Crowdsourcing Drug Development

In this white paper, we look at the role crowdsourcing can play throughout the drug development process, from discovery to early development and even late-stage manufacturing and marketing. Using numerous real-life examples as illustration, we’ll address both the strategic reasons for this approach as well as the tactical issues associated with its actual execution. This white paper is based on a webinar delivered by Alph Bingham PhD. Alph is the co-founder of InnoCentive and currently sits on the Board of Directors. He has over 25 years of experience with Eli Lilly in pharmaceutical research and development, research acquisitions and collaborations, portfolio management and R&D strategic planning.
About InnoCentive

InnoCentive is the global pioneer in crowdsourced innovation. We help innovation-driven organizations solve their critical business, scientific and technical problems by crowdsourcing ideas and solutions, either from our global network of highly educated problem solvers or from their own internal networks. By accessing vast virtual workforces with InnoCentive, organizations have been able to innovate faster, with less risk, and at a lower cost. We offer our proven Challenge Driven Innovation™ methodology, unrivalled network of over 380,000 problem solvers and purpose-built technology, as well as accompanying training and program management services. To date, InnoCentive have conducted over 2,000 external Challenges for organizations including NASA, DARPA, Thomson Reuters, AstraZeneca, GSK, Anheuser-Busch InBev, and Ford Motors.
Introduction

FINDING CHALLENGES

Challenges are hosted in the Challenge Center on our platform. Solvers can search for Challenges by keywords or filter them by discipline or type.

Around the transition from Phase II-A to Phase II-B, when the contents of the pipeline drops and the probability of success rises, we have what physicists or chemists would call “phase change”. The system shifts from one governed by probabilities to one beset by enormously expensive execution costs for each project. The funnel starts with many small projects, each consuming cash at a low rate and each having very little likelihood of succeeding – probabilities for pre-clinical projects are around the 10 to 15% range. After the phase change, most of these projects are gone, they’ve failed. The rate, however, at which each project burns cash, goes up as much as 50-fold or more but the chances of success rise to the 70 to 90% range as it goes through the late stage Phase II-B, Phase III and on into the regulatory stage.

Drugs are effectively a by-product of this very expensive endeavor of pharma R&D. It was in the midst of a strategic examination of these realities that InnoCentive was born. InnoCentive exists as a two-sided marketplace. There are buyers and there are sellers. Products flow in one direction and cash flows the other. The products are ideas and solutions. Like most marketplaces it needs a trading place, a bazaar, an exchange, a platform. That’s InnoCentive’s role. Linking the buyers we call ‘Seekers’, who are looking for an idea or a solution to problems they face within their organization, with the sellers we call ‘Solvers’, who are providing the ideas and solutions via our platform where the problems are posted and broadcast to a large and diverse network.

The effectiveness of this marketplace is a combined function of problem articulation, Solver network size and diversity and even bounty size. In InnoCentive’s world a dollar bounty amount is attached to each individual problem, making this akin to a bounty-hunting engagement model where the outlaws are tough problems in a huge variety of disciplines.
Our Seekers

We work with a variety of commercial organizations within the pharmaceutical and biotechnology space – AstraZeneca, Elanco, Cleveland Clinic and Boehringer Ingelheim just to name a few. We cannot provide an exhaustive list as all Seekers have the option to run their Challenges anonymously, just one of the ways we help protect intellectual property on both sides of the marketplace. Then we have a robust collection of not-for-profit clients including, but not limited to, many in the healthcare and therapeutic space. Organizations like Charley’s Fund for Duchenne muscular dystrophy and Prize4Life addressing Lou Gehrig’s disease. Beyond that we also engage with publicly-funded institutions and academic centers. Whether that description refers to the NASA Division for Space Medicine or the network of researchers and caregivers in the Harvard Medical Complex. Some of InnoCentive’s most rapid recent growth, in fact, has been in the engagement of government agencies like the National Institute of Health as well as the defense department. You might not think of the defense department as being relevant here but some are actually engaged in pretty sophisticated pharmaceutical drug development - just think bio-terror countermeasures.

Our Solvers

Turning to the Solver side of our two-sided marketplace, I’m going to deliberately avoid digressing into numbers and demographics. We reach millions and engage hundreds of thousands but the important solutions come from distinct individuals who at the moment of reading the Challenge had a flash of insight unmatched by the researchers and consultants that had previously tackled it. Our goal in serving any Seeker is not just to find Archimedes but to find him as he lowers himself into that fateful bath. It wasn’t his first bath, but that day it really mattered.

