Chapter II.9
Technology Transfer to Business and Industry

The Roles of Government, Academia, and the Private Sector

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1 Introduction

Transition of research to operations has taken many forms over the years. Some have referred to this process as "crossing the valley of death" (Dumont, 2001) since it is fraught with stumbling blocks and often is not successful for one reason or the other. Not all research is even considered for transition to operations and this situation is sometimes referred to as "crossing the valley of lost opportunities" (Anthes, 2003). This chapter will discuss these processes and present several examples of transition activities. Some conclusions will be drawn and some challenges will be offered.

2 Transition Pathways

Figure II.9.1 shows the transition pathways that exist in transitioning research to operations. This diagram was related to the US environmental satellite system by a committee of the National Research Council (NRC) that reflects the respective roles of the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DoD) and end-users (National Research Council, 2003). NASA has a primary research responsibility, while NOAA and DoD are the operational entities that apply satellite information for user requirements. At the research end are the NASA researchers that are either responding to requirements of users or are expanding the research based on new technology. At the other end are the users who either apply the data directly or create products that are provided to the ultimate users. In the middle are the satellite data providers who operationalize the research of NASA. Along the way some NASA research never sees the operational light of day – the valley of death. Other research makes the transition to the operational providers but

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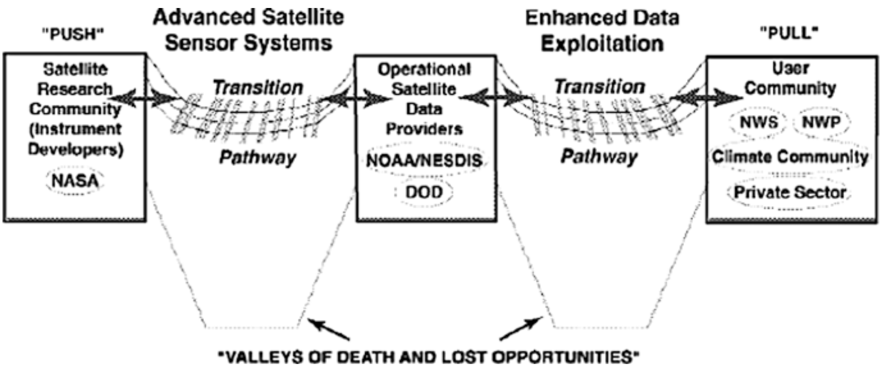

Fig. II.9.1 Transition pathways in transitioning research to operations

never makes it to the users – valley of lost opportunities. Finally, some research makes the transition and is applied by users – a successful transition.

In order to solidify the transition process a number of steps are necessary. They are depicted in Fig. II.9.2 which was the final recommendation of the NRC committee. To avoid the valley of death, clearly defined requirements which lead to proper allocation of resources by the research and operational communities – all

