

MEASUREMENT OF A STRATEGIC INVESTMENT

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ABSTRACT

The cleanup mission at Hanford is difficult. Success is defined by achieving end states and measuring performance as the cleanup progresses. Science and technology can contribute meaningfully to that success. But measuring the value of science and technology in the context of progress is not easy. Science and technology work is conducted in an environment that is full of barriers. The remedy, therefore, is to define and measure jointly, project outcomes and align behavior of all participants to these outcomes. This is true whether the work originated in science and technology or not. It is wrong to measure separately the achievements or contributions of science and technology. To have real value, any created performance measures must be tied to and synonymous with project outcomes. For total integration and success, the goals of a scientist or a technologist must be the same as a project manager. Accordingly, there is only one set of relevant performance measures and these measures should be associated with project end states.

The Hanford cleanup mission is a large, long and complex challenge requiring safe, cost effective and innovative solutions to assure that desired outcomes are achieved. The cleanup workscope is divided into five projects: tank waste, spent fuel, waste management, facility stabilization and environmental restoration. Each project operates independently against a set of milestones negotiated with the regulatory community and codified in our Tri-Party Agreement. To effectively tackle this challenge, what is needed for each project is a solid plan outlining an approach to assure everyone understands what work needs to be done and how best to proceed toward an agreed end state. Imagine having to tackle this daunting task without a clear picture of what the end state conditions look like. Imagine also working on this challenge without an effective means to know what progress looks like or whether you are moving forward at all. This paper is an attempt to put into perspective the proper role end state definition and performance measurement play in the cleanup program. But end state definition and performance measurement without context is meaningless. The real intent is to demonstrate that science and technology work is integral to cleanup end states for each project and how one can effectively measure the contribution of science and technology.

End states and performance measures are not independent concepts circling within their own spheres. In reality, these two concepts are interdependent components operating within a much larger universe or integrated system. Both concepts are important if science and technology is to have any meaningful impact on project successes. Let us explore the nature of this system for a moment. In this system there are seven components namely: end states; pathways (baselines); means to implement pathways; alternative pathways or routes; executed actions; performance measurement; and feedback. How this system works is quite simple. One starts with an end in mind or end

state. Next, a plan is developed which defines the preferred pathway to achieve the end states. Then the actual means to accomplish the pathway are now defined. This is where project baseline science and technology work is first identified. The defined pathway is augmented with alternative ideas; i.e., where better science and technology approaches are evaluated and considered. It is at this point the planning portion of the system ends and the execution portion begins. As the planned actions are initiated, measures are defined to indicate both progress against the pathway and the effectiveness of the actions taken. Finally, the measures are evaluated and through a feedback loop changes to the end state and pathway are initiated. When the cleanup challenge is viewed in this manner, the key to successful implementation of science and technology is the clear delineation and understanding of end states. With end states actually serving as a starting point then solid approaches for achieving cleanup can be mapped and investments in science and technology can be made which significantly contribute to better project outcomes. Now these science and technology investments, because of their importance to project success, then become much more strategic in value. The next question then becomes: how do you measure this value? How do you develop sound and meaningful metrics to measure the value derived from science and technology? Before answering these questions, let's explore the current conditions that science and technology work must deal with. Taken together these conditions constitute significant barriers.

At Hanford the environment is highly regulated. Every decision is made with respect to achieving compliance with our Tri-Party Agreement. The Tri-Party Agreement defines interim and final milestones, which project managers, must meet or run the risk of not achieving compliance and be in jeopardy of receiving civil or criminal penalties. The potential for penalties causes risk adverse behavior on the part of project managers who then pursue tried and proved solutions to their technical problems. These project managers are not comfortable incurring risk on a new science and technology solution. Take for example remediation of the 200 Area carbon tetrachloride groundwater plume. The project manager proposed and the regulatory community accepted pump and treat as an interim solution for remediation. While all involved parties recognize that pump and treat is not a final remedy, the fact remains that all parties are satisfied with this interim solution and there is little motivation to test alternative science and technology approaches, like bioremediation, for a more permanent solution. The system is at equilibrium and movement toward a better final solution is slow at best. A second environmental condition is the contract incentives placed on project managers. These managers receive fees for meeting Tri-Party Agreement milestones, not for trying new and innovative technologies or pursuing greater understanding with more scientific study. The funds or budgets available for the projects at Hanford are only supportive of a single pathway or baseline approach. Funds are not available to interrogate the baseline neither to understand where gaps exist nor to start alternative pathways or options that could result in better outcomes. Consequently, the project manager is forced to pursue the tried and proven pathway without the ability to explore promising options to their logical conclusion. Let us examine the decontamination activities in the 324 building, especially the B-hotcell. Part of the project involves removing structures and equipment from inside the cell. Project personnel are using a plasma arch torch as the preferred technology to cut up the material which will enable them to reach the contamination on the floor of the

