Academic Research Study: Improving the Reliability of Earned Value Management System (EVMS) Implementation

David Kester, PM-30 – Department of Energy

Mounir El Asmar, Associate Professor – Arizona State University

Research Study Purpose

- **Investigate the EIA-748 EVMS related knowledge, attitudes, and behaviors of subject matter experts across government and industry to:**
  - Identify the factors that contribute to a reliable EVMS
  - Assess the association between the EVMS and Project Outcomes

Research Study Objectives

- **Evaluate the enabling factors that drive project outcomes (i.e., correlation to staying on schedule and EVMS Compliance, etc.)**
- **Evaluate the enabling factors that drive the effective use of the EVMS (i.e., customer advocacy, intuitive nature of the system, the size and experience of the project team, etc.)**
- **Define and quantify the maturity and accuracy of EVMS data and information**
  - CII PDRI like EVMS Maturity Rating Index

Research Study Goals

- **Complete research study by the Summer 2021**

- **Anticipated value added for completing study:**
  - **Better Outcomes**. An improved understanding and appreciation through independent research of the EVMS for managing and decision making
  - **Clarity and Objectivity**. EVMS maturity level rating index to assist in determining the degree and whether the EVMS is mature and compliant
  - **Commonality and Cost Savings**. A method to satisfy the OMB expectation for EVMS reciprocity between government agencies and contractors
  - **Policy Implications**. Results will influence next EIA-748(E) update

Research Study Contributors

- **Expected research participants and benefactors include:**
  - **The Energy Facility Contractors Group (EFCOG)**
  - **The National Defense Industrial Association (NDIA)**
  - **Cognizant Federal Agencies:**
    - Department of Energy (DOE)
    - Department of Defense (DoD)
    - Defense Contract Management Agency (DCMA)
    - National Aeronautics and Space Administration (NASA)
    - National Reconnaissance Office (NRO)
    - Federal Aviation Administration (FAA)
  - **Office of Management and Budget (OMB)**
  - **Government Accountability Office (GAO)**

Research Study Lead Stakeholders

- **Mel Frank (Chair)**
  - Director, Project Controls Division
    Office of Project Management, US Department of Energy

- **Amy Basche (Vice-Chair)**
  - Chair, EFCOG Project Delivery Working Group
    Chief Operations Officer, Mission Support Alliance

Research Study Principle Investigators (PI)

- **G. Edward Gibson, Jr., PhD, PE (PI)**
  - Professor and Sunstate Chair of Construction Management and Engineering
    School of Sustainable Engineering and the Built Environment
    Arizona State University

- **Mounir El Asmar, PhD (Co-PI)**
  - Associate Professor, Del E. Webb School of Construction
    Co-Director, National Center of Excellence on SMART Innovations
    Arizona State University

- **+ 2 PhD Students**

Research Team (RT)

Core Team Roster

Role	Name	Organization	Name	Organization
Chair/Vice-Chair	Melvin Frank	DOE/PM-30	Amy Basche	Mission Support Alliance/EFCOG
Support to Chair/Vice-Chair	Karen Urschel	DOE/PM-30/CS	Craig Hewitt	Contract Support/EFCOG
Principle Investigator (PI) /Co-PI	Edd Gibson	ASU	Mounir El Asmar	ASU
Grad Student 1/ Grad Student 2		ASU		ASU
Govt. /Industry Representatives	Dave Kester	DOE/PM-30	Vicki Frahm	Sandia National Lab
Govt. /Industry Representatives	Zac West	DOE/PM-30	Doug Marbourg	Los Alamos National Lab
Govt. /Industry Representatives	Garrett Richardson	DOE/PM-30	Derek Lehman	Washington River Protection Solutions
Govt. /Industry Representatives	Betsy Ballard	DOE/EM	Robert Sudermann	Fluor
Govt. /Industry Representatives	John McGregor[1]	DoD/AAP	Tony Spillman	Washington River Protection Solutions
Govt. /Industry Representatives	Barry Levy[2]	NRO/CS	John Post	Lawrence Livermore National Lab
Govt. /Industry Representatives	Danielle Bemis	DoD/DCMA	Tom Carney/Vaughn Schlegel[4]	Lockheed Martin
Govt. /Industry Representatives	Jerald Kerby/Stefanie Terrell[3]	NASA/CAIWG	Russ Rodewald	Raytheon
Govt. /Industry Representatives	Ben Pina	DOE/NNSA	Paul Sample	CACI
Govt. /Industry Representatives	Bill Weisler	DoD/DCMA	Jeffrey King	BAE

