

# Excavating the Role of NPEs in the Innovation Process: Did We Start a Mission Possible?

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*Abstract* - The past decades have seen the rise of so-called Non-Producing/Practicing Entities (NPEs). NPEs do not use patents for appropriating own R&D investments necessary for developing technologies embedded in own products or services but solely focus on exploiting, enforcing or monetising patents. One might suspect that this behaviour impacts the innovation processes of firms and technological developments in different industrial sectors. Interviews with a panel of experts from a European country reveal most notably that the emergence of NPEs has changed the awareness of firms' management towards patents and the way of managing them. The results also indicate that the contemporary situation is still diffuse and immature, so that their full impact is difficult to understand, even from an interpretivists' perspective.

*Keywords* - Innovation process, intellectual property, Non-Producing Entities, patent brokers, patent intermediaries, patent trolls, technology.

## I. INTRODUCTION

The past decades have seen growing markets for technology [1] and a rise in activities for the commercialisation of Intellectual Property (IP), particularly the emergence of numerous new IP service models offered by technology market intermediaries [2] and particularly by what are called Non-Practicing or Non-Producing Entities (NPEs). Those NPEs are typically companies or entities that do not invent new technology directly but acquire IP from third parties and strive to sell licences and obtain licence royalties or any other income stream from exploiting that ownership situation. The NPE concept is thus related to organisational forms, such as brokers, consultancies, bridge layers, gatekeepers, TTOs, patent trolls or rather the economic concept of market intermediaries in general [3].

More specifically, Yoshino et al. [4] identified more than 125 NPEs in the U.S.A. operating more than 800 subsidiaries holding more than 9,000 patents. They estimate that 20,000 patent families are controlled by NPEs (ibid., p. 138). Additionally, NPEs account for 30–40 % of all patent suits filed in the IT and electronics industries worldwide [5]. Moreover, Ghafele and Gibert [6] found that 2,600 firms were confronted with litigation by NPEs (in this case, so-called 'patent trolls') in 2010. Compared to 1998 this represents a dramatic increase from 250 firms. Hence, these figures and the headlines cases imply that the role of NPEs for the exploitation of IP has grown substantially over time.

### A. Research Objectives

Leaving what exactly constitutes a NPE alone for the moment being, their expanding role in the exploitation of IP might indicate that they could have an impact on innovation processes. In addition, the high-profiled cases make it regularly to the headlines of the news and just from those cases one might wonder how NPEs affect the innovation processes and technological developments. At the same time, academic interest in those entities has just emerged and is in stages of infancy. Those that are investigating this phenomenon do so from a variety of perspectives but have weakly addressed the impact of the entities on the effectiveness of innovation processes and the development of technology in industrial sectors; a quest that we seek to address in this study.

That search for the role and impact of NPEs on innovation processes and technological developments brings about as research questions:

- What exactly are these NPEs and what is their impact on the innovation process?
- What dynamics are they causing for the innovation process of firms and for technological developments in industrial sectors?
- Are the NPEs altering the effectiveness of the innovation process?

By addressing these questions, this study also looks how the role of the NPEs and their impact might be modelled for the innovation process of firms and technological developments in industry. Hence, we seek to contribute to appreciative theory before formal modelling may take place [7], that potentially might guide further research.

### B. Outline of Paper

To that purpose, the paper starts with a literature review, given that it is a relatively new topic for researchers from various disciplines.

## II. LITERATURE REVIEW

For the retrieval of papers Google Scholar has been used [8]. Only studies until 2013 were included in the lit-

TABLE 1  
OVERVIEW OF RETRIEVED SOURCES

Keywords	Google Scholar
“Non-Producing Entities” AND innovation	Addy & Douglas [11], Alexy & Reitzig [12], Hall [13], Hall & Ziedonis [14], Johnson et al. [15], Lemus & Temnyalov [16], Mayergoyz [17], Morgan [18], Reitzig et al. [19].
“Non-Producing Entities” AND technology	Addy & Douglas [11], Alexy & Reitzig [12], Hall [13], Johnson et al. [15], Lemus & Temnyalov [16], Mayergoyz [17], Morgan [18], Reitzig et al. [19].
“Patent trolls” AND innovation	Bessen et al. [20], Fischer & Henkel [21], Helm [22], Lemley [23], Magliocca [24], Merges [25].
“Patent trolls” AND technology	Bessen et al. [20], Fischer & Henkel [21], Helm [22], Lemley [23], Magliocca [24], Merges [25], Reitzig et al. [19].
“IP brokers” AND innovation	Benassi & di Minin [26], Gredel et al. [27].
“IP brokers” AND technology	Benassi & di Minin [26], Gredel et al. [27], Monk [29].
“IP intermediaries” AND innovation	Benassi & di Minin [26], Pollard [30].
“IP intermediaries” AND technology	Benassi & di Minin [26], Millien & Laurie [31], Pollard [30].

