Measuring Innovation in the Age of Intangibles

Dan Munro and Creig Lamb, Shift Insights

Key messages:

- The increasing importance of intangibles in the economy complicates efforts to measure innovation
- Measures of technology adoption and intangible investments are both important for understanding innovation performance
- Patent data can provide useful insights, provided it is interpreted carefully and with attention to patent ownership, quality, and use, and not merely patent counts
- A range of input, output, and outcome measures is needed to assess innovation

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Measuring Innovation in the Age of Intangibles

Knowledge Synthesis Paper

How can we measure innovation performance and potential in an increasingly intangibles-focused global economy?

Commissioned by:
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Prepared by:
Dan Munro & Creig Lamb
Shift Insights

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Key Points

- Measuring innovation performance and potential in an increasingly intangibles-focused economy is difficult but necessary in order to provide a foundation for better policies, programs and strategies.
- Indicators and approaches to innovation measurement are better when they are *accurate* (i.e., capture the phenomenon being measured); *reliable* (i.e., produce the same results for the same phenomenon when measured across time and space); globally c*omparable*; and *meaningful*.
- Innovation measurement should:
    - draw on a mix of input, output and outcome measures – especially business spending on research and development, patents (including ownership and use), and multifactor productivity;
    - include technology-adoption and use indicators given technology's process-oriented role in contributing to innovation and productivity;
    - incorporate intangible investment indices to capture insight on inputs to intangibles-driven innovation;
    - use aggregate scorecards only as a starting point given their peculiar methodologies; and
    - use innovation surveys with caution given their accuracy and comparability challenges.
- Innovation measurement would benefit from the development of better data on patent ownership and use and intangible asset development; a systemic examination and improvement of innovation surveys; and clearer definitions and data related to inclusive and social innovation.

I. Introduction

Measuring innovation is essential. As a critical contributor to economic growth and social well-being, innovation demands better understanding. We want to know how Canada is doing on key indicators so that we can adopt targeted policies, programs and strategies that might spur improvement, and assess whether those interventions are having intended and desirable effects. However, measurement is impaired by disagreement about how to define innovation, how indicators should be classified, and changes in the nature and kinds of innovation including a shift to intangibles-driven innovation (Stundziene, et al: 2024). Even when provisional agreement is achieved, a lack of current and comparable data on relevant metrics hampers analysis. Despite efforts by the OECD to standardize definitions and data collection, many countries deviate from these standards. Persistent lags in data collection and sharing, as well as retroactive revision of data, further complicate efforts to produce accurate and timely comparisons.

As difficult as it is to measure innovation, there are strong reasons to do it and to try to do it better. This paper addresses the question: *How can we measure innovation performance and potential in an increasingly intangibles-focused global economy?*

The next section offers a critical review of current approaches to measuring innovation – including assessment of the accuracy, reliability, comparability and suitability of prominent indicators, surveys, and scorecard/ranking initiatives. Section 3 examines the rise of the *intangible economy*, its implications for innovation and growth, and assesses emerging efforts to measure intangibles, especially as they relate to innovation. Section 4 focuses on the measurement implications of *social innovation* (i.e., innovation that generates social, and not simply economic, value) and *inclusive innovation* (i.e., how opportunities to participate in, benefit from, and shape the direction of innovation are distributed). Section 5 concludes with some advice for measuring innovation distilled from the analysis.

II. Measuring Innovation

In general, indicators and approaches to innovation measurement are better when they are:

- *Accurate*. Indicators should correctly capture the phenomenon being measured.
- *Reliable*. Indicators should consistently produce the same results for the same phenomenon when measured across time and space.
- *Comparable*. Indicators are more useful if they can be used to make comparisons. This is especially important since a "good" or "right" level of innovation (or innovation input) in a jurisdiction depends on how it stacks up to peer jurisdictions.
- *Meaningful*. There are many things we *can* measure but not all of them give us a sense of the important features or dimensions of the phenomenon we are trying to understand. As Muller (2018) notes, not everything that is important is measurable, and much that is measurable is unimportant (Muller 2018).

Indicators

What indicators are worth considering, and what are their relative strengths and weaknesses?

Inputs

Innovation is difficult to measure directly, so we often turn to innovation inputs – i.e., resources and activities thought to be necessary for innovation and/or signals of a healthy ecosystem in which innovation might occur. To that end, data is often collected and shared about ***education and skills*** (e.g., educational attainment, STEM graduates, R&D personnel, literacy, numeracy and digital skills), and ***financial resources*** (e.g., R&D spending, venture capital, spending on training, and spending on technology development and adoption).

Measuring inputs is useful as many are associated with higher levels of innovation (Chatti et al: 2024). But there is no guarantee that a healthy set of inputs will lead to strong innovation. In that case, measuring inputs provides clues about an innovation ecosystem and helps identify

gaps, but too much focus on inputs risks shifting attention away from *meaningful* innovation measurement.