The premise InnoCentive is founded on differentiates itself from a classic employment model as well as a classic outsourcing CRO model. Distributed in a previously unsearchable crowd are insights, flashes of genius and ideas that would never have been evident from job applications, resumes or consulting brochures. InnoCentive’s model hinges upon the uniqueness of every human experience and the chaotic ways in which ‘aha moments’ are distributed among persons of widely varying academic and career qualifications. Essentially Archimedes, as he’s shouting “Eureka!”
Why Solvers Solve

Case Study - A Global Effort to Reduce the Costs of Phase II TB Drug Candidate PA-824

The nature of this Challenge, although not necessarily the specific subject, will be familiar to many pharma companies and not-for-profits. You have a product that's safe and efficacious but prohibitively expensive and difficult to produce, especially when that targeted market consists of patients residing primarily within emerging economies. The number of synthetic routes to any given molecular structure is a practically unsearchable space by virtue of its enormous size and attempted routes to date have not produced satisfactory alternatives. This was the case with TB Drug Candidate PA-824 so the TB Alliance decided to run a Challenge seeking a simpler and safer production method. They received solutions from around the world, amongst them two, one from China and one from India, showed sufficient promise that they were awarded the bounty by the Seeker.

There are a diverse range of motivations leading Solvers to participate with no guarantee of winning. For this Challenge the winning Solver from India told the story of his youth. His mother, the family breadwinner, was stricken with tuberculosis, so he left school and went to work. Family and friends intervened and covered the family's financial needs so he could go to college and acquire the skills and training commensurate with what others saw as his keen intellect. Having completed his degree in chemistry, he ran across this particular Challenge at a moment when he had just mastered a particular set of skills and felt compelled to give back.

The reality is that stories of this type are far more typical than we ever
imagined when we launched InnoCentive. In fact, when we launched it we asked ourselves one fundamental question: why would anybody attempt to tackle any of these problems without assurance of being paid? While this illustrates one reason why somebody would do that, it falls way short of illustrating all the reasons. Frankly, we were shocked when we realized that the number of reasons for people wanting to be engaged in a given problem is probably as diverse as the number of different people out there. Everyone has their own story, everyone has their own rationale.

Where Solvers Come From

I just spoke of a Challenge with solutions collected from India and China, but what does a typical distribution of Solver engagement look like? We’ve been working with NASA Division for Space Medicine for several years and in the early days they asked that same question. Their first pilot of seven Challenges was posted in a variety of areas, all under the responsibility of space medicine. They looked at everything from nutrition to environmental health and safety, exercise and personal care matters.

Nearly 3,000 Solvers engaged on these seven problems and opened project rooms – the global distribution is shown on the map above. Project rooms are where Solvers can see the full Challenge details, ask questions and upload their solutions. In order to create one, Solvers are first required to create an account or sign in and agree to the Challenge-Specific Agreement, which includes a stipulation that information contained in the Challenge details cannot be shared.
Successful Challenges Throughout the Drug Development Pipeline: Early Stage

In our early approaches to the pharmaceutical industry, we ran into one perception over and over again. It kind of went like this: The discovery folks would say, “That's not appropriate for us but I think you should talk to development people.” The development people would say, “You know, that's not appropriate for us. Most of the needs and the definitions of compound type have already been settled. You should talk to the discovery people.” So very early on we started plotting the stage in the pharma process that problems were being solved through our methodology of Challenge Driven Innovation. Here's some from the early stages of the drug development pipeline:

845675
Seeking suggestions for five biological targets for obesity.

1894778
Seeking a high-throughput format for a biological assay.

716076
Seeker is seeking to purchase quantities of heterocyclic molecules with MW < 650.

2855703
Seeking ideas for an accurate, sensitive, specific and facile method for measuring Pyrophosphate (PPI) in cell culture samples.

371122
Searching for a novel in vitro bone anabolic assay that can predict an in vivo bone formation response.

You can see that successful Challenges have focused on all sorts of areas: new biological targets, new biological screening methods, new additions to molecular libraries, new measurements for biochemical markers along the way, and new assay methodology.
Case Study - Harvard Catalyst: What Do We Not Know to Cure Type I Diabetes?

This Challenge was run by the Catalyst community at Harvard - the Clinical and Translational Science Center. They work in what is sometimes termed ‘the valley of death’ in the pharmaceutical industry, where there is a lot of data missing and it's hard to make leaps between some of the fundamental biological discoveries and the pragmatic discoveries that can lead to an actual therapy that benefits patients. They wanted to begin by asking the question: “What do we not know to cure Type I diabetes?”, that is - what are the problems or areas requiring further exploration and research in order for us to advance our ability to tackle Type 1 diabetes. This was actually a Challenge that some Harvard diabetes researchers advised against running, assuring them that any program in diabetes that had any likelihood of success was already underway in their labs. But they ran it anyway. They wanted to test the differences in perception between that of deeply-skilled researchers in any given disease and that of caregivers and patients who simply possess the disease and may not even know how to clearly articulate it in technical or scientific terms.

