

NOTES

To chapter 1

1. It must be stressed that this project concerns an academic problem in the first place. Concluding from nothing more than the fact that the idea to start research on this subject passed the faculty's research commission and board without having any programmatic relationships with on-going projects, this project may be a good example of the way resource allocation results from delicate politics in academic project approval procedures. Academic allocation criteria can be as simple as the amount of research capacity or the appropriate number of research projects per professor. But, of course, this is not a sufficient rationale in explaining the costs of having this subject studied.
2. For example:
The Economist – Hidden agenda, November 20th 1993. Dr. Narin claims that companies are underestimating the potential of patents in competitor technology intelligence and assessment.
NRC Handelsblad – Studie van octrooien bespaart bedrijven miljarden, 30 oktober 1991. Mr Libbenga claims that, on a global scale, industry yearly wastes several billions of dollars on 're-inventing the wheel'. Patent scrutiny would save a lot of time and research expenditure.
3. An indication of their interest in the exploitation of IPRs forms the fact that there are many examples of pharmaceutical innovation in which lawsuits cost millions and take years before they are settled. For an overview of (Dutch) pharmaceutical case law see, for instance, Schutjens (1993).
4. One of the companies that has successfully shortened its development times with the aid of the concept of 'parallel development' is the British multinational pharmaceutical company Glaxo. Though the costs of R&D were reported to rise enormously, the benefits of an R&D time reduction of approximately four years would more than compensate the increased expenses (Lynn 1991).
5. In this study, a distinction is made between the analytic levels of the nation state, industry, business, organization, management and the individual. The *nation state* refers to action from the government by means of law or other forms of regulation. *Industry* refers to the macro-economic production function of

delivering certain goods and/or services to the public. The Dutch terminology is slightly different and uses this term for the manufacturing function in a nation's economy. The term *business* is based on the concept of the segmented market and refers in this study to the therapeutical submarket, expressed in the business strategy. The term *organization* is used in a functional sense to refer to the structuring of activity and is expressed in concepts like corporate strategy or strategic business units (SBU). The latter is used to get an organizational grip on specific market characteristics (businesses) for the sake of business strategic planning. The *firm* here refers to the SBU in case of diversified companies or to the independent firm in case the company is not diversified (for instance, a specialized biotechnological enterprise). *Management* refers to the sets of actions aimed at controlling collective activity (functional sense) and the group of people in a firm which can be held accountable for these actions (institutional sense). The individual is (in an analytical sense) also referred to as the actor, he/she who decides and acts.

6. The term *pharmaceutical industry* refers to a collection of research-based, internationally operating, firms which are sometimes (still) part of large diversified companies. Though there may be a difference in organizational and managerial characteristics between independently operating firms and ones that are part of a larger (often, chemical) parent company, these differences are not considered to be necessarily relevant.
7. Having an extensive business background in these particular subjects, Redwood (1987) analyzes:
 - production, consumption and global trade,
 - the place of drugs in health care budgets,
 - government-industry relationships,
 - research and development,
 - profitability,
 - the revival of generics,
 - the industry and less developed countries,
 - the advance of multinationals, and
 - the advent of structural changes.The sources of information he refers to are roughly the same as those mentioned in the following two studies.
8. Chetley (1990) introduces the reader to
 - the obstacles to world health,

- the turn from the golden age of drug discovery to controversy in the pharmaceutical industry,
- the importance of marketing and the international search for sales,
- the struggle for clear policies by the (inter)national authorities, and
- prospected opportunities and threats for the world's health community in improving drug policies.

His main information sources were international journals, reports of international authorities (e.g. WHO, UNIDO, HAI, ABPI, IFPMA, UNICEF, UNCTAD) and academic books.

9. The points that Ballance, Pogány and Forstner (1992) considered are:
- a typology of pharmaceutical industries and products;
 - (global) production and consumption structures and developments;
 - competition;
 - the role of R&D;
 - (national) policies;
 - strategies of both individual firms and industries as a whole; and
 - prospects.

