The Voice of OECD Business

12 October 2011

BIAC Thought Starter

A Strategic Vision for

OECD Work on Science, Technology, and Innovation

Introduction

The global science, technology, and innovation (STI) landscape continues to change at breakneck speed. It impacts common global interests and national priorities with greater breadth and depth than ever before. Increasingly, STI policies are the drivers that enable us both to lay the groundwork for sustainable future economic growth and to provide the basis for addressing national, regional, and global priorities.

This BIAC Strategic Vision underscores BIAC's support for the OECD's growing range of activities and initiatives related to science, technology, and innovation. In particular, the current efforts by the Directorate of Science, Technology, and Industry (DSTI), and its associated Committees and Working Parties, to achieve greater strategic coherence - such as its current work programs related to the growing role of intangible assets and knowledge markets, to the important links of S&T with entrepreneurship and intellectual property, and to understanding the "science of science policy" - merit strong support. So, too, the growing number of horizontal efforts to link DSTI work with other OECD Directorates and with key stakeholders, public and private, shaping these developments should be commended.

But a number of other key trends and developments are transforming, research, innovation, business models and government policies. BIAC believes that the OECD's work related to science, technology, and innovation needs to address what policies and practices will really matter in the next few years. We, therefore, urge an even more forward-looking agenda over the rest of the 2011-2012 Program of Work and Budget (PWB) and in planning the PWB for 2013-2014. Specifically, the OECD needs to think strategically about how best to understand the science, technology, and innovation trends that really matter, how to be more proactive than

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reactive in policymaking, how to better link key trends to broader societal goals such as green growth, knowledge-based value creation, and inclusive development, and how to communicate these messages across the whole of government.

Key messages

To achieve this goal, BIAC recommends integrating and adding work related to the following five key considerations:

- **Problem-oriented and solutions-driven science and technology convergence in a global context:** Profound new shifts in how science and technology increasingly take place call into question traditional government S&T research policies and funding mechanisms – especially, (1) the continued globalization of the research-innovation base; (2) a shift to solutions-driven, problem-oriented science and technology; and (3) convergence across STI fields and within traditional STI domains.

- **Reflecting transformations in 21st Century Science and Technology:** Major transformations in the area of science and technology, such as the emergence of big data and Internet of things, need to be taken into account. These transformations go hand in hand with changes in the innovation process, industry structure and business models, which should be reflected in science and technology policies.

- **New sources of growth**: In today's knowledge intensive societies, intellectual assets are becoming increasingly important elements for value creation. At the same time, we need to reap the benefits of next-generation sustainable manufacturing - next-generation jobs and value-added enabled by cutting-edge STI advances and new types of platforms, tools, techniques and lifelong learning and skills built around new manufacturing and production capabilities.

- **The importance of policy coherence, policy coordination and increased collaboration**: New architectures and models for global S&T collaboration and innovation, including open innovation, innovation ecosystem, new university-industry models, innovative models for technology diffusion and a range of novel "bottom-up" and "locally-oriented" initiatives underline the increasing importance of policy coherence and a whole-of-government approach. Close cooperation with major non-member economies, which are becoming increasingly involved in global developments towards knowledge-based growth, is crucial.

- **Fostering innovation**: The provision of an enabling policy framework that facilitates the necessary financial flows, that fosters innovation and entrepreneurship, that focuses on education and the right skills set and that encourages the uptake of innovation and diffusion of technology remains an overarching requirement. We also underline the importance of taking into account the new policy framework for public science – an innovative framework for integrating "science of science policy" with "usable science" and the changing role of science for democratic participation and civic engagement.

Background

The OECD increasingly plays a critical role as a global hub for addressing important emerging trends and policy issues related to science, technology, and innovation as well as education and skills including in the areas of STI. This engagement simultaneously affects not only economic growth across the OECD members and Enhanced Engagement countries but also imperatives for meeting pressing societal grand challenges (health, green growth, energy, knowledge-based development, water, and poverty reduction). Recent cross-cutting OECD work, including the *Innovation Strategy*, *Going for Growth*, and the *Green Growth Strategy,* have all emphasized the growing importance of STI for policymakers. The complementary OECD attention paid to the globalization of research in Enhanced Engagement countries, to the OECD's new mandates to promote "inclusive development" and "green growth", and to providing new sources of sustainable growth in an era of global fiscal consolidation by governments further heightens the importance of the OECD's critical role in shaping policy-relevant STI actions and overarching thematic priorities over the next four years.

