



The future of **lightweight** innovation

How new models
for building the Web
will reshape R&D



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INTRODUCTION

Just a few years ago, launching an Internet startup typically entailed making the rounds on Sand Hill Road in Menlo Park, pitching venture capitalists an idea and a business plan illustrated by a handful of slides. Today, PowerPoint decks are replaced by working prototypes and the business plans by waiting lists for beta test accounts. Even the venture capitalists are being replaced by angels and self-financed entrepreneurs, as the cost of bringing a Web application to market falls below \$100,000. Innovation, long the exclusive domain of research and development groups (R&D) and their long-range roadmaps, has gone lightweight—agile, capital-efficient, and user-focused. Welcome to the emerging world of lightweight innovation on the Web.

Although this new model is currently most commonly found in the Web industry, over the next decade it is likely to set a new pace for every sector. While open innovation sought to merely expand the sources of new ideas, lightweight innovation seeks to disaggregate and accelerate R&D, more systematically engage end-users, and constantly invent and re-invent new platforms. Lightweight innovation itself is a disruptive way of thinking about idea generation and execution, and stands to fundamentally transform the way large organizations innovate and profit from innovation.



THE STRATEGIC CHALLENGE **1**

INNOVATING THE PROCESS OF INNOVATION

Lightweight innovation systems won't emerge in a vacuum. Existing "heavy" R&D efforts won't entirely go away, but will be transformed through their relationship with new lightweight R&D campaigns.

While lightweight innovation is working for the Web, porting it to other sectors will require rethinking and tweaking some of its underlying assumptions. In industries as diverse as pharmaceuticals and automobiles, scale matters in bringing new ideas to market. Scaling is just as sticky a problem on the Web as anywhere, perhaps even more so because success often comes in the blink of an eye and without warning. For instance, during 2009 the microblogging site, Twitter experienced multiple extended service outages as it struggled to provide sufficient server capacity to deal with a barrage of applications that utilized its open Application Program Interface (API). Yet in an indication of the kinds of synergy possible when lightweight and heavy innovation converge, Twitter quickly turned to the enormous infrastructure and talent resources at Google for assistance in scaling and managing capacity.

However, lightweight innovation does propose a central strategic challenge to large organizations over the next decade. How can we leverage the agility and austerity of lightweight innovation models, while simultaneously re-tooling traditional R&D organizations to create the supporting platforms needed for lightweight ecosystems to flourish? Specifically, while large collections of lightweight efforts can add up to significant breakthroughs, there are important pieces of innovation systems that are growing in scale. Biomedical innovation often entails massive clinical trials involving thousands of patients, a hurdle that isn't likely to disappear in the foreseeable future. Advanced scientific instruments are growing in scale and

complexity, and the massive volumes of data they generate often require entirely new infrastructures for distributed analysis. Many emerging R&D problems are so large and complex they can't be solved inside an organization, and lend themselves to collective efforts that may be best undertaken through consortia or universities. The challenge will be to find ways to pair these very large-scale, long-term collaborative platform-building projects with lightweight innovation programs operating on a completely different pace and scale.

Another important challenge for R&D managers revolves around the scalability of lightweight innovation itself. While it will increasingly be possible to develop new innovations on a smaller and smaller scale, transaction costs will still exist around the management of large collections of lightweight research efforts. The question is whether the economies of scale of large R&D organizations are well-suited to manage these costs profitably, or whether some other organizational structure will emerge to drive these transaction costs down and disrupt the large-organization advantage.

This report presents a set of guidelines for thinking about these challenges and insights on how to develop and engage new lightweight capabilities while simultaneously re-inventing the research organization. While "heavy" innovation platforms will not go away overnight, their position in the infrastructure of innovation will shift markedly. This report is a guide to anticipating and managing that shift.



2

LIGHTWEIGHT INNOVATION BEYOND TODAY'S OPEN INNOVATION PRACTICES

The kind of lightweight innovation that we see today in Web applications signals a number of important shifts that not only go well beyond recent experiments in open innovation but may also lead to an accelerated disruption across many sectors. Lightweight innovation fundamentally changes the landscape of activities that have been called R&D for the past half-century.

