



کنترل پروژه پیشرفته و ارزیابی عملکرد در پروژه‌های پیچیده (بر اساس اسناد CII)

فصل دوم:
آشنایی با ابزارهای کلیدی در استقرار APC

ارائه دهنده:

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What we will learn?

- ☐ Overview of Core APC Implementation Tools
- ☐ Work Environment Assessment Rating Tool
- ☐ Project Controls Readiness Checklist Tool
- ☐ Technology Practices Maturity Rating Tool

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Overview of Core APC Implementation Tools

Overview of Core APC Implementation Tools

❑ CII members have expressed that

1. the **current implementation** of earned value-based methods and
2. associated **key performance indicators (KPIs)**

cannot effectively control and **reliably** predict project performance.

Metrics and KPIs typically **lag** and
do **not offer** the opportunity to anticipate or proactively address problems.

What has been done to address these problems?

Overview of Core APC Implementation Tools

❑ In **response**, CII chartered RT-402,

Advanced Project Controls, to

1. investigate this important element of project management and
2. find ways to streamline the execution of project control processes
and
3. do so in real-time.

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❑ Some tools realized in 14 case studies:

- ❖ Reality capture
- ❖ Continuous field data collection
- ❖ AI anomaly detection
- ❖ Automated progress measurement

Table 3. Case Studies

	Sector	Role	Functions & Frequencies
1	Power	Owner	Daily progress & actuals; weekly schedule & cost analyses
2	Infrastructure	Contractor	Daily progress & production; weekly schedule & cost analyses
3	Oil and gas	Owner	Real-time and daily field updates; weekly reporting across functions with daily analyses based on criticality
4	Oil and gas	Contractor	Daily production, resources, and productivity; weekly schedule & cost analyses
5	Infrastructure	Contractor	Daily production, resources, and productivity; weekly schedule & cost analyses
6	Infrastructure	Contractor	Daily procurement reporting with schedule updating; daily field production, resources, and productivity; weekly schedule & cost analyses
7	Oil and gas	Contractor	Daily upstream fabrication updates; hourly to daily field production and work hours; weekly schedule & cost analyses
8	Oil and gas	Service Provider	Automated collection of actuals/quantities (with reality capture); automated payments & blockchain records
9	Oil and gas	Contractor	Daily field reporting moving with instant monitoring of critical and near-critical paths and instant safety alerts; weekly reporting of engineering, procurement, and construction; prescriptive strategic recommendations with AI support, for example on new contractors or fabrication vendors and locations. Comprehensive digitization effort.
10	Software engineering	Information Systems within Owner Company	Daily software project updates
11	Oil and gas	Owner	Percent completed on field tasks hourly; daily cost, schedule, performance metrics, productivity, and indirect ratios
12	Infrastructure	Contractor	Real-time equipment monitoring with daily field progress
13	Oil and gas	Contractor	Daily fabrication updates; real-time field progress
14	Semiconductor	Consultant	Real-time monitoring of semiconductor production variance and corresponding controls

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❑ RT-402 began its study by **defining APC as:**

“a project controls function with continuous and/or timely data collection, on-demand information analysis with expert and intelligent reasoning methods, and dynamic and on-demand reporting.”

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☐ This Implementation Resource

complements the **team's final report** with

three synergistic tools that offer step-by-step guidance on how to advance project controls capabilities.

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Overview of Core APC Implementation Tools

- When used together, the **three tools provide comprehensive guidance** on the three core facets of an APC function: work environment, project controls, and advanced technologies. S

