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Understanding the Functional Innovation System:
Achieving a Critical Balance
A Model Developed by Research Canada and Shift Health

Preamble

As an evidence-based national alliance of health research stakeholders in universities, research hospitals, industry, government and not-for-profit organizations, Research Canada is dedicated to ensuring that Canadian heath innovation achieves its fullest potential on the global stage. As a broker of consensus among diverse partners, Research Canada is uniquely mandated to take a broad view of health research that considers the totality of the innovation system: one that appreciates the steps required to translate research concepts into health impact. This document, which represents the culmination of an extensive national consultation with our stakeholders, introduces Research Canada's model of the functional innovation system as a basis for understanding how Canada can fully capitalize on its health research investments.

At the most rudimentary level, a functional innovation system must balance the ***push*** forces of knowledge creation with the forces that ***pull*** ideas and technologies toward health application and impact. It is the object of this document to begin defining the underlying principles that enable this balance; to highlight the roles of stakeholders across sectors; and to delineate measurable success factors that operate at each stage of the innovation system. By segmenting the innovation system into tangible components, it is hoped that the model will provide an evidence-based framework for identifying and addressing critical gaps, helping to chart a rational course toward achieving a robust innovation system in Canada.

Integral to the model is the notion that ***G***overnment, ***A***cademia, ***I***ndustry and ***N***ot-for-profit organizations (the "GAIN" spectrum) have pivotal roles to play at all stages of the innovation system:

- ***Government*** includes government funding agencies, research departments and support services at all levels (local, provincial or federal);
- ***Academia*** includes universities, other institutes of higher learning and, critically, academic health sciences centres; indeed, given their position at the intersection of research and patient care, academic health sciences centres are the key enabler of translational research upon which a functional innovation system is predicated;
- ***Industry*** includes multinational and home-grown biopharmaceutical companies, start-ups and support industries critical to the market success of health innovation; and
- ***Not-for-profit organizations*** include charitable foundations, public hospitals and patient advocacy groups.

Each stakeholder brings unique and essential resources to the innovation system, and each therefore benefits from a more efficient engine for innovation.

The model introduces and reinforces two important principles underpinning to the concept of "research":

- Health research does not refer simply to the discovery of genes and molecules that will become commercializable drug targets and therapeutics. Research occurs at all stages of the functional innovation system and across the GAIN spectrum. For example, industry must invest in research that improves manufacturing processes and improves the efficiency with which new products are delivered to the marketplace. Likewise, health systems must invest in the health economics, public policy and health services research that justifies investment in new health technologies and delivery options and leads to improvements in the delivery of healthcare.
- Research is global. The integrity of Canada's national system of innovation must be understood in terms of a flat world in which markets, regulatory environments and industry objectives are unquestionably global.

The model presented in this document advances a view of the innovation system that is closely aligned with the federal S&T strategy: one that underscores a strong commitment from the private sector;

prioritizes efficient commercialization of research investments; emphasizes partnerships and collaboration across the GAIN continuum; and seeks to attract and retain talent in Canada. Moreover, the model provides as an adaptable framework to assess how existing programs align with the future growth of Canada's innovation system.

The objective of this document is to trigger conversation that validates and refines Research Canada's proposed model for enabling a functional innovation system. This document is NOT a policy document and does not presume to present a comprehensive assessment of existing government policies and programs as they pertain to innovation. Rather, our framework for the functional innovation system is intended to stimulate discussion about the role of policymakers in effecting a balanced and responsive innovation investment strategy.

A. Modeling the Functional Innovation System

In health and the life sciences, as in all innovation-based fields, the creation of knowledge and its translation into practical impact is a complex, resource-intensive process. Notwithstanding this complexity, the underpinnings of a ***functional innovation system*** can and must be understood by segmenting health innovation into its component stages and forces. This modeling of the functional innovation system is *possible* because the system reflects a rational and dissectible continuum of socioeconomic relationships; and it is *necessary* because the outcomes of these discernible socioeconomic relationships are critically shaped by public policy.

While the functional innovation system is dependent on market forces, its success in delivering the social and economic dividends of health innovation reflects government commitment to supporting excellence in knowledge creation; to mitigating the investment risk in research and development; to supporting an innovation-focused healthcare system and policy environment; and to ensuring that new technologies and healthcare practices are ultimately made available to Canadians and the world.

