EVMS Environment Assessment Tool Development Process

Integrated Project/Program Management (IP2M)
Maturity and Environment Total Risk Rating (METRR)
using Earned Value Management System (EVMS)

Report No. 3, Annex A

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Executive Summary

This research report summarizes the efforts of the research team to develop the Earned Value Management System (EVMS) environment assessment tool, one of the two components of the Integrated Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR). The authors in conjunction with the research team and an extensive literature review, developed a set of 33 factors to assess the EVMS environment grouped in four categories (Culture, People, Practices, Resources). The authors hosted a series of four industry workshops where 47 industry professionals, representing 24 unique organizations as listed in Appendix A, evaluated the environment factor names and descriptions and helped narrow the list to 27 most important factors that frame the environment within which an EVMS operates. The workshop participants provided comments, and weighted (ranked) the environment factors and categories as elaborated in this report. The collected data was statistically analyzed and used to develop weighted score sheets as a mechanism for environment assessment.

This document is part of the deliverables for the research project sponsored by the DOE and has been approved by the research steering committee and Arizona State University (ASU) joint team.

The IP2M METRR is a novel assessment mechanism developed as part of a DOE-sponsored Joint Research Study led by ASU and representing 19 government, industry, and academic organizations. The research team members are 41 individuals who have a diverse background including owners, contractors, consultants, academia, and so forth. The list of the research team members is provided at the end of this document. The tool assesses a spectrum of EVMS maturity and environment issues centered around the EIA-748 EVMS Guidelines, while also referencing the Project Management Institute's American National Standards Institute (ANSI) standard for EVM (2019) and International Organization for Standardization (ISO) 21508:2018 guidance. By using the IP2M METRR (pronounced "IP2M meter") to assess both the maturity and environment of an EVMS, project leaders and personnel can understand the efficacy of that EVMS to support integrated project/program management. It also helps identify opportunities for improvement. The goal of performing this assessment is to assure project/program participants are working with accurate, timely, and reliable information to manage their work, leading to successful project/program performance.

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1. Background

The *Integrated Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR) using EVMS*, formerly called as EVMS Maturity and Environment Total Rating (EVMS METR), is an assessment mechanism developed as part of a DOE-sponsored Joint Research Study led by the Arizona State University (ASU). The tool can help project/program teams assess the maturity and environment of an EVMS application.

This research report summarizes the efforts of the research team to develop the assessment component used for assessing EVMS environment. The authors in conjunction with research team, and an extensive literature review developed a set of 33 draft environment factors, grouped in four categories (Culture, People, Practices, Resources), to be used to assess EVMS. The authors hosted a series of four separate industry workshops where 47 industry professionals evaluated the environment factor descriptions. The list of the 24 unique organizations that these professionals represented are given in Appendix A. The workshop participants provided comments, ranked/weighted the categories and factors and helped narrow important factors to a final list of 27 as elaborated in this report. The data was statistically analyzed and used to develop weighted score sheets that can be used to assess the environment surrounding an EVMS.

2. Methodology

This section outlines the methodology employed for developing EVMS assessment draft and producing the IP2M METRR score sheets. The research methods of data collection and statistical data analysis procedures are described in this section. Figure 1 provides a logic flow diagram of the research methodology, providing a visual representation of the steps undertaken by the authors.

The IP2M METRR tool includes two main sections: maturity and environment. This report will provide the methodology adapted for the environment assessment section. Further details on maturity assessment methodology and development of EVMS maturity score sheets, as shown in Figure 1, is discussed in a separate research report (research report #4, Annex A).

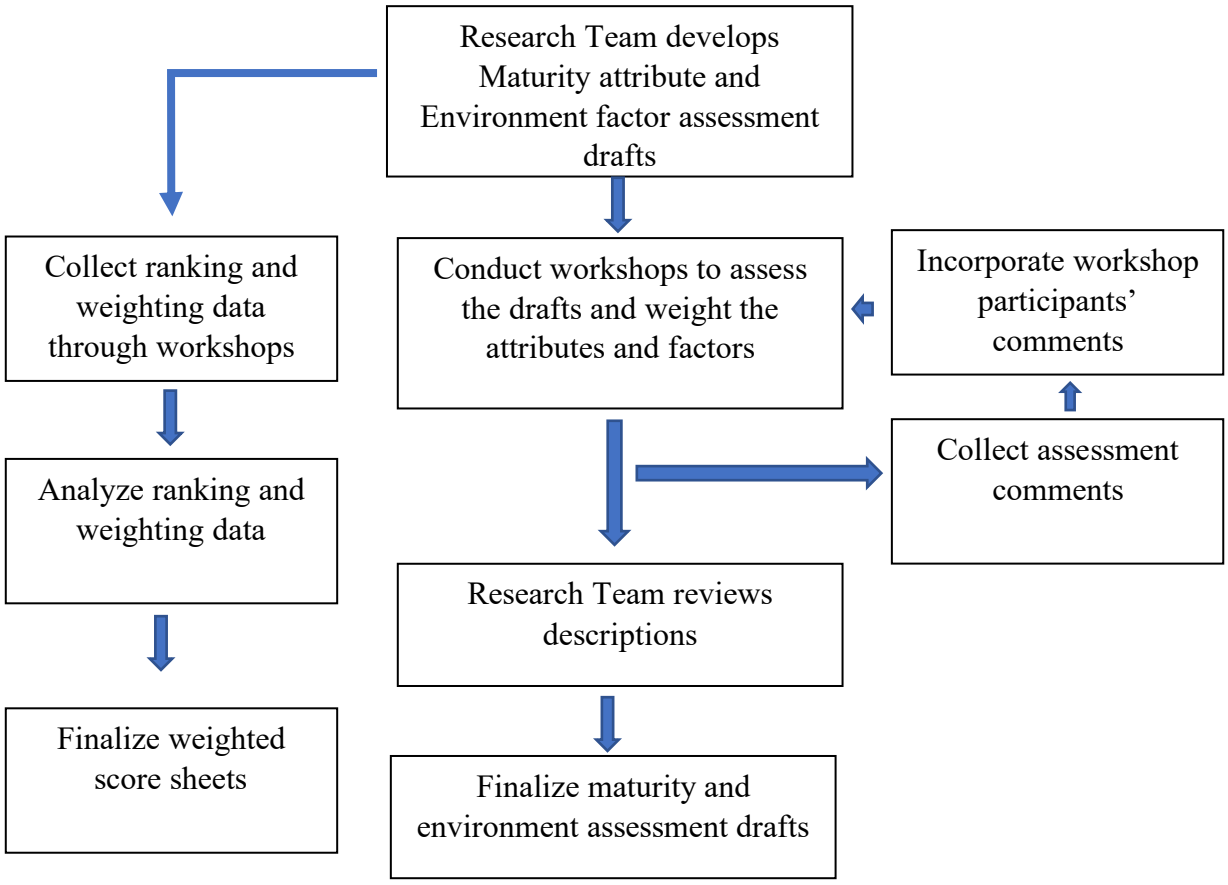

Figure 1 Research Methodology Flow Chart

The research team conducted multiple of meetings to develop the EVMS environment factor assessment drafts including their descriptions and the draft score sheets. Workshops were conducted to collect comments on the assessment drafts and develop weights to be used in score sheets. The authors used statistical methods to analyze the data collected in the workshops.

The environment assessment draft includes a structured list of descriptions detailing specific factors that should be addressed during EVMS environment evaluation, and a weighted score sheet that corresponds to each factor. The purpose of the weighted score sheet is to quantitatively gauge the rating level of each environment factor from Not Acceptable to High Performing.

3. Development of EVMS Environment Assessment Draft

The research team identified 33 factors critical to EVMS environment in four categories (Culture, People, Practices, Resources), based on literature review, industry survey and research team meetings organized by the authors with 27 government and industry professionals that are experts in EVMS (original research team members). Research team members are provided in Appendix P at the end of this report. The arrangement into categories places common factors together for ease of discussion during EVMS environment assessments. The list of the 33 factors and their references are shown in Appendix B. Each factor also has a detailed narrative that provides description of the factor (i.e., factor description). An example is shown in Table 1.

Table 1 Example Factor Description from IP2M METRR – Culture Category, Environment Factor 1g

1g.	Project/program leaders make **timely and transparent decisions** informed by the EVMS.	Timely and transparent decisions, by both the contractor and customer, are critical to project/program success. Project/Program leadership and team members have situational awareness of the progress made on programmatic objectives that lead to timely, effective decisions. The project/program places adequate emphasis on the importance of the EVMS as the means used to develop and integrate scope, schedules, and budgets, as well as understanding risk and uncertainty. The project/program uses EVMS to predict and positively influence schedule and cost outcomes using generated data, metrics, and reports in formats that assist effective management and decision-making. Sufficient communication platforms exist and disseminated information is available to enable effective decisions. Team members responsible for implementing and executing the EVMS are supported by timely decisions and input from the sponsors and have corporate support when needed. Decisions are shared transparently (e.g., scope changes are shared across key stakeholders) and are consistent.

The authors, along with help from the research team, organized four workshops where 47 EVMS practitioners provided comments on assessment draft, ranked the environment factors based on the relative impact of each on the EVMS environment and weighted each environment category versus the others. The authors used Qualtrics to administer and collect the responses of the participants. The workshops were held online via ZOOM for safety measures considering COVID-19 pandemic.

Details of these workshops are shown below:

07/16/20	Environment Workshop #1	3.5 hours	10 participants
08/12/20	Environment Workshop #2	3.5 hours	11 participants
09/10/20	Environment Workshop #3	3.5 hours	13 participants
09/15/20	Environment Workshop #4	3.5 hours	13 participants

A sample Qualtrics questionnaire used in the workshops is provided in Appendix C.

Each environment factor in the IP2M METRR was given five potential levels of assessment (see Table 2). The following levels were used by participants to assess each EVMS environment factor on the project/program. This environment factor assessment scheme was adapted and updated by the authors and the research team based on the past work done on Front End Engineering Design Maturity and Accuracy Total Rating System by the Construction Industry Institute (CII 2018).

Table 2 EVMS Environment Factor Assessment Scheme

Not Acceptable	**Needs Improvement**	**Meets Some**	**Meets Most**	**High Performing**
Rating a factor Not Acceptable indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.	Rating a factor Needs Improvement indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.	Rating a factor Meets Some indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.	Rating a factor Meets Most indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.	Rating a factor High Performing indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).

The workshop participants provided a ranking of each factor based on its relative impact to the overall EVMS environment. If the number of environment factors under a given category was even, the ranking question asked the respondents to rank the top "half plus 1" number of factors from the list of environment factors (Taherdoost 2019, McMillan et al. 2016, McMillan et al. 2014, Johns 2010). For example, if a given category had 8 factors, the respondents were asked to rank the top 5. If the number of environment factors under a given category was odd, the ranking question asked the respondents to rank the top "median" number of factors from the list of environment factors. For example, if a given category had 9 factors, the respondents had to rank the top 5.

The workshop participants were also asked to provide weights for each environment category versus the other categories (Culture, People, Practices, Resources), by allocating 100 points divided among these categories based on the relative impact on the EVMS environment. Allocating more points to a category reflects a higher relative impact on the EVMS environment.

4. EVMS Environment Workshop Process

The authors facilitated each of the workshop sessions hosted online using the Zoom platform. The authors sent information packets electronically to all confirmed workshop participants prior to each session; these included background information about the research study and the purpose of the workshop itself. Similar information packets were sent out prior to all of the workshop sessions. Potential workshop participants were asked to review all of the "pre-read" information prior to the workshop sessions, which included familiarizing themselves with the EVMS environment assessment draft, and workshop presentation. The presentation included an agenda for the session, instructions for evaluating the EVMS environment draft, including ranking and weighting.

Each session began with a Microsoft PowerPoint presentation (a sample presentation is included in Appendix D) that briefly described the objectives of the workshop, background of the research project, background of the IP2M METRR, and instructions for evaluating the assessment draft. During that presentation, participants were provided the Qualtrics url link and then collectively guided through how to fill it out (Appendix C). First, the participants were asked to use an anchor project or program, which is a sample project or program they have worked on previously or are working on that would be used as reference throughout the workshop session, when thinking about EVMS environment assessment. After that information was provided, each of the EVMS factor descriptions were then reviewed, one by one.

The facilitators addressed any questions posed by the workshop participants as the factors were individually reviewed. Adequate time was provided for participants to assess each factor, but not enough time to “over think” the factors, keeping a consistent flow and timing throughout the session. Following the review of the factor descriptions for each category, the facilitator asked each participant to rank the factors versus each other under the same category. For example, the question on the People category stated “This question is focused on the factors that make up the People Category (Category 2). Based on your experience, please rank the top 5 factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly (#1 is the most impactful).” An example of the ranking response received by a given participant to this question during the workshop (the factors not ranked did not receive any input) is given in Figure 2.

___1___	2a. The **contractor leadership team and project/program team are experienced and qualified** in implementing and executing EVMS.
___3___	2b. The **customer leadership team and project/program team are experienced** in understanding and using EVM results to inform decision-making.
_____	2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS.
_____	2d. Project/program **leadership is defined, effective, and accountable**.
___2___	2e. Implementation and execution **team members have a history of working together**.
_____	2f. **Key EVMS stakeholder turnover is minimized**.
_____	2g. Individuals responsible for the project/program and EVMS **are experienced with the local norms, conditions and regulations**.
___4___	2h. **Team members** responsible for EVMS implementation and execution **are co-located and/or accessible**.
___5___	2i. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

Figure 2 Example Environment Factor Ranking Response

After completing the review of all descriptions and the rankings, the participants were asked to weight the categories one versus the other, based on relative importance. This was done by providing 100 overall "points" and having each participant allocating points to the four categories based on their opinion of relative importance. For example, the question on weighting the categories stated: "The following four categories typically make up an EVMS environment. This question is about the relative impact of these four EVMS environment categories. Please allocate 100 points divided among these categories based on the relative impact on the EVMS environment. Allocating more points to a category reflects a higher relative impact on the EVMS environment. The total number of points should sum up to 100." An example of the response received by a given participant to this question during the workshop is provided in Figure 3.

___40___	**Culture:** Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.
___20___	**People:** People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analysist, project schedule analysist, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.
___20___	**Practices:** Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).
___20___	**Resources:** Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.
Total:_100_	

Figure 3 Example Environment Category Ranking Response

The workshops were successful in both collecting data and receiving insight from experienced industry professionals on the value and use of the tool. They also allowed the researchers a means to effectively and efficiently collect data to improve the tool, and to generate score sheets.

5. Results, Data Screening, and Analysis

This chapter outlines the results of data obtained during environment workshops, and how input obtained from these workshops was used to develop the final EVMS environment factors, descriptions and score sheets, after screening the data for reliability. This section includes a brief description of workshop facilitation, participant demographics, and data screening techniques, along with findings from the analyses.

Industry practitioners were asked to provide feedback regarding the environment factor descriptions during the workshops as well. As discussed previously, the authors used Qualtrics during the workshops to collect data. Each participant could also record additional thoughts concerning the workshops or overall EVMS environment assessment. The authors reviewed all the comments collected during the workshops with the support of the entire research team and revised the factor descriptions as needed.

The first two workshops used the list of 33 factors (7 factors under Culture, 9 factors under People, 9 factors under Practices and 8 factors under Resources) and requested feedback accordingly. The list of factors is shown in Appendix E. Workshop 1 received 202 comments that were addressed by the authors and the research team to edit the environment assessment draft which allowed the author's to use the improved draft version for Workshop 2. Workshop 2 received 166 comments that were also addressed by the authors and the research team.

The authors used the following quantitative analysis methods to represent the quantitative data collected throughout the workshops, analyze the data collected, and use the data to generate weights in the score sheets. In general, the authors followed the processes shown in Figure 4 to perform the quantitative analysis methods. The details of each process are given in next sections.

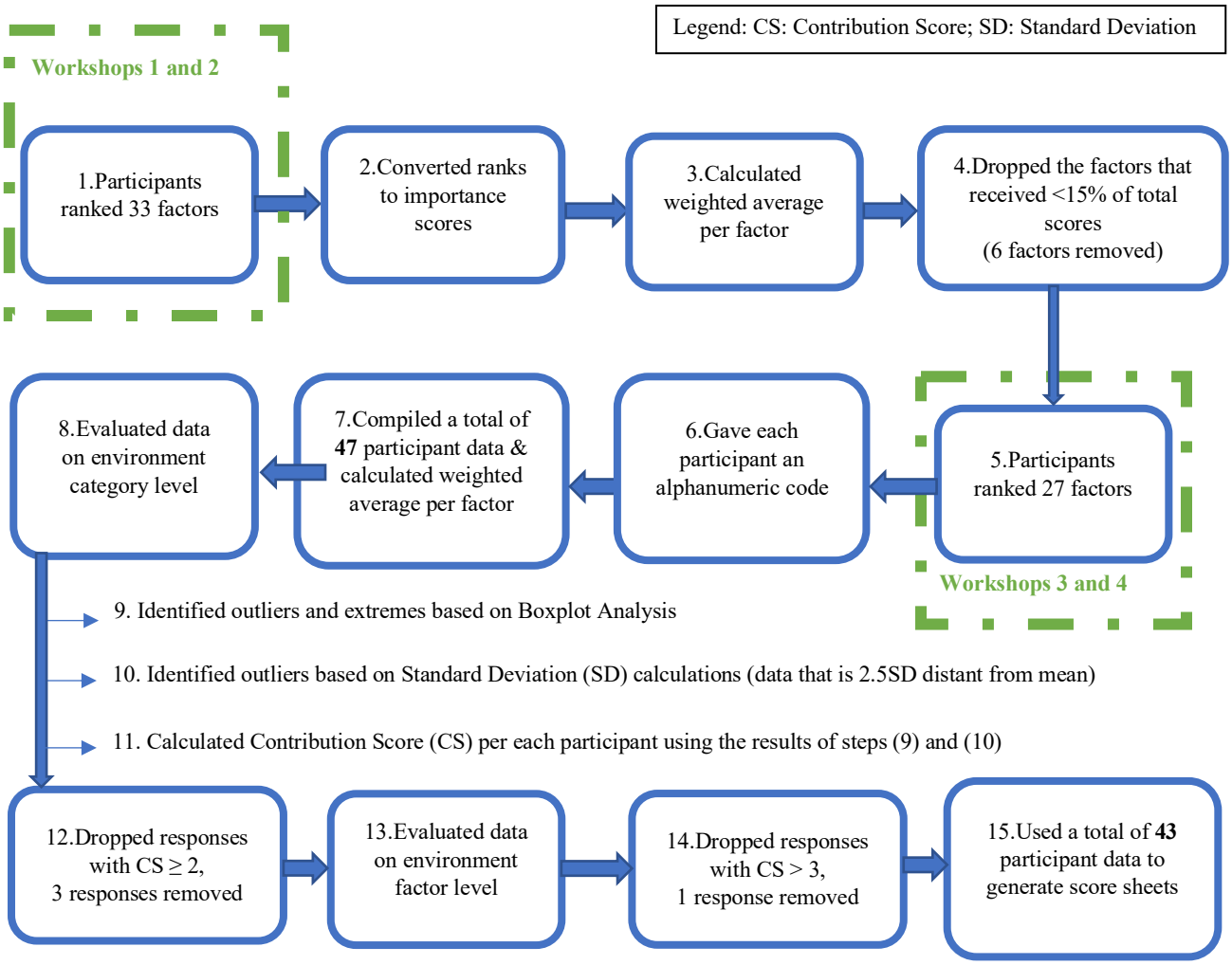

Figure 4 Data and Outlier Analysis Process

The ranks received from the workshops were placed into a Microsoft Excel spreadsheet, and each rank was translated to an importance score. If five factors were ranked, then the factor which ranked first received a score of 5, the factor ranked second received a score of 4, third received a score of 3, fourth received a score of 2 and fifth received a score of 1, and factors that were not ranked received a score of 0. The purpose for this was to convert the ranking data to the same unit of measurement used for the environment categories (importance points, also referred to as weights), and to have higher values denoting more importance, as a common basis for data analysis. Also, there was no missing data in the participant-given rankings. Figure 5 gives an example for converting ranking data to importance scores.

Factor 2a (The contractor leadership team and project/program team are experienced and qualified in implementing and executing EVMS) was ranked first by a given participant.

The same participant ranked factor 2e (Implementation and execution team members have a history of working together) as second, factor 2b (The customer leadership team and project/program team are experienced in understanding and using EVM results to inform decision-making) as third, factor 2h (Team members responsible for EVMS implementation and execution are co-located and/or accessible) as fourth, and factor 2i (Professional learning and education of key individuals responsible for EVMS implementation and execution, is appropriate to meet project/program requirements) as fifth.

Therefore, the converted scores for factors 2a, 2e, 2b, 2h and 2i were 5, 4, 3, 2, and 1 respectively.

Figure 5 Example Factor Importance Score

This process was repeated for all the received responses.

Scores were then aggregated across all respondents. The importance scores were summed per factor. For example, summing the importance scores received by all respondents for factor 1a (The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance) results in 77. Then a weighted average (percentile) was generated for all factors following equation (1):

Equation (1): Weighted Average per factor:

$$\overline{x_n} = \frac{\sum_{i=1}^{n} x_i}{\text{Total Score}} \qquad (1)$$

$\overline{x_n}$: Relative Weight of each factor (in %)
x_i: Sum of scores received of each factor
Total Score: Sum of scores for all factors

All the factors' relative percentage weights sum up to 100. Figure 6 gives an example of equation (1) application: calculating the relative weight of each factor.

Factor 1a received a total score of 77 by all participants, as mentioned above.

The total score received on all factors in Culture category was 295.

Applying Equation (1) results into the factor 1a's relative percentage weight, which is 26.1 (77/295).

Figure 6 Example Factor 1a Relative Weight

This was done for all 33 factors within the four categories. All the results of this step are shown in Appendix F.

After workshops 1 and 2 were completed and analyzed, six environment factors were dropped (i.e., they were no longer considered as independent environment factors) because these factors received less than 15% of the maximum possible factor score (some of the content of these factors were merged with the other 27 factors). This is a rubric that was adopted by the authors to remove factors which have low relative importance versus the rest. Eliminating some percentage of datapoints is a common approach in data analysis (Whelan 2008). Given that these factors were ranked by less than 5 out of 21 participants, the authors considered these factors to be of minor importance to the sample and their removal (as independent factors) is valid in the investigation (Osborne and Overbay 2004, Dixon 1953).

For example, factor 2e (team members have a history of working together) received a total score of 6, during workshops 1 and 2, which was less than 6% of the maximum possible score that could be received for factor 2e, 105 (21 responses × maximum score of 5). Therefore, factor 2e was no longer considered as an independent environment factor, and was merged with factor 1d (effective teamwork exists). Table 3 shows the specific factors which were dropped after workshops 1 and 2, with their corresponding percentages, which are lower than 15%.

Table 3 Dropped Factors

Environment Factor	%
2e: Implementation and execution **team members have a history of working together**.	5.7
2f: Key EVMS **stakeholder turnover is minimized**.	7.6
2g: Individuals responsible for the project/program and EVMS are **experienced with the local norms, conditions and regulations**.	5.7
3i: **Conflict resolution** practices and procedures are **in place and actively utilized**.	10.5
4g: **External resources are available and accessible** to support an efficient and effective EVMS.	5.3
4h: **Customer resources are available and accessible** for efficient and effective use of EVM results to support decision-making.	11.6

The total of 368 comments were received from participants in workshops 1 and 2. After addressing these comments and removing the six factors indicated above, the research team edited the environment assessment draft, which was used in the next two workshops. The revised factor list is shown in Appendix G. Workshops 3 and 4 received a total of 307 comments which were addressed by the researchers. Therefore, all the 675 comments received through the four workshops from 47 participants were resolved to produce the final version of environment assessment draft.

5.1. Developing EVMS Environment Weights

Compiling data

The ranking and weighting data from the 47 workshop participants was compiled into one Microsoft Excel spreadsheet. Each participant was given an alphanumeric code based on the workshop in which they participated in order to protect confidentiality and limit bias from the researchers. For example, WS2-4 stands for the environment Workshop 2, and last digit (4) denotes participant number 4.

Screening data

The authors performed a quality control on the dataset in order to include those data inputs that were reasonably representative of the overall sample and exclude the outliers or extremes lying far from the majority (Kwak and Kim 2017, DeSimone et al, 2015, Dixon 1953). In this way, the final weightings would be more representative of the collective whole. The screening was done first at the higher categorical level, and then on a lower factor level. The authors utilized SPSS and Microsoft Excel to perform the tasks for screening the data, and calculate the descriptive statistics (e.g., mean, median, standard deviation, variance, skewness) of the data. Analysis of descriptive statistics revealed that several of the categories and the factors were either moderately or highly skewed, indicating that responses from several of the participants were skewing the overall data set. The following process was used to assess the respondents.

Step 1 Evaluate the environment category weighting (higher-level)

As previously discussed, participants were asked to weight the four environment categories, based on the relative impact of each on the EVMS environment, allocating 100 points among the four categories based on their perception of relative importance in relation to overall environment impact.

