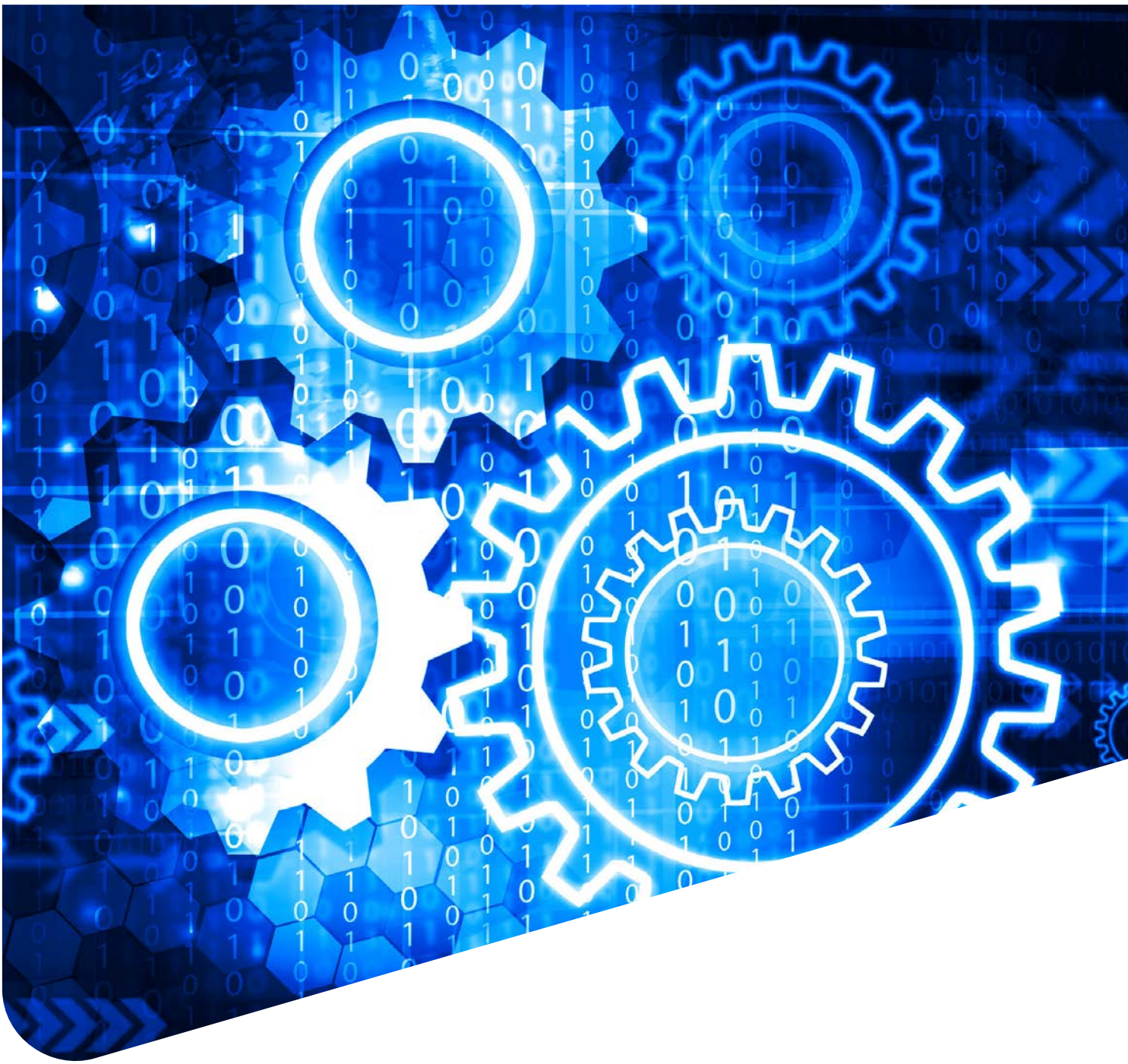

WHITE PAPER

From Research to Patent and Back Again: The research needs of R&D professionals

ADVANCING DISCOVERY

Introduction

The practical application of scientific research is of interest to scholarly researchers for many different reasons, not least because funding pressure means there has been an increased focus on the potential to monetize research. More and more universities have departments to assist researchers in patenting viable work.

Another reason for this interest is that impact reports are vital when reporting to government and independent funders. The academic community can use patents to clearly demonstrate a specific type of impact – one where scholarly research translates into practical real-world outcomes[1]. But examining scientific work that leads directly to patents is only one, very particular, perspective. There has been much less attention on **how R&D professionals use research.**

R&D departments outside higher education institutions are focused on creating new products and treatments they can bring successfully to market. They use academic research as an important resource when looking to innovate in their field; developing new products which will result in income and profit for their organization.

