

Response to Federal Register
Notice and Request for Comments

Innovation Measurement
April 13, 2007

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And

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Measuring Innovation in the 21st Century

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Innovation has become a critical driver of US economic growth. The past decade's productivity resurgence is now part of a much broader wave sweeping across the global economy.¹ Riding this wave of innovation, information technology is transitioning from an extended period of installation in the global business infrastructure to one of rapid and deep deployment into nearly all business processes, business operations and business models. Consequently, the decades ahead will likely be one in which the use of information technology in new and previously untouched areas of business activity will result in innovation being a critical driver of economic and productivity growth.

Many organizations that use information technology have already begun to successfully innovate and realize increased gains from innovative activity. Further, these innovative user organizations have expanded their view of innovation and are no longer solely focused on product and service innovation. The challenges that these trends present to the measurement of innovation are very significant. It is no longer sufficient to measure revenue resulting from new products and services to capture the full impact of innovative activity on the US economy.

Measuring innovation and its benefits is complex and challenging. As the Advisory Committee has defined innovation, it is the design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm. Innovation often results in improvements in the quality of existing products at lower prices, completely new categories of offerings, or entirely new ways of doing business. These accomplishments are difficult to quantify and measure.

The reason for the measurement challenges is the uncertainty of innovation success and the risk organizations face as a relatively small percentage of innovation initiatives generate much of the value. In response to these challenges, enterprises manage and fund innovative activity in very different ways. The heterogeneity of innovation models across enterprises adds to the

¹ Since late 1995, US productivity growth has undergone a strong resurgence. After having increased at an average of 1.4% per year between 1973 and 1995, productivity growth nearly doubled to 2.7% per year over the past eleven years. Despite a slowing in productivity growth since 2004, long term trends suggest US productivity will continue to grow in excess of the 2% per year over the next two-three decades. See: Stephen Oliner, Daniel Sichel, and Kevin Stiroh; "Explaining a Productive Decade;" *Brookings Papers on Economic Activity*; (Forthcoming).

measurement challenge. However, experience over the past decade suggests that lessons have been learned that can be applied to improving survey measures of innovation for industry sectors and the entire economy.

- Large organizations, like IBM who are successful innovators, typically have a pipeline of innovation projects that are cycling through an iterative process of market experimentation and organizational learning. Venture capital firms also manage a portfolio of potential innovations.
- Successful innovators also regularly apply screening criteria to initiatives that, in effect, create a series of gates to be passed through as various milestones are achieved.

As a result, innovative activity could be measured for the economy or a sector by surveying enterprises on measures such as the extent of the pipeline of innovation projects, the volume of market experiments and the success of organizational learning, projects achieving milestones, and initiatives passing screening criteria.

Recommendation: IBM recommends that a survey of innovative activity among US businesses be designed, developed and implemented. Much as bank lending standards are tracked to understand the availability of credit, understanding – for example -- the size of innovation project pipelines, the severity of screening criteria at each point in time and sector by sector could form the basis of a set of innovation metrics.²

Enterprise Level Innovation Can Be Linked To Macroeconomic Trends

Despite the potential to design and implement such an innovation survey, at present, benefits created by innovation activities at the enterprise level are not easily seen or measured at the macroeconomic level. Nonetheless, the National Research Council has concluded that enterprise level innovation can be related to economy-wide productivity trends.

Although economic statistics can identify a productivity gap, understanding why the gap exists requires information about firms. This can come from case studies, surveys, or a combination of both. Surveys that identify the introduction of new or significantly changed products or processes by firms can relate activity of innovation to the broader economic context that led the firms to innovate. They can also identify the barriers to innovation, the sources of information and technologies used to innovate, and the impacts of the activity, such as a change in the level of employment in the firm or in the skill levels required by the workforce as a result of the change. All of this can be related to productivity measures.³

National Research Council cites four lessons learned.⁴

1. Innovation can be measured, along with its linkages and outcomes and its economic and social environment.
2. Common concepts and definitions are necessary to provide guidance to those conducting the surveys and interpreting the results.
3. The formal structure of the manual and ongoing measurement activity can be combined to provide a dynamic learning environment for survey practitioners and users of the new information.
4. Measurement that can be made, codified, and developed in a learning environment can be used.