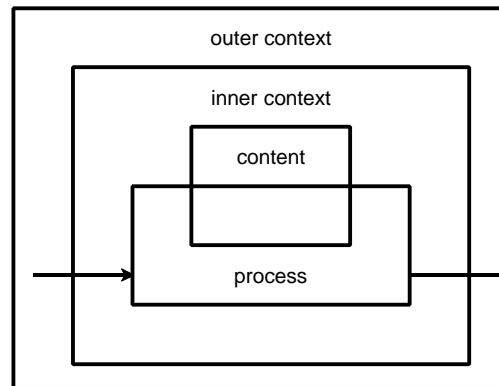
Their sources of information were:

1. the UNIDO data base, constructed from the annual responses provided by national statistical offices in more than 150 countries;
2. industry-specific literature (e.g. Scrip, IMS, academics);
3. national producer associations (e.g. PMA, PMAG, JPMA, SSCI);
4. studies carried out by intergovernmental authorities (like the WHO, UNDP, OECD, IMF, ILO);
5. company reports; and
6. the UNIDO programme on technical cooperation between pharmaceutical industries in developing and industrialized countries.

10. Taggart (1993) describes
- the historical development of the pharmaceutical industry,
 - applications of multinational and technological theories to the world's pharmaceutical industry,
 - the single European market,
 - competition,
 - some large markets (US, Japan, Europe and the UK),
 - company profiles of three main players in these markets, and
 - a prognosis.

11. Thalidomide, a popular sedative, was sold in 46 countries between 1955 and 1961. Belatedly, it was realized that the drug was responsible for birth defects in approximately 12,000 children (Ballance et al. 1992).
12. The issue of a blocking patent is related to rivalry in research and innovation competition. Whereas Plant (1934) argued that a patent granted to basic research would inefficiently block the further development of ideas, Arrow's view (1962) is that a patent lacks sufficient blocking power. As a result, while Plant argues that patents overreward basic research as a result of excessive appropriability, Arrow argues that even under patent laws basic research is bound to be underrewarded. The term 'blocking patent' is a confusing one. Strictly speaking, every effective patent blocks the development of rival products by others, for the right to block means the right to exclude others from profiting from an invention and to protect research investment. However, when a patent by itself generates no marketable commodity or when a patented commodity is overruled by a superior one, the patent can still be of significant strategic value to the inventor; it may prevent a (potential) competitor from investing in a considerable improvement upon the innovator's ideas, or it may even induce divestment of a technological trajectory.
13. Based on the framework for strategy research that Pettigrew (1985) suggests, a difference is made between an inner and outer context. Together, they are referred to as the strategic context of IP management that consists of the blocks indicated below as content and process. (figure N.1)
14. Increasing product competition (often resulting from a concentration on fewer therapeutical areas; decreasing diversification) would theoretically result in increasing differentiation, leading to earlier product obsolescence and the speeding up of R&D and marketing efforts. As a consequence, companies will try to maximize cash flow after market entry as soon as possible.

Figure N.1 A STRATEGY RESEARCH FRAMEWORK



based on Pettigrew (1985: 657)

15. These features are derived from the propositions Badaracco (1991) made about the globalization of knowledge. First, some knowledge emanates from such external sources as (patent) publications, laboratories of collaborating companies, universities, or from (other) publicly accessible sources that contribute to this vast pool of potentially commercializable knowledge in the world. Second, knowledge is migratory. It can move quickly and easily because it is encapsulated in formulas, designs, manuals, people, chemicals or books. All these forms of documented knowledge in a company's operations can be transferred or are otherwise made accessible as (proprietary) information relevant to exploitation and competition. Third, some (tacit) knowledge is embedded in social structures and moves slowly. A team or a department sometimes 'knows' things that none of its individual members know or are aware of.
16. Collier (1986) discusses the role of R&D in corporate strategy as a generator of new directions and opportunities (competitive advantage). He surveyed planners and R&D directors in more than 50 companies, in order to reveal the differences in perception between the two groups on such matters as:
- whether the company has an R&D strategic plan;
 - how often the R&D executives meet with other line executives; and

