



CANADIAN FOREST SERVICE

# Focus on Innovation

INFORMATION NOTE 1



## Understanding Innovation and Innovation Systems

### Introduction

The term “innovation” is commonly seen and heard. It is found in government policies and programs, industrial strategies, and private sector advertising, and is often used by politicians and business leaders. There is also extensive literature on innovation. But what does innovation really mean?

In this Information Note, we will propose concepts of innovation and innovation systems, including the roles of key actors. A common understanding of these concepts will benefit anyone involved or interested in innovation and innovation systems. The Canadian Forest Service (CFS) has been investing in innovation and the innovation system because it considers them key elements in forest sector transformation. Because the concepts outlined below are applicable to all sectors, we will discuss innovation and innovation systems in general. In future Notes, we will focus more specifically on innovation in the Canadian forest sector including its history, players, characteristics, and performance.

### What Is Innovation?

The Oslo Manual (OECD 2005) defines innovation as “... the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.” This internationally accepted definition is commonly used when innovation is measured in an economy. But innovation is not only an economic concept.

More broadly, innovation is a social phenomenon designed to answer the needs of society at large. Social innovation refers to “new ideas that resolve existing social, cultural, economic and environmental challenges for the benefit of people and planet. A true social innovation is systems-changing—it permanently alters the perceptions, behaviours and structures that previously gave rise to these challenges.” (Centre for Social Innovation). Increasingly, innovation is being discussed in the context of this wider societal role.

The two overarching objectives of conducting innovation activities are (1) to find solutions to social and environmental challenges, such as climate change, or the limited supply of energy, food, and water; and (2) to promote economic growth. The goal is sustainable productivity growth driven by innovation (Gault 2010). In fact, both overarching objectives are often connected. For example, in natural resources sectors, given that the environment provides the raw materials for production processes, firms<sup>1</sup> must consider environmental issues a prerequisite for economic competitiveness (i.e., ensuring long-term availability of raw materials and the social license to operate).

In this Note, we focus on a market-based approach to innovation where economic growth is often the main objective. Although there are many definitions of innovation, the CFS has developed a holistic definition that will be used for the series: **Innovation is the novel application and implementation of knowledge and/or human ingenuity to solve problems and/or take advantage of opportunities.**

### Focus on Innovation Series

Focus on Innovation is a series of Information Notes designed to provide insights on innovation and innovation systems based on CFS experience in innovation research in the forest sector. The Notes are not intended to outline Government of Canada opinions but rather to provide a basis for discussions on innovation as it relates to Canada’s forest sector. In the Notes, we will cover a wide variety of topics related to innovation to foster thinking on how best to support a sustainable, innovative, and globally competitive forest sector.

<sup>1</sup> “Firm”, not “company”, is used to agree with OECD terminology.

## Common Misconceptions about Innovation

### Invention is synonymous with innovation

Ideas or inventions are not innovations until they are successfully implemented.

### R&D is synonymous with innovation

R&D expenditures are commonly used as a proxy to indicate the level of resources a firm allocates to innovation. But R&D is only one of several innovation activities. In fact, innovation can be achieved without performing any R&D (e.g., buying a new technology) and conversely, performing R&D does not guarantee successful innovation (e.g., basic research).

### The goal of innovation is to be innovative

Innovation is a means to an end, not an end in itself. Being innovative is a way to achieve a desired economic, social, and/or environmental outcome.

### Innovation is always successful

Although innovation can significantly contribute to a firm's economic success, the fact that a firm has successfully commercialized an innovation does not guarantee it will be successful in the marketplace. For several reasons, innovative firms can easily fail.

### Only sophisticated consumer products are innovative

Many people consider a smartphone to be innovative because the product itself is so novel. The smartphone is the result of both product and process innovation. When considering paper, most people will only see a product that has been available in the marketplace for a long time, not realizing that a tremendous amount of embedded knowledge and process innovation goes into paper produced today.

## Innovation and Economic Growth

Economic theory experts agree that innovation is the key facilitator to a firm's success, a sector's competitiveness, a robust economy, and environmental sustainability (OECD 2010; BIS 2011). Thus governments worldwide are interested in promoting innovation in firms. Numerous studies have clearly demonstrated that innovative firms, sectors, and economies outperform those that are low in innovation to noninnovative (Beyer et al. 2005; BIS 2011).

There are two approaches that describe how innovation supports economic growth: market pull and technology push.

