Chapter 20

International Research & Development

International R&D is ever more important. But as well as the many advantages of R&D internationalisation for MNCs, it also poses a major challenge. This Chapter discusses the benefits and caveats of international R&D. Different roles of foreign R&D units are highlighted, the coordination of international R&D investigated and different organisational models for MNC's international R&D described.

Introduction

Empirical Relevance of International R&D

Given the high relevance of innovation for the competitiveness of MNCs, R&D is a core value chain activity. The internationalisation of R&D is not a new phenomenon. A certain level of international R&D to adapt products and technologies to local markets has always been necessary. However, basic and applied research was traditionally reserved for MNCs' home countries. In recent decades, however, some new trends have emerged (UNCTAD 2005; Shenkar/Luo 2008, p. 356), and MNCs' R&D is increasingly conducted abroad.

For example, the European Commission shows in their scoreboard (containing economic and financial data for the world top 2,000 companies) that, together with the US and Japan, the EU plays a major role in international investment. Between 2003 and 2012, the EU attracted 22% of FDI projects in R&D from the set of non-EU-companies, while 26% of FDI projects in R&D invested from the EU are based in non-EU-countries. In comparison, for the same period the US obtained only 8% of FDI projects and contracted 52% to non-US-countries. Looking at the geographical distribution of the BRIC countries, the figures confirm the increasing role of these regions. Despite these countries playing a limited role in R&D outflows (3%), they play a major role in R&D inflows (41%) (European Commission 2013a, p. 72).

In some developing countries, MNCs' R&D is increasingly targeting global markets and is integrated into the companies' core innovation efforts. The opening of the new *Audi R&D Center Asia* in Beijing (2013) or the new *Bosch* research centre in Bangalore (2014) are just two examples of the strategic importance of the internationalisation of innovation. In addition, MNCs from newly industrialised nations like Singapore, South Korea or Taiwan have begun to relocate R&D activities to other countries as well (see Chapter 5).

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R&D Intensity

However, the magnitude of foreign R&D differs substantially between industries. Most foreign investments in R&D (60%) during the period 2003-2012 were concentrated in information and communication technology (production and services), pharmaceuticals, biotechnology, automobiles and parts. In contrast, industries such as traditional/alternative energy and transport showed little interest in R&D internationalisation. This differing degree of R&D internationalisation can be partly explained through the different levels of R&D intensity in those industries; those industries with a very high R&D intensity display above average levels of R&D internationalisation. A classification of industries by *R&D intensity*, i.e. R&D expenditure as a percentage of net sales, is provided by the European Commission (see Table 20.1).

Table 20.1 *Grouping of Industrial Sectors According to R&D Intensity*

Industry Category	R&D Intensity	Examples of Industries
High R&D Intensity	>5%	pharmaceuticals and biotechnology; health care equipment and services; technology hardware and equipment; software and computer services; aerospace and defence
Medium-high R&D Intensity	2-5%	electronics and electrical equipment; automobiles and parts; industrial engineering and machinery; chemicals; personal goods; household goods; general industrials; support services
Medium-low R&D Intensity	1-2%	food products; beverages; travel and leisure; media; oil equipment; electricity; fixed line telecommunications
Low R&D Intensity	<1%	oil and gas; industrial metals; construction and materials; food and drug retailers; transportation; mining; tobacco; multi-utilities

Source: European Commission 2013a, p. 27.

Types of R&D

While R&D is often considered a homogeneous task, it is important to distinguish different types (UNCTAD 2005, p. 103). The objective of basic research is to gain a more comprehensive knowledge or understanding of the subject under study without targeting specific applications. In industry, basic research refers to research that advances scientific knowledge but does not have specific immediate commercial objectives. The objective of applied research is to gain the necessary knowledge or understanding to meet a specific, recognised need. In industry, applied research includes investigations to discover new scientific knowledge that has specific commercial objectives, e.g. with respect to products. At last, development is the systematic use of the knowledge or understanding gained from research directed towards the production of useful materials, devices, systems or methods, including the design and development of prototypes and processes.

Configuration of R&D

As with all value chain activities, the first basic decision focuses on the choice of location(s). Before concrete location(s) are selected, it must be decided whether R&D should be concentrated in one country (commonly the MNC's home country) or geographically dispersed across a number of R&D units.

Centrifugal-Centripetal Forces Model

The *forces models* of R&D internationalisation emphasise that there are positive and negative influence factors on the internationalisation of R&D which act as *opposing forces*. *Centrifugal forces* pull R&D away from the centre, i.e., the MNC's home country, while *centripetal forces* act to keep R&D in the centre (Pearce 1989, p. 38; Fisch 2001, p. 20; 2003, p. 1382). These opposing forces explain a tension over the degree of internationalisation; having the forces in equilibrium is considered to be optimal.