While academic researchers are often required to be open by their funders and institutions, commercial organizations need a certain level of confidentiality in order to productize their ideas. *"We publish very little only because we don't want to enable our competition,"* stated one contributor to this paper.

This need for confidentiality means that the way R&D teams use published scientific research is less well understood than the workflow of researchers in academic institutions. However, when it comes to developing best practice these researchers can benefit from sharing information about their habits and workflow as much as those who work in non-commercial research.

This paper is part of a wider conversation Springer Nature hopes to initiate between corporate librarians and information managers, commercially focused researchers and others involved in the R&D and innovation process about how high quality published scientific research contributes to patentable ideas.

The people who contributed to this conversation come from a variety of backgrounds and organizations in different countries, there is more information below. All asked to remain anonymous due to the high levels of confidentiality required for their work.

This paper will introduce some recent published studies on the relationship between patentable innovations and academic research, share some recent conversations with people in this space and examine the specific role scientific resources can play for organizations who are looking for breakthrough products.

"Springer content has been used to establish an understanding of the known art and identify synergistic areas where our competencies and new ideas can create valuable products for customers."

[1]Phillips, N. **2017. Game-Changers.** *Nature Index 2017 Innovation,* Vol. 548, Issue No. 7666, **pp. S9**

Overview and context

Patents are a type of intellectual property based on a new invention, such as a new product or process. Patent authorities in different countries exist to protect ideas which the owner may wish to monetize idea, but in order to grant this protection the patent authority needs to be satisfied that the idea is innovative enough to be patentable. Patent applications are often complex and expensive.

Companies bear the cost of this process in order to protect the potential income of a new idea, income they need so that they can grow and maintain their profitability: *'In a competitive economy, no business can survive long term without updating its products and services or the ways in which they are produced or delivered'*[2].

Both immediate sales and long term company growth depend on pipelines. These pipelines need both products and, right at the beginning of the process; ideas.

These ideas don't come from nowhere: *'research on innovation agrees that most innovation projects start with someone identifying a need'*[3]. R&D teams often focus on one of two areas; completely new ideas which have the potential to transform their business, or incremental developments that will improve the profitability of existing products.

In both these circumstances they will turn to established scientific research and this research will be referenced in their patent application. That R&D teams use academic research as part of their innovation process is well established. One study found that of the patents they examined: 61% linked to prior scholarship[4].

Patent applications usually reference both other patents, and Non Patent Literature, (NPL). Scientific papers fall into this NPL category:

NPL citations are more common in technologies arising from research and in areas where industry has a heavy science-based R&D emphasis, particularly the life sciences industry (biotech) and pharmaceuticals .

It is tempting for research scientists to imagine a direct relationship between their work and a patent: *'When a patent document cites a research paper, we can infer that the scholarly work may have influenced or enabled the invention. In this way these citations can be viewed as a proxy for industry's reliance on scientific knowledge'*[6].

But citations in patents to NPL can be as much about setting the context for new ideas as they are about directly monetizing the work of an academic research group. Academic research can *inform, contextualize, influence or enable new inventions*[7].

The process by which companies create innovative new ideas is not a simple one. For R&D teams, looking outside their own processes and inventions allows them to learn from an incredibly wide range of expertise on topics which may be tangential to, but important for, their own work:

[2]Elg, L. (April 2014). *Innovations and new technology - what is the role of research? Implications for public policy.* VINNOVA Analysis VA 2014:05 https://www.vinnova.se/contentassets/e5fe05cb13604be7b221f3ddbecb41c3/va_14_05.pdf

[3]Elg, L. (April 2014). *Innovations and new technology - what is the role of research? Implications for public policy.* VINNOVA Analysis VA 2014:05 https://www.vinnova.se/contentassets/e5fe05cb13604be7b221f3ddbecb41c3/va_14_05.pdf

[4]Ahmadpoor, M. & Jones, B.F. *Science* **357**, 583–587 (2017).

[5]Jefferson, O. A. et al (January 2018). *Mapping the global influence of published research on industry and innovation.* Nature Biotechnology Volume 36, pp.31-39. https://www.nature.com/articles/nbt.4049

[6]Phillips, N. **2017. Editorial.** *Nature Index 2017 Innovation, Vol. 548, Issue No. 7666,* **pp. S3** https://www.natureindex.com/supplements/nature-index-2017-innovation/index#ni-articles

[7]Jefferson, R. **2017. Game-Changers.** *Nature Index 2017 Innovation, Vol. 548, Issue No. 7666*, **pp. S8**

Research-based competence (and cooperation with academic research) can contribute in many different ways in the innovation process: by adding new competence, by identifying new areas of knowledge that may present threats or opportunities, or by identifying and solving concrete problems. "Product ideas" are not the most important contribution of academic research nor are they the main reason for companies to seek cooperation[8].