Table N.1 DETERMINISTIC-VOLUNTARISTIC VIEWS OF HUMAN ACTIVITY

| assumption / approach | deterministic orientation | voluntaristic orientation |
|---|--|--|
| human nature assumption organization structure and behavior are: | determined and constrained by external factors | autonomously chosen and create by human beings |
| ontological assumption the essence of organization structure and behavior is: | objective; an external, concrete reality existing in nature focus is on the formal structural-functional characteristics of the social system in relation to its environment | subjective; an internal, nominal construction of individual consciousness focus is on emergent action and act-meanings of individuals and their interactions with one another |
| epistemological assumption the nature and the origin of knowledge is: | positivistic; obtained by verifying and falsifying laws and causal relations existing in nature | antipositivistic; obtained by recognizing the internal frames of reference within subjects and observers |
| methodological approach tendencies to: | search for universalistic principles and techniques that are generally or widely applicable deductive and nomothetic methods of study often used, relying on quantitative, comparative, large scale surveys | search for particularistic principles and techniques relevant to specific problem or condition inductive and idiographic methods of study often used, relying on qualitative, historical case studies |

source: Van der Ven & Astley (1981: 432)

- the quality of the interaction between business planners and R&D executives.

Answering the question how companies can improve the value that is derived from their research efforts, Spencer and Triant (1989) argue for opening the lines of communication between R&D and business planning on the basis of their own personal experience at Xerox.

17. According to Lynn (1991: 9), this phenomenon was called *molecular roulette*, in order to give an idea of the risks involved in drug discovery. He describes the procedure as follows: "Essentially, hundreds upon hundreds of chemical formulations would be carefully prepared and then tested. The tests consisted of pumping the chemicals into a laboratory rat and seeing what happened to the little guy. If he keeled over, you knew it was a dud. If, alternatively, he jumped up, shook your hand and wrote out a cheque, you knew the molecule had some interesting possibilities. On average, chemists figured they would find something interesting roughly once in every thousand tries."

From the mid seventies onwards things started to change. Advances in biotechnology made the process of discovering a drug a little less unpredictable, but the metaphor of molecular roulette is still valid in the industry. Although it is now a better description of the commercial game than of the pharmaco-chemical game.

18. Assumptions and approaches often associated with deterministic-voluntaristic views of human nature are depicted in the table N.1 (Van de Ven & Joyce 1981).
19. The starting point of GST is that reality must be viewed as a (multitude of) system(s). Whether the system is an ontological or epistemological entity remains open. In this study, in line with the SSM approach, systems are regarded as epistemological entities ('they exist in the minds of people'). In describing and analyzing them, we are cognitively restricted in (re)viewing situations in reality. Therefore, we distinguish systems from their environment. Analogously, systems can be decomposed into their components. A component system (part system) can be identified as:
- a subsystem, to analyze a part of the system's set of elements;
 - an aspectsystem, to analyze a part of the relations between all the system's elements; or
 - a phasesystem, to analyze the system and/or its constituents in terms of time (stages).

20. Since the first article about the Delphi method (Dalkey & Helmer 1963) as a means of supporting group decision-making based on expertise utilization, the further development of the method can be distinguished into two co-existing application areas: the 'classic' forecasting Delphi and its derived variants, in which the Delphi method is regarded as a structured communication process supporting problem solving (Kenis 1995: 1). Basic features that distinguish the Delphi method from other methods of group interaction and that made me construct a research method based on Delphi principles, are:
- *Anonymity*. The use of questionnaires (over group sessions) prevented identification of specific opinions with particular persons.
 - *Iteration with controlled feedback*. Cross submission of the hypotheses derived from the in-depth interviews in the second round provided the information for validation, selection and reformulation of the hypotheses submitted to the panel of respondents in the third round.
 - *Statistical group response*. Results from the third round were analyzed using AGREE, a consensus measuring computer program (Popping 1988/1989). I was interested in assessing the degree of controversy (complementary to consensus) over specific items of the subject.