MORE THAN OPEN

Over the last five years, large organizations embraced new thinking about how to open up R&D. “Open innovation” strategies, which sought to broaden the pool of ideas by tapping external sources, have produced remarkable successes. Open innovation, however, still reflects a traditional emphasis in big organizations on large bets and big breakthroughs. In the end, open innovation that seeks the source of the big breakthroughs from inside the company’s R&D organization to outside it.

Over the next decade the lightweight model of innovation currently emerging on the Web will force large organizations in all sectors to evolve open innovation models that are more agile, lean and user-driven. Rather than picking a handful of big projects to fund from an idea network of internal and external experts, they will need to build capacity for high-velocity, incremental, and parallel innovation over long periods of time. It won’t be enough to merely source innovations outside the laboratory walls—those ideas need to be developed through prototyping, engagement with end-users, and lean financing structures.

This evolution from open innovation to lightweight innovation will lead traditional R&D managers into new territory. Focus on several key shifts:

- **From Open Ideation to Open Prototyping—**
Companies are getting good at sourcing product and service ideas from outside laboratory walls, but the next step will involve sourcing working models as well as accompanying business and manufacturing process innovations.
- **From Locking in IP Value to Unlocking IP Value—**
Traditional R&D, even in open innovation frameworks, seeks to protect IP aggressively. Lightweight innovation seeks to find value in unlocking IP.
- **From Top-down to Bottom-up Priorities—**
More often than not, research priorities, budgets and assignments are handled from the top down. Lightweight innovation shifts a good deal of that organizing and planning to the bottom.
- **From Big Budgets to Lean Financing Structures—**
In many large organizations, it’s hard to spend small amounts of money and be taken seriously. But making small investments quickly is the next big challenge. As veteran venture capitalist Alan Patricof recently commented, “Our biggest challenge today is to think smaller for venture capital.”¹

The differences don’t end there. These are simply a few of the key incongruities that will need to be delicately managed.

3

THE CHARACTERISTICS OF LIGHTWEIGHT INNOVATION

WHAT IT LOOKS LIKE AND HOW TO RECOGNIZE IT

In 2006, the IFTF report *Innovation in the Urban Wilderness: Lightweight Infrastructure meets Cooperative Strategy* (SR-1050) introduced a set of characteristics common in the design of emerging technical systems.⁶ While we are more concerned with organizations and processes of innovation than the physical objects and networks of infrastructure, the characteristics of lightweight infrastructure are useful in recognizing lightweight innovation. Think of the characteristics as lenses that focus our attention on the assumptions that will shape the future of innovation. Today we see these characteristics most clearly in technology and business innovations on the Web, over the next decade these characteristics will inspire innovation in many other sectors.

CHARACTERISTIC	DESCRIPTION	EXAMPLES
AD HOC RESPONSE TO IMMEDIATE NEEDS	Lightweight innovation often arises from the need to solve unexpected problems rapidly, often in crisis. This allows for early engagement with end-users and extended “beta” periods of testing, evaluation, and refinement.	Disaster information sharing systems (Sahana, Ushahidi)
NEW SCALE-ALTERING TOOLS AND MATERIALS	Lightweight innovation leverages new technologies that reduce the scale at which functions become economical or mobilize functions that used to be fixed. This allows new ideas to be rapidly prototyped, reducing risk from proof-of-concept experiments and allowing early focus on business model development.	Agile Web development (Ruby on Rails, Django)
NETWORK SCALABILITY OF ALL COMPONENT ACTIVITIES	Traditional R&D groups scale by growing bigger; lightweight innovation systems scale by engaging resources in a network. More than open innovation, lightweight processes distribute most or all of the work of innovation.	API ecosystems (Twitter)
MODULARITY AND MASHUPS	The Web is rapidly evolving into a set of software modules that can be quickly and easily interconnected. This era of what economist Hal Varian calls “combinatorial innovation” allows for constant evolution of mashups that combine the capabilities of many different pieces of intellectual property — both code and content.	Real-time notification protocols (Pubsubhubbub)
OPEN STANDARDS	Open innovation traditionally focuses on the idea sourcing part of innovation for large organizations. In lightweight innovation models, standards help spread openness throughout the entire R&D process, improving transparency.	Open mobile ecosystems (Android, iPhone)
MULTIPLE ACTORS	Traditional R&D is managed through hierarchical management structures. Lightweight innovation systems rely more heavily on peer-to-peer models that emphasize cooperation over coercion.	Open-source software (Linux, Apache)

THE DRIVERS OF LIGHTWEIGHT INNOVATION

NEW DISRUPTIVE TECHNOLOGIES

4

The shift to lightweight innovation will be fuelled by technologies that rewrite the pace, scale and choreography of research and development. These seven areas of technology will have the greatest impact on large research organizations over the next decade.

