

The Use of Patents in Dutch Biopharmaceutical SME: a Typology for Assessing Strategic Patent Management Maturity.

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Abstract

In this paper a typology is presented for use by innovation policy makers and managers of SMEs in patent-intensive businesses. For singular organisations, it helps to assess the current patent management practice in making a next step towards a more externally oriented and proactive approach to the use of patents. The underlying framework integrates patent functions with strategic planning attitudes.

Operationalisation into a questionnaire is grounded in a pilot study of three biotechnology firms, differing in size and age. The result has consequently been applied in a case study consisting of sixteen small-sized biopharmaceutical companies in the Netherlands. Having assessed patent management practices, we present our findings and discuss them in relation to the validity and use of the typology for abovementioned purposes.

Author Keywords: Intellectual property; strategic patent management; pharmaceutical biotechnology, SME.

1. Introduction

Ideal-typically, all activities concerning intellectual property (IP) are organised in a purposeful and coordinated manner as to serve the long term interests of the owner. Not in all high-technology, but certainly in the life sciences, patent portfolio decision-making is pivotal to corporate as well as business level management. To quote a manager from a large pharmaceutical company:

“Patents are the lifeblood of our business, a conditio-sine-qua-non for investing in new leads for product development.”¹

However, success and failure in life science business development indicate that this may be a commonly shared view of the proprietary conditions to R&D, but it is certainly not complied with in managerial practices of small and medium-sized enterprises (SMEs). Particularly in biotechnology start-ups, which are (in the Netherlands) predominantly erected and managed by entrepreneurs from academia,² the understanding of and the attitude towards the use of patents are in many cases blurred and certainly falling behind that of their counterparts from the large pharmaceutical or biotechnological companies. Knowing that the Dutch academic starter typically comes from a public environment where there is virtually no patent awareness, it is understandable that patent management practices in SME do not match those of large companies. Moreover, start-up and small companies are lacking the resources for managerial capacity to focus on such cost-producing activities. Especially when newly entering firms co-operate with and, in commercialising their R&D results, are becoming dependent on large companies, strategically well-developed patent management practices would contribute to a fair, equal and therefore more successful technology partnering playing field. A model as well as a mature practice of strategic patent management then is a critical success factor for an SME in patent-intensive businesses. Mature practices in large companies are a valuable source of knowledge for young and small companies that are building patent portfolios and which are often dependent on such companies to have their proprietary technologies adopted and/or commercialised, singularly or in collaboration.

Likewise, public research organisations (PROs) are increasingly expected to exploit and have their scientific research results commercialised.³ Proprietary conditions to research are external to universities' and technology research institutes' management, bringing them into similar positions as biopharmaceutical SME. Since they are, through their proprietary technologies, involved in the business of commercialising science, regarding patents solely as a means of protecting market positions will either suffice to them. Like their SME counterparts, such organisations are not in a position to market products, but are supposed to market the rights to their inventions.⁴ And although PROs in the biopharmaceutical area also own relatively small patent portfolios, they are not dependent on commercialisation tasks and for that reason not part of the empirical part of this study.

In sections 2 and 3, a framework is operationalised into an assessment tool for qualifying SME patent management practices. Its first dimension is based on Ackoff's well-known categories of strategic planning attitudes. The second dimension builds on knowledge of the functions that patents have in technology analysis, planning and research management activities of large companies in the pharmaceutical sector. These functions are described in section 3. In sections 4 and 5, we discuss a first application of the typology in the domain of pharmaceutical biotechnology, based on a pilot study of 3 firms and a case study consisting of a small-scale survey involving 16 firms. We describe outcomes from this case study, arguing for the potential value of the typology when used by SME and PRO managers as well as governmental policy makers. In the final sections 6 and 7, we summarize and present conclusions and issues for discussion and implications for future research.

2. Attitudes towards strategic planning and patents

In our view of building a corporate future, the science-based company's IP posture results from its cumulative technology and marketing efforts as well as IP attitudes of both managers and researchers. Longitudinal consistency is critical and needs to be taken into account when planning and organising for a patent portfolio that is to secure future market positions that meet the company's scope and technological abilities.⁵ Whether the scientific founder(s), managers and researchers are sufficiently aware of the ins and outs of patents, will hardly depend on their experience in operational patent activities, such as searching patent databases, writing and filing patents, or even defending them with the help of patent attorneys. A profound vision of and knowledge about business, future applications of present technologies, relevant market developments and connections to international technology and business networks, are more important managerial preconditions making the difference between creating and successfully exploiting patent positions.^{6,7,8}

In this perspective, organising for patent management processes is crucial. It is not an activity that prescribes strategy of the company and its products; it essentially develops managerial capabilities following from it.⁹ It is especially essential in dealing with changes in technologies and markets. Originating from 'the design thinking era', in which corporate planning developed as a general management discipline, it combines the internal state (the organisation) with the external state (the

environment) of the firm into a temporal framework for action. What scholars and managers have learned from the rise and fall of planning is that it needs to be valued as a learning process, more than for its prescriptive output, i.e. the plan itself. Despite all such scholarly wisdom, the use of planning as well as patenting brings about quite some controversy if not opposition, especially in SME and PRO management.¹⁰ Particularly in the academic world, research and program managers will be familiar with the arguments and strong feelings of researchers about the (in)ability to plan for the research process on the grounds of the contingent nature of its outcomes. Though there can be legitimate restrictions to pro-activeness, they are no grounds for inactiveness in planning for business, even when the business is research.¹¹ Therefore, planning is to be considered indispensable for survival in a business environment, especially for newly entering SMEs.