In short, public policy establishes the context in which the functional innovation system flourishes or falters; understanding the elements of a system in balance is therefore the precursor to effective policies that are able to achieve the public's innovation objectives.

Effective health solutions are rooted in three intersecting cycles of innovation

A functional innovation system's response to any health issue will be considered in the context of three dimensions (Figure 1). ***Technology innovation*** is often the most visible of these dimensions, dedicated to the creation of new diagnostics, drugs and devices that target disease, improve patient outcomes and reduce the burden of care on the health system. However, advances in public health are predicated on ***delivery innovation***, which is driven by the need for constant improvements in how the healthcare system is organized, how health professionals are trained and interact with one another, and how patients access technologies and services. Innovation in either of these dimensions is not possible without ***policy innovation*** that both enables technology and delivery solutions and establishes a receptive environment for their uptake.

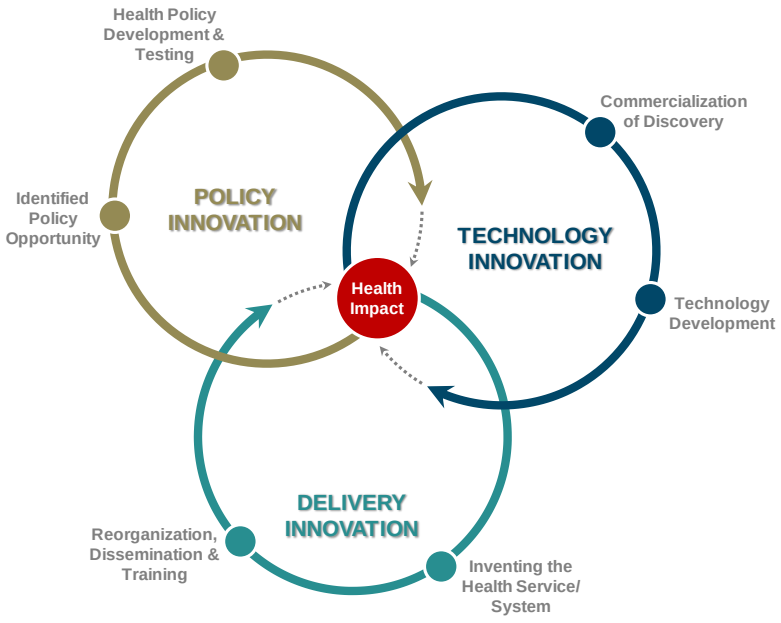


FIGURE 1. Three intersecting cycles of innovation predicate a functional innovation system.

At its core, the functional innovation system is predicated on a balance between the ***push*** of knowledge creation and the conditions that ***pull*** innovation to the realm of application, whether a new product, improved medical practices or policy/health system reform. In other words, the functional innovation system reflects: (i) society's willingness to

assume the *risk* of creating knowledge whose future benefits are uncertain; and (ii) its appetite to harness and *reward* the fraction of knowledge output that holds tangible social and economic promise. While forming part of an integrated continuum, each cycle in the functional innovation system is defined by specific prerequisites for push-pull balance and by discrete metrics of success.

This balance between push and pull is ultimately driven by and reflected in ***health impact***, which provides both the impetus for innovation and the standard by which the success of innovation is measured.

Each cycle of health innovation shares a common framework for invention

While each of the three cycles of innovation has distinct processes of knowledge creation and testing, they are all driven by and contribute to the common goal of health impact. Successfully filtering ideas through the rigours of testing and validation requires a capital, regulatory and intellectual environment that values and supports the risk-taking involved in innovation. As such, the function of each cycle is shaped by a common set of inputs: ***G***overnment, ***A***cademia, ***I***ndustry and ***N***ot-for-profit Organizations (**GAIN**), which have distinct roles to play at each stage of technology, delivery and policy innovation. Maximizing each input across the GAIN spectrum is the foundation of a functional innovation system.