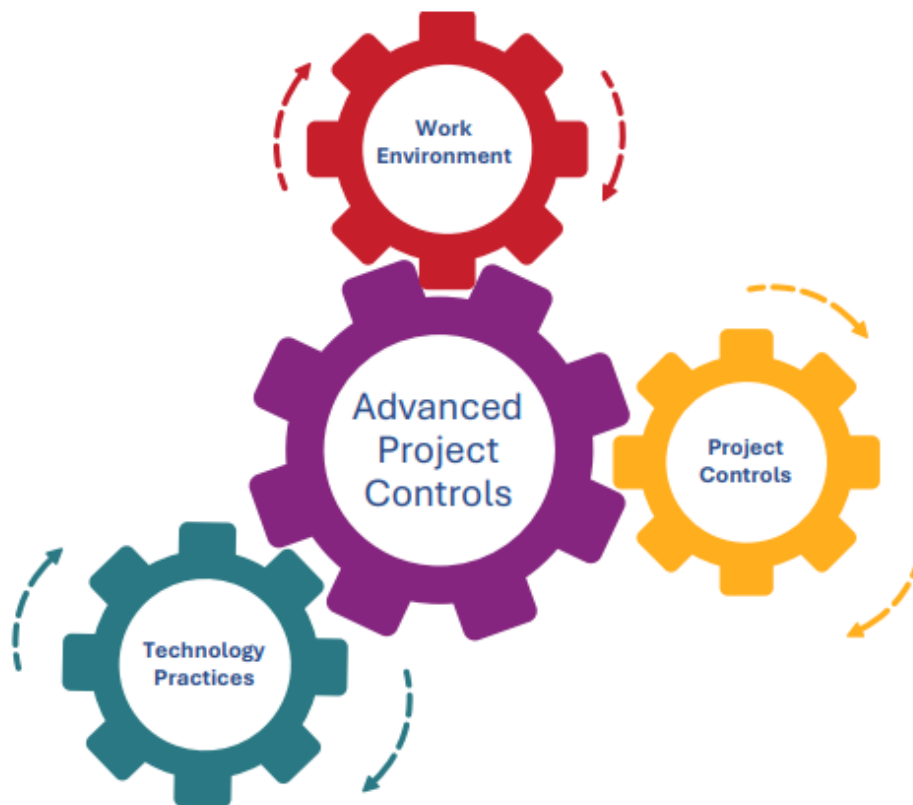


Figure 1. Advanced Project Controls

Overview of Core APC Implementation Tools

- ❑ In recognition of the three distinct facets inherent to APC—work environment, project controls, and advanced technologies—RT-402 developed three tools. These tools are the Work Environment Assessment Rating Tool, the Project Controls Readiness Checklist Tool, and the Technology Practices Maturity Rating Tool.

Rating Tool

Work Environment Assessment Rating Tool

(Four categories & 27 factors)

- Culture
- People
- Processes
- Resources



Project Controls Readiness Checklist Tool

(Three sections & 55 elements)

- Basis of Decision
- Basis of Design
- Execution Approach



Technology Practices Maturity Rating Tool

(Five subprocesses & 21 practices)

- Technology Architecture
- Workflow
- Data Collection
- Monitoring & Intelligence
- Reporting



Figure 2. APC Tools

Overview of Core APC Implementation Tools

- ❑ The **Work Environment Assessment Rating Tool** evaluates the **level** of commitment and support of
 1. **stakeholder organizations** and
 2. the **project team**toward
 - ✓ project controls and
 - ✓ its advanced implementation.

Overview of Core APC Implementation Tools

☐ The **Project Controls Readiness Checklist Tool**

1. **defines** the fundamentals for an effective controls function and
2. **assesses** the goodness of its principles, processes and procedures, and implementation.

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The ratings for tools were normalized on a **scale** from 0 to 1,000,
with higher scores indicating better performance.

These tools are implemented in **spreadsheet format**,
with **unrated (blank)** forms also available for **manual assessments**.

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- ❑ The **Technology Practices Maturity Rating Tool**,
which **complements** these two tools,
captures the advanced technology aspects of APC and
ensures a comprehensive evaluation
when all three tools are used together.

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Overview of Core APC Implementation Tools

- ❑ In **complex projects**, it is **statistically proven** that the work environment becomes the **root cause** of **gaps** and **issues** in project controls systems, such as **Earned Value Management (EVM)**.
- ❖ In other words, the **work environment**—its culture, processes, people, and resources—becomes the independent variable influencing the **goodness** of project controls, which becomes the **dependent variable**.

What does this mean?

Overview of Core APC Implementation Tools

❑ This emphasizes

the necessity for **assessing**

1. the work setting and
2. the project controls function,

as these become the **foundation** upon which advanced technologies can be successfully adopted and integrated.

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❑ Project teams planning

to implement APC

should **first assess** the level of support through

1. work environment and
2. project controls readiness

tools **before deciding** to implement advanced technologies.

A **low level of support** indicates that **advanced technologies** cannot be successfully adopted or sustained.

- ❑ If the level of support is **satisfactory**, then the adoption of **advanced technologies** can be **pursued**.

Overview of Core APC Implementation Tools

❑ Whether an **organization or project team** is

1. new to APC or

2. on the journey of advancing its project control capabilities,

simultaneously advancing the three core facets of APC is
anticipated to **yield the most benefits.**

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- ❑ **Figure 3** illustrates an example of **combined evaluation** with the three tools provided in this Implementation Resource, with the **purple triangle** **exemplifying** the competency assessment of an APC function.