In this step, the authors generated boxplots in SPSS to analyze the collected weights of each environment category. Boxplots are commonly used for graphically summarizing the distribution of a dataset (Morrison 2009). A typical boxplot is represented in Figure 7 (outliers are shown as circles and extreme values as *) and is used to detail the interquartile range, median, outliers and extreme values (Morrison 2009).

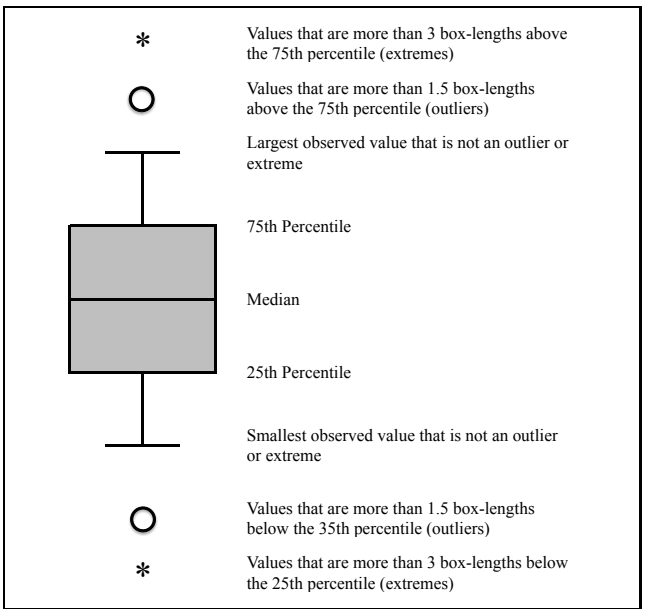

Figure 7 Sample Boxplot

As shown in Figure 7,

A data point is considered an outlier value (X) if:

$$X < (Q1 - 1.5\ IQR) \text{ or } X > (Q3 + 1.5\ IQR)$$

Where:
Q1 = 25th percentile value
Q3 = 75th percentile value
IQR = Interquartile range = Q1 – Q3

A data point is considered an extreme value (Y) if:

$$Y < (Q1 - 3\ IQR) \text{ or } Y > (Q3 + 3\ IQR)$$

Where:
Q1 = 25th percentile value
Q3 = 75th percentile value
IQR = Interquartile range = Q1 – Q3

The results of the boxplots for the four categories are shown in Figure 8, detailing the outliers, and the extreme values (if any) and allowing to visually identify participant weights that were skewing the mean category weights. A sample descriptive statistics of the workshop environment category weighting data is shown in Appendix H.

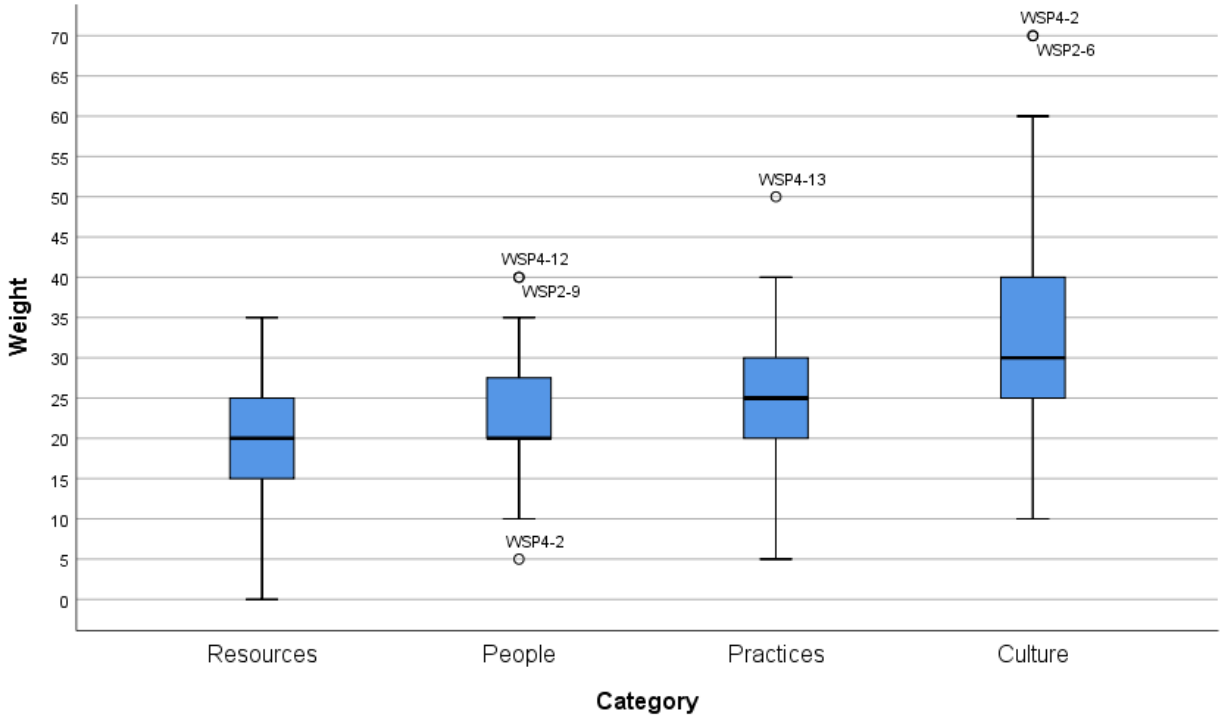

Figure 8 Category Weight Boxplot – Workshop Results – N =47

Based on the results in Figure 8, there has been no extremes in the weights provided by the participants, however in total, six outliers were identified and were provided by five participants. The list of the participants divided by category and their number of outliers are shown in Table 4.

Table 4 Category Outliers Based on Boxplots

Category	Participant	# of category outliers:
Culture	WSP2-6	2
	WSP4-2*	
People	WSP2-9	3
	WSP4-2*	
	WSP4-12	
Practices	WSP4-13	1
Resources	None	None
	Total	6
Note: * Same participant		

Next, in order to have a closer look at the data, the authors utilized Microsoft Excel to derive each category's mean and standard deviation (SD). Then each category weight given by a participant was expressed as a function of the calculated standard deviation. As such, the authors could highlight the participant-given category weights that are 2.5SD distant from the category mean. Figure 9 gives an example for calculating the category weights as a function of SD.

Culture's weight given by the workshop participant WSP2-6 was 70.00 (out of 100 points).

Whereas the category mean and standard deviation are 33.11 and 12.78 respectively.

The distance of the provided weight is 36.89 from the mean (70.00 - 33.11).

This distance is expressed as a function of the standard deviation as 2.88SD (36.89/12.78).

Figure 9 Example Category Weight as a function of SD

See the sample detailed results of this step applied for the Culture category in Appendix I. In total, five weights have been identified as 2.5SD distant from category weight mean. These results were needed to calculate the "contribution scores" elaborated as follows.

Then, following the same approach of ElZomor et al. (2016), the authors calculated category "contribution scores" (i.e., the amount a participant was skewing the data) for each workshop participant based on the number of outliers, extremes and whether their weight was 2.5SD distant from mean. The contribution scores (unitless) were calculated as follows:

Equation (2): Contribution Score:

$$\text{Contribution score per participant} =$$

$$1 \times (\text{Number of Extremes in all categories}) + 1 \times (\text{Number of Outliers in all categories}) + x$$

$$\text{Where, } x = \begin{cases} 1, \text{ if weight is 2.5SD distant from mean in 1 category} \\ 2, \text{ if weight is 2.5SD distant from mean in more than 1 category} \\ 0, \text{ otherwise} \end{cases}$$

Equation (2) contributes in viewing where each participant's response stands with respect to the combination of the following settings: (1) whether the response is an outlier based on boxplot analysis, (2) whether the response is distant from mean within only one category out of the four environment categories, and (3) whether the response is distant from mean within more than one environment category. Table 5 shows each workshop participant's contribution score by applying the equation (2) for each participant. The participants whose responses resulted into a contribution score of more than 0 are highlighted in red in Table 5. Viewing the weighting data in this fashion highlighted the contribution score ranges skewing the mean category weights the most, and ranges of scores that were relatively higher than the total workshop participant set.

Table 5 Workshop Participant Category Contribution Scores

Workshop Participant	# of Outliers in all categories	# of Extremes in all categories	x	Contribution Score	Workshop Participant	# of Outliers in all categories	# of Extremes in all categories	x	Contribution Score
WSP1-1	0	0	0	0	WSP3-5	0	0	0	0
WSP1-2	0	0	0	0	WSP3-6	0	0	0	0
WSP1-3	0	0	0	0	WSP3-7	0	0	0	0
WSP1-4	0	0	0	0	WSP3-8	0	0	0	0
WSP1-5	0	0	0	0	WSP3-9	0	0	0	0
WSP1-6	0	0	0	0	WSP3-10	0	0	0	0
WSP1-7	0	0	0	0	WSP3-11	0	0	0	0
WSP1-8	0	0	0	0	WSP3-12	0	0	0	0
WSP1-9	0	0	0	0	WSP3-13	0	0	0	0
WSP2-1	0	0	0	0	WSP4-1	0	0	0	0
WSP2-2	0	0	0	0	WSP4-2	2	0	2	4
WSP2-3	0	0	0	0	WSP4-3	0	0	0	0
WSP2-4	0	0	0	0	WSP4-4	0	0	0	0
WSP2-5	0	0	0	0	WSP4-5	0	0	0	0
WSP2-6	1	0	2	3	WSP4-6	0	0	0	0
WSP2-7	0	0	0	0	WSP4-7	0	0	0	0
WSP2-8	0	0	0	0	WSP4-8	0	0	0	0
WSP2-9	1	0	0	1	WSP4-9	0	0	0	0
WSP2-10	0	0	0	0	WSP4-10	0	0	0	0
WSP2-11	0	0	0	0	WSP4-11	0	0	0	0
WSP3-1	0	0	0	0	WSP4-12	1	0	0	1
WSP3-2	0	0	0	0	WSP4-13	1	0	1	2
WSP3-3	0	0	0	0	WSP4-14	0	0	0	0
WSP3-4	0	0	0	0					

Note: participants whose responses resulted into a contribution score of more than 0 are highlighted in red.

In total five participants showed responses that resulted into a contribution score of more than 0. The team determined that workshop participants with a contribution score greater than or equal to two should be removed from the data set. This was a logical conclusion based on looking closer to the combination of distance from mean and outliers on the boxplots. Responses of WSP2-9 and WSP4-12 were not removed because even though they showed to be outliers on the boxplots, their distance from the mean was only 2.37*SD in only one category. Therefore and subsequently, data sets from three workshop participants (WSP2-6, WSP4-2, WSP4-13) were removed from the total data set, leaving 44 data sets remaining.

Step 2 Evaluate the environment factor weighting (lower-level)

As previously discussed, participants were asked to rank order the environment factors that make up each category based on the relative impact of each to EVMS environment within a specific category. In this step, the authors performed a lower-level detailed evaluation, evaluating the ranking received on factors within categories.

After the removal of the three workshop participants from the total data set as elaborated above in Step 1, the authors proceeded to evaluate the environment factor weighting in Step 2. For that purpose, the authors first transformed the rank results of participants to importance scores as discussed earlier.

After that, for each participant, their given category weight was distributed among the category's factors as "shares", according to their importance score (ranged from 1 to 5). The reason behind this was to convert the data into a continuous data spreading across a wider range. Figure 10 gives an example of calculating the factor weights.

Participant WSP1-1 weighted the Practices category as 20 (out of 100). This participant had ranked factor 3a as "1", factor 3e as "2", factor 3c as "3", factor 3f as "4", and 3g as "5." The converted importance scores for these factors are: 5, 4, 3, 2 and 1 respectively. The maximum score that could be received on factor 1a is 15 (the sum of 5, 4, 3, 2, 1). The category weight 20 was distributed on these factors accordingly: The formula (5x20)/15 led to a share of 6.67 of factor 3a out of the participant's category weight 20. The shares of all Practices factors for this participant were summed to 20.

Figure 10 Example Factor Weight

This calculation was repeated for all factors across all categories for all participants, and the sample results of the factor weights are shown in Appendix J. These weights were used in the boxplot analysis described next.

Following the same approach of using boxplot analysis that was applied in Step 1, the authors generated boxplots in SPSS to analyze the weights of each environment factor within a given category. The results of the boxplots for all the factors are shown in Figures 11 to 14. The factors on the boxplots are rearranged based on lowest to highest medians (left to right). The sample descriptive statistics of the environment factor weighting data for each category under Culture are shown in Appendix K.

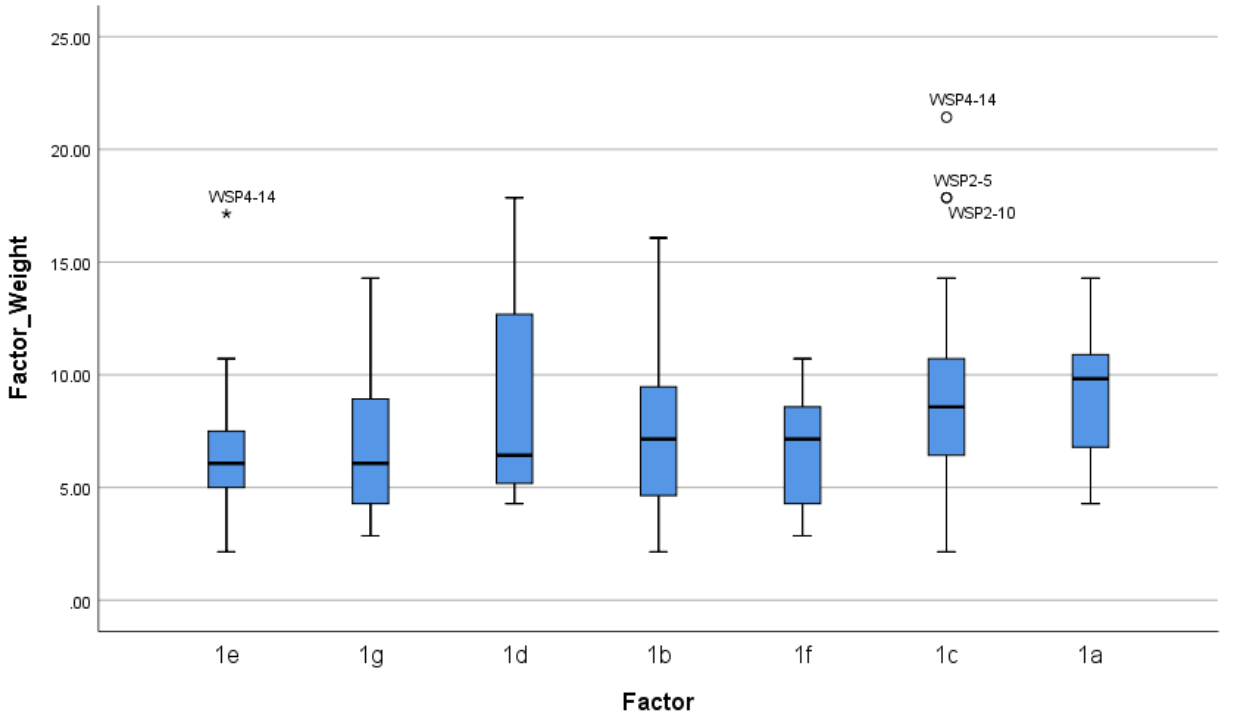

Figure 11 Factor Weight Boxplot – Culture Category – N=44

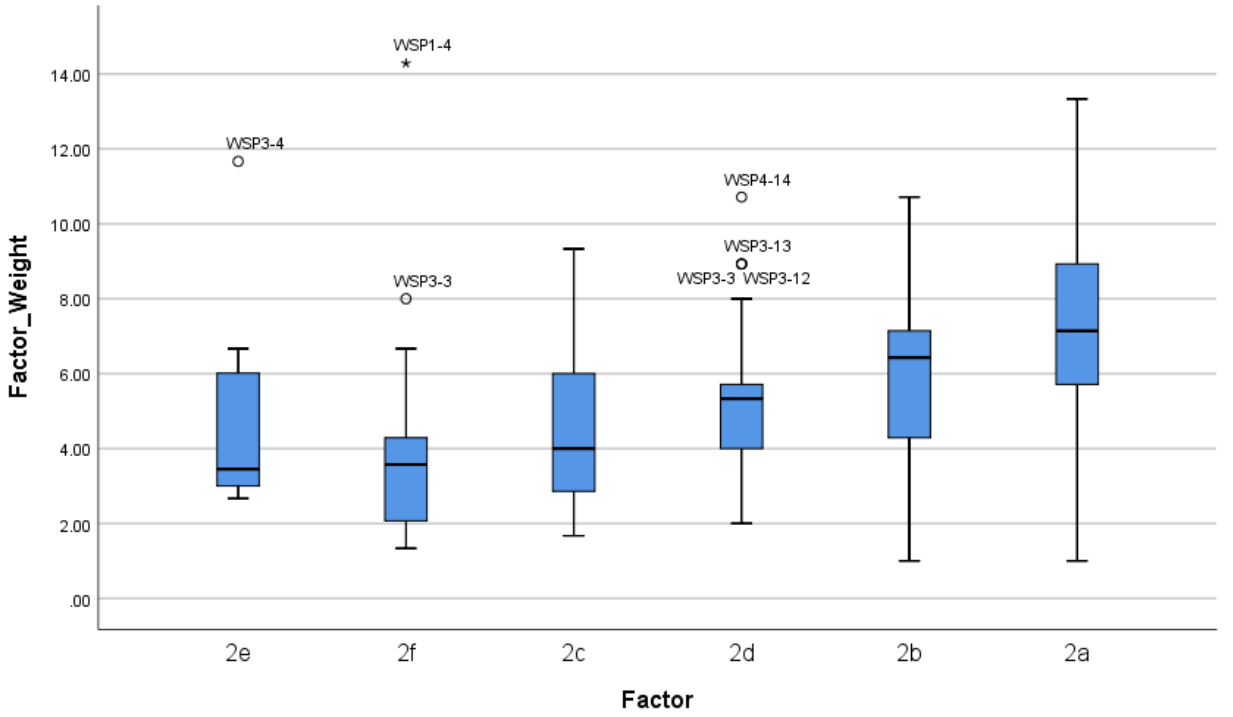

Figure 12 Factor Weight Boxplot – People Category – N=44

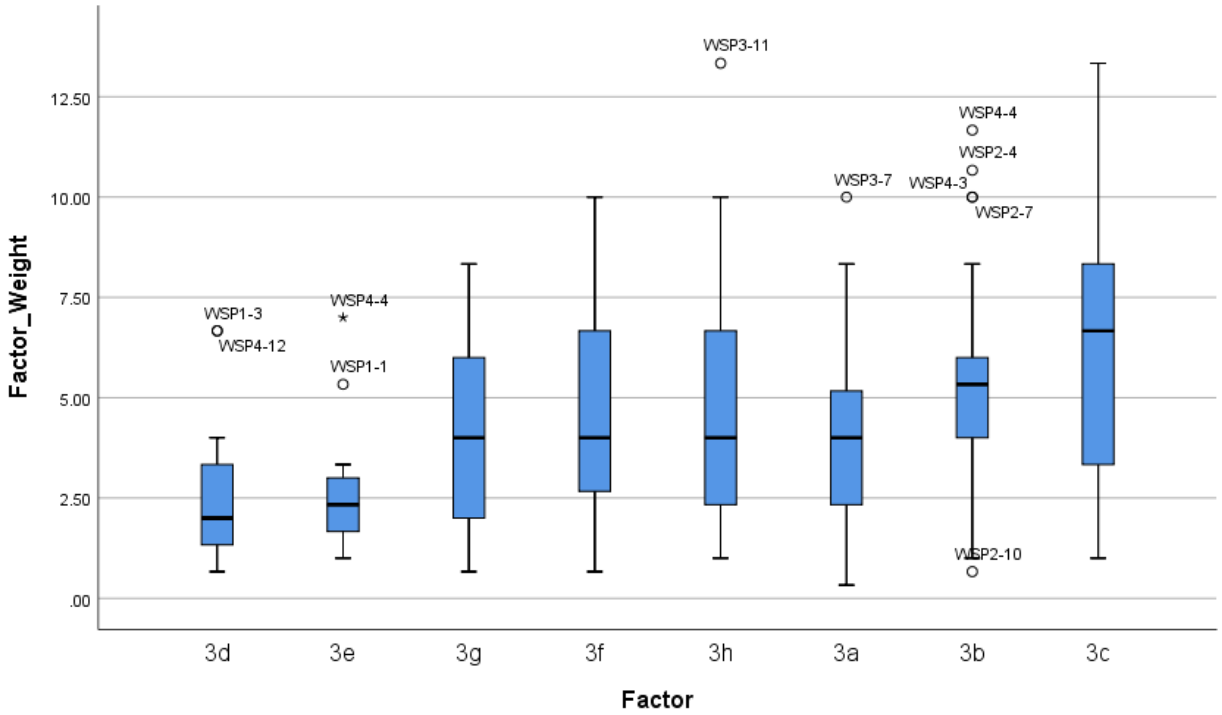

Figure 13 Factor Weight Boxplot – Practices Category – N=44

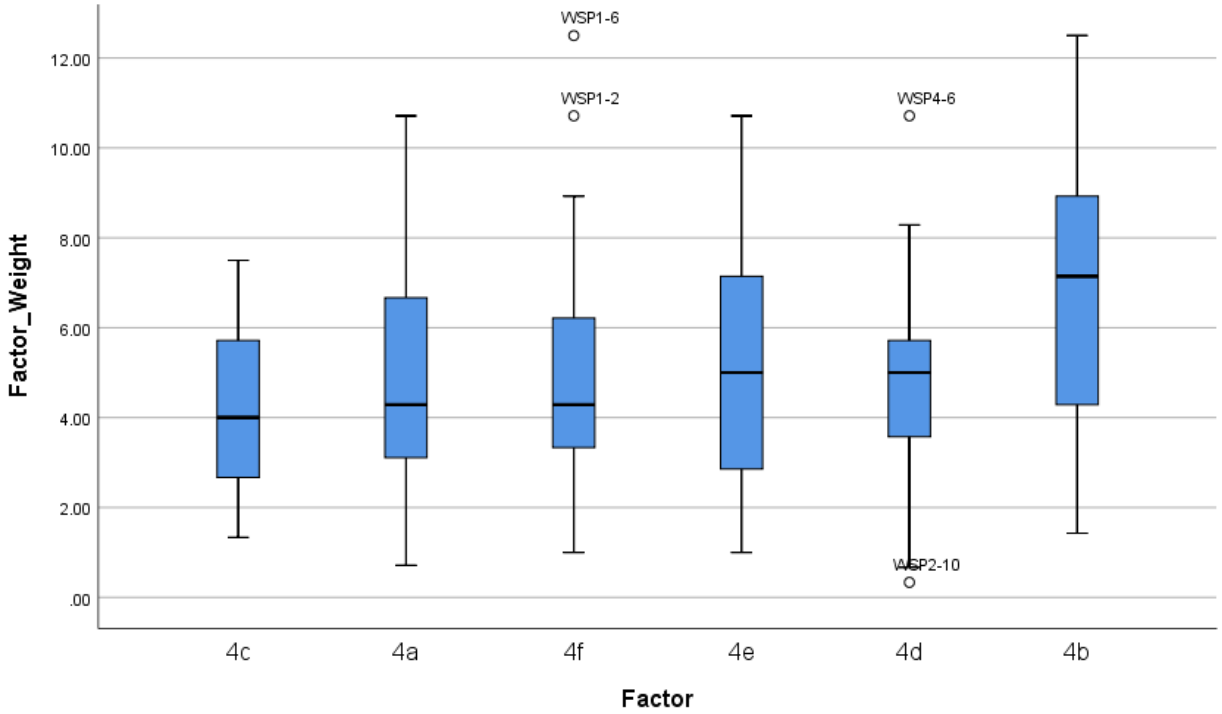

Figure 14 Factor Weight Boxplot – Resources Category – N=44

Based on the results shown in Figures 11 to 14, three extremes in the factor weights provided by the participants were identified in total by three participants, and twenty-three outliers were identified by twenty participants. As a result, the list of the participants and their number of outliers and extremes are shown in Table 6.

Table 6 Factor Outliers and Extremes Based on Boxplots

Category	Factor	Participant	# of factor outliers:	# of factor extremes:
Culture	1c	WSP2-5	1	0
	1c	WSP2-10*	1	0
	1c	WSP4-14**	1	0
	1e	WSP4-14**	0	1
People	2d	WSP3-3***	1	0
	2d	WSP3-12	1	0
	2d	WSP3-13	1	0
	2d	WSP4-14**	1	0
	2h	WSP3-4	1	0
	2i	WSP1-4	0	1
	2i	WSP3-3***	1	0
Practices	3a	WSP3-7	1	0
	3b	WSP2-4	1	0
	3b	WSP2-7	1	0
	3b	WSP2-10*	1	0
	3b	WSP4-3	1	0
	3b	WSP4-4****	1	0
	3d	WSP1-3	1	0
	3d	WSP4-12	1	0
	3e	WSP1-1	1	0
	3e	WSP4-4****	0	1
	3h	WSP3-11	1	0
Resources	4d	WSP2-10*	1	0
	4d	WSP4-6	1	0
	4f	WSP1-2	1	0
	4f	WSP1-6	1	0
		Total	23	3
Note: *, **, ***, **** Same participant				

In addition to identifying the outliers and extremes based on boxplots, and to have a closer look at the data, the authors utilized Microsoft Excel and SPSS to calculate the standard deviation of the weights in each factor. Then each participant weight was expressed as a function of the calculated standard deviation. As such, the authors could highlight the participant-given factor weights that are 2.5SD distant from the factor mean. Figure 15 gives an example for calculating the factor weights as a function of SD.