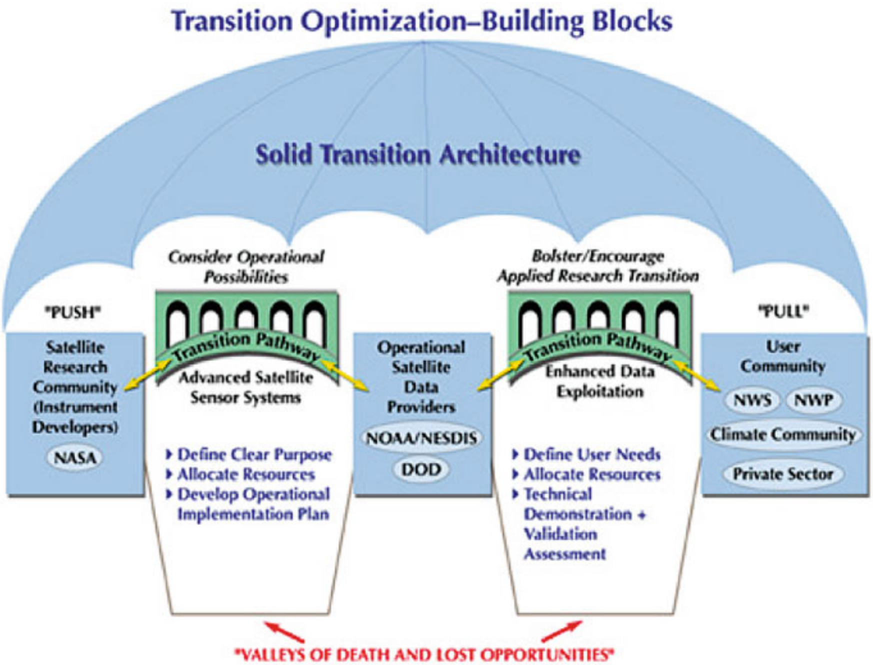

Fig. II.9.2 Transition optimization-building blocks highlighted with a detailed operational implementation plan – are mandatory to ensure that relevant research is performed and ultimately implemented by the operators.

Technology Transfer Paradigms. There are a number of ways to foster the transfer of technology.

Government Funds Support R&D. The most common way is for government funds to support research and development. In some cases academia does the research, publishes it in open literature, and industry adopts, often by licensing from academia. Sometimes small business research stipends are available from the government and industry then commercializes the results. Finally, federal laboratories may conduct the research and make it available to industry through several different avenues.

Private Sector Funds Support R&D. Less common is either private not-for-profit associations or individual companies developing and commercializing technology development. This usually requires the technology be either sufficiently mature to guarantee return on investment or be of sufficiently high payoff potential to warrant the risk.

Government, Academia, and Private Sector Establish Partnerships. This is an emerging phenomenon where the various sectors form relationships that build on the strengths of each for the common good. This is essential in a period of diminished public resources and allows all sectors to thrive through cooperation and mutual benefit. The American Meteorological Society has established a Commission dedicated to this premise and positive results have occurred since its inception in 2005.

Examples of Transition of Research to Operations. There are a whole host of examples of successful transition of research to operations. The examples range from dropwindsondes to weather radar, to wind profilers, to numerical weather prediction models, to lightning detection systems, to weather satellites – to name just a few. This chapter will focus on two examples—dropwindsondes and wind profilers.

Dropwindsondes. Hurricane reconnaissance is the backbone of the US tropical storm warning system. US Air Force and NOAA aircraft penetrate these dangerous storms and take measurements that are critical to estimating the strength, trend, and forecast track of these destructive forces. One of the most important sources of data is an instrumented device called a dropwindsonde or dropsonde that is ejected by the aircraft at significant points within the storm to collect data on the vertical structure of the storm and most significantly the character of the central pressure and the maximum winds in the eyewall. The current version of the dropwindsonde was developed with government funding by the National Center for Atmospheric Research (NCAR) and licensed to Vaisala for commercial production. A model of the device appears as Fig. II.9.3. The use of this new GPS-based dropsonde has been credited with improving the hurricane track forecasts by 20%. This was important as one famous storm – Katrina – bore down on the US Gulf Coast in 2005 (Extreme

