Innovation Vital Signs

Framework Report
An Update

June 2007
v. 2.8

Prepared for:
Innovation Vital Signs (IVS)

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Foreword

When the nation faced the competitiveness challenges of the 1980s we responded by measuring success by cost, quality, time and productivity. While these measures continue to be important the challenge today focuses on innovation. But measuring and defining innovation requires new indicators of success that are much more complex and intangible than those we have used to define our economy to date.

We know that innovation is a key driver of economic prosperity, however, we know little about how innovation is changing and the metrics we need to capture the process of innovation and the interplay of the forces that impact it. The innovation landscape is global. Innovation is occurring at an accelerating pace and consists increasingly of non-technological forms emerging in surprising ways and in unexpected places.

The pace is accelerating because of new information applications, ubiquitous communication capabilities, and the international mobility of talent. Business enterprises are becoming value focused, networked, and distributed as they adapt themselves to market opportunities and technological breakthroughs. Science is becoming increasingly multidisciplinary and multi-organizational. Business enterprises and entrepreneurs are utilizing open innovation strategies and functioning as hubs for an ecosystem of suppliers, customers, infrastructure and sources of knowledge. Business models are striving to link and leverage these *external* innovation assets to create new possibilities for optimizing the value of the whole and the power of collaborative advantage.

This project takes the first tentative steps down the path of creating an ***Innovation Vital System*** that will capture real-time insight about how this innovation ecosystem functions. Through improved understanding of these complex and interdependent factors we can better inform, educate and advance policy choices for a sustainable 21st century innovation economy.

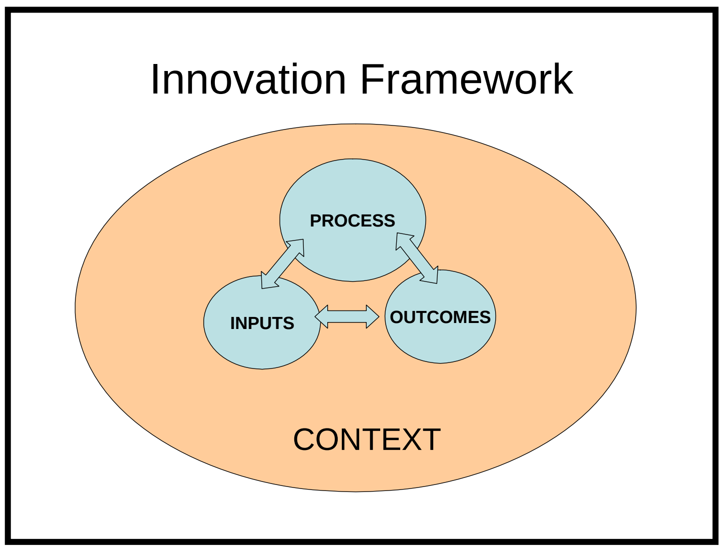
CONTENTS

EXECUTIVE SUMMARY

This report introduces a framework for describing the "national innovation ecosystem" and for guiding the development of an innovation measurement system we call **Innovation Vital Signs (IVS)**. The purpose of such a system is to provide a tool to evaluate the nation's innovation capabilities and performance, and better assess policy choices and potential impacts. [1]

The framework is based on a systematic review of 52 public indicator reports and 95 private sector sources. Our review generated an inventory of 3,126 indicators measuring multiple dimensions of innovative activity. We discovered during our review that no common framework for organizing and presenting such indicators exists. The framework we designed is comprehensive and approaches innovation as a complex and multi-faceted process and recognizes:

- both the innovation supply (inputs) and demand (outputs) and the process that connects inputs to outputs and ultimate national impacts.
- context in which innovation takes place including the macroeconomic environment, public policies, infrastructure and the national mindset for innovation.
- changes in the nature of innovation including globalization of innovative activity, new business models for managing innovation, types of innovation, service sector innovation, entrepreneurial activity and diffusion/adoption rates for innovation.



The framework organizes indicators in four broad domains as illustrated and into 14 specific factors that drive knowledge from original insight to economic impact. Based on a detailed evaluation of these indicators and a workshop we identified a set of baseline indicators from which to evolve ***innovation vital signs for the national innovation ecosystem.*** We conclude that currently available indicators and measurement methods do not adequately describe in a timely manner the dynamics of innovation today. Innovation cannot be approached as an isolated inventive activity and linear process. We need to move beyond

[1]The framework builds on the innovation ecosystem measurement concepts and recommendations prepared by Egils Milbergs, Center for Accelerating Innovation for the 21st Century Innovation Working Group of the National Innovation Initiative, Council on Competitiveness. Final report, Innovate America, December 2004. www.compete.org Additional information on the Innovation Vital Signs project can be found at www.usinnovation.org

indicators dominated by inputs such as R&D, scientific and engineering personnel, patents and number of publications. A comprehensive indicator framework is required that can link innovation inputs, processes and outcomes to better reflect the reality of innovation today. Innovation is best viewed an ecosystem of relationships, connections and diverse patterns interaction among individuals and organizations. It is a complex process in which new knowledge eventually becomes embedded into a new products, services, processes and business models that create value. This value creation process in turn generates national benefits and revenue and profit to entities who undertake the risk of being innovators.

Innovation is a process by which value is created for customers through public and private organizations that transform new knowledge and technologies into profitable products and services for national and global markets. A high rate of innovation in turn contributes to more intellectual capital, market creation, economic growth, job creation, wealth, and higher standard of living.

Innovation policy should be based on evidence. Timely, high quality relevant information is available in abundance to support fiscal, monetary and trade policies. Innovation policy for the 21st century will require new indicators, improved data collection and integration methods, and sophisticated visualization tools to understand the more subtle, qualitative and interactive elements of innovation and greater recognition of role innovation plays in the service sector. The framework offered in this report integrates the fundamental change in innovation practices from the previous closed, static, linear and individualistic perspective into a multidimensional, dynamic approach that is capable of staying abreast of the demands of a global economy.

The Innovation Vital Signs conceptual framework identifies 4 domains and 14 innovation factors that collectively interact to create the innovation capacity and performance of a nation. The following table summarizes the provisional set of indicators that emerged from our global assessment of innovation indicators.

Baseline Innovation Vital Signs 1.21

INPUTS	
Factors	**Indicators**
1- Research and Development	• R&D Expenditures • Patents • Scientific Publications/Citations
2- Talent	• Full Time Researchers • Population with Higher Education • State Appropriations for Higher Ed • Average Verbal SAT Scores • Average Math SAT Scores • Population in Life Long Learning
3- Capital	• Gross Capital Formation • Investment in ICT • Venture Capital • Initial Public Offerings • Business Angel Networks • Stock Market Value • SBIR Funding • Investment Risk
4- Networks	• Broadband Penetration • Computers per Capita • Internet Use by Business • Internet Costs • Broadband Costs • SMEs Cooperating with Others • International Technology Alliances • Federal Laboratory CRADAs • University R&D Spin Outs • Number of Business Incubators • Number of Internet Domain Names
PROCESS	
Factors	**Indicators**
5- Management	• Shareholder Value • Customer Satisfaction • Entrepreneurship • Quality of Management • # of Ideas Threatening Existing Product Lines
6- Product Development	• Firm Level Technology Absorption • Number of approved patents • Number of patents & citations • Time & Money to Develop Processes
7 - Efficiency	• Availability competent senior managers • Cost Reduction
8- Process Factors	• # Companies with Cooperation Agreements • Early stage Entrepreneurial Activity • Entrepreneurial Trends • Company Assessment of Research Quality • Company Assessment of Quality of University Collaboration • Knowledge Used from R&D overseas • Innovation Expenditure • Intensity of Innovation Investment • Enterprises Innovating In-House • Speed in Launching New Products

OUTCOMES	
Factors	**Indicators**
9-Output	• Sales of New to Market Products • Sales of New to Firm Products • Royalty/Licenses Fees/Payments • Overall private sector productivity • # of New Products Introduced • Outcomes of Innovation Activity by Sector • New Company Creation • Value Add of SMEs • New Regional or Global Markets • Sales from Exports
10- Impact	• High Technology Exports • Employment in High Tech Manufacturing and Services • # of Innovative Enterprises (mfg. and services) • Science and Technology Employment • Leading Indicators of Technology Competitiveness • High Tech Jobs Gained and Lost • Personal Income per Capita • Gross Birth Rate of New Enterprises • Net Change in Enterprise Population
CONTEXT	
Factors	**Indicators**
11 – Macroeconomy	• Real GDP • Real GDP per Capita • Inflation Rate • Average Hourly Earnings • Gross private Domestic Investment • Real Interest Rates
12- Policy	• Corporate tax rate • Overall Tax Burden • # of New Laws on Taxes, excises and Duties • # Procedures to Start a Business • Time Required to Start a Business • Prevalence of Trade Barriers • Foreign Ownership Restrictions • Intellectual Property Protection • Rule of Law Governance Indicators
13 – Infrastructure	• Judicial Independence • Intellectual Property Rights • Infrastructure Quality • Environmental Governance • Openness to Competition Index • Innovation Composite Ranking • Legal Rights Index • # of New Buildings Designed • Home Affordability
14 – Mindset	• Youth Interest in Science • Publics Leading Sources of Information on Science and Technology • Public Interest in Science and Technology • Feeling Informed about Selected Policy Issues • Science Literacy • Value Place on Creative Activity • Wish to Own One's Own Business

1. INTRODUCTION

Innovation is a key contributor to achieving our national goals—economic growth, competitiveness, comparative advantage, national security, and a higher standard of living. According to leading economists, nearly half of US total factor productivity growth is accounted for by technological progress, investment in innovation and the skills and experience of the workforce (Solow, Kendrick, Denison, Romer, Kuznets and Jorgenson). Cross-country comparisons of economic performance indicate that the intensity of national innovative activity is correlated with higher rates of productivity growth and standards of living (Porter, Furman, and Stern).

Successful innovation results in new products and services, gives rise to new markets, generates growth for enterprises, and creates customer value. Innovation improves existing products and processes, thereby contributing to higher productivity, lower costs, increased profits and employment. Firms that innovate have higher global market share, higher growth rates, higher profitability and higher market valuations. Innovation also generates spillover and cascading effects as competing firms absorb new innovations. Customers of innovative products and services gain benefits in terms of more choices, better services, lower prices and improved productivity. As innovations are adopted and diffused, the "knowledge stock" of the nation accumulates, providing the foundation for productivity growth, long-term wealth creation and higher living standards.

INNOVATION VITAL SIGNS

- *Prominent study groups and experts (e.g. PCAST, National Academies, National Innovation Initiative) have recommended improving innovation indicators, models and policy frameworks to better reflect the global, knowledge based, networked economy.*
- *Like human health no single measure captures innovation's multiplicity of features. We need to know more about knowledge production and utilization, technology transfer, standards, entrepreneurship, services innovation, general purpose technologies, public policy impact, innovation infrastructure and relating these factors to economic growth, standard of living, productivity and global competitiveness.*
- *The Innovation Vital Signs project aims to generate a bounded set of input, process and output indicators to track national innovation and competitive performance and to better inform policy implications and impact.*
- *Policymakers will have more insight on how to ensure that the US remains the most fertile and attractive environment for innovation in the world.*

2. INNOVATION AS AN ECOSYSTEM

Innovation is not a singular and independent activity but is more appropriately described as a multi-dimensional system of interacting factors, processes and agents. This paper presents a provisional framework based on a survey of innovation indicator reports and to better understand the dynamics of our ***"national innovation ecosystem."*** The framework serves as a mapping tool for organizing the vast array of innovation indicators that are currently available as well as pointing to possible data gaps.

Entrepreneurs and innovating enterprises are the prime agents for transforming knowledge and commercializing products, services and processes. Our new understanding of innovation, however, rejects the idea that innovation simply flows from some earlier process of scientific discovery. Innovation is not just a linear process that unidirectionally proceeds from science to the enterprise and then the marketplace. ***The framework here goes beyond knowledge creation (invention) and emphasizes the many additional factors that drive the transformation of knowledge into useful products and services and value for society.***

In fact innovation is non-linear and increasingly a global, multidisciplinary, distributed, and interactive activity. Successful innovation draws on many non-technical activities such as organizational design, training, financial engineering, marketing, customer relationships, etc. When today's modern enterprise innovates it rarely does it with only its own internal resources. Innovation is process in which enterprises interact with the external environment. They may draw on universities for intellectual property and talent, on the financial resources of venture capitalists, on the skills of other firms, consultants and suppliers and even source product development from customers. Said another way innovation occurs in the context of an innovation ecosystem, a system made of many players, connections and linkages between customers, suppliers government, education, research, and other economic actors.