Priorities and Strategic Objectives

BIAC appreciates that the CSTP is embarking on a discussion on its forward-looking strategy. The key themes identified in the strategy paper, i.e. (1) linking science to innovation, economic growth and social welfare; (2) enhancing the capacity to cooperation in STI; (3) fostering STI to address global and social challenges, are all extremely relevant. BIAC supports the overwhelming number of DSTI priorities and projects, and we plan to continue our active engagement with the OECD concerning their development. In addition, this BIAC Strategic Vision identifies some critical trends and domains driving STI futures and policies that have not received as much attention. BIAC recommends that the OECD increase its policy focus and analytical attention on each of them, and incorporate them as foundational elements in the on-going and future work programs related to science, technology, and innovation.

1. Problem-oriented and Solutions-driven S&T Convergence in a Global Context

Fundamental shifts are occurring in science, technology, and engineering that affect governments, business, universities and other players. Three developments, in particular, are increasingly interacting and calling into question a range of long-standing government policies, funding schemes, and S&T organizational structures within governments.

First, the globalization of the research and innovation base continues to receive well-deserved attention and prominence in the OECD's thematic priorities and work programs. It has significant implications for competitiveness, national innovation systems, the conduct of science and technology, agglomeration effects, business models and new sources of growth.

Second, there is a marked shift in all STI disciplines and in new multidisciplinary approaches to a more solutions-driven, problem-oriented research and development approach. It is driven by a growing interest in meeting global grand challenges (in areas such as health, energy, environment, water, development) and in creating new economic value-creation at all levels – from local villages to nation states, from small, high growth SMEs to the largest multinationals, and from new consumer-driven demand and user preferences reflected in market decisions. For example, the accelerating transition to a low carbon economy requires new problem-oriented, solutions-driven approaches to bridge critical gaps not only in moving from research outcomes to proof-of-concept but also in achieving market deployment by scaling up to commercial levels in ways that are economically competitive without subsidies.

Third, scientific and technological convergence increasingly is at the heart of STI policy and funding. It is precisely at the interfaces and interstices of traditional domains that many of the most exciting new research and commercial developments are taking place. They are marked by our new ability to merge technologies, processes and disciplines through collaboration or the integration of approaches that, until recently, have been viewed as distinct. In the process, convergence is creating massive disruptions and dislocations in business models and business competitiveness, in government STI funding programs and governance, and in the organizational architecture and frameworks for science and engineering. In too many instances, they have remained largely unchanged for decades despite the pace and scale of the STI shifts taking place around them.

Scientific and technological convergence increasingly drives new business models, innovative university-industry models, the emergence of social entrepreneurs and other creative new players, and a continuum of novel collaborative mechanisms and experiments. CSTP has correctly identified technology convergence as a major new game-changer and, earlier this year, began to explore its broad ramifications for policymakers.

BIAC recommends that the OECD take a proactive approach to identifying key "game-changers" in science and technology, in assessing their implications for a range of policy actions, and in getting ahead of the curve to advise governments and other key players about how they can best be harnessed to promote new sources of sustainable economic growth, to create a broader base for job creation, and to meet pressing societal challenges. Specifically, BIAC believes DSTI should become the strategic global policy hub over the next few years for addressing and integrating these shifts in more policy coherent and forward-looking ways.

2. Reflecting transformations in 21st Century Science and Technology

The cascade of massive new data produced in almost all STI disciplines, combined with a move toward data-enabled science and the need to re-use and make sense of massive existing data, have created a range of new policy issues around "Big Data". This trend affects virtually every STI field and the new interfaces among them. It is revolutionizing the way science and engineering are done. Policymakers need to understand, explore and utilize Big Data to address critical problems with broad economic, technological and societal impacts. OECD is uniquely

positioned to serve as a global leader for policy-relevant analysis and best practices linking Big Data with STI policy, innovation, new business models (public and private), education and skills, and job creation.

Recent studies have confirmed that more data will be created in the next few years than in all the past 40,000 years. Total data will quadruple in less than two years. Governments and other key stakeholders urgently need strategies, policies and best practices for dealing with all that STI data for multiple needs.