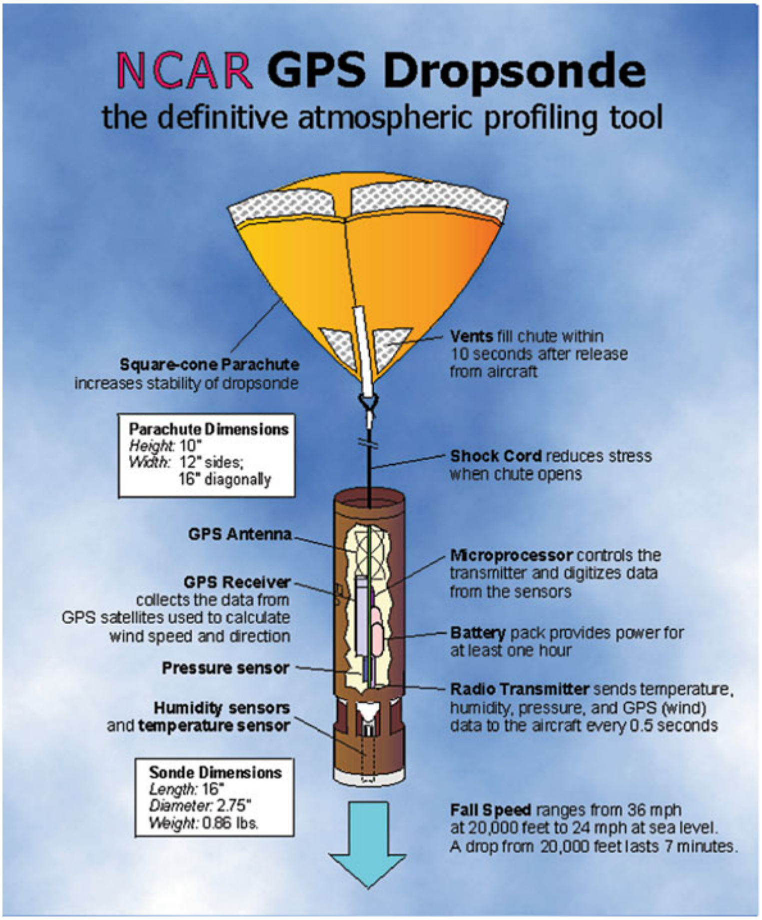

Fig. II.9.3 NCAR-developed GPS dropsonde

Weather Sourcebook). Figure II.9.4 shows the forecast track with and without the dropsonde data. Without it the track would have brought it ashore along the central Louisiana coast. With the data the track brought it ashore in the vicinity of New Orleans. The latter was spot on and allowed the weather service to provide many hours of warning to the citizens and officials of the Crescent City. Damage and loss of life were significant even with these near perfect warnings but would certainly have been more severe without them.

To summarize the dropsonde research to operations process, airborne reconnaissance needed an improved wind finding sensor. Federal funds enabled NCAR to develop a prototype GPS wind finding dropsonde. Partnership with Vaisala evolved into a license agreement to commercially produce GPS dropsondes. As a result, reconnaissance units now routinely employ GPS dropsondes during operational missions providing critical data for accurate storm forecasting.

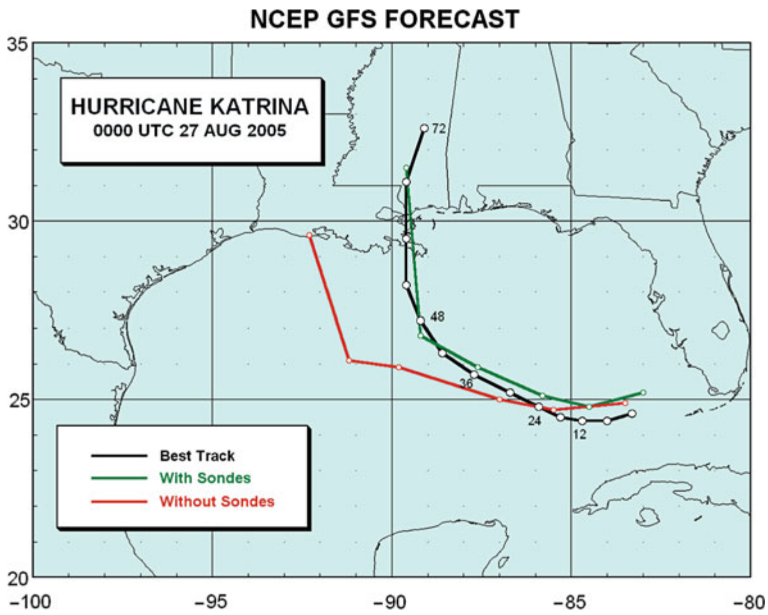

Fig. II.9.4 Katrina forecast track with and without dropsonde data (Figure courtesy of James Franklin, National Hurricane Center, USA)

Radar Wind Profilers. NOAA research laboratories were noted for world leadership in radar technology in the 1970s–1980s. A product of their advanced research was a boundary layer radar wind profiler that had potential for commercialization to support air quality forecasting and other weather forecasting needs. In 1991 NOAA competitively awarded a Cooperative Research and Development Agreement (CRADA) to Radian Corporation, Austin TX, to mutually develop and prepare the boundary layer profiler for the commercial market. The terms of the agreement provided for NOAA to continue advanced signal processing development while Radian would focus on advancing the hardware to the point where it could be mass produced. As the agreement progressed, each party did a little and mutually produced a final hardware and software package that emerged on the market in 1992–1993. Since that time, over 135 systems have been fielded in such applications as air quality, aviation, and mesoscale forecasting. A picture of the profiler appears as Fig. II.9.5 (Vaisala).

