However, the growth rate of services exports has been much higher in recent years (UNCTAD, 2004), especially in the area of "Commercial Services" exports, where the bulk of the figure likely entails a conscious offshoring decision.

The driving and constraining factors

It is not simply a search for lower costs. The outsourcing and offshoring phenomena cannot occur without the firm (i) first deconstructing itself (breaking down its value chain), then (ii) devising appropriate interfaces between the organizationally and spatially separated functions, and finally (iii) minimizing transaction costs between the outsourced entities as well as minimizing global governance overheads. This has been spurred by some well-known trends in the last decade, such as

- *The precipitous drop in IT costs* resulting from the massive investment in international bandwidth and developments in information and communication technology that have made communication over distance not just much cheaper but also much easier (Blinder, 2006).
- *Shortage of skilled technical and managerial personnel* in the US and in Europe as the population ages (McKinsey Global Institute, 2009).
- *Acceleration in the rate of technical change* (Teece, 1992) which forces a greater degree of externalization so that companies can keep up with the pace of competition.
- *Greater codification of corporate knowledge*. Technical or administrative processes which formerly were "tacit" or resident only in the minds of experienced engineers or managers are increasingly been written down in manuals, software, process specifications, and expert systems (Balconi, Pozzali, and Viale, 2007). This (i) makes the outsourced/offshored tasks more visible to the vendor or foreign affiliate personnel, (ii) reduces asymmetric information and bargaining power, (iii) improves quality control and thus reduces the fears of the outsourcing/offshoring principal, (iv) reduces negotiation, monitoring, and control costs, and finally (v) the codified "template," once created, can be used repeatedly, and in many nations, so as to reduce costs of outsourcing/offshoring through repeated experiences.
- *The modularization and distribution of tasks*. The division or dissection of complex or creative designs over geographically distributed teams is difficult, especially if considerable interactions are needed between the design teams. However, according to Sanchez and Mahoney (1996), if the tasks can be modularized, together with objective criteria for outputs and the interfaces between the components of the design (or finished product), then distributed teams can function more effectively.

The starting point for offshoring and outsourcing is for companies to deconstruct (i.e., fine-slice, codify, standardize interfaces, and modularize) their many activities. This is often described under the rubrics of knowledge management or lean programmes. In that sense it can be said that "offshoring and outsourcing start at home." The deconstruction and reorganization of company activities is a precondition for making corporate activities offshorable and reaping the benefits of offshoring and outsourcing.

In retrospect, it now seems quaint that academic literature of just two decades ago cast doubt on the exportability of services because of their alleged "inseparability," "heterogeneity," "intangibility," and "perishability" (Boddewyn, Halbrich and Perry, 1986; Zeithaml, Parasuraman, and Berry, 1985). But while remaining intangible, services can indeed be separated or deconstructed. Each service component can be rendered homogeneous through codification and standardization. And many services can be stored and transmitted electronically (Karmarkar, 2004). Can one export a haircut, a restaurant meal, or an airplane ride? No, but the reservations system, procurement function, advertising content and booking of advertising space, and other back-office functions can all be offshored or outsourced.

In the ultimate analysis, *any* business or technical operation that can be (a) codified and (b) digitized is amenable to outsourcing and offshoring. This appears to be a serious threat to advanced nation economies where the majority of jobs are in services (most manufacturing jobs having already been offshored). According to McKinsey Global Institute (2007: 5), "in 2008, we estimate that 160 million jobs, or about 11 percent of the 1.46 billion service jobs worldwide, could in theory be carried out remotely, barring any constraints on supply." Lest that create unwarranted panic, the same report shows the actual adoption of offshoring in 2008 to be a minuscule percentage of the theoretical maximum. Most importantly, even in the future, the actual extent of offshoring will fall well below its theoretical maximum because of:

(i) the consequent escalation of wages in the foreign location,
(ii) the persistence of tacit knowledge and embedded experience,
(iii) transaction costs that can be avoided with vertical integration (such as negotiations, monitoring, coordination, "hold-up," and quality control),
(iv) fears of supply chain disruptions,
(v) fears of technology spillovers and consequent competitive threat in the event that the operation is outsourced to external parties, and
(vi) regulatory prohibitions and constraints on offshoring.

For a more extended discussion of the constraints see the section entitled "Inhibiting factors" later in this chapter.

This chapter and book by no means predict the collapse of internalization or vertical integration – but only their partial retreat in the face of the global trends described.

Will high-value or core functions also be outsourced and offshored?

It is not simply a search for lower costs. In recent years, companies have also been looking for new ideas, talent, and human capital outside their companies and abroad. We are beginning to see the breakup and relocation of even R&D and innovation activities which were formerly considered "core competencies" (Mol *et al.*, 2004). Outsourcing/offshoring is no longer about cost-cutting but about closer connections, better service to clients, creativity, and innovation: "to open the enterprise up in multiple ways, allowing it to connect more intimately with partners, suppliers and customers and, most importantly, enabling it to engage in multifaceted, collaborative innovation" (Palmisano, 2006).

In part, this is because companies today are even micro-dissecting and disaggregating their R&D into finer sub-segments which are distributed to different nations and external providers. R&D is no longer treated as one sacrosanct and monolithic piece of the value chain. A pharmaceutical company can do the clinical testing (approximately 40 percent of the typical R&D budget) portion abroad, the foreign data are then fed back to a data management firm at home, which in turn outsources the data compilation, tabulation, and analysis to Hyderabad.

Mowery and Macher (2007) describe how innovation in personal computers is disaggregated worldwide. Product planning and design take place in the US or Japan while applied R&D and the design of new platforms occur in Taiwan. Design extension development takes place in China, where the bulk of assembly operations exists. Chinese engineers also design the engineering processes in their factories. Similarly, a company like Motorola while keeping aspects of chip design in the US, now has its mobile handsets designed in China.

However, this may only be the beginning of a larger recent trend for emerging nation companies to creep upward in the value chain. US, European, and Japanese companies say that it is not simply a search for lower costs of scientists and engineers – they need the talent. Kenney (2007) relates how, although integrated circuit (IC) design in India was only five years old, Wipro and Sasken each already had more than 2,000 Indian employees in outsourced IC design, and – as examples of offshoring via foreign subsidiaries (Cell C in Figure 1.1) – the Indian subsidiaries of Intel, Texas Instruments, Broadcom, and others also undertake IC design in India.

The globalization of research is still a minor, but accelerating, trend. According to UNCTAD (2005) multinational companies (which account for about half of all corporate R&D expenditures), now do more than a quarter of their R&D outside the home nation. By 2005 India had R&D centers belonging to over a hundred multinational firms. The UNCTAD (2005) study of 1,773 R&D projects in 2002–04 showed 61 percent located in Eastern Europe, India, China, and other Asian affiliates.

A major reason is that multinationals need to tap into new knowledge and talented people anywhere on the globe. The wind-turbine industry might serve as an illustrative example. The center of the wind-turbine industry has until recently been in Northern Europe with all the dominant players in the world being present in Denmark, Germany, or the Netherlands with significant R&D. This region has offered a vibrant environment with talented people, a large pool of knowledge, and government support of this new technology. However, as the technology has matured and other markets in Asia and the US have become more interesting, the wind-turbine companies are starting to break up the value chain and re-locate their activities. The world's largest wind-turbine company, Vestas, which until recently had all its R&D activities located in Denmark has now established significant R&D facilities with a global mandate in India, Singapore, and the US.[4]

In Figure 1.2 we see a wide spectrum of offshoring and outsourcing activities. Ranging from the left are basic tasks like data entry and transcription. Moving to the right are more complex tasks such as Human Resource management functions, and accounting. At the far right are highly skilled and creative activities such as portfolio analysis (requiring high mathematical knowledge), or engineering and R&D.

