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BOLD IDEAS FOR HUMANITY.™

Integrated Innovation™

September 2010

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Executive Summary

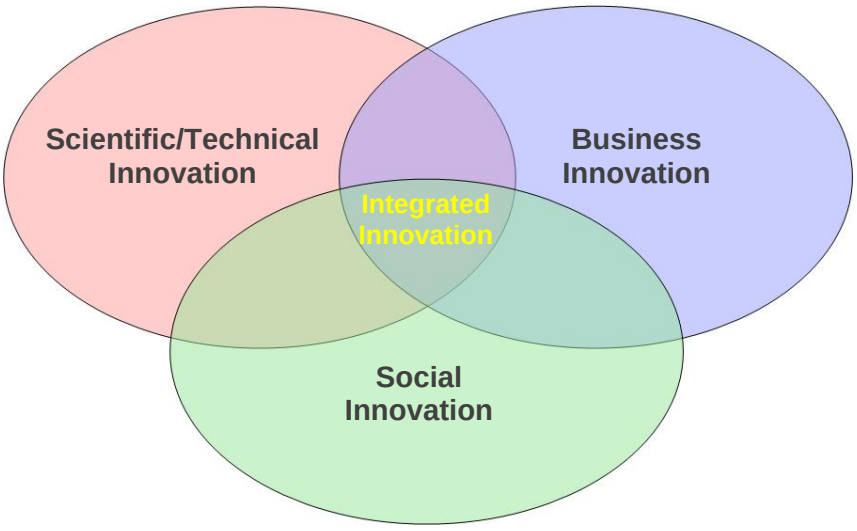
One of the most pressing questions facing *Grand Challenges Canada/Grand Défis Canada* (GCC) and the science–for-development community more broadly are the respective roles that scientific/technological, social, and business innovation can play in delivering improved global health outcomes. This paper argues that scientific and/or technological innovations have a greater chance of going to scale and achieving global impact if they are developed from the outset with appropriate social and business innovations—an approach that we call **integrated innovation™**.

Too often, public efforts to support innovation, particularly in the context of development, are hampered by a high level of risk aversion. We would argue that the best strategy to overcome this risk aversion and to minimize the risk associated with scientific and technological breakthroughs is to focus on supporting top researchers to search for breakthrough scientific/ technological innovations simultaneously with the development of appropriate social and business innovation. This integrated innovation strategy provides the greatest chance for delivery of substantial global health impacts.

WHAT IS INTEGRATED INNOVATION™?

Integrated innovation™ is the coordinated application of scientific/technological, social and business innovation to develop solutions to complex challenges. This approach does not discount the singular benefits of each of these types of innovation alone, but rather highlights the powerful synergies that can be realized by aligning all three to address a single challenge.

By its nature, **integrated innovation ™** is context-specific. Scientists working in the areas that are impacted by a challenge have a deep understanding of how that challenge manifests in their local environment. Because of this embedded knowledge, local scientists who are working on breakthrough science and technology will also have a deeper understanding of the social and business innovations that will be necessary for that technology to be implemented in their communities. The relationship between scientific/technological, social and business innovation and the concept of integrated innovation can be illustrated as follows:



A key consideration in developing a solution to a complex global challenge is to determine whether an existing product can be used, or modified, to provide a solution to the challenge. The process of developing new and/or modifying existing products and services is known as **scientific/technological innovation**.

Social innovation (in the context of **integrated innovation™**) can be thought of as research and development into the ways to bring innovation to scale in specific local and regional contexts. Social innovations can include the creation and implementation of new approaches in the context of health systems, the determinants of health, ethical/social/cultural/legal frameworks, public policy, leadership, human resources and other key components of society that influence health outcomes.

Beyond simply bringing an innovation to scale, social innovations should be both resilient and durable. The resilience of an innovation is its ability to adapt and flourish in changing environmental conditions.

The durability of an innovation can be thought of as its ability to persist over time and is often dependent on the financial sustainability of its implementation strategy. As such, the long-term success of an **integrated innovation™** approach will depend on its ability to engage for-profit companies and not-for-profit organizations in a manner that aligns their ongoing success with the success of the proposed solutions. This aligning of financial incentives with social outcomes has been called **social finance**.

Business innovation focuses on the delivery of appropriate, high quality goods and services where and when they are needed at an affordable price point.