Prominent Input Metrics

Metric	Assessment
Higher education attainment (e.g., share of population with PSE credential; graduate degree)	There is evidence that jurisdictions with higher levels of attainment tend to generate higher levels of innovation and growth (Goldin and Katz 2008). But the tendency is not a law - as Canada's world-leading level of attainment, but lagging innovation performance, illustrates.
STEM graduates (e.g., share of population or share of graduates from science, technology, engineering, mathematics field)	Much high-value innovation requires scientific and technical skills which leads some to maintain that higher levels of STEM grads are an enabling factor for innovation (OECD 2016).[1] Canada's middling level of STEM graduates and lacklustre innovation appear to confirm this. But there is no direct line from STEM graduates to innovation such that it provides a smoking gun measure.
R&D Personnel (number/ratio of people employed in R&D positions)	The number (per capita) of people employed in R&D positions offers a more proximate indicator of innovative activity than general education and skills attainment. It signals real commitment to science and innovation. One caveat is that this indicator largely follows levels of R&D spending and therefore provides at best a lagging and possibly redundant measure.
Public Expenditures on R&D (higher education R&D + government R&D as a % of GDP)	Expenditures on R&D by higher education and government institutions provides an indicator of some scientific activity and allows for comparison with other jurisdictions. Because jurisdictions will make different decisions about whether to support R&D through higher education systems or government facilities, it is often useful to combine data into a "public R&D" measure (Conference Board 2021). A limitation is that because much research is not commercialized, it might not signal innovation per se; and commercialization varies substantially by jurisdiction (Breznitz 2014).
Business Expenditures on R&D (as a % of GDP)	BERD is frequently used as a proxy measure of innovation. It signals that firms are committed to innovation, is amendable to international comparison, and captures what other measures (such as R&D personnel and patenting) try to tell us (and therefore serves as an efficient innovation indicator) (Conference Board 2021). One limitation is that much innovation does not require R&D – especially in the services sector – and/or is not recorded as R&D spending in firms' accounting. Moreover, some innovation assessments fail to distinguish between BERD conducted by domestic versus foreign-owned firms. Ownership matters as it shapes how much a country's economy will benefit from the IP and value generated by R&D and innovation (Lamb and Munro 2021).
Venture capital & private equity (as a % of GDP)	VC and PE are useful market signals about what is valuable or potentially valuable. When VCs invest in certain technologies, firms or sectors, it offers a leading indicator about innovation – both because firms with resources to innovate are better off than those without, and because the investments

[1] For a nuanced perspective, see Expert Panel on STEM Skills for the Future (2015).

	themselves are predictions about where value might emerge. VC & PE lose some utility given how much investment activity, and therefore data, is hidden from public view. Moreover, and more problematically, venture capitalists take a portfolio approach to investment: They expect a big return on only a small sample of investments and no return on most investments, thereby diminishing VC as a broader "value" signal. And in some cases, VC props up firms or sectors that never generate real value or turn a profit (Janeway 2012; Janeway 2021).

Outputs

Output indicators have the potential to provide a picture of innovation performance that is closer to value generation. An output is the result of some prior investment or activity. The output or results of R&D spending and activity, for example, might be new knowledge in the form of publications and patents. As with input indicators, however, output measures are indirect and incomplete. If our primary interest is the value that innovation generates then we will want to examine output indicators in terms of how accurately, reliably, comparably and meaningfully they capture, signal or predict that value.

Prominent Output Metrics

Metric	Assessment
Publications	Research often leads to publications. Publication counts and counts within specific fields provide clues about S&T strengths which, in turn, might signal potential innovation strengths. However, publications do not necessarily translate into value-generating innovations with many additional steps. For example, Canada has produced world-class research[2] and a Nobel prize-winner (Semeniuk 2024) for work on artificial intelligence, but struggles to support world-leading AI technologies and firms (Patriquin 2020).
Patents (patents per capita; Patent Cooperation Treaty (PCT) patents per capita; triadic patent families)	When an inventor files a patent, it is a strong signal that their idea for a product, process or service has value or potential value – otherwise why protect it. Jurisdictions that generate more patents per capita are thus viewed as having better innovation performance than others. Taylor (2016) argues that patents, despite limitations, are the best proxy measure for innovation we have. However, a patent is not the end of innovation, so high counts are not necessarily indicative of innovation-generated value. Patent trolling also diminishes this indicator's value. Certain entities will collect patents with no intention of using them to innovate, but instead to threaten genuine innovators with lawsuits and to extract payments (Besson 2015). Finally, given that contemporary innovation involves combinations of ideas, a rise in patents might not signal more ideas but simply more components of an idea with multiple parts that need protection (Gallini and Hollis 2019).
Technology Adoption	Technology adoption is a critical part of innovation. National surveys often collect data about firms' adoption and use of technology and, in some cases, enable analysis of how technology affects firm- and sector-level productivity and growth. Unfortunately, international comparisons tend to rely on technology *input* metrics

[2] In 2017, Canada ranked 2nd on Stanford University's *Global AI Vibrancy Tool*, but has since slipped to 13th of 36. https://aiindex.stanford.edu/vibrancy/

	(e.g., spending on ICT) rather than use and impact. Moreover, given how often technology transformation efforts "fail," unless linked to impact (revenues, sales, growth), technology adoption metrics offer a limited view (Davenport and Westerman 2018).

Patents as Innovation Measures: Potential and Pitfalls

Patents may be a useful measure of innovative activity if understood and used correctly. When an inventor files for a patent, it is a signal that their idea has potential value as a technology, product, service or process – otherwise why invest substantial time and money to protect it. Fees to file a single patent run mere hundreds of dollars, but inventors often spend $10,000 or more to cover legal and other fees to ensure that their patents are well-researched and properly drafted. Costs for filing a patent in the U.S., Europe or through the PCT – a critical step to operate globally – can run another $5,000 to $15,000 (Dearden 2019). Inventors and firms pay these costs because they know that patents are "linchpin[s] for innovative firms seeking capital and growth in a global knowledge economy" (Gallini and Hollis 2019).