According to McKinsey Global Institute (2003) the primary motivations for outsourcing and offshoring shift from left to right in Figure 1.2 – from a search for low cost labor, to a search for talent

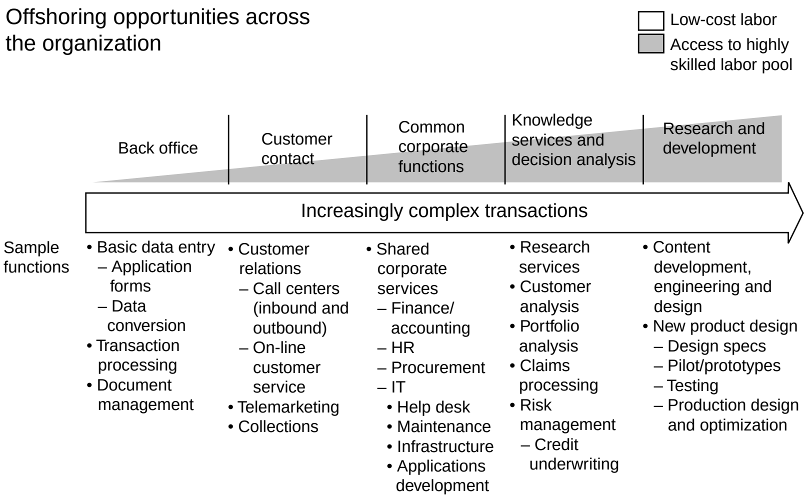

Figure 1.2. The motivations for offshoring: lowering cost or the search for talent?
Source: McKinsey Global Institute. *Offshoring – Is It a Win-Win Game?* August 2003. www.mckinsey.com/mgi/reports/pdfs/offshore/Offshoring_MGI_Perspective.pdf.

and new ideas. Manning, Massini, and Lewin's (2008) survey indicates that the search for foreign talent has risen to number two rank, just behind "cost savings," as a strategic driver for offshoring.

The old adage, that a company must never outsource its core competencies, for fear of their loss to potential competitors, remains true. However, by offshoring R&D and innovation to majority affiliates, the multinational firm retains a considerable degree of secrecy and internal control. Second, by artfully splitting the R&D function into vulnerable versus less vulnerable components, the latter can be outsourced to independent parties without much loss of competitiveness, as we saw in pharmaceutical R&D where basic research continues to be mostly undertaken in advanced nations while clinical testing is much more widespread in emerging nations.

While companies keep their core competencies close to their corporate headquarters, the range of what a firm defines as "core competencies" is becoming slimmer as even some high-value activities like R&D, design etc. are to some extent deconstructed and more standardized parts are teased out. In fact, more and more functions and activities are being deemed outsourcable and offshorable. And this is true not just for complementary or peripheral activities, but also for some activities that were previously considered as part of the core competence.

Box 1.1 What is a high-value or core function?

Core competencies of a firm exist in all portions of the value chain. Research competence is an obvious source of competitive advantage. But so is innovativeness in marketing, or brand equity creation. Below are some characteristics or attributes of "core" functions:

- Strategically vital
- At the heart of firm competitiveness
- Hard to quantify, measure or monitor for "success" vs. "failure"
- Difficult to separate from the rest of the value chain
- Difficult to teach or transfer to external partners
- Entail the highest transactions costs (in terms of knowledge transfer difficulty, absorption, dedicated assets, and opportunism)
- Entail greatest danger if leaked to competitors
- On the other hand, they are the most difficult for competitors to replicate, because they can be
- Idiosyncratic
- Non-standardized
- Tacit
- Embedded
- Complex
- Protected by IP laws
- Most related to human capital and skilled human resources (Sen and Sheil, 2006)
- Entail the greatest uncertainty of outcomes (e.g., R&D)
- The most "profitable" portions of the value chain
- A new aspect of "core competence" now may also be the firm's ability to coordinate the offshoring/outsourcing function and cooperatively optimize the relationships with multiple network partners. This is especially pertinent in companies like Dell or Nike that have relatively low or zero production value-added internally.

The rest of this chapter examines in detail the strategic drivers for outsourcing and offshoring, as well as the constraining factors. It describes four decision steps that a company must take in order to plan for the international and organizational reallocation of its activities. Finally, it scrutinizes cooperative or alliance arrangements as an intermediate organizational form between the extremes of internalization of an activity and completely arms-length outsourcing.

Causal factors promoting the outsourcing/offshoring of high-value or core functions

This section enumerates both the "pull" and "push" factors that are rapidly relocating high-value operations such as R&D away from the home nation of the multinational firm. The "pull" factors include not just lower wages and lower cost inputs (e.g., cheaper test subjects for pharmaceutical drug trials) but also the emergence of knowledge clusters such as Bangalore (for IT services) or Taipei (for IC and computer design). Finally, some of the large emerging countries now have large internal markets whose demand and marketing feedback constitute important inputs into the design of products as well as into the overall strategic management of companies. The "push" factors come from changes in several industries located in the US, Europe, and Japan. An inadequate supply of engineering and science graduates, and the loss of internal self confidence in their own innovative capacities (for example in IT hardware and the pharmaceutical industry), are pushing companies to seek talent and ideas further afield. In some cases, technology has become so complex that the diverse sources of knowledge required to design a latest product is too broad for even a giant firm's internal personnel to handle. A case in point is Boeing, which has moved to a business model that includes extensive outsourcing and offshoring with their latest airplane – the 787 Dreamliner. In some areas, what the firm lacks internally is how to apply or exploit their technical skill to diversifying end-applications or diverse markets that the firm has not encountered before. Hence they build up this competence through the use of foreign talent hired in the company's foreign subsidiary, or greater collaboration with suppliers.

Reducing wages and costs

Clearly, this remains a dominant consideration in outsourcing and offshoring in most studies (e.g., Flores and Aguilera, 2007; Dossani and

Kenney, 2004). It is paramount in the more standardized and codified business process outsourcing shown on the left side of Figure 1.2, such as document processing, customer relations, insurance and medical claims. It remains a driving factor even in tasks of some complexity such as product development, IT programming, and clinical trials. According to Doshi (2004), a 50 to 60 percent saving in costs can be realized by doing clinical trials in India compared to the US. However, the low labor cost factor diminishes in importance towards the high value right side of Figure 1.2, where the search for talent trumps the wage and salary consideration. Superficially, one would expect a negative correlation between a country's wage levels and the propensity to relocate jobs there. But this is not necessarily so. Empirical findings in studies such as Contractor and Mudambi (2008) or Bunyaratavej, Hahn, and Doh (2007) show the relationship between the average wage variable and the propensity of a country to export services is not negative, but positive or non-significant. In the long run, wage levels rise with the productivity of workers. In the economics literature this is known as the theory of marginal productivity of wages (Van Biesebroeck, 2003) – or the idea that, in the long run, wages correlate positively with the rise in productivity in an industry or nation.

Practically, we also see this in the wage bubbles and shortage of technical personnel in cities like Bangalore or Mumbai where the demand for IT-qualified personnel temporarily outstripped supply between 2006–07 (McKinsey Global Institute, 2007 and 2009). However, the skilled labor pool in India remains vast. Moreover, outsource service supplier firms have already relocated to Tier 2 cities in India as well as to the Philippines and Latin America. For a considerably long period therefore, the labor cost saving consideration will continue to drive the relocation of economic activity.

