THE PRACTITIONER

A monthly newsletter of the Energy Facility Contractors Group's Project Delivery Working Group

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# Environmental Factors

Happy New Year EFCOG Practitioners! Here we are at the threshold of a new and challenging year full of opportunity and success. What better time to take stock of our environment to assure we create optimal conditions for our upcoming achievements.

This month's *Practitioner* refocuses our attention on the Environment Factors. But before we can take the plunge, we need to understand why this is important in two words: "Self-Governance".

The primary source document for this article is attributable to the Compliance Assessment Governance (CAG), as contained within PM Earned Value Management Systems (EVMS) Compliance Review Standard Operating Procedure (ECRSOP), and based on the EIA-748 EVMS standard.

Self-governance refers to the capacity of a project/program to govern autonomously and, as such, is an important approach to overseeing the effective implementation of the EVMS. When projects/programs instill an integrated project management methodology using the EVMS in a way that benefits both the customer and contractor, the results can often lead to improved execution and the optimal performance of the project/program team.

On the "Maturity" side, EIA-748 compliance is accomplished through self-governance where both the customer and contractor hold themselves accountable for the oversight and validation of EVMS-generated data. Customer, contractor, and stakeholder active involvement in encouraging and establishing a culture of self-governance is essential to an effective EVMS.

Self-governance is a repeatable process in which the contractor (as the EVMS owner) oversees itself and controls its affairs. When a project/program instills an integrated project management methodology and promotes a culture of self-governance and compliance, it positions itself for success.

So, with a good understanding of the importance of the optimal environment in supporting self-governance, lets take a look at what and how we assess our environment.

The environmental and human factors of a project refer to events, factors, people, systems, structures, and conditions, internal and external to organizations, that influence how projects are managed and the effectiveness of project management tool such as the implementation of the EVMS. Culture, People, Practices, and Resources are the driving factors most associated with a project's environment, and as such, influence organizations' activities, decisions, behaviors, and attitudes of the people responsible for implementing the EVMS.

Let's drill down to the four components of environment: Culture, People, Practices, and Resources.

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**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 govern how people behave and interact with one another inside of a project. Organizational values and beliefs align with the development and outcomes of a successful EVMS. The project culture can promote or hinder

| Description | Checkpoint |
|---|---|
| **1A**<br><br>The contractor organization supports and is committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance. | a) The contractor integrated project team (IPT)—including corporate leadership, execution and operations personnel, oversight personnel, and support staff—is in place, and it has a demonstrated belief in the intrinsic value of the EVMS to position the project for success.<br>b) The project follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise impair a well-formed baseline plan.<br>c) The project 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 of key individuals who contribute to implementing the EVMS. Typically, this includes the availability and commitment of other personnel with specialized skills and knowledge of the EVMS, who may or may not be "dedicated" to the project.<br>d) Contractor leadership and team member attitude and discipline, at the corporate office and project levels, lead to the correct use, application, and acceptance of EVMS as an integrated project management tool used in the definition of work scope, planning and scheduling, budgeting and work authorization, managerial analysis, reporting, forecasting, and risk management.<br>e) Contractor leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making.<br>f) The contractor organization's policies include incentives and education to foster support and commitment to implementing the EVMS.<br>g) The contractor team does not choose convenience over following the EVMS regulations and procedures that apply to the project.<br>h) Project decision-making, which ultimately drives project results, is collaborative and effectively relies on EVMS-generated data and metrics.<br>i) Governance is enforced and effective at dealing with the project challenges. Self-governance refers to the capacity of a contractor to govern autonomously, an important approach in overseeing effective EVMS implementation. When a contractor instills integrated 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 project execution, and optimize the performance of the project team. |

***Table 1. Cultural Factors***

EVMS effectiveness. This category includes seven factors, 1A through 1G (Table 1). The more the project fulfills these factors, the more effective the EVMS.