Based on Ackoff,¹² we distinguish and describe four different prototypical attitudes for the planning and management of creating and exploiting patent positions, representing an increasing level of managerial activeness:

1. Inactive

Management does not take any initiative in identifying the relevant innovation environment by gathering information about scientific and technological developments in it. There is interaction with third parties, on a (co)incidental basis if that is perceived to be helpful in commercializing proprietary inventions. Young companies with this planning mode will be striving for in-house development, whereas older ones are also focussing on third party involvement. There is no systematic use of external proprietary information in developing the company's business. No IPR policies have been erected in the sense that the internal organization of the company is equipped with incentives and guidelines for the appropriation, protection, and dissemination of research results.

2. Reactive

Management is pre-occupied with maintaining the 'steady state' and, in doing so, changes its activities if necessary for the survival of the company as it is, most preferably by neutralising its effects. Patent positions are built solely on the basis of in-house technological capabilities and exploitation of them is dependent on competitors' patenting and in-licensing activities. Technology is considered the

principal source of change and circumvention the strategy for bypassing rivalling proprietary positions. The emphasis in IPR policies will be on the protection of patents. Cross-licensing deals result from third party initiatives that initially tend to be regarded as threats, not as opportunities.

3. *Active*

Management does not only react to, but is also involved in scanning the relevant innovation environment for the necessary information about external in(ter)ventions and opportunities that can be related to exploitation of the existing portfolio. Technology and the market are believed to be the principal sources of change. Proprietary information is used to identify potential partners in exploiting the company's existing as well as co-operating in related technology areas. The company's patents are actively enforced, but based on the perception of technological rivals as providing opportunities, as well as threats. So, licensing activity means not only focussing on out-, but also cross- and in-licensing opportunities.

4. *Proactive*

Management is not only actively engaged in matching the external with the internal state, but also in developing options arising from existing and future knowledge in the networks the company is involved in. Management has an internally as well as externally communicated vision of where the company is technologically heading for. This means that intellectual property is very much a collective responsibility in the company and not only management, but also researchers are involved in decision-making. Science, technology and (potential) buyers' needs are believed to be the principal sources of change. Not only the inherent functions of patents are used to the full, but also attributed functions concerning patents as a portfolio component, performance indicator, and as an asset in the company's financial policies.

The latter two planning attitudes, i.e. active and proactive, show much resemblance with what Chesbrough¹³ calls the logic of Open Innovation, a mode of innovation involving alignment of internal as well as external innovation activities as to strengthen a firm's patent portfolio and ultimately its innovation capacity. In contrast, an inactive and, particularly, a reactive planning attitude towards patent strategy show very similar characteristics with the logic of Closed Innovation. This view largely

concentrates on the control of internal resources, exploits internally established proprietary results from research, and regards the external environment as hostile.

3. Patent functions from a managerial perspective

Our starting point is the view of patents as “intermediate products of innovation representing a sanctioned behavioural relation among men that arises from the existence of goods and pertains to their use”.¹⁴

In regarding what patents actually do in the behavioural relations between and within companies, we adopt a managerial perspective. Though the above definition also refers to the strategic behaviour following from different principles and areas of jurisdiction within the international patent system, legal conditions are not subject to managerial control and therefore not part of this strategic approach to managing patents. Internal information systems, decision-making procedures and strategy formation are. Moreover, local legal requirements and application procedures are typically part of the operational approach to managing patents and are in large companies organised for at the functional and business levels of decision-making.

The use of patents for corporate management in an early stage of bio-business development will relate to typical corporate responsibilities in the areas of finance and (technology) marketing. From each of the purposes that management can have in actually using the patent in these contexts, a function is derived that we attribute to exploiting the bare ownership of patents. The logical relation suggested below is based on the perception of the inherent function as intended by the designers of patent systems (as the legal context to managers).¹⁵ In that sense, it is a sort of input to the actual use of the system by the subjects it is designed for. The attributed function is from this perspective to be considered as an output by interpretation which one can give to patents in business. We learned from the pilot study that the originally eight functions are perceived as being of a different order. This made us relate functions in the logical way we present them here.

<INSERT TABLE 1 HERE>

The utility purposes as defined in the table above are central to the managerial perspective of building a corporate future, i.e. planning, to which patents are only

instrumental. Since we focus on the role of patents in planning for a corporate future, we consider the inherent functions at least as relevant to management as the attributed functions and operationalise them as following:

1. Incentive

This function represents the patent as an input motivator to R&D efforts. The quote in the first section illustrates the importance of this function to R&D investment decision-making. When patents are an imperative in the business, also small research-based companies can on the basis of these assets take part in the large scale drug commercialisation programmes controlled by big pharmaceutical companies. By introducing incentive schemes, management can raise awareness of the importance of patents as a basis for business and stimulate researchers to make their knowledge proprietary as soon as they can. Such awareness can also be materialised by a more structural reward system which would be based not only on the patent when it is granted but also when it is exploited relating, for instance, an incentive to corporate royalty incomes. Entrepreneurial researchers as inventors to patents that are not considered strategic to the company could also be more or less stimulated to start-up their own business, whether or not maintaining a financial relation with the former employer, particularly in the public domain (i.e. PROs).

2. Appropriation

This function represents the patent as a mechanism providing ownership of an invention. The legal purpose is to rightfully distribute returns from commercialising the idea. An alternative to patenting is secrecy, which is generally more difficult to maintain on a product than on a process innovation. Making in-house knowledge proprietary helps positioning the company technologically, which is crucial for the exploitation of patents. In the pharmaceutical industry, misappropriation can be a reason to terminate a drug development project. Aspects to which companies will vary in their level of appropriation activeness involve the following questions:

- Who takes the initiative for patent filing procedures?
- To what extent is it a subject in:
 - Regular meetings within the company
 - Labour or outsourcing contracts, and

- Research proposals?
- Are there guidelines for secrecy, authorisation for publication, etc.?

