

U.S. ARMY CORPS OF ENGINEERS UTILIZATION AND MANAGEMENT OF HYDROLOGIC MODELS

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Abstract

The U.S. Army Corps of Engineers (Corps) has recently initiated an effort to improve the management of hydrologic models used throughout the agency. As one of the nation's largest water resource agencies, the Corps has numerous offices located throughout the country that are involved in the management of complex water resource projects and systems. In accomplishing this work, a wide variety of different hydrologic models have been developed, procured, and used over time in order to meet these diverse modeling needs. Corps hydrologic-related missions include planning, design, and operation of water resources projects for flood damage reduction, coastal protection, navigation, water quality, and water supply. This approach has resulted in a large inventory of hydrologic models and other related software across the agency.

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The Corps has initiated its Science and Engineering Technology (SET) initiative to allow Communities of Practice (representatives of practitioners across the Corps), to drive consistent tools and practices. As a part of SET, the Corps is conducting an inventory and assessment of their hydrologic tools and models based on criteria such as functionality, suitability, cost, ease of use, compliance with security requirements, and others. Based on this information, efforts will be made to identify key models and tools that best meet the overall needs of the agency, and then focus future investments in these tools to improve efficiency and effectiveness in managing hydrologic models. This effort will also assist the Corps in developing its U.S. Office of Management and Budget (OMB) Form 300 Business Cases. The SET inventory effort was initiated in Fiscal Year 2005, and with continued funding, will assess software in other disciplines in the Corps as well.

One of the key goals in this program is to improve the overall value of investments in hydrologic and other models. This could be accomplished through reduced acquisition, development, maintenance, and training costs for models, increased cost effectiveness, reducing the overall inventory of models, and better standardization of technology across the many Corps offices performing hydrologic modeling. This paper will describe these efforts to better manage the Corps software inventory and assess hydrologic models under the SET initiative.

INTRODUCTION

The U. S. Army Corps of Engineers (Corps) recently initiated its Science and Engineering Technology (SET) initiative to help establish common science and engineering policies, practices, and tools across the regional offices, through the Communities of Practice (CoPs). Under the SET initiative, the Corps is conducting an inventory and assessment of their software tools and models based on criteria such as functionality, suitability, cost, ease of use, compliance with security requirements, and others. The initial inventory efforts included separate

inventories of models used by the Hydraulics, Hydrology and Coastal (HH&C); Geotechnical and Materials; and the Hydrographic Surveying CoPs.

As one of the nation's largest water resource agencies, the Corps has numerous offices located throughout the country that are involved in the management of complex water resource projects and systems. In accomplishing this work, a wide variety of different hydrologic models have been developed, procured, and used over time in order to meet these diverse modeling needs. Corps hydrologic-related missions include planning, design, and operation of water resources projects for flood damage reduction, coastal protection, navigation, water quality, and water supply. This approach has resulted in a large inventory of hydrologic models and other related software across the agency.

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Based on the inventories of models and tools, the Corps is making efforts to identify key models that best meet the overall needs of the agency, and then focus future investments in these tools to improve efficiency and effectiveness in managing these models. One of the key goals in this program is to improve the overall value of model investments. Improved model investments could be accomplished through reduced acquisition, development, maintenance, and training costs for models, increased cost effectiveness, reducing the overall inventory of models, and better standardization of technology across the many Corps offices performing modeling. Standardization of models will allow virtual teaming, as employees will be more familiar with models as they work from one geographic location to another, and from one organizational element to another. This paper will describe the efforts by the HH&C CoP to better manage the Corps inventory of hydrologic models under the SET initiative.

BACKGROUND

With approximately 35,000 employees and thousands of water resource projects throughout the nation, the Corps is the largest Federal water resource agency in the nation. In order to effectively plan, design, operate, and maintain this water resources infrastructure, the Corps has compiled an extensive set of hydrologic models and tools. Many of these tools were developed corporately by national technical centers such as the Corps Hydrologic Engineering Center (HEC), the Laboratories of the Corps Engineering Research and Development Center (ERDC), and purchased by commercial acquisitions. Others were locally developed by individuals in offices throughout the U.S. to meet their unique needs. However, this decentralized approach has led to a wide range of different models being used across the agency, and a large investment of financial resources to operate, maintain, and provide training for these tools. The proliferation of tools also results in reduced interoperability, and makes it more difficult for staff from one office to assist those of other offices. Declining research and development funding makes it critical that the Corps focus research and development funding for hydrologic and other models using more of a corporate approach to develop tools that can be utilized across the agency, as well as in coordination with the tools of other key entities involved in hydrologic modeling.

