Int Health 2017; **9**: 145–147
doi:10.1093/inthealth/ihx009

COMMENTARY

Enablers of innovation in digital public health surveillance: lessons from Flutracking

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Received 11 December 2016; revised 16 February 2017; editorial decision 20 February 2017; accepted 13 April 2017

Opportunities for digital innovation in public health surveillance have never been greater. Social media data streams, Open Data initiatives, mHealth geotagged data, and the 'internet of things' are ripe for development. To embrace these opportunities we need to provide public health professionals with environments that support experimentation with new technology. Innovative practitioners will lead discovery, adaption, trialling and deployment of new technological solutions mostly developed outside their organisation. To enhance innovation agencies will need to learn from 'startup culture' and the practices of large organisations that ring fence innovative teams to protect them and allow them to 'break rules', 'fail fast', and innovate.

Keywords: Epidemiology, Innovation, Public health, Surveillance

This commentary is based upon the experience and networks created by developing Flutracking.net for online influenza-like illness surveillance and Vaxtracker.net for vaccine adverse event monitoring.[1,2] The insights gained apply equally to local, regional and national public health agencies. Government agencies have a unique legislated role in public health surveillance and response and cannot delegate innovation to private entities.

Flutracking.net is one of the largest online influenza-like illness surveillance system in the world with over 26 000 survey responses each week during winter in Australia. The development of this program dating from 2005, while valiantly supported by management, was not without difficulties. For a typical public health unit we needed access to extremely non-standard technology, such as non-government domain names on government servers, hiring external developers, renting external server spaces (after we overloaded the shared server performing payroll functions), Facebook advertising, debugging software, to name a few examples. Purchasing software or subscriptions to online services via credit cards that were not approved providers were not the least of our challenges.

As Flutracking grew so did our network and we learned from the Google Flu Trends team in New York City (at a review of Google Flu Trends in 2010 'Floogle 2010') and partnered in a series of three International Workshops on Participatory Surveillance (IWOPS) (A. Crawley, J. Olsen, T. Jayaraman, M. Libel, M. Smolinski, manuscript submitted) and an EpiHack supported by the Skoll Global Threats Fund.[3] We learned about user experience testing, agile development and rapid iteration from the Google Flu Trends engineers. IWOPS and EpiHack provided insights into a myriad of rapidly deployed digital surveillance experiments. While some of the largest public health institutions in the world participated in the IWOPS events, it became evident that small private tech start-ups or small agile teams in larger organisations were best poised to exploit digital participatory surveillance, mHealth (mobile phone supported health technology), internet of things (internet connected sensors or data loggers), and social media surveillance streams that are already forging new frontiers in surveillance.[4–7] It was clear that traditional government IT departments face challenges in innovation due to limited flexibility in programming language platforms and server environments, and their necessary focus on enterprise applications, networks, security and backups.

New applications (not necessarily surveillance related in their initial intent) are being built daily by developers all around the world. Apps designed for data visualisation, collaborative team work, mapping, intelligence dashboards, and social media analytics developed for marketing or web companies might equally support public health surveillance. Our challenge is to focus on discovery of these new applications, rapidly test them for relevance to surveillance activities, and adapt and deploy them. A tech-savvy practitioner trawling resources on new and emerging

technology, such as the *Journal of Medical Internet Research* or Product Hunt (www.producthunt.com), could discover and experiment with five to ten new applications per week.[8] Just three such practitioners could tie up a small IT department in evaluating and approving these applications. Additional challenges are the natural scepticism associated with introducing multiple new tools into an agency environment creating increased support, procurement and security burdens.

There is much to learn from the lean startup culture of Silicon Valley, such as rapid prototyping to build a 'minimal viable product' to validate with users, running small experiments and forgiving 'failure' when the experiments fail.[9] But perhaps the most important challenge is how to stimulate and support innovation in large public health agencies where so much surveillance expertise resides. We managed to negotiate a supportive environment for Flutracking.net and Vaxtracker.net through luck and persistence but it would have been easier if we had known there were proven models of innovation from industry that explained the organisational journey and structures required.

The example of the Lockheed Skunkworks and the Three Horizons of Growth model provide insights that could have accelerated our innovation journey.[10] The Three Horizons of Growth innovation framework describes three timelines (horizons) that need to be planned for to allow an organisation to continue to create value or grow by adapting to and planning for change.[11] Initiatives should be driven in all three horizons concurrently. Horizon One is the focus on core business functions—from a public health surveillance perspective this includes core functions such as maintaining a safe secure network and supporting routine disease surveillance databases with appropriate backups (Figure 1). Horizon Two comprises one or a small number of surveillance activities which are demonstrating increasing growth and/or public health value. Horizon Two may arise from new methods that build on Horizon One and provide support for Horizon Three—these could include upskilling the technical expertise of surveillance officers, building new analytical data visualisation and mapping platforms, and moving the experiments from Horizon Three into routine surveillance. Horizon Two may also include important new surveillance activities, such as those for newly emergent but established, diseases. Horizon Three is a horizon that supports surveillance for novel diseases and syndromes, and new methods for conducting surveillance that involve experimentation and may be at high risk of failure. Successful projects in Horizon Three then move back into Horizon Two and eventually may become the core Horizon One activities of the evolved organisation. Innovative practices and innovative teams will usually be working in Horizon Two and particularly Horizon Three but the skills, personalities and perspectives required at these horizons may be quite different to those at Horizon One. The challenge for agencies is to maintain the discipline required in the core Horizon One activities while driving scale-up of a small handful of initiatives in Horizon Two and supporting a portfolio of options for the future in Horizon Three. The difficulty is designing an organisation capable of all three at the same time.