3. *Protection*

The patent as the legal ability to exclude others from gaining returns on investments the proprietor made to create the invention. This is the most commonly known, but not necessarily the most important function of patents. That depends on the efforts made by management to enforce it. Excluding others implies identifying actors by scanning proprietary information outside as well as inside the company. Externally focused technology intelligence is to serve patent enforcement and, eventually, litigation purposes. Internally focused intelligence is in a much earlier stage to prevent or screen for potentially appropriable information to be presented in other forms of publication than as a patent, such as scientific papers and oral conference presentations. This internal function serves to prevent losing the option of protecting appropriable knowledge as a result of which commercialisation is in many cases blocked. In operationalising this function we are interested in the activities companies engage in focusing on ‘proprietary friction’:

- Prevention (detecting and informing about potential infringement);
- Negotiation (investigating and settling disputes outside court); and/or
- Litigation (initiating and pursuing legal proceedings in a court of law).

4. *Dissemination*

The patent as a source of information open to rivalling companies (as a consequence of the patent as a publication), often inducing ‘circumvention’, but also to be shared between researchers within the company as a source of inspiration for or as an inducement to terminate research. From the perspective of the subject company, we therefore need to find out to what extent information on patents of rivals is used (external patent information). To what extent information on its own patents is used, can not be assessed by the subject company. Operationalisation of this function focuses on the following two questions:

- How is the internal dissemination of patent information organised?
- To what extent is the use and interpretation of patent information subject to regular meetings?

As attributed functions we distinguish:

5. Liability

The financial meaning of patent liability is that of securing a loan, for instance when working capital is needed for the company's future operations. We learned from the pilot study that, at least in The Netherlands, this is not regarded an option. Dutch tax policy prohibits sale & lease-back constructions with patents as securities ever since the so-called 'technolease' deal between Philips and the Rabobank was disapproved of.¹⁶ Valuation problems and claw back clauses that would prevent patents to be sold to third parties in case of insolvency would be the reasons.¹⁷ Since the description of the case study results started from this financial meaning of this function, the other strategically relevant meaning of this function of the patent has not been included. But, it certainly is part of our conceptualization of Strategic Patent Management, for it requires some internal organisation. Large companies need to do so as a consequence of the Sarbanes-Oxley act, the new regime for Corporate Governance.

The legal meaning of patent liability concerns the prevention of patent infringement and can result in either precluding the infringing company from using the specified technology or causing it to pay a toll for that use.¹⁸ Since we are interested in both creating and exploiting patents, this managerial activity is to generate freedom-to-operate without endangering research to be programmed for future in-house use. In that sense it is the other side of the same coin of protection, but relating to third party ownership and, thus, a relevant illustration of our defining starting point of the patent as a sanctioned behavioural relation between rivalling technology producers.

6. Portfolio component

The patent as part of a set of more or less related proprietary technologies that serve the corporate future. The two defining characteristics of patents as intermediate products that imply relations between owners make them strategic not only in their external role, but also in their internal role. In that sense they represent inventions that should be related through their future translation into products that the organisation intends and is able to market. Portfolio management is in that view aiming at building coherence between the creation and exploitation and/or commercialisation of

proprietary technologies; turning technology into business as effectively and efficiently as possible. In market terms this longitudinal relation is often expressed in the patent and market positions of the company.

Apart from such strategic coherence, decision-making about the patent portfolio will result in either one of these options for a particular patent: selling or out-licensing it or keeping it with the intention of further investing in the commercialisation of the technology under own or shared risk. In the exploitation of patents by smaller biotechnology companies, selling the patent is usually not an option, since young companies are first of all interested in building their portfolio rather than rationalizing it. Selling a patent usually is an option to bio-pharmaceutical companies when there is a proper scale achieved in the portfolio and when there is sufficient longitudinal experience with the in-house capabilities to create patent positions. Moreover, in the human health area, small companies often lack the resources to enter into lengthy and expensive developmental trajectories and therefore need to enter into co-operative modes of prolonged development and commercialisation of new product technologies.

However, in building an unsurpassable proprietary position, coherence in technology and business makes patents as portfolio components a pivotal part in strategizing.

7. *Asset*

The patent as a financially valuated means of producing gains to the owner. Though patents are bought and sold, the institutional conditions of valuation and accounting of immaterial assets are more problematic than to their material counterparts. There are three accounting bases for patents: their costs, potential revenues and as so-called real options. The main problems concern cost allocation and revenue recognition. Despite the shift in attention of business, policy makers and scholars, from material to immaterial production and monetization in economics, there is no consensus between accounting standards organisations as how to formalize such immaterial assets as patents. As a result, companies that report on their proprietary technology yearly vary in the degree to which they activate patents. Some depreciate annual spending within the year in which they are incurred as costs; others do so over a maximum of three years. The statutory accounting principles applied vary as well (e.g. historic). And, if not activated, patents can be valuated for other purposes. But, not all companies deal with their patents from a financial perspective. Therefore, in the questionnaire this

function has been operationalised as a measure for the awareness of this financial perspective.

8. Performance indicator

The patent as an informational medium to represent the company's research performance and technology marketing potential. Analogously to publications in the public domain of science, patents are the predominant indicator for technological achievements in the private domain of science-based business. This brings important advantages to, in particular young, biotechnology firms as it can help them in building a trustworthy image towards potential investors, research partners and clients.

Our operationalisation focuses on the two related questions:

- Are patents used to assess one's own and other companies' technological achievements? And
- To what extent are patents used in communication and strategic decision-making (for instance, in partnering)?