Motives for the Internationalisation of R&D

The general trend towards internationalisation of R&D is based on a number of different motives (Schmid 2000, pp. 2-3; Zentes/Swoboda/Morschett 2004, pp. 537-540; Shenkar/Luo 2008, pp. 356-360; OECD 2008, p. 39; Schmiele 2012, pp. 101-106; European Commission 2012, pp. 3-7):

- *access to scarce production factors*, in particular qualified research personnel
- exploitation of *cost advantages* in the host country, e.g. lower wages
- enhanced *speed* of R&D, e.g. through international division of labour
- *tapping local knowledge* in host countries and establishing links to local information and communication networks, e.g. by establishing "listening posts" in lead markets or in regional innovation clusters (see Chapter 8), and *proximity to scientific institutions*, e.g. universities or private research institutes, to gather knowledge and capabilities
- enhanced *innovation power* by creating competition between R&D units
- development and exploitation of *complementary resources* and *competences* in different locations
- *circumvention of legal restrictions* in the home country or better acceptance of certain technologies in different host countries
- securing *market access* and fulfilling *legal requirements* (e.g. local content)
- better *identification of local market needs* and easy *adaptation* of technologies to local markets by the presence of R&D in the host country

- *avoiding not-invented-here syndrome* at the foreign subsidiaries
- *enhancing the innovation capacity* of the MNC by leveraging the knowledge of different R&D units to identify a diversity of ideas and local needs and developing a truly transnational R&D process in which these diverse stimuli are systematically combined.

R&D Internationalisation as By-Product

Frequently, R&D internationalisation is a *by-product* and not the result of planned internationalisation. In the case of M&As, which are not usually targeted at the R&D units of the acquired companies, the dispersion of R&D may be the result of "administrative heritage" and is often retained to avoid a brain drain (Schmid 2000, pp. 6-7).

Motives for a Regional Concentration of R&D

There are a number of arguments against the internationalisation of R&D. These *centripetal forces* are mainly based on the dispersion of R&D activities and not necessarily against internationalisation. Given that concentrated R&D activities are usually located in the MNC's home country, i.e. in the headquarters, the effect is the same. Advantages of R&D concentration include (Schmid 2000, pp. 5-6; Zentes/Swoboda/Morschett 2004, pp. 541-542; Shenkar/Luo 2008, p. 359; European Commission 2012, p. 6):

- achieving *economies of scale* and reaching a *critical mass* for R&D activities
- *economies of scope*, since carrying out various R&D projects in one location can produce spill-over effects
- easier *coordination and control* of the activities which might help to avoid dissipation of efforts and to reach a better alignment between R&D activities and corporate goals
- *better communication* due to the presence of all researchers in a single location and personal *face-to-face contact*, which is particularly important in the case of tacit knowledge (since R&D requires dense knowledge exchange)
- establishment of *informal networks* among the different researchers
- *simplified organisation*, since complex cross-border structures and processes can be avoided
- *avoidance of unintended duplication* of research work, since local researchers are usually better informed about their colleagues' projects
- *avoidance of conflicts* between researchers at different locations

- relevance of *country-of-origin effects* that are usually rooted in the MNC's home country
- higher likelihood of establishing a *uniform R&D culture*
- better chance of avoiding a *proprietary knowledge leak* when research results and innovations only have to be communicated within a single R&D centre.

Overall, these aspects lead to R&D being traditionally highly concentrated in the MNC's home country and being the least fragmented of an MNC's economic activities (UNCTAD 2005, p. xxiv).

Internationalisation of Different Types of R&D

When it comes to the different advantages and disadvantages of R&D internationalisation, the mentioned forces affect different types to different extents. Thus, R&D is often not undertaken in the same location (Kuemmerle 1997; Boutellier/Gassmann/Zedtwitz 2008, p. 189). Development is often collocated at manufacturing sites while basic research frequently either remains at the corporate headquarters or is located in *regional innovation clusters*. Both development and applied research serve to support local marketing while basic research helps in scanning and evaluating external sources, e.g. by establishing listening posts or tapping the knowledge of university spin-offs. Finally, development and applied research are pulled towards attractive markets since their purpose is adaptation of technology to particular market needs, while basic research is pulled towards the quality of scientific input.

Roles of International R&D Units

UNCTAD Typology

For subsidiaries in general (see Chapter 3), international R&D units can be categorised into different roles. Based on the type of R&D undertaken and the primary motives for the establishment of the R&D unit, UNCTAD (2005, pp. 138-139) suggests the following typology (see also Pearce 1989, pp. 111-112; Nobel/Birkinshaw 1998, pp. 481-483; Fisch 2004, p. 148; Zedtwitz 2005, pp. 1-4; Shenkar/Luo 2008, p. 361):

- Local adapters are "*market seeking*" R&D units. Their purpose is to facilitate exploiting HQ technologies by adapting them to local context.
- Locally integrated laboratories (also called "indigenous technology units" or "international independent laboratories") are more advanced than local adapters and are capable of *independent innovation* aimed primarily at local (and perhaps regional) markets. The units remain linked

to local production and are usually a natural evolution from local adapters.

- The most advanced type of innovative activity conducted by foreign affiliates is the international technology creator (also called "internationally interdependent laboratory" or "global technology unit"). This unit serves the same purpose as core innovating centres in the home country. These facilities can do both research and development, and their output is typically aimed at *global exploitation* by the parent company.
- The fourth role for a R&D unit is the *technology scanning* or *monitoring unit*. This is typically a "business intelligence" function undertaken to identify and generate new ideas. With the same purpose, but in the absence of a separate R&D facility, scanning can also be done by another department of the MNC.

