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PSU-ETM 610 TMP – Technology Management Practices across Borders: Summer'11 Term

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[BASF: GLOBAL R&D MANAGEMENT]

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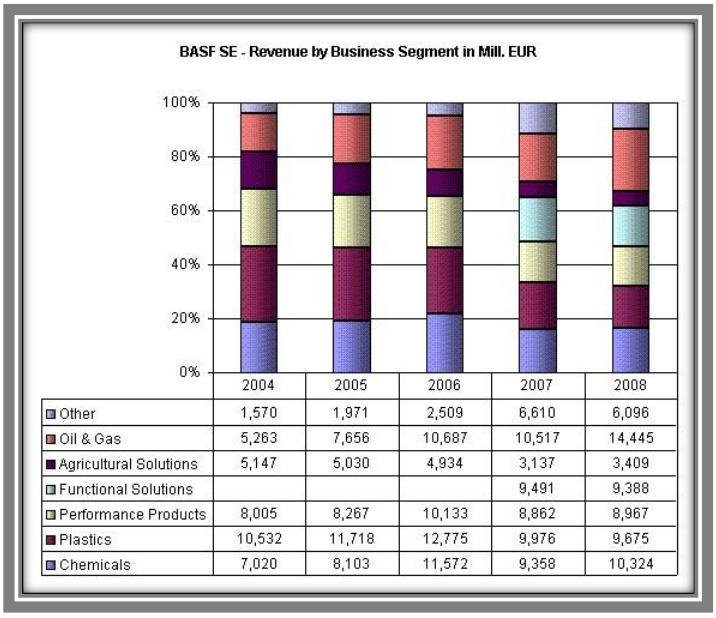
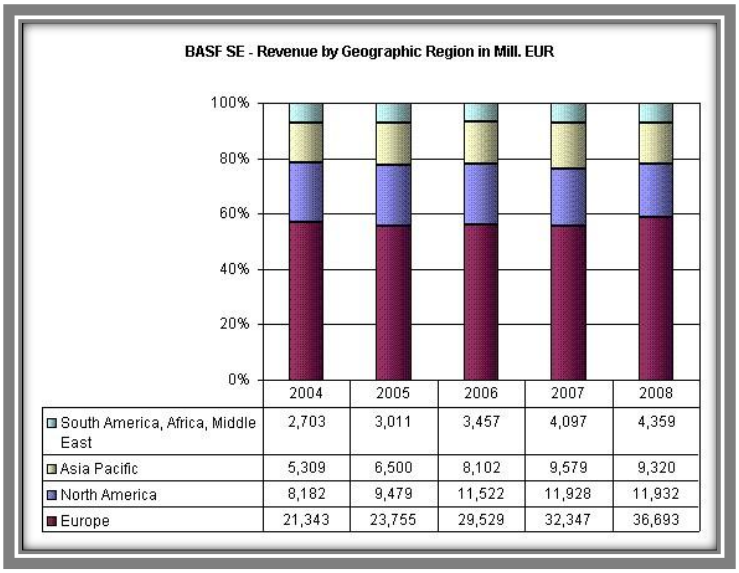
BASF SE: The Chemical Company

BASF SE is one of the world's largest multinational chemical companies (Datamonitor 2010). The company six business segments: chemicals, plastics, agricultural solutions, functional solutions, performance products, and oil and gas. These segments contain 14 divisions that manage 72 global and regional business units. BASF's main operations are in Europe but it has presence and has its presence in North America, It is BASF is headquartered Ludwigshafen, Germany, has about 109,000 employees worldwide, and 385 production sites. The company had $71 billion in 2009 with a net profit of $2 billion. Revenues by business segment and by region are shown in Figure 1 and 2 respectively (BASF 2010). BASF has a relatively balanced revenue portfolio by business segment however by region 60% of its revenues are from Europe.



	2004	2005	2006	2007	2008
Other	1,570	1,971	2,509	6,610	6,096
Oil & Gas	5,263	7,656	10,687	10,517	14,445
Agricultural Solutions	5,147	5,030	4,934	3,137	3,409
Functional Solutions				9,491	9,388
Performance Products	8,005	8,267	10,133	8,862	8,967
Plastics	10,532	11,718	12,775	9,976	9,675
Chemicals	7,020	8,103	11,572	9,358	10,324

Figure 1: Revenue by Business Segment (Source: BASF SE 2009 Annual Report)



	2004	2005	2006	2007	2008
South America, Africa, Middle East	2,703	3,011	3,457	4,097	4,359
Asia Pacific	5,309	6,500	8,102	9,579	9,320
North America	8,182	9,479	11,522	11,928	11,932
Europe	21,343	23,755	29,529	32,347	36,693

Figure 2: BASF SE Revenue by Geographic Region (Source: BASF SE 2009 Annual Report)

Business Description

BASF operates in 80 countries via a structure called “Verbund” (Datamonitor 2010). “Verbund”, a German word meaning "linked" or " maximally integrated". Central to the company's operations is the Verbund structure. BASF applies an integrated approach to manufacturing, research and development (R&D), infrastructure, processes, energy and waste management, and overall management philosophy. BASF considers Verbund a competitive advantage which includes linking plants in a “production Verbund” to create efficient value-adding chains from basic chemicals to higher value products. At Verbund sites, BASF uses byproducts of chemical reactions, which might otherwise have to be disposed of, as raw materials for other processes.

The oil and gas segment operates through the Wintershall Group (Wintershall) and include exploration and production of oil and gas as well as trading, transport, and storage. The performance products segment of BASF has four divisions: dispersions and pigments; care chemicals; paper chemicals; and performance chemicals. These cover products such as pigments, additives, adhesives, coatings, paint, cosmetics, cleaning, nutrition, paper chemicals, treatment chemicals, automotive oils, and textile treatments. The chemicals segment includes a range of products from basic petrochemicals and inorganic chemicals to higher-value intermediates. These are used in BASF’s Verbund as well as specialty chemicals for electronics and pharmaceuticals. The plastics segment produces performance polymers and polyurethanes. Polyurethanes are used in automotive, construction, shoes, mattress, household appliances, and sports. The functional solutions segment produces construction chemicals, coatings, and catalysts. The agricultural solutions segment provides products such as fungicides, insecticides, herbicides, and seed treatments.