The market pull approach responds to existing customer needs, whereas technology push involves developing new technology that actually creates new customer needs. Technology push is generally riskier because the market response is uncertain. Although the business strategies between the two approaches differ, the goal of both is to increase profitability and market share, resulting in economic growth.

Typically, highly competitive industrial sectors are also highly innovative, and to stay competitive, firms in these sectors invest in innovation. Furthermore, the degree of novelty of an innovative product or process (i.e., new to the firm, sector, country, or world) can affect the firm's profitability. Highly novel innovations (a world-first) are often game changers, attracting investors and driving the firm's profits. For example, when the personal computer was introduced, its high degree of novelty helped propel Apple into the global limelight because the technology revolutionized how people managed information and interacted with the world.

Whether product, process, marketing, or organizational, the type of innovation a firm implements to improve its economic competitiveness depends on the circumstances inherent to the sector in which the firm operates. In the high-tech sector, for instance, a firm's focus is on continuously introducing innovative products to the market to stay competitive. Conversely, in natural resource industries, the primary focus has been mostly on process innovation, which can lead to improvements in productivity and/or reduced production costs, increasing a firm's short-term profit margin. But this focus on process innovation is beginning to shift in some natural resource sectors where more product innovation is being implemented (e.g., forest sector transformative technologies such as bioactive paper and nanocrystalline cellulose).

The economic competitiveness of a sector can be optimized by applying innovation along the entire value chain. A value chain represents all the stages required for the commercialization of a product, from collecting the raw materials to manufacturing the final product to bringing it to the marketplace. Different types of innovations can be applied at each stage to optimize the firm's economic competitiveness. To make this process as effective as possible, it is necessary to consider not only the individual steps along the chain but also the entire chain—not only innovation but also an understanding of the innovation system.

## Innovation Systems

### What Is an Innovation System?

Innovation involves the creation and implementation of new products and processes, whereas an innovation system is the collaborative mechanism that supports innovation and ensures that it is taking place efficiently. From a CFS perspective, an innovation system is **an interactive process among a wide**

## variety of actors for the generation and exchange of relevant knowledge to support innovation along the value chain.

The concept of national innovation systems was introduced in the late 1980s (Fagerberg and Sapprasert 2011). There is no accepted definition of national innovation systems. What is important is the web of interaction or the system (OECD 1997). National innovation systems can be defined broadly in terms of the institutions involved in the generation, commercialization, and diffusion of new and better products, processes, and services (i.e., technical change), and in terms of the incentive structures and competencies in these institutions that influence the rate and direction of such change (Patel and Pavitt 1998). National innovation systems provide the necessary infrastructure and framework conditions that influence all innovation activities in a country. These innovation activities can be specific to a sector (e.g., forest sector) and/or a region (e.g., clusters<sup>2</sup>).

### Why Is It Important to Consider the Innovation System?

A common understanding of the innovation system benefits both individual actors in the system and the system overall. Understanding the roles and interactions of all the actors in the system allows an individual actor to capitalize on the strengths of other players and to take advantage of opportunities. In addition, an innovation system where actors share a common vision increases efficiencies by maximizing synergies. The resulting increased alignment generally enhances the system's performance. A better performing system will in turn generally benefit the individual actors (e.g., increased capability to capitalize on new market opportunities, increased attraction of private sector investment, quicker industry uptake and application of research results). The institutional alignment in the system affects the probability that the outcomes of innovation activities will be achieved.

From a government perspective, examining an innovation system is an important tool to support policy development and program implementation. It can be used to plan human and financial resource allocation; identify areas of expertise and knowledge gaps; and optimize policies, regulations, and programs to enhance the system's performance.

### What Are the Key Elements of an Innovation System?

The key elements of an innovation system are actors, innovation activities, linkages, outcomes, impacts, and framework conditions:

- **Actors** engage in innovation activities, and have linkages with other actors.
- **Innovation activities** are all the scientific, technological, organizational, financial, and commercial steps that actually result in—or are intended to lead to—the implementation of innovations (OECD 2005). Other innovation activities can include R&D, invention, innovation, training and development, capital investment, and intellectual property protection.
- **Linkages** include any interaction between the actors, such as collaboration; contracts; joint research; licensing of intellectual property; flow of data, information, or knowledge from or to public or private sources; joint purchase of equipment; and exchange of human resources.
- **Outcomes** are the direct, short-term results of innovation activities, and can include changes in employment, skill levels, or market share as a result of innovation, and longer-term economic and social impacts (Lonmo and Schaan 2005).
- **Impacts** are long-term or indirect results like economic growth, productivity, and social welfare (Godin 2004).
- **Framework conditions** are “those factors that are external to a firm and that drive and shape the innovation activity of firms; and influence their innovation performance and subsequent market success” (Allman et al. 2011).