New methods of data-intensive exploration in STI fields, such as e-science or computationally-enabled science and the need to handle massive existing data underline the increasing importance of being able to cope with big data. Two trends have emerged that make the challenges of massive new data challenges increasingly significant. First, new methods of data-intensive exploration in STI fields, which some have dubbed e-Science or computationally-enabled science, have created the so-called Fourth Paradigm that builds on the traditional paradigms of empirical description, theoretical models and generalizations and, more recently, simulating complex phenomena through ICT. Second, government policies not only confront the challenges of massive "new" Big Data, but new ones related to making use (and re-use) of massive existing data.

BIAC, therefore, recommends that the OECD add and integrate the new policy challenges of Big Data into the PWB's of each of DSTI's key Committees and Working Parties. Based on previous work by ICCP, we encourage CSTP to consider a thematic focus on Big Data, Data-driven Science and Computationally-enabled STI as a key driver of S&T across all disciplines and general purpose technologies (such as biotechnology and nanotechnology). This could include a series of workshops and outreach programs to better understand the nature and magnitude of the shifts in massive data for science and technology policies and funding. It also could include some targeted initiatives to develop Best Practices and/or OECD Guidelines for enabling, accessing and using Big Data in STI fields. The CIIE could address how Big Data in STI fields increasingly transforms business models, innovation strategies, and entrepreneurial opportunities and can contribute to sustainable new sources of economic growth, value creation and jobs. NESTI could help countries and other stakeholders develop new metrics and methodologies for measuring, assessing and benchmarking key aspects of Big Data.

The Internet of Things, which brings us the real time big data, will increasingly drive STI fields, new economic growth, inclusive development and other thematic priorities such as innovative green growth. It promises to create new business models, to advance societal goals such as Green Growth, and to reduce societal costs, waste and risks. It has the potential to change usage patterns for scarce resources, such as water and electricity, by enabling more dynamic pricing and improving efficiency. In short, physical objects are becoming a type of information system with enormous promise.

Smart grids and evolving energy-efficiency systems are part of the Internet of Things. So, too, are the role of sensing and ICT-enabled technologies for transportation systems and sustainable cities. Another example of the Internet of Things' widespread impact is in agriculture and food. As several leading experts recently commented, models informed largely by sensor-

supplied data can provide new insights about the role of agriculture in carbon, energy, nutrient and water cycles. They expect that expanded sensing and ICT capabilities will be critical to meeting the food, feed, and fiber requirements of a growing global population, as well as meeting energy and eco-system needs.

The Internet of Things can generate better information and analysis, which can significantly improve decision-making at many levels. A key issue to be addressed in this context is how to get best value from the vast amount of data available. New value provided by Big Data/Internet of Things could be a major source of growth and lead to new industrial developments and new markets.

Closely related to the idea of an Internet of Things is the surge of research interest in the science and engineering of complex, networked dynamic systems. Numerous efforts now are underway to engineer networks for inclusive development and to provide new ways to address pressing energy, environment, water, and transportation needs in developing economies.

Developments such as the Internet of Things are at the heart not only of the new research enterprise across many STI fields but also the business opportunities for new sources of economic growth and job creation. BIAC believes the OECD could do more to identify key developments such as these and to re-orient the STI agenda towards the policy issues that will matter the most over the next decade. For example, a new, horizontal initiative between the CSTP and CIIE on the Internet of Things could address the broad policy continuum that spans research, innovation, entrepreneurship and high growth SME creation, new business models and economic value chains and could help guide policymakers about the broad policy implications of these transformational new STI-enabled developments.

3. New sources of growth

In today's knowledge-based societies, intangible assets are becoming increasingly important in the process of value creation. As mentioned in our previous vision paper, new sources of growth are emerging. The increasing role of data, digitally enabled global value chains, new business models, and social innovations represent significant new developments related to intellectual assets. Our economies, therefore, have to develop new mixes of resources and skills within new innovation eco-systems to adapt to the changing processes of value creation.

Intellectual assets are increasingly important to the efficiency of capital markets, to good corporate governance, to investment decisions and to understanding the growing role of intellectual capital in new growth theories and policies. The OECD has played a major role in documenting the changing nature of value creation and in analyzing new innovation-oriented activities, which largely rely on research and development, patents, software, human resources and new organizational structures. BIAC believes that work on intellectual assets should remain high on the agenda to further improve the understanding of their contribution to value creation in the context of a rapidly changing environment.

