Appropriate Governance of the Life Sciences - 1

Multinational Company Innovation Strategies

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This policy brief is one of a series describing Innogen's research on strategic innovation issues in life sciences, the governance and regulation of innovation and the resulting innovation trajectories determining which products are developed and which companies take the lead in developing them.

SUSTAINABILITY OF CURRENT PHARMACEUTICAL INNOVATION MODELS

For more than ten years, analysts have been claiming that, despite a series of life science-related innovations, the overall drug discovery and development model of the pharmaceutical sector is fundamentally unsustainable. Explanations have included failure of innovative capacity, too great a focus on incremental rather than radical innovation, excessive regulation, and lack of venture capital investment.

The life science innovation model has been remarkably resistant to change compared to the IT sector

However, from an alternative perspective, one could say that the pharmaceutical innovation model has been remarkably resistant to change compared, for example, to information and communication technology. Despite difficulties in markets, the emergence of a series of potentially disruptive innovations, the steady build-up of an onerous regulatory system, development costs approaching $1 billion per product and a development life span of up to 12 years, the underlying business model of the sector has remained remarkably constant, and indeed has been reinforced, over the past fifty years. The dominance of the multinational pharmaceutical companies ('big pharma') and their prevailing block-buster drug model of innovation has until now been unassailable.

Disruptive change is becoming increasingly inevitable

This paper examines this remarkable robustness in the pharmaceutical innovation model, but also recognises that disruptive change is becoming increasingly inevitable. It focuses on the combinations of circumstances likely to lead to radical disruption and points to the need for such change to be carefully managed to ensure that life science research continues to deliver both public and commercial benefits.

INCREMENTAL AND DISRUPTIVE INNOVATION

Most life science innovations have been 'incremental' or path-dependent in that they are easily accommodated within the current innovation model. More rarely an innovation is potentially path-breaking or 'disruptive', stepping outside existing paradigms, leading to discontinuities in innovation pathways, to major shifts in product types and their place in the market, and even to the creation of new industry sectors or radical re-structuring of existing sectors.

Underlying at least some of the public and commercial investment in life sciences has been the assumption that the technology in question might be the 'next big thing', the path-breaking innovation that will lead a company to become a multinational in its own right, with a winning strategy that is different from incumbent multinationals. More realistic investors assume that they will support a new

biotechnology firm (NBF) only until it becomes large enough or successful enough to be taken over by, or to license its technology to, a multinational.

BARRIERS TO ENTRY

Regulators impose constraints on life science innovation through the lengthy, expensive and complex set of requirements needed to bring a product to the market. This forms a barrier to entry for any new firm and is one of the most important factors giving multinational companies their dominant role in the sector. A symbiotic relationship has built up between the sectoral innovation system and regulatory bodies since the 1950s, with each change in the regulatory environment being incorporated into the innovation system in a way that reinforced the dominant position of the multinational companies.

Regulation is the key, controlling influence on the long term resistance to change of the 'big pharma' innovation model

Many analyses acknowledge a role for regulation as one factor among many in influencing sectoral innovation systems in life sciences. However, we would give it *the key, controlling* role in explaining the long term resistance to change of the current innovation model of the multinationals. By acting as such an effective barrier to entry to the sector it has ensured that, with a few early exceptions, no NBF has been able to develop an innovation strategy which challenges or would compete with those of the multinational companies.

The market context is also an important, but lesser, barrier to entry to the sector. Unlike most markets, products are not sold directly to the public. Despite the increasing volume of direct-to-consumer sales, drugs are still delivered mainly through highly specialist health care networks, publicly or privately funded. As with regulation, it is very difficult for a new entrant to break through this barrier and to market its products independently of the multinational companies.

PROBLEMS OF MATURITY – A SECTOR THAT IS RIPE FOR DISRUPTION

An important factor in charting the future of the pharmaceutical sector is its maturity, in the sense that drugs have been developed for all the easy targets and they are now off-patent generic products no longer attracting high profit margins. It has become increasingly difficult to find new products that are effective enough to compete with existing product ranges, safe enough to pass regulatory scrutiny, and cheap enough to manufacture. These factors, rather than complacency or a failure of innovative capacity, are the main reason for the drying up of product pipelines. The problem became urgent for pharmaceutical companies in the late 1980s, and for agrochemicals in the early 1980s. They are an indication of a sector that is ripe for a period of creative destruction where new companies with a range of different innovation models challenge the status quo.

Biotechnology may have enabled companies ride out their maturity problems for another ten years

Biotechnology was expected to answer this challenge but most industry-watchers point to its failure so far to rejuvenate product pipelines. However, from an alternative perspective, biotechnology may have succeeded in enabling pharmaceutical companies to ride out their maturity problems for at least another ten years, contributing to preventing major disruption of their innovation model and a slide to become mere producers of commodity chemicals.

COMPARING CASES – DEGREES OF DISRUPTION

Using three case studies, we compared the impact of GM crops on the agrochemical industry with that of pharmacogenetics and stem cells on the pharmaceutical sector. We identified why some innovations fail to have the predicted disruptive impacts, while others are more disruptive than expected. An innovation that challenges a sector's internal R&D model and at the same time its regulatory and market environments is much more likely to be seriously disruptive or path-breaking than one which affects only one of these areas.