At the time when patent systems were erected by laws and treaties, patents were not granted to (large) companies to the extent that they are now. Patents are here and in general increasingly understood in the context of organisation and management. Moreover, the changing innovation regime adds another dimension to increasing business interaction: patents as a subject to market transactions.^{19,20} Despite the 'knowledge economy discourse', valuation practices have not yet changed in the sense that such immaterial assets have become equivalent to material assets under accountancy and finance standards. At the moment that intellectual property would be valued not only for consolidation but also for transaction purposes, at least one precondition for the marketing of intellectual property rights would be met (intellectual capitalism²¹). As long as such institutional reform is lacking, the patent functions of 'asset' and 'liability' are more or less hypothetical in their interpretation for the managerial purposes as described above. Nevertheless, we believe that for analytical purposes this distinction should be made to serve the development of thinking about IP management and policy.²² After all, there is certainly a logic following the inherent functions of the patent as intended by its nineteenth century designers.²³

4. The typology in a pilot study

For the purpose of operationalising to improve the conceptual framework, we performed a pilot study consisting of three interviews with four people, representing three Dutch firms active in the domain of pharmaceutical biotechnology. These are described in table 2.

<INSERT TABLE 2 HERE>

The first aim was to improve the scales we had defined up to then for use in a written questionnaire, in such a way that it would meet the ‘discourse’ in which managers think and communicate about patents. Because the planning dimension of the typology is sensitive to socially desirable answering, we avoided using these categories in formulating the item scales of the questionnaire.

One of the main lessons we learned from the pilot was that the Liability function was not recognised by respondents for reasons explained in the previous section. We dropped this function from the questionnaire we used for our Dutch biopharma case, but decided to maintain this function in the typology framework since countries already differ in their tax regimes for valuation which may also change in the long term to meet demands of IPR markets in a knowledge economy.

Comments from respondents led to a fair number of essential reformulations of answer categories in the questionnaire. For the majority of items in the questionnaire, we used an almost one-to-one translation of the scales formulated in the typology framework. The items that we have addressed for each of the patent functions in our framework can be found in table 4. A full representation of both the framework and questionnaire (in Dutch) is available upon request.

5. The typology in a case study

For a first ‘proof of principle’ of the typology we sent out the questionnaire among Dutch biopharmaceutical SME. A large part of Dutch Biotechnology consists of firms in the area of human health, including therapeutics/pharmaceuticals, diagnostics and preventive solutions.²⁴ By the end of 2003 there were 138 so-called dedicated

biotechnology firms¹ in the Netherlands, of which 44% were active in human health biotechnology. About one-fifth of all dedicated biotechnology firms in the Netherlands consider therapeutics/pharmaceuticals as their primary or secondary target market.²⁵

In order to reduce sectoral differences, we included dedicated biotechnology firms that are only involved in therapeutics/pharmaceuticals. Furthermore, we focussed on dedicated biotechnology firms that are R&D-driven and aiming at translating their R&D outcomes into proprietary therapeutical applications. It is in particular to those dedicated biotechnology firms that the creation and exploitation of patents are relevant as their core business of new product development.²⁶ This means that firms were not taken into consideration if they have services as their main activity, like contract research in drug discovery or contract manufacturing of biopharmaceuticals. Finally, we included not only firms that already had patents granted or filed, but also firms without any patents to avoid excluding firms that are in the process of creating intellectual property. Particularly, their perceptions and opinions are of interest to our study. In total, a selection was made of 40 dedicated biotechnology firms active in the field of therapeutics/pharmaceuticals. This set represents approximately 29% of the total population of dedicated biotechnology firms in the Netherlands.

The questionnaire we developed, consists of twenty-three multiple choice items, complemented with eight questions concerning the year of foundation, firm size, the number of employees involved in R&D, the number of staff involved in IP management, the size of the patent portfolio, and general data about the firm and the respondent. Prior to sending the questionnaire, the firms were contacted by phone in order to identify the most appropriate staff members as respondent. The questionnaire was sent to the firms in June 2004. After three weeks a reminder was sent, followed by contact over the phone. In August 2004, a total response was gathered of twenty questionnaires of which four had to be excluded. Those four firms were either part of a holding structure in which all IPR matters were dealt with at the corporate level abroad or firms that appeared to be too much service-oriented, not holding patents at

¹ Dedicated implies that these firms are concentrating all their efforts on biotechnology research and commercialisation. Dedicated biotechnology firms are often relatively small- to medium-sized firms that have started to pursue the exploitation of a piece of proprietary biotechnology.

all. The included firms are relatively young, as the majority of them were created after 1996. Furthermore, the firms are relatively small in terms of total employment – only 3 firms have more than 10 employees – and thus also in terms of R&D efforts. Only two firms have no patents granted or filed yet; the others have patent portfolios consisting of at least one patent family. Most firms have appointed 1 or 2 staff members as responsible for IPR matters; three firms have no formal IPR staff at all. Table 3 presents an anonymous description of the response to the mailing.

<INSERT TABLE 3 HERE>

Table 4 presents the item results per patent function differentiated to planning type.

<INSERT TABLE 4 HERE>

Incentive to innovate

Patents can act as an incentive to stimulate innovation in a firm, in particular when some sort of reward is granted to the researchers involved or when opportunities are offered to commercialise research outcomes outside the firm, for example through realising a spin-off or spin-out. The majority of the firms in our sample show an inactive attitude towards the patent as an incentive, as they have not (yet) implemented any kind of reward mechanism for patenting by their personnel. Furthermore, most of the firms stated that they are averse to spinning out research results with commercial potential not regarded as part of their core competency.

Appropriation of an invention

This is related to the opportunities that patents offer in appropriating rights to exploit specific technical knowledge developed by a firm. The overall picture of this function is fuzzy, as the respondents show considerable differences concerning aspects of appropriation as a process.

First, the initiative to patent research results is in most cases taken by a combination of managers, researchers and an (external) patent agent. This implies a predominantly active and even pro-active attitude, as the initiative to patent is not assigned to a single functionary but taken by multiple actors in the organisation.

Second, patenting is for six firms not a subject on the standard agenda in internal meetings, pointing at an inactive attitude. At the same time, six firms witness a pro-active attitude, as patenting actually is a standard issue of their internal meetings before and after the invention has been made, and in which the most relevant actors are involved, i.e. management, researchers and patent agents.

