



VINNOVA INFORMATION  
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# Relationships between R&D Investments, Innovation and Economic Growth

A Conference Summary from VINNOVA



# Evaluation is the key

INNOVATION POLICY is about targeting and designing measures that generate value-adding economic impacts. Consequently, understanding the relationships between different innovation policy measures, and their different impacts, is of fundamental importance. Therefore, VINNOVA thoroughly evaluates the logics of different research and innovation programs before they are launched. Moreover, VINNOVA devotes considerable resources to the evaluations of different programs – during their lifetime and after they are finished.

In order to draw on the knowledge frontier in innovation policy evaluation, an international advisory board including some of the world's leading evaluation experts has been engaged in VINNOVA's evaluation activities. The advisory board meets twice a year. The latest advisory board meeting was followed by an open conference on impact evaluation, which took place May 8, 2008 in Stockholm. This report summarizes the presentations and the discussions that took place at this conference.

Five presentations focusing on different areas and challenges in research and innovation policy evaluation represented the core of the conference. Each of them was followed by comments and an open discussion. Stephanie Shipp, from the National Institute of Standards and Technology (NIST), USA, presented

approaches, experiences and impacts from the most ambitiously designed and evaluated R&D program in the world, the Advanced Technology Program (ATP). This was followed by Charles Wessner, the National Academies of Sciences (NAS), USA. He presented the results from a recently finished evaluation of the Small Business Innovation Research Program (SBIR).

Erik Arnold, from Technopolis in the UK, continued with a presentation of the impact evaluation of the importance of Swedish R&D-programs in the history and success of the GSM technology and the telecommunications industry in Sweden. Jari Romanainen, from Tekes in Finland, followed with a presentation of the approaches and experiences of Tekes' evaluations and their use as a basis for strategies and policy design.

The final presentation by Irwin Feller, senior visiting scientist at the American Association for the Advancement of Science (AAAS), focused on key lessons for evaluation and policy. They were based on his long and broad experience from numbers of R&D-programs and policy evaluations.

Please visit our web site for more information and documentation from the conference: [www.VINNOVA.se/economic\\_growth\\_080508](http://www.VINNOVA.se/economic_growth_080508)



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## The art and science of measuring outcomes

**Stephanie Shipp was the opening speaker at the seminar. The title of her presentation was: »Impacts of R&D-Funding from the U.S. ATP/TIP, NSF and NIH programs.« Shipp pointed out that measuring outcomes may seem like straightforward science – but it is in fact also an art.**

STEPHANIE SHIPP IS THE DIRECTOR of the Technology Innovation Program at The National Institute of Standards and Technology (NIST), U.S. Department of Commerce. Shipp has been deeply involved in measuring the impact of different R&D-funding programs in the U.S. for a number of years. She was excited to take part in the seminar.

»I think, as Per Eriksson pointed out, that these events present excellent opportunities for us to share knowledge, and learn from each other. For me, it's a good lesson to hear what you do in Sweden. I see this as a two-way partnership.«

During her talk, Shipp presented the methodology behind the former Advanced Technology Program (ATP), which was very successful in the U.S. The ATP co-invested in industry-led projects, positioned after the basic science stage but before product development. Its goal: innovation for broad national economic benefit.

»Our aim was to measure what you call

economic growth. We have done it in multiple ways, using for example surveys and case studies. And I must say that measuring outcomes and outputs is really both an art and a science.«

A primary purpose of the surveys was to determine whether the ATP people had selected the right projects to invest in. Awarded companies were tracked several years after they had received the funds. Each survey covered background information, goals, technology, strategies, partnerships, risks, expectations for the future and many other factors.

»Sometimes we learned more from the failures than from the successes. And because we fund high risk projects, we do expect some to fail.«

Case study benefit-cost analyses were used to estimate the impact of federal technology development projects.

»Case studies describe the whole project from start to end. The disadvantages are that they are very costly. It may also be difficult to acquire data from companies.«

Stephanie Shipp presented a couple of her favorite case studies. One measured the impact of an ATP project that was launched to improve the quality of vehicles manufactured in the U.S.

»We only measured a few of the benefits, because you can't measure them all. The study

showed an increase in the quality of U.S. autos, which led to increased demand. 1,400 new jobs were created as a result – and this is just one ATP project!«

»In another very cool cluster of projects, valuable metals are sorted out from heaps of scrap metal. The case study analysis showed that the projects are both economically and environmentally friendly.«

Stephanie Shipp concluded that the ultimate outcomes usually cannot be predicted. They may occur long after research is completed, and often depend on actions taken by others.