Escalating R&D costs and risks

The percentage of sales expended on R&D has escalated across all sectors. The pharmaceutical business is a good exemplar. US firms spent a total of $62 billion on R&D in 2008. However, the output of commercially viable new molecules was so low that the expenditure for each new successful drug rose to $1.2 billion. This constitutes too high a risk even for the majors.

Internal creativity limitations

In some sectors, at least, there is considerable questioning as to the ability to maintain an adequate degree of innovation from only internal sources of creativity, e.g., pharmaceuticals (Kleyn, Kitney, and Atun, 2007). Pharmaceutical firms are already hedging the risks of internal development with a plethora of alliances and co-development partners, as well as doing more research abroad in their foreign subsidiaries. In high technology areas, it is the search for external talent, more than wage savings, that drive firms. The same can be seen in wind-turbines and also in the case of Boeing with their outsourcing of key components for the new 787 Dreamliner.

The demand for foreign scientific talent

In their multi-industry survey, Manning, Massini, and Lewin (2008) reported that the search for foreign talent had risen to the number two strategic driver behind "cost savings" as a motivator for offshoring. Since the number of post-graduate degrees awarded in the sciences and engineering to citizens or residents of the US and Europe have been more or less stagnant since the 1990s, there is an emerging shortage of post-graduate degree holders in several technical areas (National Science Foundation, 2009). At the same time, in certain technical fields, the talent pool in emerging nations is increasingly more capable, more up to date and attuned to developments anywhere in the world (Florida, 2005).

This is reflected in the relocation of scientific and research jobs away from the home base of the multinational company and even to emerging nations like China and India. Based on the latest available information[5] from the National Science Foundation (2009), the data indicate that in just two years between 2002 and 2004, R&D spending by the foreign majority affiliates of US-based pharmaceutical companies jumped by more than 25 percent. In 2004, the ratio of US drug company R&D spending in their foreign affiliates over R&D expenditures at home in the US rose to 17 percent. This is by no means only a pharmaceutical sector, or high-tech phenomenon. The figure for all US-based multinationals was slightly higher – with R&D expenditures in foreign majority affiliates being 18 percent of R&D spending by all parent companies in the US home base. In 2002–04, the Indian majority affiliate of all US multinational firms operating there increased their R&D by 217 percent, albeit from a then tiny base.[6]

The growing supply of foreign scientific talent

The absolute numbers of science and engineering graduates in emerging nations has been rapidly escalating (Bunyaratavej, Hahn, and Doh, 2007; McKinsey Global Institute, 2007). There are varying estimates of the number of S&E graduates because not all are degree holders, but may only carry a three-year certification or technical diploma. Wadhwa and Gereffi (2005) estimate that, in 2004, China graduated about 350,000 engineers and 290,000 with three-year certifications; India graduated about 112,000 and 103,000 with three-year equivalent diplomas. By comparison, the United States graduated about 140,000 and 85,000 with a lesser qualification. But then the authors themselves say that "these are inappropriate comparisons." While the quality of scientists and engineers from the top programs in China or India is comparable to the US, in emerging nations there is a rapid drop off in the caliber of training as one goes down the rankings into the second- and third-tier universities.

Having said that, even if we were to take only the top 10 percent of graduates in Brazil, Russia, India, or China (the "BRIC" countries), that would add up to about half the technical talent pool in the US. These are eager, hungry, and creative personnel who, incidentally, can be hired for a quarter of the salary levels of the US.

Beyond engineering and science disciplines, the talent pool in BRIC nations in related areas such as mathematics is even larger. Witness the massive training programs by companies in India which take non-engineering graduates and teach them how to be programmers or business systems experts.

Knowledge clusters in emerging countries

A knowledge cluster is a dense network of interlocking companies, suppliers, and university and research centers whose proximity and interactions create an industry capability in innovation and responsiveness that is not easily replicable elsewhere. As more companies are drawn to a cluster, that adds to the cluster's attraction as a center of excellence. Tapping into foreign knowledge clusters as a locational motivation is confirmed in several studies such as Alcacer and Chung (2007) or Cantwell and Mudambi (2005) who studied knowledge-seeking subsidiary formation; Patel and Vega (1999); and Sorensen, Rivkin, and Fleming (2006). Knowledge clusters not only attract knowledge-seeking foreign direct investment (FDI) but also mobile expatriate talent. As income levels and economic growth in emerging countries have escalated, we see the beginning of a "reverse brain drain" to places like St. Petersburg, Bangalore, Bombay, and Shanghai. A bio-tech cluster is emerging in Singapore because of generous tax incentives and government support. As more multinational companies are attracted to a knowledge cluster, this reinforces the virtuous cycle of related company agglomeration (Manning, 2008).

As part of its plans to invest over $1 billion in India, in 2008 Cisco opened its "Globalization Center East" in Bangalore with three declared objectives: (i) innovation, (ii) talent development, and (iii) participation in Asia's growth. General Electric Company already uses India as a global "center of excellence" for several products and technology areas. GE's Technology Center in Bangalore, with 3,800 researchers (almost all Indians or scientists of Indian origin lured back) is by some measures the company's single largest R&D grouping (Bhandari, 2009): "The work done here is for aircraft engines, turbines, water treatment plants, diesel locomotives and healthcare instruments . . . In addition, there is a 400-strong team that carries out work on "blue sky" technologies." According to Bhandari (2009), by 2010 India will have about one-sixth of GE's technologists worldwide.

Knowledge clusters are also augmented by universities which are symbiotic to the industry for both the supply of fresh talent as well as basic research. According to Un, Cuervo-Cazurra, and Asakawa (2008), when a company engages in research collaboration with an external party, the most fruitful innovations come from alliances with university collaborators. For this reason, the Danish wind-turbine company, Vestas, did not just establish a large R&D center in Chennai, India, but also developed strong links to the local universities, in particular, the Indian Institute of Technology.

Growing importance of foreign markets (and foreign market feedback)

Market feedback, as an essential input into the innovation and development process, has long been accepted as axiomatically true. However, foreign market feedback to augment the design process is a more recent idea, and one not yet universally implemented (Patel and Vega, 1999). In part, this is a reflection of the growing importance of foreign markets (Flores and Aguilera, 2007). While still a small fraction, the percentage of companies that have more than 50 percent of their sales outside their home countries is growing every year. Economic growth rates outside of the traditional company centers in the US, Japan, and Europe are much higher.

According to Farrell (2006), the importance of the local market is one of the five or six top criteria used by companies to choose their offshore locations. The importance of a foreign market can be judged by (i) existing size, (ii) potential size, (iii) as a node or hub in the global supply chain, as well as (iv) a source of cutting-edge ideas.

For basic consumer products (e.g., such as those sold by Unilever or Nestlé) the BRIC nations are already large markets. For medical and pharmaceutical products, they are on the cusp of rapid growth. Part of the motivation for relocating clinical trials to China, India, or Brazil is to build goodwill, a local "presence," and relationships with the government and Food and Drug Administration (FDA or similar regulatory agencies) there. Equally, conducting trials by hiring local doctors, nurses, and hospital administrators who administer the trials, creates a pool of foreign influence agents useful to the companies' future sales growth. This is an additional advantage on top of the other benefits of clinical trials in emerging countries – the obvious cost savings, the larger test subject pool, the fact that test subjects in developing nations are "drug-naïve,"[7] less stringent local FDA requirements, and cheaper and faster data compilation.

As an internal market, Taiwan is small or only medium sized. However, as a design hub for integrated circuits or PCs, as a global supply chain integrator – linking Chinese production centers with western markets or western technology with the mainland Chinese market – Taiwan's importance far exceeds its size (Mowery and Macher, 2007). A large number of offshoring and outsourcing sites in Taiwan are motivated by its central nodal position.