² For one example of a national innovation index, see: *IBM-Melbourne Institute, Innovation Index of Australian Industry*, (Available at <http://www-07.ibm.com/au/innovationindex/>) April 2007.

³ National Research Council; "Measuring Innovation in Business and Industry" in *Measuring Research and Development Expenditures in the US Economy*; pp 92-93; (National Academies Press, Washington D.C. 2005)

⁴ See National Research Council (2005), pp 100-101

The Service Sector – The Neglected Economic Driver

In addition to the challenge of measuring innovation at the macroeconomic level, there are also challenges in measuring innovation at the sector level. Measurement is especially problematic in the services sector where there is a significant paucity of data.

For decades, the service sector's share of the global economy has grown steadily. Currently, the service sector accounts for over two-thirds of world Gross Domestic Product (GDP) and recently surpassed agriculture as the largest source of jobs in the global economy. In the United States, the service sector generates 80 percent of the GDP and employs roughly the same percent of the US workforce.

Significant innovation, resulting in increased productivity and efficiencies occurs in the service sector. Services are essential for the efficient operation of an economy, facilitating commercial transactions and enabling the production and delivery of goods and other services. In developed countries, the service sector employs far more people and creates many more new jobs than the manufacturing sector. In addition, services are a crucial component of innovation and production in a host of manufacturing industries and agriculture. Services firms can build infrastructure, hone competitiveness, ignite technological development, increase productivity and expand trade capacity. In fact, research has shown that economies with more efficient service sectors enjoy higher productivity and growth.⁵ Services leverage human capital and play a critical role in a country's competitiveness – as well as, social and economic growth.

There is a dearth of adequate data, indicators, and methods to assess and analyze service innovation. The service sector is quite broad and there is a wide variance among different types of services. The various service segments interact with each other and also other segments of the economy, making data gathering a challenge. In addition, much of the innovation that takes place across the services sector is intangible, and occurs across borders, making it very difficult to track. Furthermore, innovation statistics remain strongly focused on tangible and technological innovation. The measurement of knowledge inputs and innovative processes and outputs in services is a key area where additional focus is required. Finally, more research needs to be done to develop new, more robust indicators that can better capture how and when service innovation is taking place.

While it is difficult to measure innovation in services, finding ways to secure better data and performance measurements is important. Without such data, the contribution of services innovation to the economy will be undervalued which could lead to under investment, ultimately resulting in a negative impact to US competitiveness and the economy.

The recently released National Bureau of Asian Research study "*The Measure of a Nation: Quantifying Innovative Strength through Improved Service Sector Metrics*" provides a comprehensive view of the services related data gaps and importantly identifies four key areas for improvement:

- A more nuanced classification system with finer granularity of data on activities
- Improved survey detail in the tracking of service sector activity
- Improved accounting for the transfer of intangible assets
- The development of more accurate service price indexes and input/output matrixes.

Recommendation: IBM concurs with the recommendations outlined in the report and hopes that the US government will undertake concentrated efforts to address these gaps, and further expand the services-related work that is currently underway.

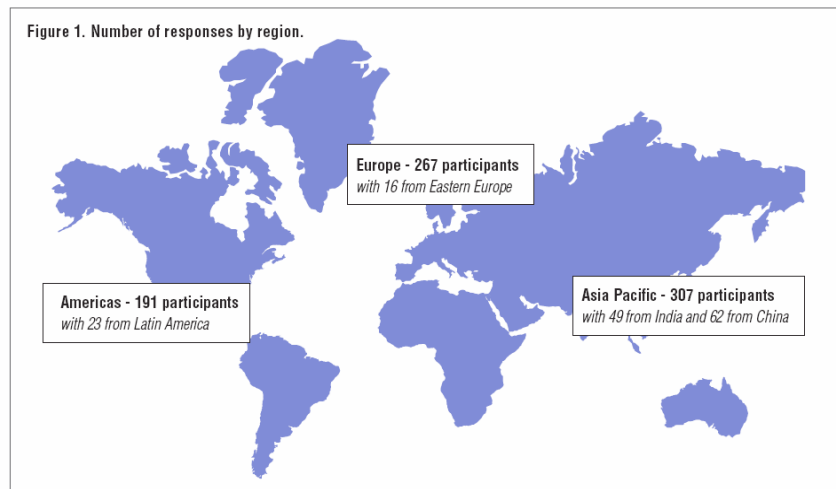
⁵ Catherine Mann, The US Current Account, New Economy Services, and Implications for Productivity, *Review of International Economics*, forthcoming.

