# **1.61 Decision Science and Support Tools**

**Project Number & Title**

1.61 - Decision Science and Support Tools

**Project Lead and Deputy**

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**Project Period**

FY16-FY19

**Project Summary**

This project will provide communities and other community-relevant decision makers with access to decision support approaches and tools to better frame their environmental problems and decision contexts, facilitating sustainable outcome decision-making. Decisions that promote sustainable outcomes and minimize unintended consequences require access to relevant information, structured analytic approaches, tools for assessing and optimizing outcomes, examining trade-offs, and tracking progress. Helping communities contribute information and develop their understanding of sustainability will assist stakeholders in solving social, economic, and environmental issues.

Work in this project has four primary aims:

(1) Improving our understanding of community decision needs and objectives to support user oriented tool design;

(2) Informing sustainable outcomes through tools that structure community defined decision-focused processes;

(3) Developing generalizable tools emphasizing interoperability, system-level understanding, and adaptability to user preferences, capacity, and informational resources of communities;

(4) Providing accessibility to tools identified through decision contexts, community typologies, and needs-based gap analyses.

Product usability will be demonstrated in conjunction with other related Sustainable and Healthy Communities (SHC) projects (e.g., Project 2.62 Community Public Health and Well-Being and Project 4.6 Systems-based Methods for Community Sustainability) through the continued development of case study applications of decision-making methods that integrate community preferred approaches and values along with science-based sustainability assessments.

**Project Description**

Problem and Decision Context

The over-arching research question for SHC can be stated as: How does the EPA help achieve more sustainable outcomes in all types of communities, ranging in size, demographics, locations, and resilience capacity. Research and development in this project seeks to address this question by developing tools and application approaches informed by decision science for those engaged in helping communities advance sustainability goals and reduce the risk of regulatory non-compliance. This will be done through identifying community user decision needs and translate those into the development of generalizable methodologies for the identification, creation, re-use, distribution, and application of resultant tools to communities. An important part of achieving our goals is to identify internal and external organizations, e.g. Office of Solid Waste and Emergency Response; the Rockefeller 100 Resilient Cities Program, that are working in the same areas and find ways to complement their work in order to achieve the best results in the most efficient way.

Outputs

This project will directly contribute to five SHC outputs.

1.61.1 Guidance to Support the Design of Software Applications and Decision Processes for Different Types of Communities (Initial version FY16)

1.61.2 Methods to allow communities to calculate indicators and indices of sustainability and well-being using local data (FY17)

1.61.5 Demonstration of interoperability with a system of databases and tools integrating Economic, Environmental, and Health and Well-being endpoints (FY17)

1.61.3 Searchable Library of Available Community Decision Support Tools and Modules; Software to Help Users Identify and Use Appropriate Tools for Their Needs (FY18)

1.61.4 Next-generation decision support tools that capitalize on existing re-useable software and advances in information technology to ensure interoperability while filling gaps in tools currently available to inform community decisions that promote sustainability (FY19)

Focus Areas

*Focus Area #1: Decision-focused Design and Use of Tools* – Integrating current and future knowledge of group/organizational decision-making, community typology, and user decision needs into the design, identification, and application of tools by communities.

Representative questions:

* How can community characterization, typology, ecosystem beneficiaries, and understanding about decision processes be used to tailor assessment and decision tools to widely shared needs?
* How are community decision frames, needs and objectives changing in this period of rapid climate, demographic, and economic change, and how can we create resilient/ adaptive decision tools to meet those needs and ensure the relevance of EPA’s decision tools for the near and medium term?
* How can ORD leverage digital tools (existing or new) to engage communities in identifying their sustainability challenges and regulatory compliance requirements, eliciting community based suggestions and ideas for solving those challenges, and then infusing the decision making process with those ideas for consideration?

The Key Products for Focus Area #1 include two products related to the state of practice for using decision processes and support tool development. The key products are:

1. Design innovation guidance for support tools and community relevant decision processes: This product is an on-going assessment mechanism of what in existing tools are useful to communities, combined with a crosswalk of community types, user need/capacities, and relevant group decision strategies, yielding reports that provide information to EPA and external developers regarding best practices for developing tools, including user-interface design, re-use of existing tools and components, and appropriate levels of functionality for different community types and decision contexts. The document will also help highlight gaps in the current tool inventory and provide insight towards interoperability, re-usability of software components, computing platforms, and methods of deployment and development. This product will help EPA and external tool builders, e.g. Ecosystem Based Management Tools Network, design tools and search and delivery platforms with the greatest impact by offering information, and guidance on the needs of different types of communities. Examples of external tool builders that might benefit from this guidance are organizations building scenario planning tools, and organizations such as the Ecosystem Based Management Tools network (EBM Tools). This product will contribute directly to Output 1.61.1, by providing information for software application development for different types and needs of communities, and to Outputs 1.61.3 and 1.61.4, by providing information that can be incorporated into next generation tool design, development, and deployment.
2. Emerging decision support research and guidance: This product describes emerging decision and computer science methods. Tools will be identified and evaluated for their ability to provide 1) appropriate level of decision-making, and 2) reuse, interoperability, and reduction of redundancies among tools within and external to EPA. A report suggesting how cognitive preferences e.g. bounded rationality, satisficing; and components, e.g. API interfaces and Web relational vocabularies (ontologies), may be integrated into a comprehensive vision of next generation tool development. The guidance will be applied showing discovery and integration of decision methods and components in the development of the demonstration tool (*Tool Category iv*) described below. This product will benefit environmental and sustainability software developers, both internal and external to the Project and Agency. This product will contribute directly to Output 1.61.1, by providing guidance for software application development for different types and needs of communities, Output 1.61.5 in demonstration tool development, and to Output 1.61.4, by highlighting emerging capabilities and features that can be incorporated into next generation tool design and development.

*Focus Area #2: Software Re-Configuration for Community-Based Use* – Devising novel re-combinations of existing software components and interaction platforms serving user needs for data analysis, sustainability assessments, and decision-making. For example, an interoperable component for storm water management using the EPA SWMM model. This component will be used to provide storm water runoff information within scenario planning tools such as Urban Footprint.

Representative questions:

* + How can locally-held and owned data be easily incorporated into mapping tools, indicators, and indices, synthesized and made accessible, to enable communities to compare among different areas within the community, allowing insights into where improvements are possible, and informing decisions that promote sustainability and equity?
  + What existing SHC tools can be modularized and made interoperable to increase their usefulness and reduce obsolescence?

The Key Products for Focus Area #2 relate to the development of decision tools and include:

1. Tools for Decisions Affecting Community Sustainability: This product describes software tools, components and documentation that will be developed to support communities in making decisions with more sustainable outcomes. This product is expected to include both the development of new decision support tools, enhancements to existing tools, and methods/components for the delivery of both new and existing tools. Tools selected for development will be those identified as important in the gap analysis, in scope for the EPA mission, and in scope as much as possible to the current EPA skill set. Software tools and components may include:
2. Conventional tools, i.e. desktop applications identified as important in the gap analysis.
3. Leverage existing components of tools to create software supporting analysis of locally generated data for calculation of indicators that can be used by community specific beneficiaries.
4. Decision processes and frameworks adaptable to community type, decision method needs, regulatory requirements, and tool functionality. Functionality could include: inter-operable components, cloud-based calculation, risk/uncertainty analysis, systems-level assessment, trade-off analysis, user defined indicators, disparate data and information normalization, optimization components for efficient or combined solutions, visualization capabilities, and audit tools that record decision steps. Open Architecture framework examples (EPA and external) that can integrate tools as plug-in and/or model output include but are not limited to:
   1. DASEES is a web-based, open source structured decision making interface supporting problem formulation, scoping, prioritization, and integrated systems level assessment of alternative scenarios.
   2. FRAMES is a software-based modeling system (i.e., the infrastructure) within which collections of models and modeling tools (e.g., data retrieval and analysis) are developed and applied to real world problems.
   3. **ENVISION** is a GIS-based tool for scenario-based community and regional integrated planning and environmental assessments.  It provides a robust platform for integrating a variety of spatially explicit models of landscape change processes and production for conducting alternative futures analyses.
   4. Urban Footprint – Urban Footprint is an open source cutting-edge scenario development and modeling tool used to express the varying impacts of development and infrastructure investment choices at a variety of scales.
5. Tools demonstrating component re-use and interoperability.
6. Inter-operable Cloud-based software components that would allow users to connect and combine tools through the internet.

This product will directly meet Output 1.61.4 by demonstrating the potential of next generation decision support tools. It also will address Output 1.61.2 through targeted re-use of components for specific community and data needs and Output 1.61.5 demonstrating interoperability of existing SHC tools.

*Focus Area #3: Tool Development, Support, and Delivery* – Identifying new areas for tool development, capitalizing on emerging support infrastructure, and providing user-defined search and delivery mechanisms.

Representative questions:

* + How can new information technology be harnessed to improve delivery of SHC tools to communities and other users to support application of research results?
  + What criteria and standards for future tool development will facilitate collaborative development of decision tools?
  + How can SHC target development of new tools or improvement of existing tools (both internal and external) to fill gaps in decision support needed for different types of communities to inform decisions that promote sustainability and well-being?

