Development of a Technical, Economic, and Risk Assessment Framework for the Evaluation of Work Reduction Opportunities



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To achieve operational efficiency and long-term economic sustainability, existing nuclear power plant stakeholders are identifying work reduction opportunities (WROs) as part of their approach to integrated operations for nuclear (ION) [1]. These WROs provide an opportunity to replace manually intensive activities with technology-enabled solutions to achieve cost savings. Executing these WROs at scale (i.e., system level to fleet level) is not a simple process and presents several challenges that include (but are not limited to) technical feasibility, performance uncertainty, organizational adoption of change, and others.

To alleviate these challenges, INL researchers have developed an evaluation framework in collaboration with Sargent & Lundy, LLC and Southern Nuclear Company to enable the successful implementation of new technological processes and WROs. This framework, known as the Technical, Economic, and Risk Assessment (TERA), is a method to systematically evaluate WROs. Through a series of interviews, process modeling, and an evaluation of technology integration into existing processes, TERA provides an understanding of the challenges and expected outcomes from potential WROs. The TERA framework is designed to ensure stakeholders can make informed decisions on modernization investments, overcoming challenges, and optimizing operations in the nuclear sector.

Technical, Economic, and Risk Assessment Framework

The TERA framework serves a twofold purpose when evaluating WROs. First, TERA screens and assesses WROs from technical, economic, and risk perspectives as shown in Figure 6. The screening is performed qualitatively in collaboration with stakeholders. A process map of the screened WRO is then developed and evaluated using quantitative models. Second, TERA results inform strategic development and implementation of modernized technologies, highlighting potential benefits to plant business.

TERA begins with a screening phase where the process is examined through a hybrid combination of Lean Six Sigma and ION guiding principles. This framework examines the current processes using the Lean Six Sigma Suppliers, Inputs, Process, Outputs, Consumers methodology but retains the key ION elements of people, technology, process, and governance as important factors to the nuclear decision-making process. By combining the principles of Lean Six Sigma and ION, the developed screening process provides a systematic evaluation methodology that is specific to the nuclear industry.

The output of TERA is an evaluation of WROs with the following perspectives:

- Technical – The technical assessment focuses on the process itself and the technical solution. This part of the assessment develops key performance indicators for measuring process performance. In addition, the technical assessment evaluates the feasibility and requirements of the potential solutions.
- Economic – The economic assessment focuses on the cost-benefit performance of the proposed solution which involves estimating the costs of the current process, the costs of developing and deploying the new solution, and the uncertainties in each. Through this assessment, the WRO will be evaluated for cost savings, break-even period, and the net present value of the investment.
- Risk – The risk assessment focuses on the identification and evaluation of potential consequences associated with the implementation of WROs. The risk assessment can also be used to evaluate any potential impacts on plant or personnel safety.

Once WRO solutions have been identified and scenarios analyzed, decision-making involves a careful weighing of benefits against the potential implementation risks. The TERA process develops an assessment of the various WROs in the form of key performance indicators, total cost of ownership, and risks. Using the insights from the TERA process, decision-makers can rank WRO solutions based on their business impact and potential risks. By doing so, the decision-making process becomes data-driven and risk-informed, thus ensuring that choices are backed by rigorous analysis and evaluation.

Real-world Application

LWRS Program collaborated with Sargent & Lundy, LLC and Southern Nuclear Company on a practical application of TERA. Through the analysis and screening conducted as part of the TERA process, five specific WROs were identified. These WROs were contained within two larger processes known as the work week planning and condition reporting process. Within the condition reporting process, one of the significantly beneficial WROs that was identified during the screening was the creation of a condition reporting research aid for system engineers.

The analysis of the conditioning research aid focused on the information-gathering process done by system engineers for equipment reliability-related research. Modeling and analysis predicted that a system engineering research aid could cut research process costs by 25% annually (approximately $570K in yearly cost savings). Assuming an initial cost of two million dollars and a full level of adoption (meaning all system engineers use the new process), the cost savings are overwhelmingly positive with a break-even date of less than four years. A full summary of the TERA framework and case study is detailed in "Development of a Technical, Economic, and Risk Assessment Tool for the Evaluation of Work Reduction Opportunities" INL/RPT-23-74724 [2].

References:

1. Remer, S. J., 2022, Integrated Operations for Nuclear Business Operation Model Analysis and Industry Validation, INL/RPT-22-68671, August 2022, Idaho National Laboratory, Idaho Falls, ID, USA. https://www.osti.gov/servlets/purl/1894935.
2. Spangler, R. M., V. Agarwal, C. A. Primer, J. K. Hansen, S. Lawrence, C. Howard, J. McCague, M. Lohens, P. Golub, R. Herb, and J. Budraitis, 2023, Development of a Technical, Economic, and Risk Assessment Tool for the Evaluation of Work Reduction Opportunities. INL/RPT-23-74724, September 2023, Idaho National Laboratory, Idaho Falls, ID, USA. https://doi.org/10.2172/2008364.

Figure 6. The technical, economic, and risk assessment is used to evaluate WROs.