These four roles are closely linked to the necessary *communication flows* in the R&D network. More explicitly, a model proposed by Bartlett/Beamish (2014, pp. 374-385) describes different innovation models that explain the direction of knowledge flows (see also Gassmann/Zedtwitz 1996, p. 10). In the "*centre-for-global*" model, R&D is carried out in one concentrated location and the new technology is then exploited globally. This follows the traditional "*centralised hub*" model for MNCs (see Chapter 1). "*Local-for-local*" R&D is undertaken in different country subsidiaries and relies on subsidiary-based knowledge used to identify local market needs and create innovations targeting the local market. Cross-border communication is low in this case. In "*local-for-global*" processes, a foreign R&D unit takes a leading role as an *international technology creator* and creates innovations that are subsequently used by the whole MNC. This case of a specialised task is a clear expression of a *transnational organisation*. Another transnational innovation model leads to "*global-for-global*" processes, where R&D units work together to create an innovation. Globally linked but widely dispersed capabilities and resources are used to enhance the MNC's R&D capacity and the results are exploited by all organisational units within the MNC.

International R&D Alliances

Besides the configuration and role of international R&D, the MNC must also consider its operation mode (see Chapter 14 for the basic options). As well as conducting R&D on their own, in wholly-owned R&D units, MNCs can also choose cooperative operation modes for their R&D activities, e.g. by establishing a joint venture or through a contractual arrangement like (active or passive) licensing. As with other value-added activities, the market option is

available, i.e. purchasing new technologies from independent external sources.

Benefits of R&D Alliances

R&D alliances have a number of benefits (Rotering 1990, pp. 80-81; Zentes/Swoboda/Morschett 2004, pp. 552-553; Dunning/Lundan 2008, p. 379):

- *synergy effects* through the exploitation of complementary technological knowledge
- *expansion of internal expertise* by tapping the partner's tacit and explicit knowledge
- *sharing of costs* of R&D projects
- *enhanced flexibility* to react to changes in the technological environment, e.g. by enabling a higher number of simultaneous research projects
- *reduced risk* by spreading technological and financial risk, given the high uncertainty in the field of R&D
- *shorter innovation cycles*
- concentration of resources on *core competences*
- joint *establishment of norms and standards* for new technologies
- *better exploitation of research findings*, e.g. due to complementary marketing potentials (e.g. sales regions or products).

Disadvantages of R&D Alliances

Unfortunately, R&D alliances also have many substantial disadvantages. Theoretically, these can often be explained with the *transaction cost approach* (via the low efficiency of inter-company knowledge transfer) or the *knowledge-based view* (via the better effectiveness of intra-company knowledge transfer). Caveats include (see, e.g., Rotering 1990, p. 85; Zentes/Swoboda/Morschett 2004, pp. 553-554; Oesterle 2005, pp. 776-778):

- *technological dependence* on external partners and potential *erosion of core competences*
- *problems* in the course of the *knowledge transfer* between partners due to low absorptive capacity for proprietary knowledge and a lack of effective knowledge transfer mechanisms in alliances
- danger of *knowledge dissemination* to the partner or others
- risk of losing a competitive advantage (alliances as *learning races*)
- high *coordination effort* and high negotiation costs
- *reduction in internal decision power* and company-individual flexibility

- *difficulties in assigning profits* from an innovation to each partner
- *potentially enhanced time requirements* due to coordination and communication efforts.

Strong Growth in R&D Alliances

Overall, as a basic trend, strategic R&D alliances are strongly on the increase. The relevance of cooperative R&D has been increasing for the last 50 years (UNCTAD 2005, p. 126; OECD 2008, p. 59). Rising international competition and ubiquitous knowledge lead to collaboration to reach strategic goals. The data from the Cooperative Agreements and Technology Indicators shows the steady growth between 1980 and 2006 of worldwide business technology partnerships (National Science Foundation 2010, pp. 52-53). Although collaborative activity in R&D is not new, it has evolved towards direct strategic uses (Narula 2003, p. 110). Companies increasingly set up collaborations with other enterprises, suppliers, commercial laboratories, universities or other external parties. In the EU-27 over one in four enterprises (25.5%) were engaged in such a cooperation for product and/or process innovation (Eurostat 2013). In addition to the importance of collaboration, MNCs still seem to prefer R&D partners that are geographically close (Belderbos/Gilsing/Jacob 2011, p. 10). Since 2005, the number of well-chosen collaborations has increased in the health and biotechnology sector. The growing demand for new medicines, the "patent cliff" of expiring blockbuster patents and new opportunities in therapeutic biotech have shown that no single company can develop excellence in all the areas of research required to develop a new drug. Moreover, there are strong pressures on pharmaceutical companies to reduce drug development costs and share the risks involved (UNCTAD 2005, p. 126; European Commission 2013a, p. 57).