Some research concludes that intellectual property "embodied in patents" is a major driver of long-term growth, and other research finds that ICT patents specifically are a main contributor to growth (Rothwell et al 2013; Nguyen and Doytch 2022). Some studies find an association between patents and growth, but cast doubt on causal direction and mechanisms (Gold et al 2017). Patent trolling also diminishes patents as an innovation proxy measure. Certain entities will collect patents with no intention of using them to innovate, but instead to threaten genuine innovators with lawsuits and to extract payments (Besson 2015). Moreover, given that contemporary innovation involves combinations of ideas, a rise in patents might not signal more ideas but simply more components of an idea with multiple parts that need protection (Gallini and Hollis 2019).

In that case, when using patents as a proxy measure for innovation, we will want to move beyond mere patent counts, and look instead at ownership, quality and use. Consider ownership. Analysis of a representative sample of patents by Gallini and Hollis (2019), for example, shows that "the majority of 'Canadian-invented' patents issued in the US [where patenting has greater value in global markets] are assigned to firms outside Canada or foreign subsidiaries in Canada on the date of issue." This "patent assignment deficit" is substantial and has been "growing over time." In effect, Canadian inventors are losing out on the benefits of the IP they generate because they do not own it. To know whether innovation embodied in patents generates economic or social value *for Canada*, then, we should look at data about patent ownership in addition to patent counts.

Outcomes

Outcome indicators have the benefit of being closer to the *value* generated by innovation – i.e., the point at which an innovation becomes an innovation and not merely an invention. But they tend to measure at such a high and indirect level that we risk losing sight of the *innovation* in the innovation metric. Ultimately, we want to see innovation reflected in productivity and growth statistics, as well as in health and well-being measures. So many variables other than innovation shape productivity, growth, health and well-being that measurement efforts are better off taking a step back and focusing on other outcome indicators.

Metric	Assessment
Global Trade & Market Share *(Observatory of Economic Complexity)*	Some innovation scorecard exercises include export market share in "high tech" or "high innovation" sectors (such as pharmaceuticals and ICT) based on the idea that capturing a greater global share of trade in "innovative" sectors like these signals better innovation performance. The rationale ignores intervening variables and the fact that there will be different levels of innovation among firms and across countries within the "innovative" sectors. Nevertheless, there is some value in the measure – especially in assessing whether a country is gaining or losing ground in a competitive industry. The Observatory of Economic Complexity provides useful data about sector and subsector economic strengths and weaknesses. https://oec.world/en/profile/world/wld
Multifactor Productivity	Multifactor productivity (MFP) is a peculiar measure of innovation performance (Taylor 2016; Expert Panel on Business Innovation 2009). The OECD defines MFP as: "*the overall efficiency with which labour and capital inputs are used together in the production process. Changes in MFP reflect the effects of changes in management practices, brand names, organizational change, general knowledge, network effects, spillovers from production factors, adjustment costs, economies of scale, the effects of imperfect competition and measurement errors*" (OECD 2024). MFP captures innovation which might otherwise escape direct measurement (such as innovation not associated with R&D spending). But it leaves open the problem of identifying and measuring what innovation actually is and what kind we might be seeing. It gives us a sense of how much aggregate "innovation" (plus measurement error and noise) we have in an economy, but almost nothing about what it is and how we got it.

Additional Considerations

- ***Background Conditions and Intervening Variables***. Innovation analyses can benefit from examining background conditions and factors. The contextual variables identified in the CCA's 2009 assessment of business innovation (specifically the "factors that influence choice of an innovation strategy") and the Munk School and Brookfield Institute's *Inclusive Innovation Monitor* (specifically, "policies" and "market structure") are illustrative (Expert Panel on Business Innovation 2009; Munro and Zachariah 2021). They include economic composition, competitive intensity, import/export exposure, climate for new ventures, innovation policies and programs, regulation, and value chain structure.

- ***NAICS Categories***. Innovation measurement is hampered by the fact that NAICS codes – the classification of businesses into industries, sectors and subsectors – lag leading innovation in the economy. Until new NAICS categories are created for firms built on new kinds of technologies, models, and markets, some innovative activities will be lumped in with other businesses under existing codes effectively obscured from view.

- ***Global Value Chains***. The changing nature of global value chains (GVCs) affects both the nature of innovation and how we can measure it. Breznitz (2007, 2021) notes that the

globalization and *fragmentation* of production over the past few decades has changed innovation such that successful strategies and activities must focus on *niche*s within larger GVCs and develop specialized capabilities to capture those niches. The Netherlands, for example, does not attempt to master the entire semiconductor production process. Instead, its leading firm, ASML, focuses exclusively on designing, building and servicing high precision lithography machines used in just one stage of chip manufacturing (Munro and Lamb 2024). What this means for innovation measurement is that many aggregate indicators have diminishing value because they are not able to capture the niche-level activity that characterizes innovation in a context of dispersed and fragmented GVCs (Breznitz 2007; Breznitz 2021).

Innovation Surveys

Much of the data we have about R&D investment, venture capital, patents, technology-related spending and other indicators are collected through surveys of firms. In many cases, surveys give us direct, albeit subjective, information about the innovation activities of firms. Three kinds of surveys have been useful in the Canadian context:

- Statistics Canada's *Survey of Innovation of Business Strategy* (SIBS)[3] collects information from firms across all sectors about innovation spending, activities, and results. Using the OECD's Oslo Manual as a foundation, the survey asks about new or improved products, processes, and services, as well as information about firms' sales, expenditures, purchases and employment which allows for analysis that ties innovation activities to key inputs and outputs/outcomes. Results are often compared to the European Union's *Community Innovation Survey* (CIS)[4] which is also informed by the Oslo Manual and asks many of the same questions (albeit worded differently).