The GAIN spectrum must be inclusive of: ***Government*** at all levels, including federal tax, granting and regulatory agencies, provincial ministries of health and regional economic development organizations; ***Academia***, including university laboratories, health sciences centres and other publicly funded, not-for-profit research institutes; ***Industry***, including large pharmaceutical companies, small biotech/specialty technology companies, medical device and diagnostics manufacturers, and the investment community; and the ***Not-for-profit Sector***, including hospital and disease-specific foundations, patient advocacy organizations and public-private consortia. Implicit in this schema is the role of the consumer as represented by each GAIN input: the taxpayer; the academic researcher and trainee; the employee and investor; and the patient and healthcare consumer.

PUSH and PULL are pivotal where the cycles of health innovation intersect

The interdependence of the three dimensions of innovation is expressed in their ability both to fuel innovation and to create the conditions for its uptake. The cycles, then, are in a dynamic equilibrium in which technology, delivery and policy effect a system-wide balance of push and pull (refer to the numbered nodes in Figure 2):

1. The health policy framework both enables discovery in the broadest sense and provides the impetus to select and harvest discoveries for further development.

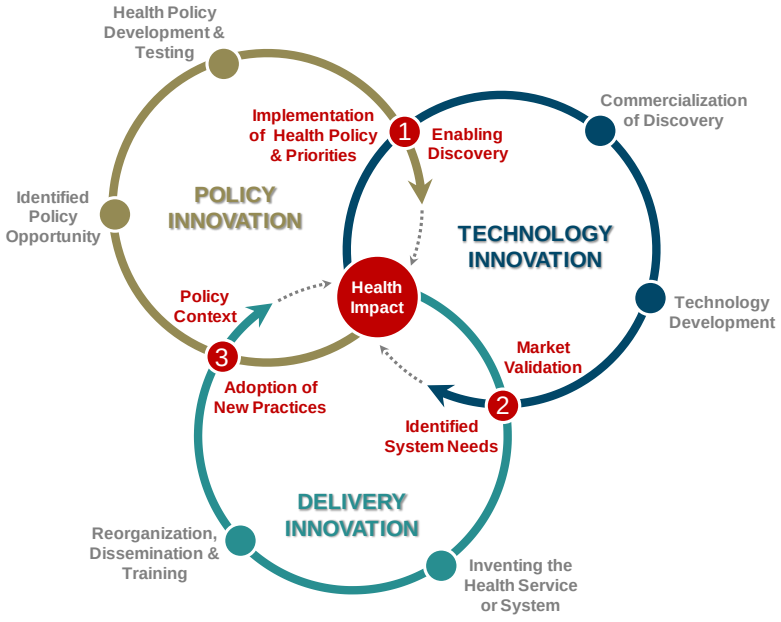


FIGURE 2. The three cycles of innovation operate in a dynamic equilibrium of push and pull.

2. Effective validation and refinement of the market opportunity for new technologies depends on the recognition, measurement and satisfaction of health system needs.

3. The successful adoption of new healthcare practices requires a policy framework that supports health system change.

The system is fuelled by balanced investments in the pillars of research

Research underpins the intersecting cycles of technology, delivery and policy innovation. The pillars of research—discovery and clinical research, outcomes and health services research, and health economics and population health research—are dynamically interactive and interdependent.

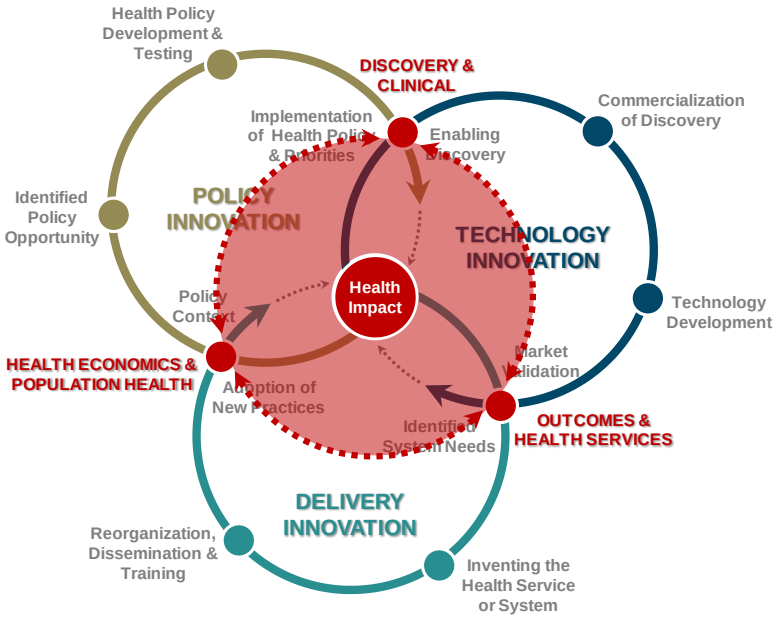


FIGURE 3. Balanced investment in health research underpins a functional innovation system.