To summarize the wind profiler transition process, there was a community requirement for continuous monitoring of the winds and temperatures aloft in the boundary layer. Federal research funds led to the development of a family of radar wind profilers by NOAA. The government awarded a CRADA to Radian (subsequently acquired by Vaisala) in 1991 to marry the requirements with the product. The CRADA has been renewed three times since 1991 and has returned stipends to NOAA in excess of $1 million to benefit continued research and development. Vaisala now has evolved the capability into a complete line of wind profilers that meet a full range of atmospheric needs.

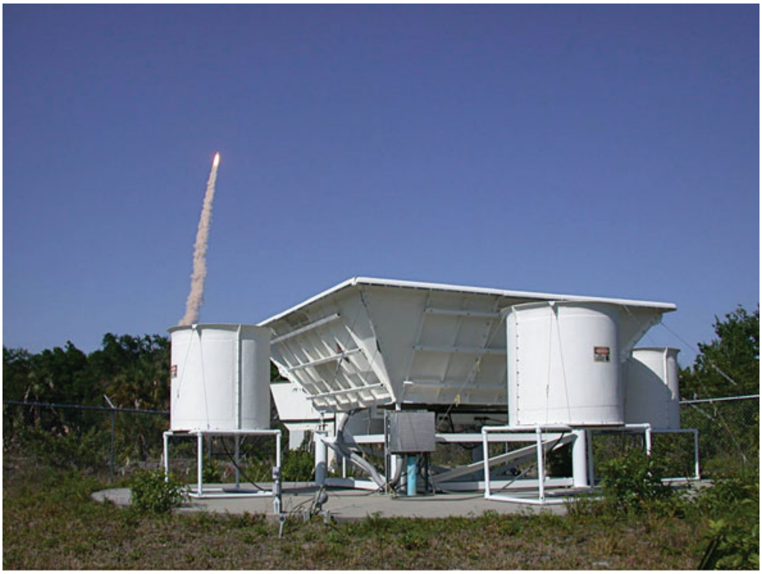

Fig. II.9.5 NOAA developed and Radian fielded boundary layer wind profiler at Cape Canaveral FL during the launch of the Space Shuttle

3 The Future – Partnerships

The question is Can government, academia, and the private sector establish true and effective partnerships to meet the needs of the entire community for technology transition in the future? What is needed is a relationship that resembles a legal partnership that involves close cooperation between parties having specified joint rights and responsibilities. The government, academia, and industry have different yet complimentary needs but if resources are pooled and risks shared the costs can be managed. How to do this is the big question – testbeds may be the answer. Testbeds provide infrastructure for transitioning from research to operations. The testbed needs the flexibility to test many new ideas, the expertise to judge which of them are viable, and the infrastructure to harden the sensors, algorithms, and models that will generate new products for operations (Ruffieux and Furger, 2006). Figure II.9.6 provides a model of how a testbed could work.

For the meteorological community a testbed could be defined as "a working relationship in a quasi-operational framework among forecasters, researchers, private sector, and government agencies aimed at solving operational and practical regional problems with a strong connection to end-users." The testbed concept has been put into action in Helsinki Finland with the Helsinki Testbed depicted in Fig. II.9.7 (Dabberdt et al., 2005). The partners include

