Measuring Innovation Performance

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Measuring Innovation Performance

Executive Summary

Innovation is key to growth and competitiveness in the modern economy. The benefits of innovation to both companies at the corporate level and economy at the national level is irrefutable. From a firm perspective, innovation leads to new products, processes and services, which allow a firm to reduce its production costs, access new markets or develop new ways of doing things. Innovative companies augment the general competence base in their field, and trigger learning processes, which may benefit, or spill over into, other areas or sectors. This is what Sena (2004, p.F313) highlighted in his recent article as the “multiple spill-over effects” in an economy. Investments in innovation have an impact on national economic growth and long-term competitiveness. Governments around the world realise the potential benefits of such investments and are keen to develop indicators to measure the extent of their investments and their innovation capability.

This industry digest looks at the developments of innovation performance measurement at the corporate, national and global level, with particular focus on the national level in recent years. We generalised that at the national level, innovation performance measurement tools are devised mainly to benchmark the innovation performance of the whole country against that of other countries in the region or worldwide. The measurement tools often come in the form of innovation scoreboards. These innovation scoreboards are used to measure innovation performance of the nation as a whole based on data from both private and public sectors. At the corporate level, the innovation performance tools usually come in the form of innovation index, indicated in terms of the level (intensity) of innovation performance in the firm. Return on innovation investment is a particular indicator that is of most interest to CEOs in the private sectors. While private sectors can measure their return on innovation investment (ROI²), it is difficult for public sector or non-profit organisations to do so. On the whole, there is a lack of tools to measure return on public sector’s investment in innovation or how innovation investment impact the bottom line. Therefore this remains a challenge for future research.
Corporate Innovation Measurement

Measuring innovation performance in private sector organisations is a relatively new area. Many companies have little experience in determining suitable metrics for innovation. Sometimes, their metrics may be too biased or one-sided, focusing on technological innovations and tracking patent submissions while ignoring non-patentable innovations. Some may even be misleading, such as accounting the volume of ideas generated from an idea management initiative. Innovation performance measurement in the private sector varies widely according to how each organisation defines innovation, and requires careful scrutiny in order to realise the usefulness of their innovation metrics.

There are however, a number of metrics that are commonly used for measuring innovations in the private sector:

- **Revenue growth from new products**: Most widely used metric by the leading firms. It is based on strategic targets set by the business and an understanding of how the company can achieve its growth targets (the Innovation Gap).

- **Patent submission**: An increasingly popular approach that is widely abused by many firms outside of the high tech and pharmaceutical industries. Patents are only one form of protectable intellectual property and many firms focus more on the legal aspects of protection than the business upside.

- **Idea submission and flow**: The ideas flowing through an idea management system provide a visible reference point to the volume and quality of submissions.

- **Innovation capacity**: Companies measure innovation capacity using survey tools such as KEYS, the Innovation Climate Questionnaire or other tools and use the information on a 12- to 24-month basis to determine whether the company has become more innovative.

Forrester researchers revealed from a survey of 20 manufacturing firms worldwide that 70 percent of the firms used “revenue from new products” to measure the success rate of their innovations. Another 60 percent used “profits from new products”; 50 percent used “gains in market share”; 35 percent used “time-to-market”; 25 percent used “number of patents filed”, while 10 percent used “conversion rate of patents into products” to measure the success of their innovations.

In another survey launched by Boston Consulting Group in October 2003, which assessed senior managers’ views and experiences concerning “innovation-to-cash” process, majority of the respondents (48 percent) measure their success with innovation using the “overall revenue growth” indicator. Other popular indicators include: customer satisfaction (34 percent), percentage of sales from new products (33 percent), number of new products or services (25 percent), etc.

According to Mark Turrell (2004), leading companies are able to realise that a single metric, such as revenue growth or idea submission, is a poor indicator of innovation performance, and are developing a so-called “innovation index”, which combines a series of metrics to provide a more balanced view of innovation.

Recent developments in innovation index include the Index of Corporate Innovation (ICI) developed by the Conference Board of Canada, to help companies audit their innovation performance. This diagnostic tool was the first to be offered in Canada to help organisations to assess, benchmark and improve innovation inside the firm. (See Table 1).
Some organisations have made use of the Balanced Scorecard to measure innovation. The Balanced Scorecard (BSC) is a strategic management and measurement system developed by Drs. Robert Kaplan (Harvard Business School) and David Norton in the early 1990’s. It looks at the organisation from four perspectives: financial perspective, customer perspective, internal process perspective and learning and growth perspective. Some of the indicators used in the BSC are relevant to the outcomes of innovation. However, "even the BSC advocates acknowledge the difficulties of measuring outputs of innovation and resort to customer surveys with indexes constructed from them". (See Table 1).