In addition, as more scientists and engineers enter the service sector, there is a need for new skills for services-related jobs. Specifically, management skills to design and execute business model innovation are needed. Science and engineering graduates are not only working on the problems of designing and delivering new offerings, they are increasingly working on the problem of business model innovation along side management graduates. IBM's Service Science, Management, and Engineering (SSM&E) initiative is working with universities to create just these types of skills in new graduates.

Recommendation: To accelerate business model innovation, IBM recommends an increased focus on science, management, and engineering graduate programs to promote the growth in both the quantity and quality of interdisciplinary skills needed for services-related jobs.

The Scope of Innovative Activity Has Vastly Expanded

Challenges aside, recent experience with innovation surveys has shown that survey research can provide valuable insight. To learn more about their thoughts on innovation, in 2006 IBM spoke at length with 765 CEOs, business executives and public sector leaders from around the world.⁶

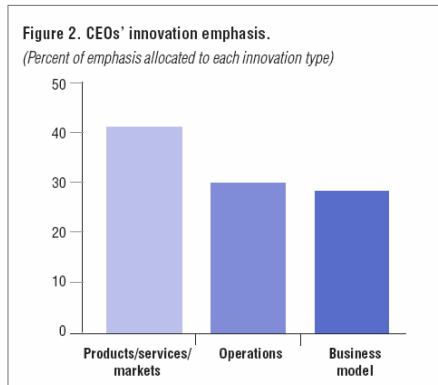


For a genuinely global perspective, the sample included a broad cross section of CEOs and public sector leaders, spanning 20 different industries and 11 geographic regions including representation both from mature markets and from important developing markets such as China, India, Eastern Europe and Latin America. See Figure 1. The sample comprised leaders of companies both large and small, some public and some privately held. The interview format and the substantial sample size provided tremendous opportunities for both qualitative and quantitative analysis.

Three innovation types were the subject of the survey.

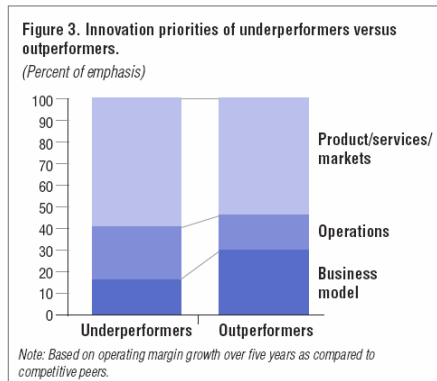
- Business model – Innovation in the organizational structure, skills, and capabilities as well as financial model of the business
- Operational – Innovation that improves the effectiveness and efficiency of core processes and functions
- Products/services/markets – Innovation applied to products or services or “go-to-market” activities.

⁶ IBM Global Business Services; *Expanding the Innovation Horizon, The Global CEO Study 2006*; April 2006.



Leaders frequently define their businesses in terms of the products and services they take to market and are the natural focus their innovative energy. But with technological advances and globalization presenting so many new opportunities – and threats – CEOs are now giving business model innovation as prominent a place on their agendas as products, services, go-to-market and operational innovation. See Figure 2. As one CEO suggested, “the three areas are essential, equally important and inseparable from each other.” Some CEOs who have not focused on business model innovation in the past now believe it is time. In one CEO’s words, “We are at the critical point where we should transform our business model itself.”

While the fact that CEOs are now focusing almost 30 percent of their innovation efforts on their business models is surprising, the survey’s financial analysis uncovered an even more interesting point. Companies that have grown their operating margins faster than their competitors were putting *twice* as much emphasis on business model innovation as underperformers. See Figure 3.



Although business model innovation is clearly important to CEOs, it is part of a combination of innovation activity – which makes it critical to understand more about how CEOs have been managing each type of innovation. With business model innovation, the most important benefits that are anticipated are cost reduction, strategic flexibility, focus and specialization, and rapidly exploiting new markets and product opportunities.

In the context of the Advisory Committee’s work on innovation metrics, these findings provide important insights into the key areas where innovation is occurring, which therefore, need to be included in the

scope of the metrics work.