erature review. Furthermore, the three research questions have guided the retrieval process from the search engine. To find more specific suitable to the research questions, we used combinations of specific keywords for the retrieval. These keywords have been captured in Table 1. It should be noted that NPEs also appear under a variety of labels, when referring to more specific forms and specific activities, a case in point being patent trolls. To that purpose we have used the classification proposed by Fahimi-Steingraeber et al. [9]; only, the Technology Transfer Offices and universities have been omitted. For data retrieval the term NPE was used in combination with ‘innovation’ and ‘technology’. All retrieved papers were inspected on relevance of title and abstract for inclusion in the analysis; if an abstract was absent this was replaced by a quick inspection of the contents. Papers that were addressing the relationship between patenting and setting standards have been excluded; a case in point is the study by Baron et al. [10]. Altogether the search strategy yielded the papers that can be found in the overview in Table 1.

The sources indicated in Table 1 are spread among very different outlets. Some of them are publications in academic journal, but also contributions to conferences, working papers and presentations can be found among the retrieved sources. This indicates that this specific research topic is under development and also attracts attention from many. This should indicate that many of the papers might be propositional, an assertion that needs confirmation later on. Furthermore, the use of the keywords ‘technology’ and ‘innovation’ yielded similar papers; that possible indicates that the terms ‘technology’ and ‘innovation’ are loosely used or that they are intertwined for this specific domain. On closer inspection of the papers it seems that most use ‘innovation’ and ‘technology’ as a substitute for ‘inven-

tion’. However, that distinction has little bearing on the analysis that follows.

### B. Interpretation of Retrieved Sources

After the check on relevance and inclusion in the review, the papers were scrutinised. To that purpose, a spreadsheet was used, where the research methods were recorded, the extent of the literature review, the (theoretical) contributions from the perspective of innovation process and technological developments in (specific) industrial sectors evaluated, and how the sources addressed the research questions (posed in the beginning of this paper). For the research methods a classification ‘propositional’ was used if the paper was a literature review or proposed a new line of inquiry or was a practitioner’s point of view. The classification and analysis in the spreadsheet paved the way for directing the empirical component of the study.

However, given the high rate of propositional papers, it seems that this specific research domain is full of opinions, commensurate with the notion by Fischer and Henkel [11]. That is partly due to the number of papers that address the legal aspects of NPEs. In these papers, authors dwell on court cases and implications, often resulting in propositions for improving the legislature of the patenting system. However, given the research objectives our interest goes to empirical research; empirical papers have been captured in Table 2.

### C. Reflecting on Direction of Research

The majority of the papers retrieved focus on legal aspects and their consequences, especially with respect to costs. Some, such as Morgan [18], claim that patent extortionists only constitute a very small percentage of the legal cases in the U.S.A. That majority of papers also holds what one could call a ‘traditional’ view. In that canonical perspective, NPEs, particularly the ‘patent trolls’, facilitate innovation because they offer smaller firms and inventors the possibility for protective litigation. A specific instance is the court case *e-Bay* versus *MercExchange*, cited in many papers, where restrictions for injunctions were imposed and that has reduced the potential for litigation. In this context, it should also be noted that practices for litigation in most of Europe differ from the regime in the U.S.A., effectively leading to less cases and less questionable court cases by

TABLE 2  
OVERVIEW OF RETRIEVED EMPIRICAL STUDIES

Keywords	Google Scholar
Non-Producing Entities	Hall & Ziedonis [14], Lemus & Temnyalov [16].
Patent Trolls	Fischer & Henkel [21], Magliocca [24], Merges [25].
IP Brokers	Benassi & di Minin [26], Gredel et al. [27], Monk [29].
IP intermediaries	Benassi & di Minin [26].

patent trolls in European court cases [17]. Most interestingly, Magliocca [24] points out to a parallel situation in the 19<sup>th</sup> century when farmers were targeted by ‘patent sharks’, much alike today’s activities by patent trolls. However, generally speaking, NPEs, particularly patent trolls, are seen as hindering innovation because their activities divert resources from R&D to costs of litigation and could ultimately even result in higher prices for consumers.

