In a book about how today’s winners are lining up their IP, Carol Daniel at City, University of London discusses how algorithms, designs, images, documents, know-how, written media and proof of concepts are joining patents as key elements in the innovation mix.

The process of IP commercialization is evolving with the technology-driven solutions that industry is now developing. When knowledge generation is a major driver of innovation, it is making what is regarded as soft IP more prominent in technology and knowledge transfer.

Key areas of innovation include: artificial intelligence, machine learning, automotive, energy systems and storage, therapeutic medicine, social engineering, software, digital media and advanced sensor systems. Most of these areas of innovation are also increasingly being underpinned by AI and a knowledge base implemented through information technology.

Therefore IP around algorithms, designs, images, documentation, know-how, written material (media) and proof-of-concept models, often referred to as soft IP, are increasingly important. It is not always possible to file these ideas and developments as patents as they may not meet the criteria for patenting and/or they involve many different concepts that taken as a whole may make the cost of patenting uneconomic weighed against the potential commercial benefit. In such circumstances, the IP must be kept confidential and only disclosed to interested parties under a non-disclosure agreement.

In other circumstances and where this is feasible, value can be added to the soft IP by patenting certain key elements, such as specific recipes, methodologies, processes and algorithms; alternatively, there may be scope for adding value by protection through registered designs. Compared
to a traditional patent, still widely used for IP protection in engineering (eg, sensors and mechanical systems) and medical-related technologies, the use of trademarks and logos are becoming important for adding value to innovations arising from subject areas where patent protection is often not feasible such as the social sciences, arts and humanities.

A previous focus on patentable IP is now widening to encompass these softer forms of IP. However, they are often more difficult to licence, as there tends to be less receptiveness from industry that often expects a patent portfolio alongside the research outputs. Such inhibitions can be overcome by creating start-ups that bring together researchers and managers so that knowledge can be more easily transferred into the business. The university becomes a key player in such collaboration allowing the IP to be commercially exploited in an effective way, particularly where there is only know-how or documentation.

In some cases, particularly those that lead to a software or non-technical business, some initial funding can add value to the existing IP, whether by contracting professional software developers to turn the basic research into a proof of concept or providing market research for the business to identify specific market opportunities and potential early-stage customers. The software and the market know-how in the company database, as well as any trade marks, become an essential and valuable part of the IP package.

These combinations of soft IP in the form of software, documents, designs, concepts, drawings, designs and know-how are finding their way into widespread use through consultancy, co-design, apps and e-learning, as evidenced in some of the following examples. From our experience at City of implementing the research output of academics, these are often documented as concepts in media, designs, methods and algorithms, which are then articulated through the development of software tools.

Data and software enhancement
A basic software application to screen the visual acuity of children starting school was significantly enhanced by allowing access through a browser from a remote server linked to a sophisticated data management system. A spin-out, Thomas Screening Solutions, was created with a licence to the original software and a customer contact list developed through discussions with the NHS participants who originally trialled the concept. It is now screening vision, hearing and body mass at schools throughout the United Kingdom, as well as for the NHS and Specsavers, whilst developing new opportunities in the United States.

Multi-user online world
A multi-user online world, Eva Park, was co-designed with those suffering from aphasia, a brain condition that limits their use of language. This knowledge was articulated through the development of software code to create a series of virtual locations, including shops, restaurants, houses, a hairdresser, a bar and a disco. Users in the form of personalized avatars can practise their speech and make social connections. Clinicians will be able to access this assessment tool under licence.

E-learning and workshops
Knowledge about improving the quality of maternity care is being mobilized on a large scale through a set of standards to guide the performance of midwifery units in hospitals and in primary care. City supported the development of this concept through funding the development of a package of e-learning and workshops that was created from the original academic work. This copyrighted material, which includes documented standards, has now been licensed to the Midwifery Unit Network to take forward commercially.

Minimal viable product for analytics
In psychology, learning analytics have been developed into an application to support and track student’s experience and is now being deployed as a minimum viable product known as Quodl. Levels of engagement and wellbeing are measured through a mix of gamification and tools that students can use on their own electronic device to engage better with the learning process. By working closely with a third-party software developer, this package of tacit
knowledge and research expertise is now ready to be turned into a robust enterprise product under licence.

**Games for clinical training**
A series of board games for training clinical staff, Drug Round, Substance Abuse and First Aid, which are based on research in health science, has been designed, documented and released as commercial product in collaboration with Focus Games.

**Social movements**
Research into the quality of life for the elderly in care homes that began as a small project is now turning into a social movement and a charity, My HomeLife, which operates a consultancy model to improve leadership, integrated care and community engagement, is now in the process of being developed into a charitable organization that hopes to scale the operational knowledge gained into a nationwide service.

**Algorithms**
A modelling technique and algorithm for estimating the threat of a multi-path, multi-technology cyberattack has given Crossword Cybersecurity plc the foundation for encapsulating this documented knowledge into a software tool for assessing how effectively an organization’s assets are protected.

**IP commercialization**
Higher education institutions like City are not in a position to directly commercialize the innovations and the IP that arises from their research. Their IP and any related commercial contracts remain the cornerstones on which they rely in reaching the market. Essentially, there are two avenues to commercial exploitation: either through licensing the IP or creating spin-outs; or in some cases a combination of the two. This provides City with royalty revenue or equity in the business or a combination of both.