Framework conditions can constrain or enhance innovation. In the innovation system literature, framework conditions refer to all the external factors within which a firm innovates and over which it usually has no control. Framework conditions shape the innovation process and its performance by moderating the flow of people, finance, knowledge, and services (Allman et al. 2011). Framework conditions can apply to all innovation systems (macro framework conditions) or to sector-specific innovation systems (sector-level framework conditions). From a government perspective, there are three types of framework conditions. The first type includes those that governments can control (e.g., judiciary systems; infrastructure; and policy, programs, and regulations). The second type includes those that governments can control but that change slowly (e.g., education level; general health of a population; and culture of innovation, which refers to the general willingness to take risk). The third type includes the framework conditions that government cannot control (e.g., climate, foreign international policy, and global financial circumstances).

Together these elements contribute to the functioning of an innovation system (Figure 1). The actors and their main roles are outlined in more detail below.

**Industry** — Industry's main role is to commercialize innovative products and processes to increase their economic competitiveness. Individual firms, as part of industry, are the central actors in

<sup>2</sup> Clusters are significant concentrations of innovative firms around a nucleus of R&D facilities in a single locale (NRC 2009). Innovation is fostered by close geographic linkages between the various actors, which facilitates knowledge flow and promotes synergies.

an innovation system. Depending on its business strategy, a firm can harness the knowledge produced by other actors in the innovation system to support the implementation of innovation along the value chain. It can also choose to focus its efforts on current business practices instead of collaborating with the other actors in the system. A firm will choose to integrate innovation in its business strategy only if conditions are favorable (Council of Canadian Academies 2009). For example, a firm will invest in innovation activities when it has the appropriate resources and believes it has the potential to obtain a reasonable return on innovation investments.

**Governments** — Governments have a variety of roles related to innovation, including fostering strategic partnerships; creating and disseminating scientific knowledge; providing funding; and developing and implementing policies, standards, and support programs such as tax incentives and trade missions. Governments can enforce regulations and manage the framework conditions, as well as enhance innovation by optimizing linkages and institutional arrangements between actors in the innovation system. Not only do governments

influence the environment where innovation takes place but they also innovate internally to improve their overall efficiency and effectiveness.

**Education and Research Institutions** — Education and research institutions include universities, colleges, technical institutes, and high schools as well as public and private research centers. The main role of education institutions is to produce highly qualified individuals. Graduates transfer knowledge when they become part of the work force. Both education and research institutions create knowledge that can be transferred to other actors in the system through consultancy and publication.

**Innovation Intermediaries** — An innovation intermediary, also referred to as a Center of Excellence, can be defined as “an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; ... and helping find advice, funding and support for the innovation