CS - Contract Support

1) Emily Beltramo will represent John McGregor at 1st meeting due to conflict in John's schedule.
2) While Barry Levy will represent NRO/Ivan Bembers on the core team, Ivan is planning to attend the 1st meeting.
3) Stefanie and Jerald will alternate in representing NASA and other federal agencies of the Civilian Agency Industry Working Group (CAIWG); Stefanie will attend the 1st meeting.
4) Vaughn is the alternate representative for Lockheed Martin and will attend when Tom is unable to attend.

Products

Create a high-value and innovative assessment and rating mechanism that specifically applies to the EVMS with high usage and impact for government and industry. Deliverables include:

- A proven EVMS implementation and **assessment** mechanism/process;
- Automated **Toolset** with associated user instruction documentation;
- Research summary giving an **overview** of the research and key findings;
- Research **report** providing a detailed discussion of all research work;
- Informs EIA-748E update;
- **Training** sessions; and
- EFCOG/NDIA conference **presentations**.

SINAI FOR THE NEW YORK TIMES

Israeli politicians.

Global Study Puts Numbers On Diet's Role In Longevity

By ANDREW JACOBS

Mom is right when she says to eat your peas.

In one of the largest surveys of data on global dietary habits and longevity, researchers found that consuming vegetables, fruit, fish and whole grains was strongly associated with a longer life — and that people who skimped on such healthy foods were more likely to die before their time.

The study, published on Wednesday in the British journal The Lancet, concluded that one-fifth of deaths around the world were associated with poor diets — defined as those short on fresh vegetables, seeds and nuts but heavy in sugar, salt and trans fats.

In 2017, that came to 11 million deaths that could have been avoided, the researchers said. Most of those, around 10 million, were from cardiovascular disease, researchers found. The next biggest diet-related killers were cancer, with 913,000 deaths, and Type 2 diabetes, which claimed 339,000 lives.

"These numbers are really striking," said Dr. Francesco Branca, the top nutritionist at the World Health Organization, who was not involved in the study. "This should be a wake-up call for the world."

No. 56,834

The New York Times

NEW YORK, SUNDAY, APRIL 12, 2015

related deaths. For example, Uzbekistan had 892 deaths per 100,000 people compared with 89 in Israel.

Beyond its sobering conclusion, the study was notable for what it prescribed: Rather than browbeating people to reduce their consumption of the fats and sugars that are correlated with illness and premature death, the authors determined that adding healthier foods to global diets was a more effective way to reduce mortality.

That's because the gap between the amount of nourishing foods people should eat but don't is much greater than that between the levels of harmful things they regularly put in their mouths but shouldn't, said Dr. Ashkan Afshin, an epidemiologist at the University of Washington who was the paper's lead author. For example, he noted that global average intake of red meat was 27 grams a day, slightly higher than the recommended daily limit of 23 grams. But when it comes to eating healthful nuts and seeds, most people eat on average 3 grams, far less than the 21 grams considered optimal. The only exception was excess salt, which the research

Methodology *(6 of 11)*

1. Perform an extensive **literature review**, to develop a detailed basis for the effort.
2. **Recruit** experienced team members representing the various agencies/organization benefiting from the project.
3. Develop shared and **consistent definitions** where needed.
4. Work closely with the Research Team (RT) to further **refine the scope, objectives, and tasks**
5. Conduct a **short questionnaire of EVMS practitioners** within NDIA and EFCOG concerning the RT's working definition as applicable and the expected impact of assessing the maturity and accuracy of its EVMS / controls component.
6. Coordinate with DOE/other CFA/GAO/NDIA/EFCOG and **develop the assessment mechanism** using input and feedback from the RT and questionnaire to support the development of both maturity and accuracy of EVMS development.