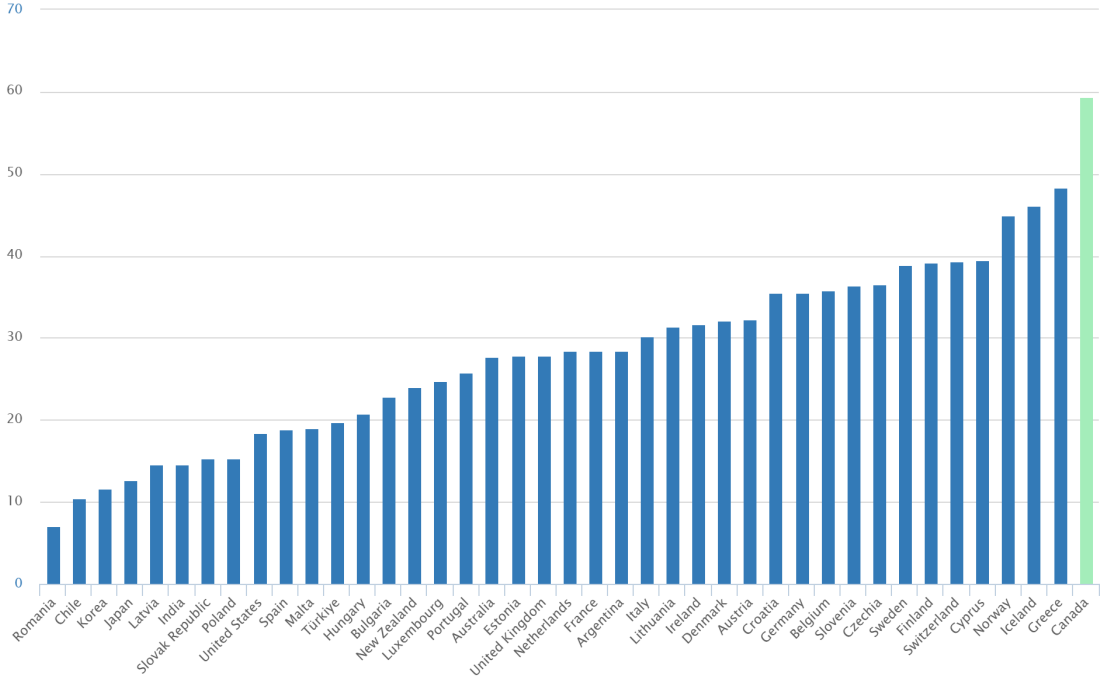
  A notable and striking feature of SIBS and CIS results is that on key questions, Canadian firms report the highest levels of innovation among all countries. For example, 60% of Canadian firms say they developed a new product innovation, which is 10 percentage points higher than the next country, and roughly twice the average of all firms surveyed. Given that other innovation metrics suggest that Canada does not perform at the level of many peer countries, there is reason to be skeptical of SIBS for comparative purposes. That said, it helps us understand firms' innovation activity over time. It may be *inaccurate* but nevertheless *reliable.* Moreover, while some results might distort performance, differences by industry, region and firm size provide useful information to assess innovation intensity in the Canadian economy.

- Surveys on technology adoption capture how firms use technology to improve their activities and provide a sense of which technologies are diffusing more quickly than others. Canada's *Survey of Advanced Technology (SAT)*[5] and *Survey of Digital Technology*

[3] https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5171
[4] https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey
[5] https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=4223

and Internet Use (SDTIU)[6] are worth exploring. Like SIBS, the results of the SAT and SDTIU do not allow for easy international comparison, but the large sample sizes allow for comparison of tech adoption across sectors, regions and firm size in Canada's economy.

Percentage of firms reporting product innovation in previous 3 years



Source: OECD (2024) www.stip.oecd.org/stats - drawing data from SIBS and CIS.

- The *Global Entrepreneurship Monitor* (GEM)[7] surveys the entrepreneurial attitudes and behaviours of samples of adult populations in 45 to 120 countries (depending on the year), and the opinions of small samples of "experts" in each country about entrepreneurship (GEM 2024). The Adult Population Survey (APS) component collects the views of at least 2,000 adults aged 18 to 64 in each country, allowing for analysis by gender, region and other variables. The National Expert Survey (NES) collects the views of at least 36 experts in each country. Given the opacity of GEM's reporting of exact sample sizes and who the experts are, there is reason to be skeptical of the value of the NES.

  As others have noted, even the higher-sample APS produces peculiar results. Canadian respondents are more likely than any other population to say they have started a business. But other (objective) data show that Canada's start-up rate is middling in the OECD. As with Canadian firms' self-reported innovation activities in SIBS which appear out of line with objective indicators, ordinary Canadians' self-reported entrepreneurial activity is out of line with official business registration statistics (Conference Board 2021).

[6] https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurveyProduct&Id=1525485
[7] http://gem-consortium.ns-client.xyz/about/gem/5

- Another resource is Statistics Canada's *Business Innovation and Growth Support* (BIGS) database which collects administrative that "cover government activities that support business innovation and growth, such as funding, consulting services to enterprises, industry-facing research and development, support provided directly or in partnership, as well as support for technology development (commercialization) and exports."[8] Researchers may find BIGS helpful in understanding factors contributing to innovation performance, including government supports. However, the database does not appear to have international peers and therefore lacks global comparability. Moreover, having only been launched in 2018, BIGS has limited utility for time-series and longitudinal analyses, especially given the COVID-related disruptions in business activity within that time period.