Table 1. Innovation Measurement Tools

<table>
<thead>
<tr>
<th>Tool</th>
<th>Indicators</th>
<th>How it Works</th>
<th>Devised by</th>
</tr>
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<tbody>
<tr>
<td>Index of Corporate Innovation (ICI)⁵</td>
<td>Corporate Culture, Leadership, Workforce Capacity, Organisational processes and structure, Collaboration and partnership, Investment in innovation, Innovative performance</td>
<td>Employees will be asked to complete on-line surveys. The consultant will then analyse the surveys and provide the ICI report card to the organisation. From the results, action plans will be devised and integrated into the organisation’s operations and strategy.</td>
<td>Conference Board of Canada</td>
</tr>
<tr>
<td>Balanced Scorecard</td>
<td>Indicators relevant to measuring innovation (Singapore examples)⁶: Customer perspective, Customer-loyalty index (%), Public contact programme (under PS21), Developmental perspective, R&amp;D expenses ($), Hours, R &amp; D (% of total time spent), R&amp;D expenses/total expenses, (%) Investment in training/customers (No.), Patents pending (No.), Average age of company patents (No.), Suggested improvements/employee (No.), Competence development expense/employee ($), Satisfied-employee index, Employee’s view (empowerment index) (No.), Share of employees below age X (%), Ratio of new products (less than X years old) to full company catalogue (%)</td>
<td>The balanced scorecard methodology builds on some key concepts of previous management ideas such as Total Quality Management (TQM), including customer-defined quality, continuous improvement, employee empowerment, and measurement-based management and feedback. It involves developing outcome metrics based on the priorities of the strategic plan, which provides the key business drivers and criteria. Processes are then designed to collect information relevant to these metrics. Decision makers examine the outcomes of various measured processes and strategies and track the results to guide the company and provide feedback.⁷</td>
<td>Developed by Robert Kaplan and David Norton. Applied by both public and private organisations worldwide.</td>
</tr>
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In his article on "Measuring Your Return on Innovation", Thomas D Kuczmarski (2000) provided a pretty comprehensive look at measuring innovation at the corporate level. He divided innovation metrics into two types:

- Innovation performance metrics (those that measure growth); and
- Innovation programme metrics (those that measure and reflect programme management and control).

Innovation performance metrics include return on innovation investment (ROI2 or R2I), new product success rate, new product survival rate, cumulative new product revenue and cumulative new product profit, and growth impact. (See Table 2).

Programme metrics include R&D innovation emphasis ratio, innovation-portfolio mix, process-pipeline flow, innovation revenues per employee, and speed to market. (See Table 3).