- Finnish Meteorological Institute (FMI)
- Vaisala Oyj

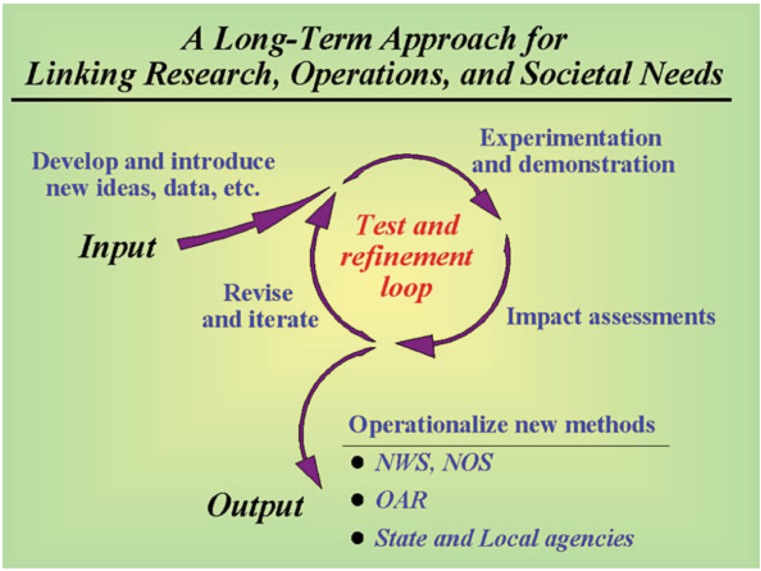

Fig. II.9.6 Testbed model

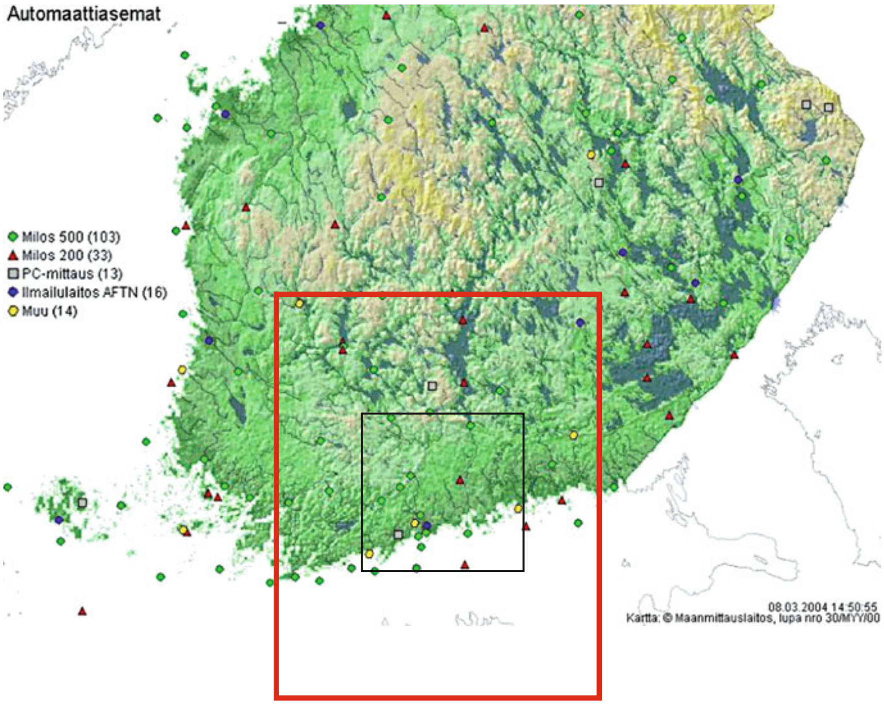

Fig. II.9.7 Helsinki Testbed (larger square) is the outer limit for model work and the smaller square is the intensive region for high density observations

- Nokia
- TVO Power company
- Radiation and Nuclear Safety Authority STUK
- Road administration, Road enterprise
- Helsinki Metropolitan Area Council – Air Quality
- World Championships in Athletics 2005

The Helsinki Testbed has experienced multiple uses as follows:
May 2005 – test of communications
August 2005

- nowcasting by extrapolation; convection
- world championships in Athletics
- no database yet, limited remote sensing instrumentation

November 2005

- snow/rain

January–February 2006

- Inversions

May 2006

- Sea breeze, fog

August 2006

- Convection

The research plan for the Helsinki Testbed includes

- water phase: rain/snow/mixed
- visibility
  - fog and
  - precipitation phase and intensity
- inversion height and strength
- urban-mesoscale model
- air quality model
- sea breeze
- sensitivity tests with LAM
- road surface radiation balance model

So the Helsinki Testbed provides a database for measurements, numerical weather prediction fields with access over the internet for all users. It provides infrastructure for research to operation activities with an extensive measurement capability.

4 Summary

The challenge of transitioning research to operations is crossing both the valley of death and the valley of lost opportunities. The research to operations transition can take many forms: government investment, government licenses, CRADAs, and corporate investment. Testbeds can be a bridge for research to operations transition. They provide for multi-sector partnerships and cooperation where bugs in the system can be worked out before the system is made fully operational – saving money and resources.

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