Innovation Scorecards

Innovation scorecards are a popular way to monitor innovation performance. Prominent scorecards include WIPO's *Global Innovation Index*[9] and IMD's *World Competitiveness Ranking*.[10] In Canada, the Conference Board of Canada's *How Canada Performs Innovation Scorecard* has benchmarked Canada's innovation potential and performance against 15 to 20 peer countries for 30 years.[11] Recently, the Century Initiative introduced its economy, innovation and entrepreneurship component of its broader *National Scorecard on Canada's Growth and Prosperity*.[12] While these exercises have some benefits, their methodologies and the way results are interpreted undermine much of what they offer.

Scorecard Benefits

Scorecards and composites have three key benefits.

- First, by aggregating a collection of relevant indicators, scorecards steer around (though not necessarily overcome) deficiencies in the accuracy and reliability of individual indicators. By pooling indirect, incomplete and noisy indicators, scorecards offer a ***rough overall sense of ecosystem health and performance***.
- Second, scorecards offer a rough sense of how well a given country fares ***relative to peers and competitors over time***. Setting aside ranking accuracy, if the methodology is consistent, a scorecard can offer a *reliable* sense of *relative* improvement or deterioration in innovation performance and potential.

  Finally, scorecards have value insofar as they provide ***inventories of indicators*** and data that can be employed by other innovation measurement exercises. Whether the aggregation, weighting and ranking serve any meaningful purposes, the fact that scorecard producers pull data into one place is helpful to those developing their own innovation assessments.

[8] https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5304
[9] https://www.wipo.int/gii-ranking/en/
[10] https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/
[11] https://www.conferenceboard.ca/product/innovation-report-card_2024/
[12] https://www.centuryinitiative.ca/scorecard/home

Scorecard Limitations

Four limitations of scorecards stand out.

- First, scorecards tend to aggregate dozens of ***indicators with varying and questionable utility***. Some have used "wikipedia edits per million population" and "feature films per million population" as creative output measures. A case can be made that these and other minor indicators provide some insight, but the more these kinds of indicators are included, the less meaningful the picture of innovation performance that emerges.
- Second, scorecards often have ***questionable indicator weighing methodologies*** -- giving equal weight to indicators that should be given different weight. Giving wikipedia edits as much weight as business expenditures on R&D seems to miss the point of collecting and using data to offer a meaningful picture.
- Third, some scorecards have ***questionable ranking methodologies*** that overemphasize small differences. The Conference Board's scorecard is illustrative. To calculate its letter grades, the Conference Board takes the top and bottom overall scores of its comparator countries and creates quartiles (Conference Board 2021). Countries that end up in the top quartile are assigned an "A" while those in the bottom are assigned a "D" even if the absolute difference between the top and bottom quartiles is minimal. For perspective, whereas the Conference Board's 2021 scorecard assigned Australia, France, Ireland and the UK "D" grades, these countries ranked 4th, 11th, 19th, and 25th, respectively, of the 132 countries ranked in WIPO's 2021 Global Innovation Index (WIPO 2021).
- Finally, scorecards are often misinterpreted. Users ***overemphasize*** the ***differences in rankings*** (making too much of the difference between a 5th and 12th place ranking, for example) and ***movements in rankings*** (making too much of a "slip" from 10th to 15th). In the WIPO and IMD scorecards, there is very little difference in the performance of countries within 10 or so places of each other. While the organizations that produce the rankings point this out, they nevertheless continue to rank and observers nevertheless continue to overplay differences.

III. The Intangible Shift and Innovation Measurement

Since the 1970s, the global economy has been undergoing an *intangible shift* which has significant implications for innovation and innovation measurement. A rising share of economic growth and prosperity globally is being driven by intangible assets and investments (e.g. data, digital services, marketing, brands, design, firm-specific training, and networks), while tangible assets (e.g., buildings, machinery, equipment and product inventories) are contributing a declining share (Lamb and Munro 2020; Haskel and Westlake 2017; Haskel and Westlake 2022; Asselin and Speer 2020). Firms and countries focused on intangibles are experiencing faster growth and productivity improvements than those focused more on tangible assets and activities (Lamb and Munro 2020; Haskel and Westlake 2017; Haskel and Westlake 2022; Asselin and Speer 2020).

To be sure, tangible assets and activities remain important to innovation and growth. While intangible innovation is increasingly important, much of it runs on tangible rails – including physical communications infrastructure (e.g., internet lines, satellites and receivers); computing hardware (e.g., phones and computers on which intangible goods and services are accessed); transportation infrastructure and activities; and other manufactured goods and technologies. But even in these more physical industries and activities, opportunities for intangible-driven innovation are increasing – including, for example, using data and software to improve supply chain logistics, developing digital agriculture services that can be exported, and improving brand recognition and value across all industries.

Why is it so hard to measure intangibles?

Efforts to measure innovation and the value it generates must pay closer attention to the intangible shift. The challenge is to find data and metrics that are accurate, reliable, comparable and meaningful. In the case of intangibles, measurement challenges are exacerbated by their defining characteristic – intangibility. As Park *et al* (2024) note, "intangible assets are less identifiable than tangible ones and therefore they are difficult to define and measure. For example, intangible assets in accounting focuses on quantifiable resources owned by a company, while the management perspective of intangible assets focuses on human and intellectual capital." While they offer a very useful definition of an intangible asset as "*a resource that is non-physical, non-financial, has long life, and has potential to provide future benefits to the owner*" the measurement challenges remain (Park et al 2024).

