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Engineering Management & Systems Engineering;
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Main Menu

Mohammad Al-Jawah, Loren Denton and Joanna Resurreccion Defend Doctoral Research

Mohammad Al-Jawah

Mohammad (center) with advisor Prof. Deason, World Bank executive Dr. Alaa Sarhan, members of the Examining Committee and guests

On September 25, 2013, Mohammad J. Al-Jawah defended his doctoral dissertation research on “A Decision Aiding Framework for Investing in Cleaning Systems for Solar Photovoltaic (PV) Power Plants in Arid Regions.” Mohammed previously earned a Bachelor of Science degree in Mechanical Engineering and a Master of Science degree in Civil Engineering, both from the George Washington University, where he graduated in 2004 and 2006, respectively.

The purpose of Mohammad’s dissertation research was to develop, test, and evaluate a framework to assist investors in photovoltaic (PV) power plants in dust-prone arid regions in making informed decisions regarding selection among PV panel cleaning alternatives. Soiling of PV panels is a problem in dust-prone arid regions such as the Arabian Gulf, where daily dust deposition and frequent dust storms, coupled with lack of rainfall can compromise PV panel energy output.

There are several alternatives to clean the PV panels. However, not much research has been done to determine the most favorable means to do so or how often it is feasible to perform the cleanup. Furthermore, the decision maker/investor face difficulty in selecting among several cleaning alternatives given the competing requirements that must be considered in the selection process. Therefore, in his research, a framework was developed to assist investors in PV power plants determine: (1) how often it is economically feasible to clean the PV panels using different cleaning alternatives, (2) what impacts those cleanups have on the overarching factors considered during the selection process, and (3) what the most favorable cleaning alternative is in light of several competing requirements.

A hypothetical 1 MW PV plant located in Riyadh, Saudi Arabia, was used to test the developed framework which was accomplished by: (1) estimating the PV plant’s lifetime energy yield using a PV performance simulation program, (2) researching and estimating the effects of daily dust deposition and dust storms on the panels’ output, (3) surveying and collecting PV panel cleaning alternative cost and performance data, (4) developing a spreadsheet program to simulate PV

plant lifetime performance under different scenarios using input data from the previous 3 steps, (5) using a multi criteria decision method (MCDM) to select among cleaning alternatives in light of competing criteria, (6) performing a sensitivity check on the criteria weights in the MCDM to check the robustness of the results.

Mohammad's research results indicated that although PV panel cleaning can consume large amounts of water and result in release of harmful emissions to the environment, the benefits of such cleaning can be worth it. The results also indicated that for each given scenario, an optimum cleaning threshold can be determined. It was also determined that initiating a cleanup when the soiling reaches a certain threshold is a preferable approach to cleaning using a fixed schedule. In addition, One-on-one interviews with subject matter experts to elicit their opinion resulted in determination of the selection criteria and priorities used in the MCDM which consequently resulted in selection of a preferred alternative. The results of the MCDM showed that opinion and preferences can vary drastically among different stakeholders and that, for each particular scenario, the set of relevant criteria and their priorities will depend on the stakeholders involved and their influence on the selection decision.

Subject matter expert evaluation of the developed framework on whether it can improve selection among PV panel cleaning alternatives was accomplished via a questionnaire in which the experts rated the degree of their agreement or disagreement on a Likert scale. Average results indicated agreement that the study can improve selection among PV panel cleaning alternatives.

Loren Denton

Loren answers questions from his Research Committee

On May 23, 2013, Loren Denton defended his doctoral dissertation proposal on "A Critical Examination of the Relative Effectiveness of the U.S. Environmental Protection Agency's Safe Drinking Water Act Enforcement: an Empirical Evaluation of the Environmental Protection Agency's Drinking Water Enforcement Response Policy." Loren, a 17 year veteran of the environmental protection agency, has been the Chief of the Municipal Enforcement Branch, Water Enforcement Division, in the headquarters of the Environmental Protection Agency for the