Third, the majority of the respondents do not oblige their researchers to include patentability as a standard item when formulating research proposals, although some of these firms appreciate it when included. We regard such firms as having an inactive or reactive planning attitude. Six firms have made the inclusion of patentability in research proposals mandatory. However, only three firms also include aspects related to exploitation or commercialisation prospects.

Fourth, almost all firms in the sample have arranged the rights of ownership and exploitation of intellectual property by means of contracts, for which standard formats are often used and in consultation with the most relevant stakeholders and experts (active attitude). However, only two firms indicated that they actually supervise the compliance with the conditions or rules included in the contracts (pro-active). Three firms have indicated to have no contractual arrangements at all for patent ownership and exploitation (inactive).

Fifth, nine firms stated that they arranged secrecy issues by means of labour contracts or non-disclosure rules for both the firms' own and external researchers like Ph.D. students employed by a university. Moreover, these nine firms reported that these arrangements and rules are well known among employees and that compliance is supervised, implying a pro-active attitude. Six firms arrange secrecy and non-disclosure for their own employees. This seems to point at situations in which there are no arrangements made in the case of hiring external researchers. One firm explicitly mentioned that no formal arrangements are made, nor that anyone had been appointed for contractual affairs.

Finally, also relating to secrecy is the issue of publishing research results at conferences or in scientific journals. One firm indicated having no arrangements at all or staff appointed to supervise publishing. Furthermore, six other firms also indicated having no formal and standardised arrangements or staff responsible for supervision of publishing activities. But they also indicated that they would implement specific arrangements when necessary. The latter implies a reactive attitude. The majority of the sample has arranged publishing procedures and staff have been explicitly

appointed the responsibility for supervising compliance. Most of these firms also reported that the procedures concerning secrecy are actually known and complied with by the firms' researchers. This indicates a pro-active attitude.

Protection of intellectual property

Protection of intellectual property is, together with appropriation, the best known function of patents in general as well as in the perception of the companies involved in our case study. In the typology, we included the way firms have organised the identification of infringement, the way firms tend to prevent infringement, and finally their attitude towards prosecuting the infringing party. For a better understanding of the case study outcomes, it needs to be stated that all respondents but one indicated never having been confronted with infringement, neither actively (by infringing another firm's rights) or passively (other parties infringing the firms' rights).

A remarkable and also worrisome outcome is that ten out of the sixteen firms indicated that they have not appointed the identification of infringement to any internal staff or external agents. This means that the majority of the sample is inactive and therefore highly vulnerable. Another interesting outcome is that no respondent has outsourced the identification of infringement to specialised organisations, which could be of particular relevance to small and medium-sized firms with limited human resources.

Also remarkable is that six firms stated not to do anything when infringement occurs or is likely to occur; an inactive attitude in this aspect. Two other firms will only react when a third party gives official warnings of (potential) infringement. Another six firms indicated that they would provide and react to (early) warnings of infringement. Only one firm indicated to pro-actively engage into offering a license.

Finally, the firms' attitudes to prosecution are varying. Three firms stated that they would never prosecute in case of infringement, thus staying inactive at all time! Four firms would only prosecute as soon as the firm experiences economic consequences resulting from infringement. Two firms indicated to prosecute in any case, and six firms state that prosecution is only initiated when no other solutions are left.

Dissemination of patent information

The dissemination function of patents in the typology includes the availability of patent information to serve a variety of goals.

The majority of the firms show a pro-active attitude concerning the use of patent information, as they indicated to use patent information for:

- Assessing the patentability of their own research,
- Generating new ideas and input for their research, and ultimately
- Gaining insight in their competitors' research strategies.

Two firms indicated not to use patent information at all.

Surprisingly, five firms indicated not to have any source of patent information like freely accessible patent databases. Another five firms indicated to have some sort of central access to patent information, but the use of it by employees is mainly incidental and not stimulated or supported by the organisation of the firm. This is surprising as most firms indicated to use patent information in a pro-active way; how can you do so without having access to patent information? The other six firms disseminate patent information on a more structural basis.

Patents as assets

The asset function of patents in the typology is related to the extent of patents being considered as an asset, valued on financial grounds. Seven firms indicated not to value their patents at all. Five firms indicated to value patents only on the basis of historical cost price or procurement price, and only for external purposes (e.g. a firm's annual report). Two firms use valuation principles for internal and external purposes. These firms value their patents for external purposes on the basis of cost price, but also value their patents on the basis of the expected returns or market potential for internal purposes.

The patent portfolio

Patenting for the corporate future means that patents should be related to each other in a commercial and technological way as to build long term coherence and success in the company's activities. In the typology we operationalised portfolio building as the way in which potential patents are evaluated against the existing portfolio and the extent to which the existing portfolio is evaluated in relation to that of competitors. Furthermore, the activities of firms in realising licensing agreements are included. Of course, such activities are related to the dissemination function of patents and the company's 'business intelligence efforts'.

Six firms indicated to start application procedures as soon as patenting seems feasible, however without involving any kind of evaluation with the existing patent portfolio. The majority of the firms indicated to evaluate all potential patents on their technological and commercial added value with respect to the existing portfolio. However, no respondent indicated that they already performed such evaluation ex-ante, i.e. before an invention occurs, for example by means of including specific patent paragraphs in new research proposals. This indicates a low level of technology analysis for decision-making.

Most of the firms stated to evaluate their existing patent portfolios on the basis of their financial potential and their perceived strategic value, indicating a pro-active attitude in the typology. Furthermore, three firms evaluate their portfolio mainly on the basis of costs, while another three firms perform portfolio evaluations mainly on the basis of their financial value. Only one firm indicated not to perform any kind of portfolio evaluation at all.