The function of research in each of these pillars is to create new knowledge. The depth and breadth of the inventory of new knowledge determines the depth and breadth of opportunities for its application. A functional innovation system mines new knowledge, filters it through the dynamics of push and pull among the three cycles, and actualizes output in two interdependent ways: (i) innovation whose value may be captured in the form of market-worthy intellectual property that may eventually be commercialized following a systematic process of appraisal and validation; and (ii) knowledge whose value resides in evidence-based healthcare and public health policies, practices and guidelines, with the potential to improve the effectiveness of healthcare delivery and the social, health and economic well-being of the community.

The axis of an innovation-based economy is knowledge creation. The functionality of the system of innovation is therefore directly related to balanced strategic investments across the pillars of health research.

B. The Technology Innovation Cycle: A Study in Balance

The technology development cycle (Figure 4) encompasses four fundamental phases—***Research***, ***Development***, ***Market Validation*** and ***Delivery***—which trace the path of knowledge as it moves from the realm of creative scientific pursuit through commercial development to social and economic impact.

1. ***Research*** is the original creative impulse of innovation. As the bedrock of the innovation system, research is defined by excellence in knowledge creation and is typically described by the cardinal four pillars of health research, which include discovery, clinical, health services and population/public health research. By expanding our understanding of health and healthcare, research yields unpredictable discoveries and evidence that may have a direct impact on how our health system manages and prevents illness, how health professionals deliver care and how patients take ownership of their health. It is those discoveries that offer commercial opportunities for technology development on which subsequent phases of the technology innovation cycle must capitalize.

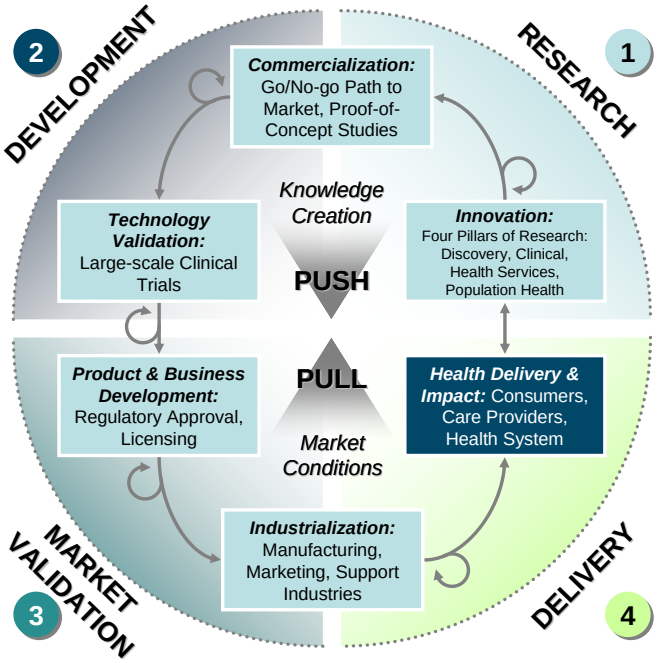


FIGURE 4. Conceptual model of the technology innovation cycle.