Factor 1c's weight given by the workshop participant WSP4-14 is 21.43.

Whereas the factor mean and standard deviation are 9.04 and 4.30 respectively.

The distance of the provided weight is 12.39 from the mean (21.43-9.04).

This distance is expressed as a function of the standard deviation as 2.88SD (12.39/4.30).

Figure 15 Example Factor Weight as a function of SD

See the sample detailed results of this step applied for all the factors under Culture in Appendix L. The red highlighted in the appendix indicates that the factor weight is 2.5SD distant from the factor mean, for those factors which were ranked by participants. In total, 6 weights have been identified as 2.5SD distant from factor weight mean, by five participants.

Next, the authors used equation (2) to calculate the "contribution scores" for all participants based on the number of outliers, extremes and whether their factor weight was 2.5SD distant from the mean for each factor.

Table 7 shows each workshop participant's factor contribution score. Viewing the weighting data in this fashion highlighted the contribution score ranges skewing the mean factor weights the most, and ranges of scores that were relatively higher than the total workshop participant set.

Table 7 Workshop Participant Factor Contribution Scores – N=44

Workshop Participant	# of Outliers	# of Extremes	x	Contribution Score	Workshop Participant	# of Outliers	# of Extremes	x	Contribution Score
WSP1-1	1	0	0	1	WSP3-4	1	0	0	1
WSP1-2	1	0	0	1	WSP3-5	0	0	0	0
WSP1-3	1	0	0	1	WSP3-6	0	0	0	0
WSP1-4	0	1	0	1	WSP3-7	1	0	0	1
WSP1-5	0	0	0	0	WSP3-8	0	0	0	0
WSP1-6	1	0	1	2	WSP3-9	0	0	0	0
WSP1-7	0	0	0	0	WSP3-10	0	0	0	0
WSP1-8	0	0	0	0	WSP3-11	1	0	1	2
WSP1-9	0	0	0	0	WSP3-12	1	0	0	1
WSP2-1	0	0	0	0	WSP3-13	1	0	0	1
WSP2-2	0	0	0	0	WSP4-1	0	0	0	0
WSP2-3	0	0	0	0	WSP4-3	1	0	0	1
WSP2-4	1	0	0	1	WSP4-4	1	1	0	2
WSP2-5	1	0	0	1	WSP4-5	0	0	0	0
WSP2-7	1	0	0	1	WSP4-6	1	0	1	2
WSP2-8	0	0	0	0	WSP4-7	0	0	0	0
WSP2-9	0	0	0	0	WSP4-8	0	0	0	0
WSP2-10	3	0	0	3	WSP4-9	0	0	0	0
WSP2-11	0	0	0	0	WSP4-10	0	0	0	0
WSP3-1	0	0	0	0	WSP4-11	0	0	0	0
WSP3-2	0	0	0	0	WSP4-12	1	0	1	2
WSP3-3	2	0	0	2	WSP4-14	2	1	2	5

Note: participants whose responses resulted into a contribution score of more than 3 are highlighted in red.

The team decided that workshop participants with a contribution score greater than three should be removed from the data set. This was a logical conclusion based on looking closer to the combination of distance from mean and having outliers and extremes on boxplot. WSP4-14, as highlighted in red, was found to be the only participant who has in total two outliers, one extreme, and two weights distant from factor weight mean in two different categories. Therefore, the data set from one workshop participants (WSP4-14) was removed from the total data set.

In summary, WSP4-14 was added to the list of the three participants WSP2-6, WSP4-2, WSP4-13 which were previously removed based on a higher-level category analysis. In total, the removal of four participant data leads to a total of 43 datasets that are useful to the derivation of factor and category weights in IP2M METRR.

The next section describes the procedures used for finalizing the IP2M METRR Environment score sheet.

5.2. Finalizing the EVMS Environment Score Sheets

Appendix M shows the participant demographics, and sample data results for the total of 43 datasets (excluding the four outlier participant data), by applying equation (1) on the 43 datasets to calculate the weighted average per factor, as well as calculating the average of the weights given by the participants for each environment category. The results were rounded to the nearest tenth; for this, numbers with decimals greater or equal to 0.05 were rounded up, and numbers with decimals less than 0.05 were rounded down. Figure 16 gives an example for calculating the factor relative weight, after outliers were removed.

Summing the importance scores received on factor 1a (The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance) resulted in 150.

Whereas the total score received on all factors under the Culture category was 602.

Dividing 150 by 602 resulted in the factor's relative weight of 24.9%.

Figure 16 Example Factor Relative Weight

See Appendix M for the sample data results of all the factors under Culture. This information will be used in the further steps described below.

First, in order to normalize the weighted averages of all the factors across all the environment categories, received by the respondents, the following equation was applied.

Equation (3): Normalized weighted average per factor across all environment categories:

$$Normalized\ Weighted\ Average\ = \overline{x_n} \times Category\ Average$$

Normalized Weighted Average: Factor weight relative to all other environment factors (in %)

$\overline{x_n}$: Relative Weight of each factor, result of equation (1) (in %)

Category Average = Average of the weights given by participants for each environment category

All the calculated normalized weighted averages sum up to 100. Figure 17 gives an example of equation (3) application: calculating the normalized weighted average for each factor.

Factor 1a says "The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance."

Applying the equation (1) resulted into the factor's relative percentage weight ($\overline{x_n}$), which is 24.9 within its culture category; whereas the culture category's average weight received by the participants is 31.3.

Applying the equation (3) results into the factor's normalized weighted average, which is 7.79 percent (24.9 × 31.3 / 100), rounded to 8.

Figure 17 Example Normalized Factor Weighted Average

All the results of this step are shown in Appendix N.

Second, in order to determine the scores for the different levels in each factor (Not Acceptable, Needs Improvement, Meets Some, Meets Most, High Performing), calculations of scores by linear interpolation between the levels "Needs Improvement" and "High Performance" was performed. Here, rounding of each number was necessary to complete the environment score sheet, as only integers are used as weights on the environment score sheets. A standard rounding procedure was used, where numbers with decimals greater than or equal to 0.50 were rounded up, and numbers with decimals less than 0.50 were rounded down.

The authors presented two options concerning the scoring of factors to the Research Team. Option A represented a 0-100 scoring range.

Step 1

All the "Not Acceptable" levels were given the score of '0'.

Step 2 – Option A (linear interpolation)

For each factor, the following was applied:

Level "Needs Improvement" = 0 + Normalized Weighted Average / 4
Level "Meets Some" = Level "Needs Improvement" + Normalized Weighted Average / 4
Level "Meets Most" = Level "Meets Some" + Normalized Weighted Average / 4
Level "High Performing" = Normalized Weighted Average

The authors' assumption is that factors have a linear progression in terms of importance. Figure 18 gives an example score calculation at the different factor rating levels (Not Acceptable, Needs Improvement, Meets Some, Meets Most, High Performing) in Option A.

In Option A, Factor 1a's ("*The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.*") normalized weighted average was 7.79.

- Not Acceptable = 0
- Needs Improvement = 0 + 7.79/4 = 1.94, rounded to 2
- Meets Some = 1.94 + 1.94 = 3.88, rounded to 4
- Meets Most = 3.88 + 1.94 = 5.82, rounded to 6
- High Performing = 7.79, rounded to 8

Figure 18 Example Factor Score Calculation for all Rating Levels – Option A

Option B represented a 0-1000 point scheme, with the normalized weighted average of each factor was multiplied by 10. Figure 19 gives an example score calculation at the different factor rating levels in Option B.

In Option B, Factor 1a's 7.79 × 10 = 77.9

- Not Acceptable = 0
- Needs Improvement = 0 + 77.9/4 = 19.47, rounded to 19
- Meets Some = 19.47 + 19.47 = 38.94, rounded to 39
- Meets Most = 38.94 + 19. 47 = 58.41, rounded to 58
- High Performing = 77.9, rounded to 80

Figure 19 Example Factor Score Calculation for all Rating Levels – Option B

In some exceptional cases for Option A, applying step 2 of Option A (linear interpolation), resulted in duplicate factor rating scores, therefore the highest integer on the highest level was kept, whereas lower levels were decreased by one to reach zero. For further clarification, the below example is given.

Table 8 Example of score sheet result for 1d – Option A

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
1d. **Effective teamwork exists,** and team members are working synergistically toward common project/program goals.	0	1	1	2	2

For example, factor 1d in Table 8 is an example of an exceptional case, where the same weight shows across different levels. Therefore, the authors changed the results to keep the highest integer on the highest level, and lower levels were decreased by one to reach zero. This change's result is shown in Table 9 below.

Table 9 Example of score sheet result for 1d – adjusted

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
1d. **Effective teamwork exists,** and team members are working synergistically toward common project/program goals.	0	0	0	1	2

The Option A results for all Factors are shown in Tables 10-14.

Table 10 Culture Category Score Sheet – Option A (100 range)

1. **Culture** *Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	0	2	4	6	8
1b. The **customer organization is supportive and committed** to the implementation and use of EVMS.	0	1	3	4	5
1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.	0	1	3	4	6
1d. **Effective teamwork exists** and team members are working synergistically toward common project/program goals.	0	0	0	1	2
1e. The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.	0	0	1	2	3
1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	0	0	0	1	2
1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.	0	1	2	4	5
Column Totals (For Culture)	**0**	**5**	**13**	**22**	**31**

Table 11 People Category Score Sheet – Option A (100 range)

2. **People** *People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
2a. The **contractor team is experienced and qualified** in implementing and executing the EVMS.	0	2	3	5	7
2b. The **customer team is experienced** in understanding and using EVM results to inform decision-making.	0	1	3	4	5
2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	0	0	1	2	3
2d. Project/program **leadership is defined, effective, and accountable**.	0	1	2	4	5
2e. **Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.	0	0	0	0	1
2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.	0	0	1	2	3
Column Totals (For People)	**0**	**4**	**10**	**17**	**24**

Table 12 Practices Category Score Sheet – Option A (100 range)

3. **Practices**

Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
3a. **Communication is open and effective**, including consistent terminology, metrics, and reports.	0	0	1	2	3
3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.	0	1	2	3	4
3c. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	0	1	2	3	4
3d. Domain application **Subject Matter Expert (SME) input is adequate** and timely.	0	0	0	0	1
3e. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.	0	0	0	0	1
3f. **Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.	0	1	2	3	4
3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	0	0	1	2	3
3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	0	0	1	2	3
Column Totals (For Practices)	**0**	**3**	**9**	**15**	**23**

Table 13 Resources Category Score Sheet – Option A (100 range)

4. **Resources** *Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
4a. **Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.	0	0	1	2	3
4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS**.	0	1	2	3	4
4c. The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.	0	0	1	2	3
4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.	0	1	2	3	4
4e. **Adequate technology/software and tools are integrated and used** for the EVMS.	0	1	2	4	5
4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.	0	0	1	2	3
Column Totals (For Resources)	**0**	**3**	**9**	**16**	**22**

As an alternative, the authors followed the following scheme to generate the scores of the environment score sheets for Option B. Option B represents a 0-1000 scoring range.

Step 1

All the “Not Acceptable” levels were given the score of ‘0’.

Step 2 – Option B

For each factor, the following was applied:

Level “Needs Improvement”=0+Normalized Weighted Average×10 / 4
Level “Meets Some” = Level “Needs Improvement” + Normalized Weighted Average×10 / 4
Level “Meets Most” = Level “Meets Some” + Normalized Weighted Average×10 / 4
Level “High Performing” = Normalized Weighted Average×10

Tables 14-17 represent the results of all the level scores for all the environment factors by following the above steps, for Option B.

Table 14 Culture Category Score Sheet – Option B (1000 range)

1. **Culture**

Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	0	19	39	58	78
1b. The **customer organization is supportive and committed** to the implementation and use of EVMS.	0	14	27	41	54
1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.	0	15	30	45	60
1d. **Effective teamwork exists** and team members are working synergistically toward common project/program goals.	0	5	11	16	22
1e. The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.	0	8	16	24	32
1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	0	5	9	14	19
1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.	0	12	24	36	48
Column Totals (For Culture)	**0**	**78**	**156**	**234**	**313**

Table 15 People Category Score Sheet – Option B (1000 range)

2. **People**

People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
2a. The **contractor team is experienced and qualified** in implementing and executing the EVMS.	0	17	34	50	67
2b. The **customer team is experienced** in understanding and using EVM results to inform decision-making.	0	13	27	40	54
2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	0	8	17	25	34
2d. Project/program **leadership is defined, effective, and accountable**.	0	12	25	37	49
2e. **Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.	0	2	5	7	9
2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.	0	6	13	19	25
Column Totals (For People)	**0**	**58**	**121**	**178**	**238**

Table 16 Practices Category Score Sheet – Option B (1000 range)

3. **Practices**

Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
3a. **Communication is open and effective**, including consistent terminology, metrics, and reports.	0	8	16	24	31
3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.	0	11	22	33	44
3c. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	0	11	22	33	44
3d. Domain application **Subject Matter Expert (SME) input is adequate** and timely.	0	3	6	9	12
3e. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.	0	2	4	7	9
3f. **Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.	0	9	18	27	35
3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	0	7	15	22	30
3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	0	7	15	22	30
Column Totals (For Practices)	**0**	**58**	**118**	**177**	**235**

Table 17 Resources Category Score Sheet – Option B (1000 range)

4. **Resources** *Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
4a. **Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.	0	8	17	25	34
4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS**.	0	9	18	28	37
4c. The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.	0	7	14	20	27
4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.	0	9	18	26	35
4e. **Adequate technology/software and tools are integrated and used** for the EVMS.	0	12	23	35	47
4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.	0	8	17	25	34
Column Totals (For Resources)	**0**	**53**	**107**	**159**	**214**

In order to select the final score sheet option, between Options A and B, for the EVMS environment assessment tool, the authors and the research team held a meeting on December 8, 2020. After going through a thorough discussion of these two options, the research team decided to select Option B with the following justification and caveats.

(1) To use Option B score sheets (score range 0-1000), as this method contains more precision/differentiation in scores when assessing the EVMS environment.
(2) To rearrange the factors by importance/score, from high importance to low (based on each factor's score), as well as renumber/rename them accordingly.

The final score sheets with the score range of 0-1000 and new numbering of factors are shown in Tables 18-21. The final list of factors and factor descriptions are given in Appendix O.

Table 18 Culture Category Final Score Sheet

1. **Culture**
Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.

Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	0	19	39	58	78
1b. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.	0	15	30	45	60
1c. The **customer organization is supportive and committed** to the implementation and use of EVMS.	0	14	27	41	54
1d. Project/program leaders make **timely and transparent decisions** informed by the EVMS.	0	12	24	36	48
1e. The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.	0	8	16	24	32
1f. **Effective teamwork exists** and team members are working synergistically toward common project/program goals.	0	5	11	16	22
1g. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	0	5	9	14	19
Column Totals (For Culture)	**0**	**78**	**156**	**234**	**313**

Table 19 People Category Final Score Sheet

2. **People** *People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
2a. The **contractor team is experienced and qualified** in implementing and executing the EVMS.	0	17	34	50	67
2b. The **customer team is experienced** in understanding and using EVM results to inform decision-making.	0	13	27	40	54
2c. Project/program **leadership is defined, effective, and accountable**.	0	12	25	37	49
2d. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	0	8	17	25	34
2e. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.	0	6	13	19	25
2f. **Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.	0	2	5	7	9
Column Totals (For People)	**0**	**58**	**121**	**178**	**238**

Table 20 Practices Category Final Score Sheet

3. **Practices** *Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
3a. The project/program **promotes and follows standard practices** to implement and execute an EVMS.	0	11	22	33	44
3b. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	0	11	22	33	44
3c. **Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.	0	9	18	27	35
3d. **Communication is open and effective**, including consistent terminology, metrics, and reports.	0	8	16	24	31
3e. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	0	7	15	22	30
3f. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	0	7	15	22	30
3g. Appropriate **Subject Matter Expert (SME)** input is adequate and timely.	0	3	6	9	12
3h. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.	0	2	4	7	9
Column Totals (For Practices)	**0**	**58**	**118**	**177**	**235**

Table 21 Resources Category Final Score Sheet

4. **Resources** *Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.*					
Factors for Review	*Not Acceptable*	*Needs Improvement*	*Meets Some*	*Meets Most*	*High Performing*
4a. **Adequate technology/software and tools are integrated and used** for the EVMS.	0	12	23	35	47
4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS**.	0	9	18	28	37
4c. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.	0	9	18	26	35
4d. **Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.	0	8	17	25	34
4e. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.	0	8	17	25	34
4f. The **project/program utilizes an appropriate periodic cycle** for executing the EVMS effectively and efficiently.	0	7	14	20	27
Column Totals (For Resources)	**0**	**53**	**107**	**159**	**214**

6. Conclusions

The research results presented in this report fulfilled the objective of developing a novel assessment tool that allows evaluation of the environment surrounding integrated project/program management systems using EVMS. This novel assessment tool took as its basis an extensive literature review and industry survey described in other reports.

The authors, working closely with the research team, created a set of 33 EVMS environment factors grouped in four environment categories (Culture, People, Practices, Resources). The tool was then improved and refined to a final list of 27 most important factors. The final configuration of the tool was based on the data collected from 47 industry professionals representing 24 unique organizations and collected through four industry workshops. The authors with the support of the research team addressed a total of 675 comments received from the industry workshops regarding the factor names and their descriptions during the workshops. The data collected from the workshops helped finalize the relative weights associated with each environment factor in terms of importance. The results showed that certain EVMS environment factors are more important than others for an effective EVMS. The resulting novel tool provides a mechanism for understanding important factors impacting the environment around an integrated project/program management system, including the ability to measure this environment.

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APPENDICES

Appendix A. Workshop Participants' Organizations

AzTech International
BAE Systems
Bechtel
Booz Allen Hamilton
Central Plateau Cleanup Company
ClearPlan Consulting
Comcast
Fermi National Accelerator Laboratory (FNAL)
Fluor
Forces GC
Hitachi
Humphreys & Associates
Idaho National Laboratory (INL)
Jacobs
Johns Hopkins University Applied Physics Laboratory
Lockheed Martin
Los Alamos National Lab (LANL)
National Scientific Foundation (NSF)
Olde Stone Consulting, LLC
Savannah River Nuclear Solutions (SRNS)
Washington River Protection Solutions (WRPS)
US Department of Defense
US Department of Energy
US Navy

Note: The organization names are in alphabetical order.

Appendix B. List of Environment Factors and References

Culture Category		
Factor and Description		**References**
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	Research team; Aramali et al. (2021); PDRI adapted (item 4a); Laqua (2018); King (2018); Griffith and Gibson (2001); Stamps and Nasar (1997); Saudargas and Zanolli (1990)
1b.	The **customer organization is supportive and committed** to the implementation of EVMS.	Research team; Aramali et al. (2021); PDRI adapted (item 4a); Laqua (2018); King (2018); Griffith and Gibson (2001); Stamps and Nasar (1997); Saudargas and Zanolli (1990)
1c.	The project/program **team culture fosters trust, honesty, transparency, communication, and shared values** across functions.	Research team; PDRI adapted (item 1d); 113_3_v2-Alignment during FEP; McLaughlin (2017); Burke (2014); Griffith and Gibson (2001)
1d.	**Effective teamwork exists** and synergistic team members are working toward a common goal.	Research team; Alleman (2014); Griffith and Gibson (2001)
1e.	The project/program **leadership effectively manages change** using EVMS, including corrective actions and continuous improvement.	Research team; Aramali et al. (2021); PDRI adapted (item 1e); Piderit (2000); Gibson and Hamilton (1994)
1f.	**Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	Research team; Aramali et al. (2021); 113_3_v2-Alignment during FEP; Griffith and Gibson (2001)
1g.	Project/program leaders make **timely and transparent decisions** informed by the EVMS.	Research team; 113_3_v2-Alignment during FEP

People Category		
Factor and Description		**References**
2a.	The **contractor leadership team and project/program team are experienced and qualified** in implementing and executing EVMS.	Research team; Aramali et al. (2021); PDRI adapted (item 1a, 2b); Lim et al. (2016); Kim et al. (2003); Nelson and Winter (1982)
2b.	The **customer leadership team and project/program team are experienced** in understanding and using EVM results to inform decision-making.	Research team; Aramali et al. (2021); PDRI adapted (item 1a, 2b); Lim et al. (2016); Kim et al. (2003); Nelson and Winter (1982)
2c.	**Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	Research team; Aramali et al. (2021); PDRI adapted (item 1b, 1d, 2c); Oberlender and Trost (2001); Griffith and Gibson (2001); CII (1999)
2d.	Project/program **leadership is defined, effective, and accountable**.	Research team; PDRI adapted (item 1c); Kim et al. (2003); Griffith and Gibson (2001); Oberlender and Trost (2001); CII (1999)
2e.	Implementation and execution **team members have a history of working together**.	PDRI adapted (item 2g); Oberlender and Trost (2001); Moreland et al. (1998)
2f.	Key EVMS **stakeholder turnover is minimized**.	Research team; PDRI adapted (item 1f, 2e, 4a); Woods (2017); Griffith and Gibson (2001); Gibson and Hamilton (1994); Saudargas and Zanolli (1990)
2g.	Individuals responsible for the project/program and EVMS are **experienced with the local norms, conditions and regulations**.	Aramali et al. (2021); PDRI adapted (item 4c); Nelson and Winter (1982); Skitmore et al. (1990)
2h.	**Team members** responsible for EVMS implementation and execution **are co-located and/or accessible**.	PDRI adapted (item 2f); Heinemann and Zeiss (2002)

Practices Category		
Factor and Description		**References**
3a.	**Communication is open and effective**, including consistent terminology, metrics, and reports.	Research team; Aramali et al. (2021); PDRI adapted (item 3a); Griffith and Gibson (2001); Pinto (1990)
3b.	The project/program **promotes and follows standard practices** to implement and execute an EVMS.	Research team; Aramali et al. (2021); PDRI adapted (item 3b, 4f), Heinemann and Zeiss (2002); Griffith and Gibson (2001)
3c.	**Sufficient EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	Research team; Aramali et al. (2021); PDRI adapted (item 3c), 113_3_v2-Alignment during FEP; Griffith and Gibson (2001)
3d.	**Input of project/program execution Subject Matter Expert (SME) knowledge** into the EVMS process **is adequate** and timely.	Research team; PDRI adapted (item 3d); Dave and Koskela (2009)
3e.	**Adequate coordination exists** between the key disciplines involved in implementing and executing the EVMS.	Research team; PDRI adapted (item 3e); Winograd (1993)
3f.	**Roles and responsibilities are defined**, **documented and well-understood** for team members responsible for implementing and executing EVMS.	Research team; Griffith and Gibson (2001)
3g.	**Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	Research team; Aramali et al. (2021)
3h.	**Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	Research team; Aramali et al. (2021)
3i.	**Conflict resolution** practices and procedures are **in place and actively utilized**.	Bryde et al. (2018); Crossno and Weeks (2016)

Resources Category		
Factor and Description		**References**
4a.	**Sufficient calendar time and workhours are committed and available** for implementing and executing the EVMS.	Research team; PDRI adapted (item 4b); Rigby and Bilodeau (2015); Ostrowski (2006); Oberlender and Trost (2001); Lan and DeMets (1989)
4b.	**Sufficient funding is committed and available** for implementing and executing the EVMS.	Research team; PDRI adapted (item 4e); Griffith and Gibson (2001); Oberlender and Trost (2001)
4c.	The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.	Research team
4d.	The **EVMS core team's size and composition are adequate** for the project/program.	Research team; Aramali et al. (2021)
4e.	**Adequate technology/software and tools are integrated and used** for the EVMS.	Research team; Aramali et al. (2021); Alleman (2014)
4f.	**Data are readily available** to populate EVMS tools supporting analyses for decision-making.	Research team
4g.	**External resources are available and accessible** to support an efficient and effective EVMS.	Research team
4h.	**Customer resources are available and accessible** for efficient and effective use of EVM results to support decision-making.	Research team

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Appendix C. Sample Qualtrics Questionnaire - Environment Workshop

Overview The Earned Value Management System (EVMS) Maturity and Environment Total Rating (METR) is an assessment mechanism being developed as part of a DOE-sponsored Joint Research Study led by Arizona State University (ASU) and representing 15+ government and industry organizations. The envisioned tool will assess a spectrum of EVMS maturity and environment issues centered around the 32 EIA-748 EVMS Guidelines.

The purpose of this workshop is to review and provide feedback on the environment assessment section of the draft EVMS METR tool.