The attitude of firms towards licensing activities is operationalised by the number of licensing agreements (both in- and out-), in combination with the type of actor taking the initiative in licensing activity. None of the firms in the sample can be characterised as inactive with regard to licensing. However, two firms show very small numbers of licensing agreements and in these cases third parties approached them (reactive). Furthermore, eight firms are involved in several licensing agreements where the initiative was taken by third parties, but also by the firms' management, implying a more active role of the firm in exploiting its patent portfolio. Finally, six firms indicated that the identification of licensing opportunities is also done by the firms' researchers, together with management and third parties.

Patents as performance indicator

Patents are a well-known and notorious performance measure at various levels of aggregation, for instance to indicate a firm's inventiveness. In this respect, a firm can use its patents for corporate communication and public relations to highlight its performance and to create a positive image towards its stakeholders. Patents can also be used to assess a rivaling firm's (technological) performance, for instance when technology partnering is considered.

The use of patent information for assessing a potential partner's patent portfolio varies strongly in our sample. Four firms indicated not to use patent information at all

when selecting potential partners. To another four firms this has only a limited priority. However, six firms indicated to use this kind of information with a high priority and two firms even with the highest priority.

The majority in our case sample use patents (granted and filed) as a means to communicate about the firm's technological performance. Four firms do not communicate at all about their patents. Three firms communicate about their patents only after they have been granted and only to external parties, which we consider as reactive. Three other firms communicate about their patenting activities after having filed a patent and after the patent has been granted, but merely to external parties. Five firms communicate both about patent filings and patents granted to external parties as well as within their own organisation.

6. Conclusions

What we can learn from this study is not so much how biopharmaceutical SMEs in the Netherlands manage the creation and exploitation of their patents in general. The empirical insights produced in this case can only be considered indicative. Probably, they are most of all relevant to Dutch patent system and innovation policy authorities. In our view, the value of this study is rather in the typology itself. Operationalisation of the framework underlying it allows a rare theoretical elaboration into the organisation of strategic patent management, taking SME contingencies into account. Usually, strategic patent management as a practice is considered a large companies' affair to start with.

The typology can be used as an instrument for surveying patent-intensive sectors for policy making purposes as well. An example of such would be to serve as an impetus to patent authorities more effectively campaigning to promote the use of public patent databases. The same would go for tax regime changes as to stimulate innovation in a national or regional economy. But it can also be applied in singular situations by venture capitalists for financial participation decisions, especially critical in a business where rivals are large companies that have mature patent management practices. Since, not knowing whether an investment in the commercialisation of a proprietary technology is liable to infringement claims, poses a business risk that is not acceptable to investors (Sarbanes-Oxley; corporate governance compliance).

The pilot study confirmed the relevance of seven of the eight functions. Except for Liability, respondents in these companies acknowledged each of the functions as relevant to both the creation and exploitation of patents (see also section 3.5). The typology as a frame of reference was reported an eye-opener to respondents in the pilot study.

However, not all respondents considered each patent function relevant in the sense that they also acknowledged a need to plan and organise for it. Such differences seem to vary strongly with firm size, age and technology ('organisational contingency').²⁷ We believe this variation is to a large extent a consequence of the variation among managers and researchers in levels of awareness and attitude towards patents and planning. Since planning awareness is generally low in SMEs, developing this managerial capability is crucial for the continuity of bio-pharmaceutical companies. This outcome of the case study certainly seems to validate the choice of dimensions of the framework; patent function and planning attitude.

With regard to patent functions, we believe the case sample confirms the relatively underdeveloped use of the patent in its full extent.²⁸ This is particularly expressed by the variation in attitude that the respondents attribute to the different functions but also to the dimensions constituting the functions in our typology. An example of the former is the difference between the functions of patents as a means to appropriate knowledge and to stimulate employees to create and exploit patent positions. An example of the latter is the difference between the constituting dimensions of the Dissemination function: the majority of the respondents indicated to use patent information as input to their innovation process and also to their strategic management, although only a few respondents indicated to stimulate the use of patent information or to provide structural and free access to patent information sources. In the last section, we will discuss this apparently contradicting phenomenon.

Despite the small number of companies involved in this study, the outcomes still provide ground for some remarks and issues about strategic patent management in Dutch Biotechnology for mainly two reasons. First, the sample of pilot plus case studies still represented 14% of the total population of biotechnology companies in the Netherlands and almost one third of the companies in the area of human health. Second, the case sample highly resembles the lion's share of Dutch Biotechnology,

i.e. they are relatively young, small both in terms of personnel and turnover, and mostly in the early stages of company development.

The main remark is in line with the above notions about the variation in attitudes and in functions. The survey provides a strongly varying image when it concerns the way the 16 firms in the sample have organised their patent management processes. This confirms what we experienced prior to this study. We believe that this is only partially a consequence of a lack of financial means or human resources. Despite the highly demanding proprietary conditions to bio-pharmaceutical technology development, this variation in practices is resulting from the lack of awareness of the potential value and functions of patents, particularly in companies that were spin-offs from the public domain science.

Furthermore, the survey shows some remarkable findings, mostly in the sense that the respondents appear to be inactive or reactive in a number of functions:

- Most of the companies have no explicit incentive mechanisms to stimulate employees to create and/or exploit patents.
- A worrisome number of companies have not formally appointed the responsibility for the identification of potential infringement to any internal staff or even external agents.
- Between one to two thirds of the companies in the sample remain inactive in case of potential and even actual infringement of their patents.
- Although the majority of the companies indicated to use patent information in a pro-active way, only a few companies seem to have organised for the dissemination of patent information throughout the organisation and to stimulate the use of such information in research planning.
- Most companies do not value their patents and if they do, it is only based on the initial cost or procurement price. Possibly they do not see the advantages of also valuating the patents based on commercial prospects. This is probably related to a general lack of commercial foresight in IP matters. Consequence is that the pressure to exploit patents by marketing the technology is also low.

