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editorial

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Where will we get the next generation of medicinal chemists?

The medicinal chemist in the pharmaceutical industry has traditionally been the linchpin within the multi-disciplinary small molecule drug discovery teams. Their scientific and professional skills have enabled them to translate complex datasets from multiple sources and from other disciplines into iterative molecular design concepts, which have made them central to the inventive process of identifying new medicines. The publication in next month's Drug Discovery Today [1] provides an ideal backdrop to explore the question of where our future medicinal chemistry leaders and innovators will come from in an environment where cost-containment and chemistry outsourcing tend to prevail. I will draw upon the strategy within my own organisation, GSK, where I am responsible for the R&D teams (including medicinal chemists) who discover and develop the next generation of medicines for respiratory diseases and where I am also the company's 'Chief Chemist' and as such play a strategic role in ensuring that our chemistry organisation strives for excellence, is able to meet the future demands of the business and is sustainable.

The number of scientists employed in pharmaceutical R&D has decreased substantially over the past decade as a result of mergers, acquisitions and general economic constraint. In the UK for example, the numbers have fallen 28% from a peak of 32,000 in 2007 to 23,000 in 2013 [2]. Furthermore, within our industry there is a growing focus on biological approaches such as monoclonal antibodies or cell and gene therapy to target very specific patient phenotypes, stimulated by our expanded knowledge of the human genome. For example, in 2015, one third of new drugs approved in the US by the Food and Drug Administration (FDA) were antibodies, peptides or enzymes, compared with about a quarter in 2014 [3]. We can therefore reasonably assume that the number of medicinal chemists in the pharmaceutical industry in the UK has decreased by about a third since 2007.

During this time, however, the use of contract research organisations (CROs) and fee-for-service providers based in countries with a lower cost base, has increased. Indeed, many CROs have benefitted from the expertise and experienced medicinal chemists who left the pharmaceutical industry during the downsizing in the late 2000s [4]. You do not have to look far to find a chemist with substantial industrial pedigree working in a CRO or perhaps working in an advisory capacity within a thriving biotech industry [5].

These factors have shaped the strategy of individual pharmaceutical companies and to some extent have polarised the community in how they have responded. Many have focused on 'cost minimisation', whereby they reduce the number of chemists in their organisation and use the residual experience to manage outsourced chemistry functions with CROs or 'off-shore' all the wet chemistry to fee-for-service organisations. The impact on the financial bottom line is immediate and this strategy can be made to work successfully, at least against near-term goals.

An alternative strategy however is to maximise the 'cost-effectiveness' of each chemist in the organisation. In this scenario, starting materials or intermediates are outsourced thus enabling the internal chemists to focus on the innovative and value added

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ideas and activities. A mixed model utilising both approaches is obviously possible and one which GSK employs to good effect.

Within GSK R&D a thorough evaluation led us to a core strategy of maximising the cost effectiveness of our chemists by investing heavily and continuously in professional development and providing a framework for them to focus on higher value and innovative activities. Investing in chemistry talent is an important part of our strategy to reduce the high levels of drug discovery attrition which have been so problematical within our industry.

The strategy revolves around three core themes: (1) attracting chemists with exceptional potential, (2) collaborating with external centres of excellence, and (3) investing in professional development at all levels.

Whilst the cost containment benefits of outsourcing are immediately obvious, it is ultimately our ability to innovate that will determine our success in the medium to long term. We believe that our business is dependent on multiple diverse and talented people thinking about the challenges within drug discovery. Our approach around each of the three core themes is briefly described below.

Attract potential talent

The main thrust of our recruitment philosophy in medicinal chemistry is to bring in high quality early talent. In practice, this means that our recruitment processes are focused on the ability firstly to interact with and secondly to identify individuals with potential rather than chemists with a track record. To ensure that this is not a 'leap of faith'... by either GSK or the individual... we have developed a number of structured programmes with different universities, of which the medicinal chemistry modules with the University of Nottingham [1] is one.