South Korea's consumer market for mobile telecommunication, wireless devices, and flat-panel displays is arguably one of the most advanced in the world, with a high degree of competition, and with fussy and demanding customers. Consequently Korea has become a fecund source of innovative ideas. This explains the establishment of new product development centers in Korea by US, European, and Japanese companies, as well as alliances between them and firms such as Samsung.

Development speed as a response to acceleration in the rate of technical change

As technical change accelerates and competition intensifies, "companies selling their products around the world need to progress products from development to the market with ever-increasing speed" (Kuemmerle, 1997). For the pharmaceutical industry, being bound by patent expiration dates, every month of delay can sometimes make a discernable difference in profitability. Outsourcing of clinical trials and screening of compounds can often be speedier in contract providers rather than performed inside the company (Getz, 2007; Sen and Shiel, 2006). Faster development and faster market entry as a motivator for offshoring has increased from 27% to 46% in responses from 1,600 companies tracked by Duke University (Manning, Massini, and Lewin, 2008). In high-tech sectors such as aircraft engines, with each sale involving millions, any delay in the promised delivery date to Boeing or Airbus may mean loss of the order to a competitor. By the same token, earlier completion of an R&D project can be a big competitive boost over rivals. General Electric credits its Bangalore R&D center's computer simulation and computer analytic skills with reducing the testing time for new aircraft engines by as much as 50 percent (Bhandari, 2009).

Broadening of knowledge inputs needed for R&D or core activities

For reasons that are as yet imperfectly understood – but probably connected with the increasing complexity of products and diversity of their market applications – even large firms are finding their internal innovative capacity inadequate. Hence they seek a diversity of external inputs into the design process from external agents and allies (Alcacer and Chung, 2002; Sjölander and Granstrand, 1990) as well as foreign locations (Kuemmerle, 1997) which can complement the firm's own efforts. Chesbrough and Teece (2002) state that "to organize a business for innovation, managers must first determine whether the innovation in question is autonomous (it can be pursued independently) or systemic (it requires complementary innovations)."

The drug discovery process has begun to fundamentally change from chemistry to molecular biology and genetics: from the more or less speculative screening of thousands of chemical compounds to see what therapeutic results they may achieve, to the manipulation of molecules based on some underlying hypotheses or hunches. But as a result, the scope of knowledge inputs has grown beyond the ken of most single firms. Even the giants can no longer garner the requisite knowledge in-house, or in the corporate headquarters nation alone. Hence the proliferation of small specialized biotechs, contract research organizations, and university collaborations worldwide (Cockburn, 2004).

The increase in R&D costs may have a greater than linear relationship to the number of knowledge input sources, because of search, learning, and integration costs – a hypothesis that was implied in Granstrand, Patel, and Pavitt (1997). However, if these diverse knowledge inputs are provided by external partners, then the search costs can be avoided and the learning and integration costs reduced.

Broadening scope of the end-applications of certain technologies

Certain technologies turn out to have end uses in areas that are unrelated to a firm's prior experience. Applied Materials, Inc. is a company whose core competence was defined as making equipment for the computer chip industry. However, closer analysis of the scope of their corporate knowledge revealed that the real expertise of the firm was nanotechnology – the ability to sense, manipulate, and fabricate structures at the molecular level. So defined, Applied Materials had technology useful in solar energy, flat-panel displays, energy-efficient glass, and fuel cells. But these were end-applications where Applied Materials had no industry experience. To bridge a downstream application gap a company has three alternatives: internal growth (which can be slow), or acquisitions in the diverse fields (often too risky), or the formation of cooperative R&D arrangements and alliances with firms already established in those end applications. This increases the return on R&D, lowers risk, and increases the firm's performance by positioning it in a broader range of end product offerings (Nichols-Nixon and Woo, 2003).

Deconstruction and routinization or codification of portions of high-value functions

Activities considered to be "core" or of high strategic importance can, nevertheless, be deconstructed into sub-segments that are routine and others that remain tacit, proprietary, and secret. The human resource management function has aspects of critical importance to strategy. But others such as benefits management or record-keeping can be routinized and outsourced (Blinder, 2006). Certain research and intellectual assets are properly treated as highly proprietary and never to be outsourced. But other aspects of the R&D function are mundane, and can be systematized, and codified with the help of IT systems, e.g., patent applications and product design. What used to be considered one monolithic block in the company's value chain is now amenable to micro-dissection into its component sub-routines.

For example, the pharmaceutical industry is slowly moving towards standard IT-based formats for clinical trial analysis, data collection, and reporting to regulatory authorities (various FDAs), and furthermore, to eventually have this codification "harmonized" and standardized across countries. Also, for example, Cockburn (2004) indicates that modern technologies and automated equipment are speeding the screening of larger numbers of preliminary compounds for possible pharmaceutical use. On the face of it, this trend seems to be an argument for *not* outsourcing or offshoring – since automation reduces skilled labor content and reduces wage costs borne by pharmaceutical firms in high wage nations. However, the fact is that greater automation in the compound screening process also entails a routinization of the screening process.[8] Once routinized, a process can be outsourced and offshored, thus yielding even further savings to the company.

The remaining two causal factors promoting outsourcing and offshoring summarize familiar economics theory arguments for de-integration.

The quest for flexibility and "leaner" organizations

As the rate of change in industries grows, firms feel greater pressures to become more flexible. In such an environment, vertical integration is held to be cumbersome. Shedding some parts of the firm's operations is supposed to result in a leaner, but more flexible firm, better able to respond to contingencies in the business environment (Rothaermel, Hitt, and Jobe, 2006).

Auxiliary or support functions, such as occasional or sporadic testing, or analytical tools not always used, if kept in-house entail idle fixed costs which are not fully utilized. By the same token, in times of peak demand, or facing competitive pressure or hurry, internal capacity to perform a particular sub-routine may be completely used up. In such cases, outsourcing as a means of temporarily adding auxiliary capacity is necessary. Capabilities used only occasionally, or subject to sudden demand can profitably be outsourced (Langlois, 2003).

Experience and scale economies in external provider companies (or in offshore company service centers)

When some auxiliary or support functions in the various divisions or departments of a firm are not performed continually, this can result in insufficient learning in a particular niche activity. By contrast, outsourced contract providers – by aggregating demand over all their clients – can achieve economies of scale and experience and achieve deep learning which makes them more proficient and more efficient than companies performing the same functions in-house. This is because specialization results in deeper and more repetitive learning in that specialist function compared to the client firms in that particular niche (Holcomb and Hitt, 2007). The same learning, specialization, and scale advantages can also accrue in offshoring, if the offshore center of the company is given a mandate to perform a certain activity or service for all of the company divisions' worldwide operations.

Strategic decision-making steps for the optimal allocation of the economic activity of the firm (applies to both outsourcing and offshoring)

Some of the arguments in the foregoing section may appear to apply only to outsourcing to external providers. But they also apply to offshoring, if the firm designates a foreign subsidiary as the specialist provider of a certain niche service to the entire global firm. This is in fact part of the strategic rationale for General Electric's or CISCO's Indian subsidiaries which are given mandates to perform niche services such as computer simulation and testing of aircraft engines for the entire global company.