GM crops have been highly disruptive of the innovation model of the agrochemical

industry because of their simultaneous impacts on company R&D(requiring a shift from chemical to biology-based development and production systems), on markets (selling seeds is a very different business from selling pesticides), and on regulatory systems (the European Union deemed it necessary to develop a new regulatory system from scratch to deal with this new product type). There are some important lessons to be learned by the pharmaceutical sector from the earlier experience of the agrochemical industry with GM crops.

Pharmaco-genetics seems unlikely to be disruptive for the pharmaceutical industry

With pharmacogenetics, companies have so far exerted more control over the way the innovation system is evolving. They are attempting to guide market expectations and at the same time focusing on applications which will avoid potential market disruption, and they are also influencing the plans and expectations of regulators as they consider modifications to regulatory systems. Pharmacogenetics therefore seems unlikely to be disruptive for the pharmaceutical industry.

Stem cells, as with GM crops, could have major simultaneous impacts on innovation systems, markets and regulatory systems, in a manner that is much less controllable by the multinational companies than is pharmacogenetics and therefore highly disruptive. An important difference from GM crops is that so far pharmaceutical companies are only planning to use the technology in an incremental manner, as a tool to develop new and better drugs, and not generally to develop stem cell based therapeutic products.

REGULATORY – TECHNOLOGY INTERACTIONS

GM crops were almost totally disruptive of agrochemical innovation systems but they would have been a much less disruptive innovation for seed companies of any size. However, once the agrochemical industry had decided to focus its future innovation system on GM crops, these other players were either bought out by agro-biotechnology companies or left the field, as for example did Unilever. One could speculate that, if GM crops had been developed by seed companies, European regulators would have been less likely to erect such an onerous regulatory system.

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A similar situation arises for stem cells. They would be highly disruptive of pharmaceutical R&D systems, markets and possibly also regulatory systems, but largely an incremental innovation, for example for a small tissue engineering company. Whether the multinationals or the tissue engineering companies take the lead in developing stem cells as products will depend mainly on the still-evolving regulatory systems. If this becomes so onerous that it is impossible for small companies to continue to operate independently, then stem cells will mainly be an incremental innovation for pharmaceutical companies who will use them to develop faster and cheaper drug testing systems as an alternative to clinical trials. Multinational pharmaceutical companies are unlikely to develop tissue-based therapies from stem cells because of their disruptive impact on innovation systems and markets. On the other hand if NBFs are able to develop stem cell therapies, this may be externally subversive of pharmaceutical innovation systems rather than internally disruptive, in that it will undermine some important drug markets.

Stem cell technology developed by NBFs may become externally subversive of 'big pharma' innovation rather than internally disruptive

The research community and the industry have so far paid little attention to the role of regulatory systems in determining the kinds of company that are able to develop innovative technology and the nature of, and markets for, the products themselves.

THE FUTURE OF 'BIG PHARMA'

The agro-biotechnology sector has already seen major change and radical re-structuring of its profit models, at least partly as a result of incorporation of GM crops within its product range. Companies in this sector are now no longer divisions of joint companies with pharmaceutical companies. They are less varied, less powerful and less able to withstand disruptive shocks than they were previously.

It is conceivable that pharmaceutical multinationals could continue to survive in their present form despite the alleged unsustainability of their innovation models. However, this model is being undermined, not only from within through the problems of maturity, but also through regulatory and market challenges, with demands for cheaper drugs, regulatory changes encouraging drugs to be developed for small niche markets and an increasingly negative public image of the sector. These factors were also part of the environment that contributed to the disruption of the agro-biotechnology sector.

The balance of power is slowly shifting

The pharmaceutical innovation sector is now becoming more diversified – it is still dominated by the pharmaceutical MNCs but the balance of power is slowly shifting and impacts from regulatory systems and market structures are the primary influences likely to speed up the rate of change.

The key to managed change is through the regulatory system

If disruptive change in pharmaceutical innovation systems is indeed increasingly inevitable, it will be important for the delivery of medical benefits to the public that this change is balanced and carefully orchestrated. The key to achieving this is through evolution of the regulatory system – regulatory change needs to be accompanied by a good understanding of the subtlety and complexity of the interactions between regulation and innovation in life sciences. Among other things this will require a more detailed analysis of the nature of the regulatory systems themselves which is the subject of further papers and policy briefs.

NOTES

This Innogen policy brief is based on Tait, J. (2007), "Systemic Interactions in Life Science Innovation", *Technology Analysis and Strategic Management*, 19/3:257-277.

Social science research in the ESRC Genomics Network (EGN) interprets the field of genomics broadly, including plant, animal and health related innovations in life sciences. The Network ranges across five of the UK's leading universities, and involves over a hundred researchers, administrative and support staff, and international visiting research fellows. It is one of the largest social science investments in the ESRC's current portfolio, and is becoming the largest concentration of social scientific research on life sciences in the world.

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