The Key Products in Focus Area #3 relate to a user needs gap and opportunity analysis and searchable library of available tools and include:

1. Gap Analysis of Community Tool Needs: This product is based on on-going tool inventory efforts, available models and tools, decision methods, etc. will be categorized according to decision process and community typology to identify coverage and gaps. The gaps identified will point to opportunities to fill high priority community needs. Community typologies are considered an important factor as there are expected to be intersections in expertise, decision needs, shared stressors and high priority concerns. Further, community expertise will be instructive as to the community resources, skills and capacity of potential users. This product will enable SHC to determine the unmet needs for communities, EPA Regions, and program offices. This information will be used by this and other SHC projects e.g. 4.6 (Systems-based Assessment), to prioritize and guide development of tools. Program offices and regions may find this information useful, both as an opportunity to voice their priorities and possibly to identify opportunities for tool development of their own. This product will contribute directly to Outputs 1.61.3 and 1.61.4, by providing information and priorities on which tools are needed and how they will be used.
2. An inventory of models, tools, and methods for use by communities: This product will produce a searchable library of models, tools, components and decision methods applicable to supporting decision making; providing information to communities through the Registry of EPA Applications, Models, and Databases (READ) registry. The library user interface will provide sorting/ narrowing capabilities along several possible paths, (decision support taxonomy, structured decision making process, community type, and decision need). Sorting by type would bin tools into, for example, advanced-basic groupings by the level of engagement with sustainability and the capacity of the user. The diagnosis and prescriptive capabilities could be improved by examining user choices (example: WebMD) and learning from this information to support similar users-problem area combinations Interface development will be informed through assessing the field of existing databases and interfaces that have been designed for similar purposes and adopting technology to the extent appropriate and possible, potentially re-using mechanisms developed by non-EPA organizations, where the code is freely available. The data base will be used by EPA regions and community-level decision makers (and available to ORD researchers and Program Office partners) via web-based interfaces. This product will contribute directly to output 1.61.3. It also fulfills in part Outputs 1.61.1 and 1.61.4 by identifying relevant models, tools and methods.

**Nature of the Work**

*Extramural:* Because of the project emphasis on tool development, contract support will most likely be continued with existing tasks to facilitate interoperability/software re-use efforts, in addition to on-going existing tools surveys. There is the potential need for contract support for gap analysis/next generation tools, guidance documents, and searchable database products. Continued typological and new sociological/decision work into user needs/decision process preferences will require contractor support or post doc/SSC support. At a minimum, it is expected that 60% of the work will be completed through extramural vehicles addressing software development, social/decision research, and future tool design and deployment planning.

*In-House:* The most readily available contributions will be the subject specific expertise informing the reuse and interoperability tool development efforts. Co-ordination is required between Project 1.61, OSIM, and OEI to achieve every project output. Continued work with the Registry of EPA Applications, Models, and Databases (READ) Council on Regulatory and Environmental Modeling (CREM), ORD research programs, and external communities of practice are necessary to complete the gap analyses, existing tools surveys, and development of the searchable database. Social/decision work with communities mediated through Program Offices and Regions will inform the guidance documents, searchable database structure, and next generation tools. Up to 40% in-house contribution to the needed project work is expected to be dedicated to software programming, social and decision context specific expertise, and knowledge and information management specialists.

**Collaboration**

*Internal:*

* Projects 1.62 (EnviroAtlas) and 2.62 (Community Public Health) for software reuse and interoperability efforts
* Projects 2.61 ( Ecosystem Goods & Services) and 2.64 (Indicators and Indices) for tools calculating indicators and indices
* Projects 3.63 (Sustainable Management of Materials) and 4.6 (Systems-based Assessment) for Systems-level assessment and systems framing tools
* Projects 3.61 (Contaminated Sites) and 4.6 (Systems-based Assessment) for application and testing of tools

External:

* OEI and OSIM for life cycle management of existing and next generation tools
* SSWR, CSS, and ACE for searchable database information and next generation tools planning
* Regional community engagement specialists for social/user decision tool use requirements
* Program Offices, Regions, CREM, and OSC for tool gap analyses
* OSWER for assessing remedial alternatives, site re-use and community engagement
* Communities of practice for guidance on existing and new tool development

**Assumptions/Constraints**

* Availability of suitable existing components, or tool source code, for demonstration of software interoperability
* Availability of community data and stakeholder co-operation for locally generated sustainability indices
* Co-ordination between ORD and OSIM for the long-term development, support, and maintenance of tools
* Access to existing tools and cooperation from experts to complete a sufficient tool review and gap analysis to identify and prioritize needed tools and functions
* Increased in-house capability for software development

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