To chapter 2

1. The role concept relates to social interaction, which is central to systems analysis. Without interaction, a system would be no more than a collection of elements (objects or human beings). In social systems theory, 'acting' implies attributes that statically (structure) and/or dynamically (process) characterize the system as a set of relations between the elements: sets of roles.
In an organizational context, a role is a set of behavioral patterns belonging to a position. The characteristics of the actor may affect *how* a role is performed, but not *that* it is performed. For example, Mintzberg's role concept for managerial activity is grouped into the following three categories:
 - interpersonal (figurehead, liaison, leader);
 - informational (monitor, disseminator, spokesman); and
 - decisional (entrepreneur, disturbance handler, resource allocator and negotiator) (Mintzberg 1973: 59).
2. For instance, see Redwood (1987) on the pharmaceutical industry, Van der Werf (1989) on the industrial development of a region or Hanks et al. (1994) on the

taxonomy itself in relation to organizations. Hanks and colleagues elaborate on one of the main problems in the application of the concept; the empirical definition and limitation of the stages. Their definition of an organizational life-cycle stage stems from Galbraith (1982), who defines it as "a unique configuration of variables related to an organization's context and structure."

3. For instance, Bijker & Law (1992), Dosi (1982), Jasanoff et al. (1995), Latour & Woolgar (1979), Van Lente (1993) and Mensch (1979).
4. Foray (1995: 114) relates these peculiar characteristics of knowledge to the systemic character of knowledge production; the fact that it is irreversible, divisible and modular.
5. This conclusion can be drawn from studies like the one conducted by Mensch (1979), whose analyses of basic innovations show the decreasing – but still remarkably long – lead times between invention and innovation. In the case of pharmaceutical innovations, see table N.2.
6. Contrary to Badaracco (1991), who claims that the view of "the firm as an island of managerial coordination in a sea of market relationships" has become obsolete, I suggest that knowledge-driven relationships between organizations are boundary setting activities. Organizationally, these activities have blurred the boundaries between firms. Social relationships change radically as a consequence of the globalization of knowledge, and they will continue to do so as information and communication technologies become more widespread. But, legally, migratory knowledge re-affirms boundaries between rivaling knowledge producers because the associated concepts of property and their claims have not changed. These are made explicit by such registering devices as the patent system and the cooperative contract. More than ever before, competition between firms focuses on the appropriation of knowledge. IP law will have to take such developments into account.

Table N.2 SOME PHARMACEUTICAL INNOVATIONS

| product | innovation | invention | innovator |
|----------------------|------------|-----------|--------------------------|
| kinine production | 1820 | 1790 | Pelletier-Ceventan |
| pharmaceutical prod. | 1827 | 1771 | |
| aspirine | 1899 | 1853 | Bayer |
| insuline | 1922 | 1889 | Toronto General Hospital |
| penicilline | 1942 | 1928 | Kemball Bishop & Co |
| streptomycine | 1944 | 1921 | Merck & Co |
| contraceptive pill | 1960 | 1954 | Searle Drug |

based on Mensch (1979)

7. The important category of improvement innovations relates to the latter determinant of research results, and Rosenberg (1982: 149) emphasizes that it contributes to more than half of the cumulative economic effects of technological progress.
8. An indication of the importance of research reputation forms the personnel advertisement of Lucent Technologies (Bell Labs) in *Intermediar*, September 6, 1996, under the title "Je kunt alleen het unieke uit mensen halen als je ze de kans geeft het te etaleren" (One can only elicit the unique from people if you give them the chance to display it). It referred to seven Nobel prize winners that are/were connected to Bell Labs.
9. In 1980, the US Congress passed the Patent and Trademark Amendments of 1980 (Public Law 96-517), also known as the Bayh-Dole Act. This act gave universities (and other non-profit institutions, including small business firms) the right to retain the property rights to inventions resulting from federally funded research. In 1984, these rights were further expanded by removing certain restrictions in the Bayh-Dole Act on the kinds of inventions that universities could own and the right of universities to assign their IPRs to other parties (Public Law 98-620).