The punchline was that despite the perceived unlikelihood that it was going to produce results, there were 195 submissions. After an extensive review process involving over 200 reviewers, they identified twelve winners from a diverse range of backgrounds and some of whom were entirely new to diabetes. They then posted a set of brand-new diabetes research targets on their website and invited proposals for funding in any of the twelve categories identified through the Challenge. That gives you some idea of how far even Harvard could go in better understanding the unknown unknowns.

EVALUATING CHALLENGES

The evaluation process doesn’t have to involve 200 reviewers and they don’t have to be external - typically it involves between two and ten internal reviewers. After InnoCentive perform an initial screening of submissions, filtering out those that are irrelevant, offensive or ridiculous, we recommend an evaluation process of at least two steps. The first with one person, typically the Challenge Owner, providing a preliminary evaluation that filters out all that are easily identifiable as having little value. The second step would involve a larger team, potentially multidisciplinary. During the evaluation phase Seekers can ask Solvers any follow up questions via InnoCentive.
Case Study - Prize4Life

This was a series of Challenges that actually covered multiple stages along the pipeline. It was undertaken by Prize4Life, a not-for-profit foundation that was established to address Lou Gehrig's disease. The creation of this foundation was a joint project between MIT and Harvard students after one of the students was stricken with ALS or Lou Gehrig's disease while they were studying together. As part of their studies they had looked at alternative business models, one of which was crowdsourcing so they decided to form their foundation around it. In speaking with very gifted researchers and academia around the world, they found that one of the main problems was the absence of a crisp, clear biomarker that would inform therapeutic researchers whether the disease was being retarded or blocked in its progression, so this was decided as the subject of the Challenge program.

This was a one-million-dollar Challenge and the reward went to Seward Rutkove in 2011. Interestingly there was $175,000 issued in prizes prior to the final award, one of which was to a dermatologist with no prior ALS background. When speaking with the scientists at the foundation, they indicated that they are continuing to work on these other solutions, as although only the one solution met all the criteria for the final award, these others still showed promise and could potentially provide even simpler ways of bio-marking the progression of this disease in the future.

AWARD AMOUNTS

Award amounts are determined prior to launching a Challenge and will be impacted by a number of factors including the Challenge type and difficulty, the deliverables required and the organizational value of any potential solution. It is something that our Challenge Experts will be able to advise you on as part of the Challenge formulation process. Typically award amounts range from $10,000 to $100,000.
InnoCentive Challenge Types

Ideation Challenges

A global brainstorm for producing breakthrough ideas. This could include ideas for a new product line, creative solutions to technical problems, a new commercial application for a current product, or even a viral marketing idea for recruiting new customers. Ideation Challenges guarantee that at least one Solver will win an award. Solvers grant the Seeker a non-exclusive license to use any submitted solution, awarded or non-awarded.

Theoretical Challenges

For seeking a feasible design or concept that you don’t yet want to reduce to practice. A solution to a Theoretical Challenge will solidify the Solver’s concept with detailed descriptions, specifications, and supporting precedents that would bring a good idea closer to becoming an actual product, technical solution, or service. A Solver can expect a substantial financial reward if their submission is chosen as a winning solution by the Seeker, but an award need only be made if all the Challenge criteria are met; partial awards are also a possibility. Awarded Solvers are required to either transfer or license the IP in their solutions to the Seeker. The Seeker does not obtain the rights to submissions they do not award.

Reduction to Practice (RTP) Challenge

For seeking a prototype that shows an idea in actual practice (though on a non-commercial scale). In an RTP Challenge, in addition to a detailed description, Solvers are asked to present physical evidence that proves their solution will work within the Seeker’s specific needs, decision criteria, or manufacturing parameters or the information necessary for the Seeker to test their solution. Like the Theoretical Challenge, an award need only be made if all the Challenge criteria are met. Depending on the Challenge requirements, winning Solvers will be required to either transfer or license the IP in their solutions to the Seeker. As in the case of a Theoretical Challenge, the Seeker does not obtain the rights to submissions they do not award.

eRFP

A request for a partner or supplier to provide materials or expertise to help solve a business Challenge. Seekers use the InnoCentive marketplace to find businesses or consultants that have already developed the technology or solution they need or have the experience to help them develop it. Unlike other Challenges where a cash award is granted for the winning solution, eRFP winners typically negotiate the terms of the contract directly with the Seeker.
Case Study - NIH Single Cell Analysis: Follow That Cell

This was another multi-stage Challenge program, which was seeking to develop new tools and methods for predicting the behavior and function of a single cell in complex tissue over time. This ability could help reveal valuable information such as how cells transition from a healthy to diseased state, or identify changes that influence a cell’s responsiveness to treatment.