Table 2. Performance Metrics

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<tr>
<th>Metric</th>
<th>Components</th>
<th>Potential Implications</th>
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<tbody>
<tr>
<td>Return on innovation investment (R2I)</td>
<td>Cumulative net profits generated from new products launched</td>
<td>Single, standard measure for comparing performance between divisions, over time, and within industry.</td>
</tr>
<tr>
<td></td>
<td>Research costs + development costs + incremental production costs + initial commercialisation pre-launch costs</td>
<td></td>
</tr>
<tr>
<td>Cumulative profits</td>
<td>Cumulative (3-5 years) profits from new products</td>
<td>Impact on income statement</td>
</tr>
<tr>
<td>Cumulative revenues</td>
<td>Cumulative (3-5 years) revenues from new products</td>
<td>Impact on income statement</td>
</tr>
<tr>
<td>Growth impact</td>
<td>Revenues from new products over 3-5 years 3 year revenue growth</td>
<td>Contribution to firm growth</td>
</tr>
<tr>
<td>Success rate</td>
<td>Number of new products exceeding 3-year original forecasts</td>
<td>Indicates quality of planning</td>
</tr>
<tr>
<td></td>
<td>Total number of new products commercialised in last 3 years</td>
<td></td>
</tr>
<tr>
<td>New product survival rate</td>
<td>Number of new products remaining in the market (time period X)</td>
<td>Provides insight about the demand of new product introductions relative to total new product efforts</td>
</tr>
<tr>
<td></td>
<td>Total number of new products launched (time period X)</td>
<td></td>
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Table 3. Programme Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Category</th>
<th>Components</th>
<th>Potential Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed-to-market</td>
<td>Speed</td>
<td>$\Sigma$ (Time from idea generation to market launch for new products)</td>
<td>Indicated efficiency of R&amp;D process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total number of new products</td>
<td></td>
</tr>
<tr>
<td>R&amp;D innovation emphasis</td>
<td>Amount</td>
<td>Cumulative (3-5 years) R&amp;D expenditure allocated solely to new products</td>
<td>Indicates strength of innovation focus within R&amp;D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cumulative (3-5 years) R&amp;D expenditure</td>
<td>Allows for simple check on R&amp;D execution of innovation strategy</td>
</tr>
<tr>
<td>New product portfolio mix:</td>
<td>Type</td>
<td>Number of new products of type X</td>
<td>Indicates how well balanced new products portfolio is compared with strategic goal</td>
</tr>
<tr>
<td>New product types:</td>
<td></td>
<td>Total number of new products</td>
<td></td>
</tr>
<tr>
<td>1. New to market</td>
<td></td>
<td>Revenues from new products of type X</td>
<td></td>
</tr>
<tr>
<td>2. New to company</td>
<td></td>
<td>Total revenues from new products</td>
<td></td>
</tr>
<tr>
<td>3. Line extensions/ improvements</td>
<td></td>
<td>Expenditure for products of type X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total expenditure on new products</td>
<td></td>
</tr>
<tr>
<td>Process Pipeline Flow</td>
<td>Amount</td>
<td>Number of new product concepts in each stage of development</td>
<td>Quantifies how full the pipeline is and helps with forecasting future revenues and expenses. Can also indicate at which stages there might be bottlenecks or glitches in the process.</td>
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<tr>
<td></td>
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<td>Sample product stages:</td>
<td></td>
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<td></td>
<td></td>
<td>1. Concept analysis</td>
<td></td>
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<td></td>
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<td>2. Prototype development</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3. Market testing</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4. First year of launch</td>
<td></td>
</tr>
<tr>
<td>Innovation revenues/ employee</td>
<td>Success</td>
<td>Total annual revenues from commercialised new products</td>
<td>Provides insight about the effectiveness of additional resource allocations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total number of full-time equivalent employees devoted solely to innovation initiatives</td>
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National Innovation Measurement

Governments around the world sought innovation to increase public value. Since the beginning of the 21st century many of the world’s nation states have engaged in serious efforts to reform their governments and inject a culture of innovation into their public sectors. Countries like the United States, United Kingdom, Australia, New Zealand and the European countries have developed one form of indices or another to measure their innovation performance.

Australia

In 2001, the Australian Government introduced a $3 billion "Backing Australia's Ability” initiative to promote science and innovation over five years from 2001-02 to 2005-06. It is the largest and most comprehensive set of measures ever put in place by any Australian Government in support of science and innovation. An innovation scoreboard was designed to benchmark Australia against other OECD countries. The scorecard uses 15 indicators to measure innovation performance, and is designed to reflect the flow of the innovation process. The indicators are grouped into six categories:

- Knowledge creation - the ability to generate new ideas and technologies;
- Human resources - the capacity of the labour force to transform these ideas and technologies into tangible economic outcomes;
- Finance - the pool of funds available to commercialise ideas and technologies;
- Knowledge diffusion - the capacity of the economy to transfer new ideas and technologies to other firms;
- Collaboration - the international linkages of Australia’s innovation system; and
- Market outcomes - economic return on the investment in innovation.

The innovation scorecard is comparable with scorecards from the OECD, the European Union, Canada, New Zealand, and some States of the USA.

Canada

There are abundant data on science and innovation in Canada. In total, there are over 100 different indicators used to assess science and technology in the country and the provinces.