History

BASF’s original name was Badische Anilin-und Soda-Fabrik, founded in 1865 by Friedrich Engelhorn to produce coal tar dyes and precursors (Datamonitor 2010), (Werner Abelshauser 2004). Within a few decades Badische Anilin-und Soda-Fabrik became a world leader in the dye industry. BASF Aktiengesellschaft was incorporated in Germany in 1952. In 1973, it changed its name to BASF Aktiengesellschaft (BASF). In the 1960s, BASF began building production sites internationally in Brazil, France, India, Japan, US, Australia, Mexico, Argentina, Spain, Belgium, Italy, and the United Kingdom. It then expanded into consumer and high-value product lines. By 1980s BASF had penetrated into Asian markets. In 1998 it built a large steam cracker plant for refineries and chemical processing plants in Texas to establish a beach-head in the United States. The next year BASF and Shell formed a joint venture to manufacture plastics. In 2000 BASF established a petrochemical plant in China and became the largest foreign chemical investor. This decade has witnessed BASF’s expansion through a variety of acquisitions, joint ventures, divestitures, and plant openings, and penetration into new regions to make it the world’s largest chemical company. In 2007 it became a European company, changing its name to BASF Societas Europaea (SE). BASF does not stand still and will continue to grow applying changes to its strategy as needed.

Products and Services

BASF is one of the largest chemical companies in the world and has an extensive product portfolio as listed in Table 1: BASF: Products and Services Table 1 (Datamonitor 2010):

Table 1: BASF: Products and Services (Datamonitor 2010)

Category	Product
Chemicals	Inorganics
	Glues
	Resins
	Catalysts
	Petrochemicals
	Intermediates (such as amines, diols, polyalcohols, acids, and specialties)
Plastics	Styrenics
	Performance polymers
	Engineering plastics
	Polyamide and its intermediates
	Polyurethanes
Performance Products	Dispersions and pigments
	Care chemicals
	Paper chemicals
	Performance chemicals
Agricultural Products and Nutrition	Fungicides
	Insecticides
	Herbicides
	Seed treatment products
	Cosmetics, pharmaceuticals, animal, and human nutrition
	Fragrance and flavors products
Functional Solutions	Catalysts
	Engineered coatings
	Mobile emissions catalysts
	Precious and base metal services
	Process catalysts and technologies
	Stationary emissions catalysts
	Surface technologies
	Temperature sensing
	Construction chemicals
	Coatings
	Automotive OEM
	Industrial coatings
	Automotive refinish

	Decorative paints
Oil and Gas	Exploration and production of crude oil and natural gas
	Trading of natural gas

SWOT Analysis: Summary

Being one of the world's largest chemical companies spanning 80 countries gives BASF significant bargaining power and clout to compete against regional and local players. However, increasing regulations may tend to erode its margins due additional costs of doing business. A SWOT analysis summary is presented below in Table 2:

Table 2: BASF SWOT Analysis (Datamonitor 2010)

Strengths • World leader as a chemical company • Leverages vertical and horizontal integration (Verbund) • Has a diversified product, customer, and regional base	**Weaknesses** • Administrative action (fines) due to Ciba • Less expenditure on R&D than competitors [e.g. BASF spent 3% of revenue, while Bayer spent 9% (2009)]
Opportunities • Growth in specialty chemicals market worldwide • Acquisition of Cognis (leading supplier of specialty chemicals) • Strategic Partnership with Dow Chemical Company • Technology cooperation agreements (especially in plant biotechnology to increase crop yield)	**Threats** • New and more stringent regulations (such as REACH). This is an increasing trend globally. • Production, procurement, market, environmental risks due technical failures, natural disasters, supply chain disruptions, environmental contaminations, etc. • Exploration risks related to oil exploration • Production risks related to chemical manufacturing [e.g. fines due to inadvertent environmental pollution]

Competitors

BASF SE is the world's largest chemical company with a market capitalization of $83 billion. However, its major competitors are also the main players in the chemical industry. The following table (Table 3) provides a list of the major players in the chemical industry and a comparison of the relative company size of the competitors (Standard and Poor's NetAdvantage 2011).

Table 3: Chemical Industry: BASF and Competitors - Market Capitalization
(Standard and Poor's NetAdvantage 2011)

Company Name	Ticker	Market Value-Total ($M)	EPS	Yield %
BASF SE	BASFY	83,177.45	8.84	2.50
DU PONT (E.I.) DE NEMOURS & CO.	DD	46,704.67	3.58	3.20
DOW CHEMICAL CO. (THE)	DOW	41,827.13	1.85	2.80
AKZO NOBEL NV	AKZOY	16,048.45	4.26	1.80
PPG INDUSTRIES, INC.	PPG	13,302.16	5.86	2.70
EASTMAN CHEMICAL CO.	EMN	7,087.99	7.59	1.80
FMC CORP.	FMC	5,617.95	2.59	0.70
ASHLAND INC.	ASH	4,906.49	8.33	1.10
HUNTSMAN CORP.	HUN	4,221.34	1.10	2.20
SOLUTIA INC.	SOA	2,742.83	1.67	
CABOT CORP.	CBT	2,517.96	3.15	1.80
OLIN CORP.	OLN	1,708.51	2.29	3.70
LSB INDUSTRIES, INC.	LXU	970.44	2.12	
PENFORD CORP.	PENX	64.11	-0.85	
CHINA GENGSHENG MINERALS, INC.	CHGS	42.78	-0.01	
SHENGDATECH, INC.	SDTH	13.55	0.50	
EPOLIN, INC.	EPLN	0.12		