Given the Description and Checkpoints provided (above), a typical assessment whether self or externally performed, is now left to determine and how to validate the "Checkpoint" criteria has been met. For example:

Checkpoint a) *The contractor integrated project team (IPT)—including corporate leadership, execution and operations personnel, oversight personnel, and support staff—is in place, and it has a demonstrated belief in the intrinsic value of the EVMS to position the project for success.*

You can certainly ask for a list of IPT personnel, but assessing "*... if corporate leadership, execution and operations personnel, oversight personnel, and support staff—is in place, and it has a demonstrated belief in the intrinsic value of the EVMS*..." could be bit tricky and will

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require thought in identifying what might be available to demonstrate through objective evidence, that the checkpoint can be validated.

Consider an approach that identifies artifacts which validates "…EV data and information is used to make informed decisions using documented policies, letters, memos, practices, roles and responsibilities that establish and reinforce the belief and use of earned value"
Below is Culture 1A, "a through I, with Descriptions, Check Point, and proposed "Demonstrated Objective Evidence: Validate that…" example artifacts for your consideration.

| **CULTURE 1A – The contractor organization supports and is committed to EVMS implementation, including making the necessary investments for regular maintenance and self-governance.** | |
|---|---|
| **Checkpoint** | ***Demonstrated Objective Evidence: Validate that…*** |
| The contractor integrated project team (IPT)—including corporate leadership, execution and operations personnel, oversight personnel, and support staff—is in place, and it has a demonstrated belief in the intrinsic value of the EVMS to position the project for success. | *…EV data and information is used to make informed decisions using documented policies, letters, memos, practices, roles and responsibilities that establish and reinforce the belief and use of earned value* |
| The project follows an integrated project management strategy to identify and manage risks using the EVMS that would otherwise impair a well-formed baseline plan. | *…appropriate and applicable, documented contract / company / project level risk management policies, procedures, plans and registers are being used to manage / process / assess / resolve, with documented reports on risk management issues* |
| The project 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 of key individuals who contribute to implementing the EVMS. Typically, this includes the availability and commitment of other personnel with specialized skills and knowledge of the EVMS, who may or may not be "dedicated" to the project. | *…the Contractors' organization is not resource constrained to the point where EVMS subject matter experts are available, reporting at an effective level equal to or above project peers, with an avenue to express independent views on the health and compliant state of the EVMS.* |
| Contractor leadership and team member attitude and discipline, at the corporate office and project levels, lead to the correct use, application, and acceptance of EVMS as an integrated project management tool used in the definition of work scope, planning and scheduling, budgeting and work authorization, managerial analysis, reporting, forecasting, and risk management. | *…the Project Manager (TPM) / President issued documented direction / informed decisions to the Direct Reports (DRs) / Project Managers (PMs) for the resolution of any of the earned value data and information topics identified* |

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| Contractor leadership actively revisits the most effective ways to evaluate EVMS metrics that support decision-making. | *…documented direction/informed decisions provided by TPM, DRs, IPT, or PMs was executed in a clear, concise, effective manner without delay, or clarifications were requested immediately* |
| The contractor organization's policies include incentives and education to foster support and commitment to implementing the EVMS. | *…follow-up to the informed decision actions were promptly documented and reported back to the issuer (TPM, DRs, IPT, or PMs) with respect effectiveness of issue resolution* |
| The contractor team does not choose convenience over following the EVMS regulations and procedures that apply to the project. | *…if the issue was not resolved, the process steps were repeated until effective resolution was achieved and documented* |
| Project decision-making, which ultimately drives project results, is collaborative and effectively relies on EVMS-generated data and metrics. | *…there is documented collaboration between contractor organizations and other stakeholders, demonstrating discussions and decisions made, and the outcome of the collaboration with respect to the program/project* |
| Governance is enforced and effective at dealing with the project challenges. Self-governance refers to the capacity of a contractor to govern autonomously, an important approach in overseeing effective EVMS implementation. When a contractor instills integrated 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 project execution, and optimize the performance of the project team. | *…there is documented self-governance assessments, presentations, and or other written forms of communication frequently used to record the health, compliance and ongoing improvement of the contractors EVMS, and that Self-Governance should is institutionalized, supported by written policy/procedure, and otherwise made part of the routine monthly process.* |

So, if you're considering the next step in self-governance, with the purpose of assessing the environment in which you operate, it is very likely you will be taking important steps in improving the execution and performance of your project or program.