To illustrate, consider the role of data in intangibles-driven innovation. Some firms use data to support a range of innovative activities – such as customer data to improve marketing; health data to assist with drug and health technology innovation; or even bundling and selling user data to others firms pursuing new and improved products, services and processes. The measurement challenge is that while there are some indicators that can tell us if a firm is collecting or building datasets, we have little (measured and comparable) insight into the size and value of those datasets for innovation. The development of standardized and globally comparable surveys about data activities is still a work in progress (Bavdaž et al. 2023).

Indicators

Intangibles-related innovation measurement overlaps with other innovation measurement approaches. Tracking intangibles involves using some familiar measures like R&D spending and investment in technology development where these are oriented towards developing intangible assets. Other measures take on greater importance, such as those related to IP.

Ontario's Expert Panel on Intellectual Property notes that there are at least thirteen categories of IP that should be considered. These include contracts, copyright (including moral rights and neighbouring rights), domain names, geographical indications, industrial designs or design patents, integrated circuit topography, patents, plant breeders' rights, personality rights,

trademarks, tradenames, trade secrets, and utility models (Expert Panel on Intellectual Property 2020). Standard and internationally comparable indicators and data for all thirteen IP categories are not available, but there are some. In its Global Innovation Index (WIPO 2024), for example, WIPO collects and uses data on:

- trademarks
- industrial designs
- patents
- PCT patents
- utility models
- intellectual property payments

WIPO also includes an ***intangible asset intensity*** metric which is a promising measure, but perhaps not well executed. WIPO calculates intangible asset intensity for an entire country based on data and performance of just the top 15 firms in a country. This produces a skewed picture of a country's overall (intangible) innovation economy in cases where its top 15 firms constitute a small and/or unrepresentative sample.

One of the benefits of using IP-related indicators to get some purchase on intangible innovation is that they are asset-based – that is, they are further downstream from the kinds of input indicators often used in measurement and therefore offer a better picture of innovation *performance*. According to some analysts, many intangible assets do not deliver value directly; they need to be deployed in business strategies and combined with other intangible and tangible assets to generate value (Haskel and Westlake 2018). A brand, for example, captures value only when it is combined with products or services that customers might want to purchase. Starbucks' logo has *potential* value that is only realized or captured when it is put on cups to help sell coffee in bricks and mortar locations. By contrast, the cups and stores have stand-alone (albeit limited) value even without the logo. In that case, IP-related measures offer a partial, directional signal but not a comprehensive picture of intangibles-related innovation performance. A firm has to do something with IP to capture value.

Intangible Investment Intensity Indices

Composite indices that bundle and weigh relevant measures might help generate broader pictures of the health of intangible investment and activity that both diminish the effects of distortions in individual indicators and recognize that performing well on innovation overall does not require strong performance on every indicator. For reasons of data availability (and different measurement aims) economists who have developed index approaches tend to focus less on intangible *assets* and more on the *investment* to create intangible assets. While there are many variations, a core framework (developed by Corrado *et al* (2005) is shared by most indices and identifies three main categories of intangible investment (Haskel and Westlake 2018; Corrado et al 2005; Corrado 2009)

- **computerized information** – any investment that involves "putting information into computers to make them useful in the long run" including software purchased by firms, software developed by firms, and database development.
- **innovative property** – including investment in R&D (and protection of the patents, designs and other IP it generates), mineral exploration, artistic originals, designs, and other product development costs.
- **economic competencies** – including investments in training, market research, branding, and business process re-engineering.

Statistics Canada economists Gu and Macdonald (2020) made adjustments and additions to the model to allow for analysis of intangible investment intensity in Canada by industry down to the 2-digit NAICS level. Lamb and Munro (2024) made further refinements to the approach to allow for analysis of intangible investment intensity at the 3- and 4-digit NAICS levels in Canada, as well as to adjust for skew in certain indicators included in the index. The general model used by these three sets of analysts, and their variations, are presented in the table below.

Table: Components of Three Intangible Investment Intensity Models

Intangible Category	Type of Investment *business expenditures*		
	Corrado et al (2005)	**Wu & Macdonald (2020)**	**Lamb & Munro (2024)**
Computerized information	• Software development • Database development	• Purchased software • Custom software • Own-account software	• Custom software design and development • Own-account software design and development • Computer systems design and related services • Data processing, hosting, and related services
Innovative properties	• R&D • Mineral exploration • Creating entertainment and artistic originals • Design and other product development costs	• R&D • Mineral exploration • Financial industry development costs • New architecture & design • Other science (purchased and own-account)	• R&D • Specialized design services • Architectural, engineering and related services
Economic	• Market research and branding	• Advertising	• Advertising, public relations,

competencies	● Training ● Business process re-engineering	● Firm-specific human capital ● Purchased organizational capital ● Own-account organizational capital	and related services ● Tuition and similar fees for trade, technical and professional training ● Other educational training and services

One of the benefits of using composite indices to measuring intangibles-related innovation is that the investment categories align with standard national accounts and therefore have potential for international comparison. However, to our knowledge there has not yet been a large-scale multi-country comparative effort (along the lines of other innovation ranking and scorecard exercises). Such indices might also help with explanatory analyses and assessments of policy effectiveness when combined with more downstream output indicators.