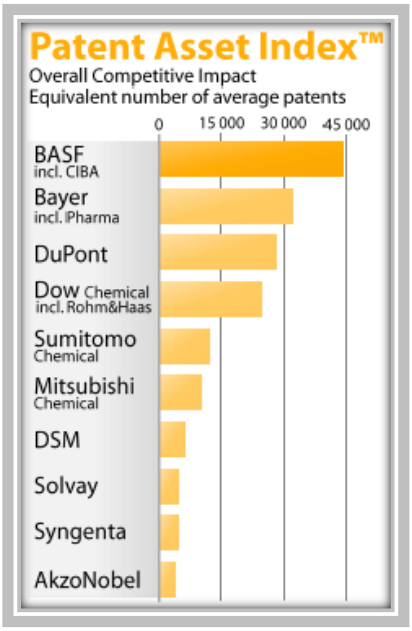
Research and Development

According to a press release BASF announced that it will increase its research and development (R&D) budget for 2011 from $2.1 billion in 2010 (Monicca Egoy 2011). The 2009 R&D expenditure was $2 billion. BASF states its position as:

> "Research and development are the foundations to secure our future. BASF will therefore also be increasing its R&D spending in 2011, the International Year of Chemistry," said Andreas Kreimeyer, BASF's research executive director…..BASF said "product innovations have brought in increased revenues for the group, adding that in 2010 alone, it 'overachieved' its target of generating €6 billion [$8.5 billion] sales from new and improved products applications that have been in the market for less than five years".

BASF has a global R&D team of over 9,600 staff engaged in 3,000 projects including 1,900 cooperative projects. BASF's R&D has programs and partnerships with universities, research institutes, technology startups, customers, and other industry leaders. BASF expects that its sales based on innovation will reach $8.5 - $11.4 billion by 2015.

Professor Ernst of Otto Beisheim School of Management (WHU), Germany has developed a "patent asset index" to gauge a company's "innovative strength". The index is based on "based on the portfolio size (number of patent families) and the competitive impact (number of citations in other patents and market coverage)". According to this index BASF is ranked first as of December 2010 (Figure 3).

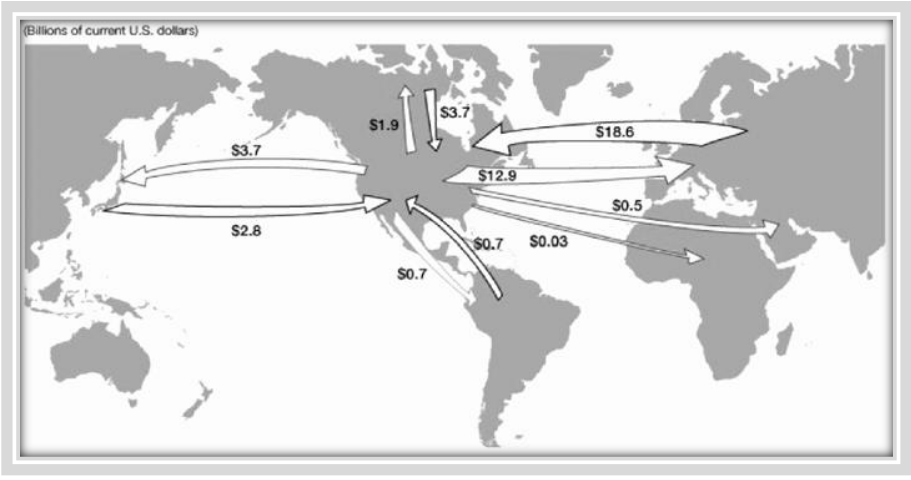


Source: PatentSight; methodology: Prof. Ernst, WHU

Figure 3: Patent Asset Index and BASF Ranking

Internationalization of R&D

The major multinational corporations (MNCs) consider international or global R&D as an important aspect of global competitiveness and have consistently increased their global R&D budgets since the 1980s (Roman Boutellier 2008), (Gassmann and Zedtwitz 1998). There is a major flow of R&D investment budgets from and to the United States, Europe, and Asia (Figure 4).



Source: National Science Board, Science and Engineering Indicator (2005).

Figure 4: Foreign-owned R&D in the US and US-owned R&D overseas ($ billion) (Roman Boutellier 2008) p. 42

Globally, R&D expenditure has been generally increasing with the increase being modest in the chemical sector and strong in pharmaceuticals and biotechnology (Willetts 2010) as shown in Figure 5.