Far less is written about the actual role of NPEs in terms of the impact on innovation process and technological developments in (specific) industrial sectors. Even though touched on in the sources with a legal perspective, the impact on innovation processes and technological developments in industrial sectors continues to be elusive. In that perspective, Hall [13] states that increased innovation activities due to the patenting systems are most likely to happen in pharmaceutical, biotechnology and specialty chemicals sectors, and possibly in medical and scientific instruments and small-scale machinery sectors. In fact, a little later she states that firms consider generally lead-time for new product and service development and superior sales and service more important for appropriation of returns on product and service innovation than patenting.

Those findings from the literature review suggest that whereas NPEs are receiving more academic attention, their actual impact on innovation process and technological developments in (specific) industrial sectors remains under-researched. That finding has far-reaching implications for industry. While companies find themselves drawn to active patent management, its impact and necessity are ill-understood. Hence, that necessitates research that looks at aspects for innovation process and technological developments in (specific) industrial sectors to understand how companies and industrial sectors should deal with NPEs and patenting strategies.

### III. RESEARCH METHODOLOGY

Because the activity domain of NPEs is relatively specialised and potentially diverse, the consultation of experts is the natural choice for this research. Particularly, the Delphi study allows consulting experts in a structured manner [32][33]. Experts were chosen with complementary knowledge about NPEs, following guidelines by [34] and [35]. Our expert panel includes key informants from patent law firms, university technology transfer offices, academic experts and experts from firms providing IP services others than those of classical legal services provided by patent law firms (e.g. patent analytics).

#### A. Design of Research Instrument

Whereas the current paper is describing the outcomes of interviews, these are factually the outcomes of the first round of a Delphi study. That unusual approach to the Delphi study is instigated by the research topic being rather

open and many of the potential issues ill-defined. We wanted to elicit as accurately as possible and open-minded the impact of NPEs on innovation processes and technological developments.

To the purpose, five models and one classification of archetypes were chosen for the interviews and provoking discussions with the experts:

- The innovation funnel, derived from [36] and [37].
- The open innovation process, derived from [38] and [39].
- The interrelationship between major innovative activities, derived from [40].
- The model for technology cycles, derived from [41].
- The Model for Collaborative Networks, derived from [42].

These models illustrate the innovation processes and development of technologies from different perspectives. In addition to these models, the classification of archetypes [9] was used in the interviews. To support the interviews and to evoke responses from the interviewees a visualisation was used. That was done because the use of visualisation has been connected to exploratory research, e.g. [43] and might even stimulate interviewees’ thoughts [44]. Hence, the semi-structured interviews with visualisations offered the potential to engage in rich dialogue with the interviews.

#### B. Selection of Experts

The eight experts for the interviewees were drawn from those active in one specific European country. The experts wished to remain anonymous, mainly due to the sensitivity of the information disclosed as well as the community of practitioners being relative small. This corresponds also with the motivation for the Delphi study in terms of anonymous consultation of experts.

The spectrum varies from academics to practitioners, from IP generators to those that commercialise, from wider perspectives of innovation processes and technological developments to actors with specific functions (see Table 3).

TABLE 3  
OVERVIEW OF INTERVIEWEES

Role	(Main) activities
A Professor	Open innovation, fuzzy front end of innovation.
B Chamber of Commerce	Advisory services to companies, knowledge center for IP.
C Patent consultant	Intermediary, consultancy for patenting and commercialisation.
D Professor/patent lawyer	Copyright, patent law, infringement cases.
E IP Consultant	Consultancy for patenting, developer of software support,
F Technology Transfer Office	Patenting and commercialisation of inventions of regional universities.
G Patent lawyer	Advisory services, patent law, infringement cases.
H Professor	Service innovation.

That variety also induced as wide variety of responses, but above all elevated relevant aspects.