At the same time, one of the most overlooked sources of new economic growth and job creation can come from revitalizing the manufacturing base of many OECD countries in a knowledge-based economy. Exciting developments are emerging in universities, public-research organizations, SMEs, and large multinational enterprises that can provide the basis for next-generation sustainable manufacturing – including new skills and job creation. New developments in many STI fields and in new interdisciplinary approaches provide the basis for many of them. But to transform these potential opportunities into strong flows of new products, services and processes requires supportive government policies and STI-led advances that enable these new approaches to manufacturing. DSTI can play an important role in identifying how new STI developments and innovation strategies can be scaled up into new productive economic capabilities centered on next-generation sustainable manufacturing.

BIAC urges that, in an era of increased global competition and concern about sustainable growth, DSTI redouble its attention on next-generation, STI-enabled manufacturing as a core driver for enhancing the production capabilities and the employment base of many OECD countries, and for using innovative new manufacturing breakthroughs (often at small scale and linked to services and knowledge) to create jobs, greener growth, and more inclusive development. In this context, it should also be borne in mind that the globalization of R&D has a huge impact on regions. “Smart specialization” is one step in this direction. Yet, the regional dimensions of innovation trends need to be given increased attention.

BIAC recommends that the OECD analyze the state of next-generation sustainable manufacturing made possible by new advances in STI fields and to develop new policy instruments that can facilitate an environment in which they can flourish. The CIIE recently completed valuable work on sustainable manufacturing today, including the issuance of a Sustainable Manufacturing Toolkit. The Working Party on Biotechnology (WPB) has undertaken path-breaking global work in areas such as the future of the bio-based production economy, industrial biotechnology, and, more recently, synthetic biology. The Working Party on Nanotechnology has begun to address how manufacturing at the nanoscale will have widespread implications in the years to come and how nanotechnology will likely transform manufacturing. Each provides a solid foundation for additional work on creating a core platform for next-generation sustainable manufacturing and job creation.

4. The importance of policy coherence, policy coordination and increased collaboration

As highlighted by the OECD Innovation Strategy, innovation requires political leadership, policy coherence and policy coordination and needs to be fully integrated into national economic policies in ways that cut across the priorities of different Ministries. Looking forward, we encourage the OECD to continue to work towards a whole-of-government approach and to help establish comprehensive framework conditions suggested by the Innovation Strategy.

Cooperation needs to be strengthened not only among different Ministries, but also between countries. Particular attention needs to be paid to major non-member economies, which are becoming increasingly involved in global developments towards knowledge-based growth.

While traditionally, innovation has been regarded as spreading from developed to developing countries, this is now changing as innovation is also increasingly moving from developing to developed countries. The innovation eco-system will need to be considered globally. We call upon the OECD to continue monitoring developments with regard to innovation in major non-member economies, which will provide important insights for both OECD and non-OECD countries, and to involve these countries increasingly in OECD policy discussions. New work on innovation and development presents an excellent opportunity for further involving non-member economies in OECD work related to innovation.

Collaborative mechanisms increasingly are the "new normal" in science and engineering for business, governments, civil society and universities. But best practices, new policy frameworks to enable new types of collaboration, and rigorous assessments of a wide range of STI collaborative models and experiments lag. This threatens to slow down the development and diffusion of innovative collaborative mechanisms which are essential to enabling science, technology and engineering and to extracting the maximum social value from them. One key question to be addressed is how to set up an efficient governance system for effective collaboration between the various partners, including, regions, countries, industry science, the general public, etc.

BIAC urges the OECD to build on its solid foundation and expertise with collaborative mechanisms, to become the global STI clearinghouse for identifying new models, providing toolkits and guidelines about them, and rigorously assessing different types of collaborative mechanisms for policymakers. WIPO-green could serve as a best practice example where the business sector takes initiative in realizing the mechanism. It also offers the opportunity for greater strategic integration of the DSTI Committees and for a better alignment with existing DSTI horizontal priorities related to intangible assets and new sources of economic growth.