»The portfolio of ATP projects shows that benefits indeed exceeded costs. But it's very hard to predict the future; otherwise we would all be rich!«

Stephan Kuhlmann, Professor of Foundations of Science, Technology and Society at the University of Twente in the Netherlands was invited to give his comments on Shipp's presentation. He used the iceberg metaphor.

»It's very important not to miss the spill-overs. The iceberg has to be explored from underneath, since most impacts are not immediately recognized. My second point is to drill selectively, but to drill deep!«

»VINNOVA is one of the world's leading organizations in this field. Creating intelligent and supportive ways to measure is crucial for innovation policy,« Professor Kuhlmann noted. ■



## Wanted: Increased incentives for innovation

**Charles Wessner is a Director of the National Academies in Washington D.C. In his presentation, he stressed three key points: innovation is crucial for global competitiveness; small businesses and universities are central for innovation; and institutional change is necessary.**

»ADDRESSING THE INNOVATION Imperative: An Account of the American SBIR Program« was the topic of Charles Wessner's talk. He began by addressing the three most important points. The first is: innovation is key to maintaining a country's competitive position in the global economy.

»There really is a global challenge. We face it in the United States, and the Swedes are also completely aware of it. Sweden is prepared to do whatever is necessary – as long as nothing changes,« said Wessner jokingly.

The second point is: small businesses and universities play a key role in the innovation process.

»It's not just that small businesses are nice: we absolutely need them in order for our economy to survive.«

Charles Wessner's third point is: institutional change is necessary to compete successfully, and new incentives are required for change. He pointed out that there is a general lack of incentives for radical innovation in Sweden.

Few major new firms have been established since 1970. A notable difference between the Swedish and the American systems are the bankruptcy laws.

»One of our great strengths is the gentle bankruptcy law. In the U.S., we have a willingness to tolerate failure.«

Charles Wessner went on to present the American SBIR program as a way to bridge the Valley of Death. SBIR stands for Small Business Innovation Research, and the program was originally set up in 1982.

»SBIR was created before we knew how important small firms are, and before we had a good understanding of the Valley of Death. It has been active for 25 years, and it represents nearly twice the seed stage venture funding. Participating agencies vary in size, but the program remains effective. Thus, SBIR is scalable – which VINNOVA has demonstrated very convincingly.«

»A few years ago, Swedes would tell me they were not sure that this program would work in Sweden. Now we know that there's an enormous interest. You've got the researchers and the ideas. The question is: Where's the money?«

Wessner called SBIR a »win-win-win proposition«. Entrepreneurs like it, and so do universities and governments. The National Academies have done a comprehensive eva-

luation of the SBIR program. It shows that SBIR Awards have a substantial impact on participating companies: 25 percent of the companies said they were founded as a result of the award. SBIR also played a key role in 70 percent of the cases where a decision was taken to pursue a research project. Charles Wessner concluded that SBIR is a way to speed the process of innovation, and that speed is essential for a country's companies to compete.

»One of the classic criticisms – and compliments – to the Swedish system is that you have some of the best intellectual capital in the world. And you keep that carefully guarded, inside the universities, to make sure no one uses it to start a company or hire people.«

VINNOVA's Lennart Norgren commented upon Charles Wessner's presentation by saying that an increasing number of countries are adopting, or adapting, the American SBIR program.

»This can be interpreted as politicians realizing that the government has a role in bridging the Valley of Death. That is something new.«

»Charles Wessner mentioned that Sweden ought to reinforce its SBIR program – Forska&Väx – and that other agencies should start their own SBIR. I wonder if variations in design have anything to do with outcomes? Does the design matter, or are other conditions more important?« asked Norgren. ■



## Swedish mobile telephony – a success story

**Once upon a time, there was a small country with a high population of skilled engineers. The engineers developed a technology that managed to conquer the world. After that, we all lived happily ever after. The end? No, Erik Arnold demonstrated that there is more to technology development.**

DURING HIS PRESENTATION, Erik Arnold told »The GSM Story« with the subtitle »Effects of research on Swedish mobile telephone developments«.

»This story is almost a piece of archeology, it's very fascinating! It is also a story of transformation, in which research plays a significant – but not the only – part«, said Erik Arnold, Managing Director of Technopolis in the United Kingdom.

To understand the story, it is necessary to have a modern, complex understanding of the innovation process, argued Arnold. He presented a theoretical model containing new ideas, needs and a marketplace. Underpinning it all is the state of the art in technology and production: the stock of existing knowledge.