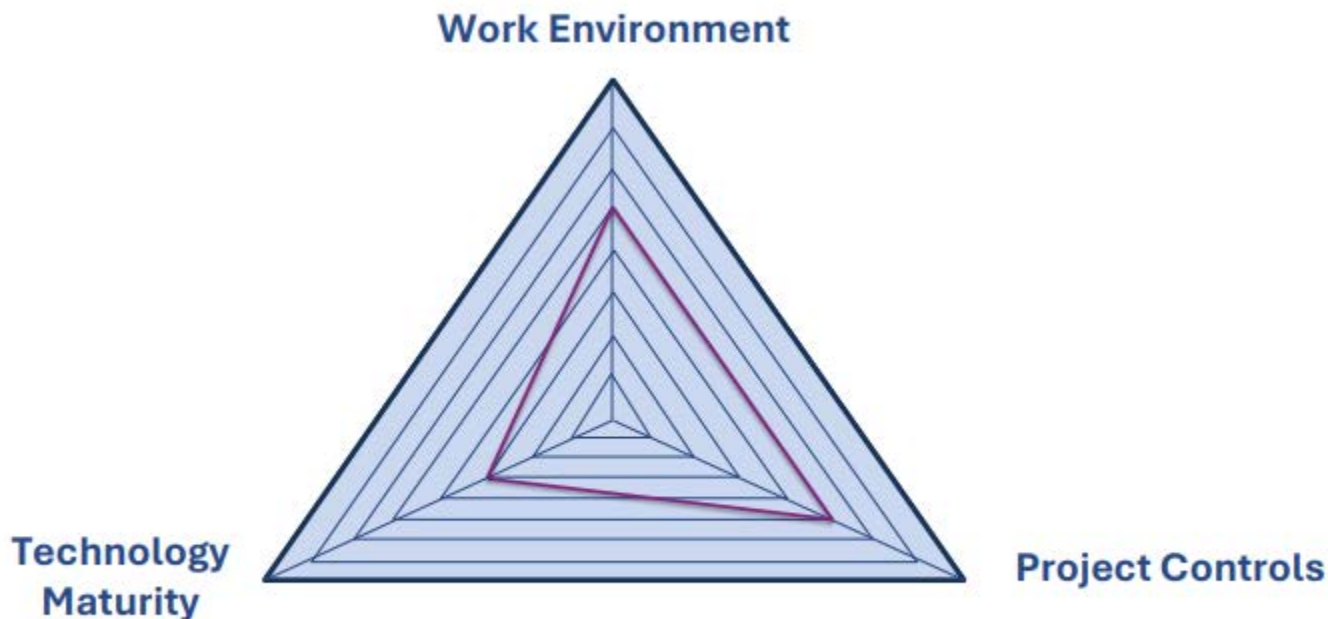


Figure 3. Competency Assessment Example

Overview of Core APC Implementation Tools

- ❑ **To holistically guide** CII member companies in their APC journey, RT-402 generated **additional resources**, such as the **prioritization** of
1. **real-time metrics** and **information** items or
 2. **high-value AI applications** in project controls.

These additional resources are included in the team's final report.

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- ❑ **Table 1** lists all RT-402 resources with **corresponding publications** to assist the reader.
- ❑ The **combined use** of such a set of tools and resources delineates a path of **increasing sophistication**, eventually culminating in an APC function that **empowers decision-makers** with sound and timely decisions.

Table 1. RT-402 Resources

Resource	Publication
Work Environment Assessment Rating Tool	Chapter 3 & Appendices I to III
Project Controls Readiness Checklist Tool	Chapter 4 & Appendices IV & V
Technology Practices Maturity Rating Tool	Chapter 5 & Appendices VI to VIII
Prioritization of real-time information	Final Report - Chapter 4 & Appendices I & II
Real-time automation of project controls processes	Final Report - Chapter 5
Technology domains, catalog of technologies, and technology readiness assessment	Final Report - Chapters 6 to 8 & Appendix III
AI data requirements	Final Report - Chapter 9
High-value AI applications	Final Report - Chapter 9 & Appendix IV

Overview of Core APC Implementation Tools

- ❑ Chapter 3 details the Work Environment Assessment Rating Tool,
- ❑ Chapter 4 the Project Controls Readiness Checklist Tool, and
- ❑ Chapter 5 the Technology Practices Maturity Rating Tool.

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☐ For the **environmental tool**:

1. Appendix I outlines the factors for the work environment tool,
2. Appendix II provides factor weights and rating criteria, and
3. Appendix III includes unrated forms for manual assessments.

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❑ For the **readiness tool**,

1. Appendix IV defines project controls readiness, and
2. Appendix V provides unrated forms.

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❑ For the **technology practices tool**,

1. Appendix VI defines the practices and rating criteria,
2. Appendix VII quantifies maturity ratings, and
3. Appendix VIII includes unrated forms.

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Overview of Core APC Implementation Tools

Table 2 lists the acronyms used in this document.

Table 2. Acronyms

APC	Advanced Project Controls
EVM	Earned Value Management
IP2M METRR	Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR)
KPI	Key Performance Indicator
N/A	Not Applicable
SME	Subject Matter Expert

Work Environment Assessment Rating Tool

Work environment assessment rating tool

❑ The Work Environment Assessment Rating Tool is based in **MS Excel™**.