Therefore for a framework to be useful for monitoring innovation performance it needs to be balanced across a variety of domains and recognize that more than innovation inputs come into play. We note that no framework can be definitive and final. The framework will always be a work in progress. Innovation and how we describe and measure it is inherently dynamic and constantly evolving.

3. DEFINING INNOVATION

No standard definition of innovation exists. Earlier definitions tended to have a narrow focus on the specific characteristics of an innovative product or service. Over time these definitions have broadened to include how organizations innovate. Today's definitions describe innovation as a system and the context in which innovation processes operate. Some examples of definitions are below.

Innovation Definitions
Innovation is "the commercial or industrial application of something new—a new product, process or method of production; a new market or sources of supply; a new form of commercial business or financial organization." *Schumpeter, Theory of Economic Development, 1911*
Innovation covers a wide range of activities to improve firm performance, including the implementation of a new or significantly improved product, service, distribution process, manufacturing process, marketing method or organizational method. *European Commission, Innobarameter 2004, November 2004*

Innovation success is the degree to which value is created for customers through enterprises that transform new knowledge and technologies into profitable products and services for national and global markets. A high rate of innovation in turn contributes to more market creation, economic growth, job creation, wealth and a higher standard of living. *21st Century Working Group, National Innovation Initiative, 2004*
Innovation is the intersection of invention and insight, leading to the creation of social and economic value. *Innovate America Report, Council on Competitiveness, December 2004*
Innovation—the blend of invention, insight and entrepreneurship that launches growth industries, generates new value and creates high value jobs. *Ahead of the Curve, The Business Council of New York State, Inc., 2006*
An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. Innovation activities are all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD,2005*
The design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational models for the purpose of creating new value for customers and financial returns for the firm. *Measuring Innovation in the 21st Century Economy Advisory Committee, Department of Commerce. Federal Register Notice, April 13, 2007,*

The definitions above update our perspective on innovation. To generate real economic benefits, the nation must not only generate fresh ideas and intellectual property, but also innovate across many technical and non-technical dimensions to be globally competitive and commercially successful.

4. DESIGNING THE INNOVATION FRAMEWORK

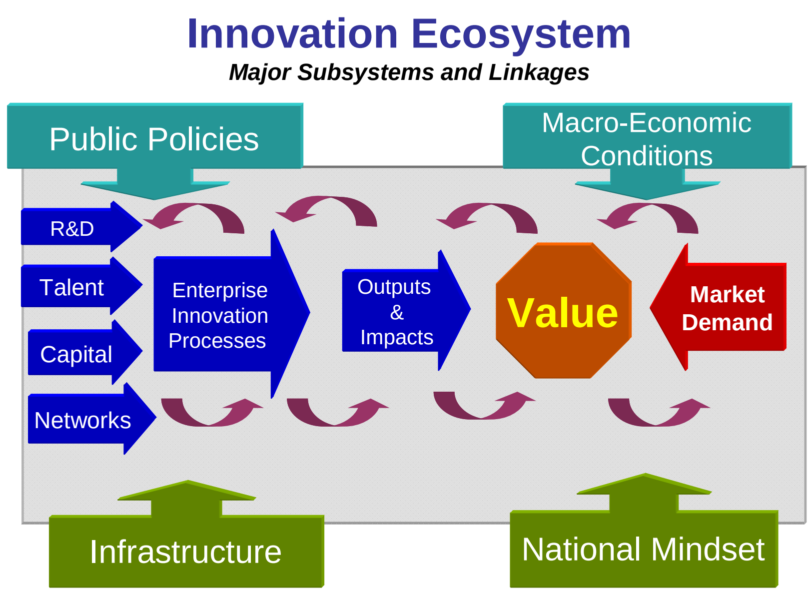
The "function of a framework is to help guide data collection and analysis of the fundamental determinants of innovation and performance" **(Mowery, 1997)**

Our review of reports made clear there is little consensus on a common reporting framework, or for that matter, an underlying model of innovation. Accordingly, it was necessary to generate a working framework for categorizing in a consistent way the indicators identified in our survey. In constructing our innovation framework we considered a number of levels of abstraction and detail -- from an individual technology project, to the enterprise, to the industry sector, to the national and even global level. We also were mindful that innovation should not be viewed as a singular linear and independent activity. It is more appropriately described as a multi-dimensional system of interacting factors, processes, and collaborating agents -- or a national innovation ecosystem. We adopted a framework that was comprehensive and capable of integrating a broader range of indicators from the traditional to the R&D linear chain model. The framework we developed provides an end to end view of innovation that recognizes the entire ideation-to-market cycle, including inputs, the processes of innovating enterprises, the outputs of innovation, and contextual factors that impact innovation activity. The framework briefly consists of the following domains and innovation factors.

- **Innovation inputs** such as R&D, talent, capital, and networks.
- **Innovation Processes** of private enterprise such as source of ideas in the pipeline, product development cycle time, management strategy/practices, type of business model, internationalization of innovative activity, and commercialization.
- **Innovation Outcomes** which include firm level **Outputs** such as new products commercialized, market penetration and growth, cost reduction, profits, revenues and value to customers. **Impact** indictors such as contribution to GDP growth, employment, productivity, standard of living, competitiveness and global market share.

In addition to elements directly related to innovation we identified four contextual domains that influence the rate and direction of innovative activity.

- **Macro-economic** conditions such as fiscal/monetary environment, interest rates, global economic growth rates, gross investment trends.
- **Public policy** conditions such as R&D funding policy, taxes, intellectual property, regulations, standards and market access policies.
- **Infrastructure** conditions such as the legal system, information infrastructure, intellectual property rights, quality of the physical infrastructure.
- **National Mindset.** This grouping includes youth interest in science, cultural factors, and science literacy, entrepreneurial attitudes and openness to collaboration.



We defined 14 factors within this framework and used these as our landscape for mapping indicators. Working through these 14 factors proved useful and illuminating. It enabled us to logically "cluster" indicators from heterogeneous data sources, and then cross walk a variety of innovation taxonomies into a common basis for comparison and assessment.[2] It also enabled us to better understand some of the complex relationships between the factors and the processes of innovation by examining the indicators that are available. It helped us identify strengths and weaknesses of the available indicators, and also enabled us to identify areas in which there are obvious data gaps. The 14 factors analysis also demonstrated that the relative strengths and weaknesses are not the same for the five major groupings of indicators -- national through private sector. What it also revealed is that the areas with the greatest challenges in terms of available indicators tend to be those around which there is the most curiosity and also the highest level of vagueness due to the difficulties in quantifying some of the new indicators developed to capture such data. The 14 factors analysis also surfaced insights as to priorities, directions, and opportunities for future work and research. The principal criteria used in evaluating indicators to be included in the baseline are presented in the table below.[3]

Utility of Indicator Criteria	Quality of Indicator Criteria
1. Significance – how important/sensitive is the indicator as a measure of innovative activity or as a determinant of innovation outcomes?	**1. Accuracy**—is the indicator based on a credible primary source using a reliable methodology for data collection, analysis and reporting?
2. Policy Relevance –is there active public interest in the indicator, is it useful for policy development, and help measure the impact of public choices?	**2, Timeliness** – to what degree is the indicator available in timely and regularly reported manner?
3. Clarity – can the indicator be readily understood by a wide variety of stakeholders?	**3. Comparability** – is the indicator comparable and can it be harmonized across domains (e.g. industry sector, regional, international, time)?
4. Acceptance – how many official and well recognized reporting sources utilize the indicator?	**4. Accessibility** – is the indicator available and in an accessible format from primary and/or secondary resources?

The following section discusses in more detail the 14 factors that were employed and the baseline indicators that emerged as most significant and useful.

4.1 INNOVATION INPUT FACTORS

The range, scope and effectiveness of innovation will depend on the type, quantity and quality of key innovation resources (inputs). Approximately 50% of indicators identified in our indicator inventory clustered into the following four input factors.

Research and development. This innovation factor consists of knowledge creation activity. The primary indicators for this factor are well established and include sources of R&D expenditures in the public and private sector and R&D expenditures by performing organizations such as universities, federal laboratories

[2] Appendix 1 summarizes the indicator count by framework domains and innovation factors. Detailed back-up data for each report and private sector sources is available in a separate document or database.
[3] Appendix 2 elaborates in more detail the criteria used in evaluating the indicators.

and private research facilities. .This domain also includes related indicators such as scientific publications and intellectual property (patents). Extensive data bases such as those prepared by the National Science Foundation are available in these areas. Over 17% of the 3126 indicators identified in our sample of indicator reports were categorized in this domain. These indicators are frequently overused as proxies of a nation's innovation capabilities. While R&D spending is an important driver of innovative activity it does not operate independently of other innovation factors. Intellectual property can also arise as a by-product of developing new products and services. Innovative business models, processes, and marketing methods are generally of a non-R&D based nature. .

Talent-- The demand for creativity and innovative talent is increasing and this is probably the most important set of indicators in our framework. It is the individual scientist, engineer, entrepreneur or team innovator that does the real innovative work and value creation. The traditional way talent is measured is through tracking educational attainment of the labor force and graduates in universities and colleges in scientific, mathematics and engineering disciplines. It is generally acknowledged that the more significant and revealing measures of labor force quality and operational competencies are lacking. All countries striving to be at the leading edge of technology debate the issue of brain drain and brain gain increasing the interest in measuring the ebb and flow of talent across borders whether it be for education, finding work, starting a business or permanently residing in a country. This "brain circulation" can reflect the relative attractiveness of national innovation systems and other considerations such as lifestyle, quality of life, immigration laws, freedom of association etc. With the baby boomers facing the retirement years there is concern over the production of skilled personnel and availability of talented immigrants. These trends underscore the need for relevant and timely innovation indicators to meet these policy concerns.

Capital-- A key to developing and diffusing innovation into the economy and generating productivity growth is the size, characteristics and rate of investment in the nation's capital stock (e.g., machines, equipment). Much credit is given specifically to ICT investment as contributing to higher productivity growth rates after 1995. Access to venture capital and initial public offerings (IPOs), while relatively small to total capital investment, plays a critical role in financing technology based start-ups and the early growth stage of companies. Venture backed companies have contributed enormously to employment and rising stock market valuations particularly during the 1990s. The federal government's Small Business Innovation Research (SBIR) program is a major source of seed capital.

Networks-- More innovation is of a collaborative nature spurred on by the exponential growth and pervasiveness of computer and communication technologies such as the internet, e-mail, collaboration software applications, search engines, social networks and mobile devices. The number of people and business firms having access to computers and high speed data/voice/video connections can increase innovation capabilities, the speed and efficiency of innovation and create enormous new markets for on-line services ranging from financial services, education, e-commerce, health care and public services. Federal policy changes such as the Stevenson-Wydler Act and the Federal Technology Transfer Act have stimulated technology partnerships between universities and federal labs and increased the commercialization rate of publicly funded R&D.

INPUTS	
Factors	**Baseline Indicators**
1- Research and Development	• R&D Expenditures • Patents • Scientific Publications
2- Talent	• Full Time Researchers • Population with Higher Education • State Appropriations for Higher Ed • Average Verbal SAT Scores • Average Math SAT Scores • Population in Life Long Learning
3- Capital	• Gross Capital Formation • Investment in ICT • Venture Capital • Initial Public Offerings • Business Angel Networks • Stock Market Value • SBIR Funding • Investment Risk
4- Networks	• Broadband Penetration • Computers per Capita • Internet Use by Business • Internet Costs • Broadband Costs • SMEs Cooperating with Others • International Technology Alliances • Federal Laboratory CRADAs • University R&D Spin Outs • Number of Business Incubators • Number of Internet Domain Names

4.2 INNOVATION PROCESS FACTORS

Innovating enterprises have the primary role in the US economy to fuse customer demand (current and those in the future) with the innovation resources it can access, develop, manage and exploit. This domain focuses on innovating enterprises whether established or entrepreneurial start-ups. From a firm level perspective innovation is typically defined as bringing of an invention or insight into a significantly new or improved product, service or production technology to market. Innovation can also be of a non-technological nature involving business models, training, cultural change, reorganized information systems, marketing strategies and redeployment of assets.

Despite the large number of innovation reports and databases, they provide limited insight into how innovation is sourced, managed and measured by private sector organizations. This is somewhat surprising given the central role the private sector plays in the innovation process. There are few systematically collected indicators on private sector innovation activities and practices across different size businesses, sectors and geography. Many business firm surveys are done as ad hoc, one-time research projects. The most systematic, longitudinal and comprehensive effort currently is the Community Innovation Surveys done by the OECD in European Union member states. [4]

Measuring innovative activity of enterprises, large and small, is of critical value in order to understand which industries and firms are the innovation leaders and what attributes characterize that leadership. What are the sector/firm specific drivers of innovation and what is the impact on firm performance? What internal processes are used to manage the innovation including top leadership commitment, sources of ideas, organizational culture, project management tools/metrics, collaboration with customers, investment levels, intellectual property protection, IT support and marketing strategy?