Bringing a product to market is very different from testing an idea. Companies bring a huge amount of expertise to their innovations, expertise in markets and manufacturing, quality assurance, legal standards, regulatory compliance and many more areas necessary to make an idea into a patentable product.

The need for innovative new ideas to which companies can apply business acumen, and the ability of scientific work to inform innovation both directly and indirectly, means the work of a publisher can support R&D, accelerate the innovation process, help to protect Intellectual Property and actively support patent filing.

Understanding the pipeline: Research and the Innovation Process

The studies referenced above create a picture of the mutually beneficial relationship between R&D and scientific literature. To explore these ideas further, Springer Nature was able to initiate conversations[10] with a variety of people involved in research and development including a Director, Head of Knowledge Management, Senior Information Scientist and Librarian. They all worked for organizations whose commercial success is driven by innovation, and in a variety of industries from automotive and connectivity services to energy and pharmaceuticals.

These industries translated into research interests that cover Pharma, Biotechnology, Chemical Manufacturing, Electronics, Materials & Steel, Aerospace, and Energy. It's important to note that commercial research often crosses subject boundaries.

They work on long term projects, the most common lengths of time from initial ideas generation to patent filing was 1-3 or 5-10 years, perhaps reflecting the different industries of the participants. They are privately funded; none worked on projects where funding was received from public investment only. The majority was private investment only, while a few were involved in partnership projects.

One element of the patent process the contributors highlighted is that patents don't always lead immediately to new products. Patents might also be filed as a tactical move to protect the IP of the new invention prior to further development. But in many of our conversations Springer Nature content was used to inform projects in which a new invention would go through to full commercialization and market launch.

So how did they use scientific research?

During the initial exploratory phase of the innovation process at their organization all of them conducted both newly commissioned research and examined existing literature.

Other uses ranged from the practical, to the more abstract: "Research findings enhance our innovation process." But overall the conversations threw light on two key areas.

[10]Both digital and real word, in a variety of contexts

Essential resources for specialist workflows

Some companies have embedded high quality data into their everyday workflow. A contributor from the Pharma industry spoke of the importance of Pharmacovigilance – the constant monitoring of drugs and active ingredients related to the company's products and those of similar products from competitors. *"We have integrated the content in our routine PV processes."*

Journal content is incredibly important for Pharmacovigilance and can indicate either a new direction of research or, often more importantly, improvements to existing products.

"One of our strategies in this context is life cycle management, the extension of already approved indication for products in the market. Initial research findings are an important prerequisite."

Pharma wasn't the only industry that used specialist content for specialist processes. Product safety was an important area, as was product testing and R&D activities that required material testing.

Scientific articles were also used to provide a context for internal data, by extracting data from articles to be incorporated into a database that meant analytics could be applied to a dataset that referenced both internal and external resources: *"Springer Nature articles enable us with various dimensions of scientific data emanating out of a product or idea or go into the expanses of the product safety data for data mining."*

Context for cost savings

Contributors outlined the clear relationship between the scientific context of a new idea, and the cost of developing that idea into a product or treatment. Exploring the published science on a particular topic allowed them to create a basis for understanding what needed to happen next to advance research and bring a product to market. This understanding could be used to estimate the resources required. *"Initial findings inform decisions on assigning resources for validating a business plan around a technology or new set of products."*

Cost savings also occurred by ensuring they knew all existing work on a topic so that basic validation wasn't unnecessarily repeated. A literature review is less cost intensive and faster than a set of experiments or early stage development.

One contributor used existing research to feed into decisions on the scope of any particular project: *"It is important to define the scope - what indications or technologies to include and or exclude."*

Again access to high quality scientific research offers a potential cost saving by informing the boundaries of a project and keeping it heading towards a successful conclusion.

For librarians and knowledge managers qualitative evidence and conversations around the contribution of scientific data to these cost saving processes is important. Cost savings created by clear decision making around project scope and viability may be enormous – but difficult to track and quantify as it is hard to prove a negative. For companies, what they choose not to do can be just as important as the projects that go ahead.

Overall, commercial R&D professionals who contributed to this paper valued academic content: *"Springer Nature is a key resource for understanding the scientific requirements of our research."*

We spoke with a Head of Computational Chemistry about their innovation process to create new cancer treatments, and their hopes for the future of information.

Is there a particular type of content that you feel is very useful for your work?

