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editorial

Barry A. Bunin

Sean Ekins

Alternative business models for drug discovery

A fundamental problem

The challenge, cost, and risk of modern drug discovery are well documented [1].

Today, anyone with a new idea for a drug must raise capital (often >$100M) to take the idea through phase 2 trials to obtain a strong return on investment (ROI). Buyers of a drug asset must pay a premium (often >$1B) after human efficacy and safety are demonstrated. Developers of a new pharmaceutical technology know first hand how hard it is in the biotech space to obtain a ROI for their technology. There is an emphasis on immediate maximum ROI for minimal investment in each asset that has naturally led an overemphasis on late stage assets. This has, in turn, led to a drought in investment for truly innovative methods and pushed further repositioning of already approved assets [2]. The tremendous challenges of drug discovery are exacerbated by the need for redundant infrastructure to maximize value. Are there any solutions within reach?

Pharmaceutical innovation is never easy – both to develop and adopt. It is also unstoppable. When the AIDS crisis hit, new HIV Protease inhibitors were developed in record time through a collaboration of industry, government, patient and academic players. People were dying, scientific collaboration and insight were needed, and it happened. Folklore has it that at Gordon Conferences over wine, researchers shared hydroxyethyl amine transition state inhibitors on napkins. Might this shed light on a new, better model?

A core root of the current inefficiencies in drug discovery are due to organizations' and individual's barriers to collaborate effectively. The need for privacy and security has created a system where there is great redundancy and intellectual inefficiency. There are however alternative business models that allow researchers simultaneously to 'cooperate and compete' [3–5]; companies have released data for neglected diseases into public databases [6–8] and academics will continue to have a much bigger role in discovery research than they have in the past [9]. Online platforms have made transactions easier. Could consortia of industry, academia, foundations, and government intellectual property guardians evolve a mechanism that allows similar efficiencies in drug discovery [9]? An ideal, web-based ecosystem would be inclusive (for-profit, non-profit) and address both scientific and business inefficiencies in a systematic, technology driven manner.

Platforms

Innovative tools are available to create a more efficient marketplace, for example Collaborative Drug Discovery (CDD), Innocentive, ChemSpider, AssayDepot, eMolecules, Pubchem and more [10]. These technology platforms are probably the solution for making drug discovery more efficient. It is also technically possible today, to profile securely every compound ever synthesized against

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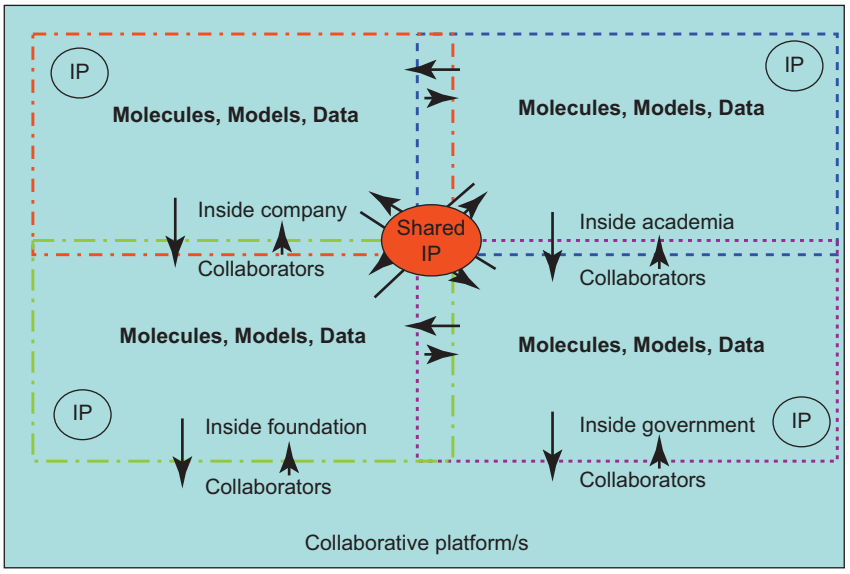

FIGURE 1

A schematic to demonstrate how biotechnology or pharmaceutical companies, academia, foundations and government could share molecule, models, data and IP, while also maintaining their own private IP, using a collaborative platform.

every assay with multiple computational models in a collaborative manner, using standard technologies [11] without disclosing structures directly. There is a need for a universal platform for collaborative drug discovery and development that will allow researchers to collaborate, while retaining refined IP rights. By integrating collaborative capabilities within natural workflows, greater efficiencies will naturally arise. This is because of the fundamental principals behind the economics of specialization – in particular, the economics of *well-integrated specialization*. One could imagine a very near future, where every best asset, uses the best algorithms/models, and best services, to fluidly and naturally partner with the right money for commercial and humanitarian applications (Fig. 1). If ever there was a need and opportunity for a catalytic new approach it is now.

The near future

The transition to the 'cloud' enables the solution for the drug discovery business. Scientists can now work in new ways, using new technologies that enable them to collaborate, which in turn are influenced heavily by the advances of Google, Facebook, LinkedIn and Amazon in the cloud. These mainstream applications have paved the way for mass acceptance of a cloud-based life and cloud-based work and the step to drug discovery is much closer. The prerequisite to enable the efficiencies of integrated specialization, are secure, trusted collaborative platforms [10]. By integrated specialization, we mean within researchers natural workflows or with minimal interruption, to be able to securely and selectively collaborate with anyone or any organization with truly complementary and best in class capabilities. Mechanisms that balance allowing maximum collective contributions, with maximum control of intellectual property ownership, provide greater efficiencies for everyone. Table 1 shows some suggested 'pain points' for the drug discovery industry in the collaborative space along with technical solutions.

Fortunately, the paradigm of collaborative technologies for biomedical research [12] has been well established and collaborative technologies for drug discovery provides a new, approach to collective efficiency during a challenging period for the drug discovery industry. Collaborative platforms with rich, flexible privacy and sharing controls provide an inspiring, tangible path to realize collective efficiencies that our industry, and human health, demands.

TABLE 1

Individual and organizational pain points addressed by collaborative technologies

Individual pain points	Organizational need	Technical solution
Keep scientist's data private until ready to share (i.e. with the rest of their groups)	Collaboration is as much about more efficient work within a single organization as between organizations.	Temporal data access controls
Allow scientists to partition or sequester data to enable selective data sharing	Control of chemical or biological data access based on project-specific permissions	Spatial data partitioning
Allow collaboration in scientist's natural workflow (i.e. without uploading data multiple times in multiple places)	Control based on type of data – especially given a marketplace with specialization in synthesis, screening, discovery, development	Sequester by data classification

Conflicts of interest

BB is a Board Member and CEO of Collaborative Drug Discovery Inc and PI on a Bill and Melinda Gates Foundation Grant #49852 'Collaborative drug discovery for TB through a novel database of SAR data optimized to promote data archiving and sharing'. SE consults for Collaborative Drug Discovery, Inc on the aforementioned grant.

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Barry A. Bunin
Collaborative Drug Discovery, Inc.1633 Bayshore Highway, Suite 342, Burlingame, CA 94010, USA
bbunin@collaborativedrug.com

Sean Ekins
1Collaborative Drug Discovery, Inc. 1633 Bayshore Highway, Suite 342, Burlingame, CA 94010, USA