For the more radical innovations and general purpose technologies, the process may involve numerous recursive activities. Among these are items such as managing linkages with customers, partners, suppliers and knowledge providers, and integrating complementary innovations in services, public policy, and distribution models.

Poor project execution, unanticipated technical problems and funding uncertainty can slow the innovation process and pose potential barriers to revenue growth, profitability and success in the marketplace. Barriers can also be of a non-technical nature. Examples include organizational resistance, changes in market conditions, competitor response, and regulatory and legal barriers. Measuring these barriers can be useful in evaluating innovation cycle times and reducing innovation risks and time to market.

> **Management –** refers to the role management plays in setting innovation strategy and fostering, and rewarding innovative activity at the firm level. Management sets the organizational and cultural tone of the firm. Management practices, organizational factors, and internal barriers to technology development and

[4] ***The guidelines for developing enterprise level indicators have been codified by the OSLO Manual, most recently in its third edition 2006. The latest OSLO manual gives greater recognition to non-technological innovation such as organizational structures (business models), management practices and marketing innovation. The indicators which are comparable across the European Community are derived from European Community Innovation Survey. The US has no comparable innovation survey. The EC survey focuses on firm propensity to innovate and indicators related to sources of information, outcomes use of intellectual property and barriers to innovation. The most recently completed fourth survey (CIS-4) is a cross-sectional survey of all firms with over 10 employees in all 27 EU member states conducted in 2005 with over 60,000 respondents. The survey includes all manufacturing sectors and many service sectors. Data are available from the Eurostat New Cronos website. http://epp.eurostat.cec.eu.int/portal/page?_pageid=1090,30070682,1090_30298591&_dad=portal&_schema=PORTAL or http://www.esds.ac.uk/international/access/access.asp The Flash Barometer Survey (FBS) is a cross sectional survey of 4534 innovative small to medium sized with between 20 and 499 employees in 25 EU countries.***

commercialization are important indicators. These indicators are a combination of both quantitative and qualitative indicators. Variables in the mix here include demographic characteristics such as age and education, but also attempt to include items whose intent is to capture experience, as well as other elements that would speak to the ability and intent of an organization's management to innovate.

Product Development - refers to the process of taking an idea through the entire range of activities from inception to where it becomes a marketable product. While many firms keep regular and rigorous track of their internal product development activities, measuring such activities across an entire economy, or across an industry, is a much more difficult endeavor. The general activities consist of market definition, design, engineering, production, marketing, distribution and support phases. These activities can be viewed as linear steps, but the reality in most cases is much more complex. For each phase of the process there are numerous sub-processes, both internal and external to the enterprise, involving feedback loops and the coupling of each activity to downstream and upstream phases. Technical and economic problems that are uncovered in the development process often generate demand for additional research in engineering and even fundamental science. For the more radical innovations and general purpose technologies, the process may involve numerous recursive activities. Among these are items such as managing networks and collaborations with customers, partners, suppliers and knowledge providers, and integrating complementary innovations in services, public policy, and distribution models. Private enterprise can also face various types of innovation barriers such as funding uncertainty for innovation, lack of qualified talent, organizational resistance, shareholder pressures for results, fear of failure and regulatory and legal barriers.

Efficiency - the efficiency indicators, those we have evaluated in our research for this report, have to do with the ability of the economy to find innovative ways of reducing costs, improving productivity and rapidly move ideas and/or products from one stage of development and market presence to another. Efficiency can also refer to the economy's ability to absorb new ideas, such as patent technology. It can also refer to the economy's ability to smoothly support all of the steps that are required to create new businesses. Clearly, efficiency goals are supported by numerous management methodologies such as lean, six sigma and quality improvement and are desirable in all manner of business and organizational practices. However, methodologies for spurring innovation are much more variegated and less subject to rigorous management practice and measurement.

Other Process - process indicators, as we employ the term here, and include other enterprise indicators not easily classified in the other areas. Such indicators might include alternative business models and internal-to-an-organization changes that have an ability to impact innovation. The spectrum covered here spans a range of options that is virtually limitless; including items such as outsourcing practices, customer service models, collaborative relationships, and the entire field that is comprised of has become known as business process reengineering.

PROCESS	
Factors	**Baseline Indicators**
5- Management	• Shareholder Value • Customer Satisfaction • Entrepreneurship • Quality of Management • # of Ideas Threatening Existing Product Lines
6- Product Development	• Firm Level Technology Absorption • Number of approved patents • Number of patents & citations • Time & Money to Develop Processes
7 - Efficiency	• Availability competent senior managers • Cost Reduction
8- Process Factors	• # Companies with Cooperation Agreements • Early stage Entrepreneurial Activity • Entrepreneurial Trends • Company Assessment of Research Quality • Company Assessment of Quality of University Collaboration • Knowledge Used from R&D overseas • Innovation Expenditure • Intensity of Innovation Investment • Enterprises Innovating In-House • Speed in Launching New Products

4.3 INNOVATION OUTCOMES

The commercialization and adoption of new products and services by customers (business and consumers) is the centerpiece of innovation value—where the supply of innovation meets the demand for innovation. This domain also surfaces some of the more complicated and elusive measurement issues. At one level indicators can measure the direct outputs of enterprises or industry. These private sector outputs when aggregated impact overall national conditions, competitiveness, standard of living and quality of life. The rate of end-user adoption (diffusion) ultimately determines the long term impact of innovation on national productivity and economic growth. Customers adopt innovation not just for the functional characteristics of a new product or service, but rather by the value expected when innovations are acquired and utilized. People do not buy products; they buy expectations of future benefits (Leavitt 1969).

The value of innovation to customers, including 'intangible' variables (e.g., convenience, service support, training, testing, and observability as well as product performance) are important considerations in understanding innovation demand and how it propagates throughout the economy (spillover effects). This intersection of "innovation producers" with "innovating customers" is an important determinate of innovation demand. . In this relationship the innovation output of one enterprise becomes part of the innovation input to another enterprise, creating a virtuous cycle with a powerful multiplier effect. An example of this powerful dynamic is the high rate of innovation (price and performance) in semiconductors (Moore's Law), which helped drive innovation in the PC and software business, which in turn helped boost productivity performance in other business sectors and fed back as a driver of the PC business and so on.

Integrating indicators at the macro level with those at the micro level is another challenge. Some macro outcomes can be linked to indicators such as R&D expenditures, capital investment, educational attainment and experience of the workforce. More problematical is connecting enterprise level indicators to macro economic performance. There continues to be large scope for creative research, development of new indicators and application of existing data to statistical fields and economic analysis. .

> **Outputs –** The output of innovation may be new to firm, new to the world or new to the customer. Clearly the most important consideration by private sector organizations is measuring the expected and real return of innovative effort. Among the most important indicators are contribution of innovation to revenue, profits, return on investment, change in market share, cost reduction and intellectual property licensing revenues. Intangible outputs, such as an increase in a firm's knowledge stock and acquired competencies in managing innovation, organizational learning, reputation, branding and adaptiveness is more subjective and difficult to quantify. These intangibles may be strategically significant to long-term competitive performance. From an end-user demand perspective there are many value indicators of potential relevance such as price reductions, more choice in goods or services, improvements in quality, convenience and overall satisfaction.

> **Impact –** Growth in real GDP, GDP per capita, and increases in total factor productivity are the conventional measure for assessing the overall contribution and impact of innovation. Some other measures that are useful include employment growth, consumer price/quality trends, export/import balances, corporate earnings associated with innovation, wealth creation, global market share, and penetration of markets These impacts are cumulative from innovation outputs such as new company formation, new product introductions, the portion of product portfolios comprised by innovative products, the component of total research endeavors dedicated to innovative activities, and many others. Impact measures can also be defined in terms of geography, such as innovative industry clusters, or the development of regional innovation networks.

INNOVATION OUTCOMES	
Factors	**Baseline Indicators**
9-Output	• Sales of New to Market Products • Sales of New to Firm Products • Royalty/Licenses Fees/Payments • Overall private sector productivity • # of New Products Introduced • Outcomes of Innovation Activity by Sector • New Company Creation • Value Add of SMEs • New Regional or Global Markets • Sales from Exports
10- Impact	• High Technology Exports • Employment in High Tech Manufacturing and Services • # of Innovative Enterprises (mfg. and services) • Science and Technology Employment • Leading Indicators of Technology Competitiveness • High Tech Jobs Gained and Lost • Personal Income per Capita • Gross Birth Rate of New Enterprises • Net Change in Enterprise Population

4.4 INNOVATION CONTEXTUAL FACTORS

Four additional context domains are considered below.

Macroeconomic Conditions. The innovative activities of enterprises depend in large part on perceptions of the overall national and global economy and expectations for the future. The risk profile for innovation and expected benefits are linked to macro-economic conditions in domestic and foreign markets, cost of capital (interest rates), currency valuation, and access to markets. How these macroeconomic conditions are perceived by enterprises and influence innovative behavior may vary considerably depending on the industrial, regional and technological sector.

Public Policy Environment. The public sector is linked to the innovation process in powerful and deep ways. R&D funding from the public sector accounts for a substantial portion of national R&D investment. The choices of government in supporting a field of science (e.g., life science, nanotechnology, advanced computing) influence the direction of innovative activity. However, R&D is only one area of public policy that bears on innovation. Appendix 3 details the extensive range of public policies impacting innovation and the diverse ways these policies can stimulate or inhibit innovation.

Infrastructure. The nation's innovation infrastructure helps supply inputs and functions as an enabling platform for innovative activity. This infrastructure includes the traditional elements of the physical infrastructure such as energy and transportation and the following which play a very direct and substantial support role to innovation.

Information infrastructure provides enterprises with many of the important tools and communication platforms necessary for innovation. Global collaboration and open innovation systems rely on advances in computing, software applications and information networks.

Legal infrastructure plays a role in innovation from protecting intellectual property, ensuring the status of contracts, enforcing laws and regulations fairly and equitably, ensuring adequate disclosure and transparency, procedures for starting and operating a business and resolving disputes.

Regional innovation clusters are geographic agglomerations of similar tech-based enterprises and related support industries and services that share a common knowledge base, labor pools, markets or distribution channels (e.g., Silicon Valley—microelectronics, Detroit—automobiles, Maryland—270 Corridor-biotechnology). Measuring the presence and intensity of participation in such clusters can enhance access to innovation inputs and speed up implementation.

Scientific and research institutions are a major source of knowledge and human capital and include research universities, federal laboratories, non-profit research centers, R&D consortia, technology transfer centers and research centers of excellence. Industry utilizes a wide variety of coupling mechanisms to increase its access (e.g., personnel exchange, patent disclosure and licensing, university-industry partnerships).

Capital providers and markets that finance innovation and the acquisition of new products and services. Venture capital and government research programs have played a particularly important role in supporting technology-based entrepreneurs, start-ups and small business firms. Equity markets provide an incentive for innovators and determine the value of enterprises.

Education institutions comprising K-12 schools, universities and colleges, along with private sector training organizations, provide the pool of leading-edge scientists, engineers, managers and the technical workforce.

National Mindset. Public attitudes to science, technology and innovation and how the media circulates and amplifies innovation related information can impact political debate, influence public policy choices stimulate career choices in science and engineering and public/private investment in innovative activity. Maximizing the value of the national innovation ecosystem involves more than individual players or nodes in the ecosystem. It involves embracing value from the whole and the power of collaborative advantage-- more openness between functions, sectors, industries and cultures to build social capital of trust, reciprocity, complementary competencies, the striving for learning and excellence. A central challenge for the future is creating a mindset and culture that accepts and recognizes this new paradigm.

CONTEXTUAL FACTORS	
Factors	**Baseline Indicators**
11 – Macro-economy	• Real GDP • Real GDP per Capita • Inflation Rate • Average Hourly Earnings • Gross Private Domestic Investment • Real Interest Rates
12- Policy	• Corporate tax rate • Overall Tax Burden • # of New Laws on Taxes, excises and Duties • # Procedures to Start a Business • Time Required to Start a Business • Prevalence of Trade Barriers • Foreign Ownership Restrictions • Intellectual Property Protection • Rule of Law Governance Indicators
13 – Infrastructure	• Judicial Independence • Intellectual Property Rights • Infrastructure Quality • Environmental Governance • Openness to Competition Index • Innovation Composite Ranking • Legal Rights Index • # of New Buildings Designed • Home Affordability
14 – Mindset	• Youth Interest in Science • Publics Leading Sources of Information on Science and Technology • Public Interest in Science and Technology • Feeling Informed about Selected Policy Issues • Science Literacy • Value Place on Creative Activity • Wish to Own One's Own Business

5. SUMMARY: INNOVATION VITAL SIGNS

A dramatic change in the approach to innovation is required if we wish to sustain our competitive advantage. Doing so will require a transition to a globally integrated economy, and an innovation-driven economy capable of routinely developing and commercializing "new-to-the-world" technologies. This new growth opportunity cannot be realized with traditional methods such as increasing innovation inputs. It has to be broadened to include new business models and value creation as main drivers, and the contextual conditions in which innovation operates. The framework offered in this report integrates the fundamental change in innovation practices from the previous closed, static, linear and individualistic perspective into a multidimensional, dynamic approach that is capable of staying abreast of the demands of a global economy.