### C. Data Collection and Analysis

Given the nature of the domain and interaction necessary with the experts, hand-written notes were made during the interviews. After the interview, the notes were recorded in documents, one for each interview. Surprisingly, some of the questions and topics during the interviews made the interviewees ponder on their response. While some of them liked chatting away about specific cases and trends or responding to more specific matters (mostly for clarification), questions related to impact on innovation and technological developments proved difficult. Those responses were recorded, too. In that sense, the interviews yielded ‘stories’ for illustration, insight in actual practices of NPEs, directions of travel for industry next to direct responses to the ‘interview guide’ with its visualisations.

The analysis followed more Foucault’s approach than a typical process of coding and aggregation as typically found in the approach of grounded theory. As Allan [45] states, in principle, the grounded theory investigates actualities in the real world and analyses the data with no preconceived hypothesis [46]. In this case, the available models serves as a starting point and that gives the research preconceived knowledge, making grounded theory obsolete. At the same time, we are consulting experts. It makes more sense to use Foucault’s [47] principle of discourse analysis for the interviews with experts. That allowed extracting relevant statements of the experts rather than focusing on all statements during the interview.

## IV. RESULTS

The results of the interviewees have been analysed against the research questions posed at the beginning of the paper.

### A. What Are NPEs?

Returning to the role of the NPEs in the innovation process, the first research question, generically that was seen by the interviewees as tapping in the reservoir of unused patents (or IP). In an almost converse perspective, interviewee B saw NPEs as ‘risk investors’ and that this role means they are sieving out inventions that are failing (in terms of feasibility of new product and service development and opportunities for commercialisation). Moreover, some interviewees (such as E and G) also pointed to the role as generating IP, though that seemed to be based partly on exceptional cases and strategies. According to interviewee A that should be placed in the context that private research organisations, contract research institutions and universities have more opportunities for IP protection and therefore can and will be more active. Furthermore, NPEs could play

TABLE 4  
IMPACT OF NPEs

	Specific Impact	Interviewee(s)
Positive	Provide inventors and smaller companies with possibility for protection of IP and litigation.	B, C, D
	Tap into the reservoir of unused patents for opportunities for commercialisation.	B, C
	Offer IP commercialisation outwith business models of firms.	A, C, D
	Seed-funding.	B
	Activities of NPEs might induce higher quality of patents.	A
	‘Patent trolls’ could enforce design-around, only beneficial if more functional.	A, C, E, G
	Activities of NPEs have lead to growing awareness in industry about IP, patenting and protection.	A, D, E
Negative	NPEs are creating new business models for IP.	F, G
	Particularly ‘patent trolls’ increase litigation costs at the expense of investments in R&D.	A, D
	Generation of ideas and new product and new service developed inhibited by patent thickets and pools.	G
	Disturbing market for technology licensing and technology transfer.	D, F.
	NPEs are closed once they have acquired IP.	G
	‘Patent trolls’ create a negative image for patenting and litigation.	D, G

a role in protecting IP, either by individual firms or cluster of firms that joined forces. Some of those strategies by (producing) firms for engaging with NPEs might find its origin in the lack of resources and the specific expertise needed for specific activities.

### B. Dynamics Caused by NPEs

The second research question focuses on the dynamics that NPEs are causing. Ultimately, the most common view held by the interviewees is that NPEs shift the 3,000:1 effect of Stevens & Burley [31] to an increase of the number of inventions reaching the marketplace; the impact on the generation of ideas was seen as being marginal. That implies that the role of NPEs for IP protection and commercialisation has become more prominent but not to a great effect, necessarily.

If we look into more detail at the positive impact of NPEs on the innovation process, generically speaking, the effects of individual activities and actions of NPEs could be easily identified, though not always agreed on. The overview of that positive impact is found in Table 4. For part, this overview builds on the canonical conceptions of the effect of NPEs on innovation processes and technological developments in economic sectors. Where the positive impact from the experts’ interviews deviates is especially that design-arounds should be more functional than the patent they try to avoid and the notion that the activities of NPEs might increase the quality of patents.



The negative impact of NPEs on innovation processes is also presented in Table 4. Again, commonly held perspectives are found here. However, remarks are made about how NPEs are disturbing the markets for technology licensing and technology transfer. Moreover, some NPEs create patent thickets for blocking developers of new products and services from tapping into specific technologies or that for specific functions in products and services they hold (all) relevant patents. A case was mentioned in which a particular firm had build a dominant position in that way (it was told that this amounted to a monopoly position that was consequently blocked by the EC). Hence, patenting, IP commercialisation and innovation are hindered by the activities of the NPEs.

