



*Issues paper for the OECD Workshop on*

# **Knowledge Markets in the Life Sciences**

*16-17 October, 2008 at the  
US National Academy of Sciences*

## **Introduction**

1. In the health sector, new mechanisms are emerging to trade an increasing variety of knowledge intensive assets (e.g. data, materials, expertise, services). This OECD Workshop will explore what these “Knowledge Markets” are and what benefits they bring to health innovation and health outcomes. It will identify what types of products, materials, data, information, and know-how can create added-value when exchanged or traded. It will describe the mechanisms which try to facilitate such exchanges. The Workshop will also address what forces are driving the creation of knowledge markets; the factors that might limit their development; and their application beyond the health sector.

2. The purpose of the workshop is to help government policymakers understand the forces behind the development of Knowledge Markets, their possible impacts on innovation, and the role that public policy can play in facilitating their emergence.

## **What are Knowledge Markets?**

3. In a recent book on the biotechnology industry, Harvard Business School Professor Gary Pisano concludes that the complexity of knowledge integration suggests that “the sector needs mechanisms to bring specialists from different disciplines together and to facilitate the flow of information across organisation and disciplinary boundaries.” Knowledge markets aim to do just that; they encompass a number of different mechanisms, or marketplaces, where buyers and sellers trade different knowledge intensive goods and services. In the life sciences such tradable assets could for example be scientific data such as the outcome to clinical trials or toxicology data, but could also include experience from surgical cases which could be exchanged on a platform, or the matching of patent holders with interested licensees through a knowledge broker.

4. The stimulus for this topic came in a 2006 OECD workshop on Emerging Research Models where participants discussed the flow of information in biomedical research and identified a need for greater transparency in order to accelerate health innovation. Participants at that meeting agreed that public and private research organizations needed to move away from the prevailing practice of keeping data proprietary and, instead, develop new kinds of markets through which companies, universities, regulatory agencies, and others could exchange valuable information and data that now are presently treated as proprietary.

5. The term “Knowledge Markets” is for the purposes of this workshop loosely defined to encompass a number of different mechanisms and platforms whose goal is to increase access to existing knowledge. Buyers and sellers can pool or trade data, information, contacts and know-how. Intellectual property (IP) exchanges and patent pools, consortia, networking, matching or brokering services, clearing houses, knowledge warehouses and auctions all fall into this broadly defined concept. They are alternative ways of managing and deriving value from intellectual assets. What they have in common is that they are “mechanisms for enabling, supporting, and facilitating the mobilization, sharing, or exchange of information and knowledge.”

6. While this form of pooling, trading and sharing intellectual assets is not an entirely new concept, in the life sciences these are relatively recent phenomena. Some of the more pioneering health initiatives have emerged in a range of different technical domains and at different points in the innovation cycle. In other industries, such mechanisms have a slightly longer history – mainly in the IT where information is digitized. For example, a number of internet-based knowledge markets have recently sprung up, which exchange knowledge through a question-answer service, either with or without the monetarisation thereof (e.g. Wikipedia Reference Desk, and now defunct Google Answers). In the bio-pharmaceutical industry the

best known examples are collaborative mechanisms for intellectual property (IP pools, clearinghouses) and consortia for pre-proprietary knowledge (Biomarkers and Synthetic Biology).

### **What is driving the development of Knowledge Markets?**

7. A number of key drivers have been changing the environment for innovation in the health sector. These drivers are pushing research organisations to think creatively about the way they manage and capture value from existing knowledge, be it in house or external. There is a substantial literature – and a considerable diversity of opinion – about what are the most important of these drivers, with the following elements emerging:

- i) The dominant role of S&T and innovation in creating growth and wealth is now widely accepted.
- ii) Innovation is becoming increasingly knowledge-driven: a shift towards evidence-based innovation.
- iii) The organisation of research is changing incredibly rapidly – driven by informatics and the relatively new notion that collaboration and sharing of knowledge can be more than a zero sum game.
- iv) Rapidly improving connectivity – and the development of platform technologies/ standards - as globalisation accelerates.
- v) Meantime, changes to markets, the competition environment and technology are happening at a far faster rate than ever before – so continuous and continual learning and adaption are essential.
- vi) Profound efforts are under way to improve valuation of assets and enterprises based on knowledge and development of innovative financial models (and framework governance).

8. The rapid pace of scientific and technological advancement in the life sciences, the complexity and heterogeneity of knowledge relevant to health innovation across multiple fields and subfields and the need to integrate the vast amounts of both scientific and clinical data all combine to create challenges for achieving the interoperability, knowledge integration and accumulation necessary to harvest the full benefits of the existing knowledge base. Knowledge Markets may help address some of these challenges.