An Example: Point of Care Diagnostics

Point-of-care (POC) diagnostics provides an interesting case study of the potential importance and impact of the **integrated innovation™** approach. Serious scientific breakthroughs will be required to make POC diagnostics a reality. The key engineering challenge in relation to the development of a POC diagnostics platform is highlighted in the POC diagnostics request-for-proposals from the Bill & Melinda Gates Foundation, on which *Grand Challenges Canada/Grand Défis Canada* has partnered[1]:

> *The challenge for these POC diagnostic platforms for global health is to define and achieve the needed performance characteristics of rapid, accurate assessment of individuals' health status, including robust, simple-to-use technologies for achieving parallel, multi-pathogen, reliable and valid clinical measures in developing world settings …*

The key social innovation in rural settings to support POC diagnostic tools, therefore, will be to enable the shift from the current lab-based diagnostic paradigm to a paradigm that focuses on onsite, real-time diagnosis. Business innovation will also be important determinant of the success of the POC diagnostics platform. At the most basic level, diagnostic tools are products that will be produced and distributed by the private sector. There will be an important role for business innovation to help drive down the cost of producing and distributing POC diagnostic devices.

[1] http://www.grandchallenges.org/diagnostics/Documents/Rules_and_Guidelines_LOI.pdf

Integrated Innovation™ and *Grand Challenges Canada/Grand Défis Canada*

We believe that a clear focus on integrated innovation solutions that balance business; social and scientific/technological innovation should significantly increase the potential for the discovery and delivery of breakthrough health products and services to generate positive health outcomes. This approach will be embedded in and have a deep appreciation for the context of southern innovation – engaging leading southern researchers who work in close proximity to the challenges that are to be addressed.

It is our intention that **integrated innovation™** will be one of the unique contributions of *Grand Challenges Canada/Grand Défis Canada*. At the same time, however, we fully realize that our application of the **integrated innovation™** approach is itself an innovation. As such, it will require diligence and commitment to rapid prototyping, going to scale and evaluation. This commitment will enable *Grand Challenges Canada/Grand Défis Canada* to learn and refine our approach to integrated innovation over time.

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1. Introduction

One of the most pressing questions facing *Grand Challenges Canada/Grand Défis Canada* (GCC) and the science–for-development community more broadly are the respective roles that scientific/technological, social, and business innovation can play in delivering improved global health outcomes. This paper argues that scientific and/or technological innovations have a greater chance of going to scale and achieving global impact if they are developed from the outset with appropriate social and business innovations—an approach that we call **integrated innovation™**.

A recent example of a successful integrated innovation approach to address a significant global health challenge in lower- and middle-income countries is the development of CAPRISA 004, a tenofovirbased microbicide gel that reduces the incidence of new HIV infection by 40% in women. This innovation is the first preventive technology that can be applied by women that has been proven to reduce the incidence of new HIV infections.

What is interesting about this innovation (other than its obvious health benefits) is that it combines significant technological (the development of a new microbicide gel), social (the empowerment of women to take unilateral action to reduce the incidence of HIV infection) and business (an innovative private sector/Not-for-Profit partnership to produce and deliver the gel) innovation to deliver significant real-world health benefits. As the technology is deployed there will be opportunities for additional social and business innovation to educate women about the use and application of the technology and to develop a business model that allows for its widespread and cost effective distribution.

The term innovation is a bit of a paradox: it is now so commonly used that it is practically ubiquitous and yet it defies simple categorization or definition. At a fundamental level, however, innovation is about taking ideas or knowledge and converting them into something useful. Peter Drucker, the management guru, described innovation as "*change that creates a new dimension of performance*."

It is often unclear—particularly in a complex field like global health—which innovations will have the greatest impact. Successful innovation to address complex challenges requires experimentation and thoughtful risk-taking in order to enable the development of a broad portfolio of potential approaches from which one or two successful solutions might emerge. To this end, effective strategies to address complex challenges should:

- Enable the rapid prototyping of new innovations,
- Support rigorous evaluation that allows for the rapid termination of those
- innovations that fail to deliver on their promise of significant benefits, and
- Provide mechanisms to bring those innovations that succeed to scale.