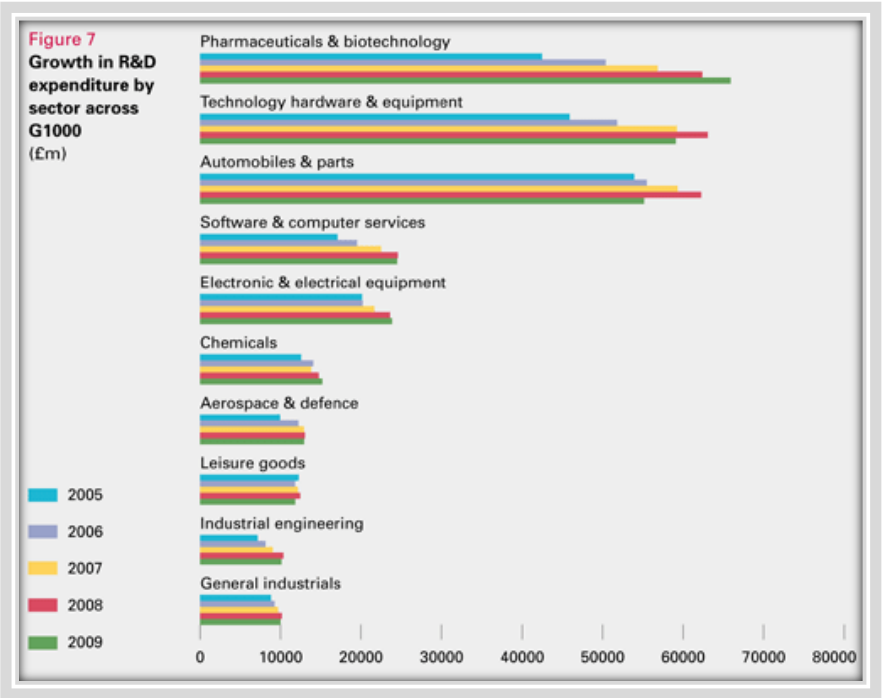
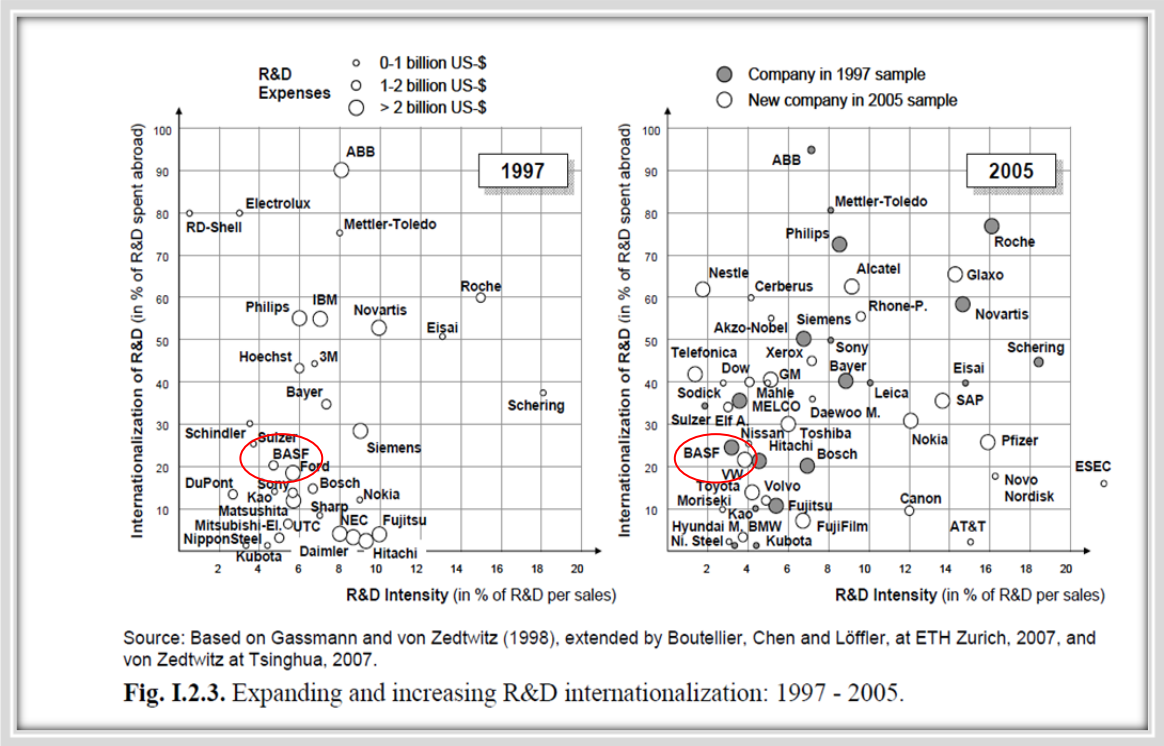


Figure 5: Growth in R&D expenditure by sector across the top 1000 global companies (Willetts 2010)

Large technology-based MNCs tend to spread their international R&D activities towards regions that have a high rate of innovation or where the local market is capable of to supporting localized product. A comparison of MNCs for R&D intensity versus Internationalization of R&D indicates that BASF, although a world leader in the chemical industry has only made a modest improvement in increasing both its R&D efforts as well internationalization of R&D from 1997 to 2005 (Roman Boutellier 2008). This is graphically depicted in Figure 6.



Source: Based on Gassmann and von Zedtwitz (1998), extended by Boutellier, Chen and Löffler, at ETH Zurich, 2007, and von Zedtwitz at Tsinghua, 2007.

Fig. I.2.3. Expanding and increasing R&D internationalization: 1997 - 2005.

Figure 6: Expanding and Increasing R&D Internationalization: 1997-2005 (Roman Boutellier 2008) p.46

R&D internationalization is a balance between favorable and unfavorable factors as shown in the Table 4 below:

Table 4: R&D internationalization is balanced by factors disfavoring international R&D activities and factors favoring R&D centralization (Roman Boutellier 2008) p.53

Table I.2.5. R&D internationalization is balanced by factors disfavoring international R&D activities and factors favoring R&D centralization.

Factors in support of central R&D	Obstacles to international R&D
• Economies of scale (critical size)	• Immobility of top class personnel
• Synergy effects	• Critical mass (for startups)
• Higher career potential	• Redundant development
• Minimal R&D costs and development time	• Language and cultural differences
• Better control over research results	• Much of scientific and technical information worldwide available by Internet
• Communication intensity	• Specific know-how easily lost when support not present
• Legal protection	• Political risks
• Common R&D culture	• No wage advantages in triad nations
	• Coordination and information costs

Source: Behrmann and Fischer (1980); De Meyer and Mizushima (1989); Coombs and Richards (1993); Carnegie Bosch Institute (1994), von Boehmer, Brockhoff, and Pearson (1992); Beckmann and Fischer (1994); Gassmann and von Zedtwitz (1996b); Allen (1977); direct investigation.

International R&D Organization Frameworks

There are five ideal forms of international R&D organizations (Roman Boutellier 2008). These are indicated in Table 5 and Figure 7.

Table 5: Five ideal forms of international R&D organization (Roman Boutellier 2008) p. 79

Table I.4.1. Five ideal forms of international R&D organization.