The first phase was completed in 2015 and involved a Theoretical Challenge in which Solvers had to submit written solutions proposing innovative ways to track the behavior and function of individual cells over a period of minutes, hours, and even days. The second phase, which ended in 2017, is where the 16 finalists from Phase 1 participated in a Reduction to Practice (RTP) Challenge, requiring them to develop and test their solutions. You can watch an interview with the five Phase 1 prize winners here. More information about the competition and announcement of the 16 finalists can be found here.
Successful Challenges Throughout the Drug Development Pipeline: Mid Stage

There’s nothing marked in ‘Pre’ above but that’s more a result of when we performed the exercise of plotting the Challenges. In fact, while LO has a gap in it here, we would actually now have a dozen Challenges to put in that stage. We built an entire Challenge type around doing lead optimization to remove some of the barriers associated with synthesis and delivery of novel molecules in order to enable an SAR (structure-activity relationship) to be conducted with greater efficiency – our Novel Molecule Challenge.

**NOVEL MOLECULE CHALLENGE**

This seeks various non-commercial chemical compounds, proteins, extracts, polymers, and DNA sequences linked by a common sub-structure, property, origin, or biological activity. Seeking organizations use these Challenges to investigate structure-activity relationships, obtain novel intermediates, expand library diversity, and so on. Seekers receive a non-exclusive license to awarded solutions, with the option to negotiate exclusive IP rights for a larger award.
Case Study - Subcutaneous Formulation Technology

This Challenge focused on actually getting a targeted therapy into the body. It was run as an electronic Request For Partners (eRFP) Challenge and was seeking ways to increase the solubility of biologic drugs (MAbs) in an aqueous solution in order to increase the concentrations deliverable by sub-cutaneous routes. Relative to other Challenge types, eRFPs tend to be down the low end in terms of submission numbers - in this case the Seeker found two that were of particular value and they wanted to pursue further.

Case Study – Lupus Drug Development

The Seeker in this instance was about to embark on a clinical trial and wanted to make sure that the design of the trial was optimized for success. While they were comfortable with their known knowns about lupus trials and lupus research, they feared the unknown unknowns. So they partnered with InnoCentive to run a Theoretical Challenge that would solicit detailed review papers, offering a $15,000 award, undoubtedly less than the cost of producing it internally and it had the virtue of being able to coalesce ideas from many different perspectives. This is what the Challenge Owner had to say: “The Challenge allowed us to tap expertise in the rest of the world. The winning response was a really thoughtful analysis with insights into the issue.”
Successful Challenges Throughout the Drug Development Pipeline: Late Stage

Here are a couple of examples:

2611751
Seeking experimentally validated synthesis for two Indacene derivatives

2442852
Seeking ideas for the development of a new risk assessment tool or modifications to an existing risk assessment tool that will identify women at high risk of breast cancer

Looking at the later stages of the drug development pipeline, we have two examples that sit near the point of submission. But Challenges could also go further - repurposing by-products or seeking new product uses for existing products - and in today's world that might even be a more important area to look at. It's important to think about molecules as having a life cycle and the more productive we can make that life cycle, the better the return.

Treating Orphan Diseases: Repurposing Discontinued Pharmaceuticals
Seeking proposals for pharmaceuticals that have been discontinued in clinical development but that could have potential to treat a non-oncology rare disease.
Type: Ideation - Award: $10,000

Novel Disease Indications for AstraZeneca Clinical Compounds
Seeking novel clinical indications for a select set of compounds previously in clinical development.
Type: Theoretical (IP Transfer) - Award: $15,000
We also have post-launch Challenge examples for the pharmaceutical industry. For decades, a major cause of drugs failing to be efficacious has simply been incorrect usage. Surveys have found that one-third of those given a prescription for a drug never take it and when they do, 50% misunderstand how. Which means around two-thirds of the population is not using medicine the way it was studied in the clinical trials. The reports that very little medication works in the real world is not surprising just on the basis of that fact alone. As a result, the industry is currently finding itself engaging with the delivery system folks and their customer base in an unprecedented way.