After all, whether outsourcing or offshoring, it is the same story, involving a common analytical approach involving four decision steps:

- **STEP 1**: micro-dissecting the firm's value chains into smaller and smaller pieces;
- **STEP 2**: asking where – over the various divisions or departments of the firm – the same function or activity is being duplicated, and whether this function can be combined across units;
- **STEP 3**: asking where in the world this function can best be performed;
- **STEP 4**: asking which organizational form is best:
  - (i) Internal Ownership and Control (at home or in a foreign majority affiliate), or
  - (ii) Cooperative Alliance, or
  - (iii) Contractual Provider.

Step 3 (geographical location decision) and Step 4 (organizational design) are not necessarily sequential, but simultaneous. In general, the strategic question amounts to this:

In which of the six cells in Figure 1.1, should each activity of the company optimally be placed?

Inhibiting factors (or why jobs still exist in Europe, the US and Japan)

There are natural limits to any economic phenomenon. This chapter and book do not ring the death knell of vertical integration or question the continued economic vitality of advanced nation economies and jobs. But there is an undoubted fundamental shift occurring on a global scale. Starting with the separation between producer and consumer in the Chalcolithic era – and the geographical relocation and specialization of economic activity, which resulted in the emergence of international trade more than five thousand years ago[9] – this trend has gathered especial force in recent years with the liberalization of world trade and investment. In services, particularly, the phenomenon has been spurred only since the mid-1990s when installed bandwidth exploded and communication prices tended closer towards their near-zero marginal cost. Finally, in both services as well as manufacturing, the greater willingness of companies to disaggregate, and "micro-dissect" portions of their value chains, has resulted in an even finer division of labor internationally.

But all economic shifts, whether disaggregation, dis-location, division of labor, or specialization, have their natural limits. The optimal configuration for a company is neither all value being added in Cell (A), in Figure 1.1, nor all activity in Cell (D.2). Instead, the optimal configuration is a spread over many or all of the six cells in Figure 1.1. This section of the chapter details the limitations on outsourcing and offshoring faced by companies.

Embedded or tacit knowledge cannot be externalized efficiently

The transfer of tacit knowledge across the boundary between unrelated companies can be difficult, protracted, and costly, compared with internalized routines, learned over many years by company personnel sharing the same payroll and loyalties. Salaries in the Philippines may indeed be lower. But complex tasks cannot be easily codified or effectively taught to developing country personnel (Contractor and Ra, 2002). Even if the knowledge can be transferred, the cost of training the foreign workers may sometimes exceed the present value of the monthly wage savings. Companies should therefore carefully calculate what operations to keep in-house and which to outsource. Azoulay (2004), who studied the decision in pharmaceutical companies to outsource clinical trials, indicates that "knowledge-intensive projects are more likely to be assigned to internal teams, while data-intensive projects are more likely to be outsourced."

The costs of vertical integration are "sunk" but benefits persist into the future

Vertically integrated firms possess advantages and efficiencies developed from their internalized routines, past learning, and resource-based advantages (Barney, 2001). Much of the costs of vertical integration are "sunk" – meaning that they were incurred in previous years. However the benefits of the accumulated internal expertise and organizational routines persist into the future.

Delays and "hold-up" risks in global supply chains

Some companies such as Boeing have discovered, to their chagrin, that giving up internal competencies in favor of external providers has been too problematic, expensive, and delayed, so that the outsourced function has been re-internalized, at considerable cost, by acquiring the outsource service provider company (Tadelis, 2007). According to Cargonews Asia (2009), "Boeing will pay about US$580 million for a South Carolina plant in an attempt to resolve supply problems dogging its long-delayed new jet 787 Dreamliner . . . The plant in question belongs to Vought Aircraft Industries and is mostly responsible for the supply of the Dreamliner's composite sections." The risks of delay in large capital cost items like aircraft can be severe, since airlines reserve the right to cancel their orders beyond a stated deadline, or can demand penalties from Boeing for delivery delays, under contract provisions.

Finer disaggregation of the supply chain can yield savings. However, one can also hypothesize that firms that outsource increase their overall supply chain risk at a faster rate than the number of external contracts, or the number of geographical relocations.[10]

Rising labor and other costs at offshore locations

Any relocation entails incremental costs of search, negotiation, set-up, knowledge transfer, and training (Farrell, 2006). But in addition to the initial set-up costs, the "running" costs of a foreign operation, and their future escalation, have also to be estimated. In offshore "hot spots" like Bangalore, Hyderabad, or Shenzhen, skilled labor costs have doubled or even quintupled since the mid-1990s. Until the 2008 recession, stories abounded where a new employee in the IT field in Bangalore would quit his job on the very first day, tempted away by a competing offer from a rival company. Rents have doubled or tripled. Streets are clogged with slow-moving traffic and – at least in India – the infrastructure is loaded beyond its peak carrying capacity in terms of electricity, water supply, pollution, transportation, and schools, etc.

On the other hand, India is investing in infrastructure and to meet the skilled labor shortage, thousands of engineering and science graduates are being retrained for IT positions. Farrell (2006) estimates that, even if Indian wages were to rise inexorably faster than in advanced nations, after twenty years there would still be a 40 percent gap in a software engineer's salary. In part this is because of the vast Indian labor pool and also because competition from other nations – including advanced countries such as the US[11] – will put a ceiling on the rate of escalation of Indian wages.

Fear of misappropriation and leakage of knowledge to potential competitors

This fear takes two forms. First, there is a concern that outsourcing can increase unintended technology spillovers especially in foreign locations (Dosi *et al.*, 2006). With a higher personnel turnover rate, and lower control in locations such as Bangalore, spillovers to rival firms in the same knowledge cluster can occur when employees are lured away. Intellectual property laws, employment contract enforceability, and the legal environment in general may be weaker than in Europe or North America. Some studies claim that this is a dominant factor in explaining R&D location decisions (Belderbos, 2003). In some cases, the competitive threat comes from the external contract provider firm which, having mastered one (outsourced) portion of the value chain, then expands its own operations to compete with its former clients.

The second fear is that, with extensive outsourcing, a "hollowing out" of a company's core competence will occur, leaving the firm weak in the long run.

These are, indeed, significant concerns, especially in the high-value portions of the production and distribution chain.

Inefficiencies resulting from spatial separation

Geographical separation between work units, and chronological dislocations necessitate the creation of virtual linkages, which entail additional communication costs and ineffective integration of tasks because of lack of trust, disparate incentive systems, time zone differences, or cultural differences (Earley and Mosakowski, 2000; Hinds and Bailey, 2003).

Problems which can be solved through ongoing face-to-face communication when activities are located next to each other become much more complicated or intractable when the personnel are separated over large distances. In cases where the interfaces among the separated activities are improperly specified and not sufficiently standardized this will result in miscommunication and inefficiency.

Certification and quality concerns

The world is still far from having uniform or harmonized regulatory standards. Each government prescribes its own rules and procedures. For some industries and regions like the EU, there are moves to reciprocally accept a patent or drug filing made in some other countries, or in the long run seek harmonization of codes across the region or world. But this is only a nascent trend. Each nation still has its own standards, requirements, and procedures.

There is therefore a higher hurdle in terms of regulatory scrutiny or a natural bias against functions performed by (i) contract providers, and/or (ii) foreign providers. (See Hindin, 2004 for pharmaceutical industry filings before the FDA which include clinical test data done by Contract Research Organizations (CROs) and data derived from foreign locales.)

Other transaction cost considerations

Transaction cost theory provides several other cogent caveats to firms making the transition from integrated to outsourced and offshored activities. These include:

- *Negotiations/training/set-up costs*. (An example would be the avoidable costs and delays in concluding contracts with CROs in the pharmaceutical industry.)
- *Contract incompleteness*. The inability of a contract, whatever its length, to cover all contingencies is known as "contact incompleteness." Since business environments can change between signing and execution, and "knowledge goods" or knowledge-based output cannot be described with exactitude, contract incompleteness is even worse when knowledge is tacit and firm-specific. Contracts are also fuzzier, more prone to cultural misunderstandings, and their enforceability less certain in foreign settings.