Confidentiality Statement:
All data provided to ASU in support of this research activity will be considered confidential information. Individual organization data will not be communicated in any form to any party other than the ASU authorized academic researchers. Any data or analyses that are shared with others or published will represent summaries of data from multiple participating organizations that have been aggregated in a way that will preclude identification of proprietary data. If you have any questions, please contact Dr. G. Edward Gibson, Jr. (egibson4@asu.edu) or Dr. Mounir El Asmar (asmar@asu.edu).

Please note that when you answer questions, you must also click on the **NEXT button (Right Arrow)** to move to the following screen.

- ○ Name: _____

Q1 Please indicate your employer type.

- ○ Government contractor
- ○ Government
- ○ Consultant
- ○ Manufacturer/Constructor
- ○ Other (Software Developer, World Bank, Non-Profit, etc). Please specify.

_____

Q2 Please provide your typical employment role.

- ○ Project controls management
- ○ Project/Program management
- ○ Compliance management
- ○ Executive or senior management
- ○ Consulting
- ○ Finance
- ○ Engineering & systems engineering
- ○ Other (Contracting, Control accounts management or other)

_____

Q3 How many years of Earned Value Management (EVM) experience do you have in total?

- ○ < 5 years
- ○ 5 to 10 years
- ○ 11 to 15 years
- ○ 16 to 20 years
- ○ 21 to 25 years
- ○ > 25 years

Think of a current or past EVMS application on a project/program that you are or were involved with. You will use this application as your anchor.

- ○ Please provide the name of the project/program (e.g., USS Enterprise):

_____

- ○ What is the approximate project/program total cost? ($ value; e.g., $60M)

_____

- ○ What is the approximate date for the start of planning? (Month and Year)

_____

- ○ What is the approximate date for the end of execution? (Month and Year)

_____

Q5 Was the information provided in Q4 a Project or a Program?

- ○ Project
- ○ Program

Q6 **Category 1. Culture.**

Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "1a has a typo in line 1"; or "1d: I do not think teamwork is important")

_____

_____

Q7 This question is focused on the factors that make up the **Culture Category** (Category 1). Based on your experience, please rank the **top 4** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly (#1 is the most impactful).

_____ 1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.

_____ 1b. The **customer organization is supportive and committed** to the implementation of EVMS.

_____ 1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.

_____ 1d. **Effective teamwork exists** and synergistic team members are working toward a common goal.

_____ 1e. The project/program **leadership effectively manages change** using EVMS, including corrective actions and continuous improvement.

_____ 1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.

_____ 1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.

Q8 **Category 2. People.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "2b has a typo in line 1"; or "2e: I do not think co-location is important").

_____

_____

Q9 This question is focused on the factors that make up the **People Category** (Category 2). Based on your experience, please rank the **top 4** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly (#1 is the most impactful).

_____ 2a. The **contractor team is experienced and qualified** in implementing and executing EVMS.

_____ 2b. The **customer team and project/program team are experienced** in understanding and using EVM results to inform decision-making.

_____ 2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS.

_____ 2d. Project/program **leadership is defined, effective, and accountable**.

_____ 2e. **Team members** responsible for EVMS implementation and execution **are co-located and/or accessible**.

_____ 2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

Q10 **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

_____

_____

Q11 This question is focused on the factors that make up the **Practices Category** (Category 3). Based on your experience, please rank the **top 5** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly (#1 is the most impactful).

_____ 3a. **Communication is open and effective**, including consistent terminology, metrics, and reports.

_____ 3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.

_____ 3c. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.

_____ 3d. Domain application **Subject Matter Expert (SME) input is adequate** and timely.

_____ 3e. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.

_____ 3f. **Roles and responsibilities are defined, documented and well-understood** for implementing and executing EVMS.

_____ 3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.

_____ 3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.

Q12 **Category 4. Resources.**

Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "4a: What does sufficient mean?"; or "4e: What does adequate mean?").

_____

_____

Q13 This question is focused on the factors that make up the **Resources Category** (Category 4). Based on your experience, please rank the **top 4** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly (#1 is the most impactful).

_____ 4a. **Sufficient calendar time and workhours are committed and available** for implementing and executing the EVMS.

_____ 4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS.**

_____ 4c. The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.

_____ 4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.

_____ 4e. **Adequate technology/software and tools are integrated and used** for the EVMS.

_____ 4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.

Q14 The following four categories typically make up an EVMS environment. This question is about the relative impact of these four EVMS environment categories. Please allocate 100 points divided among these categories based on the relative impact on the EVMS environment. Allocating more points to a category reflects a higher relative impact on the EVMS environment. The total number of points should sum up to 100.

Culture: Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS. : _____

People: People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analysist, project schedule analysist, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes. : _____

Practices: Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational

boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth). : _____

Resources: Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process. : _____

Total : _____

Q15 **Proposed Environment Factor Rating Scheme.**
The following rating levels are used to assess how well each factor is being performed on the project/program. Please provide your actionable comments or suggested edits. Do you feel this rating scheme will work for evaluating your project/program EVMS environment? (e.g., "Yes, I think this rating scheme will work effectively"; or "I do not agree with the "Meet Some" description")

High Performing: Rating a factor High Performing indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).
Meets Most: Rating a factor Meets Most indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.
Meets Some: Rating a factor Meets Some indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.
Needs Improvement: Rating a factor Needs Improvement indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.
Not Acceptable: Rating a factor Not Acceptable indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.

_____

_____

Q16 Would you like to receive **Continuing Education Unit (CEU)** credit for this workshop?

- ○ Yes
- ○ No

Q17 **General Comments.**
Please feel free to share any other thoughts about the EVMS environment assessment, as well as feedback on the workshop itself in the space below.

If you would like to modify any previous answers, you can click the left arrow to go back to the previous pages.

_____

Q18 **Are you ready to exit?** If yes, please click the yes button and the NEXT button (Right Arrow) to complete this workshop and record all your responses. Once you click next, you cannot go back to modify any previous answers. Thank you.

- ○ Yes

End of Block: Environment

Appendix D. Sample Environment Workshop Presentation

Earned Value Management Systems (EVMS) *Environment Workshop #4*

09/15/2020

EVMS Maturity and Environment Total Rating (EVMS METR)

Arizona State University

1

Environment Workshop Agenda

10:00 – 10:30 am	Introductions and Workshop Objectives
10:30 – 11:30 am	EVMS Environment Factors Review and Ranking
11:30 – 11:45 am	15-Minute Break
11:45 – 1:00 pm	EVMS Environment Factors Review and Ranking (cont'd)
1:00 – 1:15 pm	EVMS Environment Categories Review and Weighting
1:15 – 1:30 pm	Conclusions & Wrap-Up

Note: All times are in Pacific Daylight Time (PDT)

2

Welcome

Melvin Frank, Project Controls Division (PM-30), Office of Project Management (PM), U.S. Department of Energy

- Effective and Efficient EVMS: factors, enablers, barriers
- Office of Management and Budget: Reciprocity
- EIA-748 Update
- Better Governance: Plan → Do → Check → Act → (Rinse and Repeat)

3

Introductions *(30 seconds/person)*

- **Name**
- **Organization**
- **Job function**
- **Experience with EVM**

4

Workshop Objectives

- Provide background of Research Team efforts
- Introduce participants to *EVMS METR*
- Critique the EVMS environment tool structure & factors
- Rank the EVMS environment factors and weight (prioritize) categories
- Provide a copy of the draft EVMS *environment assessment tool* for participants' reference/use

5

Overview of EVMS Research Objectives

- Elevate the worth and utility of the EVMS through **unbiased scientific research**
- Develop a **scalable EVMS Maturity and Environment Model** inclusive of EIA-748 requirements that can accommodate the unique missions, program and project types of the DOE, DoD, NRO, NASA, and other agencies, as well as commercial ventures requiring disciplined scope, schedule, and cost management
- Develop a **weighted EVMS Maturity and Environment Scoring Method** that provides insights into implementation risks and opportunities
- The **target audience** includes individuals with the **necessary EVM experience, technical background**, and training in the relevant subject matter to provide an informed opinion and contribute to the decision-making process based on acceptable best practices, recognizable standards, and methods

6

Research Team Members

Team Member	Organization
Vartenie Aramali	Arizona State University
Elizabeth Betsy Ballard	Tecolote Research
Amy Basche	Mission Support Alliance
Ivan Bembers	National Reconnaissance Office
Danielle A. Bemis	U.S. Department of Defense - DCMA
O'Grady, Caitlin	U.S. Department of Defense
Thomas P. Carney	Lockheed Martin
Namho Cho	Arizona State University
Mounir El Asmar, PI	Arizona State University
Jon Fleming	National Aeronautics and Space Administration
Mark Frampton	National Reconnaissance Office
Melvin Frank	U.S. Department of Energy
G. Edward Gibson, PI	Arizona State University
Jon de Guzman	Booz Allen Hamilton
Wayne A. Harris	TechSource
Craig T. Hewitt	Washington River Protection Solutions
David Kestar	U.S. Department of Energy

Team Member	Organization
Kristen Kehrer	National Aeronautics and Space Administration
Jeffrey King	BAE Systems
Derek D. Lehman	Washington River Protection Solutions
Barry Levy	Sandia National Laboratory
Doug Marbourg	Los Alamos National Laboratory
Ben Pina	U.S. Department of Energy - NNSA
John C. Post	Critical Mission Support
Garrett Richardson	U.S. Department of Energy
Russel W. Rodewald	Raytheon Corp
Paul J. Sample	CACI International Inc.
Vaughn M. Schlegel	Lockheed Martin
Anthony W. Spillman	Washington River Protection Solutions
Robert Sudermann	FLUOR
David Tervonen	U.S. Department of Defense
William G. Weleler	U.S. Department of Defense - DCMA
Mathew Z. (Zac) West	U.S. Department of Energy

DCMA: Defense Contract Management Agency
NNSA: National Nuclear Security Administration

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Confidentiality

- Responses coded
- Only ASU team members will know who provided project information
- Data is not attributable to any individual and/or organization without your permission
- If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

8

EVMS METR Milestones

05/08/19	Team Kick-off
06/30/20	Developed Maturity and Environment Assessments
07/09/20	Maturity Workshop #1
07/16/20	Environment Workshop #1
08/05/20	Maturity Workshop #2
08/12/20	Environment Workshop #2
09/10/20	Environment Workshop #3
09/15/20	**Environment Workshop #4**
Oct-Nov 2020	Conduct additional Workshops and collect data
11/16/20	Complete Workshops
08/31/21	Finalize research, publications, and software
Sep-Dec 2021	Training

9

9

Typical Large and Complex Projects/Programs

- **Industrial**
- **Energy**
- **Defense**
- **Aerospace**
- **Manufacturing**
- **Infrastructure**
- **etc.**

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10

Definitions

Earned Value Management (EVM)

The use of performance management information, produced from the EVMS, to plan, direct, control, and forecast the execution and accomplishment of contract/project cost, schedule, and technical performance objectives.

Earned Value Management System (EVMS)

An organization's management system for project/program management that integrates a defined set of associated work scopes, schedules and budgets for effective planning, performance, and management control.

EVMS Environment

The conditions (i.e., people, culture, practices, and resources) that enable or limit the ability to manage the project/program using the EVMS, serving as a basis for timely and effective decision-making.

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EVMS Environment Tool

- EVMS environment Factors can have a significant impact on the efficacy of the EVMS
- The team identified 27 Factors divided into 4 EVMS Categories

Environment Category
A class or division of factors regarded as having particular shared characteristics, arranged in a topological fashion

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List of 27 EVMS Environment Factors (1 of 2)

1. Culture (7 factors)

1a. **The contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b. **The customer organization is supportive and committed** to the implementation of EVMS.
1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.
1d. **Effective teamwork exists** and synergistic team members are working toward a common goal.
1e. The project/program **leadership effectively manages change** using EVMS, including corrective actions and continuous improvement.
1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.
1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.

2. People (6 factors)

2a. **The contractor team is experienced and qualified** in implementing and executing EVMS.
2b. **The customer team is experienced** in understanding and using EVM results to inform decision-making.
2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS.
2d. Project/program **leadership is defined, effective, and accountable**.
2e. **Team members** responsible for EVMS implementation and execution are **co-located and/or accessible**.
2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

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List of 27 EVMS Environment Factors (2 of 2)

3. Practices (8 factors)

3a. **Communication is open and effective**, including consistent terminology, metrics, and reports.
3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.
3c. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.
3d. Domain application **Subject Matter Expert (SME) input is adequate** and timely.
3e. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.
3f. **Roles and responsibilities are defined, documented and well-understood** for implementing and executing EVMS.
3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.
3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.

4. Resources (6 factors)

4a. **Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.
4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS**.
4c. The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.
4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition.**
4e. **Adequate technology/software and tools are integrated and used** for the EVMS.
4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.

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Environment Factor Example

Category 1. Culture

Factor	Factor Name	Factor Description
1a.	**The contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	The contractor's integrated project/program team (IPT) is in place (i.e., corporate leadership, execution/operations, oversight, and support staff), has a demonstrated belief in the value and disciplined use of the EVMS. The project/program follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise negatively impact a well-formed baseline plan. It has committed resources to ensure that effective implementation of the EVMS is a priority, assuring continuous improvement and accountability at every level of the organization. This commitment ensures the availability and protected time of key individuals who contribute to implementing and executing EVMS in a substantive and measurable way. Typically, this also includes the availability/commitment of other personnel with specialized skills/knowledge, who may or may not be "dedicated" to the project/program. Leadership's and team members' attitude and discipline, both at the corporate office level and the project/program level, leads to the correct use, application, and acceptance of EVMS as an integrated project/program management tool, ranging from the definition of work scope to planning and scheduling to budgeting and work authorization, to analysis and reporting to forecasting and risk management. Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. The organization's policies provide incentives and education to foster support and commitment. The contractor's team never chooses convenience over following EVMS regulations and procedures. Decision-making relies on EVMS generated data and metrics, is collaborative and effective which ultimately drives project results. Governance is enforced and effective at dealing with the challenges of the project/program. *Comments: Self-governance refers to the capacity of a contractor to govern autonomously and, as such, is an important approach in overseeing the effective implementation of the EVMS. When a contractor instills integrated program/project management principles using the EVMS in a way that benefits all levels of the organization, the results can guide management decisions, lead to improved program/project execution, and optimize performance of the program/project team.*

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Environment Factor Example

Category 1. Culture

Factor	Factor Name	Factor Description
1a.	**The contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	The contractor's integrated project/program team (IPT) is in place (i.e., corporate leadership, execution/operations, oversight, and support staff), has a demonstrated belief in the value and disciplined use of the EVMS. The project/program follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise negatively impact a well-formed baseline plan. It has committed resources to ensure that effective implementation of the EVMS is a priority, assuring continuous improvement and accountability at every level of the organization. This commitment ensures the availability and protected time of key individuals who contribute to implementing and executing EVMS in a substantive and measurable way. Typically, this also includes the availability/commitment of other personnel with specialized skills/knowledge, who may or may not be "dedicated" to the project/program. Leadership's and team members' attitude and discipline, both at the corporate office level and the project/program level, leads to the correct use, application, and acceptance of EVMS as an integrated project/program management tool, ranging from the definition of work scope to planning and scheduling to budgeting and work authorization, to analysis and reporting to forecasting and risk management. Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. The organization's policies provide incentives and education to foster support and commitment. The contractor's team never chooses convenience over following EVMS regulations and procedures. Decision-making relies on EVMS generated data and metrics, is collaborative and effective which ultimately drives project results. Governance is enforced and effective at dealing with the challenges of the project/program. *Comments: Self-governance refers to the capacity of a contractor to govern autonomously and, as such, is an important approach in overseeing the effective implementation of the EVMS. When a contractor instills integrated program/project management principles using the EVMS in a way that benefits all levels of the organization, the results can guide management decisions, lead to improved program/project execution, and optimize performance of the program/project team.*

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Environment Factor Example

Category 1. Culture		
Factor	Factor Name	Factor Description
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	The contractor's integrated project/program team (IPT) is in place (i.e., corporate leadership, execution/operations, oversight, and support staff), has a demonstrated belief in the value and disciplined use of the EVMS. The project/program follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise negatively impact a well-formed baseline plan. It has committed resources to ensure that effective implementation of the EVMS is a priority, assuring continuous improvement and accountability at every level of the organization. This commitment ensures the availability and protected time of key individuals who contribute to implementing and executing EVMS in a substantive and measurable way. Typically, this also includes the availability/commitment of other personnel with specialized skills/knowledge, who may or may not be "dedicated" to the project/program. Leadership's and team members' attitude and discipline, both at the corporate office level and the project/program level, leads to the correct use, application, and acceptance of EVMS as an integrated project/program management tool, ranging from the definition of work scope to planning and scheduling to budgeting and work authorization, to analysis and reporting to forecasting and risk management. Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. The organization's policies provide incentives and education to foster support and commitment. The contractor's team never chooses convenience over following EVMS regulations and procedures. Decision-making relies on EVMS generated data and metrics, is collaborative and effective which ultimately drives project results. Governance is enforced and effective at dealing with the challenges of the project/program. *Comments: Self-governance refers to the capacity of a contractor to govern autonomously and, as such, is an important approach in overseeing the effective implementation of the EVMS. When a contractor instills integrated program/project management principles using the EVMS in a way that benefits all levels of the organization, the results can guide management decisions, lead to improved program/project execution, and optimize performance of the program/project team.*

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17

Environment Factor Example

Category 1. Culture		
Factor	Factor Name	Factor Description
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	The contractor's integrated project/program team (IPT) is in place (i.e., corporate leadership, execution/operations, oversight, and support staff), has a demonstrated belief in the value and disciplined use of the EVMS. The project/program follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise negatively impact a well-formed baseline plan. It has committed resources to ensure that effective implementation of the EVMS is a priority, assuring continuous improvement and accountability at every level of the organization. This commitment ensures the availability and protected time of key individuals who contribute to implementing and executing EVMS in a substantive and measurable way. Typically, this also includes the availability/commitment of other personnel with specialized skills/knowledge, who may or may not be "dedicated" to the project/program. Leadership's and team members' attitude and discipline, both at the corporate office level and the project/program level, leads to the correct use, application, and acceptance of EVMS as an integrated project/program management tool, ranging from the definition of work scope to planning and scheduling to budgeting and work authorization, to analysis and reporting to forecasting and risk management. Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. The organization's policies provide incentives and education to foster support and commitment. The contractor's team never chooses convenience over following EVMS regulations and procedures. Decision-making relies on EVMS generated data and metrics, is collaborative and effective which ultimately drives project results. Governance is enforced and effective at dealing with the challenges of the project/program. *Comments: Self-governance refers to the capacity of a contractor to govern autonomously and, as such, is an important approach in overseeing the effective implementation of the EVMS. When a contractor instills integrated program/project management principles using the EVMS in a way that benefits all levels of the organization, the results can guide management decisions, lead to improved program/project execution, and optimize performance of the program/project team.*

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Environment Rating Scheme

Not Acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
Rating a factor **Not Acceptable** indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.	Rating a factor **Needs Improvement** indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.	Rating a factor **Meets Some** indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.	Rating a factor **Meets Most** indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.	Rating a factor **High Performing** indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).

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Environment Rating Scheme

Not Acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
Rating a factor **Not Acceptable** indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.	Rating a factor **Needs Improvement** indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.	Rating a factor **Meets Some** indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.	Rating a factor **Meets Most** indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.	Rating a factor **High Performing** indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).

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Environment Rating Scheme

Not Acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
Rating a factor **Not Acceptable** indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.	Rating a factor **Needs Improvement** indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.	Rating a factor **Meets Some** indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.	Rating a factor **Meets Most** indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.	Rating a factor **High Performing** indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).

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21

We need your help to:

- Critique the 27 EVMS Environment Factors and the assessment mechanism
- Develop credible weights for the EVMS environment factors and categories

Hence, the purpose of this workshop

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Let's get to work!

- Click on https://tinyURL.com/evmsEnvironment

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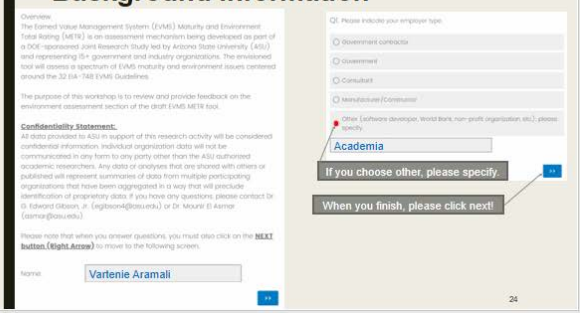
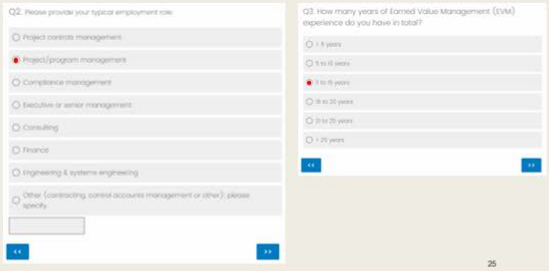
Background Information



24

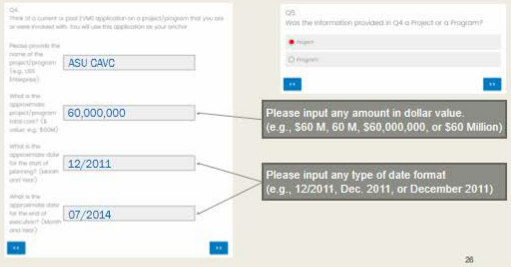
Background Information



25

25

Project/Program Anchor



26

26

Stop Here.

Q8. **Category 1. Culture.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "1a has a typo in line 1"; or "1d: I do not think teamwork is important")

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EVMS Environment Tool Evaluation/Input

Specific instructions for this exercise are as follows:

1. First, collectively participants will **review** each factor (each factor will be projected on Zoom in order).
2. Participants can ask questions and provide comments and suggestions on each of the 27 factors in order. Participants should use the Qualtrics **comment** box for each category to provide edits/suggestions/input related to any of the factors.
3. Once all factors within a category have been reviewed (e.g., 3a through 3h), participants will be asked to **rank** these factors relative to one another. When ranking, think about your ongoing or recent project/program (the anchor you provided) and rank order these factors based on your perception of their relative impact on the EVMS environment.

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Example: Factor 3a. Communication

Category 3. Practices		
Factor	**Factor Name**	**Factor Description**
3a.	**Communication is open and effective**, including consistent metrics and reports.	Open and effective communication channels exist at all times to transfer EVMS information in an efficient and expedient manner. Communication is important for building and maintaining a productive interface between the project/program and EVSM stakeholders including consistent terminology. A communication plan with stakeholders is identified, including clear milestones for involving specific stakeholders as needed. The availability of metrics and reports allows management, both customer and contractor, visibility into the current state of the project/program. For example, realistic status / Estimates at Completion (EACs) are communicated at all levels internally and externally. The project/program clearly identifies and communicates required metrics and reports for the EVMS. These metrics and reports are produced in a timely manner to communicate any existing anomalies and support effective management decision-making. Moreover, conflict resolution practices and procedures are in place and actively utilized.

29

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Review Factors and Provide Feedback

Category 3. Practices		
Factor	**Factor Name**	**Factor Description**
3a.	**Communication is open and effective**, including consistent metrics and reports.	Open and effective communication channels exist at all times to transfer EVMS information in an efficient and expedient manner. Communication is important for building and maintaining a productive interface between the project/program and EVSM stakeholders including consistent terminology. A communication plan with stakeholders is identified, including clear milestones for involving specific stakeholders as needed. The availability of metrics and reports allows management, both customer and contractor, visibility into the current state of the project/program. For example, realistic status / Estimates at Completion (EACs) are communicated at all levels internally and externally. The project/program clearly identifies and communicates required metrics and reports for the EVMS. These metrics and reports are produced in a timely manner to communicate any existing anomalies and support effective management decision-making. Moreover, conflict resolution practices and procedures are in place and actively utilized.

Needs to also include "Consistent terminology"

30

30

Review Factors and Provide Feedback

Q10. **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

3a Factor name: Needs to include "Consistent terminology"
Second Sentence: Typo – EVSM should say EVMS

(then hit Enter to input 3b on a new line)

31

Review Factors and Provide Feedback

Q10. **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

3a Factor name: Needs to include "Consistent terminology"
Second Sentence: Typo – EVSM should say EVMS

32

Review Factors and Provide Feedback

Q10. **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

3a Factor name: Needs to include "Consistent terminology"
Second Sentence: Typo – EVSM should say EVMS

33

Review Factors and Provide Feedback

Q10. **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

3a Factor name: Needs to include "Consistent terminology"
Second Sentence: Typo – EVSM should say EVMS

3b Nothing; 3c Nothing; 3d Nothing; etc.

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Rank Factors

You can rank your Top 5 (or Top 4). Your most impactful factor is ranked #1.

The order of the Factors is randomized.

Note that you are not allowed to rank more than 5 factors here.

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Rank Factors

You can rank your Top 5 (or Top 4). Your most impactful factor is ranked #1.

The order of the Factors is randomized.