Recently the conference Board of Canada and the Canadian Science and Innovation Indicators Consortium (CSIIC) conducted the first national exercise to benchmark science and technology in the country. It arrived at 16 indicators:

- Knowledge performance
  - Gross domestic expenditure on R&D as a percentage of GDP (GERD/GDP)
  - Business enterprise expenditure on R&D as a percentage of GDP (BERD/GDP)
  - Publication of scientific papers per 1 million population
  - Triadic patent families
  - University-Industry Collaboration in R&D
A more comprehensive overview on Canada’s innovation benchmarks can be found in the report “Exploring Canada’s Innovation Character: Benchmarking Against Global Best”,12 which presents a framework for understanding innovation, evaluates Canada’s performance and makes suggestions for future actions. In order to assess Canada’s performance, the Conference Board of Canada has selected 17 indicators of innovation and evaluated Canada against 10 other countries: Australia, Finland, France, Germany, Italy, Japan, Spain, Sweden, the United Kingdom and the United States. The indicators used are of those listed above, with an additional indicator: “Human resources in science and technology occupations” under “Skills Performance”.

Europe

In Europe, the primary instrument for measuring innovative strength is the Trend Chart on Innovation13 which provides collection, updating, analysis and dissemination of information in innovation policies (and indicators) at national and EU level. One component of the Trend Chart is the European Innovation Scoreboard (EIS). The European Innovation Scoreboard, which was developed and published under the request of the Lisbon European Council, has been used as a measuring and benchmarking tool for measuring innovation performance in the European Union since 2000. The Scoreboard tracks 17 main indicators for all of the 25 member countries, 3 candidate countries (Bulgaria, Romania, Turkey), 3 associate countries (Iceland, Norway, Switzerland), the U.S. and Japan13.

Each year, revisions and improvements were made to the EIS. The 2004 scoreboard is drawn up using 20 indicators, measuring human resources, the creation of new knowledge, the transmission and application of knowledge, and innovation finance. A composite indicator, “Summary Innovation Index” (SII),14 provides an overview of national performances. The 2004 EIS examines for the first time15:

- non-technological innovation;
- sector specific innovation; and
- differences between types of innovators and innovation modes.
New Zealand

Just as Dr. Elaine C. Kamarck (2003) has stated, New Zealand’s record in innovation and reform over the past two decades is nothing less than remarkable. It has made tremendous efforts to inject competition and continuous innovation into government, and as such, it has been studied by nations all over the world who are seeking to improve their own government performance. However, Allen Schick (Kamarck, 2003) cautioned that New Zealand’s reforms rely very much on the notion of contracts, and its model may not be feasible in countries that have large informal sectors.16

The New Zealand government has identified an initial set of 17 growth and innovation indicators, which are intended to provide information on New Zealand's progress towards achieving a high value-added economy. The indicators are categorised into five key 'headline' indicators 17:

- Material standard of living
- Productivity
- Talent and skills
- Innovation, entrepreneurship and technological change
- Global connectedness

The fourth ‘headline’ indicator “Innovation, entrepreneurship and technological change” is unique to measuring innovation. The indicators selected to reflect this are 18:

- Breakdown of R&D investment by sector and by type
- Intangible investment as a percentage of GDP
- Innovativeness of New Zealand firms
- Proportion of firms using the latest technology in value-added high-tech manufactures
- Value-added in high-tech manufactures as a share of total gross value-added.

Specifically, the Innovation Report Card19 published by the Science and Innovation Advisory Council (SIAC) in 2001 tracked the progress of innovation in New Zealand. It tracked innovation in five key areas:

- People’s skills and knowledge
- Performance on the global stage
- Generating wealth from ideas
- Networks and ICT infrastructure
- Attitudes and culture

Despite the publishing of the Innovation Report Card, the SIAC highlighted in its report, Turning Great Ideas into Great Ventures,20 that it has not yet progressed work on a set of explicit innovation indicators for New Zealand. The innovation report card suggested a number of high-level goals and indicators to measure progress towards an overall innovative New Zealand goal and vision, but a set of sub-goals to focus on investment of resources, and key indicators that allow the government to measure its progress are needed.
United Kingdom

In the recently published *Science and Innovation Investment Framework 2004-2014*, the U.K. government has set out specific targets to a basket of indicators to measure U.K. science and innovation progress.