- *"Hold-up" costs* and fears when as part of the contract (i) large function-specific investments need to be made by one of the contracting parties and in the event of future conflict (ii) those assets have few alternative uses in the nation (Klein, 1996). This fear inhibits either an external outsource provider or the focal firm, depending on which party is making the large dedicated investment.
- *Monitoring and coordination costs/central overheads*. As companies increase the number of their outsourced and offshored functions, greater oversight, monitoring, and coordination are required (Azoulay, 2004). Takeishi (2001) describes these as the increased cost and overheads of "boundary-spanning" efforts. Many firms have had to create new departments to handle all their outsourcing arrangements (Barthelemy, 2001). Some organizations have been overwhelmed by the volume of additional monitoring and coordination tasks – in handling the increased strategic complexity and supply chain risks (Rothaermel, Hitt, and Jobe, 2006). Overhead expenses may grow at a higher than linear rate to the number of outsourcing arrangements.

Data privacy and security

This concern is specific to and crucial in certain areas like medical and financial records. IT professionals claim that this is an easily solvable matter, through encryption or by stripping names and identifying markers from records and splitting the operation over several discrete units of the company or over different external providers, so that no single unit has the capability of assembling an entire record. However, this remains a significant concern.

Xenophobia and protectionism in advanced economies

Several foreign call centers, such as Dell's, have been brought back to the US after American customers complained of poor service and language difficulties. In general, xenophobia and a rising sense of protectionism could put a damper on the offshoring and outsourcing trend in some areas, such as customer service.

However, this also illustrates another constraint. The labor pool in China, India, Brazil, and the Philippines may appear vast. However, it is stratified. Only the top tier in those labor markets exhibits world-class skills, and there is a significant drop-off in capability going down into the second and third tiers of the labor pools. Indeed, the processing efficiency of customer service in Philippine or Indian call centers has declined in the last five years. The cream of the foreign labor pools has been lured away by other firms, or has gone into more attractive occupations. The second- and third-tier personnel can do the same jobs – but more slowly, less satisfactorily, and with stronger local accents.

Erosion of competitiveness in external service provider firms

Barthelemy (2003) indicates that, infrequently, an external service provider may lose its technological edge and then the function may have to be reincorporated into the client firm, or another external contract provider sought. When selecting an external provider, an initial assessment of their technology trajectory and absorptive capacity are desirable.

At the same time, supplier and buyer firms can benefit and augment each other's technological competencies through greater ongoing cooperation in an alliance arrangement.

Cooperation: neither in-house nor contractually distant

The search for the optimum (organizational and spatial) configuration of a firm these days necessarily includes arrangements that are neither completely in-company, nor arms-length with distant contractors. Instead, cooperative relationships between two firms that remain distinct – or corporate "alliances" – are often preferred. In Figure 1.1, these comprise Cells (B.1) and (D.1).

According to surveys of some of the world's largest enterprises, over one-fifth of their revenues comes from alliances, or for many other firms some 30 percent of their R&D expenditures is shared with co-development partners (Kale and Singh, 2009). Globally, the nominal number of alliance arrangements must run into the millions. IBM and CISCO alone each claim over 100,000 "partnerships." The character of most of the listed arrangements may not be much more than contractual, or temporary, or in some cases is merely a listing with no ongoing joint activity. Nevertheless, it would be correct to estimate that a significant fraction of the 100,000 partnerships of IBM or

CISCO entail real ongoing relationships. These relationships between the managements of the allies involve cooperative behaviors that go well beyond what their formal agreement states. Moreover, several of their alliances include major joint commitments and investments amounting to many millions of dollars.

The strategic objectives of alliances

Alliance arrangements encompass a multiplicity of purposes, such as joint R&D, the transfer of technology from one firm to another, cooperative supply chain links, or the joint development of a market (Contractor and Lorange, 2002). These involve diverse strategic objectives such as:

Cost reduction

Examples include new systems developed by CISCO, or one of its partners which are more efficient than the existing version. The new configuration is then licensed from one ally to the other. However, the transfer of technology and its implementation cost in another country requires future collaboration of an unknown extent. Hence the cost of the technology transfer borne by each partner cannot be exactly specified in the agreement. However, with an ongoing relationship, based on trust and forbearance, the sacrifice made by a partner, in one deal, is remembered and they may be compensated with a sweeter arrangement in the future.

Risk reduction

Alliances between biotech and big pharmaceutical firms are predicated on the big company's limited internal knowledge in new areas like genetics, and the small partner's deep specialized knowledge, nimbleness, creativity, speed, and freedom from the big company's restrictive organizational culture. The large pharmaceutical firm's deeper pockets share part of the risk of developing a new molecular entity, and it is also better at the (nowadays international) clinical testing and certification process, and the increasingly expensive marketing phase. This is an example of risk-sharing based on complementary contributions by the two partners.

However, in joint exploration in the natural resources area, or in R&D for new technologies jointly undertaken by IBM and a partner, the talent and money contributed by each member of the coalition is not complementary, but similar. In such a case, the alliance is simply a risk-pooling or risk-sharing device.

In the same vein, when industry giants like Microsoft or Novartis take small equity stakes in a hundred start-up companies, or pay in advance to acquire unknown future rights to technology that may or may not emerge from their start-up partners, this is akin to buying one hundred lottery tickets (with a small investment in each) rather then spending the entire R&D budget on say two large R&D projects. This is another risk reduction device and a "real-options" approach to participating in possible future technology developments.

Revenue enhancing or market accessing alliances

Alliances where one ally contributes intellectual assets or a technology, while the other contributes access to a market, are very common internationally. The classic example is the successful Abbott-Takeda 50/50 joint venture (JV) for the American market. Takeda's contribution was the drug, while Abbott's expertise was US certification and marketing under the *Prevacid* brand name.

Many cross-licensing agreements in the pharmaceutical industry involve not merely the exchange of patents, but really the exchange of territorial rights to different countries. New computer applications or software are licensed because the developer does not wish to carry the risks or costs of a foreign market development. They would rather leave that end of the value chain (in that region) to a local partner who has better understanding of the regional culture, regulatory practices, and distribution.

In the 1980s, 7-Eleven, a chain of convenience stores, was highly integrated, even owning the cows which supplied the milk on their shelves. Today, most of their procurement is outsourced, but under very cooperative relationships where the allies share proprietary knowledge (Gottfredson, Puryear and Phillips, 2005). 7-Eleven's core competence is today described as gathering and analyzing data from its hundreds of thousands of consumers worldwide, and selectively sharing this with their suppliers. 7-Eleven even goes so far as to recommend changes in recipes and packaging design. Major suppliers co-invest in market research, store displays, and kiosks, and even install dedicated machinery in their factories for special 7-Eleven orders – risks they would not take were it not for a trusting alliance relationship built up with the company.

The learning objective

In many alliances, the dominant strategic objective is learning. Since 2005, when new legislation in India again allowed product patents for drugs, the pharmaceutical industry view of India has made an almost 180 degree turn.[12] India is now considered a very desirable growth market. Foreign companies are rapidly forming subsidiaries and alliances with Indian partners for all portions of the value chain, from marketing in India, to clinical testing and certification, and even joint R&D. In the latter two areas, a dominant objective is mutual learning. The Indian partner wishes to learn the technology or research procedures, while the foreign partner wishes to learn about the Indian market, institutions, and regulation.