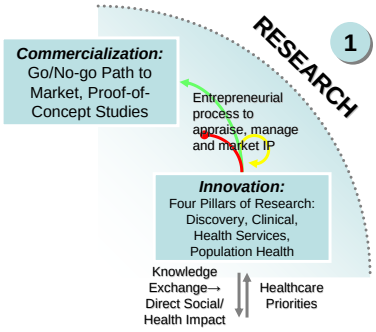
2. ***Development*** refers to the high-risk, high-cost preclinical research activities and clinical trials that bring a promising discovery from proof-of-concept to validated technology. Success in this phase presupposes that entrepreneurs, through an appropriate combination of private and public sector support, have the financial, technical and management support needed to navigate the protracted, uncertain research and commercialization paths that lead to potential product markets.
3. ***Market Validation*** refers to the process of turning a technology into a marketable product. It encompasses the public regulatory machinery that evaluates the net benefit of new technologies for human health and establishes the limits of their applications. It also includes the crucial business development activities that bring technologies and companies together, ensuring that the industrial, manufacturing and marketing capacity is in place to bring products to the global marketplace.
4. ***Delivery*** is the culmination of the technology innovation cycle. In order to find a sustainable market niche, innovative products must respond to the needs of consumers/patients, health practitioners/care providers and the health system as a whole. Symmetrically, in order to sustain the impetus to innovate—and shape the trajectory of research—the marketplace must continue to demand and reward the value that innovation can bring to the health of patients and the effectiveness of care.

When the system is working well, the transition between each phase effectively acts as a knowledge application filter, with only the most worthy intellectual products and technologies receiving the commitment of resources needed to graduate to the next phase in the continuum. When this judicious process of appraisal, selection and reinvestment is dysfunctional, either because the decision-making apparatus is unsophisticated or because there are insufficient resources to capitalize on the most promising opportunities, investments made in earlier phases are effectively wasted.

Over the past ten years, Canada has made a concerted commitment to reinvigorating the public research enterprise through substantial investments in outstanding research, world-class talent and cutting-edge infrastructure. The new federal innovation strategy, *Mobilizing Science and Technology to Canada's Advantage*, reflects the government's implicit recognition that these investments in the push of knowledge creation have not been matched by adequate market forces to fulfill the commercial promise of Canadian research.

An understanding of the functional innovation system is fundamental to the government's efforts to correct persistent structural imbalances that have stifled the social and economic impact of Canadian research excellence.

Balancing Push and Pull across the Technology Innovation Cycle



RESEARCH. The objective of research is to create knowledge; from the perspective of health research, this encompasses a knowledge continuum that stretches from discovery and clinical research through to health services and population/public health research. Actualizing this inventory of new knowledge may be viewed from two perspectives: (i) knowledge whose value resides in evidence-based healthcare and public health policies, practices and guidelines, with the potential to improve the effectiveness of healthcare delivery and the social, health and economic well-being of the community; and (ii) innovation whose value may be captured in the form of market-worthy intellectual property that may eventually be commercialized following a systematic process of appraisal and validation. The successful transition from knowledge creation to commercialization necessitates an entrepreneurial process to appraise, manage and market IP; this is required to ensure that commercialization decisions are responsive to and aligned with prevailing market conditions.

To foster an environment conducive to innovation—and to enable effective translation of relevant ideas into marketable opportunities—requires specific inputs from all GAIN stakeholders:

- ***Government*** plays a pivotal role in laying the foundation for knowledge creation, as there is otherwise little market incentive for discovery, clinical, health services and population health research; government investment in the form of infrastructure development, HQP training and incentives, operating funds and commercialization support are essential in galvanizing the contributions from other stakeholders;
- ***Academia*** is responsible for creating the research and training environment that is essential to knowledge creation;
- ***Industry*** supports the strategic research alliances and seed investments that expedite the translation of innovative ideas into marketable opportunities; and
- ***NGOs***, motivated by public health and consumer mandates, are potential partners in the co-funding of research, infrastructure and training programs and in developing commercialization support (including but not limited to not-for-profit business incubators and other business development expertise).

Success in the research dimension of the technology innovation cycle can be monitored through various metrics:

- ***Talent Pool.*** Successful research programs/initiatives thrive on a sustainable critical mass of highly qualified personnel (HQP). Parameters for evaluating the strength of the talent pool may include the

number of graduates generated, their retention rate in Canada, the number of HQP employed in knowledge-based activities, growth in HQP recruited from abroad, and the number of industrial and international training partnerships.

- ***Global Competitiveness of Research Output.*** Success in research must be evaluated within a global context to ensure that local research initiatives/programs remain competitive with international benchmarks. Examples of metrics for comparison may include total and per capita investment in R&D, the number of highly-cited scientific publications, industry collaboration with public research institutions and participation in international research initiatives.
- ***IP Output.*** The tangible commercial outputs of research can be measured in terms of the number and quality of awarded patents, the capitalization of spin-off companies and the scale and nature of pharmaceutical research alliances with Canadian IP developers.