### **Policy interest in Knowledge Markets**

9. The existing norms of IP protection and the nature of competition in the health and biotechnology related industries is such that vast amounts of data, information and knowledge created throughout the health innovation cycle is largely held proprietary. While some amount of property rights are necessary as an incentive for innovation, there remains a substantial amount of knowledge and other intellectual assets that are generated which are not core business and could be exchanged (for money or for other knowledge assets or services) at terms beneficial to both the provider and consumer of such knowledge.

10. Achieving greater access and exploitation of existing knowledge, by facilitating the trading and sharing thereof, would increase the efficiency of the health innovation cycle and potentially deliver a number of positive health and economic outcomes. For example, creating consortia or knowledge commons for pre-competitive knowledge can speed up the pace of innovation in early stage technologies such as synthetic biology, and perhaps avoid or reduce patent thickets or anti-commons which deter innovation. By sharing knowledge about failures, or know-how about regulatory procedures, drug development costs might be reduced. Knowledge markets may also bring opportunities to health care

provision as such, by paving the way towards personalised medical care (for example if data from ‘failed’ drugs are repurposed with pharmacogenetic research). The benefits of more efficient and effective exploitation of our existing knowledge resources could thus be harnessed not only by the biotech and pharmaceutical industries, but also by patients, health care providers, the financial investing community and – if used to address global health challenges – to society at large.

### **Underused and ‘Undershed’ knowledge**

11. At present it is primarily vertically integrated companies, including biotechnology and pharmaceutical firms, who scan, integrate and build value from in-house knowledge assets. Beyond that the inter-relationships between firms through the explosive increase of outsourcing, as well as mergers, licensing and other forms of collaborations, are allowing for the exchange and value-creation from out-house knowledge assets. Yet, increasingly, experts are suggesting that present business strategies and even the organisational structure of the bio-pharmaceutical sector are not as productive as might be possible.

12. A core element of productivity is the efficient management of intellectual assets. Much of the present literature is focused on in-house knowledge management inefficiencies, with little attention paid to the potential that such knowledge can derive if employed out-house. Knowledge markets address precisely this inefficiency; the ‘underuse’ and ‘undersharing’ of the large amounts of data and information created throughout the innovation cycle. In some cases knowledge that is held privately may not be of value on its own, but could have added value when aggregated into databases. In other cases old data or data about failures may be worthless to its owner, yet significant in different research tracks in other companies, perhaps even in entirely different domains. There is also the type of knowledge or data that is of competitive interest to the holder, but that, when pooled is worth more to the various stakeholders than the sum of its parts (e.g., SNPs and biomarker consortia). This latter type of knowledge asset will likely be the hardest to create a market for, as the difficulty of asset valuation, and the inherent competition of the industry present challenges to the creation of a viable market for exchange.

13. The types of under-developed or under-utilised information in health innovation might include:

- Pre-competitive knowledge currently held proprietary that if aggregated, integrated and made interoperable and searchable could yield new information building perhaps in particular, on experience from the human genome project and the SNPs consortium.
- Information associated with failed and abandoned projects (which if companies were able to market some portion of might help recoup some of their research investments). For example, failed drugs might be repurposed and find a new market in pharmacogenetics research.
- Databases that are presently maintained in-house but could be scaled and shared for mutual benefit, such as for example toxicology data.
- Intellectual assets that could be of higher value out-of rather than in-house. For example, developing a means by which firms could access one-another’s’ compound libraries.
- Proprietary know-how relating for example to the regulatory framework, or clinical trial software, can be of value and therefore find a market out-house.
- Promising lead molecules which are not taken forward into Phase II trials due to lack/cost of capital or poor market expectations, where approaches to securitize late stage development could have value

14. The expert workshop will address what kind of knowledge is being underused in the life sciences and what sorts of new institutions and organisational mechanisms for creating value could emerge to exploit this knowledge. If one deconstructs the innovation cycle into modular units, is it possible to envision different sorts of knowledge markets that will buy, sell, trade the modules more efficiently than is done now? It may be, for example that certain discrete and fundable intellectual assets would be worth more – both in monetary and scientific value – if they were traded within a knowledge market rather than used in-house.

### **Challenges to creating knowledge markets**

15. This approach for more sharing of data is aimed at abetting the development of programmes or potential products that otherwise would languish. The concept of knowledge markets represents a major shift from traditional strategies that emphasize safeguarding IP and toward more connectivity and sharing of IP. As such, it necessitates a cultural shift – as well as a competitive and legal shift – on the part of various players within the biomedical research sector, a change that is fraught with difficulties. Obviously, greater exchange of data and knowledge, if it can indeed be arranged, would not be all-encompassing because the promise of IP exclusivity and the economic benefits accompanying product exclusivity are a major driving force behind health innovation. The challenge will be to identify those intellectual assets for which an economic incentive for their exchange would exist, provided that the necessary market platforms are created.