Open Innovation

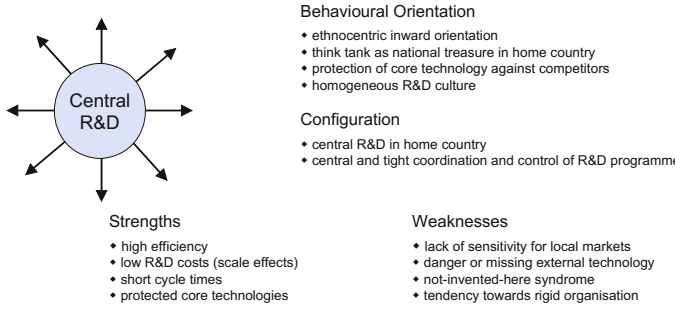
A new type of R&D cooperation is gaining importance, regardless of national or international/global perspective. Firms are increasingly open to *outside innovation* (open innovation, open R&D) (Gassmann/Enkel/Chesbrough 2010). Open innovation can be defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough/Vanhaverbeke/West 2006, p. 1). Companies investing in *open innovation activities* have reported considerable success, but they also face risks and barriers. "*Procter & Gamble* announced that they were able to increase their product success rate by 50% and the efficiency of their R&D by 60% by introducing the open innovation concept to the organization. *Philips* has a well-established open innovation environment, while *Siemens* started a huge corporate open innovation program in 2009." (Enkel/Gassmann/Chesbrough 2009, p. 312).

Organisational Model for International R&D

Boutellier, Gassmann and Zedtwitz (2008, pp. 77-95) have proposed an organisational model for international R&D that is frequently applied in literature. This model, which is based on the concepts of Bartlett/Ghoshal and Perlmutter (see Chapter 2), involves the simultaneous configuration and coordination of international R&D. It distinguishes R&D concepts based on the *geographical dispersion* of internal competencies and knowledge bases and the *degree of cooperation* between R&D sites, which reflects the level of global integration of R&D activities.

Ethnocentric Centralised R&D

Figure 20.1

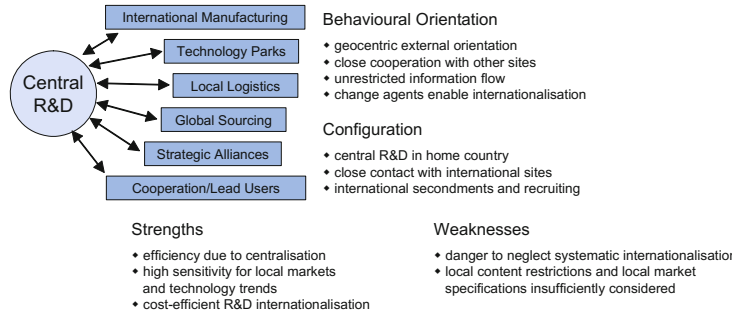


Source: Boutellier/Gassmann/Zedtwitz 2008, p. 80.

In the *ethnocentric centralised R&D organisation*, all R&D is concentrated in the home country. Examples include *Toyota* or *IBM*. The MNC assumes that the HQ is technologically superior to its subsidiaries. Central R&D creates new products and technologies which are then distributed worldwide. Physical colocation of R&D employees and a common understanding of the R&D strategy facilitate the control of R&D activities and enhance efficiency. Other advantages and disadvantages are shown in Figure 20.1.

The more dependent the company is on foreign markets, the more inappropriate the ethnocentric approach becomes. In the *geocentric centralised* model (see Figure 20.2), a multicultural and multinational work force is hired but the efficiency of centralisation is maintained by concentrating the activities at a central R&D site. Examples include *Beiersdorf* and *P&G*. Geocentric centralised R&D combines the advantages of internationalisation with the advantages of a physically centralised R&D.

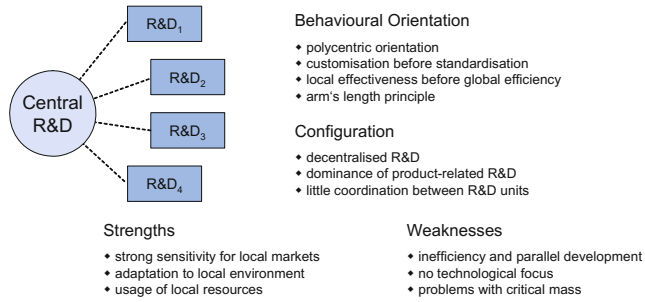
Figure 20.2 *Geocentric Centralised R&D*



Source: Boutellier/Gassmann/Zedtwitz 2008, p. 82.

Centralisation often limits the potential adaptation to local markets. In the *polycentric decentralised R&D model* (see Figure 20.3), differences between markets are emphasised by giving autonomy to dispersed R&D units who have the task of developing technologies and products that fulfil the requirements of their host country. The units in the different countries are *independent* from each other and there is no strong corporate R&D to supervise the dispersed activities. This model was frequently used by European MNCs in the 1970s and 1980s.

Figure 20.3 *Polycentric Decentralised R&D*

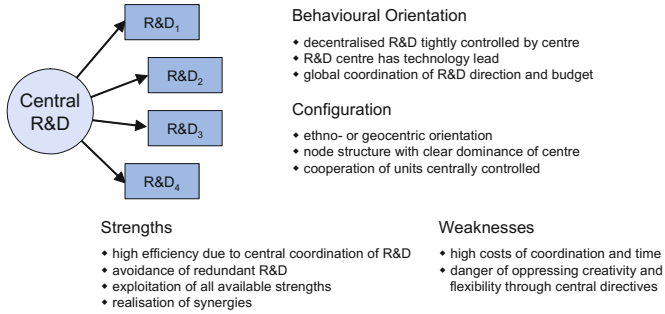


Source: Boutellier/Gassmann/Zedtwitz 2008, p. 84

In the *R&D hub model* (see Figure 20.4), strategic R&D is concentrated in the home country where the main research centre is located. This research centre is responsible for all basic research activities and takes a global lead in most technologies.

