Reducing Risk in Bioscience Development: Closing the Information to Knowledge Gap

Parenteau BioConsultants, LLC

Top biotechnology R&D executives maintain the vision of the company and often represent the most knowledgeable and experienced members of the team. In most biotechnology companies, the future success of the company is often riding on their decisions. Their decisions must be informed, astute and insightful. Productive insight is the definition for breakthrough and a company looks to its scientific leadership to provide that insight, set a productive pipeline strategy, make its products, and keep it competitive.

But today's senior R&D executive is faced with the challenge of turning a continuous stream of information into knowledge that can help them set the right direction and fuel progress in their programs. There is often a gap between the kind of insightful knowledge one needs and the information gathered – the information to knowledge gap. This is compounded by today's world of technology, where the shear amount of data that is generated and reported can prove overwhelming, making the assimilation of information ever more critical. This white paper discusses ways bioscience companies can improve the quality and efficiency of translation of information into pertinent knowledge to yield the insight needed for better strategy, decisions, and direction.

Today's critical challenge

Beyond critical financial resources, pharmaceutical and biotechnology analysts Burns and Sammut[1] argue that there are certain capabilities that are critical for success. Among them is the ability to "manage knowledge" across departments, from discovery to marketing extending both within and outside of an individual therapeutic area. Knowledge should be leveraged to glean insights and synergies in efforts. They note that this is "no easy task" in knowledge-intensive industries.

Gary Pisano, in his book *Science Business, The Promise, The Reality and The Future of Biotech*[2] points out that in the past,

[1] Burns and Sammut, *Healtcare Innovation Across Sectors: Convergences and Divergences* in: The Business of Healthcare Innovation, LR Burns, ed. 2005 Cambridge Univ. Press

[2] Pisano, Science Business, The Promise, The Reality, and The Future of Biotech, 2006, Harvard Business School Press.

applied research had at least 100 papers to serve as a technical foundation but because of the rapid "progress" of technology, there are now only approximately 8 highly relevant papers to serve as the basis for a new biotechnology product. Of course there is no paucity of scientific publication or data and so while there may be only 8 highly relevant papers, the bioscientist must now grapple with hundreds to thousands of somewhat relevant papers. Added to this is the need for on-target interpretation and an applied science perspective, which is left to the industry scientist, as the objectives of most of today's scientific publications do not fulfill the needs of industry This adds the likelihood of significant gaps between data and relevant information as well as between information and knowledge.

In his well-known studies on accuracy of scientific interpretation and analysis[3], John Ioannidis finds that most studies are flawed and most conclusions are off-target, victims of poor design and bias towards achieving a particular result. Of course, for the industrial R&D head, these issues become very real. In biotechnology, there may only be one chance at producing a successful product from a technology. Unlike the analyses and conclusions Ioannidis refers to, the study designs and conclusions drawn by an industrial R&D head must be informed, unbiased and on-target. They must rely on knowledge as a critical guide.

The Need for a Broad Perspective

Burns and Sammut[4] contend that the scope of information and expertise needed for optimum R&D performance must cast a wide net to be most effective and go beyond what is directly related to the development of the product. In bioscience in particular, assimilation of knowledge from other areas of bioscience may offer clues to mechanism and response that cannot be gained through a focused approach alone as biological processes and relationships are variations on a theme and more developed areas of scientific study may hold important information directly relevant to the problem in another area. Conversely, if the scenario developed using another biological system appears to conflict with what is being developed, it adds a note of caution and directs attention to areas for further clarification thereby helping to reduce the risk of weak development paths.

[3] Ioannidis JPA (2005) Why Most Published Research Findings Are False. PLoS Med 2(8): e124 doi:10.1371/journal.pmed.0020124

[4] Ibid.

Lack of highly relevant information, the need for accurate, expert interpretation, and the need for assimilation of information and knowledge from a wide swath of bioscience combine to create a significant challenge to today's head of bioscience R&D.

Finding Knowledge in Information

Lack of awareness and inability to assimilate and use information is one of the most prevalent problems in the interpretation and use of bioscience today. This has led some to "text mining" as a way to "discover" the gems hiding in the wealth of data present in scientific publications. However, the quality of the output is directly related to the quality of the questions asked in these analyses, still requiring an advanced level of expertise to gain the knowledge one is in search of. An additional weakness to computerized text mining is that text mining software can analyze and find connections between what has been written yet the **important insight may lie "between the lines."**

Size Doesn't Matter – Every Company Needs the Same Knowledge

It is obvious from the challenges, that the importance of information to knowledge is critical throughout the research and development process. It will be used to set technology strategy and objectives, determine pipeline possibilities and establish the hypotheses that will guide the direction of R&D no matter how large or small the bioscience company. This means that even the smallest companies should invest early in gathering the necessary information and knowledge to make informed decisions. In fact, it may prove more critical to the smaller company that lacks the resources to change its direction or expand its internal research.