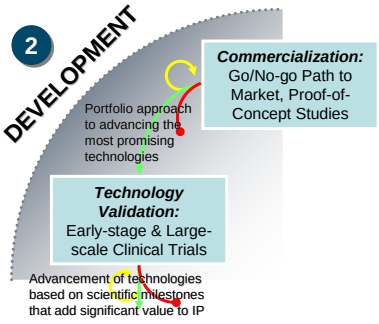
Success in research is predicated on the uncompromising pursuit of excellence, which means that public institutions, researchers and trainees must have access to the technologies and resources that allow them to pursue relevant, globally competitive opportunities for knowledge creation. Canada must ensure that it pursues a balanced investment strategy focused on harnessing excellence across the country.

Balancing PUSH and PULL

- There is little market incentive for discovery health research, so most of the opportunity must be borne by government.
- Fully exploiting investments in space and equipment before inevitable obsolescence requires judicious balance among operating, HQP and infrastructure funds.

Canada's Opportunity

- Investments in infrastructure and HQP through CFI have established world-class research facilities across the country, have significantly expanded capacity and have recruited world-class talent.
- Operating budgets of Tri-Council Funding Agencies are unable to keep pace and sustain excellence.



DEVELOPMENT. The objective of development is to transform a commercially viable discovery into a validated, market-worthy technology. As only a small fraction of the intellectual property that is initially commercialized from academic institutions (in the form of a start-up company, licensing opportunity or research partnership) will survive scientific and commercial attrition as technologies move through development, it is crucial that expensive, high-risk technology development decisions be scientifically rigorous, market-responsive and milestone-driven.

Development is predicated on entrepreneurship, and the successful entrepreneur, in turn, is one whose willingness to take risk is supported by an environment that values, eases and rewards risk. All stakeholders play a critical role in fostering this environment:

- ***Government*** provides the market-oriented research investment incentives and/or subsidies (such as R&D tax credits or funds through the Industrial Research Assistance Program) that help to share or mitigate risk;
- ***Academia*** provides critical expertise and facilities to test innovative products in preclinical models or using human volunteers;
- ***Industry***, through private sector investment funds and other financial vehicles, provides venture and other forms of risk capital that lend commercial value to technology opportunities—and also provides the operational and management expertise that distinguish successful start-up companies; and

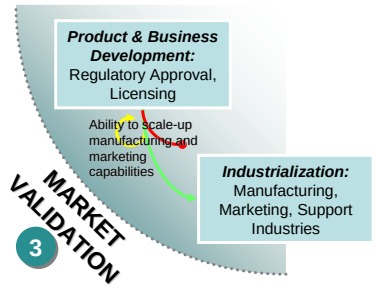
- ***NGOs*** can provide co-funding for development programs, particularly for public health priorities for which the market proposition is unclear and the market risk of development prohibitive.

If the development phase of the innovation system is functioning well, the return on investment will be measured by the following quantifiable surrogates of success:

- ***Private Sector Research Investment.*** As technology developed is ultimately motivated by market opportunity, the private sector should bear a major share of the scientific and commercial risk.
- ***Availability and Quality of Risk Capital.*** Start-up biotechnology companies require the vote of market confidence that comes from venture capital (VC) investment. To be viable, however, VC investment must be both sufficiently large and patient to endure costly, time-consuming technology development activities—and reinforced by advisory expertise that helps young companies navigate sophisticated management decisions.
- ***Validation Activities.*** In the life sciences, development requires clinical investigation of technologies in human subjects; a productive technology innovation system will feature a robust pipeline of products moving through early- and late-stages of development.

As commercially viable ideas migrate through technology development, the balance between push and pull ultimately pivots on the ability of the entrepreneur to take risk; it is in supporting this culture of risk-taking where Canada must strengthen its resolve.

Balancing PUSH and PULL	***Canada's Opportunity***
• Government cannot pick winners; technology development decisions—and associated risk—must be assumed by the market. • Requires a business environment that encourages entrepreneurial risk-taking, rewards private sector research investment and leverages public-private partnerships to maximize the likelihood of success.	• Notwithstanding our generous tax incentive system for business investment in R&D, Canada lags behind benchmark countries, such as the US and Israel, in the availability of risk capital. • Our biotech companies are thus undercapitalized and fail or are acquired before sufficient value is added to their IP.