The initial preference is usually for licensing the IP to an established business, as it represent a faster route to market and, for the company, the IP is likely to provide a complementary product or service that fits well with its business model or provides a new commercial development, as in the case of Crossword Cybersecurity.

**Why license IP**
Companies and even start-ups can often see the benefit in taking IP that has had a substantial investment of resources from the university and led to a proof of concept that can be developed into a new product or service. Licensing IP, which has leading-edge research and development behind it, also provides a fast track for businesses seeking to develop new products and services with reduced upfront costs.

There are many opportunities for companies to find technologies or innovations that are available on the market through platforms and brokers, including patent exchanges. Not enough businesses take advantage of the research output from universities and what they can offer to industry and commerce. There is always an inclination to develop commercial opportunities internally without considering first what is on offer externally and whether this can provide a competitive advantage at a lower cost.

Usually, no single organization has the solution to develop a new commercial opportunity be it a product or service and there is always more than one avenue to creating a new product. Such an approach also provides insights into what other organizations are developing and provides a competitive overview that can be highly valuable in developing a new product. As not all knowledge developed in research is necessarily patentable, then patent searches should not be completely relied upon as a means of establishing current developments.

As a combination, the university has the technical know-how that it can transfer to the business and can assist with further development, while the company can focus on its commercial capability to turn the technical innovation into a new product or to complement an existing product or service. Once agreements have been established, incubators, such as the London City, are an additional resource that can support the commercial objectives of collaborating companies, as well as offering specific technical and commercial knowledge.

**Structuring spin-outs**
Spin-outs to commercialise university innovations are often considered when there are no established businesses that can be identified or can be attracted to the IP that has been developed.

In some cases, funding opportunities may be available from investors and through grants that will allow further
development of the innovation through a spin-out. In other situations, a commercial partner may be found that would prefer to exploit the opportunity by means of a joint venture or a commercial team is willing to take the concept forward as a business or there is an opportunity to team up with third parties, such as end users.

In the physical sciences, innovations from universities are often characterised as business to business, rather than business to consumer, which creates long and risky lead times from research to commercial exploitation. It’s not unusual for start-up businesses to develop over several years before making any significant revenue. The three essential components for a spin-out at the outset are: a committed technical team to support the development of the product; a commercial manager; and funding.

Usually a university will take equity in the business alongside the academic technical team, usually comprising the inventors, the commercial manager and investors. The university IP policy covers how revenue from the commercial exploitation of innovations is shared between the inventors, the school or department and the university’s research and enterprise office. Initial revenue is usually directed in favour of the inventors and provides an incentive for academics to engage with commercial activities arising from their research.

Finding a suitable commercial manager for a new venture can also be a challenge. In the scenario of a joint venture, the commercial collaborator often provides or donates such skills to the business. In other cases, it may be a matter of finding someone prepared to work for sweat equity as in the early days there may be no cash available for remuneration. The university’s IP will also be licensed to the business for a mutually agreed royalty.

New start-ups are risky and will usually seek further funding downstream and may in some cases develop new innovations or pivot their business model into an opportunity that was not anticipated at the start of the project. Further investment funding will usually lead to dilution of existing shareholders, including that of the university.

By taking some equity and some licence royalties, the university hedges its bets and provides a more balanced portfolio approach. If the business changes its business model downstream and is no longer reliant on the original IP licensed then a university can still fall back on some equity. Similarly, if the equity is significantly diluted, then there is still the prospect of some royalty income. Furthermore, royalties are more likely to arise earlier in the development of the business when it has some established sales, before the company is eventually sold when shareholders can cash in equity.

**Conclusion**

As more of the innovations developed at universities like City become interdisciplinary and involve complex relationships, the idea of a single invention no longer holds true. In technology transfer, we are beyond taking just a patent transactional approach, working instead as true collaborative teams where copyright, know-how, design, trademarks and databases make an ever-increasing contribution to the transfer of knowledge and commercialization of IP.

It is an approach that applies to a centre renowned for its research and development, innovations, consultancy and technology, the Centre for Compressor Technology, which collaborates with and provides services to world-class manufacturers. Over more than two decades, the centre has created a wealth of knowledge about twin-screw machines, encapsulated in soft IP, such as data, databases, designs, software tools and know-how, as well as harder IP in the form of specific inventions relating to twin-screw designs. This IP has been licensed to manufacturers in part or in a complete package based on their needs. In addition, such licenses often require a transfer of know-how from the academics and specialist training forms an essential part of the IP package which is highly valued by clients.
City, University of London was a pioneer in commercializing its IP. In the late 1970s, it started a spin-out company, City Technology Ltd (now part of Honeywell) that was eventually sold in 1993 for £25 million. At the time, it was the most successful venture into business by a UK university. City continues to build on this legacy, exploring the potential for IP commercialization across a full range of subjects from psychology through AI, health sciences, medical devices, cybersecurity, engineering, mathematics and business. For further details, see: www.city.ac.uk.

Dr Carol Daniel is senior managing consultant at City, University of London. He advises researchers on commercializing the IP in their novel processes, methods, solutions and software, as well as on how they can use it to raise funds and win contracts. He has also played a leading role in bringing numerous spin-outs to market.