Configuration	Organizational structure	Behavioral orientation
Ethnocentric centralized R&D	Centralized R&D	National inward orientation
Geocentric centralized R&D	Centralized R&D	International external orientation
Polycentric decentralized R&D	Highly dispersed R&D, weak center	Competition among independent R&D units
R&D hub model	Dispersed R&D, strong center	Supportive role of foreign R&D units
Integrated R&D network	Highly dispersed R&D, several competence centers	Synergetic integration of international R&D units

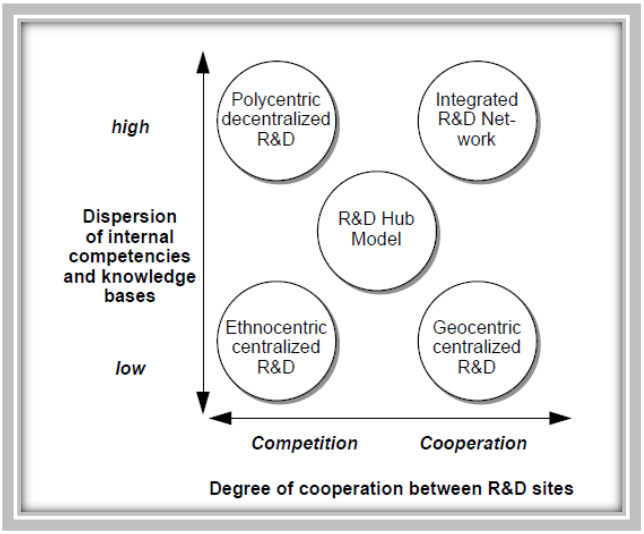


Figure 7: Five concepts of organizational design can be distinguished by analyzing the degree of cooperation between R&D sites and the dispersion of internal competencies and knowledge bases. (Roman Boutellier 2008) p. 78

BASF fits into the "R&D Hub Model" which is not uncommon for German and Japanese companies (Roman Boutellier 2008) Figure 8.

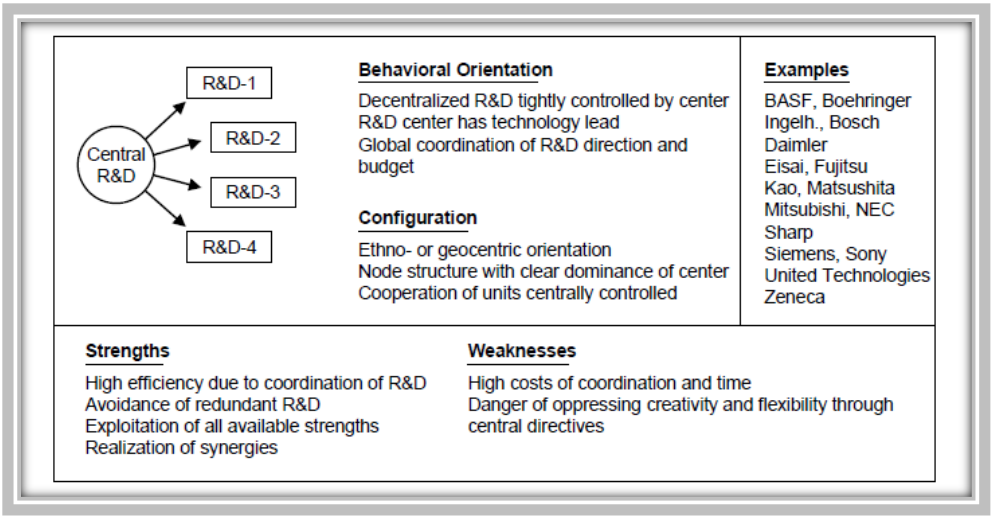


Figure 8: The R&D hub model is usually a reaction by centralized companies to the internationalization of resources. As the decentralized R&D units evolve and gain proficient know-how in their respective technology area, the hub model is superseded by a network organization. (Roman Boutellier 2008) p. 86

International R&D Organization Structure

BASF follows a typical four-level structure for international R&D organizations consisting of (1) regional plus legal structure, (2) hierarchical plus functional structure, (3) Projects and processes, and (4) informal links and networks, as shown in Figure 9 (Roman Boutellier 2008).

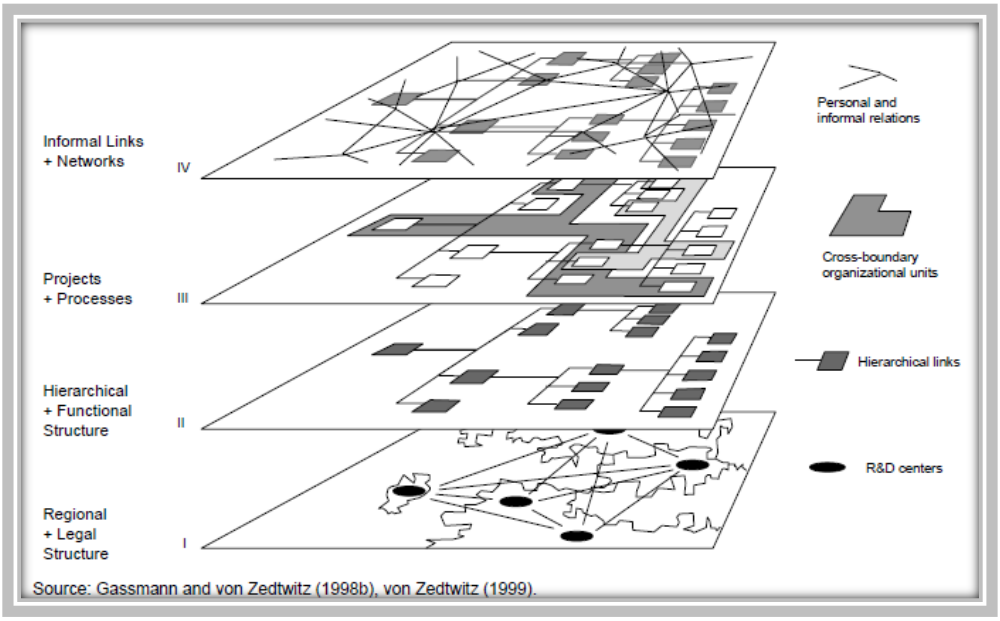


Figure 9: Four levels of structure in transnational R&D organization (Roman Boutellier 2008)

The reference (Roman Boutellier 2008) also points out the inherent issues or barriers at the four levels as shown in Figure 10. For example, *socialization* of a new idea or process is important in an *informal network* but may exclude key stakeholders and is difficult to scale and replicate.