Methodology *(continued)*

7. Identify the external participants and projects to include in this effort, **develop the data collection approach** and evaluation methods.
8. **Conduct a series of workshops** for invited personnel to comment on the tool and importance of identified factors. It is envisioned that these workshops will tap expertise from 20-40 owner and contractor organizations, both inside and outside of NDIA and EFCOG membership, including OGA if possible, with representation of between 40 and 60 individuals.
9. **Finalize the assessment mechanism** and test its effectiveness with both completed and ongoing projects. It is anticipated that approximately 25-35 completed projects (after the fact) and 5-15 ongoing efforts will be assessed looking specifically at the tool's effectiveness in evaluating the efficacy of the EVMS implementation.
10. Working closely with the RT, **synthesize the results** of the quantitative and qualitative data analysis into a concise guide.
11. **Develop publications and presentations.** Include results and any tools developed; provide recommendations for updates to the EVMS publications as applicable.

Methodology

Research Schedule		2019												2020												2021											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	NDIA IPMD Conf.		♦						♦						♦						♦						♦						♦				
	Team meetings (tentative)		♦			ASU			♦		ASU			ASU	♦			♦			♦		ASU		ASU		♦			ASU			♦			♦	♦
	Interim Reports								♦				♦						♦						♦						♦						
	Training																																♦		♦	
1	**Review of Literature and State of Practice**	■	■																																		
2	**Recruit Team**	■	■	■	■																																
3	**Define Project**	■	■	■	■	■																															
4	**Finalize Scope and Objectives**		■	■	■	■																															
5	**Questionnaire**				■	■	■	■	■																													
6	**Develop Draft Assessment Tool**					■	■	■	■	■	■	■	■																									
7	**Identify Data Sample**								■	■	■	■	■																									
8	**Conduct Workshops**													■	■	■	■	■	■	■	■	■																
9	**Finalize and Test**													■	■	■	■	■	■	■	■	■	■															
10	**Synthesize Results into Guide**																			■	■	■	■	■			■	■	■	■	■	■	■					
11	**Develop Publications and Presentations**																										■	■	■	■	■	■	■	■	■	■	■

Early Step: EVMS Guides, by Agency

- Find the common elements between NDIA EIA 748-D and other EVMS guides

	NDIA Earned Value Management Systems EIA-748-D Intent Guide	DoD Department of Defense Earned Value Management System Interpretation Guide	DOE EVMS guide reports EIA-748 as basic requirement	NASA
Guideline 1	Define Work Scope (WBS)	Define the Authorized Work Elements	Section 2: EVMS Critical Information and Suggested Uses	NASA WBS Handbook NASA EVM Project-Control Account Manager Reference Guide
Guideline 2	Define Project Organization (OBS)	Define Program Organizational Structure		
Guideline 3	Integrate Processes	Integrate Subsidiary Management Processes		
…	Identify Overhead Management	Identify Overhead Management		
Guideline 32	Document Performance Measurement Baseline Changes	Document PMB Changes	Section 4: Surveillance of contractor's EVMS	NASA Integrated Baseline Review (IBR) Handbook

Sample of EVMS Maturity: Dimension #1

- Each of the 32 elements will have a detailed description to facilitate a consistent assessment
  - *Each will be developed by the research team*