Breakthrough scientific/technological innovations—those that truly have global impact — are high risk. They are also critical to realizing significant improvements in global health. Too often, public efforts to support innovation, particularly in the context of development, are hampered by a high level of risk aversion. We would argue that the best strategy to overcome this risk aversion and to minimize the risk associated with scientific and technological breakthroughs is to focus on supporting top researchers to search for breakthrough scientific/ technological innovations simultaneously with the development of appropriate social and business innovation. This integrated innovation strategy provides the greatest chance for delivery of substantial global health impacts.

It is undoubtedly true that there are significant benefits that can be realized simply by designing new social and/or business innovations to enhance and enable the delivery of existing health technologies. This is because of the so-called *implementation gap*—the gap between the development of effective health solutions and the capacity to implement them. One example of this implementation gap highlighted by the Bill & Melinda Gates Foundation is the gap between the development of technologies to prevent maternal and newborn deaths and the implementation of those technologies in low- and middle-income countries:[2]

> *Unfortunately in poor countries, many tools and treatments are not reaching moms and children when and where they're needed. Millions of newborns die each year, yet up to 70 percent could be saved if they and their families simply had access to inexpensive solutions such as antibiotics, sterile blades to cut umbilical cords, immediate, exclusive breastfeeding and skin-toskin contact to keep babies warm.*

According to this analysis, up to 70% of the causes of maternal and child health problems could be addressed by implementing proven health technologies. It is obviously crucial to bring this 70% to scale. It is equally important, however, to address the 30% of deaths that we don't know much about. Here we need to innovate to save lives and provide new and better (and more affordable) health solutions.

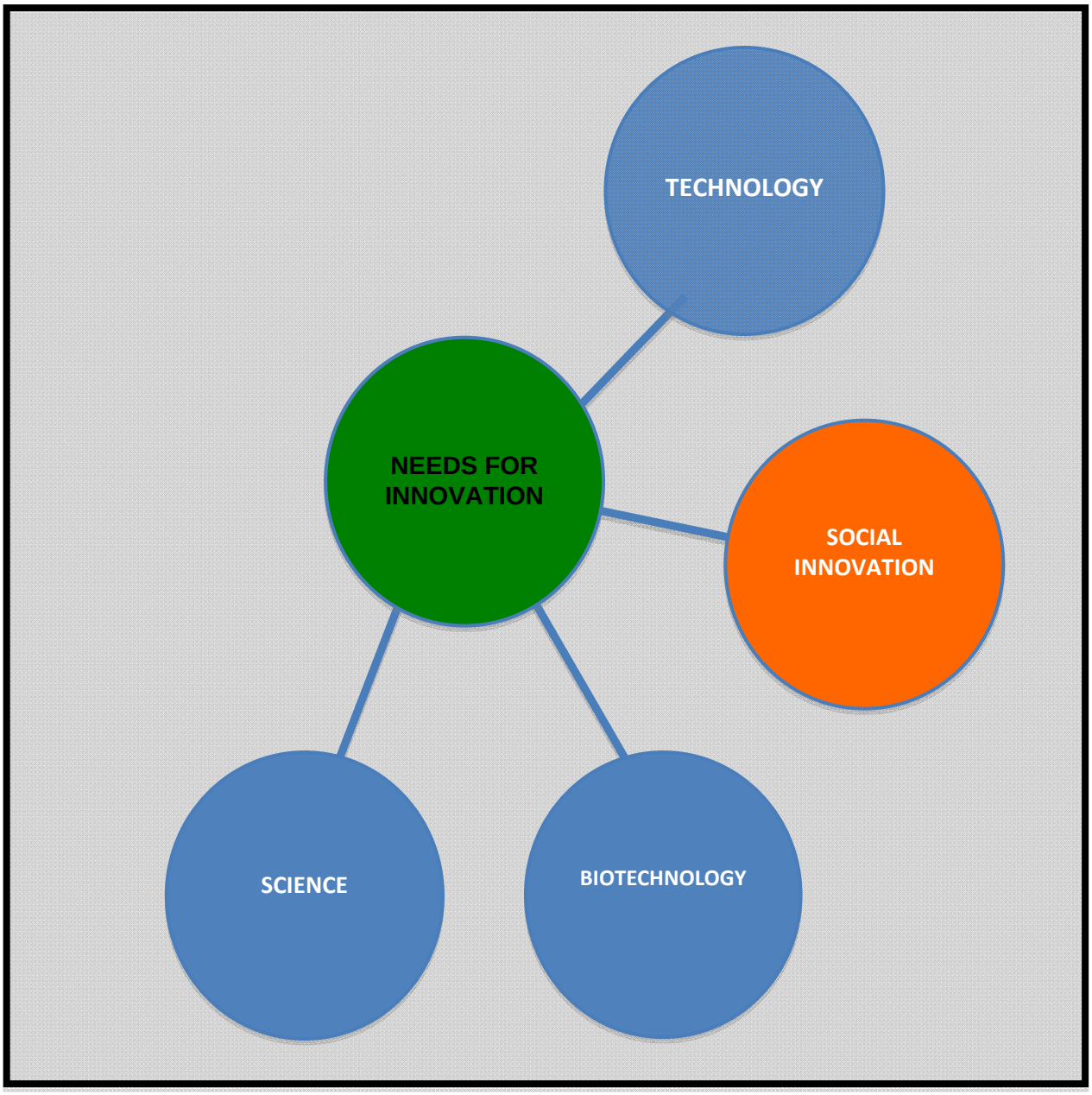
Melinda Gates recently highlighted the importance of both technological and social/cultural innovation in India, emphasizing that both are equally important in driving global health gains. These connections are captured in **Figure 1** (over). The blue circles capture the need for science-based innovation while the orange circle highlights the equally important need for social innovation to address the challenges of low- and middle-income countries.[3]