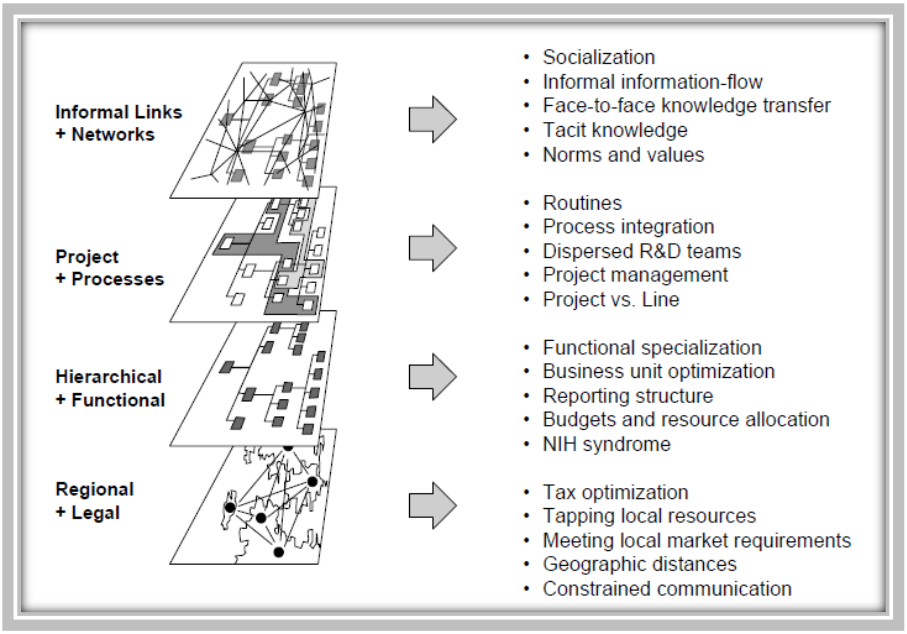


Figure 10: Issues in International R&D organization (Roman Boutellier 2008)

Coordination of International R&D

Reger interviewed 18 European and Japanese companies to address suitable forms of coordination and interaction for international R&D and developed a coordination framework consisting of: structural, hybrid, informal, and internal markets as detailed in Figure 11 (Reger 1999). Figure 12 and Figure 13 indicate BASF's approach to coordination between corporate and the divisions and for international R&D.

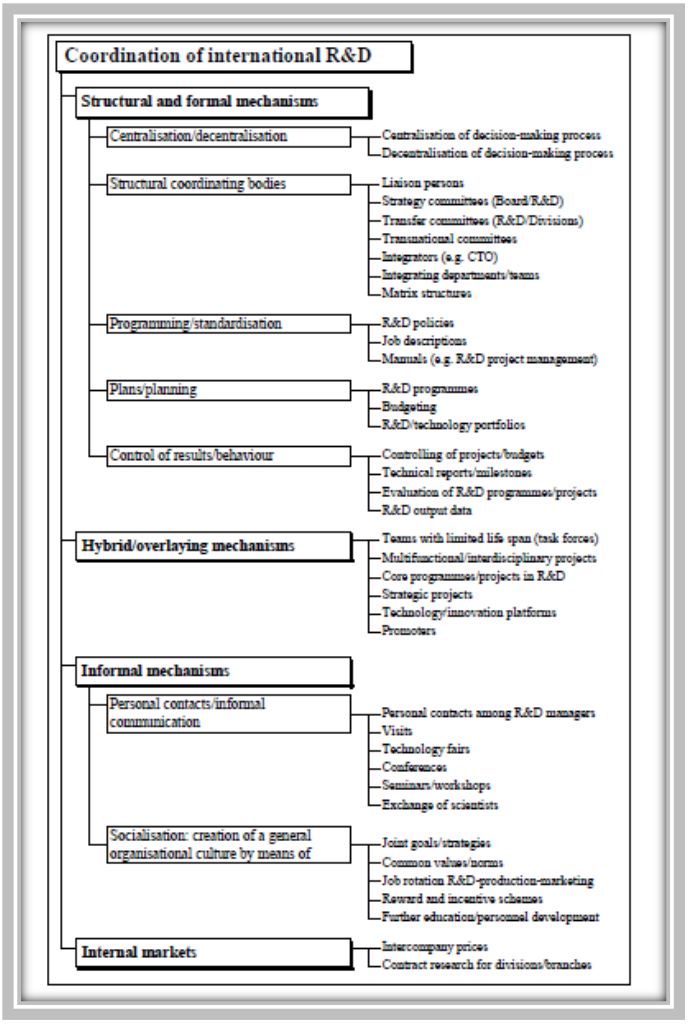


Figure 11: Four categories of coordination mechanisms (Reger 1999)