MARKET VALIDATION. The objective of market validation is to transform a scientifically validated and commercially viable technology into a marketable product, both locally and globally. A seamless transition is predicated on several factors: (i) ***regulatory efficiency***—while stringent regulatory requirements are crucial to protecting public safety, the process must be transparent, consistent and responsive, ensuring that products of value are delivered to the market expeditiously; (ii) ***availability of value-added support industries***—the transition from pilot- to commercial-scale manufacturing may present novel logistical and technical challenges, the difficulty of which may be alleviated through the availability of diverse industrial expertise; and (iii) ***the opportunity to leverage the experience and capacities of well-established industry stakeholders***—licensing opportunities with industry stakeholders may provide invaluable product development channels and access to global markets, providing access to the manufacturing capacity and market know-how that may not be readily available in the public domain.

While the market validation phase may imply a primary role for government and industry stakeholders, both academia and NGOs make essential contributions to the process:

- ***Government*** enforces the efficient regulatory processes and provides the incentives, such as a favourable income tax structure, needed to foster an innovation-friendly business environment that encourages investment by receptor companies;
- ***Academia*** provides the research partnerships to improve industrial practices, helping to ensure the competitiveness and operating effectiveness of support industries;
- ***Industry*** brings technical knowledge, expertise in regulatory submissions, industrial capacity and global reach; and
- ***NGOs,*** leveraging their access to global thought leaders and utilizing their formidable financial resources, play a crucial role in addressing regulatory and market hurdles in developing markets, in turn delivering value-added products to neglected populations.

If the market validation phase of the innovation system is functioning well, its success can be measured by the following:

- ***Approval of Products.*** As the efficiency of regulatory infrastructure improves, there should be a commensurate increase in the number of submissions reviewed and the number of products approved.
- ***Intensity of Value-added Support Industries.*** The success of the market validation phase is also reflected in the health and intensity of support industries, as reflected by growth in employment numbers, improvements in company profitability and investments in capital.
- ***Transactional Deals and Spin-offs.*** The number of high-value spin-offs and biotech and pharma licensing deals are the ultimate arbiter of success in transitioning from validation technology to marketable product.

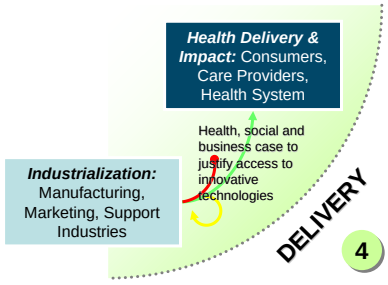
An effective market validation phase is mobilized by an efficient regulatory approval process and a critical mass of support industries and receptor companies. Collectively, these create the favourable market conditions to ensure success in local markets and strengthen the commercial foothold in the global arena.

Balancing PUSH and PULL

- Although the market for life sciences products is global, the local market plays a critical role in strengthening the commercial foothold of innovative technologies.
- Efficient regulatory review and the availability of receptor companies for marketable technologies reinforce local market demand and incentive for innovation.

Canada's Opportunity

- Inconsistent representation from the R&D, manufacturing and business development operations of global biopharmaceutical firms creates a disadvantage for Canadian biotech companies.
- Inefficient regulatory processes have frustrated Canadian leadership in new product approvals.



DELIVERY. The premise of delivery is the satisfaction of market demand for innovation. New products that fill the health needs of consumers, health professional and/or the health system have the opportunity to differentiate themselves and compete in a defined market niche—provided that the projected health, social and economic benefits attribute sufficient value to the technology to justify its cost. The corollary to this market proposition is that markets that fail to compensate the risk of value-added technologies effectively depress the incentive to innovate.

Delivery reflects a critical balance between the perception of value—for both technology users and developers and ***over both short- and long-term time horizons***—and the realities of cost; striking this balance, to which all stakeholders must contribute, ultimately determines which products reach the marketplace.