Our conception of integrated innovation builds on this notion by suggesting that the best strategy for enabling the long-term impact of a breakthrough technological/scientific technology is not to focus separately on scientific and social innovations, but to bring these circles together, along with business innovation, and ensure that they are developed in conjunction with one another.

[2] http://www.thegatesnotes.com/Important-Trips/article.aspx?ID=138
[3] http://www.thegatesnotes.com/Important-Trips/Article.aspx?ID=138

The remainder of this paper will explore this idea further by taking a more detailed look at what we mean by **integrated innovation™** and exploring the potential impact of the integrated innovation approach in a real world example, point-of-care diagnostics. The paper concludes with a discussion of **integrated innovation™** in the context of *Grand Challenges Canada/Grand Défis Canada*.

Figure 1: Balancing Social and Scientific Innovation



2. What is Integrated Innovation™?

Integrated innovation™ is the coordinated application of scientific/technological, social and business innovation to develop solutions to complex challenges. This approach does not discount the singular benefits of each of these types of innovation alone, but rather highlights the powerful synergies that can be realized by aligning all three to address a single challenge.

By its nature, **integrated innovation™** is context-specific. In other words, it takes as a starting point that solutions to challenges must be tailored to the specific context in which they will be applied. Scientists working in the areas that are impacted by a challenge have a deep understanding of how that challenge manifests in their local environment. Because of this embedded knowledge, local scientists who are working on breakthrough science and technology will also have a deeper understanding of the social and business innovations that will be necessary for that technology to be implemented in their communities.

As Roger Martin, Dean of the Rotman School of Management at the University of Toronto, has said, "*the key is to move from a producer-driven perspective to a consumer-driven perspective*." In context of global health, consumers are the individuals and communities who are the potential beneficiaries of new health products and interventions. A successful integrated innovation approach will require the flexibility to move back and forth between the perspectives of producers (scientists and researchers) and consumers (individuals, communities, and health practitioners in Low- and Middle-Income Countries) to support the development of breakthrough technologies while also ensuring that these technologies can be delivered where they are most needed.

In applying an **integrated innovation™** approach to a complex real-world challenge, it is useful to work through three decision points:

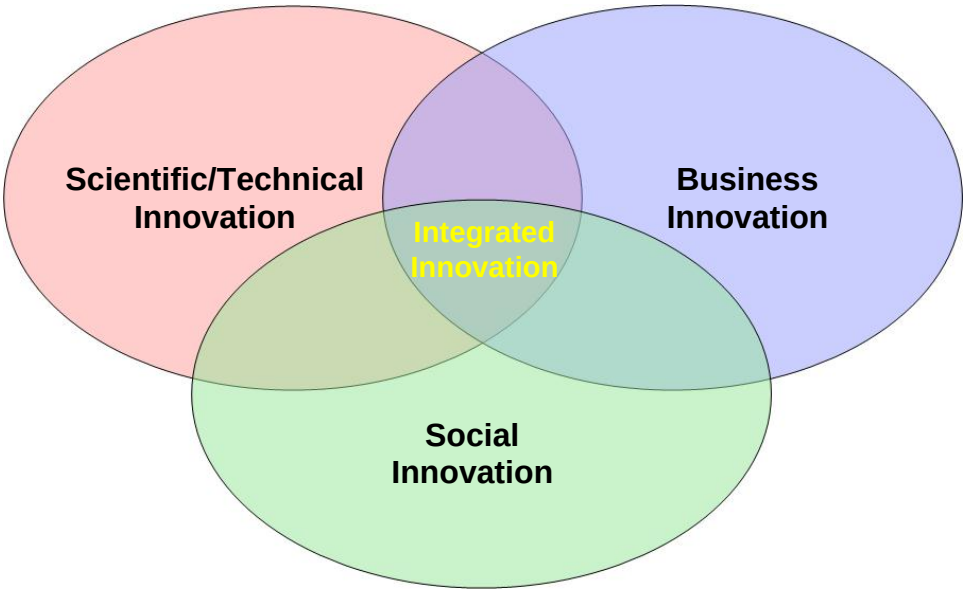
1. *Scientific/technological Innovation* – What products, technologies, processes and know-how might be necessary to address the challenge?

2. *Social Innovation* – Are there social innovations (including health systems, the determinants of health, ethical/social/cultural/legal frameworks, public policies, leadership and human resources among others) that will be necessary to bring the solutions that are developed to scale in local communities in an appropriate manner?

3. *Business Innovation* – Are there appropriate business systems in place to produce and deliver the solution at an affordable price point?

The relationship between these three forms of innovation and the concept of integrated innovation can be depicted as follows: (please see **Figure 2** over)

Figure 2: Situating Integrated Innovation



The remainder of this section takes a closer look at each of these three forms of innovation. It is important to bear in mind that a number of excellent books have been written that explore the subtleties of each. As such, the descriptions that are provided in the following sub-sections are neither exhaustive nor definitive. Instead, they are illustrative of the kinds of innovation that might be combined through an integrated innovation approach to deliver meaningful and impactful results.

2.1 Scientific/Technological Innovation

A key consideration in developing a solution to a complex global challenge is to determine whether an existing product can be used, or modified, to provide a solution to the challenge (e.g., the use of anti-diabetic drugs such as rosiglitazone to combat malaria), or whether an entirely new technology (e.g., a malaria vaccine), must be developed to effect a solution. The process of developing new and/or modifying existing products and services is known as **scientific/technological innovation**. Although some important global challenges can be addressed through the implementation of existing technologies, the solution to many global challenges will depend on breakthrough scientific/technological innovation.

A powerful example of scientific/technological innovation is the Grand Challenges in Global Health program that has been funded by the Bill & Melinda Gates Foundation[4].

[4] Building on the lessons learned from their early investments through the GCGH program, recently the Bill & Melinda Gates Foundation has put a stronger emphasis on implementation science in the projects that they fund and have adopted some new more bottom-up approaches to innovation such as the Grand challenges Exploration program which has also engaged a broader range of low- and middle-income country scientists

2.2 Social Innovation

Even where an effective technological solution exists to address a specific challenge, the local community must have the capacity to take the solution to scale before its potential impact can become a reality. As such, **social innovation** (in the context of **integrated innovation**™) can be thought of as research and development into the ways to bring innovation to scale in specific local and regional contexts. Social innovations can include the creation and implementation of new approaches in the context of health systems, the determinants of health, ethical/social/cultural/legal frameworks, public policy, leadership, human resources and other key components of society that influence health outcomes.

Beyond simply bringing an innovation to scale, social innovations should be both resilient and durable. The resilience of an innovation is its ability to adapt and flourish in changing environmental conditions. This capacity is particularly important in many low- and middle-income countries where a range of external and internal factors (such as famine, drought, political shifts, the creation of new infrastructure, etc) can lead to significant changes in their communities' ability to implement and maintain new innovations of any kind.