I like review articles very much – they offer perspectives, other experts in the field have provided a digest. I find the Nature Reviews series of publications very, very helpful - The Nature Reviews Drug Discovery and Cancer and so on. Because they do a wonderful job of digesting, summarizing and reviewing the critical work that is out there.

Can you tell us a little bit about the drug discovery process and how scientific resources contribute to this work?

If we resume discovery operations to enhance what we have already have in the clinic, then we go back and review back-ups or second generation or third generation. We follow what might have happened in the clinic and try to use that information prospectively to gain new feedback.
It's a feedback loop, an iterative design. We might learn something like; the molecule works but it needs to have an additional attribute, or a particular attribute changed. Or it may need to have more utility, so we halt or slow down development to improve the treatment before it actually gets launched.
This happens in product design all the time outside of discovery, it's just that the timelines are much, much longer in drug discovery because every single time that we make an enhanced molecule we have to repeat all of the previous steps; we repeat toxicology studies, we have to scale up – there is no taking short cuts at this point. We repeat everything, because whenever we are giving new drugs to humans it's a very high bar as far as safety is concerned.

Breakthrough vs Improvements

Both our contributors and wider research highlighted two key goals for innovations, regardless of which industry was under discussion. It was well recognized that incremental improvement to existing products could make those products more profitable, and open up new market opportunities, but also that brand new breakthrough products had the potential for far higher earnings. Despite the higher level of risk involved, companies put more money into R&D when they are hunting for the potentially much larger return on investment from a brand new idea:

PwC's Innovation Benchmark study shows that companies investing more in innovation are more likely to be focused on breakthrough innovation than on incremental improvement.

The more focused they are on creating a breakthrough the more innovation teams need access to cutting edge science. Science that details entirely new concepts, methods and inventions.

And the more focused they are on breakthrough products, the more R&D departments need access to expertise from outside their organization to spark new ideas.

It's not only global corporations that invest in R&D to create working on breakthrough inventions. For smaller companies, partnership working was vital to innovation:

Small entities (those with under $1 billion in revenue) are also more likely than their large counterparts to work with academics and research institutions, where R&D is often conducted. Doing so is a way for these organizations to avoid the cost of conducting innovation in-house

For librarians and information managers who know this to be one of their organization's strategic goals, it is important to make the connection between access to high quality scientific information and breakthrough treatments and products that can be transformational for a company.

What are the information management tools you would like to have, but don't yet?

I've been following and hearing a lot about machine learning and Artificial Intelligence. Places like Google and IBM and others are working on a way to take all of the published record and use computers to ingest the information and organize it, and put it all at our fingertips.
Then we'll have access to all of the knowledge; the ingestion will lead to analysis and the AI will build networks of content so that people can pull out the relevant information much more easily.
I'm very excited about this prospect because that is very difficult right now. We try to stay up-to-date with information and how things are developing, but it is a losing battle because we simply cannot ingest the primary information as quickly as it comes out. By that I mean, digest it and then look for the critical material then retain it and recall it when necessary. So we will have to have computers to help us in that for augmented intelligence, so that's what I'm looking for.
And finally, what would be the impact of removing access to scholarly content to innovation within your company?

We need this content, it is critical, it's absolutely essential, without it nothing works.

[11]Staack, V and Cole, B. (June 2017). *Reinventing innovation: Five findings to guide strategy through execution.* London, PriceWaterhouseCoopers https://www.pwc.com/us/en/advisory-services/business-innovation/assets/2017-innovation-benchmark-findings.pdf

[12]Elg, L. (April 2014). *Innovations and new technology - what is the role of research? Implications for public policy.* VINNOVA Analysis VA 2014:05 https://www.vinnova.se/contentassets/e5fe05cb13604be7b221f3ddbecb41c3/va_14_05.pdf

Conclusion

This paper has opened a discussion about the way R&D professionals, often prevented from sharing information on best practice by strict confidentiality requirements, use published scientific content in their workflow.

For some industries, especially Pharma and Healthcare, research content has also become an essential component for finding data to validate new ideas and to feed into iterative product development processes. For others, the broad context and latest developments of their field of enquiry helped them to plan new product development and design successful projects.

In the future, Text and Data Mining in combination with Data Analytics and AI will vastly increase the value of research content for most industries, enabling them to find meaningful, specific data more quickly and efficiently. Data that enhances their innovation processes. But our contributors also valued review articles as a way of keeping up with their field –articles in which acknowledged experts had read, digested and summarized new studies.

Overall our contributors were unequivocal about their reliance on scientific content to provide a broad context for proposed innovations, save on costs, and contribute to specialist workflow.

We need this content, it is critical, it's absolutely essential, without it nothing works.