Sample Healthcare Delivery Challenges

- ChangeNow4Health Innovative Healthcare Ideas $10,000
- What Do We Not Know to Cure Type 1 Diabetes? $30,000
- Games for Health: Inspiring Adolescents to take Control of their Health $10,000
- Cleveland Clinic: Implantable Micro-Sensor for Displacement and Mechanical Load $30,000
- Cleveland Clinic: Build an Efficient Pipeline to Find the Most Powerful Predictors $30,000

Can We Crowdsourse a Cure for Cancer?

As I was preparing to speak one morning at the Cleveland Clinic, I picked up a Forbes magazine and there was an article in there from Haydn Shaughnessy entitled “Can We Crowdsourse a Cure for Cancer”. Haydn says, “We are taking two main pathways with crowdsourcing. There is the trivial – my apologies to Dell and Starbucks - where we use the crowd to provide feedback on product features. And there is the profound - where we use adjacent areas of expertise to cast new light on scientific and industrial challenges (the InnoCentive model).” I think the answer to his question is both yes and no. I don’t think cancer is going to yield like, for instance, the space program yielded and in the same way that we launched a rocket, we’ll announce a cure to cancer. You saw the different types of problems that are being tackled through crowdsourcing earlier and so I think it will certainly play an important role in breaking down the many hurdles that are in our way by bringing the thinking of other disciplines and other fields to bear on this particular problem.
Case Study – Roche Diagnostics

Roche Diagnostics provides a great example of how crowdsourcing compares to other methods. The basic hypothesis Roche wanted to test was: putting more eyes on a problem will allow us to solve them quicker and more effectively. But they also wanted to test whether this was best done by tapping an internal R&D community (i.e. employees of Roche Diagnostics) or an external network of scientists (i.e. InnoCentive’s Solver Network). The problem they wanted solving was one that they had been working on, through traditional evaluation optimization research, for 15 years. In the end, they were not able to find a solution to this problem through their internal R&D community however with InnoCentive, they were - and did so in just 60 days. Not only that, but amongst the solutions they received through InnoCentive, they found everything they had tried over that 15-year period.

The Economics of Pharma R&D

The reality is that pharma spends more of its R&D dollars on failure than it does on success. While we might have all sorts of ways to rationalize it, wouldn’t it be better if we spent the other way around and we produced more results and more therapies for patients in need? 

The InnoCentive model was designed to address three specific issues:

Diversity: Different people view problems from different perspectives and those that you think are the most qualified to solve them, might not actually be able to. Having people come at problems from lateral directions can produce surprising results. In fact, if I were to take all successful InnoCentive Challenges, I’d estimate that nine times out of ten the problem is solved by somebody unexpected.
Spot Market: The process of engaging those outside of your own internal R&D community can be complex. It’s filled with negotiators and lawyers and searching and tracking things down. The cumulative cost of all of that in any open innovation system adds to the cost burden. InnoCentive was designed to have a streamlined way in which you could reach thousands of people with one contract. One set of redlines, one straightforward engagement, thousands of brains tackling your problem. IP requirements are declared and agreed upon by all parties upfront and rights are quickly transferred at the end of the engagement.

Risk Management: I was attending a discussion of the future of pharma in Madrid a couple of years ago. A senior economist from the Milken Institute said, “Frankly we look at pharma and we scratch our heads. As an economist, we don’t know how it works. The amount of risk that is taken on and held internally by a pharmaceutical company is the kind of risk that we would associate with a small country, not a corporation.” I talked with this economist at some length during the coffee breaks. There is a rational reason why Pharma evolved to the state it’s in today but it does not necessarily guarantee it survival going forward. A lot of what was done for risk management within the InnoCentive economic design was to address that – paying for results rather than efforts and having the external network share the risk. Will that alone solve the problem? Of course not, but it’s a piece of it.

Q&A

What is the cost benefit of Challenges versus outsourcing to CROs?

There’s not an organization out there that won’t promise you three things: We’ll do it better. We’ll do it faster. We’ll do it cheaper. My advice to you as pharma employees looking to evaluate those claims - ask: How are you doing it faster? How are you doing it better? Why do you think it’s going to be cheaper? Here I’m going to give you the answer to why Challenges are cheaper. It’s cheaper because we’re going to strip away your cost of failure. If you make five different attempts to tackle a problem, you’re going to be pleased with the progress you’re making but its costly and takes time. Why not have all five of those attempts done in parallel and then only write the bounty check to the person who actually solved it. It’s going to be cheaper because you’re not serial processing the failures inevitable with complex problems, you’re going to be parallel processing them and you’re not going to be on the financial hook for the failures.
For more information on how you can run your own Challenges to rapidly solve problems and accelerate your innovation outcomes:

CALL US
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