16. One suggestion made at the Emerging Research Models workshop was to find non-threatening -- non core business -- ways of implementing this idea on a pilot basis. Some such consortia for sharing pre-competitive data already exist, notably in the development of biomarkers and synthetic biology , and these ‘neutral sandboxes’ should be examined to derive what dynamics allow for them to work, and how this might be extrapolated to other areas of research and types of knowledge. Similarly, valuable lessons can be learnt from industries where knowledge markets have a tangible existence, such as in electronic information exchange, as well as from existing initiatives with similar objectives in the life sciences (e.g., increasing transparency, pooling resources, matching supply and demand).

17. There are likely to be plenty of practical and policy obstacles to overcome before such knowledge markets become widespread. For one, national antitrust laws restrict certain kinds of cooperative exchanges between companies in the same market niche. For another, for-profit companies as well as the broader research community, are intensely competitive and very much depend on this culture to thrive. This competitiveness is likely to be further accentuated as new companies from developing countries begin to enter research intensive industries and offer their research and development services to companies in Europe and North America.

18. Even with a mindset and willingness of private and public researchers to increase the exchange of knowledge assets, there remain a number of practical difficulties to overcome. In order for a monetarised market to be functional it must be possible to assess and report the value of a knowledge asset. While some international initiatives pushing for intellectual capital reporting exist, they are far from common practice and are not internationally harmonised. Information asymmetries between knowledge holders, brokers and potential buyers further exacerbates this issue. The lack of interoperability between data sets might also present another practical difficulty that could hamper the pooling or exchange of these assets, even when such exchange would be mutually beneficial to the various stakeholders.

### **Mechanisms and incentives for trading knowledge**

19. The market values intellectual assets – and thus knowledge. This means that any information asymmetry between Chief Knowledge Officers, and others taking a technology appraisal approach to

valuing assets, and the market analysts that react to such appraisals, needs to be narrowed if market values are to match the “real” value of innovation and the S&T that underpins innovation.

20. Better guidelines for the reporting of knowledge and intellectual assets might help – but *prima facie* policy needs to drive the narrowing of such information asymmetry (though it is recognised that public policy may intentionally place a different value on innovation in some technology areas than an open market might – but in such cases policy intervention needs to be goal driven and transparent). The existence of mechanisms that allow the market to reflect the true value of innovation and the knowledge that underpins it would open new financial opportunities both for knowledge asset owners (by way of employing their assets to attract capital) and investors (through more transparency in asset reporting and valuation).

21. The emergence of mechanisms to share and trade knowledge creates a new type of market in which knowledge is the product under demand. This opens up new opportunities for existing players in the life science industry, as well as for potential new entrants. Owners of knowledge assets have a new, and potentially earlier source of income by selling or licensing data or patents. On the other hand, there will be a need for knowledge brokers to match the suppliers and users of the knowledge that is ‘on the market’. Some such niche brokers have already emerged, for example in the matching of targeted philanthropic funding with appropriate research projects, or in the licensing of older and failed lead molecules.

22. Another shift that is driving the emergence of knowledge markets is the push for greater transparency of publicly funded research and its outcomes. With the pressure to make clinical trial data publicly available, some of the interoperability and transparency issues that present a challenge to knowledge pooling and trading are alleviated, while the public research space becomes more transparent and accessible.

### **Policy advice to OECD member Countries**

23. Knowledge markets are about improving knowledge creation and development as well as about capturing returns on that knowledge. For OECD countries the key issues are whether there exist policies and incentives which could encourage firms to participate in different markets where previously privately held data and information can be valued, pooled and exchanged. For the moment, the policies that encourage this transition are not well understood. Indeed, what the role of government could be needs exploring.

24. The OECD workshop on Knowledge Markets in the Life Sciences will include participants from the private sector, the public research community, the financial community and government policymakers. Beyond simply describing current trends in the development of different types of knowledge markets, this workshop seeks to better understand where such mechanisms are applicable and for what purposes. It will ask participants to discuss whether knowledge markets help improve health innovation and if so what role governments might play.

25. Specifically, the workshop will explore:

- The inefficiencies of the present health innovation cycle are and how Knowledge Markets might address these
- How to better commercially exploit knowledge, theory and experience
- What kind of knowledge is already shared or pooled and what kind of knowledge still leaves potential for further value capture?

- How various stakeholders could benefit from increased knowledge trading?
- What are the different modalities for sharing?
- How is the knowledge reported and valued?
- Who participates? Is the community open or closed?
- What infrastructures – scientific, informational, regulatory, legal – are necessary?
- What are the challenges to building knowledge markets and how might they be overcome?
- What policies or incentives might encourage experimentation with knowledge markets?