Notably, interviewee E explained that the activities for patenting and the involvement of NPEs is not restricted to specific phases of the innovation process or the stage-gate approach for new product and new service development. According to him, activities for assessing patent portfolios happen on a continuous basis. The consequence of that continuously, as feedback and feedforward mechanisms, ‘producers’ have to assess infringement of IP and the generation of IP for diverse reasons.

### C. Impact on Effectiveness

That leaves to look at the models as potential representation for the impact and effectiveness of NPEs’ activities. Table 5 contains the overview of the responses by the interviewees to the models. The widespread responses possibly indicate that it is difficult to position NPEs in the existing models for innovation and technology cycles. It is evident that actor-oriented modelling would be necessary but not directly clear how. Some of the points mentioned direct towards game-theoretical approaches, however, that seems to apply more to specific situations of IP, decision-making and negotiations. That means that the interviews did not directly set out the contours of generic model that could be used by other researchers.

### D. Archetypes of NPEs

The final part of the interviews consisted of the verification of the archetypes for NPEs. In the four archetypes, the private and contract research organisations were missing, according to interviewee A, although they might be viewed partly as inventors and universities. Interviewee B found that ‘risk investors’ were missing; these venture capitalists might want acquire IP for spin-offs and then later sell off the companies. Since these venture capitalists build on the feasibility of ideas, they are hardly active in the fuzzy front end of innovation processes. Also, interviewee B pointed out the Technology Transfer Offices are far more diverse than suggested by the classification. Interviewee C made a strong plea that brokers have a different business model than intermediaries; the latter take risk, whereas the former more or less negotiates between two parties but has no

TABLE 5  
RESPONSES TO MODELS FOR INNOVATION PROCESSES AND TECHNOLOGY CYCLES

Model	Responses	Interviewees
Innovation funnel	<ul style="list-style-type: none"> <li>Does not represent role of NPEs.</li> <li>Opportunities for NPEs at ‘gates’ as selection mechanism.</li> <li>NPEs are positioned in innovation funnel</li> </ul>	A, B, C, E
Open Innovation	<ul style="list-style-type: none"> <li>Opportunities for NPEs at ‘gates’ as selection mech.</li> <li>Position of NPEs in idea generation through various mechanisms.</li> <li>New service development less likely to rely on external ideas/inventions.</li> </ul>	A, B, E, G, B
Interrelationship major innovative activities	<ul style="list-style-type: none"> <li>Not suitable; onus on singular firm.</li> </ul>	A, C, G
Technology cycle	<ul style="list-style-type: none"> <li>Not applicable or suitable for IP.</li> <li>Too much focused on single product.</li> </ul>	A, C, B
Model for Collaborative Networks	<ul style="list-style-type: none"> <li>Actors are visible in interaction.</li> <li>Focus of model on production and supply chain.</li> </ul>	A, E, F, G

involvement with the risks associated with patents. Both interviewee C and F did not see the distinction between universities and TTOs since they are interconnected, no matter the form it takes (collaboration between universities for commercialisation). Furthermore, interviewee G suggested that there are also ‘knowledge-producing entities’ that solely focus on generating patents for the purpose of creating patent thickets that inevitably lead to licensing of IP. Therefore, the interviews provided evidence that either the original classification by Fahimi-Steingraeber et al. [9] needs to be revisited or that the diversity in forms of NPEs is so large that a classification is of little use.

## V. DISCUSSION OF FINDINGS

In the network of actors and from the perspective of our research, the first question is when and how does IP commercialisation takes place? The traditional view is that IP is patented and subsequently offered to interested parties for developing product and services. Principally, that is reflected in the underlying literature that takes a linear view. By contrast, most of the interviewees saw IP commercialisation as a more intricate process where there is a continuous interaction between actors to identify opportunities for IP, to capitalise IP and to take competitive measures to protect IP. That means that even during the new product and service development process there might be continuous iterative loops for assessing IP identification, exploitation and protection. Moreover, tools are being developed to facilitate this process for all actors in this process, which lowers access to IP. With the procedure and processes for

registering IP remaining relatively stable, this might lead to more incentives, from a diverse nature, to identify and to commercialise IP. This finding that the process surrounding IP have become more intricate and that all actors are more active, appeared in most interviews.