10. Illustrative of the importance of patent information is Smith's evaluation of patent literature (Sviridov 1981):
 - It is the largest and most comprehensive source of (commercially viable) technical information in the world;
 - The technical information derived from it is extremely comprehensive and is proving to be a prime source of R&D information;
 - It serves to avoid duplication of R&D activity (re-inventing the wheel);
 - Unlike periodical literature, patents, by definition, contain new information, ideas and data from research and can serve as a source of new ideas in a different but related field;
 - Patents discuss the difficulties associated with previous research, development or production techniques and can offer (if only abstractly) a specific method of overcoming problems;
 - Patent information can help to design products by providing a selection of alternative production techniques;
 - With a little more development, patents can provide an impetus for the exploitation of ideas;
 - Patents can be an excellent starting point in the search for an idea to satisfy a consumer requirement.

11. Apart from managing publicly accessible database systems and libraries, national and international patent authorities also have an informative function. For instance, the World Intellectual Property Organization (WIPO) co-sponsored such meetings as: the Moscow symposium (1974) on *patent information in scientific research and development*, the Munich symposium (1977) on *the usefulness of patent information for industry*, and the Varna, Bulgaria, symposium (1980) on *the role of patent information in the transfer of technology* (Sviridov 1981).

12. This finding, based on empirical research, is supported by Harabi's survey (1995) on the effectiveness of R&D-spillover channels in the Swiss industry. R&D spillovers were defined as knowledge exchanges in which the effects of research performed in one economic unit lead to improvements of technology in a second economic unit (firm, industry or country are the usual aggregate levels of analysis in economics). He concluded that the most effective way of exchanging technical knowledge between firms in the same industry is by conducting internal R&D, followed by reverse engineering and the utilization of publications and information from technical meetings for process innovations. Patent licensing and patent information disclosure were seen by several

respondents (R&D executives) as moderately effective or not effective at all. Interorganizational learning that relies on interpersonal communication was judged to be moderately effective, in the following order of intermediate channels:

1. publications and technical meetings,
2. conversations with the employees of innovating firms, and
3. the hiring away of employees from competing firms.

13. Either by an X, Y or A (Schmoch 1993: 194). An X means that one particular prior document shows features of the invention and questions the inventive step of these features, if taken alone. A Y means that a combination of citations is relevant to the features described in the patent claim. An A refers to publications on the state of the art prior to the current patent application.
14. One of the typical management functions in the latter stages of the TLC is investigating regulations on the taxation of income derived from exploiting IP in international arenas (Smith & Parr 1994: 14). The value of intangible assets is becoming an issue in taxation as the value of the traditional tangible tax basis dwindles relative to the growth of intangible assets in companies' balance sheets. This issue can have effects on the exploitation contracts that firms make with banks in order to finance activities. For instance, Philips signed a contract with the Rabo bank on the financial (fiscal) exploitation of (part of) their IPRs, in which they exchanged a limited disposition of their IPRs for needed short-term working capital.
15. 'Exploitation' seems puzzling at first sight because market exchanges are by definition voluntary. Each party enters them in the hope of improving its material situation in some respect (Miller 1987). This understanding of 'exploitation' should be distinguished from coercive interactions, which are easier to see and in which there is a one-way transfer of value from one party, who is in the position to inflict damage, to another through this interaction. This latter approach has long been associated with Marx. The first approach identifies exploitation in terms of the allocation of resources against which background an exchange is made. We refer to the use of technology as an instrument of market power (Kingston 1984) in relation to the technologically relevant environment, with which competitive and cooperative relations are created alongside the development of the technology and the firm's proprietary positions in this technology.