Strong alliance relationships with a CRO may remain contractual, in legal form. But when mutual trust develops, the two become allies for the long term (Sen and Shiel, 2006) and are increasingly willing to risk larger investments into R&D projects, which benefit each other from mutual learning over the long run (Dyer and Singh, 1998).

An Indian company may begin as a contract partner to do clinical trials for a US firm in India (Cell [D.2] in Figure 1.1). Initially, the US company is not familiar with the Indian medical establishment or government. But later, as they learn, and as the relationship with the Indian partner deepens, the American company may buy a partial equity stake in the Indian company (which moves them into Cell [D.1] in Figure 1.1) or acquire the latter outright and convert it into an Indian subsidiary (Cell [C]).

Joint R&D

The "lean manufacturing" concept that began in Japan superficially appears to have cost reduction as its main objective. Indeed, the engineers of say Toyota and its suppliers will do intensive joint R&D with the idea of shaving pennies off the cost of a component. But an equally important unheralded objective is to get the supplier base to share the costs and risks (and rewards) of joint R&D. An arms-length supplier will not do R&D that benefits the large firm. They have no assurance of being able to share in the fruits or rewards of a successful new component design. However, if the relationship is cooperative, deeply interactive, and based on trust, a supplier has the incentive to risk investing in joint R&D because they know their sacrifices and investment will be remembered, even if one particular R&D project does not yield much. In an adversarial, arms-length, competitive environment, with multiple suppliers bidding for the same component order, the transaction costs of dealing with arms-length parties are too high. Compared to a contractual strategy landscape, in the Japanese "*keiretsu*" system, the number of suppliers the focal firm deals with is reduced. The fewer chosen suppliers are then invited to form deeper cooperative relationships with the assembler who often will take a small equity stake in the partner. (This is more to signify trust and membership in a corporate "family," rather than the small equity stake having any real voting power.) Consequently, the relationships with the chosen fewer suppliers are more intensely interactive. There is greater mutual disclosure of proprietary knowledge. In an alliance context there is far more joint R&D than in an arms-length environment.

CROs and big pharmaceutical firms that have developed trust over the years then have an incentive in investing in co-specialized assets. For example, they jointly develop a common IT platform and management processes whereby their interaction and communications are more standardized and less costly. Neither ally would undertake the cost and risk of a relationship-specific R&D investment without some assurance of an ongoing alliance link between them.

Diversifying the product and market portfolio

Earlier we discussed the example of Applied Materials, Inc., a company in the business of selling equipment for the fabrication of computer chips. But the real expertise of this company may be described as nanotechnology (the ability to sense and manipulate matter at the molecular level). Nanotechnology has applications in many other fields totally unrelated to the company's prior experience, such as flat screen displays, and solar cells. Forming alliances with companies in those unrelated areas gives Applied Materials a presence (and a future revenue stream) in product and market areas in which they could not have hoped to enter by themselves. Takeda, despite having a significant Japanese presence, did not feel sanguine enough about their own abilities to get rapid FDA approval and market share in the US. That is why they invited Abbott to form a 50/50 joint venture alliance for what turned out to be a very mutually profitable blockbuster drug – *Prevacid*.

Which is more important – alliance structure or process?

An alliance will typically have a legal agreement that specifies its structure, such as royalty or milestone payments, unit price or quantities in supply chain agreements, rights to buy the partner's shares, or in the case of an equity joint venture, the shareholding of the two partners that jointly create and run the (third) joint venture company. But in most situations, the industry and the environment change rapidly enough, so that no agreement, however lengthy, can cover all the eventualities. This is described by the term "contract incompleteness" or the inability to foresee and specify all future possibilities (Williamson, 1975). And this is one reason why healthy alliances go beyond contract specifications to a cooperative relationship between the two or more firms – based on mutual trust, forbearance, openness, friendly exchange of personnel, and willingness to share risks, costs, and rewards. A legal structure is desirable. Many would call it a necessity. But successful alliance executives know that the language of their legal agreement is only a beginning and that the arrangement will often need to be renegotiated as conditions change.

The drawbacks of entangling alliances

Unlike purely contractual and distant outsourcing links (Cells [B.2] and [D.2] in Figure 1.1), alliances (Cells [B.1] and [D.1]) typically entail higher investments, longer-term commitments, and deeper relationships. But there is also a higher mutual vulnerability. When alliances terminate there may sometimes also be higher costs than in arms-length contracts.

First, relationship building takes time and considerable effort. For many firms, this requires patience and cultivating new relationship-building skills which they may not have possessed or needed in the past (Holcomb and Hitt, 2007). In addition, to keep the relationships developing entails an ongoing management overhead cost (Tadelis, 2007). Large organizations like Novartis, with more than 500 alliance partners at any given time, need huge departments with lawyers, engineers and other highly paid personnel to negotiate, transfer knowledge and intellectual property, monitor the arrangements, and act as interface between the hundreds of allies and the focal company.

This is a large and complex task. "Contract incompleteness" means that one alliance partner often seeks a renegotiation as industry conditions change. By all accounts, the Abbott-Takeda Joint Venture was a success for both parties. However, in the latter half of their alliance relationship, Abbott had a disagreement with Takeda (and even sued them in 2005 to force a change) alleging that the transfer price (per kilogram) at which Takeda sold the "active pharmaceutical ingredient" (API) to the 50/50 joint venture was too high. Clearly, the higher the unit price of the API, or key raw material, the higher are Takeda's profits. The profit mark-up on the API is 100 percent earned by Takeda, in Japan, without incurring US taxes. By contrast, any profits made by the joint venture company had to be shared 50/50 with Abbott (and that, too, after paying US corporate income taxes). Alliances often have such inherent (or "built-in") conflicts of interests. The two companies, whilst entangled in an alliance, nevertheless remain separate entities.

The termination rate of alliances may, or may not, be different from single-management companies. Data are unavailable.[13] Moreover, termination itself does not signify failure. Many alliances in high-tech areas are wound up at the behest of both alliance partners – with mutual consent. This occurs when the patent runs out, or when the technology has progressed on to the next generation. The strategic purpose of many alliances is intrinsically, and intentionally, medium term. However, it is true that when alliances terminate, the division of assets is messier than when a single company terminates an operation. The overall distribution of benefits that accrued to each ally is rarely commensurate with the costs and risks borne by each. Over the entire Abbott-Takeda alliance cycle,[14] the benefit/cost ratio for both companies was greater than 1. However, the ratio was not the same for both firms. In retrospect, while both were better off forming the alliance (compared to the go-it-alone or internalization alternative), the net value captured by one partner was greater than the net value captured by the other.

Alliances are now a permanent feature of business

Alliances, as we know them today, were virtually non-existent or very few at the start of the twentieth century. Their proliferation in the last twenty years is a reflection of the fact that, for certain strategic objectives, neither complete internalization nor arms-length contracts are optimal. Instead, an intermediate organizational form – namely alliances – provides the best choice in many circumstances. Today, there is hardly a major company that does not have several cooperative or alliance-based relationships as part of its overall operations. No passing fad, alliances are now a minor but permanent part of the strategy landscape. Today, a mix of in-company operations, contracted outsourcing as well as a network of several cooperative alliance arrangements constitutes the "portfolio" of any significantly sized company – one that searches for, links to, and extracts cooperative value from multiple relationships (Chesbrough, 2007).