cell. When a new laser technology was proposed for cutting the material (faster and with less secondary waste) neither the incentive nor funding was available within the project to encourage the project manager to give the new technology a try. Congress also provides some negative motivation to the project manager. Concerned with value for appropriated funds, Congress is intolerant with options that fail and consequently do not motivate project managers to explore better, though albeit, riskier options. The long reach arm is an example of a developed technology that helped shape congressional opinion in a negative manner. The arm was developed for use in a high level waste tank. It was developed without much user input. Multi-millions of dollars were spent on its development but the technology was never deployed because of user non-acceptance due to the premature availability of the technology in terms of schedule. Finally, there exists long-standing attitudes ingrained within project managers to achieve results in the most expeditious manner possible. These attitudes are not conducive to change and the use of alternative ideas. The literature is replete with examples of opportunities lost; i.e., good technologies that remain either on a shelf or in a warehouse because of project manager attitudes and the lack of communications from technology developers. Examples include: use of pump and treat systems rather than permeable reactive barriers; the use of cable drilling rather than sonic drilling or push technologies; and the use of sanding rather than lasers or chemical means of decontaminating surfaces. These environmental conditions make it extremely difficult for the performance measurement tool to stem the tide and enhance the use of science and technology in the cleanup efforts. These conditions are not going away so we, therefore, need to construct performance measures for science and technology that look inseparable from project measures and that will drive desired behavior, the use of new technology, within projects.

Given the fact that performance measurement is part of a larger system and that science and technology operates in a naturally adverse environment, one needs to address this relationship of performance measures and science and technology from a different vantagepoint. How do you motivate project managers, operating in the above referenced environment, to use science and technology to better enable them to reach their end state? The use of historical performance measures will not work. Historical methods means that we measure how we implement or make progress against the defined pathway or baseline; i.e., the number of science needs met; the number of initiated demonstrations; or the number of technology deployments. While these measures tell something "about the health of the patient" they are output oriented (measures something produced) not outcome oriented and do not drive behavior change which is necessary to achieve end states successfully. It can further be argued that these historical measures focus on processes, which is not a mark of an effective performance measure. If historical measures are not sufficient, where do we turn? We learn that science and technology activities must be fully linked to the goals and objectives of the project end users. A second accepted approach for science and technology performance measures is to gauge success on the basis of solutions provided. In this context, the amount costs are reduced, schedules advanced or technical risks abated become the means to judge the success of science and technology efforts. Measuring the degree of assistance provided by science and technology in furthering goals and objectives is better than an output based method

but still suffers from the standpoint that we are not driven to the final project outcomes which are of most interest to project managers and users.

One really needs to define measures in terms of what science and technology can do to effect the final agreed to project end states or outcomes. If an outcome is something that follows as a result of consequence of some action, then successful performance measures need to indicate how science and technology contributions are making meaningful inroads to that end. If measures can be tied to end states, then project managers will now measure in a broader context. Project managers will now measure what is important to them and project managers will understand or recognize the multiyear nature of this endeavor. This will give much more room for science and technology efforts to have an impact on results. What would these specific science and technology performance measures look like? The best answer is drawn from a draft paper co-authored by Steve Stein of the Pacific Northwest National Laboratory and Edgar Berkey of Concurrent Technologies who maintained: "...but measure jointly defined with end users are essential for an impactful science and technology program. Measures reflecting the science and technology programs enabling roles in delivering solutions will require end user collaboration. And like all effective measures, those for environmental management will need to: address key organizational objectives; be outcome versus process oriented; measure outcomes as trends over time; use information that is directly understandable; assure measures are within the span of control of those accountable and operate at a series of levels." This mutuality is key and there must be joint accountability of the player for the outcomes. Users (project managers) with ultimate accountability must have a solid defined pathway or baseline; must support alternative paths and must define a decision point where a new idea will be considered to supplant an existing one. For the producer of science and technology, accountability means understanding the baseline and the ensuing problems and needs and standing commitment to provide alternative solutions at a time and cost conducive for the user's (project manager) acceptance. Collaboration between the project manager and the technology developer in defining performance measures that drive toward end states is key to the successful use of performance measures to stimulate science and technology integration into project baselines. Jointly defined performance indicators should be both leading and lagging and have the following trait. Leading indicators should drive the behaviors that you want to achieve. At Hanford, we want in our projects: good baselines, technology insertion points, analysis of baseline alternatives; roadmapping to identify gaps in baseline logic; investments in alternative approaches; regulatory acceptance and stakeholder understanding. The project manager and the technologist should jointly construct measures that support attainment of the above behaviors. Both parties should work from their respective roles toward the same measures and end states. Lagging indicators would then measure the effectiveness of the ongoing work, especially how the last component of the R&D cycle namely deployment has contributed to progress. Measures could include: number of high priority problems and needs addressed; the amount of risk reduced, cost savings achieved or schedules enhanced; the amount of waste dispositioned, land remediated and buildings decommissioned; and finally the return on investment. These lagging indicators should be of interest to both the project manager and the technologist

and should be used by both to measure progress and success in terms of project end states.

Performance measures can help facilitate the use of science and technology against the cleanup challenge. But to do so performance measures must be viewed as tools—tools that exist to drive behavior change. This behavior change is necessary among regulators, project managers, congressional staff and technology developers. These tools should be used to drive desired behaviors and should not be used as a report card; i.e., to evaluate how well a contractor is doing. These tools, as indicators will tell us clearly whether we are making progress or whether we have changes to make. In actuality, we do not need separate performance measures for science and technology. We need to join forces with the end user (project manager) to define outcomes—outcomes which science and technology help to achieve. In this manner, we are all striving for the same end states and the system is complete.