It seems that the companies in the sample, and therefore possibly a large number of other biotechnology companies in the Netherlands, are not aware of the opportunities offered by patents and the necessity of installing proper mechanisms and organisational arrangements in order to meet the demanding processes of creating and

exploiting patent positions. We believe that companies in sectors that are highly science and technology driven, and in which patents are a condition-sine-qua-non to business, need to be fully aware of the strategic value of patents and act upon it! Such companies cannot prosper on the long term without strategic patent management that should be pro-active, if contingencies allow so. There is much professionalism to gain for mature strategic patent management if the above findings would be representative for Dutch Biotechnology.

7. Discussion

A number of issues emerge from the study we have presented here.

1. The small size of the sample. As a result of the small size of the sample no proper statistics could have been performed to test the validity and consistency of the typology. Therefore, in the methodology used, we explained measures taken to build validity. Furthermore, the small numbers did not allow for any statistics to yield any significant patterns to be interpreted for describing or let alone explaining patent practices.
2. The influence of firm size. The empirical findings seem to indicate that the firms in our sample have an incomplete awareness of the functions that patents can fulfil. It could be tempting to go one step further by stating that the majority of the firms in our sample do not manage their creation and exploitation of patents professionally. However, one could also argue that our findings are mainly related to the limited means of SME. Filing and maintaining patents can be rather expensive, and monitoring of infringement and protection of patents may well be beyond the financial possibilities of small firms. This is likely to be true. But then the question also arises why firms apply for a patent in the first place?
3. Sectoral or national differences. We have developed and tested the typology with Dutch pharmaceutical biotechnology companies as a sample case. At this stage, it is not clear to us to what extent national or even sectoral factors influenced the outcomes of the survey. Although Biotechnology is highly international, it can be assumed that managerial practices regarding IP differ among countries, since we know that in the US and UK patent awareness in the public domain is greater than in The Netherlands. Such differences are caused by factors like laws and regulations, entrepreneurial spirit, values and beliefs, labour markets, public R&D

and innovation policies, etc.^{29,30} The same accounts for possible differences between sectors. We have not applied the typology in other science and technology driven sectors such as ICT or nanotechnology. And even within Biotechnology, differences might appear as we concentrated on the biopharmaceutical sector. Biotechnology companies serving agricultural and food markets have different IP management practices than the human health biotech companies.

4. Value for universities and (public) research organisations. The typology has proven to be useful in characterising the patent management processes within science and technology driven enterprises. However, we also believe that the two dimensions of patent functions and planning attitudes are useful to characterise IP management within public research organisations and universities. These organisations are increasingly expected to professionalize their IP processes, often in the context of improving their economic and social contribution to society. A typology like the one we present here could help them in this process. In adapting the typology, possible changes might be expected when we consider the ‘attributed’ patent functions as they have been elaborated as particularly relevant to the commercial environment of private companies like competitor analysis or attraction of venture capital.
5. Lack of IP awareness. The question arises whose problem it is when a lack of awareness exists about IP management within companies, and even whose responsibility it is to take action in improving IP management practices? Is there a role for public policies or should it solely be a matter of the market? First of all, and of course, this is a problem of the organisations that aim to create and exploit intellectual property, regardless if they are private companies, universities or public research organisations. IP management should be an integral element of their overall strategies and operations. It is therefore also fully their own responsibility to improve their IP management processes. However, we believe that in cases of a general lack of awareness affecting a large number of companies, like it appears to be the case in Dutch Biotechnology, some rationale for public action seems legitimate. Perhaps not in the shape of (additional) specific rules and demands, for instance in relation to R&D subsidies, but more in the sense of education and information supply. National agencies responsible for

intellectual property, like national patent bureaus, should play an active role in this matter, more than they do now.

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¹ A.H. Van Reekum, *Intellectual Property in Pharmaceutical Innovation: A Model for Managing the Creation of Knowledge under Proprietary Conditions* (Labyrint; Capelle a/d IJssel, 1999)

² Biopartner, *The Netherlands Life Sciences Sector report 2004: Moving forward*. (Drukkerij Damen, Ede-Wageningen, 2004).

³ We make a distinction between ‘exploitation’ and ‘commercialisation’: Exploitation is about making the bare right to the process, product or service technology valuable to anyone producing the material artefact following from it. There is no material transformation process involved in marketing the right through ‘knowledge markets’ to users that need the knowledge as input to their transformation processes (pipe line). Commercialisation includes the actual transformation of the technology into a process and/or product which is then produced, marketed and sold to (industrial or end) users.

⁴ N. Thumm, Strategic Patenting in Biotechnology. *Technology Analysis and Strategic Management*, 16 (4), 2004, pp. 529-538.

⁵ A. Ries & J. Trout, *Positioning: The Battle for Your Mind*. (Revised Edition, Warner Books; New York, 1986).

⁶ Van Reekum, *op. cit.*, Ref.1.

⁷ O. Granstrand, *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism* (Edward Elgar; Cheltenham, 1999).

⁸ H. Chesbrough, *The Logic of Open Innovation: Managing Intellectual Property*. *California Management Review*, 45 (3), Spring 2003.

⁹ Referring to Chandler’s famous adagio: “Structure follows Strategy”, which is acknowledged to be of crucial importance by e.g. Henry Mintzberg. See his *The Rise and Fall of Strategic Planning* (The Free Press; New York, 1994).

¹⁰ R.L. Ackoff, *Creating the Corporate Future: Plan or Be Planned For* (John Wiley & Sons; New York, 1981).

¹¹ Ackoff, *ibid.*

¹² Ackoff, *ibid.*

¹³ Chesbrough, *op. cit.*, Ref. 8.

¹⁴ E.G. Furubotn & S. Pejovich, *The Economics of Property Rights* (Bailinger Publishing; Cambridge (Mass.), 1974).

¹⁵ Thumm, *op. cit.* Ref. 4, refers to this distinction between inherent and attributed functions as the primary and secondary use of patents: p. 529.