Note that you are not allowed to rank more than 5 factors here.

36

Let's get started with Environment Factors!

- We will project the Handout on the screen

37

Q6. **Category 1. Culture.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "1a has a typo in line 1"; or "1d: I do not think teamwork is important")

38

39

Q8. **Category 2. People.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "2b has a typo in line 1"; or "2e: I do not think co-location is important").

40

Q9. This question is focused on the factors that make up the **People Category** (Category 2). Based on your experience, please rank the **top 4** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly. (#1 is the most impactful).

2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

2d. Project/program **leadership is defined, effective, and accountable**.

2e. **Team members** responsible for EVMS implementation and execution **are co-located and/or accessible**.

2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS.

2b. The **customer team and project/program team are experienced** in understanding and using EVM results to inform decision-making.

2a. The **contractor team is experienced and qualified** in implementing and executing EVMS.

41

41

Break

15-minute break

42

42

Let's continue with Environment Factors!

- We will project the Handout on the screen

43

Q10. **Category 3. Practices.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "3c has a typo in description line 4"; or "3d: What does adequate mean?").

44

Q8. This question is focused on the factors that make up the **Practices Category** (Category 3). Based on your experience, please rank the **top 5** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly. (#1 is the most impactful).

3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.

3k. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.

3a. **Communication is open and effective** including consistent terminology, metrics, and reports.

3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.

3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.

3c. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.

3d. Domain application **Subject Matter Expert (SME) input is adequate** and timely.

3j. **Roles and responsibilities are defined, documented and well-understood** for implementing and executing EVMS.

45

45

Q12. **Category 4. Resources.**
Please provide your actionable comments or suggested edits related to any factors that make up this environment category. Make sure to specify the factor number and exact location of your comment (e.g., "4a: What does sufficient mean?"; or "4e: What does adequate mean?").

46

46

Q13. This question is focused on the factors that make up the **Resources Category** (Category 4). Based on your experience, please rank the **top 4** factors in order of relative impact on the EVMS environment. When ranking, think about your anchor project/program and sort factors accordingly. (#1 is the most impactful).

4a. **Adequate technology/software and tools are integrated and used** for the EVMS.

4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.

4c. The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.

4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS.**

4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.

4e. **Sufficient calendar time and workhours are committed and available** for implementing and executing the EVMS.

47

Weight the Categories

Q14.
The following four categories typically make up an EVMS environment. This question is about the relative impact of these four EVMS environment categories. Please allocate 100 points divided among these categories based on the relative impact on the EVMS environment. Allocating more points to a category reflects a higher relative impact on the EVMS environment. The total number of points should sum up to 100.

Resources: Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.

People: People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.

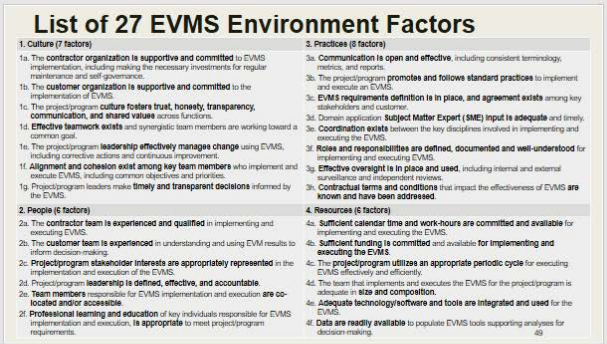
Practices: Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).

Culture: Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.

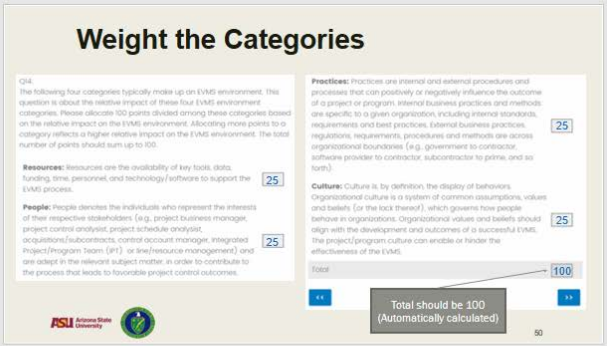
Total

Total should be 100 (Automatically calculated)

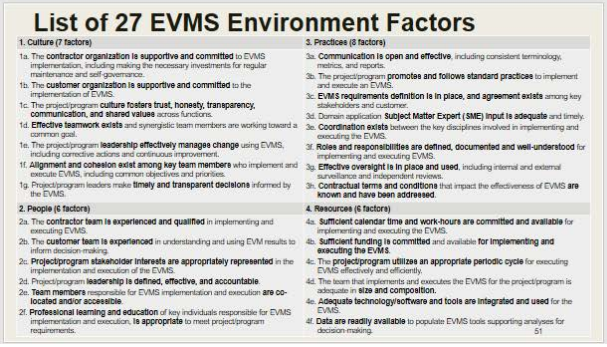
48

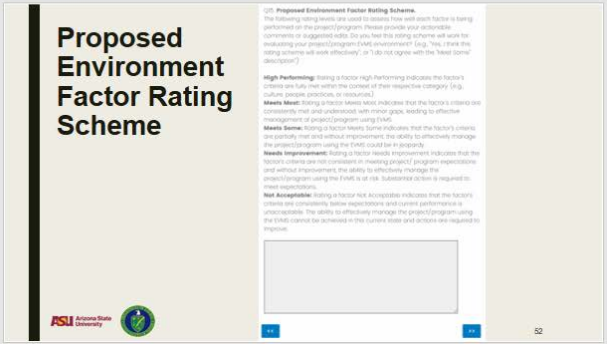

List of 27 EVMS Environment Factors
1. Culture (7 factors)
1a. The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b. The customer organization is supportive and committed to the implementation of EVMS.
1c. The project/program culture fosters trust, honesty, transparency, communication, and shared values across functions.
1d. Effective teamwork exists and synergistic team members are working toward a common goal.
1e. The project/program leadership effectively manages change using EVMS, including corrective actions and continuous improvement.
1f. Alignment and cohesion exist among key team members who implement and execute EVMS, including common objectives and priorities.
1g. Project/program leaders make timely and transparent decisions informed by the EVMS.
2. People (6 factors)
2a. The contractor team is experienced and qualified in implementing and executing EVMS.
2b. The customer team is experienced in understanding and using EVM results to inform decision-making.
2c. Project/program stakeholder interests are appropriately represented in the implementation and execution of the EVMS.
2d. Project/program leadership is defined, effective, and accountable.
2e. Team members responsible for EVMS implementation and execution are co-located and/or accessible.
2f. Professional learning and education of key individuals responsible for EVMS implementation and execution, is appropriate to meet project/program requirements.
3. Practices (8 factors)
3a. Communication is open and effective, including consistent terminology, metrics, and reports.
3b. The project/program promotes and follows standard practices to implement and execute an EVMS.
3c. EVMS requirements definition is in place, and agreement exists among key stakeholders and customer.
3d. Domain application Subject Matter Expert (SME) input is adequate and timely.
3e. Coordination exists between the key disciplines involved in implementing and executing the EVMS.
3f. Roles and responsibilities are defined, documented and well-understood for implementing and executing EVMS.
3g. Effective oversight is in place and used, including internal and external surveillance and independent reviews.
3h. Contractual terms and conditions that impact the effectiveness of EVMS are known and have been addressed.
4. Resources (6 factors)
4a. Sufficient calendar time and work-hours are committed and available for implementing and executing the EVMS.
4b. Sufficient funding is committed and available for implementing and executing the EVMS.
4c. The project/program utilizes an appropriate periodic cycle for executing EVMS effectively and efficiently.
4d. The team that implements and executes the EVMS for the project/program is adequate in size and composition.
4e. Adequate technology/software and tools are integrated and used for the EVMS.
4f. Data are readily available to populate EVMS tools supporting analyses for decision-making.
49

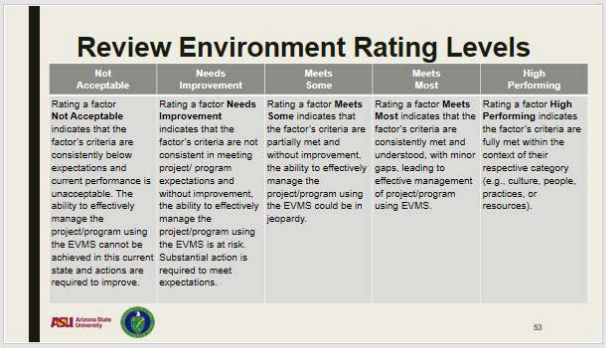
49


Weight the Categories
Q14.
The following four categories typically make up an EVMS environment. This question is about the relative impact of these four EVMS environment categories. Please allocate 100 points divided among these categories based on the relative impact on the EVMS environment. Allocating more points to a category reflects a higher relative impact on the EVMS environment. The total number of points should sum up to 100.
Resources: Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.
25
People: People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.
25
Practices: Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth.).
25
Culture: Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.
25
Total
100
Total should be 100 (Automatically calculated)
50

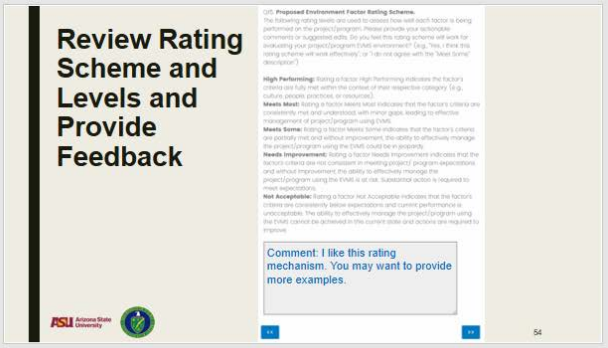
50


List of 27 EVMS Environment Factors
1. Culture (7 factors)
1a. The contractor organization is supportive and committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b. The customer organization is supportive and committed to the implementation of EVMS.
1c. The project/program culture fosters trust, honesty, transparency, communication, and shared values across functions.
1d. Effective teamwork exists and synergistic team members are working toward a common goal.
1e. The project/program leadership effectively manages change using EVMS, including corrective actions and continuous improvement.
1f. Alignment and cohesion exist among key team members who implement and execute EVMS, including common objectives and priorities.
1g. Project/program leaders make timely and transparent decisions informed by the EVMS.
2. People (6 factors)
2a. The contractor team is experienced and qualified in implementing and executing EVMS.
2b. The customer team is experienced in understanding and using EVM results to inform decision-making.
2c. Project/program stakeholder interests are appropriately represented in the implementation and execution of the EVMS.
2d. Project/program leadership is defined, effective, and accountable.
2e. Team members responsible for EVMS implementation and execution are co-located and/or accessible.
2f. Professional learning and education of key individuals responsible for EVMS implementation and execution, is appropriate to meet project/program requirements.
3. Practices (8 factors)
3a. Communication is open and effective, including consistent terminology, metrics, and reports.
3b. The project/program promotes and follows standard practices to implement and execute an EVMS.
3c. EVMS requirements definition is in place, and agreement exists among key stakeholders and customer.
3d. Domain application Subject Matter Expert (SME) input is adequate and timely.
3e. Coordination exists between the key disciplines involved in implementing and executing the EVMS.
3f. Roles and responsibilities are defined, documented and well-understood for implementing and executing EVMS.
3g. Effective oversight is in place and used, including internal and external surveillance and independent reviews.
3h. Contractual terms and conditions that impact the effectiveness of EVMS are known and have been addressed.
4. Resources (6 factors)
4a. Sufficient calendar time and work-hours are committed and available for implementing and executing the EVMS.
4b. Sufficient funding is committed and available for implementing and executing the EVMS.
4c. The project/program utilizes an appropriate periodic cycle for executing EVMS effectively and efficiently.
4d. The team that implements and executes the EVMS for the project/program is adequate in size and composition.
4e. Adequate technology/software and tools are integrated and used for the EVMS.
4f. Data are readily available to populate EVMS tools supporting analyses for decision-making.
51

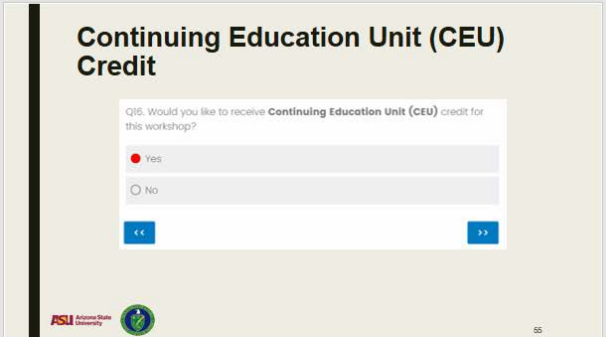

Proposed Environment Factor Rating Scheme
52

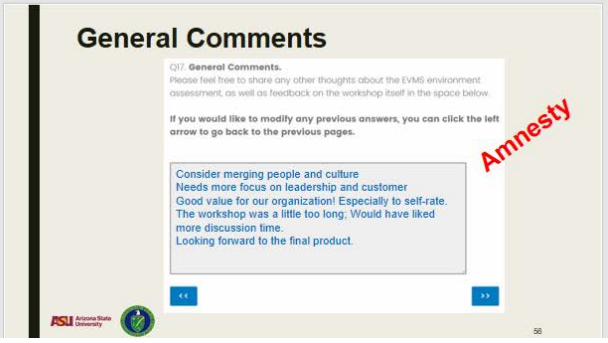

Review Environment Rating Levels
Not Acceptable
Rating a factor Not Acceptable indicates that the factor's criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program using the EVMS cannot be achieved in this current state and actions are required to improve.
Needs Improvement
Rating a factor Needs Improvement indicates that the factor's criteria are not consistent in meeting project/ program expectations and without improvement, the ability to effectively manage the project/program using the EVMS is at risk. Substantial action is required to meet expectations.
Meets Some
Rating a factor Meets Some indicates that the factor's criteria are partially met and without improvement, the ability to effectively manage the project/program using the EVMS could be in jeopardy.
Meets Most
Rating a factor Meets Most indicates that the factor's criteria are consistently met and understood, with minor gaps, leading to effective management of project/program using EVMS.
High Performing
Rating a factor High Performing indicates the factor's criteria are fully met within the context of their respective category (e.g., culture, people, practices, or resources).
53

53


Review Rating Scheme and Levels and Provide Feedback
Comment: I like this rating mechanism. You may want to provide more examples.
54

54


Continuing Education Unit (CEU) Credit
Q16. Would you like to receive Continuing Education Unit (CEU) credit for this workshop?
Yes
No
55


General Comments
Q17. General Comments.
Please feel free to share any other thoughts about the EVMS environment assessment, as well as feedback on the workshop itself in the space below.
If you would like to modify any previous answers, you can click the left arrow to go back to the previous pages.
Consider merging people and culture
Needs more focus on leadership and customer
Good value for our organization! Especially to self-rate.
The workshop was a little too long; Would have liked more discussion time.
Looking forward to the final product.
Amnesty
56

Exit Confirmation

QIR.
Are you ready to exit? If yes, please click the yes button and the NEXT button (Right Arrow) to complete this workshop and record all your responses. Once you click next, you cannot go back to modify any previous answers. Thank you.

Yes

Please click on NEXT button (Right Arrow) to record your responses.
If you click here, you will not be able to modify any previous answers.

57

57

Completion Screen

If you see this screen, your response is successfully saved in our database.

Survey Completion
0% 100%

EVMS METR: Environment Factors Workshop

We thank you for your time spent taking this survey.
Your response has been recorded.

58

58

Conclusions & Wrap-up

- What we did today
  - *Reviewed the 27 EVMS environment factors*
  - *Weighted and ranked the factors and the categories*
- Thank you for your input!
- CEUs will be emailed to you
- We will send you published documents when they become available

59

EVMS Environment Rating Score Sheet Example

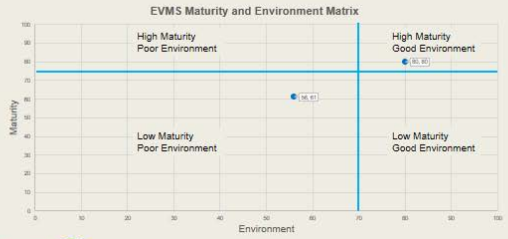
1. Culture
Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.

Factors for Review	Not Acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.					X
1b. The **customer organization is supportive and committed** to the implementation of EVMS.					X
1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.				X	
1d. **Effective teamwork exists** and synergistic team members are working toward a common goal.			X		
1e. The project/program **leadership effectively manages change** using EVMS, including corrective actions and continuous improvement.				X	
1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.				X	
1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.			X		
Column Totals (For Culture)*	0	0	2	3	2

*frequency number in column

60

Envisioned EVMS Rating Plot



61

Questions/Comments/Discussion

THANK YOU!

62

Appendix E. List of Environment Factors (Workshops 1 and 2)

Total of 33 Factors:

Culture (7 factors), **People** (9 factors), **Practices** (9 factors), and **Resources** (8 factors)

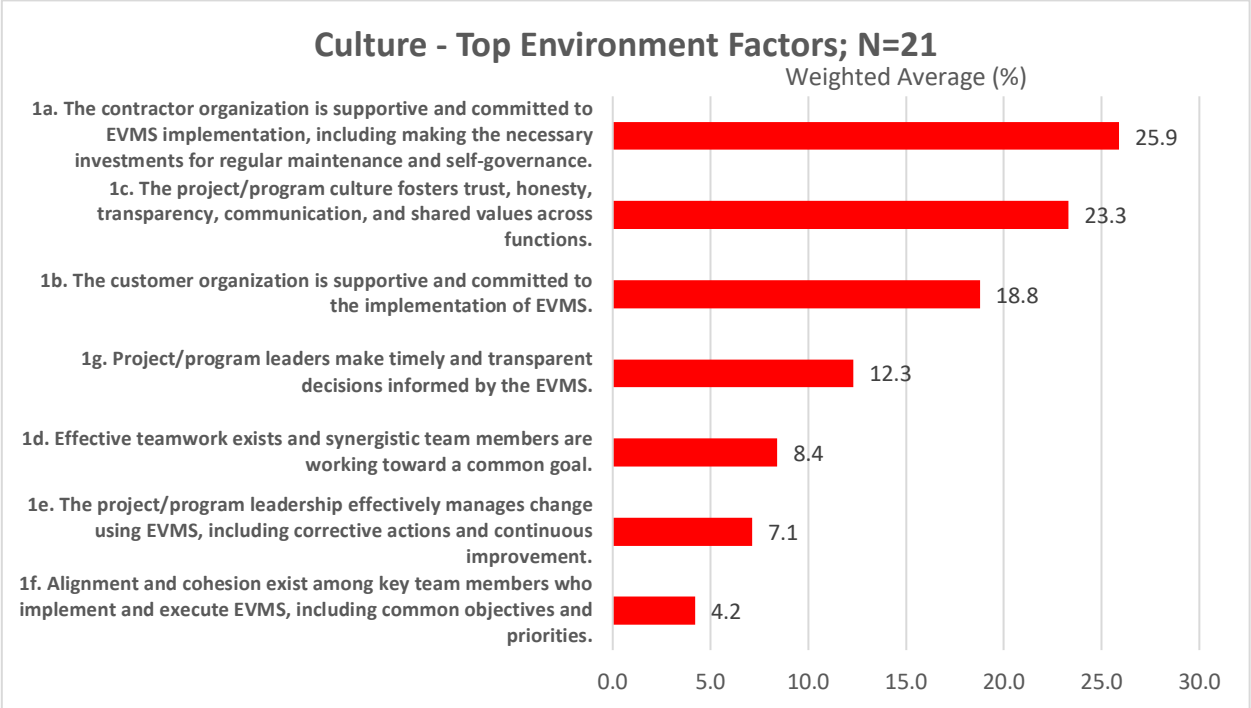
1. Culture (7 factors)	
Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof), which governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.	
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b.	The **customer organization is supportive and committed** to the implementation of EVMS.
1c.	The project/program **team culture fosters trust, honesty, transparency, communication, and shared values** across functions.
1d.	**Effective teamwork exists** and synergistic team members are working toward a common goal.
1e.	The project/program **leadership effectively manages change** using EVMS, including corrective actions and continuous improvement.
1f.	**Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.
1g.	Project/program leaders make **timely and transparent decisions** informed by the EVMS.

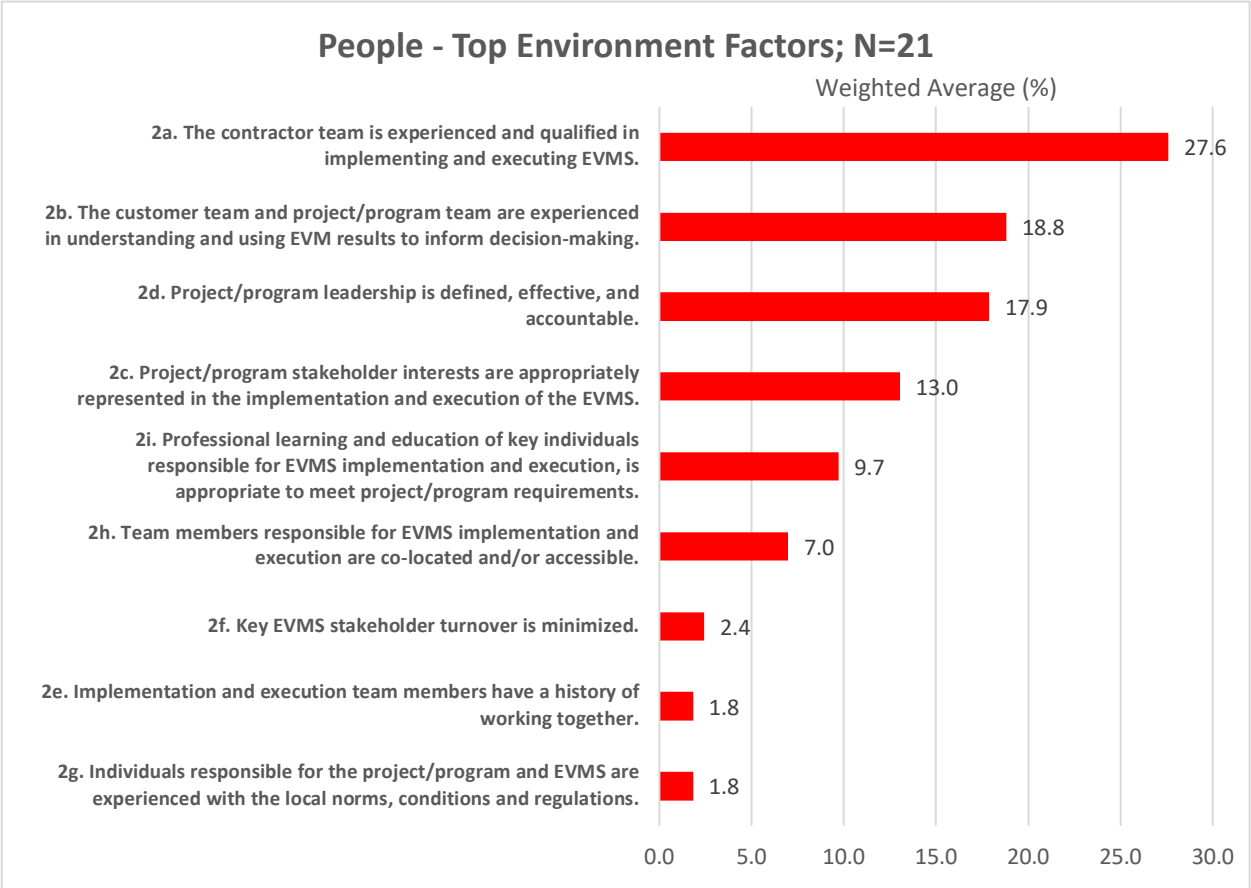
2. People (9 factors)	
People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analysist, project schedule analyst, acquisitions/subcontracts, control account manager, IPT or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.	
2a.	The **contractor leadership team and project/program team are experienced and qualified** in implementing and executing EVMS.
2b.	The **customer leadership team and project/program team are experienced** in understanding and using EVM results to inform decision-making.
2c.	**Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**
2d.	Project/program **leadership is defined, effective, and accountable**.
2e.	Implementation and execution **team members have a history of working together**.
2f.	Key EVMS **stakeholder turnover is minimized**.
2g.	Individuals responsible for the project/program and EVMS are **experienced with the local norms, conditions and regulations**.
2h.	**Team members** responsible for EVMS implementation and execution **are co-located and/or accessible**.
2i.	**Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

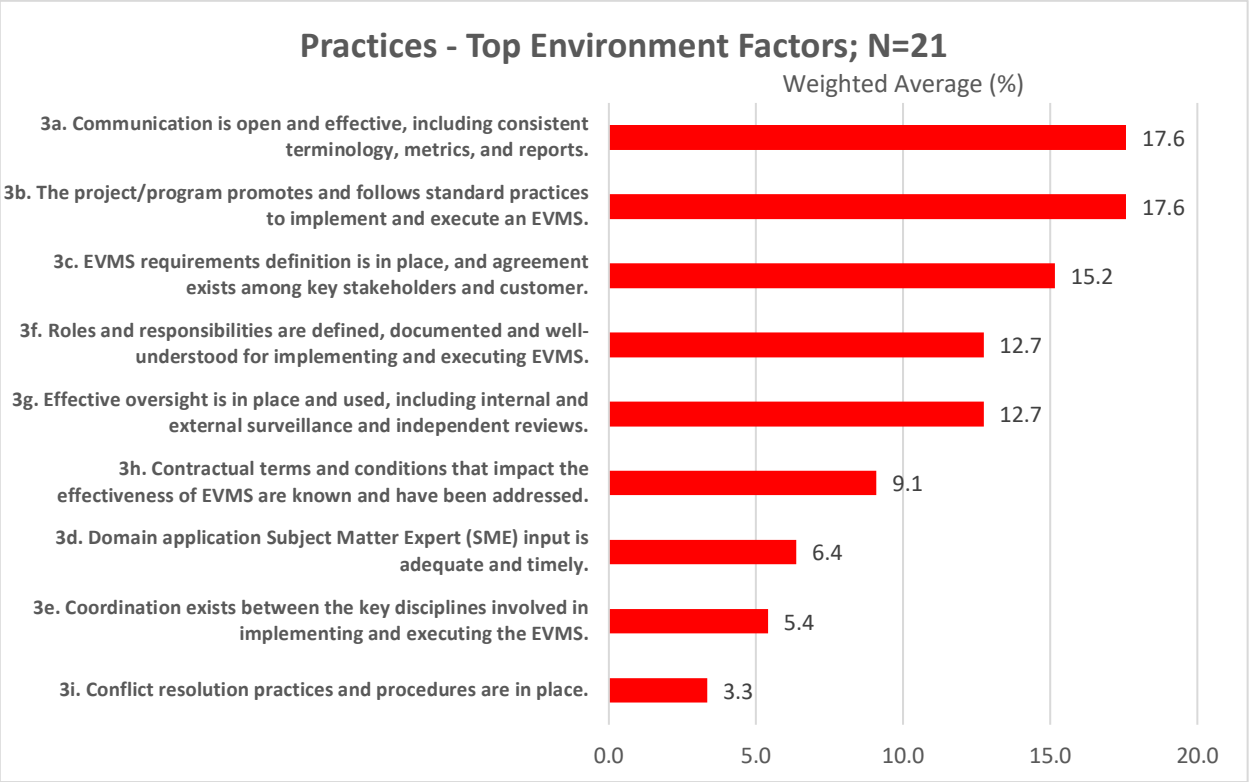
3. Practices (9 factors)	
Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).	
3a.	**Communication is open and effective**, including consistent terminology, metrics, and reports.
3b.	The project/program **promotes and follows standard practices** to implement and execute an EVMS.
3c.	**Sufficient EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.
3d.	**Input of project/program execution Subject Matter Expert (SME) knowledge** into the EVMS process **is adequate** and timely.
3e.	**Adequate coordination exists** between the key disciplines involved in implementing and executing the EVMS.
3f.	**Roles and responsibilities are defined**, **documented and well-understood** for team members responsible for implementing and executing EVMS.
3g.	**Effective oversight is in place and used**, including internal and external surveillance and independent reviews.
3h.	**Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.
3i.	**Conflict resolution** practices and procedures are **in place and actively utilized**.