TECHNOLOGY AREA	DESCRIPTION	SIGNALS
CLOUD COMPUTING	Cloud computing allows lightweight innovation groups to outsource non-core support functions and rapidly scale infrastructure for successful experiments. Beyond the Web industry, it will render on-demand supercomputer-based modeling and simulation more accessible—this will make it possible to rapidly iterate simulated product and service designs in silico.	Amazon EC2, Eucalyptus
AGILE WEB FRAMEWORKS	New frameworks for quickly building data-rich Web applications support “agile” development models that dispense with traditional product planning protocols. From a core idea, quickly developed prototypes can be tested on a daily basis, as the underlying code is standardized and modularized—allowing one part of a system to be changed while the overall service remains in operation.	Rails Rumble, Django
OPEN HARDWARE	The models of open-source licensing and collaborative development pioneered in software over the last decade will increasingly be applied to hardware. The free exchange of schematics, bills of materials, and logic designs will accelerate and expand innovation in hardware design, manufacturing, and application.	Accenture partnership with Bug Labs⁷, Chumby, programmable logic arrays/system-on-a-chip
COMBINATORIAL MANUFACTURING	A host of technologies for programming matter will drive a broad shift from manufacturing to growing objects, one layer or molecule at a time. Much as low-cost laser printing jumpstarted the desktop publishing revolution, these technologies will “unleash a wave of small-scale manufacturing innovation.” ⁸	Micro-manufacturing, 3-d printing
SOCIAL IDEA AND INNOVATION MANAGEMENT	Open innovation strategies embrace the sourcing of ideas from outside traditional R&D organizations. However, collaborative platforms will allow management of the entire innovation process as a distributed network—from idea to evaluation to implementation.	BrightIdea.com, InnoCentive@Work
UBIQUITOUS SENSING	Every sensory data stream is a potential site for lightweight innovation. As the kinds and number of sensors proliferate in places, on people and even inside us, the lightweight model of rapid, user-engaged prototyping of niche applications will allow us to discover novel uses. Mining these data sets on a large scale will revolutionize our understanding of human behavior.	Pachube
DESKTOP BIOTECHNOLOGY	For the most part, the pharmaceutical industry has been a countercurrent to lightweight innovation—R&D is becoming more capital-intensive, lengthy, and centralized. But the falling cost and complexity of biotechnology tools and “source code” have the potential to unlock roadblocks in life sciences, by empowering a wave of “garage biotech” innovation akin to the shift in the computer industry that followed the introduction of personal computers.	Macromolecule microarrays, DIYbio.org, BioBricks



5 LIGHTWEIGHT INNOVATION

GUIDELINES FOR REINVENTION

Lightweight innovation processes are emerging in the Web industry, driven by new ideas about how to organize innovation and technologies that reduce the cost and complexity of incremental innovation. But how can we unlock the potential of lightweight models in other industries? This section highlights a few generalized tools that are likely to deliver specific capabilities to organizations that seek to experiment with lightweight models. The tools are organized into four broad domains: knowledge, people, money, and places.

KNOWLEDGE > INVERT THE INCUBATOR

Traditional incubators support start-up companies by providing office space and basic business services. For everything else, incubator tenants must go to the market—talent, Web hosting, and software components, for example. In an effort to address these issues, a new incubator model is emerging. Instead of providing commodity resources such as office space that can be easily obtained on the market (or bootstrapped), “inverted” incubators like Betaworks in New York City focus on mentoring and sharing of mission-critical infrastructure and intellectual property across a portfolio of incubated, acquired, and funded projects and companies.

What Does It Mean? Inverted incubators seek to accelerate innovation by constantly developing a common platform of intellectual property that builds value on top of open data, knowledge commons, and other shared resources. This shortens the time needed to develop new products and services that leverage this pool of incremental innovations.