To the degree indicators are currently defined and available the provisional framework establishes a baseline for a more comprehensive and textured view of the national innovation system. It also points us in directions to identify gap areas in which we need improved and new measures. As the framework and criteria for selecting Innovation Vital Signs evolves we anticipate the following uses:

- Awareness—provides information to policymakers, public and media for more comprehensively understanding the performance of the national innovation system.
- Performance—monitors progress and results against public policy objectives.
- Signaling and Monitoring—calls attention to significant innovation issues, trends and growth opportunities
- Accountability and Evaluation—supports formulation of government R&D budgets and innovation policies, and compliance with GPRA.
- Consensus Building—informs policy process on the potential impact of alternative innovation funding, policies and strategies.

Appendix 1 -- Innovation Indicators Count by Framework Domains and Factors

Global Indicators

GLOBAL INVENTORY COUNT (12/30/2006))	INPUTS				PROCESS				OUTCOMES		CONTEXT				
	R&D	Talent	Capital	Networks	Management	Prod Dev	Efficiency	Other	Output	Impact	Macro-Econ	Policy	Infrastructure	Mindset	Totals
OCED Science, Technology & Industry Scoreboard 2006	26	11	2	7	0	0	0	0	0	30	0	0	0	0	76
European Innovation Scoreboard 2005 Database	10	4	2	3	0	0	0	2	2	3	0	0	0	0	26
OECD Main Science and Technology Indicators (elec)	108	56	0	0	0	0	0	0	0	0	0	0	0	0	164
Main Science and Technology Indicators 2006/1 OECD	52	18	0	0	0	0	0	0	6	4	8	0	0	0	88
Oslo Innovation Scorecard 2004	6	4	0	0	0	0	0	0	1	2	0	0	0	0	13
IMD World Competitiveness Yearbook 2006	11	40	32	14	11	0	0	0	14	34	48	28	68	13	313
Global Competitiveness Index 2006	4	16	5	5	2	1	0	7	0	1	9	12	26	1	89
World Bank Knowledge Assessment Methodology (KAM)	6	23	6	10	0	0	2	0	4	3	8	9	12	0	83
Economic Freedom World Index 2006	0	0	5	0	0	0	0	0	0	1	7	23	5	0	41
Science and Technology Priorities of OECD Countries	18	0	0	0	0	0	0	0	0	0	0	0	0	0	18
World Bank Doing Business Indicators 2006	0	0	8	0	0	0	0	31	0	0	2	0	0	0	41
Global Entrepreneurship Monitor 2004-5	0	6	5	0	0	0	0	3	1	5	0	0	0	0	20
Capital Access Index 2005 -- Milken Institute	0	0	33	0	0	0	0	0	0	1	6	3	14	0	57
OECD Education at a Glance 2005	0	27	0	0	0	0	0	0	0	2	0	0	0	0	29
Industrial Development Report	3	5	3	3	0	0	0	1	0	2	0	0	19	2	38
Trend Chart report: Innovation in Services?	1	3	1	7	0	0	0	11	2	0	0	0	0	0	25
UN World Investment Report	4	9	146	1	0	0	0	7	20	38	2	40	0	0	267
Benchmarking Innovation & Framework Conditions 2004	4	5	2	0	0	0	8	2	0	0	1	4	1	0	27
Global Innovation Indicators Sub-Total	253	227	250	50	13	1	10	64	50	126	91	119	145	16	1415

National Indicators

NATIONAL INVENTORY COUNT (12/30/2006))	INPUTS				PROCESS				OUTCOMES		CONTEXT				
	R&D	Talent	Capital	Networks	Management	Prod Dev	Efficiency	Other	Output	Impact	Macro-Econ	Policy	Infrastructure	Mindset	Totals
NSF Science and Engineering Indicators 2006	114	115	3	0	0	0	0	0	0	11	0	0	2	21	266
CEA Economic Indicators	0	5	6	0	0	0	0	0	0	9	17	0	0	0	37
BLS National Productivity	0	0	0	0	0	0	0	0	0	13	0	0	0	0	13
BEA/NSF R&D Satellite Account	13	0	0	0	0	0	0	0	1	0	4	0	0	0	18
UK Productivity and Competitiveness Indicators 2006	5	2	3	1	1	0	0	1	4	6	2	0	3	0	28
Norway Science and Technology Indicators 2005	9	5	0	3	0	0	0	0	0	1	0	0	0	0	18
EU Regional Benchmarking	5	7	0	3	0	0	0	1	0	2	5	0	1	0	24
New Zealand Economic Development Indicators 2005	6	12	15	0	0	1	4	0	2	13	19	2	2	0	76
Australia Public Science and Technology Report 2006	28	4	0	17	0	0	0	0	2	0	0	0	0	0	51
Canada Performance and Potential 2005-06	7	19	5	3	0	0	0	0	0	3	9	1	55	1	103
National Innovation Indicators Sub-Total	187	169	32	27	1	1	4	2	9	58	56	3	63	22	634

Regional Indicators

REGIONAL INVENTORY COUNT (12/30/2006))	INPUTS				PROCESS				OUTCOMES		CONTEXT				
	R&D	Talent	Capital	Networks	Management	Prod Dev	Efficiency	Other	Output	Impact	Macro-Econ	Policy	Infrastructure	Mindset	Totals
ASTRA State Level S&T Indicators 2005	9	9	5	1	0	0	0	1	0	8	0	0	0	0	33
Washington State Index of Innovation and Technology 2006	2	4	5	0	0	0	0	0	4	10	0	1	3	0	29
Index of Silicon Valley 2006	1	12	1	0	0	0	0	0	2	7	0	0	15	0	38
Philadelphia Life Sciences Cluster 2005	14	25	9	0	0	0	0	5	1	1	0	0	0	0	55
Arkansasin the Knowledge Based Economy 2005	13	18	12	3	0	0	0	0	1	28	0	0	0	0	75
State New Economy Index	2	4	2	5	0	0	0	0	1	6	0	0	1	0	21
State Science and Technology Index 2004 Milken	13	18	12	3	0	0	0	0	1	28	0	0	0	0	75
Index Massachusetts Innovation Economy 2006-5	3	4	3	0	0	1	0	0	4	4	0	0	1	0	20
Southern Innovation Index	5	34	4	4	0	0	0	0	0	5	0	0	0	0	52
Region Lazio Innovation Scorecard 2005	5	4	1	5	0	0	0	2	2	6	0	0	1	0	26
State Based Assessment of Australian Research	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Southern Community Index	0	2	0	0	0	0	0	0	0	6	0	0	2	4	14
Hong Kong Creativity Index	6	13	0	21	0	0	0	3	6	3	0	1	33	35	121
Toronto Cultural Index and Plan	0	0	0	0	0	0	0	0	0	8	0	0	3	0	11
Wired Top Ten Geek Cities	0	0	0	5	0	0	0	0	1	0	0	0	0	2	8
Regional Innovation Indicators Sub-Total	80	147	54	47	0	1	0	11	23	120	0	2	59	41	585

Enterprise Indicators

ENTERPRISE INVENTORY COUNT (12/30/2006))	INPUTS				PROCESS				OUTCOMES		CONTEXT				
	R&D	Talent	Capital	Networks	Management	Prod Dev	Efficiency	Other	Output	Impact	Macro-Econ	Policy	Infrastructure	Mindset	Totals
Index of Corporate Innovation -- Canada	0	0	0	0	9	1	0	6	6	0	0	0	0	0	22
Fujitsu Innovation Index 2006	0	0	0	0	11	1	4	16	9	0	0	0	0	0	41
Balanced Scorecard	0	0	0	0	1	10	0	18	22	6	0	0	0	0	57
Danish Intellectual Capital Statement	0	0	0	0	0	0	0	24	0	0	0	0	0	0	24
EU Benchmarking Enterprise	2	4	3	7	0	0	0	1	0	4	2	4	4	0	31
Intangibles to Tangibles Kaplan & Norton	0	0	0	0	0	15	0	0	92	0	0	0	0	0	107
Entrepreneurial Indicators FORA Denmark	0	3	14	1	0	0	0	0	0	0	0	13	21	7	59
European Community Intangible Assets Repository	0	0	0	0	0	6	0	36	17	1	0	0	0	0	60
Innovation in New Zealand	0	0	0	0	0	0	0	75	16	0	0	0	0	0	91
Enterprise Innovation Indicators Sub-Total	2	7	17	8	21	33	4	176	162	11	2	17	25	7	492
Innovation Indicator Inventory Grand Total	522	550	353	132	35	36	18	253	244	315	149	141	292	86	3126
SUMMARY By Report Type															
Global Innovation Indicators Sub-Total	253	227	250	50	13	1	10	64	50	126	91	119	145	16	1415
National Innovation Indicators Sub-Total	187	169	32	27	1	1	4	2	9	58	56	3	63	22	634
Regional Innovation Indicators Sub-Total	80	147	54	47	0	1	0	11	23	120	0	2	59	41	585
Enterprise Innovation Indicators Sub-Total	2	7	17	8	21	33	4	176	162	11	2	17	25	7	492
Innovation Indicator Inventory Grand Total	522	550	353	132	35	36	18	253	244	315	149	141	292	86	3126

Most Commonly Cited Indicators By Report Intensity	# Global	# National	# Regional	# Enterprise	SUM for ALL
Total # REPORTS	18	10	15	9	52
R&D Expenditures	12	8	10	1	31
All Employment Indicators*	10	7	11	0	28
Venture Capital	8	3	11	2	24
Labor Force Characteristics	8	6	8	1	23
Intellectual Property	9	4	8	1	22
Scientists and Engineers	9	4	7	1	21
Higher Education	7	2	8	0	17
Process Factors	4	3	5	5	17
Internet	5	4	6	1	16
Collaborative Activity	5	6	5	0	16
Employment Impact	5	3	8	0	16
Trade Impact	8	4	3	1	16
Talent Factors	6	4	3	2	15
Organizational Factors	6	2	1	6	15
Revenues	5	3	1	6	15
Kindergarten through Secondary Education	6	2	6	0	14
Equity	3	2	5	2	12
Communication Infrastructure	6	1	4	1	12
Output Measures	1	3	3	5	12
Cluster Development, New Enterprise Growth	0	0	11	1	12
Scientific Publications	3	7	1	0	11
Foreign Direct Investment	6	2	2	1	11
Other Impact Indicators	4	3	4	0	11
Gross Domestic Product Indicators	5	6	0	0	11
Financial Assets and Infrastructure	6	2	0	1	9
Business Investment	4	4	0	1	9
Computer Ownership Activity	4	1	4	0	9
Legal System, Effectiveness and Integrity	7	0	1	1	9
Education Expenditures	1	2	5	0	8
New Enterprises	0	1	7	0	8
Interest rates	4	4	0	0	8
Tax Policy	4	2	1	1	8
Other R&D	3	3	1	0	7
Mobility of Students and Labor Force	3	2	2	0	7
Supply Factors including sources of innovation	4	1	0	2	7
Customer Relationship	2	0	1	4	7
New Products Introduced	1	1	1	4	7
Inflation, cost of living, producer prices	5	2	0	0	7
Quality of Life	2	1	4	0	7
Political Stability	2	3	2	0	7
Management and Organizational Values	2	1	0	3	6
Exports	2	1	2	1	6
Employment (firm output)	2	1	3	0	6
Productivity	1	5	0	0	6
Employment Indicators (Macro)	3	3	0	0	6
Exchange Rates	5	1	0	0	6
Regulatory System	5	1	0	0	6
Trade Policy	5	0	1	0	6
Public Safety	3	1	2	0	6