A complete example set of Culture, People, Practices, and Resources "Demonstrated Objective Evidence" proposed artifacts is available by contacting Craig Hewitt. Note that these proposed example artifacts are draft. While each project may have a unique approach, the commonality here is the "Demonstrated Objective Evidence."

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# Practitioners "Call to Action"

The EFCOG PDWG was requested to add an FY24 Annual Work Plan activity to collaboratively tackle the development of a "Problem Statement" to address repeat observations/findings related to indirect budget/cost activities in the schedule and a broader topic regarding similar scope in shared services/LOE accounts.

| | | | | |
|---|---|---|---|---|
| **8. Indirect Budget/Cost Management and the Schedule** | Driver: **DOE PM-30/EFCOG Problem Statement**<br>Benefit: **Common understanding of the problem and the Optimized Solutions** | **Optimized Compliance with EIA-748 and CAS** | **A. Gilstrap** | **9/30/24** |

***Draft Problem Statement***

"DOE Contractors managing projects across the complex must utilize processes that are compliant to multiple requirements (i.e., EIA-748, CAS). The management of indirect labor (resources and costs) within the PMB has not always been at a level which allows DOE to measure project performance in a Current, Accurate, Complete, Repeatable, Auditable, and Compliant (CACRAC), manner time-phased throughout the project lifecycle. DOE needs its contractors to better monitor specific indirect activities in the IMS to improve forecasting, decision -making, and validation. These indirect activities also impact planning, budgeting and work authorization, risk management, change control, and analysis and management reporting."

**Assertions**

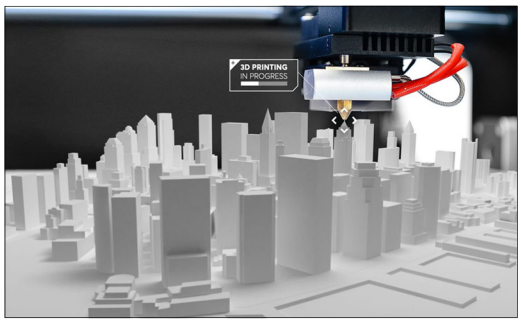
- The indirect work scope is definable.
- The indirect work scope can be related to discrete work scope
- There is clear accountability for planning and execution of the indirect work scope.
- The integration between management systems is maintained at all times during the planning and execution of the indirect work scope.
- There is accurate, timely, and meaningful reporting of indirect work scope performance.
- The indirect work scope performance metrics are relatable to the PMB.

This task requires the support of Subject Matter Experts (SMEs) in indirect activities, accounting, Cost Accounting Standards (CAS), disclosure statements, level of effort activities, shared services, and scheduling. If you are a demonstrated SME in one or more of the categories identified and interested in supporting this task, please contact Andrea Gilstrap directly andrea.gilstrap@inl.gov.

# It Is Not One World

# 3D printing offers big promises for construction. Will the innovation live up to the hype?

*By Grace Ellis, Autodesk.com*




3D printing has been a big buzz term over the past decade–and for good reason. Though initially developed for product prototyping purposes, 3D printing technology has advanced to the point where it has emerged as a key player in a variety of industries.

While clearly, 3D printing technology has proven beneficial in the medical, aerospace, and tool-making arenas since its inception, there's one other field that's potentially poised to break out: the construction sector.

With 3D printers now capable of printing building walls and processing cement, the technology could help reshape construction as we know it. But is 3D printing in construction just a fleeting trend or does it have real staying power as a technology that can serve as a key long-term solution? Below, we'll explore how 3D has been already making waves in construction and what the future looks like.