Innovation Measurement Is Often Neglected or Focused On Convenient Measures⁷

As the 2006 IBM CEO Survey suggests, many organizations have extraordinary innovation capabilities, both among individuals and at the organizational level. However, winning in the new hyper-competitive marketplace is not just about having innovation capabilities. Innovation processes must be robust, repeatable, and continually improving. Measurement enables effective management of innovation and ensures that it will improve over time. Ironically, the measurement of innovation is one of the least innovative of all our measurement ‘systems.’

It is critically important, as the Advisory Committee has done, to develop a clear operational definition of the meaning of “innovation” in all its various forms. It is impossible to measure what is not defined. Every organization needs to explicitly identify its “Innovation Measurement System” and complete an audit to determine what existing measures are facilitating innovation and which are inhibiting it. There is also a need to supplement good existing measures with new, emergent

⁷ Dean R. Spitzer; *Transforming Performance Measurement, Rethinking the Way We Measure and Drive Organizational Success*; (Amacom, New York, New York, 2007). Dean Spitzer is a researcher at the Almaden Research Center, IBM Corporation.

ones. For example, there are quite a few well-validated innovation climate measures that could really help build a more consistently facilitative environment for innovation.

Existing measurement has focused on easily countable inputs and outputs. But, as Albert Einstein said, “What counts often can’t be counted and what can be counted often doesn’t count.” There has been little attention to process or outcome measures. The existing processes and outcome measures may be inadequate.

Most quantitative measures are lagging indicators that do not provide much insight into the drivers of innovation. The bias toward quantitative and easily aggregated measures has hindered understanding of the high-value intangibles, such as innovation.

Recommendation: There needs to be tolerance of qualitative and even subjective measures if enterprises are going to manage innovation, learn about it, and continuously improve it. Increasing understanding through measurement is as much a social as it is a technical activity.

There is tendency to be too intent on developing ‘metrics’ that can be automated. Automation is fine, but it often limits the ability to understand the complex interactions involved in many intangible constructs. There is learning and improvement from measuring, especially from the dialogue that is involved in defining and relating existing and new measures.

Recommendation: Measurement needs to be treated less like ‘a project’ and more like an ongoing ‘dialogue.’ It is important to have a robust and continuing dialogue around the measurement of innovation.

The innovation dialogue will need to recognize that over time, as more is learned, the qualitative measures will become quantitative as measures are “hardened”. The transition to new metrics occurs because traditional measures fail to give adequate visibility to the drivers of innovation, important contextual factors in the innovation process, and outcomes that do not neatly fit into existing categories. There is often a reluctance to change measurement systems that have provided rich rewards. Unfortunately, dependency on traditional easily quantifiable measures is quite limiting. Over time the new measures, when and if they emerge, will become better defined and will then be more easily quantified.

Qualitative Measures Are Well Suited For Innovation Metrics

The design of an innovation measurement system for the US should be grounded in basic principles of innovation management.