How to Get Started: Create a fund for developing small ideas around big data sets or other commons. Target projects at the sub-\$100,000 level, require 1 or 2 people to develop over a maximum of 3–4 months. Provide basic infrastructure common to all, but leave the entrepreneurs to secure only what they need from vendors. Pursue 5–6 parallel projects that have the potential for synergistic cross-fertilization.

PEOPLE > RE-ENGINEER INNOVATION NETWORKS

Open innovation strategies have helped many R&D organizations expand the range of partners they engage in creating and developing new ideas. Lightweight innovation networks push this even further by amplifying the agility, modularity and scalability of such efforts. Crowdsourcing allows organizations to quickly convene ad hoc groups around problems, and will provide new organization structures for moving those ideas from implementation. Platforms like BrightIdea’s Switchboard and Pipeline (<http://www.brightidea.com>) not only provide a place for people within a firm’s innovation network to submit ideas, but tools for managers to filter and sort a potentially overwhelming stream of possibilities, and then assign them for followup and exploration to partners in production networks.

What Does It Mean? In their book, *The Only Sustainable Edge*, Hegel and Brown described the “vibrant local business ecosystem focused on incremental innovation in motorcycle design and manufacturing” in Chongqing, China. The cluster’s success derived from large networks of agile small-scale manufacturers working in close cooperation and competition. The use of social idea and innovation management platforms could replicate some of the advantages of these clusters, tapping many suppliers of incremental innovations. Idea management might allow firms to keep some aspects of R&D integration centralized, while decentralizing others.

How to Get Started: Deploy an idea management platform to crowdsource a couple of the most vexing and complex research problems you face. Try to break the problem up into smaller pieces and get the questions out to as big an audience as possible, especially outside the organization. As ideas emerge, aggressively filter and select candidates for micro-grants: short, small R&D efforts that engage end-users at the earliest feasible stage.

MONEY > FROM MOON ROCKETS TO CUBESATS

Many big companies still focus their long-term R&D strategy around Apollo-scale “moon rocket” projects, even while the economics of their business are rapidly changing. In areas where costs are rapidly falling—which increasingly encompasses large swaths of both manufacturing and services—shifting to a lightweight innovation strategy should involve re-focusing on smaller-scale, platform-focused incremental and combinatorial innovation. Instead of moon rockets, organizations should be building figurative “cubesats”: small, cheap, expendable satellites based on open-reference platforms that can be rapidly designed, manufactured, and deployed.

What Does It Mean? The lasting impact of the recession of 2009 will be an extended period of austerity for large organizations. We’ll see a lingering desire for rapid ROI, and faster and less capital-intensive R&D. Open innovation won’t keep the pipeline full as venture investment is at an historic low. In software and biotechnology, long-term structural shifts are underway and will likely reduce the flow of funds to startups over the next decade.

How to Get Started: Cubesat-scale projects should focus on areas where costs are rapidly falling. Take a basic product or service that the organization can produce cost-effectively, and pare it back to as basic as possible; then publish as much information about it as you can. Use an innovation prize to encourage people to hack it, repurpose it, and redefine it. Bring the best ideas to market, no matter how small the potential. “Cubesat” projects should not only be smaller in scale and shorter in duration, but should break-even quickly. They need not be multi-billion dollar businesses in the beginning. The goal is to develop a new pipeline, where R&D is driven from the bottom up, not the top down.

PLACES > POP-UP LABS

Traditional office workplaces are starting to break down, driven by the demand of today’s knowledge work force for mobility and flexibility. As this broader trend filters down into laboratories and other spaces for R&D, we will see the need for more open, shared workplaces where people can come together around interests and problems. While the Internet has allowed teams to collaborate at great distances, from locations of their choosing, it has also created a desire for spaces that can provide the inter-personal face-to-face social aspects of work. “Pop-up labs” are where the rubber meets the road for open innovation strategies. As Andrew Witty, CEO of GlaxoSmithKline, remarked at a major science parks conference, his partnerships with biotechnology companies were forcing him to quite literally “tear down the walls” of his laboratories in order to co-locate them with his own scientists.

What Does It Mean? “Science motels” will serve as project and community-specific hubs, where rapid sharing and creation of tacit knowledge will leverage face-to-face interactions. Some of these will be just pop-up labs, temporary facilities created to meet the needs of a lightweight innovation network. Some may fill the gaps in-between bigger “heavy” R&D facilities, such as Singapore’s Phase Z.Ro Technopreneur Park. Built out of old shipping containers, Phase Z.Ro occupied fallow land prior to the construction of the second phase of the much larger Biopolis science park.