»The model says that new knowledge is one ingredient amongst many. The whole system has got to work, and innovation can start anywhere. This is also crucial in a policy context.«

The Nordic area has been a telephone society for a long time, even going back to the

age of fixed telephony. In the transition from the first generation of mobile telephony – NMT – to the second generation – GSM – the Nordic countries got a head start. Ericsson and the Swedish state telecoms company, Televerket, were in a very strong position to influence the interface. The GSM standard could be developed to their own advantage.

Going from NMT to GSM, Swedish engineers were faced with six major problems. In order to solve them, research was mobilized. Ericsson employee Sven-Olof Öhrvik was one of the key players. He engaged the research community at Lund University, Linköping University, Chalmers University and the Royal Institute of Technology through the informal »radio club«. Test beds served as important ways to focus the research, both for industry and universities. However, the second-generation transition involved no fundamental research: the development was all dependent on refining the stock of existing knowledge.

»Thinking in policy terms, you'd be completely nuts if you decided to put all the money into engineering types of research. And you'd be just as stupid putting all the money into basic research. If you want to walk, one leg is good. But two legs are somewhat faster.«

»We need different incentive systems for industry and universities, and we need a lot of people and information moving back and

forth. We also need some source of money – use-oriented funders. Their role is completely distinct from that of the research councils. It requires different skills, governance, decision-making mechanisms and empowerment of project and program officers.«

According to Arnold, an innovation agency needs technological capability in order to take intelligent risks. That way they can lose small, but win big. Absorptive capacity is crucial, and innovation systems need both informal focusing devices and formal programs. Another conclusion is that small, medium-sized and large companies matter.

Connie Chang, an independent consultant from the U.S., commented on Erik Arnold's presentation. She found his study of the development of GSM remarkable, and wanted to highlight some nuances.

»When you're in an innovation agency, you have to be nimble and intelligent. It's not just going from administrative capability to technical competence, it's beyond that. You have to have an appreciation for the business aspects, because that is what an innovation is. The knowledge you create, the invention, has to be pulled all the way to the market place,« Chang pointed out. ■



## Whoever understands change is the winner

**The Finnish innovation agency, Tekes, has a good reputation in the global policy community. Many other agencies look to them for inspiration and advice. Therefore, the views of Tekes representative Jari Romanainen were highly appreciated at this seminar day.**

TEKES PLAYS AN IMPORTANT ROLE in the Finnish innovation system, a role that is quite similar to that of VINNOVA in Sweden.

»We not only help design and implement policy; we also interact directly with the scientific community. We work with the Finnish Academy, but also with other organizations closer to the market. Tekes collaborates with anybody doing R&D in Finland, but we are also a part of the whole innovation delivery system«, said Jari Romanainen, Executive Director of Customer-ship at Tekes.

His presentation was entitled »Effects and impact following from Tekes's efforts in Finland«, and he argued that, when analyzing the societal impact of Tekes, and of similar agencies, one has to take into account that it is not only dependent on what Tekes does, but also on the actions of the whole innovation system.

Many different driving forces influence innovation policy. According to Romanainen, the globalization of business and the change in

societies and markets are two very important external drivers. Changing demands of governance is another.

»We have to take into account the multilevel nature of EU governance for example. And we have to make policies on the different levels coherent and make sure they have the same aims.«

»This is a complex thing, there are so many actors in an innovation system. In order to understand it, we have to look a bit wider and try to understand how its strategic behavior changes over time. Policy is about managing transitions. Understanding these questions is a challenge to innovation agencies all over the world. Whoever understands change is the winner.«

Thus, Jari Romanainen wants to see a shift in focus, from concentrating on the actors in the innovation system, to adapting a more systemic viewpoint. Business models, services, R&D, technology, strategic behavior – these are all factors that agencies have to deal with.

»We have to understand the dynamics of the innovation systems, what makes them tick. This plays a crucial role in the whole process of policy-making. Understanding cultural contexts is also very important,« said Romanainen.

He emphasized the importance of the evaluation process in creating and maintaining an

effective innovation policy. Evaluation is a continuous learning process, which improves the understanding of how the systems work, and how they change over time. Evaluation is also important for the accountability of the policies that are being implemented.

Traditional methods for evaluation do not work anymore, argued Jari Romanainen. He called for new, and more experimental, approaches to policy evaluation.