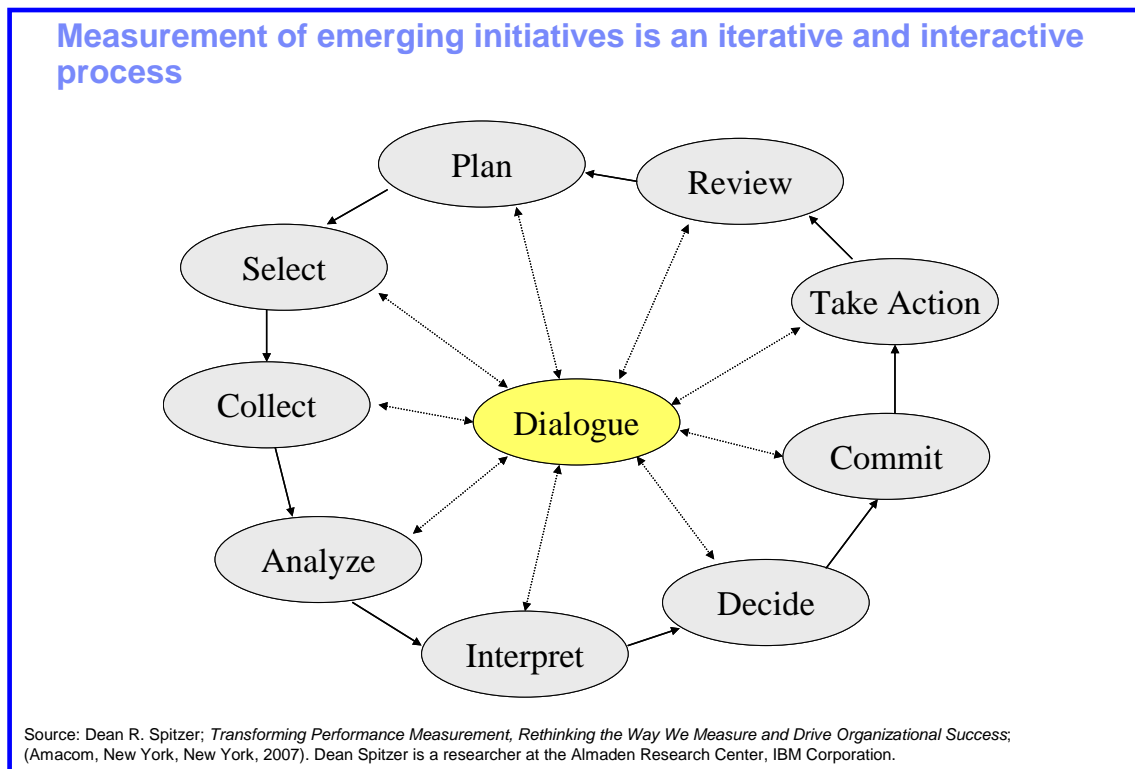
Recent research has shown that a small proportion of research and development projects – perhaps 10% -- account for much of the value created.⁸ The significant uncertainty surrounding any one project, this result suggests, causes enterprises to search for management systems that mitigate the resulting risk and increase the probability of success. The 2006 IBM CEO Survey found a range of management systems employed by CEOs and their organizations.⁹

⁸ F.M. Scherer, Dietmer Harhoff, and Jorg Kukies; “Uncertainty and the Size Distribution of Rewards from Innovation”; *Journal of Evolutionary Economics*; Volume 10, 2000, pp. 175-200.

⁹ IBM, American Productivity and Quality Council (APQC), and Innosight, are currently sponsoring an Open Innovation Research Study which is intended to help organizations measure their innovative capabilities that matter most to performance. Initial results have found that the sourcing and shaping of ideas at innovative firms tends to conform to a small number of self-reinforcing combinations of cultural and operational factors which are called “archetypes” of innovation. There is no single model of innovation that works for all firms. Instead, firms recognize the benefits and drawbacks of the innovation archetype they inhabit, compare their approach to others in their archetype, and borrow selectively from other categories to fill gaps in their capabilities. By developing self-reinforcing capabilities that support the existing strengths of the firm, companies stand a much better chance of bolstering their innovativeness.

Despite the uncertainty of the outcomes of innovation projects and the wide range of responses that enterprises build into their management systems, experience over the past decade suggests that a pipeline of innovation projects often does exist and such projects are managed through an iterative and interactive process – a first principle of innovation management. Chart 1 shows that organizations plan and select initiatives in a collaborative fashion, often with external partners, with collaboration continuing as performance data are collected, analyzed and interpreted. Based on available performance data, the initiative is altered and adjusted as appropriate.