Most Commonly Cited Indicators By Report Intensity	# Global	# National	# Regional	# Enterprise	SUM for ALL
Total # REPORTS	18	10	15	9	52
Physical Infrastructure, Air, Rail, Energy etc	3	0	3	0	6
Interest Rates	3	1	0	1	5
Product Development Activity	1	0	0	4	5
Customer Satisfaction	0	0	0	5	5
GDP and Value Add	1	1	3	0	5
Income	0	0	5	0	5
Fiscal Position of Government	2	3	0	0	5
Trade Indicators	4	1	0	0	5
Other Policy Indicators	5	0	0	0	5
Other Infrastructure	2	0	3	0	5
Other Mindset Indicators	2	1	1	1	5
Other Capital Factor	0	1	2	1	4
Employee Skills and Competencies	0	0	0	4	4
Productivity	1	1	2	0	4
Other Macroeconomic Factors	0	3	0	1	4
Environmental Conditions	1	1	1	1	4
Health Indicators	3	1	0	0	4
Confidence in government	1	1	2	0	4
Sources of Information	0	2	2	0	4
Tolerance to race, gender, immigrants etc	2	0	2	0	4
Tax Policy	1	0	0	2	3
Production Factors	2	0	0	1	3
Foreign Direct Investment	2	0	1	0	3
Stock Market Capitalization and Listings	1	0	1	1	3
Demography, Age Distribution	2	1	0	0	3
Human Rights	2	0	1	0	3
Public understanding of science technology	1	1	1	0	3
Social Networking Intensity	0	0	2	0	2
Efficiency Factors	0	1	0	1	2
Market Share	0	0	0	2	2
Electronic Commerce	1	0	1	0	2
Purchasing Power Parity	1	0	0	1	2
Entrepreneurial Attitudes	0	0	1	1	2
Capital Regulations	1	0	0	0	1
Merger and Acquisition	0	0	0	1	1
Media Activity	1	0	0	0	1
Profits	1	0	0	0	1
Stock Market Valuation and Measures	1	0	0	0	1
Cost Reduction	0	0	0	1	1
Intellectual Property Laws, Enforcement	1	0	0	0	1
Philanthropic Attitudes and Behavior	0	0	1	0	1
*Consolidation of Employment Indicators					
Employment Indicators (Macro-Economic)	3	3	0	0	6
Employment Impact	5	3	8	0	16
Employment (Firm Output)	2	1	3	0	6
All Employment Indicators	10	7	11	0	28

Appendix 2—Innovation Scoring Criteria

Innovation Indicator Criteria - Utility	
Scoring Criteria	**Description**
Significance	This indicator is a score for how important or sensitive the indicator is as a measure of innovative or innovation activity or as a determinant of innovation outcomes. It is also a subjective measure or how well the indicator is thought to correlate with innovation inputs, processes, and potential outputs. A low significance score indicates that the indicator's link to innovation is tenuous.
Policy Relevance	The Policy side of the scoring has to do with the ability of the indicator to be connected to a policy driven innovation outcome, or the ability of the indicator to be used as an *a priori* indication of an expected enhancement of the innovation environment. Ultimately, a high policy score should indicate that the measure in question is a lever that can be employed in driving policy-related innovation indicators – positive and negative, within the economy or the area under scrutiny.
Clarity	The clarity of the indicator, as defined for the purposes in our screening process, deals with the fundamental question of how well the indicator actually represents the item that it appears to at face value. In general, direct indicators are given a high clarity score; indicators that are derivatives or composites tend to receiver lower scores. For example, total venture capital investment in an economy would receive a high clarity score. The average dollar value of venture investments over a five year time span would receive a lower clarity score.
Acceptance	Or the scoring criteria used here, this might be the most subjective and hard to define. Essentially, this score is based on the evaluators' judgments on how well received an indicator is within the community that it serves, but it is also a judgment as to how well it might be accepted as a measure of innovation within that same community. It is also an evaluation that may be influenced by the number of other official and private sector sources rely on this data as a solid indicator of innovation activity. As an example, R&D spending statistics for private business reported by a government statistical agency would have a high acceptance score. Unemployment rates for graduate engineers would have a lower acceptance as an indicator of innovation.

Innovation Indicator Criteria - Quality	
Scoring Criteria	**Description**
Accuracy	The accuracy score is based on the reviewers' knowledge about the indicator being based on a credible primary source using a reliable methodology for data collection, analysis, and reporting. This is also the case for scores that might come from less reliable sources or covering an area where the ability to properly measure the data being reported come into question. Labor force participation data are well developed and regarded as highly accurate. Certain measures of the quality of the labor force, items such as educational attainment and participation in advanced training or employer-sponsored programs are liable to be regarded with a higher degree of skepticism.
Timeliness	The timeliness score is based on several items. The first is the fact that an indicator is reported on regular. The second element of the timeliness score is the frequency of that reporting. The third evaluative element would be whether or not the item under review, even if it is an irregularly reported item, is reported on with a minimum of delay. Industry data that is reported on a monthly basis with only a 4 week delay from the end of the previous month would receive a very high score. An indicator that is reported on annually with a 24 to 36 month compilation delay would receive a low score.
Comparability	There are several elements to a comparability score. The first is whether the indicator reports on the same item for each release of data, and this reporting is maintained consistently over time, with adjustments being made to maintain comparability. Another element of comparability is how well the indicator can be harmonized across domains (e.g. industry sector, regional, international, time). Does the indicator report on the same activity in all cases. Also, comparability can be called into question for items where the definitions of a process or a specific activity or achievement are not the same. An example is the number of employees in a given job category or activity. In some cases and engineer by one definition is not an engineer in the definitions used in other countries or industries.
Accessibility	The elements used to derive our accessibility scores were based on two factors. The first is whether or not the indicator is published in readily and publicly available data sources. The second is a consideration related to private sector data sources. In these cases, there was a second scoring concern added to the evaluation, that being consideration of whether the data collectors and compilers would technically be able to report out selected subsets of their data in order to track innovation. Another concern with private sector data especially that compiled by market research firms, would be the ability or desire of such firms to report innovation- related data at no cost to the users of the data who would be looking to use the data as elements of a larger innovation scoring exercise.

Appendix 3 - Public Policy Relationship to Innovation

Public Policy	Examples of Innovation Impact
R&D Funding	Impacts scientific direction (e.g., life sciences, nanotechnology, advanced computing) and production of scientists and engineers. Supports innovation infrastructure of universities, research centers, federal labs, industry research. Specialized programs like ATP support pre-competitive collaboration. MEP supports small manufacturers and SBIR technology-based start-ups. Public R&D goals and administrative procedures can conflict and misalign with private sector goals, expectations and management requirements.
Macro Fiscal and Monetary Policy	Influences the cost of capital for innovation, rate of national economic growth investment decisions, stock market valuation of innovative enterprises, etc. Currency policy, foreign and domestic, impacts international competitiveness.
Technology Transfer Policy	Bayh-Dole Act and Federal Tech Transfer Act impact the incentive for industry-university-lab collaboration and rate of knowledge flow to innovators
Human Resource Policy	Federal education and training programs, education subsidies and research funds to support universities are a determinant of the supply of qualified workers needed for scientific research, development, and commercialization of innovation.
Tax Policy	Provides R&D incentive. Rate of depreciation affects transfer of knowledge embedded in new capital. Provides level of incentives for consumers to adopt innovation.
Standards	Facilitates platform technologies, such as Internet, computing systems, software. Standards can also function as a barrier to technical change and can restrict markets.
Procurement	Government can stimulate market and standards development through large-scale aggregation. Design specifications can restrict the introduction of new technologies.
Antitrust	Can encourage industry innovation collaboration. Encourages new market entrants.
Intellectual Property	Acts as incentive for innovators. Can restrict entry of competitors. IP protection can be weak globally, reducing return to innovation.
Market Access	Choice and access to foreign markets, export conditions and foreign direct investment influence market potential, risk and growth. Export controls can inhibit competitiveness.
Economic Regulation	Impacts innovation investment through pricing control, rates of return, market share restrictions and entry of competitive alternatives.
Social and Environmental Regulation	Can act as stimulus to innovation and also impact performance parameters of innovation. Type of regulation also impacts industry costs, relationship to suppliers and employment conditions.
Health Care Policy	Major driver of business cost of operations. Demographics and growing demand for health care creates opportunity for new products, services and productivity-enhancing technology
Privacy	Public concern creates additional demand for protecting information flows and assets.
Homeland Security	Creates government market for innovation, and creates additional economic requirements for managing risks and vulnerabilities of most economic sectors, including information industry, financial industry, water, energy, transportation, manufacturing supply chains, etc.
Employment & Trade Policy	Globalization trends can create political pressures and add to protectionist risks, constraints on global investment, “buy America” provisions. Labor, environmental and health standards can disrupt employment and investment patterns.

Appendix 4
Selected Innovation Vital Signs
Definitions and Indicators in Support of IVS Project 1.6

Input Factors
1- Research and Development
2- Talent
3- Capital
4- Networks
Process Factors
5- Management
6- Product Development
7 - Efficiency
8- Process Factors
Outcome Factors
9- Output
10- Impact
Context Factors
11 – Macroeconomy
12- Policy
13 – Infrastructure
14 – Mindset

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
1.0	**R&D Expenditures**	**R&D expenditures are** the most commonly use indicator of innovation capacity and competitive advantage. This consists of the total expenditure on R&D by nationally resident companies, research institutes, university and government laboratories, etc. It excludes R&D expenditures financed by domestic firms but performed abroad. Three types of R&D activities are typically covered: basic research, applied research and development leading to new products, processes and services.	The main aggregate used for international comparisons is gross domestic expenditure on R&D (GERD). Derivative indicators include: • R&D as percentage of GDP • R&D per capita • R&D by performing sector and source of funds • Basic Research expenditures by performing sector and source of funds • R&D financed overseas • R&D by government defense and civilian agencies • R&D by performer such as universities, government labs, private sector, etc • R&D by discipline • R&D expenditures by state or region • R&D by broad social objective, such as health, environment, security, high performance computing, biotechnology, nanotechnology, etc • R&D expenditures classified by high, medium and low tech manufacturing and service sectors	Trends in the R&D expenditures are a popular measure of competitiveness, innovation and potential for future economic growth. However, empirical studies are not clear on the nature, causality and related factors of this correlation. EU has adopted the Lisbon Strategy which calls for increasing R&D expenditure to 3 per cent of GDP by 2010, two thirds of which should come from the business enterprise sector. The BEA is experimenting with treating R&D as an investment, not as a current expense, with the effect of boosting GDP growth estimates. For international comparisons of R&D and other expenditure indicators countries are also presented in million current PPP dollars or million 2000 dollars—constant prices and PPP. The *Frascati Manual—The Measurement of Scientific and Technological Activities: Proposed Standard for Surveys of Research and Experimental Development*—is the international standard developed by OECD for collecting and using R&D statistics. ***Sources***: NSF, OECD, World Bank, UNESCO are major sources for R&D expenditure data.

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1.0	**Patents**	**Patent statistics** are used as an indicator of the inventiveness of countries, regions, and firms as well as proxies for knowledge diffusion and how internationalized innovative activities are. Among the available indicators of R&D output, patent indicators are probably the most frequently used. There is no standard method of presenting indicators from patents. Methodological choices include: 1) **patent applications;** 2) **patents granted;** 3) **triadic patent family;** and **4) international applications using the Patent Cooperation Treaty (PCT) procedure.** **1) Priority date** is the initial date of filing a patent application **2) Application date** is the date on which the patent office receives the necessary documents and filing fee **3) Publication date** is the date on which the patent is published. **4) Grant date** is the date when the patent office issues a patent to the applicant	• USPTO patents per million population • Triadic patent families per million population • Patents allocated to the country of the inventor, using fractional counting in the case of multiple inventor countries. A **triadic patent family** relates to patents applied for at the EPO and the Japanese Patent Office (JPO) and patents granted by USPTO by priority date to form patent families.	In the US a patent is awarded to the first person to make an invention regardless of who first files an application for that invention **(first to invent)** while in most countries the patent is awarded to the first person to file an application on that invention regardless of who was the first to invent **(first to file).** The US can be expected to be more dominant than other countries in these statistics due to a home advantage effect. OECD suggests patent time series should be computed with respect to the priority date, which is the earliest and therefore closest to the invention date. On average it takes three years for a patent to be granted at the United States Patent and Trademark Office (USPTO) and five years at the European Patent Office (EPO). **Sources:** Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. OECD,
1.0	**Scientific publications**	Scientific publications are widely utilized as performance indictors of national science and innovation systems.	• **number of papers—**number of papers published during time period • **total citations—**number of citations received in time period • **citation impact—**number of citations received per paper published • **per cent cited papers—**number of papers cited during period	**Bibliometrics** refers to statistical analysis of scientific publications and their citations. The **NSF** through its series of biennial Science Indicators Reports, **Science and Engineering Indicators,** publishes information on **science and engineering (S&E) articles**. This data source is derived from the Science Indicators database prepared specifically for the NSF by CHI Research, Inc. The Institute for Scientific Information (ISI) also known as Thomson ISA