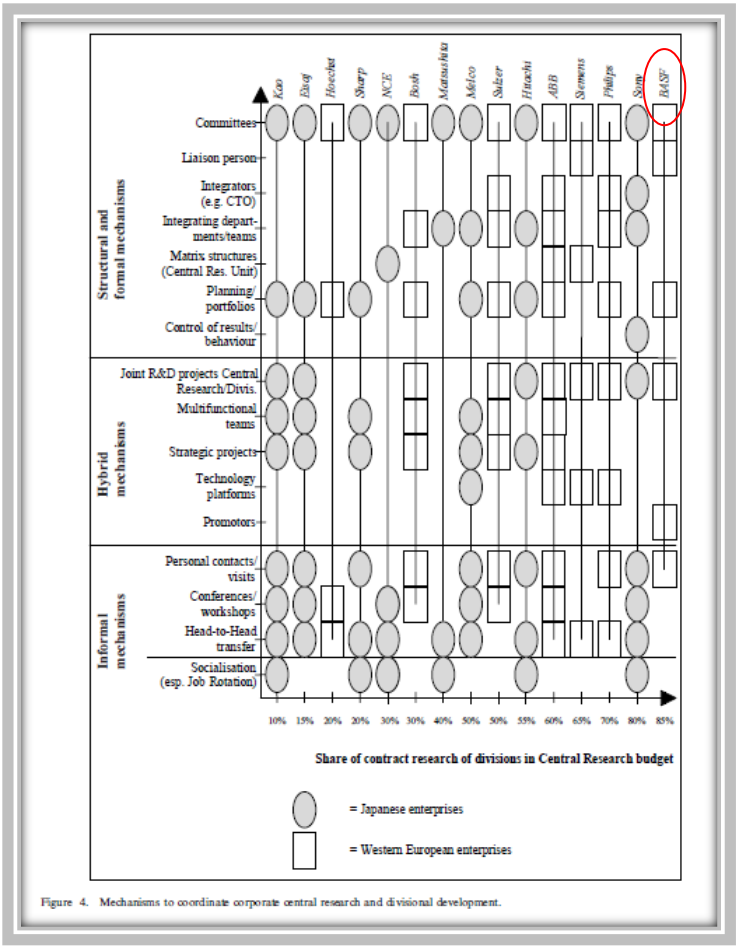


Figure 4. Mechanisms to coordinate corporate central research and divisional development.

Figure 12: Mechanisms to coordinate central research and divisional development (Reger 1999)

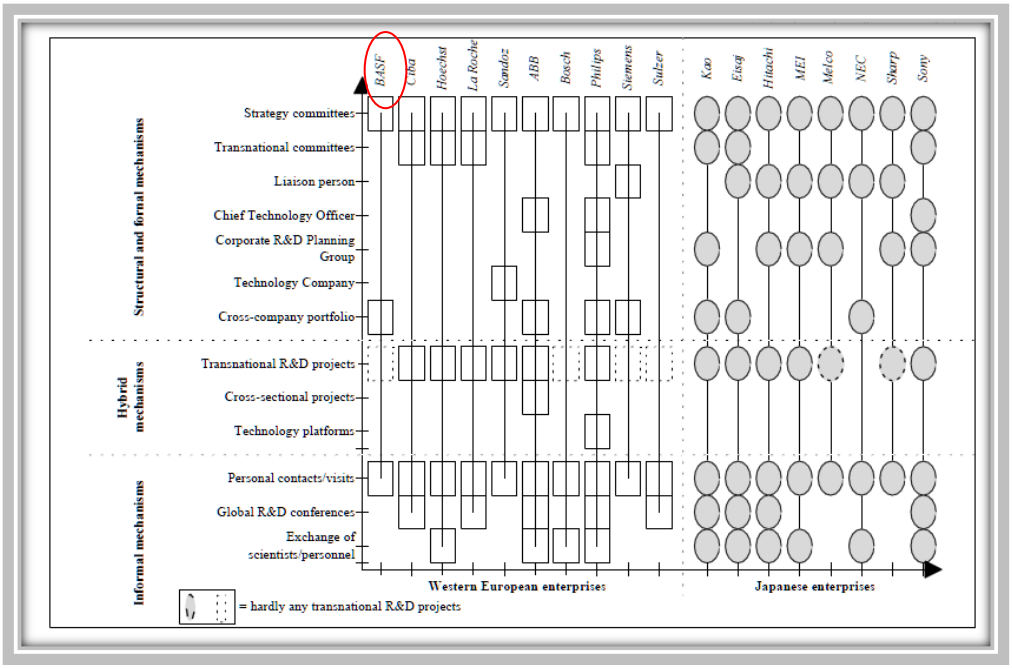
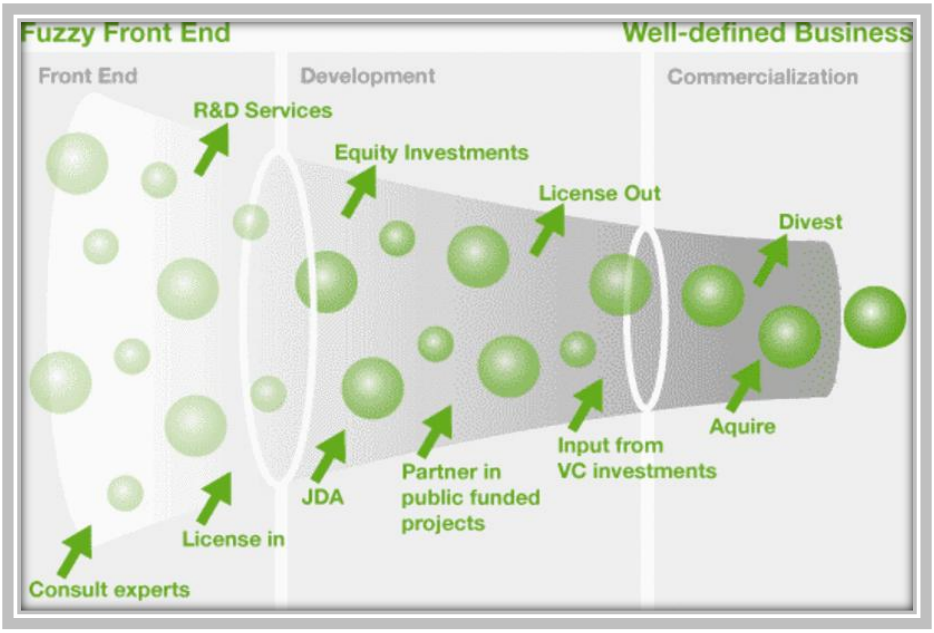


Figure 13: Mechanism to coordinate international R&D (Reger 1999)

Open Innovation

BASF has embraced open innovation and considers it an important aspect of its business and R&D. BASF includes consultants, partnerships (joint development agreements-JDA), licensing-ins, venture capital investments and acquisitions as a way to expedite innovation (Figure 14). Partnerships include universities, start-ups, and existing and potential customers. BASF has also established a Joint Innovation Lab for organic electronics as an example foster cooperation between different companies and institutes.