The flexibility and tolerance of failure in a Skunkworks or Horizon Three project team allows rapid trial and error experiments so that the time from initiation to evaluation of impact is shortened. Management must explain the relevance of the activities and teams working on Horizon Two and Three to those

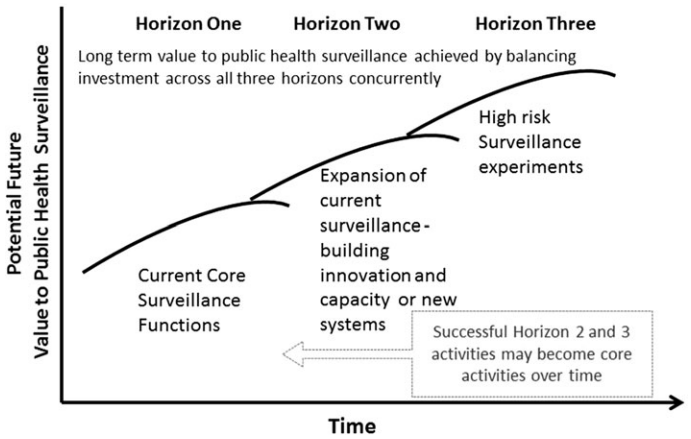

Figure 1. The Three Horizons of Growth adapted in public health surveillance (adapted from The Alchemy of Growth: Practical Insights for Building the Enduring Enterprise).[11]

with their head down maintaining the organisations core functions, who may see these experiments as a waste of resources, a distraction, or a threat to security or reputation (which they may be!). Flutracking.net began as a typical Horizon Three experiment—we had no idea whether anyone would sign up to participate and whether any useful signals would be detected. We were surprised when 400 people participated in the first year in 2006. We and others were concerned that we had 'missed the pandemic' in 2009 but this resolved when Flutracking contributed to the insight that the 2009 influenza pandemic was indeed 'mild in most but severe in some'.[12,13] Flutracking moved into Horizon Two as it became a more routine and understood method of surveillance. However, the programmatic challenges that arise from developing a proof-of-concept for new surveillance systems and the challenges to evaluating novel approaches in order to validate a nascent system should not be underestimated.

In 1943, Lockheed Martin wished to fast track the development of jet engines for fighter aircraft but recognised it would be difficult to make rapid innovative progress in their large multi-layered, multi-division organisation. They created a small team that became known as the 'Skunkworks' to work on the project.[10] The Skunkworks had streamlined approval processes to experiment and permission to fail fast and learn from mistakes. They had unprecedented autonomy and flexible engagement of external experts to fill knowledge gaps.

To support exploitation of digital public health surveillance both organisational cultural and technological interventions will be required (Box 1).

The US Health and Human Services Idea Lab is an example of a large public health agency attempting to support internal innovation and support 'disruptive ideas and actions' through idea accelerator programmes, and entrepreneur and innovators-in-residence programmes.[14] Staff time is the main cost of experimenting with innovation as the cost of most technology is relatively minor and continues to decrease.

I reflect that when I began my work in public health surveillance in 1992, I had access to the best technology available in the world in my workplace. For many of us working in government

Box 1. Cultural and technological enablers of digital public health surveillance

Cultural enablers

- Task IT with devising safe and secure spaces to enable innovation—management and legislation should set the appetite for risk.
- Expect and forgive failure as part of promoting innovation.
- Allow experiments with 'minimal viable products', test, learn, iterate, retest.
- Ring fence and protect innovation teams.
- Make it easy for external developers to work with your team.
- Consider hiring engineers into your public health team—they look at data differently, are tech friendly, practical and complement traditional public health statistics teams.

Technological enablers

- Provide dedicated laptops that are safe spaces for innovation, where users are granted full access to install and trial new software.
- Virtual workstations or 'off the grid' laptops can have full and direct access to the internet, bypassing and isolated from sensitive internal networks that may hold confidential data.
- Payment processing that will allow staff to use credit card facilities to manage online infrastructure and applications; e.g., being able to register domain names, rent servers, buy secure server certificates to encrypt data, and pay subscriptions for the many online applications that only allow purchase via credit card.

agencies and even universities, the best technology in terms of flexibility and range of applications available is now found in our home or on our laptop or smartphone. We need to return to the progressiveness of government and universities in the early days of the internet and liberate public health practitioners to innovate. Public health needs digital surveillance 'skunkworks' across large and small agencies and countries at all level of development.

Author's contributions: CD has undertaken all the duties of authorship and is guarantor of the paper.

Acknowledgements: I would like to thank Dr David Durrheim for providing feedback on the initial draft of the paper and Mr David White, one of the authors responsible for developing the Three Horizons of Growth Framework for reviewing that section of the manuscript.

Funding: Flutracking.net is funded by the Commonwealth Department of Health and Ageing, Australia.

Competing interests: None declared.

Ethical approval: Not required.

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