Chart 1



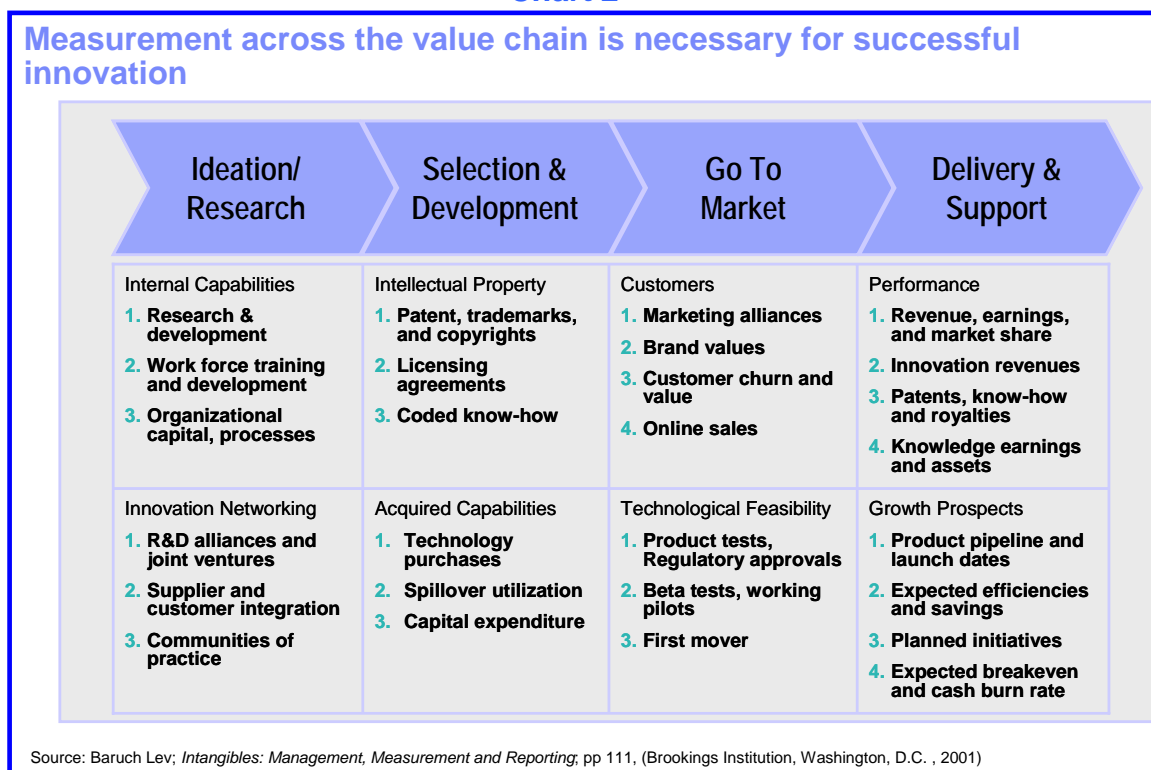
Innovation initiatives are typically conducting an ongoing series of market experiments and the results are enhancing organizational learning. All of which is attempting to understand the nature and extent of client value creation and thereby reduce the uncertainty associated with the set of innovation projects.

Value can also be created as a result of productivity gains resulting from business process improvement. The productivity gains from innovative activity can be accelerated with increased focus on all aspects of required organizational change. In the past, new technology was deployed, then at some point business processes were changed to leverage the new technology, and then finally, organizational behavior was addressed to incent change and boost productivity. Actions were taken in a serial fashion, thus elongating the time to return or productivity gains. Addressing all three elements -- process, technology and culture -- "simultaneously" can lead to accelerated results. Consequently, innovation measurement should also attempt to measure the intersection of all three elements.

Thus, enterprises have learned that innovation involves more than research and development activity. As Chart 2 shows, commercialization actions, as well as the need to delivery and support client engagements, are required to complement new product and service offerings emerging from the laboratory – another important principle of innovation management. In fact, with

business model innovation now taking on increased importance, commercialization and customer support activities are of even greater importance. Because the activities in the chain are not all revenue generating activities, milestones are needed to measure achievement in each case. Chart 2 also shows illustrative milestones for each activity. In addition to milestones, screening criteria can be developed as project move through each set of activities.

Chart 2



Recommended Approach for Economy-Wide Innovation Measurement

Based on the development of business practices such as those outlined above, survey research can be designed to measure the extent and nature of innovative activity underway in various sectors of the economy as well as for the entire economy. Innovative activity could be measured by collecting data on measures such as the extent of the pipeline of projects, market experiments and organizational learning as well as projects achieving milestones and initiatives passing screening criteria.

Currently, the Bureau of the Census has an extensive data collection program for expenditures on tangible assets. IBM recommends that a similar data collection program be designed and implemented for innovative activity, principally in support of the development of intangible assets.

As described by the Bureau of the Census, the Annual Capital Expenditures Survey (ACES) provides detailed information on capital investment in structures and equipment. The survey is based on a sample of approximately 46,000 companies with employees and approximately 15,000 companies without employees. Beginning in 1999, data on expenditures for physical capital is published for industries comprised primarily of three-digit and selected four-digit industries from the North American Industry Classification System (NAICS).