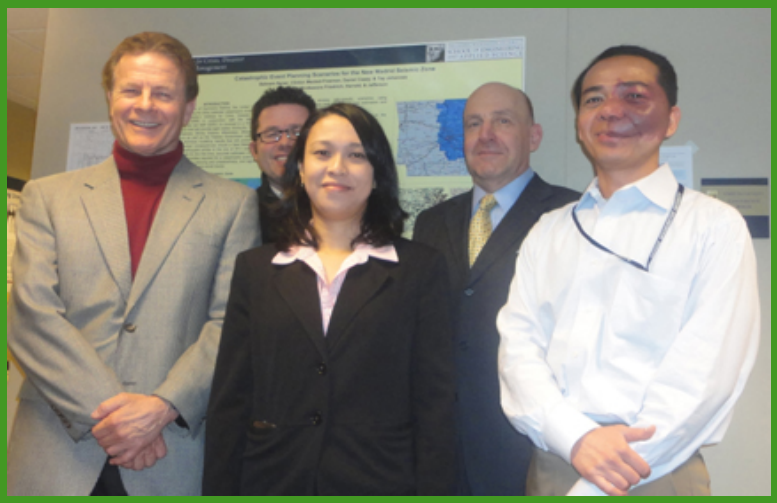
past five years. Loren holds a Bachelor of Arts degree in Biology from the University of Colorado, where he graduated in 1990, and a Master of Science degree in Environmental Engineering, also from the University of Colorado, where he graduated for the second time in 1996.

Doctoral research has to do with implementation of something called the Enforcement Response Policy (ERP) that EPA adopted in 2009. When the ERP was instituted in December 2009, approximately 7,000 Public Water Systems (PWSs) were considered to be in significant violation of the law. Over the first year (2010), the number of significant violators dropped by approximately 50%. However, since 2011, the number of significant violators remaining on the agency's Enforcement Targeting Tool (ETT) list has plateaued, with approximately 3-4,000 remaining each quarter.

Preliminary data review suggests that thousands of significant violators remain on the ETT and that enforcement is not occurring from a top-down approach. The data suggest that EPA and the States need a better prioritization tool that can be used at the State level to ensure action on "the worst of the worst" across each state. At the national level, a better prioritization tool would more clearly direct staff and financial resources during SDWA oversight.

Since there are more PWSs out of compliance than can be reasonably addressed with current budgets and staff levels, prioritization of significant violators is required for effective enforcement. The purpose of Loren's study is to determine if EPA's recently implemented Enforcement Response Policy towards non-compliant public water systems is positively impacting the effectiveness of state and national enforcement and remediation of the most significant drinking water violations. His research study will analyze the current identification (and implied prioritization) tool, the ETT, comparatively with the "Alternate Formula" ETT suggested in the ERP. Additionally, his study will create a true prioritization tool using SDWIS data, subject matter experts, and the Analytic Hierarchy Process (AHP) methodology for decision-making.

Joanna Resurreccion



Johanna poses with Professors Deason, van Dorp, Gallay and Santos

Joanna Z. Resurreccion successfully defended her dissertation on “Stochastic Inventory Modeling and Integration to Multi-criteria Risk Decision-making for Interdependent Economic and Infrastructure Systems” to her Final Examining Committee consisting of Associate Professor Michael Duffey, Professor Rene van Dorp, Professor Jonathan Deason, Assistant Professor Joost Santos and Professorial Lecturer David Gallay.

In her research, Johanna examined extreme risks associated with natural and man-made disasters that involve disruptions in the production of goods or provision of services in interdependent systems. The reduced supply of critical goods and services will degrade production outputs and create ripple effects of direct and indirect disruptions. Input-output modeling evaluates the propagation of disaster consequences by quantifying the associated economic risks of disruption, namely economic loss and inoperability, for multi-sectoral economic regions.

Joanna’s dissertation examined the reliability of these risk estimates by formulating a stochastic inventory-based risk assessment model using a multi-objective optimization framework for minimizing economic losses and sector inoperability. The research also utilized inventory-to-sales ratio data from the Bureau of Economic Analysis for modeling uncertainty in the levels of finished goods inventory and the beta distribution to integrate uncertainty in decision-maker preferences associated with the multi-objective framework. The framework focused on the development of a holistic, flexible and scalable decision support system through a Dynamic Cross Prioritization Plot (DCPP) for identifying inventory enhancement opportunities among critically disrupted systems that is applicable to different regions and disaster scenarios.