There are a few outstanding *technical challenges* for intangible intensity indices:

- *Investment types*. There is ongoing disagreement about which types of investment to include, and how to weigh different types to generate a picture of overall intangible investment intensity.
- *Data standards*. Data used to populate the categories and types of investment are not consistently defined, collected and shared across countries or models.
- *Data gaps*. The indices miss activities that are not accompanied by formal investments captured in firm accounting. For example, some firms – especially smaller firms – might free up employee time for them to "learn by doing" (Besson 2015) but not record that as a training investment. As Haskel & Westlake (2018) put it, "at least some knowledge comes into the firm by no investment at all."

A more fundamental challenge is that the indices function as *input* measures and therefore face the same limitations as other innovation input indicators. While there is evidence that firms and countries that make intangible investments tend to see better productivity and growth, there is no guarantee that investment will produce valuable intangible assets (Haskel and Westlake 2018; Lamb and Munro 2020). Higher investment is associated with valuable outputs such as IP, brands and databases, but much more needs to be in place in the (intangible) innovation ecosystem for that to happen (Park et al 2024).

IV. Social and Inclusive Innovation

The rise of social and inclusive innovation are positive developments in the innovation ecosystem but raise new measurement challenges.

Social Innovation

Stanford's Center for Social Innovation defines social innovation as "the process of developing and deploying effective solutions to challenging and often systematic social and environmental issues in support of social progress."[13] But, as Cunha and Benneworth (2020) note, "there is almost no agreement on what kind of indicators or metrics might capture or allow the evaluation of social innovation and its impact." Part of this is a function of the messiness of the social innovation *process* which tends to be cross-sectoral, cross-disciplinary, and involves actors in multiple organizations at different sites. Moreover, because social innovators want to share rather than protect their solutions, they often avoid IP registration which has been a key mechanism for tracking innovation outputs generally (Cunha & Benneworth 2020; Phills et al 2008).

To be sure, some conventional measures of innovation may have relevance. Certain input measures might come into play (e.g., education and skills, R&D spending and activity, certain kinds of social impact VC and PE); and some output indicators may be relevant (e.g., publications if academic partners are involved, and technology adoption where relevant). At the same time, the kinds of value or outcomes social innovation pursues tend to be non-economic which means that economic metrics like revenues, MFP, and growth will be less relevant.

Moreover, measuring social innovation performance requires indicators that align with the specific kind of change or value pursued. Social innovation addressed at homelessness needs metrics on homelessness; social innovation focused on an environmental challenge needs metrics on the specific environmental goal being pursued. Qualitative case studies of specific initiatives and their impact are also a prominent impact assessment strategy. Still, the ways to examine social innovation impact measurement strategies are so varied, incommensurable and project-specific that aggregating national or regional performance and making international comparisons is difficult.

Inclusive Innovation

Measuring inclusive innovation is also problematic, but not nearly so much as social innovation. Inclusive innovation is innovation – that is, it involves the development of new or emerging products, processes, services or organizational models that generate value. Innovation is *inclusive* when there are:

[13] https://www.gsb.stanford.edu/experience/about/centers-institutes/csi/defining-social-innovation

- opportunities for all people to *participate*;
- *fair distribution* of the benefits and harm produced by innovation; and
- opportunities for all to *shape the priorities and direction* of innovation (Munro 2020; Stanley et al 2018; OECD 2017).

Measuring inclusive innovation, then, involves adding an inclusive lens to many of the standard measures of innovation. We want to know, for example, not simply how many STEM graduates and how many people are employed as R&D personnel, but also the gender, racial, regional and (dis)ability makeup of those cohorts. Similarly, in addition to knowing if firms and the economy are growing as a result of innovation, we want to know those gains are distributed.

Some steps towards inclusive innovation measurement have been taken by the UK's Nesta and, in Canada, by the Munk School's Innovation Policy Lab and the Brookfield Institute with their *Inclusive Innovation Monitor* (Stanley et al 2018; Munro and Zachariah 2021). Nesta's approach is more qualitative and focused on *policy* assessment. While not pointing to any specific data to populate its indicators (except in the context of case studies), ***Nesta's framework*** (see below) points analysts to the right questions and right categories of measurement to explore.

The ***Inclusive Innovation Monitor*** is more quantitative, with a focus on curating accurate, reliable, comparable and meaningful data and indicators to assess how well jurisdictions are doing on inclusive innovation. The indicators chosen for the *IIM* (see below) align with many standard indicators of innovation measurement and, for that reason, face the same limitations. The IIM adds an inclusive lens to each of the indicators where data are available, examining how inputs, activities and outcomes are distributed by age, race, gender, region, (dis)ability, immigration status, Indigenous identity, and other categories. This allows for a picture of both the state of innovation and distribution (to the extent that each can be measured).

The designers of the IIM had hoped to further populate the framework and begin to examine the relationships among variables. Unfortunately, the IIM was abandoned after its first iteration (for reasons related to COVID and organizational change), but an archived version is available.[14]

[14] https://inclusive-monitor.webflow.io/canada

Nesta's Inclusive Innovation Policy Framework

Inclusive innovation policy framework

Dimension	Indicator of an inclusive approach
1. Overall objectives Do the overall aims of innovation policy involve more than economic growth?	1.1. Objectives are not exclusively related to economic growth, but take account of a wider range of socially desirable outcomes, such as sustainability, equality, health and wellbeing.
2. Direction of innovation Whose needs are being met?	2.1. Support for innovation addressing 'societal' challenges and needs. 2.2. Support for innovation addressing the particular needs of excluded groups.
3. Participation in innovation Who participates in innovation?	3.1. Measures to increase the participation of underrepresented and excluded social groups in innovation and innovative sectors of the economy 3.2. Measures to increase the participation of disadvantaged or lagging regions and districts. 3.3. Measures to promote innovation in low-productivity or low-innovation sectors. 3.4 Measures to involve civil society and social economy organisations in innovation.
4. Governance of innovation Who sets priorities, and how are the outcomes of innovation managed?	4.1. Measures to broaden participation in innovation priority-setting. 4.2. Measures to broaden participation in the regulation of innovation. 4.3. Measures to mitigate the risks of innovation. 4.4. Measures to promote fair distribution of the benefits of innovation.