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			divided by the number of papers published during period • **impact relative to world—** citation impact for country divided by citation impact for the world • **percentage papers in world—** number of papers for country divided by the total number of papers for the world • **per cent cited relative to world—**percentage of cited papers Indicators can be further analyzed by field.	produces a major statistical database—*National Science Indicators database*—on scientific papers and citations that reflect research performance by over 170 countries and covers 6,400 of the world's leading journals of science and technology. It is made available online through the Web of Science database, a part of the Web of Knowledge collection of databases. **Sources:** NSF, OECD
2.0	**Expenditure on tertiary education**	Measure of direct public and private expenditure in tertiary education institutions including expenditure on R&D.	• Gross Higher Education Expenditures • Related measures are e**xpenditure per student** and as a percentage of GDP. Some indicator reports disaggregate such data by source of funds into public and private expenditures. • State appropriations for Higher education	A widely used indictor of investment in human capital. **Sources: *Education at a Glance: OECD Indicators*** is released annually by the OECD and compares country performance with up-to-date array of education performance indicators.
2.0	**Tertiary Education in Science and Technology**	A measure of the stock of human resources in science and technology (HRST). An innovation economy requires an increasingly educated, skilled and adaptable workforce. Highly skilled S&T human resources are necessary to support technology intense innovation and diffusion. The indicator specifically, measures supply of new S&E (science and engineering) graduates in the fields of life sciences, physical sciences mathematics and	• Overall percentage of population with higher education • Total S&E Graduates • S&E Graduates per 1000 population • S&E students enrolled in college by sex, race. ethnicity, family income and institution type. • First time entry rates into tertiary education	More countries are systematically tracking scientific, technical and engineering personnel deemed necessary for innovation and longer term economic growth. International comparisons of educational levels should be interpreted cautiously because of large differences in educational systems, access, and the level of attainment that is required to receive a tertiary degree. Indicator may cover everything from graduates of one-year diploma programs to PhDs. Graduates of one-year programs are of value to incremental innovation in manufacturing

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		statistics, computing engineering and engineering trades manufacturing and processing and architecture and building,.	• Full-time S&E graduate students by field, citizenship • S&E degrees award by degree level (associate, bachelor, masters, doctoral) and type • S&T graduates employed by characteristics, wage, type of institution	and in the service sector. Current US policy concern over trends in foreign enrollment in tertiary education and intentions to stay in US or return to country of origin. International migration is important channel through which companies can access skills and talent, especially in knowledge-based sectors. The OECD developed "Canberra Manual" provides definitions of S&T human resources in terms of qualification (levels and fields of study) and occupation. HRST is defined as persons who have completed education at the third level in an S&T field of study or employed in an S&T occupation where the above qualifications are normally required. **Sources:** This indicator area is tracked by most global innovation and competitiveness reports. NSF maintains an extensive time series data base and special tabulations on these indicators. NSF, World Bank, UNESCO

2.0	**R&D personnel**	**R&D personnel indicators** includes all persons employed directly on R&D, as well as those providing direct services such as R&D managers, administrators, and clerical staff. Overhead staff whose work indirectly supports R&D is excluded	• Total R&D personnel
			• R&D personnel per 1000 employees
			• R&D personnel by occupation, covering researchers, technicians and other supporting staff.
			• R&D personnel by the performing sector, including:
			  • Business
			  • Government
			  • Higher education
			  • Non-profit
			
			.
				The unit for R&D personnel can be either full-time equivalent or head count. Both the national total of R&D personnel and the R&D personnel in each institutional sector can be broken down by type of activity, location (state or territory), socio-economic objective, and field of study.
				
				Source: NSF S&E Indicators has extensive database drawing on WebCASTPER and National Center for Education Statistics. OECD – Education at a Glance.

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2.0	**Verbal and Math Proficiency**	Science and math proficiency l is considered a core measure of the quality of K-12 education and an indicator of the competencies of the future workforce	Average math scores of students in 4.8.12 grade Average verbal scores of students in 4.8, 12 grades. Student characteristics of the above, by country, by school attribute.	The program for international student assessment (PISA) administered to 15 year olds in participating countries, measures math literacy, scientific literacy, problem solving and reading literacy. It is not a conventional school test. Rather than examining how well students have learned the school curriculum, it looks at how well prepared they are for life beyond school... The World Economic Forum Competitiveness report tracks quality of science and math education based on 1-7 scale with a sample countries responding to survey of whether math and science education lag far behind most countries or are among the best in the world. Extensive compilations of data in NSF S&E indictors. National Center for Education Statistics, National Assessment of Educational Progress (US Dept of Education), OECD education database, PISA international database
2.0	**Population completing secondary education.**	The indicator measures the qualification level of the population in terms of formal educational degrees. Provides a measure for the “supply” of human capital of that age group and for the output of education systems in terms of graduates.	The reference population is all age classes between 20 and 24 years inclusive	The level of education attainment is positively linked to entry into the labor market, income levels of individuals and access to higher education. They also have a markedly higher employment rate than persons with at most lower secondary education. However the quantity of graduates may have little to do with the quality and relevant skills of graduates. Sources: National Center for Education Statistics, OECD, NSF

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
2.0	**Participation in life-long learning**	This is an indicator of number of persons involved in life-long learning and the investment being made in continuing education and on-going competencies. Productivity, service quality and the rate of innovation are all improved by training. Continuous learning by workers enhances a firm's to cope with fast paced technological change and intense global competition. Activities that qualify as life learning include courses of relevance to the employment and general interest courses, such as in languages or arts	Participation in life-long learning per 100 population aged 25-64)	An innovation economy is characterized frequently as a knowledge economy is in which individuals are continually learning new ideas and skills and participating in life-long learning activities. The ability to learn creates a more flexible and adaptable workforce and faster adjustments to economic and technological disruption. . It includes initial education, further education, continuing or further training, and training within a company, apprenticeship, on-the-job training, seminars, distance learning, and evening classes.
3.0	**Gross Capital Formation**	.A measure of the new investment by enterprises in the domestic economy in fixed assets of the economy plus net changes in the level of inventories. Normally these assets are tangible assets, but in some cases they are intangible such as intellectual property (e.g. software). The main asset types are plant & machinery, equipment, vehicles, land-improvements and buildings.	• Gross Capital Formation • Gross Capital Formation % GDP • Capital Formation by type of asset, business sector	Investment in fixed assets is an important indicator of future economic growth, although not all types of investment contribute to future growth in the same way. Also, it is difficult to internationally compare capital goods purchased because characteristics of a capital good even with the same international brand and serial or model may actually differ from country to country because of variations in local conditions, climates, regulations or producer pricing and strategy. The characteristics of physical structures are also quite complex, variable and many times unique among countries. **Sources:** Detailed standard definitions of GFCF are provided by the United Nations System of National Accounts (UNSNA) and the IMF Balance of Payments system. The definitions used by the US Bureau for Economic Analysis for the National Income & Product Accounts (NIPA's) are very similar.

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
3.0	**(ICT) Investment in Equipment and Software**	**Information and communication technologies (ICT) Investment** indicators typically cover acquisition of equipment and computer software that is used in production for more than one year. ICT has three components: information technology equipment (computers and related hardware), communications equipment and software. Software includes acquisition of pre-packaged software, customized software and software developed in house.	• Total ICT Investment • ICT expenditures (% of GDP) • ICT per capita, employee, business sector	ICT has been the most dynamic component of overall investment activity and is considered by economists as a key driver of national economic growth and productivity. One disadvantage of this indicator is that it is ultimately obtained from private sources, with a lack of good information on the reliability of the data. Another disadvantage is that part of the expenditures is for final consumption and may have few productivity or innovation benefits, The system of national accounts can vary considerably by countries, especially in regard to the measurement of software investment, methods of deflation, the breakdown by institutional sector and the length of time series. Expenditure on software has only recently been treated as investment in the national accounts, and methodologies vary greatly across countries.
3.0	**Angel Investment**	Measures activity of **angel investors who are** affluent individual that provide seed capital for business start-up. Angels typically invest their own funds, unlike venture capital funds that professionally manage pooled money.	• # of deals • $ invested in deals • Average size of deals • # of angel networks • Can be disaggregated by region, type of business, technology area.	Angel capital fills the gap in start-up financing between the "three F"s (friends, family, and fools) of seed capital and venture capital. Most traditional venture capital funds do not consider investments under US$1–2 million. Thus, angel investment is a common second round of financing for high-growth start-ups, and accounts in total for almost as much money invested annually as all venture capital funds combined. **Sources:** Angel Capital Association (US/CA). European Business Angel Network, UNH Center for Venture Research
3.0	**Venture capital**	Investment measure of specialized firms acting as intermediaries between primary sources of finance (such as pension funds, wealthy individuals or banks) and firms Management buyouts, management buy ins, and venture purchase of shares is excluded.	• Early-stage venture capital % of GDP • Venture Capital (% of GDP) • Venture capital by state or region • Cross border inflows and outflows by country of management and country of destination.	Data on venture capital are collected by national or regional venture capital associations from their members. Statistics only capture formal venture capital (provided by specialized intermediaries). As business angels are excluded, international comparisons may be affected since in the United States business angels have tended to invest much more in new firms than venture capital funds. Not all funds managed by a venture capital

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			• Venture capital by stage of financing: • **seed capital** is provided to research, assess and develop an initial concept • **start-up financing** is provided for product development and initial marketing. • **expansion financing** is provided for the growth and expansion of a company that is breaking even or profitable.	firm operating in a given country are from investors in that country. Sources: National Venture Capital Association
3.0	**SBIR Funding**	Expenditure activity of the Federal government Small Business Innovation Research (SBIR) Program aimed at increasing the role of small firms (>500 employees) in federally supported R&D. Federal agencies set-aside a fixed percentage of R&D budgets for this purpose.	• Total SBIR Expenditures • # of SBIR awards • SBIR expenditures by Phase 1, 2 and 3. • SBIR expenditure as % of venture capital • SBIR expenditures by region • SBIR by technical field	Much of the growth in the U.S. economy has been in technology based industries whose origins can be traced to government-funded research and support. SBIR program can help drive commercialization of research and technical ideas. Companies can apply for a Phase I SBIR grants to assess scientific and technical merit or projects and feasibility of an idea. Phase II grants develop the idea further. In Phase III, the innovation must be brought to market with private sector investment
3.0	**Initial Public Offering (IPO)**	An IPO (initial public offering) is a first and one-time only sale of publicly tradable stock shares in a company that has previously been owned privately.	• # of IPO's • $ value of IPO's • IPO's by company, country, region, business sector, technology, offering price	IPO's are often smaller, younger companies seeking capital to expand their business. NASDAQ is a popular market for raising capital through IPO's. The IPO of a company serves as a significant liquidity opportunity for early investors, including founders and the Venture Capital investors. The IPO procedure is specified by the U.S. Securities and Exchange Commission (SEC). The SEC maintains a publicly available, searchable database on IPO and other corporate information that is required to be filed with the SEC. The database is called EDGAR (for:

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				Electronic Data Gathering, Analysis, and Retrieval). Sources: Thomson Financial, Ernst and Young Global IPO Report
3.0	**Stock Market Value**	Valuation of enterprises reflected by stock price based on the outlook for earnings and market value of assets. Can also be measured in terms of price/earnings (P/E) ratios.	• Aggregate value of corporate equities • % change in valuation • Value and rate of change by sector, business, country, region, R&D intensity and other innovation variables.	There is growing body of literature on how financial markets value innovation and knowledge assets of publicly traded firms. The conclusion is that the market value of corporations is strongly related to its knowledge assets, and intangible assets such as intellectual property, branding, relationships are important indicators driving equity value beyond what is formally on income and balance sheets and usual R&D measures. The movements of the prices in a market or sector can be captured in price indices of which there are many. The most regularly quoted are the US Dow Jones Industrial Average, S&P 500 and Wilshire 5000, the British FTSE 100, the French CAC 40, the German DAX, the Japanese Nikkei 225 and the Hong Kong Hang Seng Index. Other indexes with regional or sector interest include the Russell Global 1000 and Biotech Index. Such indices are calculated on the basis of total market capitalization weighted to reflect contribution of the stock to the index.

