NASA's Software Bank

A special NASA service aids national productivity by providing low cost computer programs to public and private sector clients.

In an era of heightened environmental awareness, finding sites to dispose of solid waste is a difficult, complicated and tedious process, often a tug-of-war between state and local community officials.

Each candidate landfill site must meet a series of rigorous criteria, for example, slope, distance to cultural features, surface and subsurface hydrology, soil erosion potential and land ownership; in addition, the site must be sufficiently distant from residential areas, schools, airports, population centers and endangered species habitats.

Researchers at Ohio University, Athens, Ohio, are trying to make site selection less complex by programming computer software to help evaluate a candidate site. Their tool is a NASA-developed program called CLIPS, a software shell for developing expert systems. Originally developed by Johnson Space Center, CLIPS is designed to allow

At Ohio University, assistant geography professor James Lein (left) has adapted a NASA computer program to a novel use: simplifying the evaluation and selection of landfill sites for solid waste disposal. An expert system developed with the CLIPS program uses details about a candidate site, such as topography (above) or adjacent water sources (upper right) to determine whether the site meets requirements.

research and development of artificial intelligence on conventional computers.

Says Dr. James Lein, assistant professor of Ohio University's Geography Department:

"We structure the rules and parameters surrounding the decision-making process and CLIPS provides an estimate of whether a particular site fulfills the siting requirements." With an expert system, the reasoning mechanisms influencing site selection can be defined more clearly and the system can be modified to reflect changes in legislation or new information. With an expert system the site selection process is less difficult, reducing the time and costs involved. CLIPS was supplied to Ohio University by the Computer Software Management and Information Center (COSMIC®), NASA's mechanism for helping industrial, government and institutional organizations to effect significant reduction of automation costs.

Information processing by computer is still experiencing explosive growth in the United States.
Thousands of organizations are joining the ranks of computer users annually, while longtime users are regularly finding new ways to improve their operations through greater automation. NASA's way of helping them cut costs is providing them, at low cost, previously developed computer programs that have secondary utility.

Development of an entirely new program is time consuming and expensive. Frequently, however, a program developed for one purpose can be adapted to an entirely different application. Thus, software users can save time and money by taking advantage of COSMIC's service; they can purchase a program for a fraction of its original cost and get a return many times the investment, even when the cost of adapting the program to a new use is considered.

The CLIPS program has proved a valuable research tool for a wide variety of applications. At Ohio University, researchers are also exploring use of CLIPS to assist in historic preservation, which involves identification, inventory and selection of structures — or entire areas — that have special cultural or historic significance.

Other examples of CLIPS' versatility include its use to monitor product quality and quantity at a chemical plant; its employment by an attorney to help him decide which facts from a casefile are most pertinent; and its use as the core of an advanced software system that gives a user engineer instant expertise in disciplines in which he is not skilled. Another use of CLIPS is its inclusion in a text book — *Expert Systems: Principles and Programming*, by Joe Giarratano and Gary D. Riley — in use at 40 colleges and universities. CLIPS serves as the prime example of an expert system development tool in the book; sample CLIPS applications are included on a disc bound with the text book, enabling students to design and develop their own expert systems.

Widely used in business and government, CLIPS represents only one of thousands of examples wherein users have benefited from COSMIC's service.

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Located at the University of Georgia, Athens, Georgia, NASA's Computer Software Management and Information Center (COSMIC) is custodian of the large “bank” of computer programs developed in the course of work sponsored by NASA, the Department of Defense and other technology generating agencies of the government.

COSMIC gets a continual flow of these government-developed software packages and identifies those that can be adapted to secondary usage. The center stores and maintains the programs and informs potential customers of their availability through a catalog and through notices in the publication \textit{NASA Tech Briefs}.

COSMIC's library contains more than 1,200 programs for such purposes as structural analysis, artificial intelligence, computational fluid dynamics, thermal analysis, image processing, project management and a great variety of other functions. The center has distributed thousands of programs, some of which have made possible savings amounting to millions of dollars. Thus, COSMIC's service represents one of the broadest areas of economic benefit resulting from secondary use of government developed technology.

Among examples of COSMIC program uses by industry are:

MIL 3, Washington, D.C., a developer of software for the communications industry, supplies a software package — called OPNET — for developing simulations of communications satellite networks. OPNET easily supports geosynchronous or “stationary” satellites. However, the movement of low Earth orbit satellites was not supported and the frequent loss of communications when Earth blocks the line-of-sight between satellite and Earth station was not predictable.

In order to support predictions of low Earth orbit as an interim measure, pending a planned advancement of OPNET that will allow predicting satellite occlusion, MIL 3 is using a COSMIC program called ASAP (Artificial Satellite Analysis Program) as an OPNET enhancement. MIL 3 translated the ASAP program from the original FORTRAN to C language and integrated the modified version of ASAP into OPNET. The ability to directly utilize ASAP code has enabled MIL 3 to offer low Earth orbit satellite modeling capability much sooner. A planned OPNET advancement involves development of a customized second-generation orbital mechanics program based on ASAP.

Heath Tecna Aerospace Company, Kent, Washington, a major supplier of composite structures, designed and built the first full scale composite hybrid rocket motorcase. Looking for a computer program that would predict stresses in the...
motorcase walls and calculate the ideal geometry for
the domes at either end of the filament-wound
pressure vessel, company researchers discovered and
used a COSMIC program descriptively titled "Analysis
of Filament Reinforced Metal Shell Pressure Vessels."

The test motor was
built under contract to
American Rocket
Company (AMROC),
builder of privately-
developed rocket launch
vehicles. Heath Tecna
confirmed the
predictions of the
COSMIC program by
testing a subscale
motorcase to failure. A
full-scale 22-foot
motorcase was then
fabricated and
successfully test fired
by AMROC.

Scientific-Atlanta
Inc., Atlanta, Georgia, is
an internationally
known leader in cable
television electronics
and satellite
communications
networks. Company
engineers were assigned
the task of designing a
new Cassegrain antenna, which consists of a primary
radiator, a multimode horn to receive signals, a main
reflector and a subreflector.

Researchers found — and purchased — the
COSMIC program "Machine Design of Cassegrain
Feed System," which seemed uniquely formulated to
design this special type of antenna. The program
allowed for computer simulations of the antenna's
performance, allowing engineers to change the
design before any
hardware was actually
built. The program saved
time and money in the
design process, and
additionally enabled
engineers to build a
vertex tuning plate
intended to redirect
scattered energy, which
provided for greater operational economy.

Salem Automation, Pittsburgh, Pennsylvania,
conducted research on methods whereby increases
in energy efficiency and quality might be achieved in
reheat furnaces. The reheat furnace is an energy
intensive stage of steel processing, used to raise the
temperature of steel slabs, blooms or billets
to the point where they
"can be formed by
rolling.

Along with other
software, the company
used a COSMIC program
to evaluate technology intended to increase
productivity and reduce energy usage in the reheat
process. The COSMIC program — the General
Thermal Analyzer Program — solves steady state and
transient thermal problems using desk top
computers. Salem Automation used it in modeling
reheat furnaces; for example, the program can
simulate how slabs in a proposed furnace will heat
during operation.