- We developed a similar process for FEED MATRS
  - *Example on next slide*

Sample of EVMS Maturity for 1 of 32 elements

SECTION I – Organization	Definition Level					
	N/A	BEST		MEDIUM		WORST
I. ORGANIZATION	0	1	2	3	4	5
A1. Define Work Scope (WBS) A WBS is a direct representation of the work scope in the project, documenting the hierarchy and description of the tasks to be performed and their relationship to the product deliverables. The WBS breaks down all authorized work scope into appropriate elements for planning, budgeting, scheduling, cost accounting, work authorization, measuring progress, and management control. The WBS must be extended to the level necessary for management action and control based on the complexity of the work. At a minimum, the WBS is extended to the level or levels at which control accounts are established. A WBS dictionary is typically used to define the work scope for each unique element in the WBS and should include cross references to the Statement of Work (SOW) or equivalent. The WBS includes fields to identify and include: • Unique WBS number for each WBS element. • Short description. • Parent element identification (with the exception of the top WBS element). • Contract line item number for cross-reference to the Statement of Work. • Reporting level required for internal management and customer reporting purposes. • The lowest level in the WBS is the control account level (typically level 4 or 5 in the WBS structure, depending on the needs of the project). The WBS Dictionary description should include, but is not limited to, specific details such as: • End result or expected work product. • Related work to identify dependencies between elements of work. • Risk and opportunity factors. • Assumptions or limitations. • Technical specifications. • Related documents or other materials that are required for the work team to successfully complete their assignment. Typical Work Products** • Statement of Work (SOW) • Work Breakdown Structure (WBS) • Traceability matrix from Government requirements (e.g., SOW, Build Specifications) to WBS • WBS index/dictionary • Integrated Program Management Report (IPMR)	**Not required for project.**	**The WBS has been defined and approved by key stakeholders.** The WBS Dictionary is developed and approved by DOE (or other agency). The WBS contains all project work, including revisions for authorized changes and modifications. The WBS contains all contract line items and end items. The WBS is extended at a minimum to the level(s) at which control accounts are established. The WBS elements collectively provide a complete definition of work scope requirements.	**Most of the WBS structure, descriptions, and WBS dictionary have been defined, documented, and are under review, but not yet approved.** The WBS identifies all WBS elements specified for external reporting. The WBS Dictionary is ready for approval by DOE The WBS contains all project work, including revisions for authorized changes and modifications. The WBS contains all contract line items and end items. The WBS is extended at a minimum to the level(s) at which control accounts are established. The WBS elements collectively provide a complete definition of work scope requirements.	**Some of the WBS structure and element descriptions have been defined.** The WBS contains some project work and contract line items. Development of the WBS Dictionary has started. Some of the WBS elements provide definitions of work scope requirements.	**Development of the WBS structure has started.** The WBS structure is outlined but items are vague. The WBS contains little project work. The WBS is only defined at a high level and control accounts are not established. The WBS elements does not have detailed definition of work scope requirements.	**Not yet started.**

EVMS Maturity

- All levels (0-5) may not be weighted evenly…
  - *Think about impact on objectives, cost, schedule, etc.*

- Are all Guidelines created equal?
  - *We hope to know that in a couple of years!*

- Research will **define** the elements, **describe** them, **weight** them and their **definition levels**, develop an **assessment** around them, and measure their **impact** on performance.