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3.0	**R&D Tax Incentives**	In the US this would refer to the R&D tax credit and other forms including write-off of current R&D and other allowances.	• Value of R&D subsidy	This indicator represents policy used by governments of many countries as an indirect way of encouraging business R&D expenditure, in contrast to direct financial support for business R&D. OECD has developed and used a 'B index methodology' to measure and benchmark the net tax treatment of R&D in OECD countries. **Sources:** Data on R&D tax incentives are found in OECD publications such as the: • *Science, Technology and Industry Scoreboard* • *Science, Technology and Industry Outlook*.
4.0	**Computers and Broadband Deployment**	Measures of business and home access to computers, internet and high speed broadband networks. Broadband corresponds to fast Internet, and includes several technologies (DSL, Cable, wireless, dedicated lines, optical fiber, etc)	• # of broadband connected businesses and homes • Broadband penetration rate (number of broadband lines per 100 population) • # of computers per capital • Internet use by business • Internet costs • Broadband costs • # of internet domain names	The US, Europe and developing nations give high priority to expanding access to high speed internet connections as critical to deployment of advanced internet applications, digital services, networking and collaborative innovation. It is a key measure of innovation capacity of the economy and is a driver of productivity. However, broadband definitions vary widely. "Broadband" is commonly understood as high speed, always-on communication links that can move large files much more quickly than a regular phone line. Broadband Internet access is available over a variety of platforms including, cable modems, digital subscriber lines (DSL), wireless, satellite, powerline (BPL), fiber optics to the home (FTTH), or Long Reach Ethernet (LRE). Because telecommunications is one of the most intensely regulated industries and regulatory policy significantly affects the pace and nature of broadband infrastructure investment. **Sources:** NSF, OECD, World Bank

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4.0	**Technology Alliances**	Measures of the number of R&D technology alliances being formed to develop and subsequently commercialize new technologies.	• # of technology alliances registered with Dept of Justice • # of alliances worldwide by country • Share of industrial alliances by field of technology	**Sources:** NSF funds two databases on technology alliances: the Cooperative Research (CORE) database and the Cooperative Agreements and Technology Indicators database, Maastricht Economic Research Institute on Innovation and Technology (CATI-MERIT). CORE records U.S. alliances registered at the U.S. Department of Justice pursuant to the National Cooperative Research and Production Act (NCRPA). CATI-MERIT covers domestic and international technology agreements and is based on public announcements, tabulated according to the country of ownership of the parent companies involved
4.0	**Federal CRADA's and Technology Transfer**	Cooperative Research and Development Agreements (CRADA's) are measures of federal laboratory-industry collaboration, technology transfer and partnerships.	• # CRADAs • # CRADAs by agency, laboratory, technology field • Other related indicators include: • Invention disclosures, patents and invention licenses.	CRADAs are one of several technology-based industry government collaboration tools available. .Federal laboratories entering into CRADAs with industrial firms and other organizations may share personnel, services, or facilities (but not funds) as part of a joint R&D project with the potential to promote industrial innovation consistent with the agency's mission. Simple CRADA counts offer a limited but illustrative window for viewing overall trends and federal agency participants. Related metrics of invention disclosures, patents, and invention licenses. Differences R&D funding structures and character of work across agencies may influence the distribution and comparability of these indicators. CRADA and other technology transfer activities are highly concentrated. DOD and DOE. ***Sources:*** Data on these and other federal technology transfer activities are available from NSF and the Department of Commerce, pursuant to federal technology transfer statutes.

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4.0	**University Spin-Outs**		• # university patent disclosures • # university licensing deals, exclusive and non-exclusive • $ licensing revenues • # companies created • $ venture capital invested in spin-outs • Efficiency of above can be measured by output generated by R&D expenditure. Data can also be broken out by institution, state, region and field of technology	**The Bayh-Dole University and Small Business Patent Act (**1980) established a uniform government-wide policy and process for government grantees and contractors to retain title to inventions resulting from federally supported R&D and stimulated invention disclosure, tech transfer and patent licensing activities at universities who were prime recipients of federal R&D funds. Metrics used to measure this activity and outputs may not be appropriate indicators for effectiveness or quality. Counting the number of spin-outs created and license deals executed per unit of R&D expenditure overlooks the importance of quality. It has been argued that narrowly defined metrics encourage universities to focus on negotiating licensing deals with industry or entrepreneurs, and may artificially increased the number of spin-out ventures. Channeling resources into licensing revenue may result in promising technologies to be prematurely spun-out with little change of attracting venture funding and being sustainable, thus failing to make a significant economic contribution. ***Sources::*** U.S. PTO, *Technology Assessment and Forecast Report: U.S. Colleges and Universities, Utility Patent Grants,* and NSF special tabulations, Association of University Technology Managers, *AUTM Licensing Survey* ASTRA
4.0	**Innovative SMEs co-operating with others**	Measures cooperative arrangements of innovating SMEs. Firms with co-operation activities are those that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years of the survey period. (*Community Innovation Survey*)	• Innovative SMEs cooperating with others (% of total number of SMEs)	This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations, in particular in ICT, often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms and between firms and other firms. The indicator is limited to SMEs because almost all large firms

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
				are involved in innovation co-operation**.** **Sources**: EU Community Innovation Survey.
6.0	**Enterprise innovation processes**	Measures on the characteristics of innovation activity at enterprise level based on the Community Innovation Survey (CIS).	CIS indicators cover: • Product, process, ongoing and abandoned innovation • Innovation activity and expenditure • Intramural research and experimental development (R&D) • Effects of innovation • Public funding of innovation • Innovation co-operation • Sources of information for innovation • Hampered innovation activity • Patents and other protection methods • Organizational and marketing Indicators can be disaggregated at the level of country, type of innovator, size-classes (employees), unit (percentage and absolute value), classification of economic activities (in accordance with NACE Rev. 1) and innovation indicators.	The *Community Innovation Survey* is the best available cross country data set carried out on a two yearly basis covering EU Member States, candidate countries, Iceland and Norway. The guidelines for developing enterprise level indicators have been codified by the OSLO Manual, most recently in its third edition 2006. The latest OSLO manual gives greater recognition to non-technological innovation such as organizational structures (business models), management practices and marketing innovation. The indicators which are comparable across the European Community are derived from European Community Innovation Survey. The US has no comparable innovation survey. The EC survey focuses on firm propensity to innovate and indicators related to sources of information, outcomes use of intellectual property and barriers to innovation. The most recently completed fourth survey (CIS-4) is a cross-sectional survey of all firms with over 10 employees in all 27 EU member states conducted in 2005 with over 60,000 respondents. The survey includes all manufacturing sectors and many service sectors. **Sources:** Data are available from the Eurostat New Cronos website

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
6.0	**Speed in Launching a New Product**	A measure of how quickly a new product or service is transformed from initial concept to market introduction.	• Time required for innovation stages of development • Cost reduction	For this measure to be credible it needs to be derived from a firm level performance system. Measures in this area are typically geared to production of tangible goods or services. The creation of economic value and wealth also lies in the creation, acquisition and exploitation of so-called intangibles. Competitive success requires a critical capacity to develop, manage, measure and control the flow of knowledge and intangibles. Our understanding of these processes is limited, and a major factor in this ignorance is the paucity of good data and disclosure guidelines on business intangibles.
8.0	**SMEs innovating in-house (% of SMEs)**	Sum of SMEs with in-house innovation activities. Innovative firms are defined as that that introduced new products or processes either 1) in-house or 2) in combination with other firms. This indicator does not include new products or processes developed by other firms.	• Total number of SMEs innovating in-house and as % of total SMEs. (*Community Innovation Survey*)	This indicator measures the degree to which SMEs that have introduced any new or significantly improved products or production processes. The indicator is limited to SMEs because almost all large firms innovate and because countries with an industrial structure weighted to larger firms would tend to do better. **Sources:** Community Innovation Survey
8.0	**Innovation expenditures by enterprises**	Measure of the total sum of total innovation expenditure for enterprises, in national currency and current prices. Innovation expenditures includes the full range of innovation activities: in-house R&D, extramural R&D, machinery and equipment linked to product and process innovation, spending to acquire patents and licenses, industrial design, training, and the marketing of innovations. (*Community Innovation Survey*)	• Aggregate innovation expenditure by business • Innovation expenditures (% of sales)	This indicator measures total innovation expenditure and as a percentage of total sales. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas. Overall, the indicator measures total expenditures on many activities of relevance to innovation. The indicator partly overlaps with the indicator on business R&D expenditures. **Sources:** Community Innovation Survey. No comparable US survey.

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
8.0	**SMEs who introduced an organizational innovation**	Measures small to medium sized enterprises who introduced an organizational innovation (% of SMEs)	Number or per cent of SMEs who have either introduced: • "new or significantly improved knowledge management systems", • "a major change to the organization of work within their enterprise" or • "new or significant changes in their relations with other firms or public institutions". A 'Yes' response to at least one of these categories would identify a SME as having introduced an organizational innovation. (*Community Innovation Survey*)	The Community Innovation Survey mainly asks firms about their technical innovation, Many firms, in particular in the services sectors, innovate through other non-technical forms of innovation. Examples of these are organizational innovations. This indicator tries to capture the extent that SMEs innovate through non-technical innovation. **Sources:** Community Innovation Survey
9.0	**New Products and Services Introduced**	Measures the introduction of products or services which are **new** to a business. Its characteristics or intended uses differ significantly from previously produced products or services. It does not include the selling of new products wholly produced and developed by other businesses.	• # of new products/services introduced • Type of innovating business by size and business sector • Source of innovation ideas by type of innovator • Type of innovative activity leading to new product or service • Ratio of R&D expenditures to total innovation expenditure for new product/service • Sources of innovation funding • Collaborative arrangements for development of new product/service • Export sales of new products and services • Intellectual Property receipts • Type and value of government funding support • Factors hampering innovative activity	Many of these indicators are adaptations of the EU Community Innovation Surveys such as Innovation in Zealand who conduct specialized country surveys. **Closely related indicators are:** **Significantly Improved Product/Service:** Is an existing product/service, whose performance has been significantly enhanced or upgraded. Purely aesthetic or minor modifications are not included. **New Production/ Manufacturing/ Delivery Process: i**ntroduction of new or significantly improved production technology or ways of delivering products. **Significantly Improved Production/Manufacturing/ Delivery Process:** significant changes to a business's existing processes which result in changes to the level of output, **New or Significantly Improved Service Process:** new or improved methods of supplying a service that improves the output, cost, quality or delivery of the service Numerous methodological issues are involved in

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
				attempting comparisons across national boundaries due to variances in data collection methods, sources, sample composition and definitions. Nevertheless, research in the area enterprise level innovative activity is expanding rapidly and becoming a rich source of metrics and analysis of innovation activity and outcomes. **Sources**: OECD, New Zealand Innovation, European Innovation Scorecard.
9.0	**Outcomes of Enterprise Innovation Activity**	Measures of the direct output and benefits gained by innovating enterprises	• Critical to staying in business • Increased profitability • Increased product/service offering • Opened new or expanding market within country of operations • Opened new markets overseas • Replaced products being phased out • Improved efficiency • Reduced energy consumption • Reduced environmental impact • Met health, safety and other standards	These enterprise outcome indicators are an example of a country specific survey—Innovation New Zealand.
9.0	**Sales of new-to-market products**	Sum of total revenue of new or significantly improved products for all enterprises.	• Sales of new-to-market products • (% of revenue) Total revenues for all enterprises, in national currency and current prices.	This indicator measures the sales of new or significantly improved products, which are also new to the market, as a percentage of total sales. The product must be new to the firm, which in many cases will also include innovations that are world-firsts. The main disadvantage is that there is some ambiguity in what constitutes a 'new to market' innovation. Smaller firms or firms from less developed countries could be more likely to include innovations that have already been

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
				introduced onto the market elsewhere. **Source:** Community Innovation Survey
9.0	**Sales of new-to-firm products**	Sum of total revenue of new or significantly improved products to the firm but not to the market for all enterprises.)	• Sales of new-to-firm products (% of turnover) • Total revenue for all enterprises, in national currency and current prices. (*Community Innovation Survey*)	This indicator measures the revenue of new or significantly improved products to the firm as a percentage of total sales. These products are not new to the market. Sales of new to the firm but not new to the market products are a proxy of the use or implementation of elsewhere already introduced products (or technologies). This indicator is thus a proxy for the degree of diffusion of state-of-the-art technologies. **Source:** Community Innovation Survey
9.0	**New community trademarks**	A trademark is a distinctive sign, which identifies certain goods or services as those produced or provided by a specific person or enterprise. The Community trademark offers the advantage of uniform protection in all countries of the European Union on the strength of a single registration procedure with the Office for Harmonization.	• Number of new community trademarks per million population	The Community trade mark gives its proprietor a uniform right applicable in all Member States of the European Union on the strength of a single procedure which simplifies trade mark policies at European level. It fulfils the three essential functions of a trade mark at European level: it identifies the origin of goods and services, guarantees consistent quality through evidence of the company's commitment vis-à-vis the consumer, and is a form of communication, a basis for publicity and advertising.