The Challenge of Limited Time and Expertise

As pointed out by Burns and Sammut, the scope of the information must cast a wider net than the information directly related to your specific problem to be the most effective. Most small companies rely on their academic founders and scientific advisory boards to supply this information and knowledge and then build on it through internal work and study. This can be difficult for smaller companies that have limited time and personnel to carry out the study and it also requires expertise, which may still need time to develop in more junior staff. As

industry veteran Jon Northrup explains[5] "[In applied research] there is no research just for understanding unless that understanding can be applied to creating or finding [a product candidate]." This is not only true for data generated in-house but also to the wealth of data available in the scientific literature. Analysis and assimilation of this data requires expertise and skill in applied science. **Many companies are challenged in finding a way to gain the knowledge they need when they need it.**

The challenge of interpretation of new technology or science is not exclusive to the small company. New technology is new to everyone. The lack of highly-relevant information is true for everyone and large companies often turn to academic experts for direction in early technologies just as small companies do. The difference is that larger companies have the opportunity to fill in gaps in research and more resources to investigate and assimilate additional information and can, to some extent be proven wrong, however the reality is that even large companies struggle with new science and technology. This is evidenced by the decline of pharmaceutical productivity that has coincided with the rapid advance of biological information. Every bioscience company is challenged to find efficient ways to close the information to knowledge gap. Ironically, pharmaceutical companies look to the smaller entrepreneurial biotechnology companies as being more nimble and able to respond to new technology.

Closing the Information to Knowledge Gap

Gaining the expertise needed

Processing information to relevant knowledge requires a broad base of expertise and experience. Small firms are unlikely to start with that expertise in place in all areas. **There are several ways firms have gone about filling gaps in expertise**:

1. **Reliance on academic founders to guide technology development**.
    a. Positive aspects:
        i. They have a vested interest in making things work
        ii. They are experts in the company technology
    b. Challenges:

[5] Northrup,*The Pharmaceutical Sector* in: The Business of Healthcare Innovation, LR Burns, ed. 2005 Cambridge Univ. Press.

i. Bias. They have a vested interest in being proven right. Their academic careers take precedence.
ii. They do not provide the multi-disciplinary insight needed to make scientific management decisions.
iii. They often lack experience in applied science.

2. **Reliance on a scientific advisory board (SAB) to provide multi-disciplinary expertise**
   a. Positive aspects:
      i. Can provide access to a range of top expertise not provided by staff and founders.
      ii. Can serve as a resource for up-to-date information and competitive information in their areas of scientific expertise.
   b. Challenges:
      i. Bias. Many become experts by building academic careers based on the advance of a particular concept. Bias and dogma must be guarded against.
      ii. Lack of engagement. You recruit an SAB member for their expertise and standing in the scientific community. The SAB member has little to personally gain by challenging their own thinking and thus will be an unlikely source of innovative ideas. A clinical researcher once commented that he had never come across an SAB that had yet stopped a misguided product strategy from going forward. That responsibility is yours. If they have breakthrough ideas, these ideas are much more likely to become the intellectual property of their affiliated institution than your company.
      iii. Lack of skills in applied science. As Northrup pointed out, applied science must be focused on finding answers directly relevant to the product goal. Academic experts, although distinguished scientists and clinicians, are often unskilled in applied science. While the SAB is a valuable source for competitive knowledge and information it is often not a suitable source for product direction unless one makes the effort to include industry experts on the board.

3. **Hiring in multi-disciplinary expertise**
   a. Positive aspects:
      i. Builds in-house capability

ii. Ongoing access to expertise with a vested interest in achieving a successful outcome

b. Challenges:
   i. Uncertainty in the academic talent pool. Top academic talent is not skilled in industrial research and will require on-the-job training. A certain percentage will prove to be ill-suited for or disinterested in applied science.
   ii. Top talent with applied science expertise is rare and in high demand. Attracting them to your company can be expensive and difficult for a small, high-risk company.
   iii. Successful multi-disciplinary teams require a management and financial commitment that might prove difficult to maintain in a small company.

4. Out-sourcing expertise

a. Positive aspects:
   i. Does not add to company headcount
   ii. Flexibility with a controlled level of financial commitment based on the changing needs of the company.
   iii. Can offer a fresh perspective and objectivity
   iv. The effort is entirely focused on the needs of the client
   v. A way to rapidly acquire the sophisticated knowledge that enables discovery and innovation.
   vi. Access to a level of expertise not available through staff hiring. Consultants will often be senior-level executives who can offer seasoned strategic advise to decision makers.

b. Challenges:
   i. Experienced consultants and outsourcing resources are rare for biological products
   ii. Relying on outsourced expertise may mean that the capability is not established in house when it should be. Few consulting firms have the capability to train staff as well as advise.
   iii. Management consultants may point out strategic issues but lack the ability to provide guidance on the solutions leaving the need for expert technical input. Most traditional management consultants work on the assumption that the need for technical expertise is being met within the company.

iv. Consultants with the appropriate expertise to provide solutions can be even more rare than the top talent available for hire.
v. Consultants recommend and advise but will not make the final decisions. The consultant must be willing and able to educate as well as advise to enable the client to make informed decisions on an ongoing basis.