**A History of 3D Printing in Construction**

Before we get into a history of 3D printing in the construction industry, it's first important to take a step back in time to the origins of 3D printing itself.

3D printing's roots date back to the mid-1980s when stereolithography, or SLA, was conceived. SLA works as a high-powered laser and turns a liquid resin into a solid material. SLA is an additive technology, which means it involves creating a product from the ground up in a layer-by-layer fashion. Today, SLA is still one of the most popular 3D printing technologies, though 3D printing is generally considered any technology that creates parts in an additive way. Some other popular additive technologies include selective laser sintering (SLS), fused deposition modeling (FDM) and direct metal deposition (DMD).

3D printing initially was utilized for quickly and accurately creating prototype parts. As additive processes improved, however, its viable uses began to expand. Prior to the adoption of building information modeling (BIM), 3D printing was even used by architectural firms to build scale models. It wasn't long before it was administered for more ambitious construction purposes.

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# 3D Printing in Construction

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For more than a decade, 3D printing has been used in several ambitious initiatives and projects in construction, including:

- In 2004, a USC professor attempted to 3D print a wall in what's widely accepted as the technology's first entry into construction.
- In 2014, a full canal house built using 3D printing was completed in Amsterdam.
- In 2016, a 3D-printed mansion was completed in China.

Also in 2016, the Dubai Future Foundation built its Office of the Future via 3D printing, a major milestone for the technology in the commercial construction sector. The fully functioning 2,700-square foot building was built by a large 3D printer that measured 120 x 40 x 20 feet. Construction took just 17 days.

Today, the 3D printing construction market is quickly growing, expected to reach $1.5 billion by 2024.

**The Growth of 3D Printing in Construction**

While 3D printing's emergence in the construction industry is ongoing, certain building aspects are poised for more growth than others.

***3D Printing Concrete*** — Concrete, specifically, is one of them. In fact, the concrete 3D printing market is projected to be valued at $56.4 million by 2021, growth that's largely spurred by the amount of new, innovative projects that are being planned in construction. 3D printing in concrete doesn't appear just to be a grassroots movement, either. In February 2017, Vinci, one of France's leading construction firms, purchased a stake in XtreeE, a French startup company that specializes in 3D printing concrete structural elements.

In 2019, BAM opened Europe's first concrete printing centre in the Netherland. The factory has already been tasked to deliver several 3D printed bridges throughout the region.

Though 3D printing concrete shows great potential, it's worth noting that the overall technology when it comes to the concrete material is still relative in its infancy. In fact, most 3D printers that process concrete are still being tested and tweaked today, and aren't yet designed for manufacturing purposes. However, the potential is there to additively build everything from foundations to walls to individual cinder blocks to bridges in a faster, more affordable, and more environmentally-friendly manner as the technology continues to progress.

**The Benefits of 3D Printing in Construction**

Just why is 3D printing gaining so much buzz in the construction sector? As the industry faces increasing pressure to meet tight schedules and budgets, companies are looking to new innovations to help fill the gaps. 3D printing in construction offers a significant potential to increase efficiency in the building sector, including the following ways.

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***Speed*** — 3D printing has already shown that it can build a home or building from the ground up in a matter of days. That's a significantly faster timeframe than conventional construction, which can take months and years to fully construct a commercial building. According to Marco Vonk, Marketing Manager at Saint-Gobain Weber Beamix, "You save about 60% of the time on the jobsite and 80% in labor."

***Waste reduction*** — Worldwide construction waste currently totals more than 1 billion tons each year, and according to Construction Dive, this number is expected to double by 2025. While 3D printing won't be able to solve all of the construction waste problems, it can help. This is largely because 3D printing is an additive manufacturing process that only uses as much material as is necessary for creating a structure. When paired with other waste-reducing processes and building methods like prefabrication and lean construction, the potential of a waste-zero building seems all the more likely.