R&D Hub Model

Figure 20.4

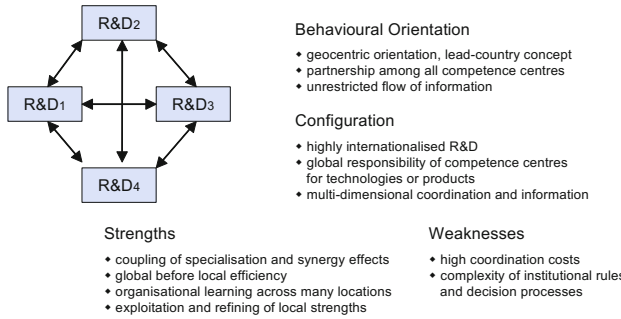


Source: Boutellier/Gassmann/Zedtwitz 2008, p. 86.

Frequently, the foreign units start as *listening posts* to tap into local knowledge which they then transfer to the HQ. The common R&D strategy is developed in the HQ and duplication of work avoided via tight control. An example of a hub model is *Volkswagen*: its group research at *Volkswagen* HQ in Wolfsburg, responsible for all of *Volkswagen AG's* brands, is supplemented by research satellites in Palo Alto, a research lab in China and another in Tokyo.

Integrated R&D Network

Figure 20.5



Source: Boutellier/Gassmann/Zedtwitz 2008, p. 88.

Finally, an *integrated R&D network* (see Figure 20.5) contains a number of interdependent R&D units in which specialisation is common and units take over the role of a *centre of excellence* in close interaction with their peer units. As described in the role typologies (see Chapter 3), units hold a "world product mandate" which is often achieved through their own initiative.

Trends within the Organisational Model

Most MNCs have realised that ethnocentric models are not adequate for meeting heterogeneous market needs and exploiting the diverse competencies in their units around the world. This leads to the establishment of *listening posts* (i.e. increased dispersion of R&D units) and to an increasing geocentric orientation which requires coordination of R&D activities. Given the complexity of R&D, the time lag between effort and result and the creativity required, foreign R&D units are increasingly empowered and given a certain level of autonomy to increase their own initiative. MNCs which have applied polycentric R&D models in the past are increasingly realising that excessive levels of autonomy can lead to inefficiency, redundant work, under-exploitation of synergy effects and insufficient exchange of knowledge, which limits innovation capacity. Thus, the result of current trends is some form of *integrated R&D network*. Once MNCs have established these, however, they realise the complexity in a widely dispersed network is high and that lateral coordination between R&D units is expensive and sometimes slow. As a consequence, the number of main research centres in an MNC is reduced and decisions re-centralised in a smaller number of research centres that take a leading role as *competence centres* for a certain technology, product or process. This consolidation process is an attempt to achieve economies of scale and improve coordination while maintaining the advantages of internationalisation (Boutellier/Gassmann/Zedwitz 2008, pp. 92-93).

Conclusion and Outlook

Effective and efficient international R&D is a prerequisite for the maintenance of an MNC's sustainable competitive advantage. Diverse market needs and growing competences all around the world mean the advantages of R&D internationalisation increasingly outweigh the disadvantages. Empirical studies – such as those by UNCTAD (2005) or the European Commission (2013b) – clearly reveal increasing levels of internationalisation. This is particularly true for development, but also increasingly for basic and applied research. Linked to this internationalisation is the trend towards R&D alliances where complementary skills are exploited by joining forces with another company.

However, a network of foreign R&D subsidiaries poses the challenge of coordinating these activities in order to align all units to the corporate goals and to reach a level of integration that optimises the opposing needs of efficiency and effectiveness. Different organisational concepts for R&D can be observed in practice, and the integrated R&D network currently seems to offer the optimal trade-off between dispersion, autonomy and integration.

The alignment of R&D with a company's other activities, which might also be dispersed worldwide, poses an additional challenge. International marketing has the task of identifying current and future customer needs (see Chapter 21). This is one root of successful R&D, besides basic research. R&D has to find solutions to customer needs which then have to be marketed by the marketing & sales department. Thus, a close link between R&D and marketing is necessary because both activities are aimed at creating *customer demand*. Furthermore, newly developed products have to be manufactured cost-efficiently and time to market has to be minimised. This requires close *collaboration* between R&D and manufacturing to acknowledge the necessities of manufacturing at the R&D stage. Conversely, manufacturing can also provide input for R&D, since it experiences suboptimal production design or unnecessary components in its daily work. Thus, tight *cross-functional integration* between R&D, manufacturing and marketing is necessary for long-term success, but it increases the complexity of finding the optimal configuration and coordination for the three activities simultaneously (Zentes/Swoboda/Morschett 2004, pp. 532, 701-705; Hill 2013, pp. 605-606).