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
9.0	**New community designs**	Number of new community designs. A registered Community design is an exclusive right for the outward appearance of a product or part of it.	• Number of new community designs per million population. • Outward appearance of a product or part of it resulting from the lines, contours, colors, shape, texture, materials and/or its ornamentation	A product can be any industrial or handicraft item including packaging, graphic symbols and typographic typefaces but excluding computer programs. It also includes products that are composed of multiple components, which may be disassembled and reassembled.
10.0	**Employment in high-tech manufacturing**	Number of employed persons in the medium high and high-tech manufacturing sectors. These include chemicals (NACE24), machinery (NACE29), office equipment (NACE30), electrical equipment (NACE31), telecommunications and related equipment (NACE32), precision instruments (NACE33), automobiles (NACE34) and aerospace and other transport (NACE35).	• Employment in medium-high and high-tech manufacturing (% of total workforce) • The total workforce includes all manufacturing and service sectors.	The share of employment in medium-high and high technology manufacturing sectors is an indicator of the manufacturing economy that is based on continual innovation through creative, inventive activity. The use of total employment gives a better indicator than using the share of manufacturing employment alone, since the latter will be affected by the hollowing out of manufacturing in some countries.
10.0	**Employment in high-tech services**	Measures employment in the high-tech services sectors including post and telecommunications (NACE64), information technology including software development (NACE72) and R&D services (NACE73).	• Employment in high-tech services (% of total workforce) • The total workforce includes all manufacturing and service sectors.	The high technology services go directly to consumers, such as telecommunications, and provide inputs to the innovative activities of other firms. The latter can increase productivity throughout the economy and support the diffusion of innovations, in particular those based on ICT.
10.0	**Trade in highly R&D-intensive industries and high technology industries**	**Highly R&D-intensive industries** are defined according to the *International Standard Industrial Classification* (ISIC) in and include: • **aerospace industry** • **electronic industry** • **office machinery and computer industry** • **pharmaceutical industry** • **medical, precision and optical instruments, watches and clocks (instruments) industry**	The OECD classification of manufacturing industries into **high-technology**, **medium-high-technology**, **medium-low-technology and low-technology groups** can be used to generate indicators on industry employment or value added by technology intensity.	Data on **trade in highly R&D-intensive industries** are taken from the OECD *International Trade Statistics* database and have been converted from the Harmonized System (HS) and the Standard International Trade Classification. Data on **trade in high-technology industries** are taken from the OECD *International Trade Statistics* database. The conversion requires attributing each product to a specific industry. Because no detailed data are available for services at present, industry and product classification only concerns manufacturing

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
				industry. **Sources:** Data on technology trade are available from the OECD *Main Science and Technology Indicators Database,* an electronic data product of *Main Science and Technology Indicators*.
10.0	**High tech Exports**	Measures of high-tech exports, in national currency and current prices.	• Exports of high technology products as a share of total exports • Value of total exports, in national currency and current prices. High-tech exports include exports of the following products: aerospace; computers and office machinery; electronics; telecommunications; pharmaceuticals; scientific instruments; electrical machinery; chemistry; non-electrical machinery and armament	The indicator measures the technological competitiveness of a country and its ability to commercialize the results of research and development (R&D) and innovation in the international markets. It also reflects product specialization by country. High technology sectors are key drivers for economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment. The Brussels European Council (2003) stressed the role of public-private partnerships in the research area as a key factor in developing new technologies and enabling the European high-tech industry to compete at the global level.
10.0	**Technology trade**	**Technology balance of payments** is a measure of commercial transactions related to exports and imports of technology consisting of money paid or received for the acquisition and use of patents, licenses, trademarks, designs, know-how and closely related technical services (including technical assistance) and for industrial R&D carried out abroad.	TBP payments as a percentage of gross domestic expenditure on R&D (GERD) gives an indication of the share of imported technology in domestic R&D efforts. TBP receipts relates to a country's exports of technology, which reflect its competitiveness in the international market for knowledge.	The technology performance of an economy is often measured by commercial transactions related to international technology transfers, and international trade and exports in the high-technology sector. Technology and international diffusion of technology are central to the changes running through the world economy in our era. TBP records a country's exports and imports of technical knowledge and services. Although the TBP reflects a country's ability to sell its technology abroad and its use of foreign technologies, a deficit does not necessarily indicate low competitiveness. Most transactions

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
				also correspond to operations between parent companies and affiliates, which may create distortions in the valuation of the technology transfer. Thus, additional qualitative and quantitative information is needed to analyze correctly a country's deficit or surplus position. **Sources:** The **Technology Balance of Payments Manual (TBP Manual)**, released by the OECD in 1990, provides a definition of the types of transactions to be included in the TBP, and the characteristics of transactions and contracts.
10.0	**Productivity**	Productivity is a measure of how efficiently production inputs are used in an economy. P productivity is a major contributor to long-run economic growth and improved living standards. Productivity also provides a broad indication of the scope for non-inflationary increases in wages and salaries. . Labor productivity is defined as GDP per hour worked. Multifactor or total factor productivity involves breaking down the growth of gross domestic product (GDP) into three components—the contribution of labor, the contribution of capital, and multi-factor productivity (MFP) which is calculated as a residual and characterized as a measure of innovation by prominent economists. Improving total factor productivity measures are a key priority in the US and Europe.	Productivity can be calculated at an aggregate national level as well as by business sector. **Labor productivity growth** can be calculated as the difference between the rate of growth of output or value added and the rate of growth of labor input. Value added is measured after deducting government real consumption of fixed capital (at constant prices) and real indirect taxes less subsidies. **Multifactor productivity** is the change in GDP that cannot be explained by changes in the quantities of capital and labor that are made available to generate GDP. MFP is sometimes described as 'disembodied technological progress'. It is the increase in GDP that is not 'embodied' in either labor or capital and comes from more efficient management of the processes of production—	There are many different approaches to the measurement of productivity. Labor productivity Measures are more timely and internationally comparable and suffers less from measurement errors than currently available multifactor productivity data. According to Dale Jorgenson existing official measures of Total Factor Productivity, generated by BLS, are not integrated with the national accounts. Also, the BLS industry-level measures of Total Factor Productivity are not consistent with the economy-wide measures; for example, industry-level measures of labor input are based on hours worked, while economy-wide measures reflect changes in the composition of hours worked by age, gender, and education that result in enhanced inputs of labor services. As a consequence, the industry-level measures fail to conform to the international standards established by the OECD *Productivity Manual*. Jorgenson and Steven Landefeld are working on a new underlying architecture of the U.S. System of National Accounts to facilitate development of improved and more granular measures of innovation and productivity by unifying the National Income and Product Accounts with productivity statistic. This would incorporate

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
			through better ways of using labor and capital, through better ways of combining them, or through reducing the amount of intermediate goods and services needed to produce a given amount of output.	BEA's new system of official statistics on output, intermediate input, employment, investment, fixed assets, and imports and exports by industry, when it becomes available in 2008. The system of industry production accounts would use the North American Industry Classification System (NAICS) employed in BEA's official statistics. The accounts would include capital and labor inputs for each industry. Industry outputs, as well as intermediate, capital, and labor inputs would be presented in current and constant prices along with Total Factor Productivity. Another similar effort is the EU KLEMS multi-factor productivity (MFP) which is a productivity measure that relates gross output to primary (capital and labor) and intermediate inputs (energy, other intermediate goods, services). **Sources:** Bureau of Economic Analysis, BLS**.** OECD has developed a reference database on productivity, the so-called **Productivity database** which provides data on productivity and productivity growth in OECD member countries.
10.0	**Enterprise Birth and Death Rates**	Measures formation of new enterprises as well as net change after adjusting for enterprise death rate	• Gross birth rates of enterprises • Net change of enterprise population (birth rate minus death rate)	**Sources:** EU Regional Benchmarks

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
10.0	**High Tech Jobs Gained and Lost**	Measures employment in the high tech sector.	• High tech jobs gained • High tech jobs lost • Net change	**Sources:** ASTRA
11.0	**GDP per capita and standard of living**	Gross domestic product (GDP) per capita is a frequently used as an indicator of national income.	• Real GDP per capita • GDP per capital by state and country • Growth rate of GDP per capita	It measures the gross value of all goods and services produced in a country and are generally accepted as an internationally comparable indicator of material living standards. **Sources:** BEA, UN, World Bank, OECD
11.0	**Gross domestic product (GDP)**	GDP in nominal and real terms is a broad measure of economic activity and considered the ultimate output of innovative activity and is a measure of overall economic performance. **Real Gross domestic product** can be defined in three different ways: as the sum of labor incomes, net profits and depreciation; as the difference between gross output and intermediate consumption; or as the sum of consumption expenditures, fixed capital formation, changes in inventories and net exports.	• **GDP year to year growth** • **GDP per capita** • **GDP by state or region** • **Real GDP growth rates** are obtained by converting GDP to constant prices and calculating the change from year to year.	There are no standard rules for converting current price GDP to constant prices and there are some differences between countries in the ways that they convert government consumption and some types of capital equipment to constant prices. **Sources:** Data on GDP and growth of real GDP in OECD countries are available in a number of data sources and publications including: • IMF World Economic Outlook • OECD Economic Outlook • OECD in Figures • OECD Factbook 2005 • Science, Technology and Industry Scoreboard. • BEA

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
11.0	**Inflation**	Refers to a rise in the general price level, as measured against a standard level of purchasing power.	There are many varying measures. The most well known are the consumer price index (CPI) which measures the change in nominal consumer prices. The GDP deflator measures inflation in new products and services created and producer price indices (PPIs). Measure prices received by a producer	Inflation measures are often modified over time, either for the relative weight of goods in the basket, or in the way in which goods from the present are compared with goods from the past. This includes hedonic adjustments and "reweighing" as well as using chained measures of inflation. **Sources:** BLS
12.0	**Public Policies**	Measures that track a variety of public policies of significance to innovation activity and outcomes	• Corporate tax rate • Overall Tax Burden • # of new laws on taxies excises and duties • # procedures to start a business • Prevalence of trade barriers • Foreign Ownership Restrictions • Intellectual Property Protection • Rule of Law Governance Indicators	No comprehensive measure or database on policy indicators presently exists. Measures cited come from a variety of data sources. **Sources:** Global Competitiveness Index, World Bank, national (e.g. Denmark) and regional innovation reports (Washington State)
13.0	**Infrastructure**	Infrastructure measures of significance to innovation performance.	• Judicial Independence • Intellectual Property Rights • Infrastructure Quality • Environmental Governance • Openness to Competition Index • Innovation Composite Ranking • Legal Rights Index • # of New Buildings Designed • Home Affordability	Diverse indicator sources make up this measurement area. **Sources**: IMD, Economic Freedom Index, EU Benchmarking Enterprise, Hong Kong Creativity Index

#	Innovation Indicator	Definition	Derivative Measures	Interpretation and References
14.0	**Public Attitudes and Sources of S&T Information**	Measures public attitudes to S&T issues and sources of S&T new s and information.	Attitudes to S&T by: • Level of interest • Youth interest in science • Science Related News Stories • Demographic characteristics • Visits to museums, zoos and libraries • How well informed about S&T Issues S&T news source by: • Television • Internet • Newspapers • Magazines	The public gets news and information about S&T from a wide variety of sources. Traditionally the largest source is TV but internet is gaining as a medium, particularly for information about specific S&T subjects. Data in this area comes from a variety of organizations, each with a different purpose and context and therefore difficult to compare internationally. . **Sources:** NSF Surveys of Public Attitudes and S&E Indicators, Pew Research Center, News Interest Center, Survey of Consumer Attitudes, IMD, international surveys and special studies and tabulations.
14.0	**Wish to Own One's Business**	The indicator measures people's preferences to own their own business. .	• # of people interested in being employee, self employed or setting up a business • Reasons for wanting to be employed or self employed • % of entrepreneurs in relationship to total workforce • Fears, difficult Issus, risks and success factors in setting up a business • Demographic characteristics of entrepreneurs	The development of entrepreneurship has gained top level policy attention, particularly in Europe and emerging economies because of the important benefits, both economically and Socially. Entrepreneurship is a driving force for the creation of jobs, competitiveness and growth. It also contributes to personal fulfillment, creativity and the achievement of social objectives. Based on opinion survey that measures the degree to which national culture and norms support entrepreneurship and the starting up of new business. Numerous factors come into play in the decision to set up a company, for example, the existence of a business opportunity, administrative complexities, as well as financial obstacles or skills. The indicator is available for the 25 countries of the EU and for the USA, Norway, Iceland and Lichtenstein. **Sources**: The data is published by European Commission "Flash Euro Barometer" Another source of entrepreneurship indicators is the Global Entrepreneurship Monitor (GEM).

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14.0	**Value Placed on Creativity**	This is a measure of cultural norms and attitudes towards creativity, value place on arts, art education and on the issue of intellectual rights protection	• Value placed on creative activity • Value place on school-aged children's creative activity	Richard Florida has articulated a framework for evaluating a creative economy in the book *The Rise of the Creative Class.* His key finding highlights the emerging pattern of geographic concentrations of the creative class in individual regions. According to his creative capital theory members of the creative class are more likely to be economic winners and succeed in generating high end jobs and economic growth. Creative people prefer places that are diverse, tolerant and open to new ideas and the presence and concentration of creative capital in a region leads to higher rates of innovation. **Sources:** Creativeclass.com, Hong Kong Creativity Index