***Design freedom*** — One of the great things about 3D printing is the design freedom that it offers. Architects are able to build complex designs that are otherwise unattainable, or too expensive or labor-intensive to create by conventional construction means. This can allow for a lot more innovation and creativity in the commercial construction space. Vonk adds, "3D concrete printing enables you to make any shape. You can bend it, you can make angles, you can make virtually any organic shape you want to, and it's a one-to-one copy to what you designed on paper."

***Reduce human error*** — According to OSHA, more than 5,000 workers are killed on the job each day. Because construction would be more programmable and automated, worker injuries and fatalities would likely decrease if 3D printing was incorporated onto the jobsite.

**The Challenges of 3D Printing in Construction**

Despite the benefits and potential that 3D printing has in the construction sector, there are a number of factors that may prohibit the technology from becoming mainstream. Below, let's explore a few of these challenges.

***High costs*** — Perhaps the biggest challenge to the widespread adoption of 3D printing technology on construction sites is the high cost of purchasing or renting such equipment and the logistics involved in getting these large 3D printers to the work site. 3D printers are costly, and that upfront purchase cost doesn't include materials or maintenance. Right now, it's difficult for many construction professionals to justify 3D printing's cost over the technology's benefits.

***Labor shortage*** — The construction sector is booming and skilled workers are in high demand. The only problem is that there are not enough of them.

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Even considering the labor shortage, 3D printing requires an even more specific skill set that would have to pull from a slimmer and more niche group of candidates. Construction labor shortages are already a problem, and finding qualified workers to employ in 3D printing construction environments could prove to be even more challenging in the future.

***Quality control*** — Weather already has the potential to slow construction progress, but issues with Mother Nature may be amplified with 3D printing. The weather, environmental factors and more are all conditions that could make 3D printing in commercial construction more of a bust than a boom. Furthermore, quality control in construction can already be a tricky matter. If not constantly monitored and overseen by real humans, quality in 3D printing could end up being a very expensive mess.

***Regulations*** — One drawback that might not immediately come to mind is the regulation of 3D printing. While regulation in 3D printing has made the news cycle recently, it still hasn't fully impacted the construction industry. However, there's also the liability that may come with using printers rather than humans to perform certain construction tasks. Currently, there's much uncertainty in this aspect of 3D printing in construction. Until laws and regulations are clearly defined, it's unlikely that 3D printing will make too much of a mark in the construction sector.

**A Hopeful Future Remains for 3D in Construction**

Does 3D printing in construction have real staying power? From what we've seen, the promise is strong, just as long as companies like BAM and Saint-Gobain continue to innovate and push boundaries.

Overall, the potential of 3D printing is too great to ignore. While the industry may never reach a point where it's used exclusively, it's only a matter of time that the technology will be improved and advance significantly. Overall, 3D printing is poised to be a viable solution that offers key benefits in cost savings and environmental friendliness for our building's future.

# Just for Fun: January's Notable Events and Famous Birthdays

1 — The Julian calendar took effect (45 B.C.), patriot Paul Revere was born (1735), and **the ball was first dropped at Times Square in New York City** (1908)

2 — Georgia became a state (1788)

3 — King Tut's tomb was discovered (1924), the March of Dimes was founded (1938), actor Mel Gibson was born (1956), Alaska became a state (1959), and quarterback Eli Manning was born (1981)

4 — Sir Isaac Newton was born (1643), Utah became a state (1896), and the euro made its debut (1999)

5 — The Yankees purchased Babe Ruth from the Red Sox (1920), construction on the Golden Gate Bridge began (1933), and the space shuttle program was authorized (1972)

6 — Joan of Arc was born (1412), Samuel Morse demonstrated the telegraph (1838), New Mexico became a state (1912), Wheel of Fortune debuted on TV (1975), and quarterback Jameis Winston was born (1994)