How to Get Started: Transform a part of your organization’s workplace into pop-up lab space focused on a broad area of interest relevant to your business—open source, DIY manufacturing, or sustainable design, for instance. Draw inspiration by visiting a community “coworking” space in your area.⁹ Invite thought leaders from outside your organization to do their own work there on a daily basis, and encourage your own innovation teams to engage them informally and on real projects. Make the effort highly visible—put it in your lobby or central atrium, not the vacant office space left behind by some earlier failed venture.

Dos and Don'ts for Putting Lightweight Innovation into Practice

DO

Make Many Very Small, Very Early Investments.

Companies traditionally shy away from very early stage seed funding due to poor economies of scale. But that's where all the action is today—waiting for good ideas to rise up the food chain won't cut it in the future. Run dozens of lightweight experiments simultaneously. The challenge will be resisting the urge for constant oversight, which will drive up transaction costs.

Build Off Open Knowledge Commons. Some of the lowest-hanging fruit in lightweight innovation are ideas that build on top of open-source knowledge commons. Today, for example, thousands of applications are now being built that leverage public government data sets. What knowledge commons are available to you and how do they enhance the value of your own proprietary data and knowledge?

Set Up Parallel Pipelines. For nearly every problem, there is both a lightweight and a heavy approach. If you're already invested in heavy approaches, create a parallel lightweight innovation process to challenge and complement it. Build in mechanisms to transfer new ideas and insights between the efforts, but don't couple them too tightly or they'll lose their independence.

Build Places for Prototyping. The physical organization of research and innovation workspaces should reflect your innovation strategy. As you embrace lightweight models, think about how to provide "shop" space where

teams can form quickly around projects and draw upon "spare parts" readily at hand. Provide opportunities for innovators to move between traditional laboratories and more open, collaborative, and short-term focused project spaces. Where lightweight and open innovation strategies overlap, make every effort to remove physical barriers between organizations, departments, and teams.

Balance Design and Data. Lightweight innovation on the Web produces tremendous amounts of data about how end-users engage new products and services. While good design can be a source of game-changing breakthroughs, don't ignore the data. This is especially critical in lightweight innovation, when your lead users may be pointing you towards something that doesn't show up in broader user behavior, and there may not be enough time to really develop breakthrough designs. But keep a balance—evolving new products and services is a socio-technical process, not a math problem to be solved.¹⁰

Launch Early and Extend Beta Periods. Lightweight innovation allows you to quickly get new products and services into the hands of end-users. By launching early, and expanding participation in stages, you can learn what works and what doesn't, and discover how your offerings are used in conjunction with other products and services. The resulting journey often leads you to unanticipated markets and applications—the photo-sharing site Flickr began its life as a game. Summize, which became Twitter's search engine, was originally created as a ratings and reviews aggregation engine. Don't be afraid of early glitches or incomplete products—in today's market

DON'T

Ignore Your People. Open innovation was all about looking outside the organization for ideas. But lightweight approaches can take simple ideas from inside and quickly test the concepts. Couple idea-management platforms with rapid prototyping capacity to leverage existing knowledge and human capital. Give the idea creators time to work on side projects—at Google, employees use up to one day a week of their time to work on self-designed projects.

Focus Exclusively on Big R&D Breakthroughs.

Large organizations tend to focus on innovations that will succeed at a large scale. But this focus on silver bullets undervalues "rapid, incremental innovations, which actually begin to look like breakthroughs over time."¹²

Ignore Large-Scale Commons Efforts. While lightweight R&D might focus on the very small, don't forget to make investments on very large-scale collaborative efforts outside the organization. Lightweight innovations on the Web almost always leverage large-scale commons of data, knowledge, and code. Engaging end-users and "makers" is often a shortcut for any industry to identify potential commons-based approaches to innovation.



ENDNOTES

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11. See, for instance, a discussion of the early launch of Pure Digital's Flip Ultra video camera, acquired by Cisco in 2009 for \$560 million: [http://www.wired.com/gadgets/miscellaneous/magazine/17-09/ff_goodenough]
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