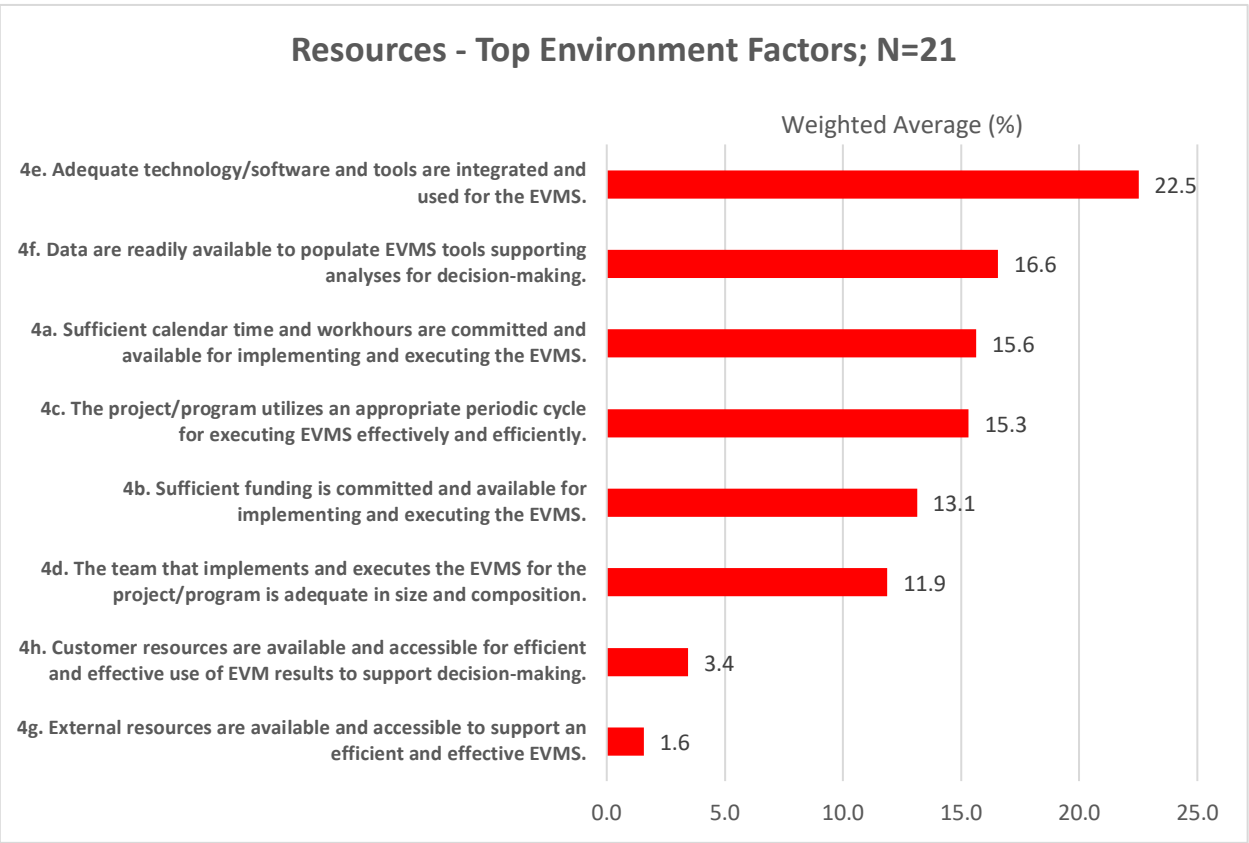
4. Resources (8 factors)	
Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.	
4a.	**Sufficient calendar time and workhours are committed and available** for implementing and executing the EVMS.
4b.	**Sufficient funding is committed and available** for implementing and executing the EVMS.
4c.	The **project/program utilizes an appropriate periodic cycle** for executing EVMS effectively and efficiently.
4d.	The **EVMS core team's size and composition are adequate** for the project/program.
4e.	**Adequate technology/software and tools are integrated and used** for the EVMS.
4f.	**Data are readily available** to populate EVMS tools supporting analyses for decision-making.
4g.	**External resources are available and accessible** to support an efficient and effective EVMS.
4h.	**Customer resources are available and accessible** for efficient and effective use of EVM results to support decision-making.

Appendix F. Environment Factor Ranking Results (Workshops 1 and 2)






Practices - Top Environment Factors; N=21
Weighted Average (%)
3a. Communication is open and effective, including consistent terminology, metrics, and reports.
17.6
3b. The project/program promotes and follows standard practices to implement and execute an EVMS.
17.6
3c. EVMS requirements definition is in place, and agreement exists among key stakeholders and customer.
15.2
3f. Roles and responsibilities are defined, documented and well-understood for implementing and executing EVMS.
12.7
3g. Effective oversight is in place and used, including internal and external surveillance and independent reviews.
12.7
3h. Contractual terms and conditions that impact the effectiveness of EVMS are known and have been addressed.
9.1
3d. Domain application Subject Matter Expert (SME) input is adequate and timely.
6.4
3e. Coordination exists between the key disciplines involved in implementing and executing the EVMS.
5.4
3i. Conflict resolution practices and procedures are in place.
3.3
0.0
5.0
10.0
15.0
20.0


Resources - Top Environment Factors; N=21
Weighted Average (%)
4e. Adequate technology/software and tools are integrated and used for the EVMS.
22.5
4f. Data are readily available to populate EVMS tools supporting analyses for decision-making.
16.6
4a. Sufficient calendar time and workhours are committed and available for implementing and executing the EVMS.
15.6
4c. The project/program utilizes an appropriate periodic cycle for executing EVMS effectively and efficiently.
15.3
4b. Sufficient funding is committed and available for implementing and executing the EVMS.
13.1
4d. The team that implements and executes the EVMS for the project/program is adequate in size and composition.
11.9
4h. Customer resources are available and accessible for efficient and effective use of EVM results to support decision-making.
3.4
4g. External resources are available and accessible to support an efficient and effective EVMS.
1.6
0.0
5.0
10.0
15.0
20.0
25.0

Appendix G. List of Environment Factors (Workshops 3 and 4)

Total of 27 Factors:

Culture (7 factors), **People** (6 factors), **Practices** (8 factors), and **Resources** (6 factors)

1. Culture (7 factors)	
Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.	
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b.	The **customer organization is supportive and committed** to the implementation and use of EVMS.
1c.	The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.
1d.	**Effective teamwork exists** and team members are working synergistically toward common project/program goals.
1e.	The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.
1f.	**Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.
1g.	Project/program leaders make **timely and transparent decisions** informed by the EVMS.

2. People (6 factors)	
People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.	
2a.	The **contractor team is experienced and qualified** in implementing and executing the EVMS.
2b.	The **customer team is experienced** in understanding and using EVM results to inform decision-making.
2c.	**Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**
2d.	Project/program **leadership is defined, effective, and accountable**.
2e.	**Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.
2f.	**Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.

3. Practices (8 factors)	
Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).	
3a.	**Communication is open and effective**, including consistent terminology, metrics, and reports.
3b.	The project/program **promotes and follows standard practices** to implement and execute an EVMS.
3c.	**EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.
3d.	Appropriate **Subject Matter Expert (SME) input is adequate** and timely.
3e.	**Coordination exists** between the key disciplines involved in implementing and executing the EVMS.
3f.	**Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.
3g.	**Effective oversight is in place and used**, including internal and external surveillance and independent reviews.
3h.	**Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.

4. Resources (6 factors)	
Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.	
4a.	**Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.
4b.	**Sufficient funding is committed** and available **for implementing and executing the EVMS**.
4c.	The **project/program utilizes an appropriate periodic cycle** for executing the EVMS effectively and efficiently.
4d.	The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.
4e.	**Adequate technology/software and tools are integrated and used** for the EVMS.
4f.	**Data are readily available** to populate EVMS tools supporting analyses for decision-making.

Appendix H. Descriptive Statistics of Environment Category Weights (Sample)

Category			Statistic	Std. Error
Culture	Mean		33.11	1.865
	95% Confidence Interval for Mean	Lower Bound	29.35	
		Upper Bound	36.86	
	5% Trimmed Mean		32.26	
	Median		30.00	
	Variance		163.532	
	Std. Deviation		12.788	
	Minimum		10	
	Maximum		70	
	Range		60	
	Interquartile Range		15	
	Skewness		1.054	.347
	Kurtosis		1.678	.681

The remaining data and analyses reside at Arizona State University with the authors.

Appendix I. Workshop Environment Category Weights – Standard Deviations (Sample)

Notes:
*SD stands for Standard Deviation.
*The red highlighted in this appendix indicates the category weight is 2.5SD distant from the category's mean.

Culture Category

Participant	Participant's Weight for this category	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-1	40	6.89	0.54
WSP1-2	15	18.11	1.42
WSP1-3	30	3.11	0.24
WSP1-4	40	6.89	0.54
WSP1-5	40	6.89	0.54
WSP1-6	15	18.11	1.42
WSP1-7	35	1.89	0.15
WSP1-8	40	6.89	0.54
WSP1-9	35	1.89	0.15
WSP2-1	45	11.89	0.93
WSP2-2	35	1.89	0.15
WSP2-3	50	16.89	1.32
WSP2-4	30	3.11	0.24
WSP2-5	50	16.89	1.32
WSP2-6	70	36.89	2.88
WSP2-7	25	8.11	0.63
WSP2-8	30	3.11	0.24
WSP2-9	30	3.11	0.24
WSP2-10	50	16.89	1.32
WSP2-11	15	18.11	1.42
WSP3-1	31	2.11	0.16
WSP3-2	30	3.11	0.24
WSP3-3	25	8.11	0.63
WSP3-4	40	6.89	0.54
WSP3-5	25	8.11	0.63
WSP3-6	30	3.11	0.24
WSP3-7	30	3.11	0.24
WSP3-8	30	3.11	0.24
WSP3-9	30	3.11	0.24
WSP3-10	25	8.11	0.63
WSP3-11	20	13.11	1.03
WSP3-12	30	3.11	0.24
WSP3-13	35	1.89	0.15

Participant	Participant's Weight for this category	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP4-1	25	8.11	0.63
WSP4-2	70	36.89	2.88
WSP4-3	30	3.11	0.24
WSP4-4	30	3.11	0.24
WSP4-5	30	3.11	0.24
WSP4-6	30	3.11	0.24
WSP4-7	20	13.11	1.03
WSP4-8	30	3.11	0.24
WSP4-9	45	11.89	0.93
WSP4-10	20	13.11	1.03
WSP4-11	35	1.89	0.15
WSP4-12	20	13.11	1.03
WSP4-13	10	23.11	1.81
WSP4-14	60	26.89	2.10

The remaining data and analyses reside at Arizona State University with the authors.

Appendix J. Weights per Environment Factor (Sample)

Weights of the Environment Factors under Culture Category

Participant	1a	1b	1c	1d	1e	1f	1g	Total Possible Score	Weight of Culture Category per Participant
WSP1-1	14.29	11.43	8.57	0.00	0.00	0.00	5.71	14	40
WSP1-2	5.36	4.29	2.14	0.00	0.00	0.00	3.21	14	15
WSP1-3	6.43	4.29	0.00	0.00	10.71	0.00	8.57	14	30
WSP1-4	14.29	0.00	11.43	0.00	5.71	8.57	0.00	14	40
WSP1-5	14.29	8.57	11.43	0.00	5.71	0.00	0.00	14	40
WSP1-6	4.29	3.21	0.00	5.36	2.14	0.00	0.00	14	15
WSP1-7	12.50	10.00	7.50	0.00	0.00	0.00	5.00	14	35
WSP1-8	8.57	11.43	14.29	0.00	0.00	0.00	5.71	14	40
WSP1-9	12.50	0.00	10.00	5.00	0.00	7.50	0.00	14	35
WSP2-1	9.64	6.43	12.86	16.07	0.00	0.00	0.00	14	45
WSP2-2	0.00	5.00	10.00	0.00	7.50	0.00	12.50	14	35
WSP2-3	0.00	7.14	0.00	17.86	0.00	10.71	14.29	14	50
WSP2-4	10.71	6.43	8.57	0.00	0.00	0.00	4.29	14	30
WSP2-5	14.29	10.71	17.86	0.00	0.00	7.14	0.00	14	50
WSP2-7	7.14	3.57	0.00	0.00	5.36	0.00	8.93	14	25
WSP2-8	10.71	4.29	8.57	0.00	6.43	0.00	0.00	14	30
WSP2-9	10.71	8.57	6.43	0.00	0.00	0.00	4.29	14	30
WSP2-10	10.71	14.29	17.86	0.00	0.00	7.14	0.00	14	50
WSP2-11	0.00	2.14	5.36	4.29	0.00	0.00	3.21	14	15
WSP3-1	11.07	8.86	6.64	0.00	0.00	0.00	4.43	14	31
WSP3-2	8.57	6.43	0.00	0.00	4.29	0.00	10.71	14	30
WSP3-3	7.14	8.93	5.36	0.00	0.00	3.57	0.00	14	25
WSP3-4	11.43	0.00	0.00	0.00	8.57	5.71	14.29	14	40
WSP3-5	0.00	0.00	7.14	0.00	5.36	3.57	8.93	14	25
WSP3-6	0.00	0.00	10.71	0.00	6.43	4.29	8.57	14	30
WSP3-7	8.57	6.43	10.71	0.00	0.00	0.00	4.29	14	30
WSP3-8	10.71	8.57	0.00	0.00	4.29	0.00	6.43	14	30
WSP3-9	10.71	6.43	8.57	0.00	0.00	0.00	4.29	14	30
WSP3-10	8.93	3.57	5.36	0.00	7.14	0.00	0.00	14	25
WSP3-11	5.71	0.00	7.14	0.00	2.86	0.00	4.29	14	20
WSP3-12	0.00	10.71	0.00	6.43	8.57	0.00	4.29	14	30
WSP3-13	7.50	0.00	5.00	12.50	0.00	0.00	10.00	14	35
WSP4-1	8.93	0.00	7.14	0.00	5.36	0.00	3.57	14	25
WSP4-3	6.43	0.00	10.71	8.57	0.00	0.00	4.29	14	30
WSP4-4	10.71	0.00	0.00	4.29	0.00	8.57	6.43	14	30
WSP4-5	0.00	0.00	4.29	0.00	6.43	8.57	10.71	14	30
WSP4-6	4.29	0.00	0.00	6.43	8.57	10.71	0.00	14	30
WSP4-7	5.71	4.29	0.00	0.00	0.00	2.86	7.14	14	20
WSP4-8	10.71	8.57	6.43	0.00	4.29	0.00	0.00	14	30

Participant	1a	1b	1c	1d	1e	1f	1g	Total Possible Score	Weight of Culture Category per Participant
WSP4-9	12.86	16.07	9.64	0.00	0.00	0.00	6.43	14	45
WSP4-10	4.29	5.71	0.00	0.00	7.14	0.00	2.86	14	20
WSP4-11	10.00	12.50	7.50	0.00	5.00	0.00	0.00	14	35
WSP4-12	4.29	7.14	2.86	5.71	0.00	0.00	0.00	14	20
WSP4-14	0.00	0.00	21.43	12.86	17.14	0.00	8.57	14	60

The remaining data resides at Arizona State University with the authors.

Appendix K. Descriptive Statistics of Environment Factor Weights (Sample)

Descriptive Statistics for Factors 1a to 1g

Factor			Statistic	Std. Error
1a	Mean		9.3056	.51144
	95% Confidence Interval for Mean	Lower Bound	8.2673	
		Upper Bound	10.3438	
	5% Trimmed Mean		9.3078	
	Median		9.8214	
	Variance		9.417	
	Std. Deviation		3.06863	
	Minimum		4.29	
	Maximum		14.29	
	Range		10.00	
	Interquartile Range		4.38	
	Skewness		-.098	.393
	Kurtosis		-.905	.768
1b	Mean		7.6129	.60913
	95% Confidence Interval for Mean	Lower Bound	6.3689	
		Upper Bound	8.8569	
	5% Trimmed Mean		7.4610	
	Median		7.1429	
	Variance		11.502	
	Std. Deviation		3.39150	
	Minimum		2.14	
	Maximum		16.07	
	Range		13.93	
	Interquartile Range		5.71	
	Skewness		.594	.421
	Kurtosis		-.036	.821
1c	Mean		9.0469	.76087
	95% Confidence Interval for Mean	Lower Bound	7.4951	
		Upper Bound	10.5987	
	5% Trimmed Mean		8.8021	
	Median		8.5714	
	Variance		18.526	
	Std. Deviation		4.30413	
	Minimum		2.14	
	Maximum		21.43	
	Range		19.29	
	Interquartile Range		4.29	
	Skewness		1.095	.414
	Kurtosis		1.462	.809
1d	Mean		8.7798	1.38423
	95% Confidence Interval for Mean	Lower Bound	5.7331	
		Upper Bound	11.8264	
	5% Trimmed Mean		8.5251	
	Median		6.4286	
	Variance		22.993	
	Std. Deviation		4.79510	
	Minimum		4.29	
	Maximum		17.86	
	Range		13.57	
	Interquartile Range		7.68	
	Skewness		.915	.637
	Kurtosis		-.638	1.232
1e	Mean		6.5909	.65784
	95% Confidence Interval for Mean	Lower Bound	5.2229	
		Upper Bound	7.9590	

Factor			Statistic	Std. Error
	5% Trimmed Mean		6.2807	
	Median		6.0714	
	Variance		9.520	
	Std. Deviation		3.08553	
	Minimum		2.14	
	Maximum		17.14	
	Range		15.00	
	Interquartile Range		2.95	
	Skewness		1.929	.491
	Kurtosis		5.906	.953
1f	Mean		6.8407	.73665
	95% Confidence Interval for Mean	Lower Bound	5.2356	
		Upper Bound	8.4457	
	5% Trimmed Mean		6.8468	
	Median		7.1429	
	Variance		7.055	
	Std. Deviation		2.65604	
	Minimum		2.86	
	Maximum		10.71	
	Range		7.86	
	Interquartile Range		4.64	
	Skewness		-.100	.616
	Kurtosis		-1.151	1.191
1g	Mean		6.8738	.59832
	95% Confidence Interval for Mean	Lower Bound	5.6501	
		Upper Bound	8.0975	
	5% Trimmed Mean		6.6786	
	Median		6.0714	
	Variance		10.740	
	Std. Deviation		3.27712	
	Minimum		2.86	
	Maximum		14.29	
	Range		11.43	
	Interquartile Range		4.64	
	Skewness		.865	.427
	Kurtosis		-.125	.833

The remaining data and analyses reside at Arizona State University with the authors.

Appendix L. Workshop Environment Factor Weights – Standard Deviations (Sample)

Notes:
*SD stands for Standard Deviation.
*The red highlighted in this appendix indicates that the factor weight is 2.5SD distant from the factor mean, for those factors which were ranked by participants.
*In the case when a participant did not weigh a factor, the distance of the participant's factor weight from mean is marked as N/A in the following tables.