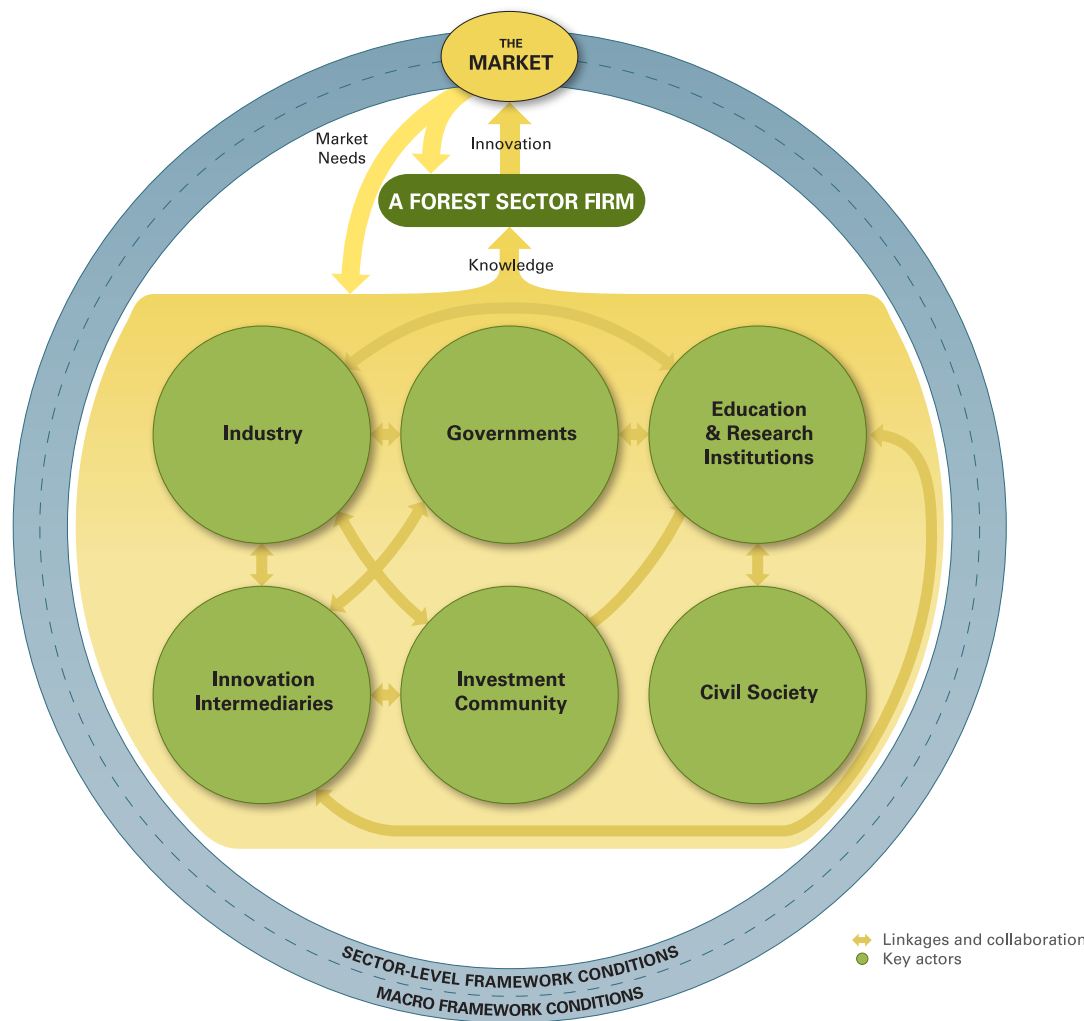


Figure 1. A generic innovation system, applicable to most sectors, showing the key actors and the relationships between them.

outcomes of such collaborations” (Howells 2006). Innovation intermediaries can act to align government priorities, policies, and programs with research being conducted in education and research institutions to support industry needs. They can assemble a critical mass of resources in one place, enabling innovation to occur, as well as provide services to firms, including market analysis, or perform innovation activities themselves. Essentially, innovation intermediaries are third-party organizations that work with the other actors in the system to foster innovation.

**Investment Community** — The investment community provides funding at different stages of the innovation process to help bring new business ideas to market. The investment community includes both public and private institutions, and encompasses different subactors such as angel investors, venture capitalists, and financial institutions. Access to funding is a common constraint to business-led innovation because innovation is often a risky, long-term process with an uncertain outcome.

**Civil Society** — Civil society plays several roles in an innovation system. It dictates market demand and acceptance, makes up the work force, and sets social and environmental expectations for how economic development should be conducted. Civil society includes individuals as well as nongovernmental organizations (NGOs).

Individuals are sources of innovation because their views on consumer products are sought by industries wishing to improve their market share. Individuals can also innovate directly by modifying a product to suit their needs or by creating a new product. Furthermore, an individual’s education, training, and lifelong learning activities are considered soft skills required to interact effectively in networks and to convert knowledge into value as part of the innovation process (Gault 2010).

Nongovernmental organizations often promote better social and environmental outcomes as part of the economic development process. With the rise of the “green movement”, a reality of today’s global marketplace, NGOs can affect how industry defines its innovation priorities as well as how it implements them.

## Conclusion

The Focus on Innovation series defines innovation as the novel application and implementation of knowledge and/or human ingenuity to solve problems and/or take advantage of opportunities. Although it is a term that can be used in a variety of contexts, innovation is crucial for economic growth (e.g., commercialization of value-added forest products), and is becoming increasingly important to maintain success in the global economy (OECD 2010). Innovation can also improve the quality of life when innovation activities are undertaken

to solve social (e.g., improve health care accessibility) and environmental (e.g., biorefineries using wood residues) problems.

An innovation system considers innovation an interactive process among a wide variety of actors for the generation and exchange of relevant knowledge along the value chain. A well-functioning innovation system enables collaboration and knowledge transfer between actors. The effectiveness of an innovation system can be determined by the degree of the alignment of its components, that is, the efficiency of the linkages between the actors. Determining the effectiveness of an innovation system is an important part of policy development but is difficult to achieve. This process relates to innovation system performance measurement, which will be discussed in subsequent Notes.

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