To chapter 3

1. In this respect, we should make a distinction in the levels of strategy formation involved in the selection of technologies and markets. Corporate strategy is concerned with determining the range and type of businesses in which the firm should be involved. Here, business refers to the technologies as well as the markets that constitute the input and output of a firm (the pipeline concept!). A business strategy establishes the basis on which a firm is to compete in selected productmarket arenas. It also integrates the various functional areas relevant to a particular business or product (Romme 1987: 2). With regard to R&D activities, program management has this latter role.
2. In SM literature, this combination of organizational phenomena is also called a firm's transformative capacity (Garud & Nayyar 1994). Garud and Nayyar claim that this transformative capacity is formed by an inter-temporal technology transfer.
3. Generally, in technology-driven organizations, employees prefer an internal origin of the technology that is introduced into the firm's pipeline. Rejection, unwillingness, and consequential rigidity produced by externally originating technology are also known as the NIH-syndrome. This rigidity often restricts the utilization of emerging technological opportunities for business development and, sometimes even, of technology created in-house.
4. Kaufmann (1984) provides an interesting analysis of the economic function of the patent system and the legal doctrines governing competition. Especially with regard to the subject of this thesis, his chapter 3 on imitation as 'the lifeblood of competition' follows the role of patents in a competitive context as described in chapter 2 of this thesis. The comparative analysis of imitation in the legal doctrines of some of the technologically most dominant Western countries illuminates the restrictions and basic considerations underlying the institution of patent systems.
5. In this corporate action context, Christensen, Andrews and Bower (1973) draw attention to a specific problem of strategic choice. The case of the US prescription drug industry in their book illustrates the company and its societal responsibilities, relating corporate strategy and moral values. They state that the ethics of strategy often involves a conflict of obligations and interests. For instance, the pharmaceutical manufacturer is caught between the need for safety

and the need for speed in the exploitation of a new drug. Similarly, there is also a dilemma when prices need to be increased in order to compensate for decreasing pay back capacity and increasing development costs, and the need for price stability or even a price decrease as required by governmental cost containment policy. Private and public interests need to be taken into consideration, especially in relation to technological development in which public science and, therefore, the public good is involved.

6. Contrary to a less formal macro-environment scanning, presumably performed by a strategy department, an innovation environment analysis is a typically discrete reference product, prompted by the corporate planning process or by the emergence of an unanticipated technological opportunity or problem. As a general approach to business environment analysis, Fry and Killing (1986) suggest the following sequence: focus the analysis through the use of concepts like (market) segmentation, competitive positioning and the (product) life cycle. Then, within this framed environment, examine the influence of such relevant groups as certain customers, competitors, suppliers, and government agencies. Finally, determine basic competitive requirements and potential profits.
7. I will not make an attempt to add to the large number of audit techniques for dealing with technology and business. See, for instance, the innovative capabilities audit framework (ICAF) of Burgelman and Maidique (1988: chapter 2) or the innovation audit of Goodman and Lawless (1994: chapter 8 & 9).
8. For techniques see, for instance, Brockhoff (1991, 1992b), Van der Eerden and Saelens (1991), Engelsman and Van Raan (1990, 1994), Mogee and Kolar (1994), Narin, Noma and Perry (1987), Narin, Smith and Albert (1993), Narin (1994), Narin and Breitzman (1995).
9. A substantial effort is often directed towards analyzing and opposing the patents of competitors; it can vary from 10-70% of the total time, but is more usually 30-40% (EIRMA 1988: 19).
10. Brockhoff (1992b) discusses the use of patent data analysis for forecasting purposes. Like some of the respondents in the pilot project, he refers to Wilson's warning that one should not expect too much from patent data because of this time lag (1987: 73). But Brockhoff formulates three sound counter arguments:
 - There are institutional differences in national patent systems. While the USPTO publishes after granting, the EPO publishes 18 months after applica-