Accuracy Types	Accuracy Factors	References
1 Project Leadership Team	a. Previous experience planning, designing and executing a project of similar size and scope.	Nelson and Winter (1982), Lim et al. (2016)
	b. Stakeholders are appropriately represented on the project leadership team.	CII (2005), CII (1999)
	c. Project leadership is defined, effective, and accountable.	CII (1998), CII (1999), CII (2005)
	d. Leadership team and organizational culture fosters trust, honesty, and shared values.	CII (2005), Burke (2014), McLaughlin (2017)
	e. Project leadership team's attitude is able to adequately manage change.	Gibson and Hamilton (1994), Piderit (2000)
	f. Key personnel turnover, e.g., how long key personnel stay with the leadership team.	Gibson and Hamilton (1994), Woods (2017)
2 Project Execution Team	a. Technical capability and relevant training/certification of the execution team.	Wei et al. (2005)
	b. Contractor/Engineer's team experience with the location, with similar projects, and with FEED process.	Nelson and Winter (1982), CII (2003), Skitmore et al. (1990)
	c. Stakeholders are appropriately represented on the project execution team.	CII (1998)
	d. Level of involvement of design leads or managers in the engineering process.	CII (2005), Wei et al. (2005)
	e. Key personnel turnover including the stability/commitment of key personnel.	Gibson and Hamilton (1994), Graetz (2000)
	f. Co-location of execution team members to one another.	Heinemann and Zeiss (2002)
	g. Team culture or history of the execution team working together.	CII (1998), Moreland et al. (1998)
3 Project Management Process	a. Communication within the team is open and effective; a communication plan is identified.	Pinto (1990), CII (2005)
	b. Priority between cost, schedule, and required project features is clear.	CII (2005)
	c. Organization implements and follows a front end planning process.	CII (2005)
	d. Significant input of construction knowledge into the FEED process.	Dave and Koskela (2009)
	e. Adequate process for coordination between key disciplines.	Winograd (1993)
	f. Alignment of FEED process with available project information.	CII (1998), CII (2005)
	g. Documentation used in preparing FEED	Aguiar (2000), CII (2003), CII (2005
	h. Review and acceptance of FEED by appropriate parties.	Stamps and Nasar (1997)
4 Project Resources	a. Commitment of key personnel on the project team.	Saudargas and Zanolli (1990), CII (2005)
	b. Calendar time allowed for preparing FEED.	Lan and DeMets (1989), CII (1998), Ostrowski (2006), Rigby and Bilodeau (2015)
	c. Quality of and level of engineering data available.	Chen et al. (2005), Oberlender and Trost (2001)
	d. Amount of funding allocated to perform FEED.	CII (1998), CII (2005)
	e. Local knowledge.	CII (1998)
	f. Availability of standards and procedures.	Heinemann and Zeiss (2002), CII (2005)

Sample of EVMS Accuracy: Dimension #2

HIGH PERFORMING	MEETS MOST	MEETS SOME	NEEDS IMPROVEMENT	NOT ACCEPTABLE
Rating a factor High Performing indicates the factor's criteria are fully met within the context of their respective category, e.g., project	Rating a factor Meets Most indicates that the factor's criteria are consistently met and understood with minor deficiencies.	Rating a factor Meets Some indicates that the factor's criteria are partially met and without improvement, project success could be in jeopardy.	Rating a factor Needs Improvement indicates that the factor's criteria are not consistent in meeting project expectations and ovement, at risk. ction to ations is	Rating a factor Not Acceptable indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. Project success cannot be achieved in this current state and actions are required to improve.