Source: BASF

Figure 14: From innovation to commercialization with open innovation

Technology Listening Posts

In today's R&D climate knowledge creation and basic research is being partially passed onto universities, research institutes, national laboratories, and specialized agents such as incubators. This helps to avoid duplications of effort. In this climate technology scouting, monitoring, and listening roles are being assigned to research departments and groups to act as "technology listening posts". The drivers for technology monitoring at each level of the R&D organization structure are listed in Figure 15. BASF has a "technology outpost" in Boston, Massachusetts for biotechnology.

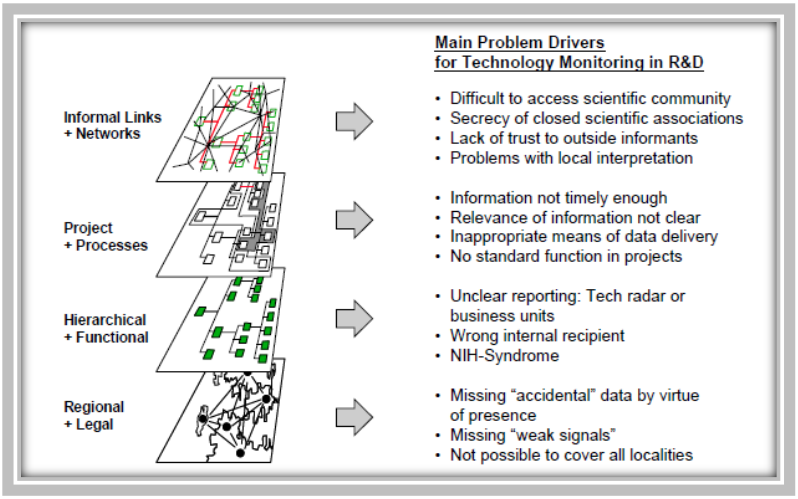


Figure 15: Main problem drivers for technology monitoring (Roman Boutellier 2008) p. 172

Home Country Effect of R&D Internationalization

Internationalization of R&D may sometimes result in the transfer of foreign technology from a multinational corporation to other partner firms in its home country. This phenomenon has been stated as "inter-firm reverse technology transfer" and has been analyzed by Criscuolo (Criscuolo 2009). Patents were analyzed for 17 European chemical and pharmaceutical MNCs which transferred knowledge or know-how from the United States to their home country. BASF was one of the companies analyzed. This is a unique prospective of foreign direct R&D investment and how it improves a home country's technological competitive performance.

Emerging Technologies: Disclosure and Reporting

A report analyzed the reporting by some of the world industry leaders (including BASF) on the use and R&D of emerging technologies (Miller 2010). Emerging technologies tend to be the outcome of global R&D management. The objective was to gain an understanding of what was and was not being reported. This may be considered a "public relations aspect of global R&D management".

For comparison a pair of leading companies was selected for each major industry as listed below:

- Chemical: Du Pont and BASF
- Oil and Gas: BP and Shell
- Cosmetics: Boots and L'Oreal
- Food Retail: Tesco and Marks & Spencer
- Pharmaceutical: AstraZeneca and GlaxoSmithKline
- Food: Nestle and Premier Foods
- Mixed: Proctor & Gamble and Unilever

BASF generally received a good score as shown in Table 6Table 6: Survey questions and findings for BASF .

Table 6: Survey questions and findings for BASF (Miller 2010)

Company	*Do they mention their own use of emerging technology?*	*Is their report particularly reader friendly?*	*Do they mention contentious issues concerning safety, the environment in terms of their emerging technology?*	*Do they discuss how they have made an effort to engage with their customers, NGO's and stakeholders?*	*Is the level of information provided on emerging technology sufficient?*
BASF	Discuss in depth their use of emerging technologies. In particular their 'growth clusters,' that are designed to address 'key areas such as markets for the future and mega trends.'[1] The five growth clusters are: bio technology, white biotechnology, changing raw materials, energy management and nano technology. 4/5	The report was relatively reader friendly. The information is brought forward effectively and in the kind of detail that is both easy to read and interesting. 3/5	They discuss in both their annual reports and their sustainability reports the importance of using emerging technologies responsibly 'Our Code of Conduct in Nanotechnology.' This is their own way of monitoring the use of nanotechnology within their company. NanoCare project funded by the German Federal Ministry of Research and Education is using research institutes and universities to discover uses and potential difficulties with the development of nanotechnology. 4/5	Dialogue Forum Nano is their own way to hear and discuss the concerns of consumer organizations. An example of BASF trying to engage with their stakeholders and Ngo's. 4/5	The level of information provided is impressive but is still lacking in some areas. Compared to DuPont there is more discussion into what Is being achieved at the moment rather than the future. 3/5

The score is assessed as

- 1/5 little or no mention of emerging technology
- 2/5 some mention of emerging technology but it is not necessarily shown clearly.
- 3/5 mention of emerging technology but perhaps in an extremely simplistic manner.
- 4/5 a good level of emerging technology talked about
- 5/5 all criteria met and expansive level of information provided. Not overly simplistic but written with enough conviction that the reader can understand entirely what emerging technology is being used.

Conclusion

In this paper an attempt has been made to describe the global R&D management framework of BASF— a large chemical multinational conglomerate. This is done by first providing an overview of the company and then the general frameworks for international R&D. BASF is described within this context. The frameworks are extended to open innovation, technology listening posts, home country effect, and reporting of emerging technologies (which are the result of a successful R&D program).

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