Working with Information

The value in information lies in how it can be used

1. Data and the information derived from it comes from external and internal sources.
2. The information is interpreted, valued and processed to contribute knowledge.
3. Knowledge from various sources is assimilated to gain insight.

The definition of breakthrough is "productive insight."

Academic literature rarely assimilates information in the way that companies require for biological product discovery and development. This is an important skill in applied bioscience to be cultivated in-house. However the reality is that the time to devote to assimilation is scant leaving a substantial gap in the translation of information to knowledge. The more an R&D organization can close that gap, the stronger and more savvy its decision-making will be. If an R&D organization is able to efficiently assimilate information in a way that helps the company and regulators understand how and why a product should work in a clinical indication you are providing that important *in vitro* and *in vivo* connectivity Northrup views as an important part of the "discovery" phase. It is one of the most valuable practices to reduce risk throughout the preclinical phase of bioscience product development.

By investing in the training of staff in applied science and exposing them to data and analysis from multiple scientific disciplines from inside or outside the company you help increase their ability to "see" and appreciate the knowledge that can be gained within each area. It is the broad inter-disciplinary approach that Burns and Sammut identify. Today's science teams should be interactive and multi-disciplinary. While some may take a silo approach to the nuts and bolt activities of product development, there should not be a silo approach in the creation of foundational knowledge and technical strategy. One of the advantages seen in biotechnology is that their smaller size and technology focus means there will be fewer silos however they are still challenged with cultivating a challenging, multi-disciplinary perspective. As the old commercial said, "Kool-aid is for kids."

Turning Information into Knowledge

How can a entrepreneurial biotechnology company at the forefront of science meet the challenge of closing the

information to knowledge gap in a way that can propel the breakthrough technology into the clinic and the marketplace with limited resources and time?

The challenge of turning information to knowledge on an ongoing basis can be broken down into a few key aspects:

- Be sure you have access to expertise that has an appreciation for translation and applied science.

- Be sure your team derives its own interpretation of external and internal data, with or without help. It is critical that this be on-target and one cannot rely on conclusions made in the literature. The goal of the academic research or publication may be very different from your goals. And as John Ionnidis points out, much of what you read may be biased and flawed.

- Understand the target biological problem by taking a broad biological process-based approach. Valuable insight can often be gained by assimilation of information and knowledge from other organ systems, disease states, developmental processes and normal responses. A biological process-based approach allows one to rapidly assimilate information in real time.

- Personnel should look closely at their specific problem area and then step back and analyze its similarities and differences with what is known in other systems. In our view, this form of benchmarking is one of the best, and easiest ways to gain valuable insight into biological mechanism. If stories differ or appear inconsistent, you gain an important heads-up early in the process when there is still time to make adjustments or investigate further, helping to increase efficiency and reduce risk. Biological complexity, redundancy and flexibility of response is not inconsistency. Nature does not reinvent many wheels and inconsistency is a red flag.

Conclusion

Foundational knowledge is an important aspect to any company's success. This white paper has discussed the value and importance of closing the information to knowledge gap in the translation of science data to relevant knowledge for bioscience product development. The optimal approach is one that combines:

1. Broad expertise

2. Developed skill in applied science
3. Assimilation of multi-disciplinary, multi-field information
4. On-target interpretation of external and internal data
5. The ability to bring it all together and use it to form hypotheses, strategy, question results and set direction.

Awareness that there is a gap between information and knowledge in bioscience is the first step. It then hinges on gathering the resources and implementation. If you need additional help in putting a plan in place to strengthen your foundational knowledge now and on an ongoing basis, consider Parenteau BioConsultants. We offer several options that can assist you in making the most of information.

Analytical Reports: PBC Paths for Progress Reports provide an in depth analysis of data in particular areas of bioscience. We use our skills in applied bioscience to translate and assimilate a broad base of information into knowledge that you can put to work immediately. Reports on specific topics may also be commissioned to meet the specific needs of the client providing a convenient, cost-effective and rapid way to get up to speed in creating foundational knowledge that can serve you well throughout the R&D process. As consultants, we are also there to support the use of this knowledge if there is a need.

Training: Our firm specializes in helping industry researchers develop skills in applied bioscience from approach to implementation. Our biological-process based approach can lend clarity and the ability to rapidly assimilate knowledge on an ongoing basis. You can bring us into your organization for training seminars on bioscience data processing and knowledge acquisition and lecture/workshops focused on your specific interests. Additional information can be found at www.parenteaubc.com.

An introduction to our approach to applied bioscience is available through our free monthly e-zine: The Best of Bioscience Letter (www.bestofbioscience.com) and two podcasts:
The Applied Biologist
Paths for Progress in Bioscience
Available on iTunes and on our websites.

If you would like to explore how our firm can be of further assistance in helping enable success in your R&D programs, please call Dr. Nancy Parenteau or Dr. Janet Hardin-Young at (617) 275-8845.