Culture Category Factors

Participant	Participant's Weight for factor 1a	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1b	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-1	14.29	4.99	1.66	11.43	3.82	1.13
WSP1-2	5.36	3.94	1.31	4.29	3.32	0.98
WSP1-3	6.43	2.87	0.96	4.29	3.32	0.98
WSP1-4	14.29	4.99	1.66	0.00	N/A	N/A
WSP1-5	14.29	4.99	1.66	8.57	0.96	0.28
WSP1-6	4.29	5.01	1.67	3.21	4.40	1.30
WSP1-7	12.50	3.20	1.07	10.00	2.39	0.71
WSP1-8	8.57	0.73	0.24	11.43	3.82	1.13
WSP1-9	12.50	3.20	1.07	0.00	N/A	N/A
WSP2-1	9.64	0.34	0.11	6.43	1.18	0.35
WSP2-2	0.00	N/A	N/A	5.00	2.61	0.77
WSP2-3	0.00	N/A	N/A	7.14	0.47	0.14
WSP2-4	10.71	1.41	0.47	6.43	1.18	0.35
WSP2-5	14.29	4.99	1.66	10.71	3.10	0.92
WSP2-7	7.14	2.16	0.72	3.57	4.04	1.19
WSP2-8	10.71	1.41	0.47	4.29	3.32	0.98
WSP2-9	10.71	1.41	0.47	8.57	0.96	0.28
WSP2-10	10.71	1.41	0.47	14.29	6.68	1.97
WSP2-11	0.00	N/A	N/A	2.14	5.47	1.61
WSP3-1	11.07	1.77	0.59	8.86	1.25	0.37
WSP3-2	8.57	0.73	0.24	6.43	1.18	0.35
WSP3-3	7.14	2.16	0.72	8.93	1.32	0.39
WSP3-4	11.43	2.13	0.71	0.00	N/A	N/A
WSP3-5	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-6	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-7	8.57	0.73	0.24	6.43	1.18	0.35
WSP3-8	10.71	1.41	0.47	8.57	0.96	0.28
WSP3-9	10.71	1.41	0.47	6.43	1.18	0.35
WSP3-10	8.93	0.37	0.12	3.57	4.04	1.19
WSP3-11	5.71	3.59	1.20	0.00	N/A	N/A
WSP3-12	0.00	N/A	N/A	10.71	3.10	0.92

Participant	Participant's Weight for factor 1a	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1b	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP3-13	7.50	1.80	0.60	0.00	N/A	N/A
WSP4-1	8.93	0.37	0.12	0.00	N/A	N/A
WSP4-3	6.43	2.87	0.96	0.00	N/A	N/A
WSP4-4	10.71	1.41	0.47	0.00	N/A	N/A
WSP4-5	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-6	4.29	5.01	1.67	0.00	N/A	N/A
WSP4-7	5.71	3.59	1.20	4.29	3.32	0.98
WSP4-8	10.71	1.41	0.47	8.57	0.96	0.28
WSP4-9	12.86	3.56	1.19	16.07	8.46	2.50
WSP4-10	4.29	5.01	1.67	5.71	1.90	0.56
WSP4-11	10.00	0.70	0.23	12.50	4.89	1.44
WSP4-12	4.29	5.01	1.67	7.14	0.47	0.14
WSP4-14	0.00	N/A	N/A	0.00	N/A	N/A

Participant	Participant's Weight for factor 1c	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1d	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-1	8.57	0.47	0.11	0.00	N/A	N/A
WSP1-2	2.14	6.90	1.60	0.00	N/A	N/A
WSP1-3	0.00	N/A	N/A	0.00	N/A	N/A
WSP1-4	11.43	2.39	0.56	0.00	N/A	N/A
WSP1-5	11.43	2.39	0.56	0.00	N/A	N/A
WSP1-6	0.00	N/A	N/A	5.36	3.42	0.71
WSP1-7	7.50	1.54	0.36	0.00	N/A	N/A
WSP1-8	14.29	5.25	1.22	0.00	N/A	N/A
WSP1-9	10.00	0.96	0.22	5.00	3.78	0.79
WSP2-1	12.86	3.82	0.89	16.07	7.29	1.52
WSP2-2	10.00	0.96	0.22	0.00	N/A	N/A
WSP2-3	0.00	N/A	N/A	17.86	9.08	1.90
WSP2-4	8.57	0.47	0.11	0.00	N/A	N/A
WSP2-5	17.86	8.82	2.05	0.00	N/A	N/A
WSP2-7	0.00	N/A	N/A	0.00	N/A	N/A
WSP2-8	8.57	0.47	0.11	0.00	N/A	N/A
WSP2-9	6.43	2.61	0.61	0.00	N/A	N/A
WSP2-10	17.86	8.82	2.05	0.00	N/A	N/A
WSP2-11	5.36	3.68	0.86	4.29	4.49	0.94
WSP3-1	6.64	2.40	0.56	0.00	N/A	N/A
WSP3-2	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-3	5.36	3.68	0.86	0.00	N/A	N/A
WSP3-4	0.00	N/A	N/A	0.00	N/A	N/A

Participant	Participant's Weight for factor 1c	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1d	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP3-5	7.14	1.90	0.44	0.00	N/A	N/A
WSP3-6	10.71	1.67	0.39	0.00	N/A	N/A
WSP3-7	10.71	1.67	0.39	0.00	N/A	N/A
WSP3-8	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-9	8.57	0.47	0.11	0.00	N/A	N/A
WSP3-10	5.36	3.68	0.86	0.00	N/A	N/A
WSP3-11	7.14	1.90	0.44	0.00	N/A	N/A
WSP3-12	0.00	N/A	N/A	6.43	2.35	0.49
WSP3-13	5.00	4.04	0.94	12.50	3.72	0.78
WSP4-1	7.14	1.90	0.44	0.00	N/A	N/A
WSP4-3	10.71	1.67	0.39	8.57	0.21	0.04
WSP4-4	0.00	N/A	N/A	4.29	4.49	0.94
WSP4-5	4.29	4.75	1.11	0.00	N/A	N/A
WSP4-6	0.00	N/A	N/A	6.43	2.35	0.49
WSP4-7	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-8	6.43	2.61	0.61	0.00	N/A	N/A
WSP4-9	9.64	0.60	0.14	0.00	N/A	N/A
WSP4-10	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-11	7.50	1.54	0.36	0.00	N/A	N/A
WSP4-12	2.86	6.18	1.44	5.71	3.07	0.64
WSP4-14	21.43	12.39	2.88	12.86	4.08	0.85

Participant	Participant's Weight for factor 1e	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1f	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-1	0.00	N/A	N/A	0.00	N/A	N/A
WSP1-2	0.00	N/A	N/A	0.00	N/A	N/A
WSP1-3	10.71	4.12	1.34	0.00	N/A	N/A
WSP1-4	5.71	0.88	0.28	8.57	1.73	0.65
WSP1-5	5.71	0.88	0.28	0.00	N/A	N/A
WSP1-6	2.14	4.45	1.44	0.00	N/A	N/A
WSP1-7	0.00	N/A	N/A	0.00	N/A	N/A
WSP1-8	0.00	N/A	N/A	0.00	N/A	N/A
WSP1-9	0.00	N/A	N/A	7.50	0.66	0.25
WSP2-1	0.00	N/A	N/A	0.00	N/A	N/A
WSP2-2	7.50	0.91	0.30	0.00	N/A	N/A
WSP2-3	0.00	N/A	N/A	10.71	3.87	1.46
WSP2-4	0.00	N/A	N/A	0.00	N/A	N/A
WSP2-5	0.00	N/A	N/A	7.14	0.30	0.11
WSP2-7	5.36	1.23	0.40	0.00	N/A	N/A

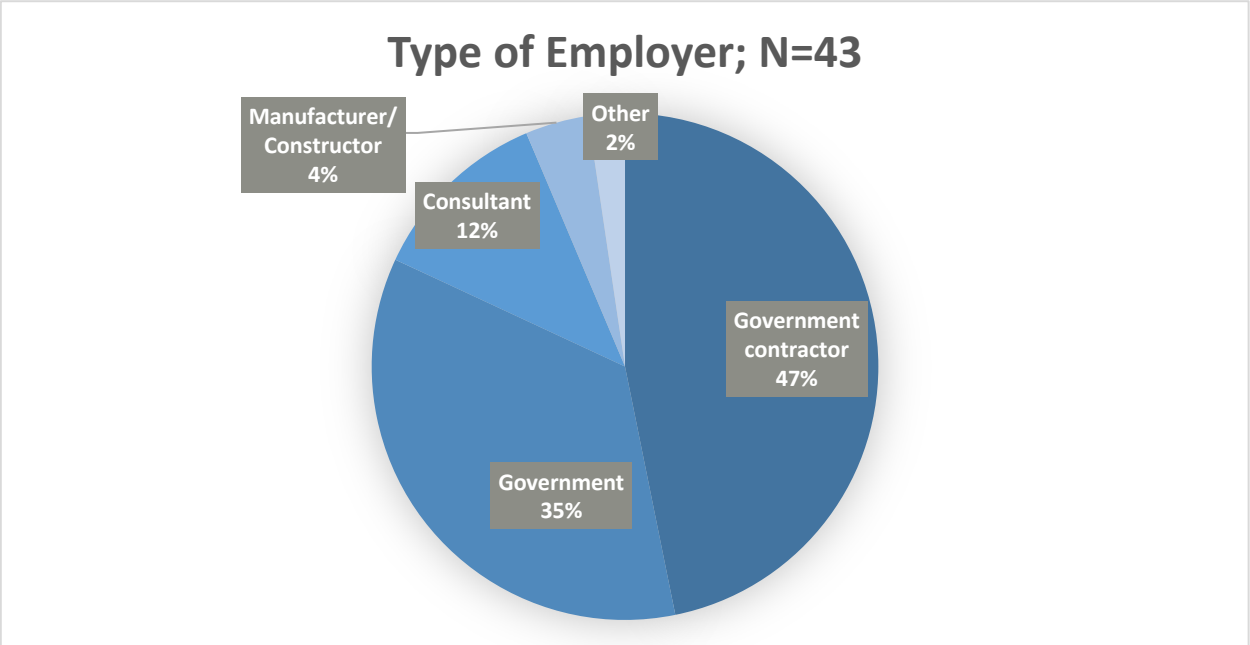
Participant	Participant's Weight for factor 1e	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD	Participant's Weight for factor 1f	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP2-8	6.43	0.16	0.05	0.00	N/A	N/A
WSP2-9	0.00	N/A	N/A	0.00	N/A	N/A
WSP2-10	0.00	N/A	N/A	7.14	0.30	0.11
WSP2-11	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-1	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-2	4.29	2.30	0.75	0.00	N/A	N/A
WSP3-3	0.00	N/A	N/A	3.57	3.27	1.23
WSP3-4	8.57	1.98	0.64	5.71	1.13	0.42
WSP3-5	5.36	1.23	0.40	3.57	3.27	1.23
WSP3-6	6.43	0.16	0.05	4.29	2.55	0.96
WSP3-7	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-8	4.29	2.30	0.75	0.00	N/A	N/A
WSP3-9	0.00	N/A	N/A	0.00	N/A	N/A
WSP3-10	7.14	0.55	0.18	0.00	N/A	N/A
WSP3-11	2.86	3.73	1.21	0.00	N/A	N/A
WSP3-12	8.57	1.98	0.64	0.00	N/A	N/A
WSP3-13	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-1	5.36	1.23	0.40	0.00	N/A	N/A
WSP4-3	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-4	0.00	N/A	N/A	8.57	1.73	0.65
WSP4-5	6.43	0.16	0.05	8.57	1.73	0.65
WSP4-6	8.57	1.98	0.64	10.71	3.87	1.46
WSP4-7	0.00	N/A	N/A	2.86	3.98	1.50
WSP4-8	4.29	2.30	0.75	0.00	N/A	N/A
WSP4-9	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-10	7.14	0.55	0.18	0.00	N/A	N/A
WSP4-11	5.00	1.59	0.52	0.00	N/A	N/A
WSP4-12	0.00	N/A	N/A	0.00	N/A	N/A
WSP4-14	17.14	10.55	3.43	0.00	N/A	N/A

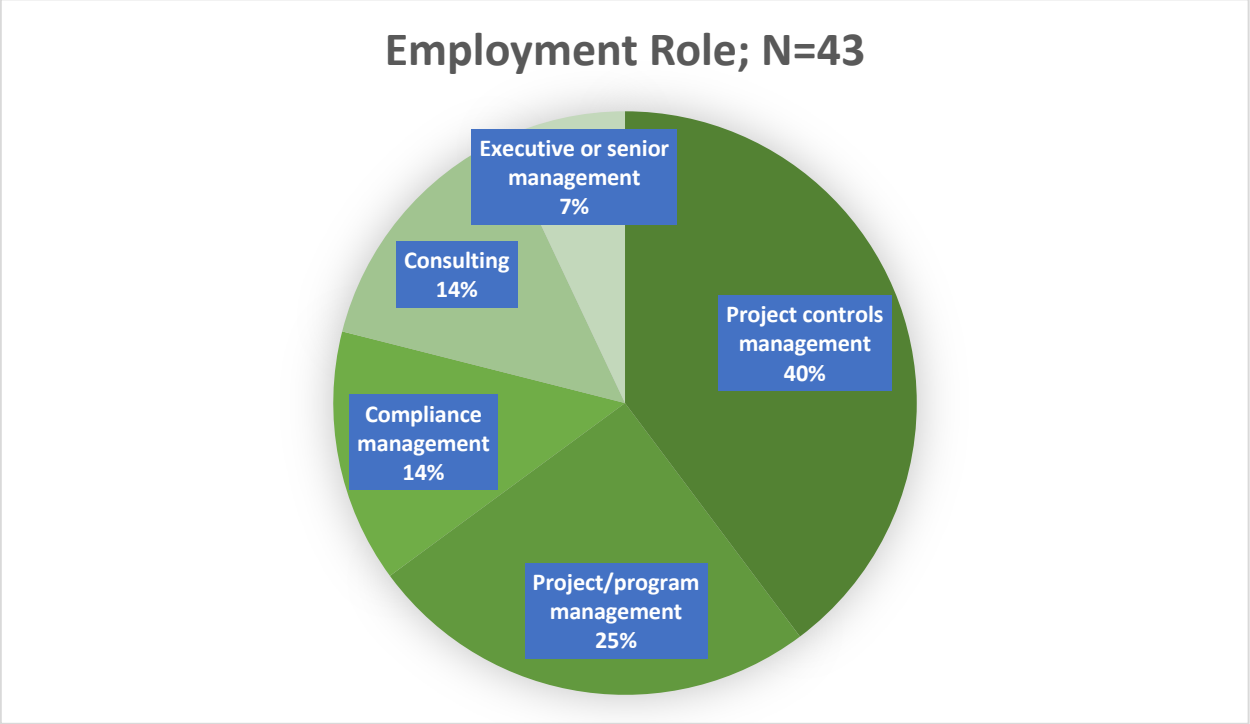
Participant	Participant's Weight for factor 1g	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-1	5.71	1.16	0.35
WSP1-2	3.21	3.66	1.12
WSP1-3	8.57	1.70	0.52
WSP1-4	0.00	N/A	N/A
WSP1-5	0.00	N/A	N/A
WSP1-6	0.00	N/A	N/A
WSP1-7	5.00	1.87	0.57

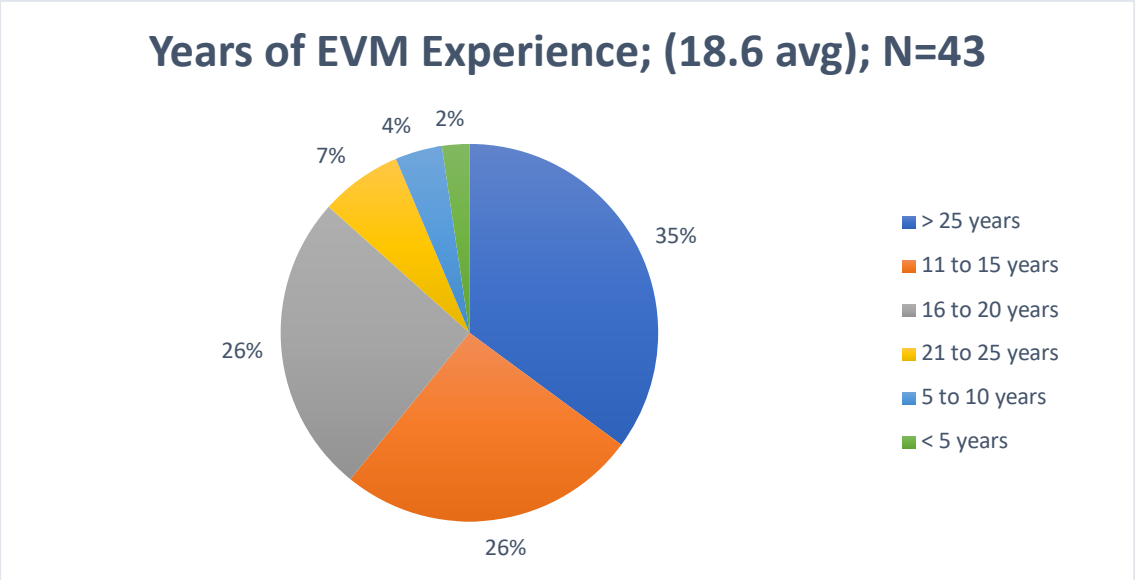
Participant	Participant's Weight for factor 1g	Distance of participant's weight from mean	Distance of participant's weight from mean in function of SD
WSP1-8	5.71	1.16	0.35
WSP1-9	0.00	N/A	N/A
WSP2-1	0.00	N/A	N/A
WSP2-2	12.50	5.63	1.72
WSP2-3	14.29	7.42	2.27
WSP2-4	4.29	2.58	0.79
WSP2-5	0.00	N/A	N/A
WSP2-7	8.93	2.06	0.63
WSP2-8	0.00	N/A	N/A
WSP2-9	4.29	2.58	0.79
WSP2-10	0.00	N/A	N/A
WSP2-11	3.21	3.66	1.12
WSP3-1	4.43	2.44	0.75
WSP3-2	10.71	3.84	1.18
WSP3-3	0.00	N/A	N/A
WSP3-4	14.29	7.42	2.27
WSP3-5	8.93	2.06	0.63
WSP3-6	8.57	1.70	0.52
WSP3-7	4.29	2.58	0.79
WSP3-8	6.43	0.44	0.13
WSP3-9	4.29	2.58	0.79
WSP3-10	0.00	N/A	N/A
WSP3-11	4.29	2.58	0.79
WSP3-12	4.29	2.58	0.79
WSP3-13	10.00	3.13	0.96
WSP4-1	3.57	3.30	1.01
WSP4-3	4.29	2.58	0.79
WSP4-4	6.43	0.44	0.13
WSP4-5	10.71	3.84	1.18
WSP4-6	0.00	N/A	N/A
WSP4-7	7.14	0.27	0.08
WSP4-8	0.00	N/A	N/A
WSP4-9	6.43	0.44	0.13
WSP4-10	2.86	4.01	1.23
WSP4-11	0.00	N/A	N/A
WSP4-12	0.00	N/A	N/A
WSP4-14	8.57	1.70	0.52

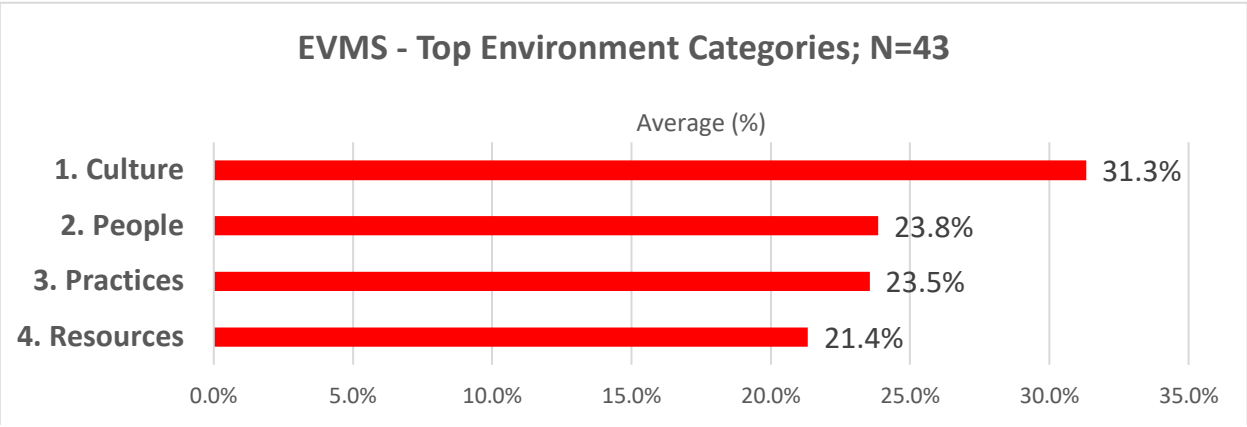
The remaining data and analyses reside at Arizona State University with the authors.

Appendix M. Environment Workshop Results Excluding Outliers (Sample)









The remaining data and analyses reside at Arizona State University with the authors.

Appendix N. Environment Normalized Factor Weights

Environment Factor	Normalized Factor Weighted Average (High Performing)
1a. The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	7.8
1b. The **customer organization is supportive and committed** to the implementation and use of EVMS.	5.4
1c. The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.	6.0
1d. **Effective teamwork exists** and team members are working synergistically toward common project/program goals.	2.2
1e. The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.	3.2
1f. **Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	1.9
1g. Project/program leaders make **timely and transparent decisions** informed by the EVMS.	4.8
2a. The **contractor team is experienced and qualified** in implementing and executing the EVMS.	6.7
2b. The **customer team is experienced** in understanding and using EVM results to inform decision-making.	5.4
2c. **Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	3.4
2d. Project/program **leadership is defined, effective, and accountable**.	4.9
2e. **Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.	0.9
2f. **Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.	2.5
3a. **Communication is open and effective**, including consistent terminology, metrics, and reports.	3.1
3b. The project/program **promotes and follows standard practices** to implement and execute an EVMS.	4.4
3c. **EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	4.4
3d. Appropriate **Subject Matter Expert (SME) input is adequate** and timely.	1.2
3e. **Coordination exists** between the key disciplines involved in implementing and executing the EVMS.	0.9

Environment Factor	Normalized Factor Weighted Average (High Performing)
3f. **Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.	3.5
3g. **Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	3.0
3h. **Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	3.0
4a. **Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.	3.4
4b. **Sufficient funding is committed** and available **for implementing and executing the EVMS**.	3.7
4c. The **project/program utilizes an appropriate periodic cycle** for executing the EVMS effectively and efficiently.	2.7
4d. The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.	3.5
4e. **Adequate technology/software and tools are integrated and used** for the EVMS.	4.7
4f. **Data are readily available** to populate EVMS tools supporting analyses for decision-making.	3.4
SUM=	100

Appendix O. Final List of Environment Factors and Descriptions

Total of 27 Factors:

Culture (7 factors), **People** (6 factors), **Practices** (8 factors), and **Resources** (6 factors)

1. Culture (7 factors)	
Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.	
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.
1b.	The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.
1c.	The **customer organization is supportive and committed** to the implementation and use of EVMS.
1d.	Project/program leaders make **timely and transparent decisions** informed by the EVMS.
1e.	The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.
1f.	**Effective teamwork exists** and team members are working synergistically toward common project/program goals.
1g.	**Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.

2. People (6 factors)	
People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.	
2a.	The **contractor team is experienced and qualified** in implementing and executing the EVMS.
2b.	The **customer team is experienced** in understanding and using EVM results to inform decision-making.
2c.	Project/program **leadership is defined, effective, and accountable**.
2d.	**Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**
2e.	**Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.
2f.	**Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.

3. Practices (8 factors)	
Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).	
3a.	The project/program **promotes and follows standard practices** to implement and execute an EVMS.
3b.	**EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.
3c.	**Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.
3d.	**Communication is open and effective**, including consistent terminology, metrics, and reports.
3e.	**Effective oversight is in place and used**, including internal and external surveillance and independent reviews.
3f.	**Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.
3g.	Appropriate **Subject Matter Expert (SME) input is adequate** and timely.
3h.	**Coordination exists** between the key disciplines involved in implementing and executing the EVMS.

4. Resources (6 factors)	
Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.	
4a.	**Adequate technology/software and tools are integrated and used** for the EVMS.
4b.	**Sufficient funding is committed** and available **for implementing and executing the EVMS**.
4c.	The team that implements and executes the EVMS for the project/program is adequate in **size and composition**.
4d.	**Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.
4e.	**Data are readily available** to populate EVMS tools supporting analyses for decision-making.
4f.	The **project/program utilizes an appropriate periodic cycle** for executing the EVMS effectively and efficiently.

1. Culture (7 factors)

Culture is, by definition, the display of behaviors. Organizational culture is a system of common assumptions, values and beliefs (or the lack thereof) that governs how people behave in organizations. Organizational values and beliefs should align with the development and outcomes of a successful EVMS. The project/program culture can enable or hinder the effectiveness of the EVMS.