The durability of an innovation can be thought of as its ability to persist over time and is often dependent on the financial sustainability of its implementation strategy. As such, the long-term success of an **integrated innovation™** approach will depend on its ability to engage for-profit companies and not-for-profit organizations in a manner that aligns their ongoing success with the success of the proposed solutions. This aligning of financial incentives with social outcomes has been called **social finance**.

Examples of possible social innovations to help bring new health technologies to scale include the training of health care workers to safely deliver the new solution, educational and communication programs to inform populations of a new treatment along with assurances on its safety, and arrangements to ensure that hard-to-reach populations are included in the treatment rollout.

2.3 Business Innovation

Business innovation focuses on the delivery of appropriate, high quality goods and services where and when they are needed at an affordable price point. In practice, there will always be trade-offs between the functionality, usability and affordability of products. Although most innovation in high income countries focuses on the first of these three dimensions, scientific and/or technological innovation can also lead to significant improvements in affordability and usability which can be as important, if not more, as drivers of global health impacts than the creation of new functionality.

Innovation in high income countries often focuses on developing expensive new solutions that provide incremental health improvements for a very limited number of rich consumers. In contrast, innovation in low- and middle-income countries is increasingly focused on "value for many", or innovation that focuses on affordability rather than on the provision of new products and services. A recent article in the MIT Technology Review (India Edition) highlights some examples of breakthrough innovations that have lead to impressive improvements in the affordability of essential health products and services (please see **Figure 3** over)[5]. Although in each of these examples the margins are lower on each unit that is consumed, innovations in affordability vastly increase the size of their potential market.

Increasingly, innovations in affordability that emerge in low- and middle-income countries will be transferred to high income countries where they will begin to displace traditional (and more expensive) health products and services.

Figure 3: Examples of Disruptive Innovations in India in Affordability

Products/ Services	From	To
Psoriasis treatment (New Millennium Indian Technology Leadership Initiative)	$20000	$100
Artificial foot (Jaipur foot)	$12000	$28
Cataract surgery (Aravind Eye Care)	$3000	$30
Laptop (Mobilis)	$2000	$200
Hepatitis B vaccine (Shantha Biotech)	$18	$0.4

[5] Mashelkar, R. A.; Borde, Sushil; "Value for Money and for Many" MIT Technology Review (India Edition) February 2010

3. An Example: Point-of-Care Diagnostics

Point-of-care (POC) diagnostics provides an interesting case study of the potential importance and impact of the **integrated innovation™** approach. It is a good example of a grand challenge that is at the nexus of scientific/technological, social and business innovation.

With respect to science and technology, serious engineering breakthroughs will be required to make POC diagnostics a reality. The key engineering challenge in relation to the development of a POC diagnostics platform is highlighted in the POC diagnostics request-for-proposals from the Bill & Melinda Gates Foundation, on which *Grand Challenges Canada/Grand Défis Canada* has partnered[6]:

> *The challenge for these POC diagnostic platforms for global health is to define and achieve the needed performance characteristics of rapid, accurate assessment of individuals' health status, including robust, simple-to-use technologies for achieving parallel, multi-pathogen, reliable and valid clinical measures in developing world settings …*

The RFP goes on to define a range of specific technical challenges in four topic areas:

1. Sample collection, concentration, and preparation
2. Amplification and detection technologies
3. Readout and signal transduction
4. Enabling technologies for diagnostics

Grand Challenges Canada/Grand Défis Canada added a fifth topic area on implementation science to highlight the potential for social innovation.

The transition to POC diagnostics echoes, in many ways, the transition from landline-based telephone systems to mobile technologies - moving from an infrastructure intensive central model to a lower infrastructure distributed diagnostics platform. As with the transition in telecommunications, the transition in diagnostics will depend both on the scientific/technological innovations themselves and on a range of social and business innovations that will support and enable their implementation.

[6] http://www.grandchallenges.org/diagnostics/Documents/Rules_and_Guidelines_LOI.pdf

Currently, diagnostics in many low- and middle-income countries rely on blood samples that are transferred to traditional medical diagnostic laboratories for testing and evaluation. In urban settings this approach can be both expensive and time consuming while in rural settings it is difficult if not impossible to implement because of a number of constraints including the lack of:

- Trained health professionals in rural settings,
- The necessary health infrastructure to safely and effectively obtain samples, and
- The necessary transportation infrastructure both for the patients to travel to the clinics
- where the diagnostic samples will be obtained and to transfer the samples from the clinics to central laboratories for testing.