Besides this cross-functional integration, *institutional openness* is becoming increasingly popular, both in practice and academia. "The field of open innovation is still at an early stage; it offers a wide field in which academics, practitioners and policy makers can be active" (Gassmann/Enkel/Chesbrough 2010, p. 219).

Further Reading

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Case Study: Sanofi*

Profile, Business Areas and History

Sanofi is an internationally active pharmaceutical (pharma) company headquartered in Paris, France. The company offers prescription and over-the-counter medicines, vaccines, various medical supplies and other therapeutic solutions. *Sanofi* operates in more than 100 countries and runs 112 industrial sites in 41 countries, with more than 110,000 employees worldwide.

Business Areas and Financial Figures

As a result of different future opportunities and challenges, *Sanofi* adapted its business structure in 2009 and divides its activities into seven different business areas, also called *growth platforms* (see Table 20.2).

Table 20.2 *Growth Platforms and Economic Importance*

Growth Platform	Function	Sales in billion EUR (in 2013)
Emerging Markets	Offers a broad product portfolio adapted to local needs of emerging markets.	10.96
Diabetes	Offers patients integrated and personalised solutions (treatments, services and technologies) to simplify the management of diabetes.	6.57
Vaccines	Deals with the task of human immunization and prevention of epidemics around the world.	3.7
Consumer Healthcare	Includes for example pain killers and treatments for coughs and colds.	3.0
New Genzyme	Therapeutic solutions for rare diseases provided and developed by *Genzyme*, a subsidiary of *Sanofi*.	2.1
Animal Health	Launches innovative products for pets and production animals and is executed by *Merial*, the animal health subsidiary of *Sanofi*.	2.0
Innovative Products	Includes products launched since 2009, and do not belong to other growth platforms with a focus on the development of biologic medicines.	0.7

Source: Sanofi 2014.

Recent History

Sanofi's net sales totalled 33.0 billion EUR in 2013, while their net income was 6.7 billion EUR. In pharmaceuticals alone, *Sanofi* had revenue of 27.3 billion EUR in 2013. However, they lost sales of 1.3 billion EUR to new *generic competition*. *Sanofi's* net sales decreased by 0.5% in 2013 compared to the previous year, while industry average was a growth of 1.9% (European Commission 2013b, p. 47).

* Sources used for this case study include the websites www.sanofi.com, various annual and interim reports, investor-relations presentations and explicitly cited sources.

Sanofi in its current state was formed in 2004 by a merger between *Sanofi-Synthélabo* and *Aventis*. Initially named *Sanofi-Aventis*, the company's name was simplified to *Sanofi* in 2011. *Sanofi-Synthélabo* came into existence in 1999 as the result of a merger between *Sanofi*, at the time a subsidiary of French oil company *Elf Aquitaine*, and *Synthélabo*, a French biopharma company. *Aventis* was a Franco-German pharmaceutical company, which emerged from the merger between the two pharmaceutical and chemical companies *Rhône-Poulenc* and *Hoechst Marion Roussel*. While an initial hostile takeover attempt by *Sanofi-Synthélabo* was prevented by *Aventis*, the French government intervened after *Aventis* sought a merger with Swiss pharmaceutical giant *Novartis*. With the goal of keeping jobs in France, the French government managed to convince the *Aventis* shareholders to accept a takeover bid of 54 billion EUR.

Significance of R&D in the Pharmaceutical Industry

Internal R&D efforts are one of the most important factors in a company's ability to develop and introduce innovative or significantly improved products and services. However, many European countries still see outsourcing R&D efforts to external companies as only moderately important for a company's innovative capacity (European Commission 2013a, pp. 29-30). Pharmaceutical R&D in general is crucial for the development of new innovative drugs and treatments, which are defined as new medications or modes of action to take care of diseases which previously could not be adequately treated (Nusser/Tischendorf 2006, p. 8).

Sanofi itself describes the importance of extensive R&D activities as follows: "To be successful in the highly competitive pharmaceutical industry, we must commit substantial resources each year to research and development in order to develop new products to take the place of products facing expiration of patent and regulatory data exclusivity or competition from new products that are perceived as being superior" (Sanofi 2012, p. 6). According to *PhRMA*, an association representing the research and manufacturing pharmaceutical companies of the United States, "a vibrant pharmaceutical research industry requires a business environment that inspires and rewards investment in research and development (…), a thriving and collaborative scientific ecosystem that advances knowledge and innovation [and] a modern, transparent regulatory system (…)" (PhRMA 2014).

Investments in R&D

The significance of R&D for the pharma industry becomes further apparent when looking at the top 50 companies worldwide in terms of investment in R&D. In 2013, 15 out of those 50 were pharma or biotech enterprises – *Sanofi* ranks 15th out of 50. With a share of roughly 18% of all R&D investments combined, the pharma and biotech sector is the most R&D intensive across

all industry sectors, with the majority of activities carried out in the United States (European Commission 2013a, pp. 40-41). Pharmaceutical R&D however is a costly, lengthy and risky process. The average time to develop a new drug is approximately 12 years. During this time, a pharma company has to invest huge amounts of capital which will be tied up in the development project. This means high opportunity costs for the company because the invested capital cannot be put to other uses (CBO 2006, p. 2). Additionally, only one in 10,000 initially examined substances will actually pass clinical trials in later stages and gain the approval of regulation authorities, leading to an effective drug reaching the market (Nusser/Tischendorf 2006, p. 36). These clinical trials can take more time than the actual research and development activities (CBO 2006, p. 19).

