A system for measuring waterflow in sewers, an aid to controlling water pollution, typifies the aerospace spinoff process

An Environmental Innovation: The Sewer Mouse

An American Digital Systems field crew prepares to install a sewer waterflow monitoring system. The system, an aerospace technology spinoff, is shown in the foreground.

In the effort to clean up America's waters, there is a little-known complicating factor: because they leak, sewer systems in many American cities are causing rather than preventing pollution of rivers and lakes. Fixing the leaks is difficult because their locations are unknown. Maintenance crews can't tear up a whole city looking for cracks in the pipes; they must first determine which areas are most likely suspects. An aerospace spinoff is providing help in that regard.

While one technician mans a safety line, another descends into a sewer to position the waterflow monitoring equipment. The system helps locate pollution-causing sewer leaks.

The problem starts with heavy rains. Rainwater naturally flows into the sewers from streets, but sewage systems are designed to accommodate it. However, they are not designed to handle the additional flow of "groundwater", rain absorbed by the earth which seeps into the sewers through leaks in pipes and sewer walls. After a storm, groundwater seepage can increase the waterflow to deluge proportions, with the result that sewage treatment plants are incapable of processing the swollen flow. When that happens the sluices must be opened, dumping raw sewage into rivers and lakes.

The Environmental Protection Agency has directed that American cities survey their sewer systems to determine the extent of their groundwater seepage problems. The basic method of doing so involves monitoring waterflow depth in the sewers under different conditions—dry, rain and after-rain—as a means of finding out when and where leakage occurs. Flow measurements can be made manually by dipsticks where there is an accessible place to make measurements. But there is another complication: the most readily accessible places, directly below manholes, are not suitable for precise measurement. Sewer design involves building small troughs in the pipes at manhole locations. These troughs help speed waterflow past manhole areas to prevent street-flooding during heavy rains, but in so doing they create a turbulent waterflow which makes accurate depth measurements impossible. To get the requisite information, municipalities needed a system for acquiring simultaneous and continuous waterflow readings from many different points within a sewer complex.

Peter Petroff provided a solution. Petroff is a Bulgarian-born inventor with about 15 years of aerospace engineering experience; he worked for NASA as an instrumentation designer on several major space programs and served with other organizations as an electronics specialist on missile and commercial aircraft developments. Petroff designed and manufactured a sophisticated sewer flow measurement system which is contributing to more effective sewage processing.

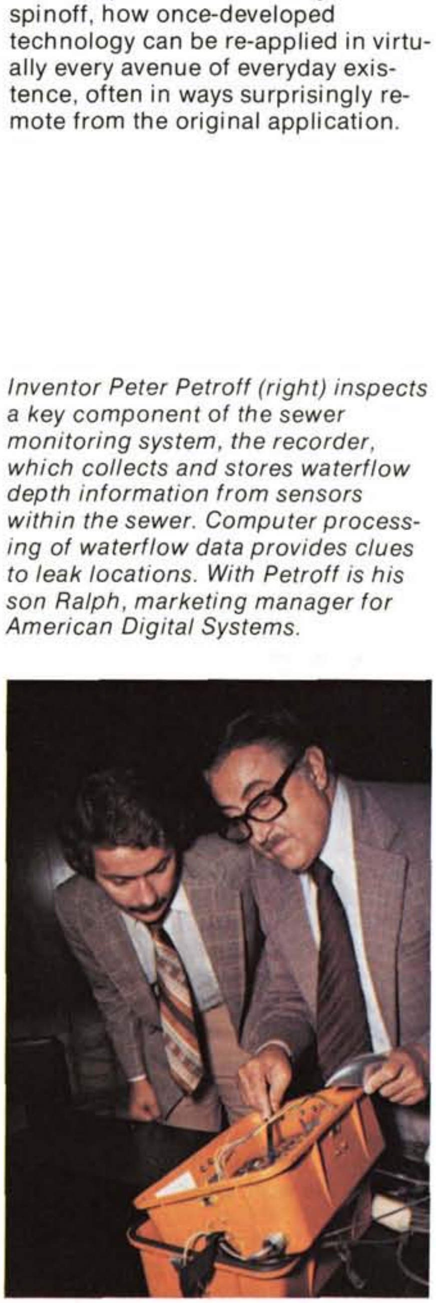
Key to the system is a device called a "mouse," because its shape suggests that of the small rodent and it has a "tail" of long cables, which are connected to a data recorder mounted a considerable distance away under a manhole lid. The mouse, bolted to the floor of a sewer pipe and streamlined to prevent waterflow disruption which would cause inaccurate readings, houses a flow-measuring transducer. The transducer senses differences in pressure, enabling calculation of the amount of water above it. The pressure reading is translated into a water depth reading and relayed through the mousetail cables to the recorder.

Typically, 50 to 100 mouses—not mice, Petroff insists—are installed throughout a city's sewer system. Each provides a water depth reading every 15 minutes, day and night for weeks in dry and wet weather. Every few days, field crews collect the stored data from the recorders and transfer it to a central computer for processing and evaluation. The system does not pinpoint specific leaks, but it does provide clues as to suspect areas for physical investigation; such narrowing of problem zones permits substantially easier and less expensive repair of leaks.

Peter Petroff founded a company to produce the equipment and to provide sewer monitoring service. Called American Digital Systems, Inc., Huntsville, Alabama, it began as a garage industry in 1975, when 40 prototype systems were built. The company has since produced several hundred monitoring systems and its field teams have conducted sewer studies in 30 American cities.

The sewer mouse story is an excellent example of the aerospace spinoff process because it underlines several facets of technology re-use. It shows, for example, the universality of spinoff, how once-developed technology can be re-applied in virtually every avenue of everyday existence, often in ways surprisingly remote from the original application.

Inventor Peter Petroff (right) inspects a key component of the sewer monitoring system, the recorder, which collects and stores waterflow depth information from sensors within the sewer. Computer processing of waterflow data provides clues to leak locations. With Petroff is his son Ralph, marketing manager for American Digital Systems.



In this instance, Petroff applied several different aerospace technologies: aerodynamic streamlining concepts in shaping the mouse; an epoxy material for the transducer housing which stemmed from aerospace research; space-derived miniaturization technology for packaging the electronic components of the data recorder; and data acquisition technology similar to that employed by NASA satellites. In other examples of spinoff, the reverse is often the case: a single type of technology is transferred to many secondary applications, each different from the other.

Petroff's formation of American Digital Systems points up the economic potential of spinoff. As happens frequently, a technology transfer resulted in establishment of an entirely new company, with attendant benefit to the nation's Gross National Product and to job creation. Some spinoffs represent only moderate increments of economic gain, but others involve values running into millions of dollars.

In the sewer application, Petroff himself was the instrument of technology transfer. Many spinoffs are accomplished in this manner; aerospace personnel move to other industries, bringing with them skills and know-how which have non-aerospace potential. Another route by which technology transfer is effected is product diversification on the part of NASA contractors, who use their aerospace experience to develop non-aerospace applications. NASA directly promotes technology transfer in a number of ways which are detailed in Section 3 of this volume.

NASA's technology utilization program, which seeks to encourage secondary application of aerospace technology, has been going on for 17 years, during which thousands of aerospace-originated innovations have found their way into everyday use. Collectively, these spinoffs represent a substantial return on the aerospace investment in terms of economic gain, improved industrial efficiency and productivity, lifestyle innovations, and solutions to problems of public concern.