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Practitioner Interview

Walter Grayman

Walter Grayman Cons., grayman@fuse.net

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**Proposed Questions for Interviews with Water Resources Engineers on
Use of Water Resources Systems Analysis in the Engineering Workplace**

Prepared by:

Technical Committee on
Excellence in Systems Analysis Teaching and Innovative Communication (ECSTATIC)
American Society of Civil Engineers (ASCE)

Committee Chair, Dr. David E. Rosenberg, Utah State University

**Submitted to the Utah State University Institutional Review Board for
Request for Determination of Non-Human Subject Research - #6063**

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BACKGROUND QUESTIONS (to ask through email ahead of time or at the beginning of the interview)

1. What is your current job title?

Owner of his own consulting firm (Water Grayman Consulting Engineer).

2. For how many years have you worked in your job?

32 years + 12 years

3. What formal training have you had in systems analysis?

Undergraduate (Carnegie Mellon University); Graduate School in Water Resources Systems Engineering (MIT).

4. If your professional activities have included systems analysis, for how many years have you performed these activities?

Sporadically since he started.

QUESTIONS ABOUT USE OF SYSTEMS ANALYSIS ON THE JOB

5. Describe your job. What is/are your roles/activities in your job?

He is a consultant with experience in wide variety of water quality, water pollution, and water resources problems. His research work includes jobs for the US Federal Government (USACE, CDC, EPA) and non-profits (water resources foundations). His non-research work are for other engineering firms that typically are working of municipalities.

6. What work projects have used systems analysis techniques to identify/evaluate/select a design or decision alternative?

Two situations: informal systems analysis and formal systems analysis.

Most of the work is informal systems analysis, by using systems concepts (ex: trying to find optimal alternatives, such as least cost or multi-objective “best” solutions). Systems analysis is always back in his hand even though a particular optimization technique is not frequently used. More formal approaches are rarely used.

Why? Clients are not very interested in a formal systems analysis optimization process. It is hard to justify expending a significant amount of money in using optimization techniques. Clients don't see much value of alternative techniques, such as uncertainty analysis.

7. What systems analysis techniques, software, and/or tools were used?

Most commonly used is Monte Carlo simulation, using Python and C++; Dynamic Programming optimization for sewage design; Genetic Algorithm for choosing pipe sizing; Ranking or Prioritization Systems to weigh factors (easy to explain to clients).

8. Have any projects coupled optimization algorithms with external simulation models, simulated system equations within the optimization framework, or used an optimization algorithm available within a simulation model? If yes, what kinds of simplifications were required in the solution approach?

Couple cases: (1) optimal sensor placement with EPA net; (2) GA with water distribution systems (using Bentley).

9. What uncertainty analyses have been used to evaluate designs or decision alternatives? If yes, what assumptions were required? What difficulties (if any) were there in communicating results of the uncertainty analysis to decision-makers?

Monte Carlo Simulation. Example: best location of monitors for monitoring contamination in rivers. In the legal arena there is more interest in uncertainty than in the design arena.

10. Have projects applied multi-objective decision methods to select a final design or decision alternative? If yes, how was a preferred alternative selected from a set of tradeoffs?

Multi-objective approaches are used fairly frequently. Clients generally understand the need of multi-objective analysis (least cost, reliability, etc...) and many objectives are evaluated. Weighted Method is typically used. There is a difficulty to show tradeoff curves with more than 2 objectives.

USE OF SYSTEMS ANALYSIS IN THE PROFESSION

11. What role should systems analysis play in professional practice? How can the profession more effectively use systems analysis in the future?

It's very important students have a good basic grasp of systems analysis, even though they will probably not use it very much.

- a. What encourages or limits the use of systems analysis in the water resources engineering profession?

Limitations: funding. It's not very easy to apply systems analysis, which can incur in extra costs. Clients quite often have hard time to understand the results.

12. What systems analysis skills and techniques should universities teach to prepare new practitioners to successfully join the profession?

Very broad exposure to several techniques: optimization, simulation, uncertainty analysis, statistical analysis, etc.

REFERRAL

13. Can you recommend a colleague we should also interview? What is their contact info? Would you be willing to put us in contact with them?

Dr. Richard Males (males@iac.net) and David Ford.

Other topics discussed:

Optimization classes that focus only on the mathematics might be too much theory and, while classes that use cases studies add a lot of value to the learning experience.