»At Tekes we use multiple methodologies to better understand the different aspects of the systems. Implementing new approaches costs more, but will significantly improve our policy relevance.«

Nicholas Vonortas, Director of the Center for International Science and Technology Policy, and Professor at The George Washington University, was given the task of responding to Jari Romanainen's presentation.

»First I want to say that Jari's talk contained enough information for a whole semester's teaching in one of my classes. And everything he said was correct, by the way.«

»Although I think I am more optimistic than Jari on what kind of analysis we can do, I am also much in favor of combinatory approaches. They can be really useful if used intelligently. Thus we need agencies that are intelligent, « Vonortas commented. ■



## Evaluation changes the terms of the debate

**Economists and policymakers alike generally accept the proposition that R&D and technological innovation are major sources of economic growth. There is, however, still not enough knowledge about what kind of R&D gives the biggest bang for the buck.**

IRWIN FELLER, PROFESSOR EMERITUS OF Economics at Pennsylvania State University, talked about this problem in his presentation »On the Effects and Impact from Publicly Funded Research Programs«. He pointed out that governments often fail when structuring R&D funds and designing innovation policies.

»By government failure we mean the tendency of governments to spend too much on R&D, to spend it in the wrong field, on the wrong performers, and to push technological solutions before the underlying science and technology is developed. It is like the proposal in the mid-1960's in the United States to build a nuclear powered airplane. I remember the President's science advisor said: 'To pursue that objective guarantees that every plane accident will be a nuclear incident'«.

According to Professor Feller, we also have to bear in mind that it takes time for the impact of public sector R&D to be felt. Transferring research to technology is a lengthy process, as is its diffusion into the market. Hence, the effects on economic growth will not be seen

until many years after the policies have been implemented. This, together with other difficulties, makes impact studies difficult to conduct.

»If you expect to look at a series of impact studies and find that they all tell you the same thing, you are dealing in la la-land – or you have a very simple policy. The literature often differs and points in opposite directions. This is a dilemma; conflicting evidence is the norm in science and evaluation research, but really only complicates the policy making.«

»A good evaluation, showing positive program impact, does not necessarily protect a program. I could fill the room with tears on the number of studies I have done which have had zero impact. This is the perennial lament of the program evaluators, and it will continue to be.«

So, if evaluation is so difficult, and the evaluations are not even being used, why continue to do them? One reason, according to Feller, is the belief that well crafted empirical studies will at some point impact the policy processes.

But there is also a more positive, research-based perspective. Evaluation, argues Feller, is used in two different ways. One is instrumental: does the study impact a decision? The other is enlightenment: does it affect the way that researchers and policymakers think about the issue?

»It is frustrating to look at evaluations only in terms of its instrumental value. There are so many other factors that come into play in the policymaker's decision-making.«

»A good evaluation changes the terms of the debate. It changes the conceptions of how the world operates. Things change very slowly. The evaluation community has to be persistent and keep doing this, recognizing that no single study is going to be convincing enough, but over time the weight of the evidence can, and has, changed the ways things are done.«

Jon Martin Hekland, Special Advisor at the Research Council of Norway, commented on Feller's presentation.

»I agree that macro studies tell us that R&D is good for economic growth, but only give us general recommendations on how to design innovation policy instruments. However, extended use of micro data in macro level analyses can improve this situation somewhat,« Hekland said.

He also pointed out that improved modeling could help the evaluation process, for example by disaggregating R&D by source of funds. On the other hand, data availability limits research, which calls for new types of analyses and more solid policy-making. ■



**On May 8, 2008, VINNOVA organized a seminar day on Relationships between R&D Investments, Innovation and Economic Growth. This is a report from that seminar. More material, including film clips of all presentations, can be found at:**  
[www.VINNOVA.se/economic\\_growth\\_080508](http://www.VINNOVA.se/economic_growth_080508)

**VINNOVA** (The Swedish Governmental Agency for Innovation Systems) is a State authority that aims to promote growth and prosperity throughout Sweden. Our particular area of responsibility comprises innovations linked to research and development. Our tasks are to fund the needs-driven research required by a competitive business and industrial sector and a flourishing society, and to strengthen the networks that are such a necessary part of this work.

**The Government has assigned VINNOVA to:**

- ...contribute making Sweden a leading research nation in which research of high scientific quality is conducted.
- ...promote sustainable growth and increased employment by acting to increase competitiveness and the emergence and expansion of successful companies.
- ...support research and development work of the highest quality in areas such as engineering, transport, communications and working life in order to promote renewal and sustainable growth.
- ...stimulate Swedish participation in European and international R&D collaboration and in the exchange of experience in the field of innovation.



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