- tion, unless the patent is granted earlier. From research by Schmoch et al. (1988), the majority of the US patent applicants appear to wait longer than 18 months, namely 2-3 years after application;
- Information may not be available in other forms before the publication of the application/granting. It enhances the data available before and allows for inferences by company specialists; and
 - Patent specifications need additional interpretation and manipulation in order to make the information suitable for forecasting purposes (Campbell 1983).
11. The largest generic markets are in the Netherlands (12.5%), Denmark (20%) and the US (15%) (Burstall 1986). Apart from the legality and economic viability of entering the generic market, it is interesting to see that markets for generics vs. specialties seem to develop in line with government regulation and its driving force: cost containment. Of course, factors other than government regulation, prescription policy, and contracting attitude of health insurers (which developments are considered government initiated) have a connection with the 'generics revival'. Cost-price margins of specialties, acquisition of generic manufacturers by large internationally operating pharmaceutical companies, etc. also play a role. At present, the 'generics revival' seems to stabilize internationally.
 12. In relation to this development, Dutch case law halted the pre-expiration development of new generic products after the Dutch Supreme Court-case Atenolol of ICI versus Medicopharma, Hoge Raad, 18 december 1992.
 13. An IPR-strategic group analysis on the basis of publically available data sources has been conducted as part of this research project by a student who wrote a thesis about the valuation and strategic group analysis of patents in the pharmaceutical industry (Goris 1994). His empirical research concerned data on the Dutch therapeutical submarkets for contraceptives and ACE-inhibitors.
 14. Saaty's method begins by determining the relative importance of the criteria in meeting the goal. Then, the extent to which the alternatives achieve each of the criteria is measured. Finally, the results of the two analyses are synthesized in order to compute the relative importance of the alternatives in meeting the goal. Each of the measurements contains several aggregated judgments of managers, expressed in pairwise comparisons of items on a given level of the hierarchy with respect to their impact on the next higher level. For additional details, see Saaty (1980).

To chapter 4

1. This perspective on the influence of the lay-out of buildings, computer systems, laboratories and recreational facilities, both as a determinant for and as a result of the organizational design of research organizations, is also expressed in some modern research facilities. In the Spring of 1995, Glaxo opened a very expensive, ultra-modern laboratory at Stevenage in the UK. Innovative features of these facilities are the use of space for personal encounters to enhance lateral communication between people, accessibility of database and mailsystems to facilitate the use of both external and internal information, and a pronounced strategy of increasing R&D productivity (Kohler 1995).
2. In the Dutch academic environment, De Leeuw (1974, 1986) introduced an application of the general systems theory to organizations; the systems theory of control. The elegance of this conceptual approach to 'real life' social systems lies in its potential simplicity, which makes it so powerful. In general, this simplicity is a major argument for systems thinking in all kinds of disciplines (Vickers 1983). The idea behind it is to reduce complex systems into a model using analytical terminology and concomitant, more or less logical, taxonomies. A few elements of this taxonomy have already been introduced in chapter 1 (see also endnotes 1.18 and 2.1). De Leeuw (1986: 112-116) defines the general conditions for effective control as follows:
 - Purpose. In general, any control aimed activity needs to be evaluated in terms of its goals. As a minimum requirement, one must be able to interpret the effects of managerial influence as intentional or unintentional. Measures can have counter influences only in terms of the goals one has set for achieving the desired effects;
 - Model of the controlled system;
 - Information on the environment and the state of the system;
 - Sufficient measures/means; and
 - Information processing capacity.
3. In general, patent figures reflect a combination of
 - technological progress (which may result from research),
 - patent-mindedness (of researchers, managers, industries, etc.),
 - practical possibilities for exploitation (strategic value),
 - the rate of legal protection (for instance, large or narrow interpretation of the patent claims by courts), and

- a presence or lack of patent policy (at the national or firm level) (Maarschalk 1948: 15).

An interesting question concerning research on the relation between publishing and patenting would be whether pharmaceutical companies that actively stimulate and support the publication of research results in scientific journals also have the highest rate of patenting.