(Stanley et al 2018).

Inclusive Innovation Monitor Indicators

Ecosystem Inputs and Conditions	Innovation Activities	Outcomes	Distribution
People and Skills + PSE Graduates + University + College + STEM + BHASE + HS grads + Adult Skills (PIAAC) + Student Skills (PISA) + Digital Literacy + Entrepreneurial Ambition + Training & Devel + Emp Spend + Govt Spend **Research and Development** + HERD + GOVERD + R&D Personnel **Research** + Articles + Scientific Articles + Top-Cited Papers Indices **Financing** + Venture Capital + Private Equity **Ease of Entrepreneurship** **Business Tax Rates**	**Business R&D** + Intensity by sector/industry + Source of funding **Technology Adoption** + ICT Investment + Advanced Tech Use **New/Improved** + Products + Services + Processes **New Firms** **Growing Firms** **Patents** **Copyrights** **Export Activities**	**Productivity** + Overall + By sector + By region **Employment** + By sector + By key sectors + By region **Income/Wages** **Economic Growth** + GDP + GDP by sector + GDP by region **Health** **Community Well-Being** **Environmental Health**	For each of the categories below, differences by: + age + class + (dis)ability + ethnic/racial identity + gender identity + immigration experience + Indigenous identity + geography + rural-urban + region + province/territory **Educational Attainment** **Labour Market Participation** **Job Quality/Security** **Employment** **Income/Wages** **Income Distribution** **Wage Gaps (by demographic)** **Wealth** **Poverty** **Intergenerational Mobility** **Health** **Community Well-Being** **Environmental Health**

(Munro 2020)

V. Advice for Measuring Innovation

There are no perfect measures of innovation. We are forced to rely on imperfect and incomplete indicators and data to cobble together an overall picture or innovation potential and performance – and, in doing so, must remember that the picture is imperfect and incomplete. While we should aspire to accuracy, reliability, comparability and meaningfulness in the indicators and measurement approaches we take, there is value in trying to measure innovation even imperfectly and incompletely. The current examination of innovation measurement approaches is not intended to deter analysts from trying, but to ensure they are aware of and acknowledge the limitations of the various approaches, especially where measurement exercises inform further analysis and policy-making.

What can we take away from this review about how to measure innovation in the age of intangibles?

- ***Draw on a mix of input, output and outcome measures***. Because innovation measurement that meets the four criteria will always be an aspirational and largely indirect activity, using a range of measures is our best option for generating a meaningful picture. Some indicators are especially useful – including BERD (while recognizing that service innovation tends not to be captured, and who is doing and stands to benefit from the R&D says much about whether there will be domestic economic or social value); patents (when we include lenses that capture ownership, quality and use); and multi-factor productivity.
- ***Include technology-adoption and use indicators***. If the point of innovation is to contribute to economic outcomes (e.g., productivity, growth) and social outcomes (e.g., health, community well-being), then knowing how technology is being adopted and used will matter. Additionally, because there is an association between technology use, R&D and innovation (Lamb and Munro 2022; Lamb and Munro 2021), tracking technology adoption serves as one among other indirect signals of innovative activity. A firm or social organization might not develop a technology themselves, but could benefit from its use.
- ***Intangible investment indices provide good insight on inputs to intangibles-driven innovation***. While investment in intangible assets does not necessarily lead to innovative products, services or processes, understanding where investments are being made and it changes over time, provides some insight into the extent to which different sectors and economies as a whole are making a shift to higher-value intangible business strategies. Ideally, analysts will examine intangible investments indices alongside output indicators (e.g., patent counts; self-reported product, service, process innovation) and outcome indicators (e.g., sector-level productivity; profitability) to understand the impact of the investments.
- ***Use aggregate scorecards only as a starting point***. Innovation scorecards and monitors offer good sources of data, but because of their peculiar ranking and scoring

methodologies, should be used only as sources of data and not as reliable pictures of innovation performance and trends.

- ***Use innovation surveys with caution.*** Surveys of firms should be a cut and dry direct way to track their innovation activities. Yet, as comparison of European and Canadian surveys alongside other innovation indicators reveals, the self-reported activity of firms might not be as reliable as one would like. In that case, while the surveys are less useful in terms of capturing levels of innovation, the changes over time may be useful indicators of waxing and waning innovation intensity.
- ***Develop better and more accessible indicators***. Innovation measurement would benefit enormously from the development of better and more accessible data on things like patent ownership and use; and intangible asset development (such as the size and nature of databases). Additionally, innovation measurement would benefit from a systemic examination and improvement of innovation surveys (such as SIBS), with a focus on articulating questions in ways that are less likely to prompt social acceptability bias, and more likely to capture innovation in services and the social sector. Finally, while the field of "social innovation" has very wide and hard to define boundaries, investment in developing tools and data to track social innovation would improve our understanding of both the extent and importance of social innovation to outcomes that matter – i.e., shared prosperity and well-being.

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