Recommendation: IBM recommends that as an analogue to the capital expenditure survey, a survey of innovative activity is required. This proposed survey can be thought of as the intangible asset complement to ACES which collects data on tangible assets. To design such a survey, research will be required. For instance, it will be necessary to determine

1. Who the business leaders are who are making such decisions and have the information necessary to respond to survey questions.
2. What the types of metrics and measures have data available for response.
3. What enterprises belong in the population of firms to be surveyed and what role in innovative activity is expected from venture capital firms, private equity providers and other financial services and investment management organizations.
4. How the responses from each of these types of firms – services firms and manufacturers who are innovating and those providing various forms of capital – should be weighted in calculating economy-wide innovative activity.
5. How private individuals, who may be focused on innovative research and activity, should be included in the population of potential respondents.

Ultimately, innovation measurement will be required to address the quality-enhancing aspects of innovation that result in step-change improvement to consumer utility. Conventional economic measurement has difficulty capturing improvements in the quality, variety and choice that result from innovation.¹⁰ By contrast, case studies from everyday life abound. The impacts on the music and entertainment industry from the innovation surrounding the iPod and MP3 players as well as the impacts on the advertising industry from innovations in search technology are among the most obvious examples.

In addition, history is replete with case studies of business and technology innovation increasing the utility, satisfaction, and living standards of consumers and profit opportunities for businesses. Migrations from coal to steam to electricity and from railway travel to automobile travel to airplane travel are among the many historic illustrations of innovations underlying dramatic economic shifts.

Today, industry after industry is deconstructing and reconstructing based on a strong wave of innovation. As a survey research capability is built, academic research in support of the development of this survey research capability should consider focusing on detailed case studies of industry innovation.

While there are surely myriad other issues to be formulated and explored, it is critical to capture information required by the US economy for growth and job creation in the 21st century. While investment in physical assets remains of critical importance, an increasingly complex world has expanded the range of assets that matter to achieving success in economic activity. Measuring and tracking innovative activity is an essential input for political and business decision makers.

IBM looks forward to reviewing the consolidated input resulting from the public comments on innovation metrics.

¹⁰ For a detailed treatment of this issue see: Charles W. Hulten *Measuring Innovation in the New Economy*, (Paper prepared for the National Bureau of Economic Research Summer Institute joint workshop of the Productivity Program and the Conference on Research in Income and Wealth, July 31 and August 1, 2000).

Summary of Recommendations

Qualitative Measurements are a Key Innovation Component - There needs to be tolerance of qualitative and even subjective measures if enterprises are going to manage innovation, learn about it, and continuously improve it. Increasing understanding through measurement is as much a social as it is a technical activity.

Innovation Measurement Should not be Static - Measurement needs to be treated less like 'a project' and more like an ongoing 'dialogue.' It is important to have a robust and continuing dialogue around the measurement of innovation. There is learning and improvement from measuring, especially from the dialogue that is involved in defining and relating existing and new measures.

A Survey of Innovative Activity Should be Developed and Implemented - IBM recommends that a survey of innovative activity among US businesses be designed, developed and implemented. IBM recommends that a data collection program, similar to the ACES (Annual Capital Expenditures Survey), which collects data on expenditures on tangible assets, be designed and implemented for innovative activity, principally in support of the development of intangible assets.

Services Related Data is Critically Needed - IBM concurs with the recommendations outlined in the recently released National Bureau of Asian Research study "*The Measure of a Nation: Quantifying Innovative Strength through Improved Service Sector Metrics*" which provides a comprehensive view of the services related data gaps and importantly identifies four key areas for improvement:

- A more nuanced classification system with finer granularity of data on activities
- Improved survey detail in the tracking of service sector activity
- Improved accounting for the transfer of intangible assets
- The development of more accurate service price indexes and input/output matrixes.

IBM hopes that the US government will undertake concentrated efforts to address these gaps, and further expand the services-related work that is currently underway.

Increased Focus is Needed to Develop Skills for a Services Driven Workforce - To accelerate business model innovation, IBM recommends an increased focus on science, management, and engineering graduate programs to promote the growth in both the quantity and quality of interdisciplinary skills needed for services-related jobs, which are driving the US economy.