As a result, the clinical practice in many rural areas is to provide treatment before obtaining confirmation of diagnosis since patients who have a serious illness may die or suffer serious and/or debilitating injury without treatment before their diagnosis is confirmed.

The key social innovation in rural settings to support POC diagnostic tools, therefore, will be to enable the shift from the current lab-based diagnostic paradigm to a paradigm that focuses on onsite, real-time diagnosis. Once this shift has taken place, it will also be critical to shift the practice of treating patients before confirming their diagnosis. Other opportunities for social innovation in support of POC diagnostic technologies will be to convince the central purchasers of health services (health ministries) to invest in new POC services rather than traditional laboratory infrastructure-based services and to provide training for local service providers to deliver and analyze POC diagnostic tools. Implementation science will play a key role in determining the global health impact of the POC diagnostics platform.

Business innovation will also be important determinant of the success of the POC diagnostics platform. At the most basic level, diagnostic tools are products that will be produced and distributed by the private sector. There will be an important role for business innovation to help drive down the cost of producing and distributing POC diagnostic devices.

At a more sophisticated level, the POC diagnostic platform architecture that is the basis for the Bill & Melinda Gates Foundation Request-For-Proposals is also a form of business innovation. The purpose of this innovation is to catalyze the growth and development of the diagnostics sector through the development of open standards, in the same way that the implementation of open standards drove both the growth of the semiconductor industry and the massive ongoing decrease in the per unit cost of computing power. Learning from the semiconductor sector, proprietary architectures tend to lead to the development of high cost/non-compatible products while architectures that are based on open standards lead to lower cost/highly compatible products and services from a wider range of manufacturers. Ultimately, this increased competition will drive the improved affordability and increased usability of POC diagnostic devices.

The impact of a simple and accurate point-of-care diagnostic platform would be profound. A study by Rafael and colleagues suggests that:

> *A new diagnostic that reaches individuals who self-treat or have no access to care would save lives and drastically reduce overtreatment. A 95% sensitive and 95% specific diagnostic requiring minimal infrastructure would avert >100,000 malaria related deaths and ~400 million unnecessary treatments, whereas a 90% sensitive and 90% specific diagnostic requiring no infrastructure would avert >300,000 malaria-related deaths and ~450 million unnecessary treatments.*[7]

[7] Rafael, M et al. *Reducing the burden of childhood malaria in Africa: the role of improved diagnostics*, Nature, 2006

4. Integrated Innovation™ and *Grand Challenges Canada/Grand Défis Canada*

In this paper we have argued that the most effective strategy to address the complex health challenges facing the developing world will be to take an **integrated innovation™** approach. For *Grand Challenges Canada/Grand Défis Canada* this will mean placing a premium on choosing grand challenges that are at the intersection of scientific/technological, business and social innovation.

We believe that a clear focus on integrated innovation solutions that balance business, social and scientific/technological innovation should significantly increase the potential for the discovery and delivery of breakthrough health products and services to generate positive health outcomes. This approach will be embedded in and have a deep appreciation for the context of southern innovation – engaging leading southern researchers who work in close proximity to the challenges that are to be addressed.

It is our intention that **integrated innovation™** will be one of the unique contributions of *Grand Challenges Canada/Grand Défis Canada*, in much the same way that **Integrative Thinking™** helps to differentiate the *Rotman School of Management* from other business schools. At the same time, however, we fully realize that our application of the **integrated innovation™** approach is itself an innovation. As such, it will require diligence and commitment to rapid prototyping, going to scale and evaluation. This commitment will enable *Grand Challenges Canada/Grand Défis Canada* to learn and refine our approach to integrated innovation over time.

Finally, we understand that the real challenge and opportunity is not what **integrated innovation™** looks like on paper, but rather, what it means in practice. To successfully evaluate the impact of the **integrated innovation™** approach over time, *Grand Challenges Canada/Grand Défis Canada* will need to return over time to two basic questions:

- How is *Grand Challenges Canada/Grand Défis Canada* implementing **integrated innovation™**, and how has this supported outcomes and impacts?
- What lessons can be learned from the application of the **integrated innovation™** approach that could be of use to other groups who are also tackling development innovation?

To this end, it is our intention to capture and share important lessons as they emerge.