7 — The first U.S. presidential elections were held (1789), TV personality Katie Couric (1957), and actors Nicolas Cage (1964) and Jeremy Renner (1971) were born, and President Clinton's impeachment trial began (1999)

8 — Singers Elvis Presley (1935) and David Bowie (1947) were born

9 — President Richard Nixon was born (1913), and Apple launched iTunes (2001) and the iPhone (2007)

10 — The world's first subway system opened in London (1863), singer Rod Stewart (1945) was born, the United Nations met for the first time (1946), and boxer George Foreman was born (1949)

11 — The Grand Canyon was declared a national monument (1908), American League baseball adopted the "designated hitter" rule (1973)

12 — Amazon founder Jeff Bezos was born (1964), Batman debuted on television (1966), and **a magnitude 7.0 earthquake struck Haiti** (2010)

14 — The Treaty of Paris officially ended the American Revolutionary War (1784), rapper LL Cool J (1968) and actor Jason Bateman (1969) were born, the Miami Dolphins completed the only undefeated season in NFL history (1973), and basketball legend Michael Jordan retired (1999)

15 — Civil Rights activist Dr. Martin Luther King Jr. was born (1929) and the first Super Bowl was played (1967)

16 — The PGA was formed (1916), Prohibition went into effect (1919), the Chevy Corvette was first unveiled (1953), and Operation Desert Storm began (1991)

17 — Statesman Benjamin Franklin was born (1706), Americans overthrew the Hawaiian monarchy (1893), and boxer Muhammad Ali (1942) and former first-lady Michelle Obama (1964) were born

18 — **Actor Kevin Costner was born** (1955)

19 — Writer Edgar Allen Poe (1809) and singer Dolly Parton (1936) were born

20 — The "British Invasion" began when the Beatles released their first album in the U.S. (1964), the Iran Hostage Crisis ended (1981), and quarterback Nick Foles was born (1989)

21 — The Kiwanis Club was formed (1915), golfer Jack Nicklaus was born (1930), and the first case of COVID-19 in the U.S. was confirmed (2020)

22 — Abortion was legalized in the U.S., and President Lyndon Johnson died (1973)

23 — The world's deadliest earthquake killed 830,000 in China (1556), statesman John Hancock was born (1737), and the Frisbee was introduced (1957)

24 — Singer Neil Diamond was born (1931), beer was first sold in cans (1935), actor John Belushi was born (1949), and British statesman Winston Churchill died (1965)

25 — Transcontinental phone service began in the U.S. (1915), the first Winter Olympics were held in Chamonix, France (1924), the first Emmy Awards were presented (1949), and singer Alicia Keys was born (1981)

26 — **The dental drill was patented** (1875), actor Paul Newman was born (1925), television was first demonstrated to the public (1926), and guitar god Eddie Van Halen (1955) and hockey legend Wayne Gretzky (1961) were born

27 — Composer Wolfgang Amadeus Mozart was born (1756), the National Geographic Society was founded (1888), and three astronauts died in a launch pad fire aboard Apollo 1 (1967)

28 — The space shuttle Challenger exploded (1986)

29 — President William McKinley was born (1843), Kansas became a state (1861), baseball's American League was founded (1900), the first members of the Baseball Hall of Fame were elected (1936), and TV personality Oprah Winfrey was born (1954)

30 — President Franklin D. Roosevelt was born (1882), Adolf Hitler was named chancellor of Germany (1933), Mohandas Gandhi was assassinated (1948), musician Phil Collins was born (1949), the Vietnam War's Tet Offensive began (1968), and actor Christian Bale (1974) was born

31 — Slavery was abolished in the U.S. (1865), **baseball legends Jackie Robinson** (1919) and **Nolan Ryan** (1938) **were born**, President Truman announced the development of the hydrogen bomb (1950), and singer Justin Timberlake was born (1981)



"Every project is an opportunity to learn, to figure out problems and challenges, to invent and reinvent."

~ David Rockwell , architect and designer