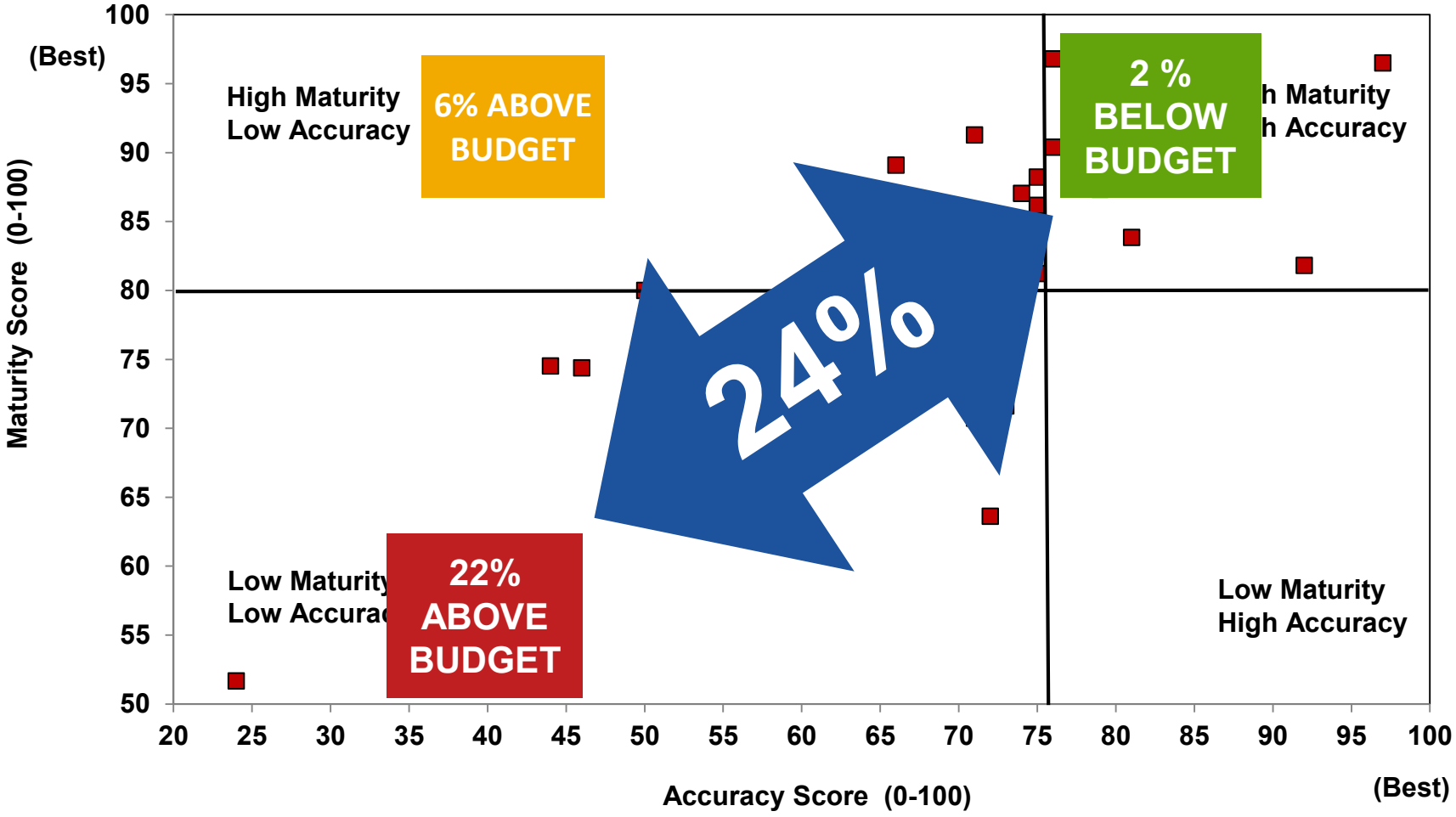
1. Project Leadership Team Accuracy Factors	
1a. Leadership team's previous **experience planning, designing, and executing** a project of similar size, scope, and/or location including FEED	Previous experience increases the familiarity of the leadership team with the project planning, design, and execution processes. Repetition plays a major role in both organizational learning (lessons learned) and in the creation of routines and capabilities in general.

Guidelines vs. Performance

- Which of the EVMS Maturity and Accuracy elements are correlated with performance?

- Hypothesis: all 32 Guidelines have some association with project outcome / performance.
  - Do they? How much?
  - How about when considering the costs incurred?

CII's FEED MATRS (An Example)



We aim to deliver

- A method and tool to consistently assess
  1. the **maturity** of EVMS
  2. the **accuracy** of EVMS by looking at its contextual factors such as resources, management support and contracting approach
  3. EVMS's **effectiveness** / potential impact on performance