In order to better manage the inventory of hydrologic models, the Corps has developed a process to evaluate the various models and tools in use. The first step in this process was to conduct an inventory of all of the models currently in use. This web-based inventory was accomplished, resulting in **over 350** responses from about 50 separate Corps offices.

Based on this inventory, practitioners assessed models using a number of factors such as functionality, ease of use, supportability, and others to determine the models that made the most sense to endorse corporately. Among the goals of this evaluation were to reduce the costs for development and support of software, increase interoperability, enable virtual teaming, and reduce duplicative tools.

The overall SET program is overseen by the Corps' National Management Board. It is led by the head of the Engineering and Construction Community of Practice, and is executed by team members from throughout the agency. The majority of the implementation is being done by the SET Support Team, in conjunction with the various CoPs. For the hydrologic and hydraulic tools, this process was overseen by the Corps' Hydrology, Hydraulics, and Coastal Community of Practice (HH&C CoP).

SET INVENTORY PROCESS

An initial inventory was conducted in July 2005 to begin identifying the population of different models in use throughout the agency. This initial inventory was done on a voluntary basis by a Web-based survey. Participants in the survey determined what software is being used; identified gaps in what is needed; and looked at whether we have everything we need, and conversely to look at whether we need everything we have. They will also make recommendations to identify tools that should be designated as "corporately endorsed", for the purposes of seeking corporate funding and a common toolset. With leveraged investment in corporately endorsed tools, the Corps anticipates reductions in cost for development and support, increased interoperability, enhanced virtual team support by other offices, and a reduction in duplicative toolsets.

There were over 350 respondents that participated in the survey. Over half of the respondents had well over 15 years of experience using the various models. The respondents also represented a very broad geographic profile across the agency. The survey results showed that there were over 380 hydrologic models and tools being used in 19 different categories. These categories are listed in Appendix A. The largest single category where respondents provided responses was in water control management and surface water hydrology, followed by others such as statistics and risk, riverine erosion, and others.

The initial survey was accomplished in a fairly informal (voluntary) basis, and not all offices were required to participate at the same level of detail. The model inventory was broken down by sub-disciplines based on the model's purpose and use. Categorizing the inventory by sub-disciplines allowed for an improved and expedited assessment as each model was evaluated by the group of experts within that sub-discipline. Follow-up work was done with teams of subject matter experts (SMEs) in the various CoPs to attempt to interpret and assess the validity of the survey results. This assessment was done by providing the survey results to these teams, and asking them to assess/validate whether they were representative, given their experience. Based on these validation efforts by the SMEs, recommendations will be provided to the HH&C CoP as to which models should be endorsed as corporate tools. There were many other individually developed tools and models that are not expected to meet the criteria for corporate endorsement, but were deemed very important nonetheless. These tools and models would continue to be

developed and maintained by individual offices when no corporate tool is available. A communication strategy is also being established to clearly communicate the results of this evaluation with others throughout the agency.

The evaluation criteria include: functionality and alternatives; cost factors; data sharing; widespread use/acceptance; ease of use; security considerations; computational validity; proprietary technology vs. open source; and supportability issues. The HH&C CoP is also conducting a gap analysis to determine if there are any critical gaps in which there are needs that are not being met by existing tools.

KEY FINDINGS

- The Corps has approximately 400 hydrologic tools in use based on this inventory.
- The Corps HH&C community is a diverse community representing a broad range of functions, needs, and stakeholders throughout the nation. This wide variety of needs cannot currently be accommodated with a very limited model toolbox.
- These tools represent a significant investment, and the varied technology and architecture presents an impediment to data sharing, interoperability, and effective cost control.
- The sheer number of tools reduces interoperability and succession planning.
- Further integration of these tools will benefit the HH&C Community, and will provide national, regional, and local benefits.

CONCLUSION

The Corps SET approach provides practioners in the Communities of Practice a way to evaluate their suite of tools. This grass-root driven analysis is linked to the management needs to control costs, increase interoperability, and enhance succession planning. Corporate endorsement of tools provides a way to more effectively identify and manage toolsets.

The SET approach has enabled more effective management of the inventory of hydrologic tools. As the process proceeds, additional refinement of the inventories will continue. Further inventories of the tools used by other CoPs will continue.

Appendix A

Software Survey Categories

- CADD
- Coastal
- Coastal Navigation
- Cold Regions Engineering
- Dam Safety
- Dredging
- Environmental and Water Quality
- Geospatial
- Groundwater Hydrology
- Hydraulic Design
- Inland Navigation
- Planning Analysis
- Reservoir Systems Analysis
- River Hydraulics
- Riverine Erosion and Sediment Transport
- Statistics and Risk
- Surface Water Hydrology
- Water Control Management
- Miscellaneous