Concluding remarks: the evolution of economic organization from the Paleolithic to the globalization era

Humans have progressed from individual self sufficiency to group cooperation, from do-it-yourself production to units that specialize in one or few items made at larger scale. Ours is a story of separation between consumer and producer – as well as a separation, by specialization, between one type of producer and another. Even within a factory or workshop, workers and operations became separated by skill level and task, because each worker, through repetition, progresses down his/her own experience and specialized skill curve. By the Chalcolithic era, in the fourth millennium BCE in Palestine, factories had become so specialized that one workshop would produce only drills or micro-borers. Another produced only tabular scrapers, another only sickles, and another only ivory figurines, and so on (Levy, 2003). From there, the output was distributed all over the Eastern Mediterranean. Today, only because our maps have strange lines called "country boundaries" do we label this as "international trade."

The seeds of all of these economic trends were planted in the Middle or Late Paleolithic era. But it was not until the waning decades of the twentieth century that these trends gathered exponential force.

Today, the ever finer disaggregation or slicing of the value chain, the relocation of each slice to remote regions, and the international division of labor by specialization have reached unparalleled proportions and a planetary scope.

In a sense, this is the logical corollary of "lean manufacturing" programs which have spread around the world. The Industrial Engineer, armed with a stopwatch, does "time-and-motion" studies of a worker's movements, analyzes each worker's turn of hand, or swivel of heel, and determines how the worker's movements can be pared down to a minimum in time, and maximum in output. The Industrial Engineer optimizes the division of labor along an assembly line, optimally dividing the operation into discrete tasks and sets the speed of the assembly line in such a way that no individual worker has slack time. He or she also seeks to replace a human with an automated machine, if technologically and economically feasible.[15] So too, the Industrial Economist seeks to divide the value chain into discrete and fine bits, to determine the optimal allocation of each slice or component over space (country), time, and organizational type (firm hierarchy, or cooperative alliance or contract).

Figure 1.1 described the six generic combinations of geography and organization type over which each firm's value chain may be allocated. The chapter then outlined a decision procedure consisting of four strategic decisions: *Step 1*: Micro-dissecting the firm's value chains into as many small pieces as economically divisible. *Step 2*: Asking if the same function or activity is being duplicated, and whether this function can be combined across different units of the company. *Step 3*: Asking where in the world this function can best be performed. *Step 4*: And for each location (where the specialized function is to be performed) asking which organizational form is best, whether (i) Internal Ownership and Control or (ii) Cooperative Alliance, or (iii) Contractual Outsource Provider. In the broadest sense, this chapter poses the question:

In which of the six cells in Figure 1.1, should each activity of the company optimally be placed?

The explosive increase in the geographic relocation and reorganization of economic activity in the last two decades is a reflection of (i) *necessity* (the intensification of competition faced by companies because of globalization and liberalization of trade and investment regimes); and (ii) the *means* to do so (i.e., the precipitous drop in transport, data transmission, and tariff costs – so that output can be relocated much farther afield from its consumer than ever before). At the same time, we have quietly undergone a revolution in management ideas and organization. From an era when Ford made everything including its own steel to the finished automobiles, from IBM preferring to withdraw from India rather than accept local partners, we are now in an era where managers are willing, even eager – in the name of efficiency – to share control with a plethora of suppliers and partners in a spectrum of arrangements, from arms-length outsourcing to the familial alliance. The chapter described the benefits and drawbacks of each organizational type, and identified the driving factors, as well as the factors inhibiting the offshore relocation of economic activity. Managers are also willing today to consider what would have been unthinkable to some even ten years ago – the outsourcing and offshoring of "core competence." Even these core or high-value portions of the value chain, such as R&D, can now be disaggregated, or micro-dissected into operations that need to be highly proprietary (for fear that the firm's knowledge may leak to competitors) *versus* those functions that are mundane or can be routinized and outsourced, with no danger to the company.

We have come a long way since the ancestral Paleolithic workshop in Grotta Sant'Angelo. The denizens of that flint-knapping and toolmaking cave have vanished into prehistory. Perhaps the genesis of that economic activity was not even a conscious act. Since the finished spearhead may be only one-fifth, or less, in weight compared to the stone raw material (i.e., it was a weight losing production process) the incentive for locating the workshop near the quarry is fairly obvious. Today, location decisions are based on planetary scale intelligence (in both its meanings, the availability of information or data, as well as meta-analytical skills in industrial economics and global management).

Notes

1 The University of Michigan Museum of Anthropology (2009) uses the term "workshop" but stops short of describing it as having any organization because of lack of physical evidence.

2 For each assembly plant, Sutton (2004) identifies a *minimum* of 24 separable major systems or sub-assemblies that constitute a modern

automobile, and classifies them into three groups: "Normally Made In-House," "Often Outsourced" and "Normally Outsourced." The outsource suppliers, in turn, procure from yet other external vendors, and so on.

3 Merchandise trade over vast distances was established long ago. Pliny the Elder complained to the Roman Senate about Rome's enormous trade deficit of 100 million sesterces per year, caused in major part by imports from Asia. He blamed Roman women's fondness for Indian textiles and Chinese silks. Roman coins are periodically dug up from Indian soil. Indian-style temples all over Southeast Asia attest to the commercial expansion by Indian traders and empires in the first millennium CE. However, another definitional and data problem arises from the fact that the nation-state, with fixed jurisdictional boundaries as a political entity, is only a few hundred years old.

4 See www.Vestas.com.

5 There is a considerable lag in reporting. Moreover, these are data only for the foreign affiliates of US-based multinationals. One can surmise that similar growth exists in contract research performed by third parties – Cell [D.2] in Figure 1.1.

6 These data are only for the US, and only for the majority affiliates of US multinationals. They do not cover foreign multinationals, or the substantial growth in foreign contract research done by arms-length parties for which aggregate global data are poor, or non-existent.

7 The term "drug-naïve" refers to the generally lowered consumption of drugs in developing nations, with the benefit that a drug under trial is less likely to interact with a drug already in the test subject's body, thereby confusing the results.

8 In some cases, though by no means all, automation also results in being able to use operators with lower skills and discretion who simply follow routine procedures and instructions.

9 Specialization of production in workshops began much earlier, probably no later than the dawn of agriculture around 10,000 BCE. However, scholarly circumspection does not allow many archeologists to admit this because the physical evidence is scant thus far, the surface of the planet barely having been scratched.

10 There is as yet no evidence, but this hypothesis could constitute a significant future research study.

11 The bottom 20 percent of wage earners in the US have seen their real income decline or stay stagnant over the past fifteen years. It is difficult to say what portion of this decline can be attributed to domestic automation and service sector productivity measures on the one hand, and competition from offshore locations on the other. The point remains,

however, that some operations in US states such as South Dakota, Utah, or the South where wages are below the US average, remain marginally competitive with several offshore locations.

12 From 1970, when socialist tendencies in India were at their peak, until 2005, India did not allow product patents for drugs, but only "process patents," a policy that spawned a healthy Indian generics industry with as many as 22,000 (mostly small) generics producers who were alleged to have gleefully copied patents filed in Europe, the US, and Japan. This resulted in medicines being available to the Indian customer at tiny fractions of the price of the patented equivalent. However, it made India a *pariah* nation, as far as the industry majors were concerned.

13 Kale and Singh (2009) quote statistics from two surveys. But there is no comparable control group of single-management firms, so that a proper assessment cannot be made.

14 The alliance was terminated and settled to mutual satisfaction in 2008–09.

15 One of the authors of this chapter, Farok Contractor, wishes to confess that he began his career as an Industrial Engineer in the Max Factor Co. factory in Gardena, California. As part of the redesign of assembly lines, he did time-and-motion studies to see how the assembly operation could be speeded up, or workers replaced by automated equipment. He was immensely popular on the factory floor.

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