Despite colourful stories, scaremongering about the impact of patent trolls and making the case for their own perspective, the impact at an aggregate level was very difficult for the interviewees to pinpoint. Some of the effects for individual firms are quite clear. However, it was less clear how the activities of NPEs and the more prominent role for IP are affecting technological developments in industry. That said, because of the dynamics that NPEs are causing firms are compelled to pay attention to it; in game-theoretical terms this would be called tit-for-tat and in management terms the Abilene paradox [48]. In addition, interviewee G stated that patents (and IP) are more and more treated like a commodity; if so, it becomes subject to trading, speculation and making deals, which does not necessarily equate with turning inventions into new products and new services. In other words, despite the intentions of all actors, a situation for patenting, litigation and constantly looking over the shoulder has been reached, that nobody wanted.

Despite this trend towards trading of IP (and patents), it is becoming apparent that IP services provision is becoming more professional. Whether that professionalism effects positively the innovation process and the technology developments in industries remains uncertain. However, and in addition, the growth of awareness among actors has caused a shift in thinking and dealing with IP.

## VI. CONCLUDING REMARKS

Even though, the findings so far point in the direction of a diversity of actors, behaviours, approaches, etc., the study is not yet complete. First, the literature review has been conducted with a limited number of keywords. For example, note that NPEs are also known under the term Non-Practicing Entities; the next step of our research will include all relevant terms for NPEs. Second, only one database has been used. Following that recommendation of Green et al. [49], next to Google Scholar at least one more database or search engine needs to be used; we intend to do so in the next step when aligning the literature review with [50][51]. Third, the number of experts is limited to eight. Fourth, the intent is to use the expert interviews as a first step of a Delphi study. While the Delphi study allows a structured consultation of experts, it was the potential bias and clarification that are needed that prompted use to substitute the first round with interviews. That came true since the interviews brought to the fore a number of notions that might have been more difficult captured by the more sterile set-up of a traditional first round of a Delphi study; a point in case are the ‘knowledge-producing entities’ that are creating patent thickets to create licensing incomes (see Table 4). Notwithstanding these limitations, the study has

already yielded findings stretching beyond the initial intent as reflected in the research questions (Section I of this paper).

### A. Further Research

Since this is the first step of a Delphi study, albeit with an uncommon approach for the first round, those findings should be interpreted with care. The stages that the interviewed experts are confronted with the shared outcome of their opinions, still has to be conducted. Those next rounds will undoubtedly lead to some shared conceptualisations and thoughts among the experts, but there will be also patches in the research where their opinions and evaluation of previous rounds will lead to difference of opinion.

Nevertheless, the findings already lead to deliberations about the overall direction we are travelling. Are the NPEs just emerging and do companies have to learn to deal with them? Are they a temporary phenomenon caused by contemporary legal settings (some organisational forms of NPEs are likely to stay, others might disappear)? Are larger firms building their own expertise with regard to IP (which equates more or less with the later thoughts of Schumpeter on the role of larger firms in the innovation landscape)? Or could all actors construct a reality in which NPEs have a overall positive impact on IP beyond awareness and the threat of litigation?

From those questions that have been raised now, it should be noted that the study started with a post-positivist approach. However, the results and the findings indicate a more blurred picture than one would expect; no matter, the less clearer conceptualisations also make it more difficult to create an overarching model for the overall activities of NPEs in relation to innovation process of firms and technological developments in industry. That means that the research has to move towards a constructivist approach, rather; the Delphi study is an appropriate approach to do so, given the need to consult experts in a systematic manner.

### B. Implications

Nevertheless, given that the findings also indicate that our original quest has become more convoluted, that raises doubts to what extent it will be possible to address the original research objectives at the beginning of this paper. While it is easy to highlight that NPEs have changed the landscape for IP commercialisation, and are still doing so, the diversity of approaches and developments indicate that the context and processes have not yet reached a stage of stability. At the same time, one might say that the diversity and the increasing awareness by all actors imply more maturity with regard to the appropriation and commercialisation of IP. Whereas some of the infringement cases make the headlines, most of the activities for IP commercialisation happen at the background, sometimes invisible to the naked eye. Does the complexity and the relatively obscurity of its activities make our search for excavating

the role of NPEs and the modelling for their impact on the innovation process of firms and on the technological developments in industry a mission impossible? Time will tell.

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