The high cost of drug development is evident when comparing a company's investment in R&D to the number of new drugs brought to market. *Sanofi*, for example, has spent an average of 10.1 billion EUR per new drug in the last ten years (Forbes 2013). In 2013, *Sanofi* spent a total of 4.8 billion EUR on R&D, a ratio to net sales of 14.5%. This ratio is called *R&D intensity*. It is usually much higher for pharma companies than other industries (CBO 2006, p. 9). *Sanofi's* R&D intensity is close to the industry average of 14.4% (European Commission 2013a, p. 45).

R&D Decentralisation

Due to challenges arising from less and less efficient R&D efforts and the growing competition from generic products, *Sanofi* started efforts in 2009 to radically overhaul its R&D structure. The people in charge aim to create the best R&D organisation among drug makers by 2015. Their goal is to significantly increase the capacity to translate scientific discoveries into new drugs, replacing those with expiring patents and replenishing revenues (Bloomberg 2012).

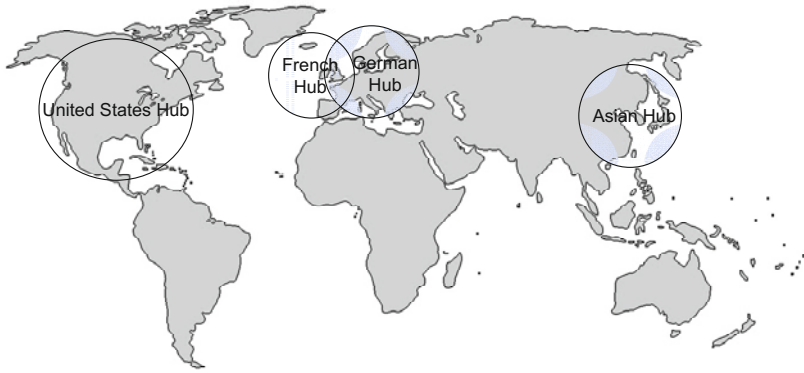
Research Hubs

One cornerstone of *Sanofi's* approach towards a streamlined and more efficient R&D structure is its decentralisation. This means that R&D activities are not exclusively carried out in a single research facility attached to the company's headquarters but instead at various local sites. *Sanofi* has divided its R&D into four different areas which are called "hubs" and described as "geographically-focused integrated research innovation centers" (Sanofi 2012, p. 47). These hubs in France, Germany, Asia and the United States – specifically the Boston area – serve to facilitate communications between different research teams and are supposed to open up R&D structures for external input. As a consequence, *Sanofi's* research is expected to be more integrated into the respective local environments, making it easier to lever-

age local expertise and resources and to cater to country-specific conditions and needs (FierceBiotech 2013).

Sanofi's Geographically Focused Research Hubs

Figure 20.6



Source: Sanofi 2014.

Areas of Excellence

This form of organisation allows *Sanofi* to settle into *local areas of excellence* where expert knowledge and innovative forces congregate. The Boston area, for example, is a place where many world class research institutes (e.g. *Harvard University* and *Massachusetts Institute of Technology*) and highly innovative *start-up companies* get together. By regrouping its R&D structure in consideration of such factors, *Sanofi* is able to actively benefit from the concentrated expertise and talent in the area. Thereby, specific core strengths and unique skills can be developed inside a particular hub, which are indispensable for handling and advancing the development of high potency drugs (CPhI 2014, p. 4).

Benefits

Sanofi's strategy of decentralisation is consistent with an overall trend in the industry to "move away from investing in single large scale R&D sites to diversifying interest across geographic regions, technologies and partnering firms" (CPhI 2014, p. 2). Besides an improved leverage of local expertise and talent, such an R&D structure increases the company's ability to react quickly and flexibly to changing market conditions or a competitor's breakthrough in one of the company's own fields of research. Switching between different innovative targets is easier and generally smoother (CPhI 2014, p. 2). The idea behind a hub is the combination of a core of strong internal competences and the advantages of a large, global company, along with the establishment of channels for external communication and collaboration. Thus, *Sanofi* aims to establish a form of organisation known as a *global R&D*

network. Such a structure is characterised by a combination of global and local action. More specifically, it means active engagement with innovative local research ecosystems while at the same time maintaining large scale global development capabilities. This idea is consistent with empirical evidence that new innovative products are generally more successful when "internal research capability and external network resources are combined" (Kim/Park 2010, p. 43). A global R&D network is open to external opportunities and allows a company to "effectively capitalize on innovation from a wide range of sources" (Sanofi 2012, p. 47). Furthermore, this R&D organisation is characterised by a core/periphery structure, in which a few significant countries represent the core of the network and a variety of less important countries its periphery. The core countries each form the centre of a hub with a number of particular periphery countries at its outskirts. The respective hubs hold a strong position within the network (European Commission 2013b, pp. 22-39).

With the shift from relying mainly on internal R&D projects to a more open approach, *Sanofi* is partaking in a general industry trend to increase *collaborations* with external partners, with the expectation of increasing the innovative potential in research and ensuring better development practices (CPhI 2014, pp. 4-5).