Indicators of progress are identified in six main areas:
- World-class excellence
- Financial sustainability
- Responsiveness
- Business investment and engagement
- Skills
- Public engagement

United States of America

The Innovation Index, devised by Michael E. Porter and Scott Stern, is an important tool that is used to measure innovation performance of the United States. The Innovation Index is a quantitative measure that captures three main contributors to a nation’s overall innovative performance:
- Common innovation infrastructure that supports innovation in the economy as a whole (e.g., investment in basic science);
- Cluster-specific conditions that support innovation in particular groups of interconnected industries (e.g., automotive, information technology); and
- Strength of the linkages among them (e.g., the ability to connect basic research to companies and the contribution of corporate efforts to the overall pool of technology and skilled personnel)

The indicators employed in the Index are:
- Total R&D personnel
- Total R&D investment
- Percentage of R&D funded by private industry
- Percentage of R&D performed by the university sector
- Spending on higher education
- Strength of intellectual property protection
- Openness to international competition
- Nation’s per capita GDP

The Southern America has its own innovation index, known as the Southern Innovation Index. The recent edition, fourth in the series, *Not Invested Here: The 2004 Southern Innovation Index* is a progress report on innovation, entrepreneurship and technology-based economic progress in the Southern USA. The Index includes state-by-state data and provides summaries of state activity in the areas of education, innovation, and entrepreneurship. The Southern Innovation Index is part of the Invented Here initiative by the Southern Growth
Policies Board (SGPB) and the Southern Technology Council (STC). Invented Here initiative is the utilisation of technology and innovation for economic growth. The initiative consists of reports, conferences, presentations and databases. The first report, *Invented Here: Measures of Southern Growth (Jul 2000)*, was an exhaustive compilation of existing data on the Southern economy, especially those measures relating to technology and innovation.

**Global Innovation Measurement**

Other than measuring innovation at the national level by various countries, there are also a number of international organizations that seek to measure innovation on a more global basis.

**Organisation for Economic Cooperation and Development**

The OECD’s Science, Technology and Industry Scoreboard,\(^4\) which compares science and technology progress in OECD member countries, consists of over 200 indicators which cover four key areas:

- the creation and diffusion of knowledge;
- the information economy;
- economic globalisation; and
- productivity and economic structure.

The 2003 edition of the scoreboard includes several new indicators that are meant to address emerging policy issues, such as the international mobility of researchers and scientists; innovation as measured by patent families; the emergence of new technologies (biotechnology and nanotechnology); the role of non-OECD countries in global science and innovation; the use of information technology by firms and households; productivity growth in OECD countries; and firm turnover.

**World Bank**

The World Bank’s Knowledge Assessment Methodology (KAM)\(^5\) is a toolkit that emerged out of the World Bank Institute’s Knowledge for Development (K4D) programme which aims to help developing countries make more effective use of knowledge for their overall economic and social development. The KAM “helps to benchmark how an economy compares with its neighbours, competitors, or others it wishes to emulate” and is designed to help countries understand their strengths and weaknesses in making the transition to the knowledge economy. It consists of a set of 80 structural and qualitative variables that serve as proxies for the four pillars that are considered critical to the development of a knowledge economy:\(^6\):

- An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship;
- An educated and skilled population that can create, share, and use knowledge well;
- A dynamic information infrastructure that can facilitate the effective communication, dissemination, and processing of information; and
An efficient innovation system of firms, research centers, universities, consultants and other organisations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.

The KAM compares indicators for a group of 128 countries, including most of the developed OECD economies and about 90 developing countries.

**World Economic Forum**

The World Economic Forum’s Global Competitiveness Report provides growth competitiveness rankings for more than 100 economies worldwide. The rankings are based on the Growth Competitiveness Index, which is composed of three main indexes, each with sub-indexes.

- Macroeconomic environment index
  - Macroeconomic stability subindex
- Public institutions index
  - Contracts and law subindex
  - Corruption subindex
- Technological index
  - Innovation subindex
  - Technology transfer subindex
  - ICT subindex


**Conclusion**

Measuring innovation depends on how each organisation or country perceives innovation to be. Traditionally, we view innovation from two perspectives: innovation as an output and innovation as a process. However, we need to view innovation from a more integrated and useful viewpoint - innovation as a system. It means looking at innovation as a system of interconnected organisations and institutions that influence the development, diffusion and use of innovations. It is only after we have a proper perspective of innovation that we can decide on how best we can measure it.

Having observed what corporations, countries, and international organisations are doing in measuring their innovation performance, we conclude that there is no single metrics or index that can measure innovation performance solely and accurately. Innovation performance measurement is based on a composite of metrics, indexes and indicators. Even then, the performance measurement tool that is relevant in one country may not be so in another, depending largely on the societal, cultural and political context of that particular country.
Endnotes