1. Culture		
Factor	**Culture Environment Factors**	**Description**
1a.	The **contractor organization is supportive and committed** to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.	The contractor's integrated project/program team (IPT) is in place (i.e., corporate leadership, execution/operations, oversight, and support staff), and has a demonstrated belief in the value and disciplined use of the EVMS. The project/program follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise negatively impact a well-formed baseline plan. It has committed resources, including funding, to ensure that effective implementation of the EVMS is a priority, assuring continuous improvement and accountability at every level of the contractor organization. This commitment ensures the availability and protected time of key individuals who contribute to implementing and executing EVMS in a substantive and measurable way. Typically, this also includes the availability/commitment of other personnel with specialized skills/knowledge, who may or may not be "dedicated" to the project/program. Leadership's and team members' attitude and discipline, both at the corporate office level and the project/program level, leads to the correct use, application, and acceptance of EVMS as an integrated project/program management tool (ranging from the definition of work scope to planning and scheduling to budgeting and work authorization, to analysis and reporting to forecasting and risk management). Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. The organization's policies provide incentives and education to foster support and commitment. The contractor's team does not choose convenience over following the EVMS regulations and procedures applicable to the project/program. Project/program decision-making, which ultimately drives project results, is collaborative, and effectively relies on EVMS generated data and metrics. Governance is enforced and effective at dealing with the challenges of the project/program. *Comments: Self-governance refers to the capacity of a contractor to govern autonomously and, as such, is an important approach in overseeing the effective implementation of the EVMS. When a contractor instills integrated project/program management principles using the EVMS in a way that benefits all levels of the organization, the results can guide management decisions, lead to improved project/program execution, and optimize performance of the project/program team.*
1b.	The project/program **culture fosters trust, honesty, transparency, communication, and shared values** across functions.	The project/program culture fosters trust, honesty, and shared values, including realistic portrayal of performance and acceptance of data transparency through open communication. Project/program culture is a system of common assumptions, values, and beliefs, which governs how people behave in teams or groups. Values and beliefs displayed in the project/program should align with the implementation of the EVMS and project/program outcomes. Project/program leadership

1. Culture		
Factor	**Culture Environment Factors**	**Description**
		develops a team culture of trust and honesty where members can maintain open, synergistic relationships. A shared EVMS implementation plan helps develop a common understanding between the customer and contractor, fostering a culture of trust by laying out how things should work. This culture may also be supported by appropriate rewards or incentives for implementation of EVMS and use of EVM data for proactive management; rewards or incentives are tied to meeting project/program goals, as well as performance thresholds. Leaders are visible and accessible. The project/program culture is heavily influenced by the supporting organizational cultures that interact with it. If these cultures are aligned, establishing a team culture is much easier. However, if not aligned, creating shared values may require additional effort. For example, the contractor & customer PM can develop bilateral Rules of Engagement (ROEs) to set expectations upfront. In any case, project/program leadership, and specifically project managers, must ensure that trust and honesty are fostered within the project/program culture, which helps integrate technical information across functional areas. This includes sharing accurate data, both positive and negative, both within and across customer and contractor organizations, with little fear of retribution. Realistic status/ Estimates at Completion (EACs) are communicated at all levels and externally.
1c.	The **customer organization is supportive and committed** to the implementation and use of EVMS.	The customer organization and its project/program team have a singular view and demonstrated belief in the value and disciplined use of EVM. They support the project/program and establish EVMS expectations as an effective tool to control the project/program, tailored to the size and complexity of the project/program. The customer has committed resources, including funding, to ensure that the effective implementation and execution of EVMS at the customer level is a priority. Customer commitment ensures an appropriate level of guidance, advocacy and accountability at the project/program level by the project/program manager and engineering leadership; this commitment includes a willingness to remove roadblocks that would hinder the implementation of the EVMS and the actual performance of work. Leadership's and team members' EVMS knowledge, attitude, and discipline, at both the customer program office and customer oversight organization, lead to the correct use, application, and acceptance of the EVMS as a management tool, including forecasting and risk management. Leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making and system corrective actions and improvements. Customer leadership does not choose convenience or preference over following EVMS regulations and procedures and must balance the need to produce a product with the requirements to maintain due diligence using EVM. The organization's policies provide incentives and education to foster support and commitment. Formal and timely examination, assessment, and acceptance of EVMS generated data, metrics, and reports provides the project/program with the potential of initiating change, where and when needed. If the project/program has multiple customers and/or sponsors, then they are consistent in their assessment of the contractor's EVMS. Customer commitment ensures consistent use and management action resultant from EVMS data.
1d.	Project/program leaders make **timely**	Timely and transparent decisions, by both the contractor and customer, are critical to project/program success. Project/Program leadership and

1. Culture		
Factor	**Culture Environment Factors**	**Description**
	and transparent decisions informed by the EVMS.	team members have situational awareness of the progress made on programmatic objectives that lead to timely, effective decisions. The project/program places adequate emphasis on the importance of the EVMS as the means used to develop and integrate scope, schedules, and budgets, as well as understanding risk and uncertainty. The project/program uses EVMS to predict and positively influence schedule and cost outcomes using generated data, metrics, and reports in formats that assist effective management and decision-making. Sufficient communication platforms exist and disseminated information is available to enable effective decisions. Team members responsible for implementing and executing the EVMS are supported by timely decisions and input from the sponsors and have corporate support when needed. Decisions are shared transparently (e.g., scope changes are shared across key stakeholders) and are consistent.
1e.	The project/program **leadership effectively manages and controls change** using EVMS, including corrective actions and continuous improvement.	The project/program leadership (including contractor and customer leadership teams) has the authority to manage and respond to changes, implement corrective actions, and employ continuous improvement practices. Changes will occur on every project/program. These include, but are not limited to, scope changes, forecasts, personnel changes, funding changes, external environmental changes, EVMS tool changes and so on. Regardless of the change, project/program leadership and the team acknowledge and are tolerant that change is a normal part of the project/program and are proactive in their response to change. The customer and contractor foster an environment that is actionable and innovates fast enough to operate in a rapidly changing environment using the EVMS. The EVMS provides a solution-based approach to addressing complex project/program problems. The customer and contractor need to remove obstacles to processing contract and baseline change management. The baseline is proactively managed to ensure that it is realistic and preserves the integrity of related metrics. Project/program leadership are diligent to ensure that the team follows a closed-loop procedure when responding to change. Project/program leadership handles changes with a positive attitude. Changes are handled proactively, resulting in positive stakeholder attitudes and outcomes leading to effective implementation and continuous improvement of EVMS.
1f.	**Effective teamwork exists** and team members are working synergistically toward common project/program goals.	EVMS stakeholders (including customer and contractor) are working synergistically together toward common project/program goals using effective teamwork. There is a mutual commitment to work together. The project/program overcomes functional silos through effective teamwork and is able to organize effectively for integrated project/program management activities. Effective teamwork promotes and welcomes a diversity of ideas and perspectives which can be beneficial to the EVMS. It is important that teamwork be developed through formal and informal team building programs as early in the project/program timeline as possible or feasible. Team building contributes to alignment by helping a group evolve from a collection of individuals into a true team. Team building seeks to resolve differences, remove roadblocks, and build and develop trust and commitment, a common mission statement, shared goals, interdependence, accountability among team members, and problem-solving skills. Team building within both the customer and contractor teams is important. Team building between

1. Culture		
Factor	**Culture Environment Factors**	**Description**
		customer and contractor is equally important, but should ensure customer independence and meeting of applicable regulations. Team building takes into account the current stage of team development (i.e., forming, storming, norming, and performing). Effective teamwork may be impacted by team members and their organizations having a history of working together on past efforts using the EVMS. In addition, excessive turnover of team members may hinder effective teamwork because of lack of continuity. Turnover requires the team to address team building activities again to minimize associated impacts.
1g.	**Alignment and cohesion exist among key team members** who implement and execute EVMS, including common objectives and priorities.	Alignment and cohesion among key EVMS stakeholders, including agreement around common objectives and current priorities, provides the team with the ability to effectively move forward together on the project/program using EVMS. Alignment is the condition where appropriate participants are working within acceptable tolerances to develop and meet a uniformly defined and understood set of project/program objectives. Effective alignment provides direction and the ability to respond to change as needed. Lack of alignment, conversely, will lead to project/program team pursuing conflicting objectives and goals. Alignment must effectively incorporate a diversity of ideas and perspectives which can be beneficial to the EVMS. Both customer and contractor work cohesively and collectively to implement the EVMS, including working with designated project controls personnel assigned to EVMS implementation. EVMS implementation and execution includes individuals from the entire project/program (e.g., corporate EVMS oversight, consultants, customer, contracts, finance and procurement offices, and so forth). EVMS alone cannot ensure alignment but it does provide mechanism for understanding lack of alignment. In the project/program environment, alignment exists in three dimensions. The first dimension is vertical and involves top-to-bottom alignment within an organization. Executives, business managers, project managers, and functional specialists within each stakeholder organization must be well-aligned. The second, horizontal, involves the cross-organizational alignment between functional groups within the organizations represented on the project/program. Different organizations (e.g., customer, prime contractor, subcontractors, external stakeholders) with a stake in the project/program must also be well-aligned. Any disconnects are understood and addressed to foster alignment. If the project/program has multiple customers and/or sponsors, then they must be taken into consideration for alignment and cohesion. The third dimension, longitudinal, involves alignment of objectives throughout the project/program lifecycle. Alignment ensures that clear lines of responsibility and authority are in place across all dimensions. *In the context of this tool, the EVMS implementation phase includes processes such as organizing, planning and scheduling, and budgeting and work authorization. The EVMS execution phase includes change control, accounting, material management, indirect budget and cost management, analysis and management reporting. Risk management and subcontract management occur in both phases (EIA 748-D Intent Guide).*

2. People (6 factors)

People denotes the individuals who represent the interests of their respective stakeholders (e.g., project business manager, project control analyst, project schedule analyst, acquisitions/subcontracts, control account manager, Integrated Project/Program Team (IPT) or line/resource management) and are adept in the relevant subject matter, in order to contribute to the process that leads to favorable project control outcomes.

2. People		
Factor	**People Environment Factors**	**Description**
2a.	The **contractor team is experienced and qualified** in implementing and executing the EVMS.	The contractor leadership team (e.g., executive management, functional organizational manager, project/program manager, contracts manager) and the contractor's project/program team (e.g., project/program manager, project controls managers, control account managers) are experienced in implementing and executing the EVMS to inform decision-making on a project/program of similar size, scope, and/or location. They are also qualified to effectively implement and execute the EVMS based on relevant training, education, certification or past experience given the nature of the project/program, its level of risk, local conditions, schedule constraints and so on. Experience and qualification may differ for implementation versus execution of the EVMS. The contractor team should have the right mixture experienced to make sure that the outcomes are successful throughout the project/program. Previous experience increases the contractor leadership team's familiarity with the project/program planning, design, and execution processes. Relevant experience is important because repetition plays a major role in both organizational learning (e.g., lessons learned, mentoring, continuous improvement) and in creating routines and capabilities in general. Realizing that everyone is inexperienced at some point, there should be a structured method for mentoring and professional development to bring these individuals up to the right level of technical knowledge and skills, given the nature of this specific project/program.
2b.	The **customer team is experienced** in understanding and using EVM results to inform decision-making.	The customer is the organization that sponsors the project/program's funding and ultimately takes over the operation of the completed project/program. The customer leadership team (e.g., sponsor representative, contracting officer) and customer project/program team (e.g., project manager, budget officer, contracting official, project controls managers, engineering lead) have previous experience using the EVM results to inform decision-making on a project/program of similar size, scope, and/or location. The customer should have the right mixture of experienced personnel to make sure that EVM is used effectively to inform decision-making. Previous experience with projects/programs of similar size and complexity increases the familiarity and understanding of the customer leadership team and project/program team with the project/program planning, design, and execution processes. Relevant experience is important because repetition plays a major role in both organizational learning (e.g., lessons learned, mentoring, continuous improvement) and in creating routines and capabilities in general. Realizing that everyone is inexperienced at some point, there should be a structured method for mentoring and professional development to bring new individuals up to the right level of technical knowledge and skills, given the nature of this specific project/program.
2c.	Project/program **leadership is**	Project/program leadership, for both the customer and the contractor, is defined, effective, and accountable, which leads to better implementation and execution of EVMS. Project/program leadership

2. People		
Factor	**People Environment Factors**	**Description**
	defined, effective, and accountable.	roles will vary across organizations and typically include a project/program sponsor, project director, customer representative, project/program manager, construction manager, operation manager and others. Organizational structure typically follows the hierarchy of executive steering committee, project/program leadership team and execution team. Furthermore, the sponsor and senior leadership can affect the environment of the project/program. These individuals are responsible for the project/program, have decision-making authority, and ultimately will be held accountable for project/program success; as stewards of the project/program, their influence will positively or negatively affect the use of EVM. Components of good leadership in the context of project/program typically include: • Good general knowledge of contracting strategy, project/program phases, and delivery systems • Good understanding of related business critical success factors • Capacity to determine and align the needs of the key stakeholders • Adequate understanding of manufacturing and/or construction, start-up, operations • Good understanding of assessing and managing uncertainties and risks Components of good leadership in the context of EVMS typically include: • A demonstrated belief in the value and disciplined use of EVMS • Clear support of EVMS as an effective tool to control the project/program • Swift action if the EVMS maturity or environment needs improvement, including system certification if needed • Implementation of a governance plan that includes EVMS • An understanding of the relationships and integration between EVMS and other systems' metrics (e.g., accounting, risk management, quality, safety, Material Requirements Planning System (MRPS), etc.) • Striving for more than minimum expectations
2d.	**Project/program stakeholder interests are appropriately represented** in the implementation and execution of the EVMS**.**	Project/program internal and external stakeholder interests are appropriately represented to provide the right input at the right time during EVMS implementation and execution. A stakeholder is an individual (or entity) who can influence the project/program or is influenced by the project/program. Appropriate internal stakeholders may include individuals representing the contractor, operations and maintenance, key design/technical leads, control account managers, project/program management, procurement, accounting, material management, quality management, sponsor, end-user and manufacturing. External stakeholders may include regulators, Indigenous peoples, local communities, state or provincial government, other government agencies and so forth. Stakeholders effectively communicate expectations and may assist with key decisions. Appropriate stakeholder input helps improve team alignment by providing a sound foundation for a successful EVMS. Proper stakeholder input also provides the leadership team and project/program management team with diverse expertise that covers both the technical and management areas of the project/program. For example, EVMS stakeholders (e.g., control account managers, project/program management) are represented on the project/program

2. People		
Factor	**People Environment Factors**	**Description**
		leadership team and appropriately engaged, providing a diversity of ideas. Another example would be that stakeholders are appropriately represented on the EVMS implementation team to ensure understanding of the project/program scope. This diverse expertise facilitates better solutions and sound judgments to the problems faced by the team.
2e.	**Professional learning and education** of key individuals responsible for EVMS implementation and execution, **is appropriate** to meet project/program requirements.	Professional learning and education of key individuals responsible for EVMS implementation and execution supports meeting project/program requirements. It allows key individuals to adequately apply earned value knowledge, offer professional input and thought leadership, and inform decision-making based on best practices and recognizable standards. Implementing and executing the EVMS requires individuals with the necessary technical background, training, EV tools knowledge, qualifications and certification in the relevant subject matter. Effective training on project/program management practices, procedures, and processes clearly communicates expectations and teaches how to implement the EVMS in the actual operation of work, and supplements experience. A rigorous and tailored professional development program is maintained as the project/program progresses, including development of technical capabilities, exposure to current practices, sharing of lessons learned among project/program managers, and relevant internal and external training/certification of key EVMS stakeholders as part of lifelong learning principles. A proactive, formalized learning and development framework should consider succession planning, cross-disciplinary training, team depth, recurring refresh training and integration across cost and schedule expertise, leading to processional growth and career advancement.
2f.	**Team members** responsible for the EVMS implementation and execution phases **are co-located and/or accessible**.	Project/program leadership and team members responsible for the EVMS implementation and execution phases of the project/program are co-located and/or accessible, which provides an opportunity for closer coordination and interaction. Team members who are co-located and/or accessible tend to develop shared goals, purpose, and culture. If the team is co-located for the general day-to-day execution of the project/program, by default those responsible for implementing the EVMS, both technical and project controls, are co-located. Co-location facilitates the development of a positive team climate, independent team processes, maturation of team members and the team itself. Team members being accessible (e.g., using video conferencing technologies and so on) can provide some of the same benefits of physical co-location. Ideally, co-location makes for more effective collaboration, but the key is to have modes that allow for the team to regularly and easily meet, converse, and share ideas, issues, and solutions. Lack of co-location and/or accessibility may be affected by time-zones and language barriers and may necessitate using additional communication techniques and technology to effectively support the project/program.

3. Practices (8 factors)

Practices are internal and external procedures and processes that can positively or negatively influence the outcome of a project or program. Internal business practices and methods are specific to a given organization, including internal standards, requirements and best practices. External business practices, regulations, requirements, procedures and methods are across organizational boundaries (e.g., government to contractor, software provider to contractor, subcontractor to prime, and so forth).

3. Practices		
Factor	**Practices Environment Factors**	**Description**
3a.	The project/program **promotes and follows standard practices** to implement and execute an EVMS.	Project/program management documents containing effective practices, procedures, processes and tools focused on the implementation and execution of the EVMS have been developed, and are consistently used and tailored to the size and complexity of the project/program. These documents are often referred to as the EVM System Description and define a uniform, consistent and realistic approach to EVMS implementation and execution. The project/program promotes and follows these standard practices. Moreover, standard practices need to include proper, realistic and up-front EVMS planning. EVMS standard practices govern the organization's project/program management system that integrates a defined set of associated work scopes, schedules and budgets for effective planning, performance, and management control. Any variation from the organization's standard procedures for a given contract must be made clear to all stakeholders to ensure alignment. Standard practices also facilitate training of all team members including less experienced members.
3b.	**EVMS requirements definition is in place, and agreement exists** among key stakeholders and customer.	EVMS requirements definition is in place, and agreement exists among key stakeholders and the customer, helping stakeholders have common expectations on the importance of EVMS. EVMS project/program objectives are clear and scaled to the size and complexity of the project/program. Customer work scope requirements including the requirement to implement the EVMS are clearly communicated and defined in writing before work begins. EVMS requirements support contractual requirements, other memoranda of understanding, scope definition, decision-making, risk management, plan optimization, negotiating project/program changes, and integrated change control, leading to more uniform and better-informed decisions.
3c.	**Roles and responsibilities are defined**, **documented and well-understood** for implementing and executing EVMS.	Practices, procedures, and processes clearly define and document the roles, responsibilities, accountability, and authority of internal and external stakeholders for both contractor and customer. Clear definition is essential for alignment toward shared goals and effective implementation and execution of the EVMS. The project/program's roles, responsibilities and authorities are well understood, consistent with the contract, followed, and updated as needed, so that the EVMS can run efficiently with no gaps. Roles and responsibilities should take into consideration the contractual inconsistencies and gaps that may exist with multi-mission or multi-stakeholder settings. Typically, roles, responsibilities and authorities are documented in a Responsibility Assignment Matrix. Roles and responsibilities that are clear make implementation and execution of EVMS much smoother, helping to meet project/program expectations.
3d.	**Communication is open and effective**,	Open and effective communication channels exist at all times to transfer EVMS information in an efficient and expedient manner.

3. Practices		
Factor	**Practices Environment Factors**	**Description**
	including consistent terminology, metrics, and reports.	Communication is important for building and maintaining a productive interface between the project/program and EVMS stakeholders including consistent terminology. A communication plan with stakeholders is identified, including clear milestones for involving specific stakeholders as needed. The availability of metrics and reports allows management, both customer and contractor, visibility into the project/program's current state. For example, realistic status / Estimates at Completion (EACs) are communicated at all levels internally and externally. As required by the contract, the project/program clearly identifies and communicates required metrics and reports for the EVMS in meaningful language and terms understandable by all parties. These metrics and reports are produced in a timely manner to communicate any existing significant variances and anomalies to support effective management decision-making. Moreover, conflict resolution practices and procedures are in place and actively utilized.
3e.	**Effective oversight is in place and used**, including internal and external surveillance and independent reviews.	Practices are in place and used for effective oversight of the EVMS by an independent entity throughout the project/program lifecycle to ensure that the project/program moves in the right direction. Evaluations of EVMS practices and processes including those used to assess EVMS implementation efficacy and/or compliance to standards are regularly performed and trends evaluated. These practices include adequate resources and management commitment to support both internal and external data-driven surveillance and independent reviews. Oversight is many times driven by contract requirements and agreements in place between customer and contractor. One type of independent assessment is having an internal, administratively independent oversight team or organization (e.g., audit, financial, project/program controls) provide this input. Conversely, an organization external to the program may be tasked to perform this type of oversight to provide the opportunity to impact change. Independent, external assessment and evaluation are important because they help remove conflicts of interest and identify other issues that may not be evident to the project/program team. Effective oversight and surveillance practices help ensure that the project/program maintains self-governance and leads to corrective action and continuous improvement.
3f.	**Contractual terms and conditions** that impact the effectiveness of EVMS **are known and have been addressed**.	Contractual terms and conditions (e.g., contract type and associated risk, use of agile, fast-tracking, large number of changes, and late requirements to use an EVMS) are known, and those that are not appropriate or conflicting with EVMS have been addressed as early as possible. In some cases, contract terms and conditions can limit the effectiveness of EVMS application. For instance, the contractual terms and conditions for EVM may not be appropriate for the contract scope (e.g., the contractor is required to implement a full EVMS on a relatively small, simple maintenance program). The contract award fee or incentives are based on the acceptable implementation and use of the EVMS and current, accurate, and complete performance data for proactive management, in addition to meeting target milestones or deliverables. Contract award fee or incentives are not tied solely to performance thresholds. This factor also considers the extent to which terms and conditions are actively enforced and strictly interpreted. Contractual terms and conditions

3. Practices		
Factor	**Practices Environment Factors**	**Description**
		are identified, including the responsibility for implementation and maintenance of EVMS, and the project/program is proactively addressing any limitations within the EVMS structure (e.g., overlap of responsibilities, mismatch of business rhythm versus capability, contract time is not conducive to project objectives and so forth). Contract modifications are reviewed to ensure that their impact on EVMS is addressed, especially changes made late in the project/program's life.
3g.	Appropriate **Subject Matter Expert (SME) input is adequate** and timely.	Appropriate SME input is utilized in a timely, effective and efficient manner, supporting the project/program execution team's needs. SMEs are typically external to the project/program and have experience and expertise in certain domains of knowledge critical for EVMS success. They can be used for independent assessment or reviews (e.g., Non Advocate Reviews (NARs)) or as a "time-shared" resource split between two or more projects/programs. Individual SMEs may cover one or more functional areas, as needed. With the significant input of appropriate SME knowledge, lessons learned are leveraged and obstacles that typically hinder the use of EVMS are identified well in advance to facilitate timely and consistent use of data, enhancing management decision-making.
3h.	**Coordination exists** between the key disciplines involved in implementing and executing the EVMS.	A formal structure of interaction between the key disciplines involved in implementing and executing the EVMS enables them to coordinate and integrate EVMS effectively with other project/program management activities. Key disciplines could include accounting, engineering, project management, procurement, supply chain integration, and others. Specifically, a cross-discipline coordination and collaboration plan exists and is followed, to assist discipline leads, compliance reporting, audits, etc. This plan, along with a responsibility matrix, is used to coordinate efforts between the customer, contractor, and external stakeholders. Typically, the coordination and collaboration plan is part of the project/program execution plan and must be updated as changes occur.

Resources (6 factors)

Resources are the availability of key tools, data, funding, time, personnel, and technology/software to support the EVMS process.

4. Resources		
Factor	**Resources Environment Factors**	**Description**
4a.	**Adequate technology/software and tools are integrated and used** for the EVMS.	Technology/software and tools are available, accessible, current, and used appropriately as part of the integrated EVMS. Appropriate investments are made in technology and infrastructure including investments in EVMS tools to assist in the actual operation of work, making decision-making and data-sharing more effective. The necessary expertise (e.g., programmers, systems analysts, etc.) is available to integrate the technology and processes and setup the interfaces between the various tools to ensure smooth integration and minimize the need for major change. Technology and processes are periodically assessed both for adequacy and potential solutions available in the marketplace. Software products can be "homegrown" internally or a commercial system provided by a vendor with adequate support. Technology/software is affected by the extent to which the tools are automated versus needing manual data input. The technology/software allow the project/program to completely integrate its EVMS processes with its other digital infrastructure systems, creating a meta-system of connected processes and tools that communicate with each other, preferably automatically. Software and tools are in place to generate all of the necessary reports, charts, and data from the summary, total program and project levels down through the Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS) and down to the Work Package (WP)/task level. Essentially, it provides the ability to drill down through the data and summarize data up to the portfolio level.
4b.	**Sufficient funding is committed** and available **for implementing and executing the EVMS**.	Sufficient funds are allocated and available to appropriately support the EVMS process for all directly involved in the project/program from initiation until the final EVMS deliverables. In some cases, the project/program is sufficiently funded however the EVMS is not funded sufficiently for implementation and execution. In other cases, though not generally acceptable, the project/program is not sufficiently funded at initiation to meet the project/program baseline requirements. In some situations, funding is provided on a year to year basis which can cause continuity concerns. In any of these cases, the EVMS effort may be severely affected. Sufficient funding requires up-front organizational allocation and commitment to accomplish EVMS requirements; funding is applied strategically and efficiently, using industry benchmarks or standards where appropriate for comparison. Funding is also available for non-project/program-specific external resources to allow the project/program to support internal and external surveillance, training, lessons learned, corrective action plans, and other needs. External resources outside of the project/program can flexibly provide surge capacity, independent assessment, or specialized knowledge on an as-needed basis either in implementing or executing an efficient and effective EVMS.
4c.	The team that implements and executes the EVMS for the project/program is	The team that implements and executes the EVMS for the project/program is adequate in size and composition to efficiently support the project/program, adjusted as needed. The customer and contractor organizations have committed time and resources to efficiently and effectively use EVM results, ensuring that decision-

4. Resources		
Factor	**Resources Environment Factors**	**Description**
	adequate in **size and composition**.	making is timely and informed. Customer and contractor organizational staffing levels are in place and adequate to execute scope and workflow successfully, including staffing levels to effectively implement the EVMS. This includes individuals from the project/program, corporate EVMS oversight, consultants, customer, project controls, contracts, finance and procurement offices, and so forth. It has the appropriate expertise, authority, and experience, with size and composition comparable to industry benchmarks where appropriate.
4d.	**Sufficient calendar time and work-hours are committed and available** for implementing and executing the EVMS.	Sufficient working days and work-hours are committed and available for all directly and indirectly involved in appropriately implementing and executing the project/program's EVMS. The magnitude of effort to perform the EVMS function is known and resources to perform the effort is available when needed. This allocation of time and work-hours allows adequate effort based on the size and complexity of the project/program. It requires organizational prioritization and commitment of resources to accomplish EVMS requirements, as well as sufficient notification to assign the resources. For example, this requires the commitment of functional managers and program specific managers to have individuals available for the effort and dedicate key personnel's time to support the EVMS.
4e.	**Data are readily available** to populate EVMS tools supporting analyses for decision-making.	Data are readily available and accessible in a consistent and timely manner according to the business rhythm. It should be shared effectively and efficiently, and support analyses to properly manage the project/program. These data are current, accurate, complete, repeatable, auditable, and contextualized to aid understanding which leads to effective, timely, and informed decision-making at all levels. Data also meet applicable EVM reporting requirements, such as file type, format, and so on.
4f.	The **project/program utilizes an appropriate periodic cycle** for executing the EVMS effectively and efficiently.	The EVMS is executed in a cycle time that is appropriate to control the project/program effectively and efficiently, according to the business rhythm calendar per the contract requirements. The appropriate periodic cycle is used to assess and prioritize workflow, ensuring demand is balanced against the capacity of the EVMS, which helps effectively plan, forecast, and allocate resources. This allows EVMS personnel and management to proactively address any issues that may occur. The same periodic cycle is followed by subcontractors, accounting, procurement, contracting and others, as required.

Appendix P. IP2M METRR Research Team
(2019-2022)

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