R&D Collaborations

According to a survey by the consulting company *McKinsey*, the pharmaceuticals industry has become more fragmented than ever before. The number of significant players has more than doubled since 1989. Additionally, companies specialising in certain parts of the value chain show growth rates far above industry average, while big pharmaceutical companies, which traditionally cover the whole value chain of developing, producing and marketing a drug, have grown at below average rates. As a result, they have begun to focus on sales and marketing while engaging in research partnerships or even outsourcing parts of their R&D. This development has led to a significantly disaggregated pharmaceutical value chain (Hunt/Manson/Morgan 2011, pp. 3-5).

Sanofi has recognised the signs of the times and begun to acquire forward-thinking biotech companies or begun engaging in selected *project-related collaborations* with them. Since 2009, the company has already invested 24 billion EUR in external growth. Biotechs are said to be generally more innovative than big pharmaceutical companies because they are more flexible, dynamic and specified. Accordingly, they are important for replenishing the major player's drug pipelines. By 2018, 50% of new drugs are expected to come from biotechs (European Commission 2013a, pp. 57-58). While bio-

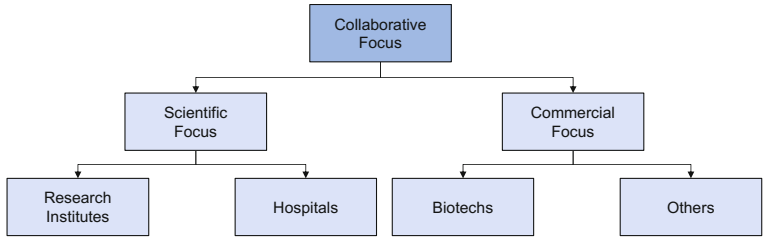
techs and start-ups are able to deliver an input of new creative ideas and approaches, big pharmaceutical companies have the necessary financial resources and expertise in lengthy clinical trials at their disposal and are capable of translating innovative ideas into marketable products. In this way, both parties profit from the collaboration. Half of *Sanofi's* current research portfolio already originates from external sources. *Sanofi* acknowledges that they have to go the *extra mile* – especially in biotechnology – to remain competitive. Because of rapid technology changes, a plethora of companies working toward the same targets simultaneously and the possibility of a promising product being outperformed by a competitor, *Sanofi's* business activities are exposed to constant risk. By engaging in collaborative R&D activities, these risks can at least be partially shared and thereby effectively countered.

Exemplary Partnerships

As mentioned above, research pharma companies operate under significant risk of failure and have to bear high costs for drug development. In response to these challenges, *Sanofi* has partnered with nine other leading pharma companies, including for example *Johnson & Johnson*, *GlaxoSmithKline* and *Pfizer*, to form the non-profit organisation *TransCelerate BioPharma*. The association's agenda includes combining financial and personnel resources from all founding partners to collaboratively solve industry-wide challenges, the establishment of guidelines for knowledge sharing and the development of clinical data standards.

Types and Characteristics of Sanofi's Collaborations

Figure 20.7



Source: Adapted from Sanofi 2014.

The second feature of *Sanofi* opening up its R&D process to an *inflow of knowledge* and ideas from outside is an enforced collaboration with research institutes and universities at a more fundamental level of research or with hospitals during biological and clinical trials. These partnerships may also be the source of new medical devices to improve therapies. The approach during joint research activities is to form combined, project-related teams composed of *Sanofi's* own research staff and scientists from institutes and universities. Instead of having two separate teams working on the same project and barely communicating with each other, as was the case in the past, this new approach facilitates communications between the involved parties and increases personal identification with the project. Company researchers visit the institute for a defined amount time and members of the institute work in *Sanofi's* laboratories for a while. For certain projects, there are even *common laboratories* being established.

One example is the foundation of a *centre of excellence* for natural products with *Fraunhofer-Gesellschaft*, Europe's biggest research institute for applied science. *Sanofi* and *Fraunhofer's* molecular biology division are going to work together on researching naturally occurring chemical and biological substances which can be transformed into antibiotics for treating infectious diseases. Within the partnership, a combined team of scientists is formed under shared leadership. They will conduct the research together, in the hope that the collaboration will lead to significant findings.

Summary and Outlook

The current prevailing trend in pharma is the encouraged and facilitated inflow of external knowledge, innovative ideas and novel compounds into a company's own R&D processes. *Sanofi* relies heavily on acquisitions to achieve external growth and receives additional input and risk- and resource-sharing partnerships in which they secure the rights to the product under development in exchange for carrying out milestones and royalty payments to the partner company. However, there are several other approaches towards externalised R&D activities.

Questions

1. Collaboration is increasingly important for the pharma industry. Describe the advantages and disadvantages of collaboration across the pharma industry.
2. Explain the concept of "open innovation" and envisage how it could be applied by *Sanofi*.

3. Compare the R&D structure of *Sanofi* with that of *Novartis* and *Pfizer*. Analyse the main differences.

Hints

1. See, e.g., Bartlett and Beamish 2014.
2. See, e.g., Chesbrough, Vanhverbeke and West 2006.
3. Examine the respective company websites www.sanofi.com, www.novartis.com, and www.pfizer.com.

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