5. Fostering innovation

In response to the concerns of many members, the CSTP plans to focus more attention on the "science of science policy" and, in particular, why public policies to support science and technology are becoming ever more important and how to understand the pathways from investments in R&D to outcomes that matter. Many governments, politicians and taxpayers legitimately are concerned about whether funding STI and investing in new research and innovation initiatives continue to produce sufficient economic returns and other societal benefits. In an era of fiscal consolidation and the need to leverage tight government budgets, BIAC strongly supports efforts to better understand and promote the role of science and technology in driving economic growth and social welfare.

BIAC, however, believes more needs to be done. We urge that the OECD and, specifically the CSTP, consider moving beyond its focus on "science of science policy" to the development of a broader "Policy Framework for Public Science" with four foundational platforms. The first, of course, needs to include a coherent approach to STI policy. It should be integrated with three other dimensions – (1) public understanding and engagement with science and technology; (2)

the more effective use of science and technology research and outcomes in policymaking (which we simply will label “usable science”) across governments; and (3) the new collaborative mechanisms and “collaboration at scale” discussed in the preceding section. CSTP could provide a value-added approach by taking a coherent, integrated approach to Public Science, by compassing a broader focus on a New Policy Framework for Public Science.

While the above-mentioned items raised a number of new considerations and developments to be considered, we would also like to highlight the continued importance of OECD work on fostering innovation and monitoring to what extent the recommendations of the Innovation Strategy are being implemented. The private sector is often urged to invest more in R&D, and we need to have a clear understanding of whether the framework conditions are right for companies to increase their R&D efforts and to what extent these expectations are realistic. While certainly not an exhaustive list, we would like to highlight in particular the importance of continued focus on the following issues:

First, access to financing, which is a key component of innovation, and policies to support capital formation will need to remain high on policy makers’ agendas as many countries are still struggling with economic difficulties. In this context, the following areas require continued attention: the role of public support schemes and best practice models in this area; the role of venture capital; tax incentives for research and innovation; and the economic value of intangible assets, which are increasingly important for both traditional companies and “knowledge companies” that heavily rely on patents or employees’ know-how. Due attention needs to be given to implications for access to financing.

Second, we encourage the OECD to play a leading global role in analyzing the contributions of entrepreneurship to innovation and job creation. CIIE can play an important role by increasing our understanding of the role of public policy in enabling entrepreneurship for innovation and the role of entrepreneurial firms (including new types of entrepreneurs such as social entrepreneurs and public-private entrepreneurs) in providing new sources of innovation and growth.

Third, we need to keep focus on the need for more people to be entrepreneurial and skilled in areas of STI, while recognizing the need for transversal skills, such as adaptability, language and communication skills, and increased use of ICT. We encourage DSTI to work with the Education Directorate to help establish relevant, high-quality education systems, particularly in the fields of science and technology.

Fourth, we highlight the importance of an effective and efficient IPR regime, which serves as a critical enabling tool for innovation. In this context, the OECD could also play a useful role by analyzing and synthesizing available collaborative mechanisms, partnerships and best practices that recognize the critical role of an effective and efficient IPR system while exploring ways of promoting the spread of environmental technologies.

Fifth, we recommend analysis on what different types of new innovations (business model innovation, design innovation, organizational innovation, etc.) mean for the public sector and for small and large companies.

Concluding remarks

In BIAC's view, the long-term policy objective of sustaining innovation must remain at the forefront of attention and receive the necessary high-level political attention. There is a growing need for international cooperation to leverage national efforts to support science, technology, and innovation. Major global challenges are too large and too complex to be solved alone. The global science, technology, and innovation landscape is changing rapidly. The OECD can and should play a major role by helping countries respond to new challenges and ensure that policies reflect the new developments. As the future priorities are being discussed, we encourage the OECD to put due emphasis on

1) Problem-oriented and solutions-driven STI policies instead of category-oriented individual policies;

2) Pro-active policy-making based on the plentiful analysis of transformations in STI, social trends, as well as new developments and sources of growth;

3) Cross-cutting global collaboration among OECD members and between OECD and non-member countries, including BRICS and developing countries, to address global challenges effectively;

4) Policy coherence and coordination in fostering innovation and entrepreneurship as well as a coherent and integrated approach to Public Science.

We hope that the above-mentioned considerations will provide useful input as the future program of work is being designed. BIAC looks forward to contributing constructively to these discussions.