- ***Government*** must ensure that formulary and pricing policies reflect the true health economics of innovative products; specifically, government must participate in the market through fair and transparent policies that maximize public access to beneficial technologies;
- ***Academia***, by conducting the heath services and outcomes research that clarifies the potential impact of new product introductions, plays an important role in providing the data upon which the public can make informed decisions;
- ***Industry***, through its marketing efforts, helps to educate consumers and health professionals about the value of new products and, through surveillance studies, continues to gather knowledge about the long-term impact of new technologies; and
- ***NGOs***, as organized, well-informed representatives of patients and their families, fulfills an essential consumer advocacy function that reinforces the need for technology access.

If the delivery phase of the innovation system is functioning well, Canadians can expect to derive the following measurable benefits:

- ***Access to New Products.*** A functional innovation system will reward the investment in research and technology development by issuing strong market demand products that respond to public health needs.
- ***Improvement in Health Outcomes.*** Investment in new technologies must be accompanied by a corresponding, quantifiable health advantage in the prevention, early detection, treatment and long-term functional impact of illness; products should result in less and less serious illness, faster or more complete recovery, and overall improvements in patients' quality of life.
- ***More Effective Deployment of Healthcare Resources.*** While healthcare costs are unlikely to decrease, new technology should allow the health system to use scarce resources more effectively, whether by obviating or minimizing patients' stay in hospital, empowering self-care or reducing long-term complications of disease.

Delivering new products to users, whether consumers, health professionals or the health system, requires a system that acknowledges and rewards the value that innovation brings; it is in making access to innovative products a matter of public policy where Canada falls short.

Balancing PUSH and PULL	***Canada's Opportunity***
• New products should respond to unmet, clearly defined healthcare needs and deliver measurable economic and healthcare benefits that justify their incremental cost. • To sustain the incentive to innovate, healthcare providers must view the introduction of new products as an investment in health improvement, not a cost.	• Above-inflation growth in healthcare expenditures, particularly drug costs, is resulting in restrictive formulary, reimbursement and pricing policies. • A systematic approach to monetizing the full healthcare and economic impact of innovation on consumers and the health system is needed.

Achieving Balance: Implications for Canada's System of Innovation

Canada's system of innovation is a system out of balance, as evidenced by an industry-led technology development track record that is systematically failing to capitalize on the innovation advantage afforded by federal investments in world-class research, people and facilities. Canada's new science and technology strategy has proposed steps to correct this imbalance, but the success of these efforts will ultimately reflect the degree to which they respond to the dynamic relationships among stakeholders and the forces of push and pull across and within each quadrant of the technology innovation cycle.

Research. An innovative economy is built on excellence in knowledge creation and on the exploitation of the unpredictable fraction of that knowledge with commercial opportunity or direct social value. While strengthening market-oriented programmes to harness intellectual property arising from Canada's public institutions, the government must also correct the operating budget shortfall (estimated at $200-300 million annually for CIHR alone) that is jeopardizing Canada's global research competitiveness and ability to capitalize fully on existing investments in infrastructure and people.

Development. Risk-taking defines entrepreneurship. To support this spirit of risk-taking and maximize the likelihood of commercial success—particularly for life sciences products whose protracted development cycles and intrinsic scientific risks can lead to premature exits—Canada must create an environment that liberates venture capital markets and enables the recruitment and training of highly qualified managers.

Market Validation. As evidenced by the success of Ireland—whose focus on building a large pharmaceutical manufacturing/support industry and establishing transparent, streamlined regulatory processes has created a receptive environment for indigenous innovation—Canada must ensure that the domestic economy is able to facilitate the transition from validated technology to marketable product.

Delivery. To be sustainable, investments in the creation of knowledge must be matched by an appetite for innovative products that rewards the risk of developing them. Canada must work with innovative companies to ensure that Canadians have timely access to technologies that promise the greatest health and economic dividends.

The functional innovation system is about effecting the right balance of push and pull at each stage of the technology innovation cycle. This balance is mediated by the appropriate allocation of roles and investments among stakeholders in government, academia, industry and the non-governmental/not-for-profit sector, and is reflected by discrete, quantifiable metrics of success throughout the value cycle. Uncoupling the interrelated elements of the functional innovation system enables the characterization of microeconomic relationships that lead to the macroeconomic goals of job creation, prosperity and global competitiveness. Quantifying this model will empower Canada with an invaluable, globally unprecedented policy instrument.

Together, we have the opportunity to develop an algorithm that will help Canadian policy-makers effect a balanced, scalable and responsive innovation investment strategy.