These programmes are as diverse as the institutions with which we interact and increase our probability of being able to identify real potential whilst at the same time enabling the individuals to test out whether we are the right organisation for them. They range from the well-known industrial placement programme, for which we have succeeded in gaining accreditation from the National Council of Work Experience and the French Chemistry Society, to a specific intensive work experience 'taster' week to enable chemistry students whose undergraduate courses do not include a work placement to gain relevant first-hand experience of the pharmaceutical industry.

Collaborate with external centres of excellence

We recognise that industry and academia have complementary skills and expertise that are relevant to the development of our medicinal chemistry workforce. As a result, we have developed high quality training and development programmes in association with UK universities such as Bristol, Kent and Strathclyde. The richness of our interactions is impossible to portray within this editorial, however the following highlights convey the essence of these collaborations.

In association with the University of Bristol, our chemistry industrial placement students are provided with standardised technical and safety training at the Bristol ChemLabS. Our association with the University of Kent is via their collaborative programme framework which has validated GSK as a provider of higher education. This means that new graduates can work towards the recognised qualification of a Postgraduate Certificate in Professional Development (Research Chemistry) for the structured training that they receive during the first 3–4 years of employment.

With respect to the collaboration with the University of Strathclyde, this is a unique partnership which enables GSK employees to work towards a higher research degree of MPhil or PhD based on their current drug discovery projects. Initially focused on medicinal chemistry with the department of Pure and Applied Chemistry at the University of Strathclyde, the programme has been extended into other areas of science (Process Chemistry, Computational Chemistry, Biological Sciences and Drug Metabolism and Pharmacokinetics). Participants on this programme benefit from both industrial and academic supervisors who provide complementary challenge and expertise to the project. A particularly exciting expansion of the programme was taken in 2011 when we recruited the first cohort of so-called 'Industrial PhD students'. These are highly talented individuals who are part of the University of Strathclyde but are hosted at GSK for the majority of their PhD project which is in an area directly aligned to our business and discovery projects.

Chemists working towards a PhD through this collaboration regularly validate our combined investment in their talent with the award of major prizes and accolades, such as the SET for Britain competition at the Houses of Parliament in the UK (2015 and 2016) or Young Industrialist of the Year (2015).

Invest in development at all levels

Whilst the programmes mentioned above are focused on early talent by first intent, they also contribute to the professional development of all our medicinal chemists. For the UK and France, for example, we have a GSK chemist assigned to each university with a premier chemistry department. That chemist is expected to conduct competency-based interviews for the industrial placement positions, as well as keep up to date with current undergraduate courses and provide the academic chemistry department with information on the pharmaceutical industry.

Furthermore, the collaborations with both the universities of Kent and Strathclyde have helped to foster a culture of scientific excellence and challenge that reaches beyond the student chemist on that particular programme. The entire laboratory team is aware of the development framework and takes part in supporting the individual. The industrial supervisors in the PhD collaboration with the University of Strathclyde, in particular, are challenging themselves with ideas and concepts from academia as a result of their interactions with the academic supervisor.

These ways of working have permeated our culture and enhance the scientific rigor and diversity in our drug discovery projects. As a result, we have further fostered this cultural exchange by exploring opportunities for our most experienced chemists to be recognised as visiting professors with premier academic chemistry departments, with interesting collaborations resulting.

Conclusion

This is a brief description of the GSK model in the UK. A similar model is employed in the US, but with US-specific out-reach activities. Our approach is focused on cost effectiveness rather than cost minimisation and answers the question posed in this editorial – where will the next generation of medicinal chemists come from? The model is both cost effective in the short term and

secures the future talent development needs for our organisation (and beyond) in the longer term. This approach brings many benefits to our organisation, including the ability to draw from a broad talent base, interaction with highly talented and motivated individuals, creative ideas being applied to drug discovery challenges and the ability to shape the future of medicinal chemistry, for example. Ultimately, however, the success of the model will be judged by the destination, which in our industry tends to be some 10 years after the medicinal chemistry costs are spent. Therefore, while an energised and motivated workforce with a great demographic holds much appeal, the ultimate effectiveness will be determined by the number of drug approvals that we achieve over the forthcoming years.

References

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