¹⁶ W. Hulsink & H. Schenk, 'Privatisation and deregulation in The Netherlands', in: D. Parker (Ed.), *Privatisation in the European Union: Theory and Policy Perspectives* (London, Routledge, 1998), p. 251.

¹⁷ Algemene Rekenkamer, *Financial relations with major companies*. Report to Parliament (Tweede Kamer der Staten Generaal), TK 25 080, nr. 2, Sdu, The Hague, 1996, p. 38.

¹⁸ A.L. Miele, *Patent Strategy: The Manager's Guide to Profiting from Patent Portfolio's* (John Wiley & Sons; New York, 2001).

¹⁹ Chesbrough, *op. cit.*, Ref. 8.

²⁰ M. Dietz & J. Elton, *Getting More from Intellectual Property*. McKinsey Quarterly, issue 4, 6-8, 2004.

²¹ Granstrand, *op. cit.*, Ref. 7.

²² In our terminology, IP management precedes IPR management to distinguish differences in activities necessary for the creation of proprietary positions from those for the exploitation of them (Van Reekum 1999: 103-106). As a consequence, valuation should be part of the managerial activities preceding patenting in the way health economic assessments have become part of registration procedures for new drugs in well-developed national markets. IP policies and management together constitute the IP strategy of companies or research organizations. Patent management and planning are part of it. Of course, IP includes other forms of proprietary rights, which have not been subject to this paper, as well as in- and outlicensing, among others of patents.

²³ Van Reekum, *op. cit.*, Ref. 1.

²⁴ S. Kern, C. Enzing & A. van der Giessen, *National report of the Dutch biotechnology sector*. Background report to the EC project Effectiveness of public policies in high tech sectors in Europe (EPOHITE), published as Annex to the Final Report 2003.

²⁵ Biopartner, *op. cit.*, Ref. 2.

²⁶ N. Thumm, *Management of Intellectual Property Rights in European Biotechnology Firms*. *Technological Forecasting and Social Change*, 67, 259-272, 2001.

²⁷ Between different sectors or technology areas such variation would likely to be explained by the relevance of patenting in the sector, technology dynamics etc, which would not necessarily have much relation to the strategic orientation of management of companies that do rely on IP as a crucial means for conducting business (Taylor & Silberston, 1973; Pavitt, 1984; Wyatt et al., 1994).

²⁸ Chesbrough, *op. cit.*, Ref. 8.

²⁹ Enzing, C. & S. Kern, *Structure, Dynamics, and Performance in National Biopharmaceutical Innovation Systems*. In: OECD, *Innovation in Pharmaceutical Biotechnology; Comparing National Innovation Systems at the Sectoral Level*. Paris, 2006.

³⁰ S. Wyatt, G. Bertin & K. Pavitt, *Patents and Multinational Corporations: Results from Questionnaires*. *World Patent Information*, 7 (3), 196-212, 1985.

TABLES AND FIGURES

Table 1 - A managerial logic of patent functions

Inherent function	utility purpose	attributed function
Incentive	investment	liability
Appropriation	positioning	portfolio component
Protection	exclusion	asset
Dissemination	reputation	performance indicator

Table 2 - The pilot study composition

Case (firm)	Foundation year	Employees	Patents/families
AM Pharma BV	Merger in 2002 between AM Pharma BV (2000) and PharmAAware (2001)	15	-/6
Kreatech BV	1990	30	150/9
Crucell NV	Merger in 2000 between Introgene (1993) and Ubisys (1996)	200	390/80

Table 3 - General characteristics of the firms that responded

Year of foundation	1 firm before 1991	1 firm in period 1991-1995	6 firms in period 1996-2000	8 firms in period 2001-2003
Total employment	5 firms with 1 to 5 employees	8 firms with 6 to 10 employees	1 firm with 11 to 25 employees	2 firms with more than 25 employees
R&D employment	10 firms with 1 to 5 employees	3 firms with 6 to 10 employees	3 firms with 11 to 25 employees	0 firms with more than 25 employees
IPR management staff	3 firms with no IPR staff	8 firms with 1 or 2 IPR staff members	4 firms with 3 to 5 IPR staff members	1 firm with 6 or more IPR staff members
Number of patents (pending and granted)	2 firms with no patents	6 firms with 1 to 5 patents	6 firms with 6 to 15 patents	2 firms with 16 or more patents

Table 4 – Case study results (in absolute numbers)

<i>Item IP management</i>	Inactive	Reactive	Active	Proactive
<i>1 Incentive</i>				
1.1 Stimulating spin-out activities	12	2	1	1
1.2 Presence of reward mechanisms	11	1	3	1
<i>2 Appropriation</i>				
2.1 Mix of staff taking initiative for patenting	-	3	9	4
2.2 IP as standard subject of internal meetings	6	3	1	6
2.3 IP as subject of research proposals	4	6	3	3
2.4 IP arranged in contracts	3	1	10	2
2.5 Arrangement of secrecy	1	6	2	7
2.6 Arrangement of the publication of results	1	6	2	7
<i>3 Protection</i>				
3.1 Identification of infringement	10	-	5	1
3.2 Way of preventing infringement	6	2	6	1
3.3 Moment of prosecution in case of infringement	3	4	2	6
<i>4 Dissemination</i>				
4.1 Use of patent information	2	1	4	9
4.2 Ways of disseminating patent information	5	5	2	4
<i>5 Asset</i>				
5.1 Valuation of patents	7	5	-	2
<i>6 Portfolio</i>				
6.1 Evaluation of potential new patent in relation to existing portfolio	6	-	9	-
6.2 Evaluation of existing patent portfolio	1	3	3	9
6.3 Licensing-in and licensing-out	-	2	8	6
<i>7 Performance/Communication</i>				
7.1 IP as criterion for partner identification/selection	4	4	6	2
7.2 Communication on patents	4	3	3	5