❖ It is divided into **four categories**:

1. culture,
2. people,
3. processes, and
4. resources.

Appendix I contains the definition of each of the tool's **27 factors** grouped by category.

Work environment assessment rating tool

- ❑ The tool requires the **evaluation** of **each factor** based on a **five-level rating** of increased work support:
 - 1 – not acceptable,
 - 2- needs improvement,
 - 3 – meets some,
 - 4 – meets most, and
 - 5 – high performing.
- ❑ The work environment **factors** were considered **universally relevant**, so each factor is expected to be **rated** for a **meaningful assessment**.
 - ❖ Thus, a “not applicable” option is not available.

Work environment assessment rating tool

SUPPORT LEVELS ASSESSMENT CRITERIA

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 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 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 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.	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).

Work environment assessment rating tool

- ❑ **Appendix II** provides a **detailed definition** of the rating criteria, which is common to all factors.
- ❑ In addition, Appendix II contains the **ratings** or **weights** of each factor.
- ❑ Based on such weights, the influence of the categories was determined as follows:
 - ❖ culture 33.1 percent,
 - ❖ people 26.1 percent,
 - ❖ processes 19.5 percent, and
 - ❖ resources 21.3 percent.

Work environment assessment rating tool

- ❑ To provide a **straightforward scale** for evaluation, the **maximum rating** was set to **1,000**,
which indicates an **optimum support** to project controls and its advanced implementation,
while the **minimum possible rating is 0**, indicating **no support** to project controls.

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Work environment assessment rating tool

☐ If **not** using the spreadsheet,

users can **manually assess** the work environment using

the **weights provided** in **Appendix II**

to **fill out** the **unrated forms** in **Appendix III**.

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Appendix

- ❑ **Appendix I** - Work Environment Factor Definitions (Work Environment Assessment Rating Tool)
- ❑ **Appendix II** - Work Factor Ratings & Assessment Criteria (Work Environment Assessment Rating Tool)
- ❑ **Appendix III** - Unrated Work Factor Assessment Forms (Work Environment Assessment Rating Tool)

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Work environment assessment rating tool

☐ The tool is divided into **five tabs**:

- 1) Introduction,
- 2) User Guide,
- 3) Input,
- 4) Output, and
- 5) Chart.

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Work environment assessment rating tool

The Introduction presents the **purpose** of the tool and provides an opportunity to fill out **specific project** and **evaluation information**.

- ☐ The User Guide includes input and output information.
- ☐ In the Input tab, users are asked to assess the level of support to APC by rating each of the 27 work factors based on the five-level rating scale.
- ☐ The Output tab illustrates the level of stakeholder organizations and project team support towards project controls and its advanced implementation. The Chart tab illustrates such support with a spider net chart.

❑ The user rates the **level of support** through each of the **27 factors** as follows:

1. The user rates each factor. See Figure 4.

❖ The rating system is straightforward, ranging from 1 (not acceptable) to 5 (high performing), ensuring clarity in the user's assessments.

GO BACK TO
PREVIOUS PAGE

CONTINUE TO
NEXT PAGE

RESET FORM

	Not Acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
B.3. Project leadership is defined, effective, and accountable.	○	○	○	○	○

Figure 4. Input

- ❑ The user rates the level of support through each of the **27 factors** as follows:
- 2. By hovering over a cell, a window with the **description of the corresponding rating criteria** will pop up. See Figure 5.
- ❖ Alternatively, Appendix II contains the definition of the rating criteria.

Not Acceptable	Needs Improvement	Meets Some
	<i>Rating a factor</i> <i>Not Acceptable indicates that the factors criteria are consistently below expectations and current performance is unacceptable. The ability to effectively manage the project/program cannot be achieved in this current state and actions are required to improve.</i>	
○		

Figure 5. Rating Criteria Pop-up

- ☐ The user rates the level of support through each of the **27 factors** as follows:
 - 3. To start over, the user should click the “Reset Form” button in the “Input” tab.
- See Figure 4.



Environment Assessment Rating Tool

GO BACK TO
PREVIOUS PAGE

CONTINUE TO
NEXT PAGE

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- ❑ The Output tab provides **visuals of the work** setting assessment.
- ❑ The category assessments reveal the organizational and project team support regarding project controls and its advanced implementation.
- ❑ For each category, it defines the **level of support** with a percentage of its total score. See Figure 6.

Characteristics	Maturity Level				
	Not acceptable	Needs Improvement	Meets Some	Meets Most	High Performing
Culture				66%	
People			34%		
Practices				71%	
Resources		20%			

Figure 5. Rating Criteria Pop-up

- Also, a visual assessment of the support regarding each factor within a given category is provided. See Figure 7.

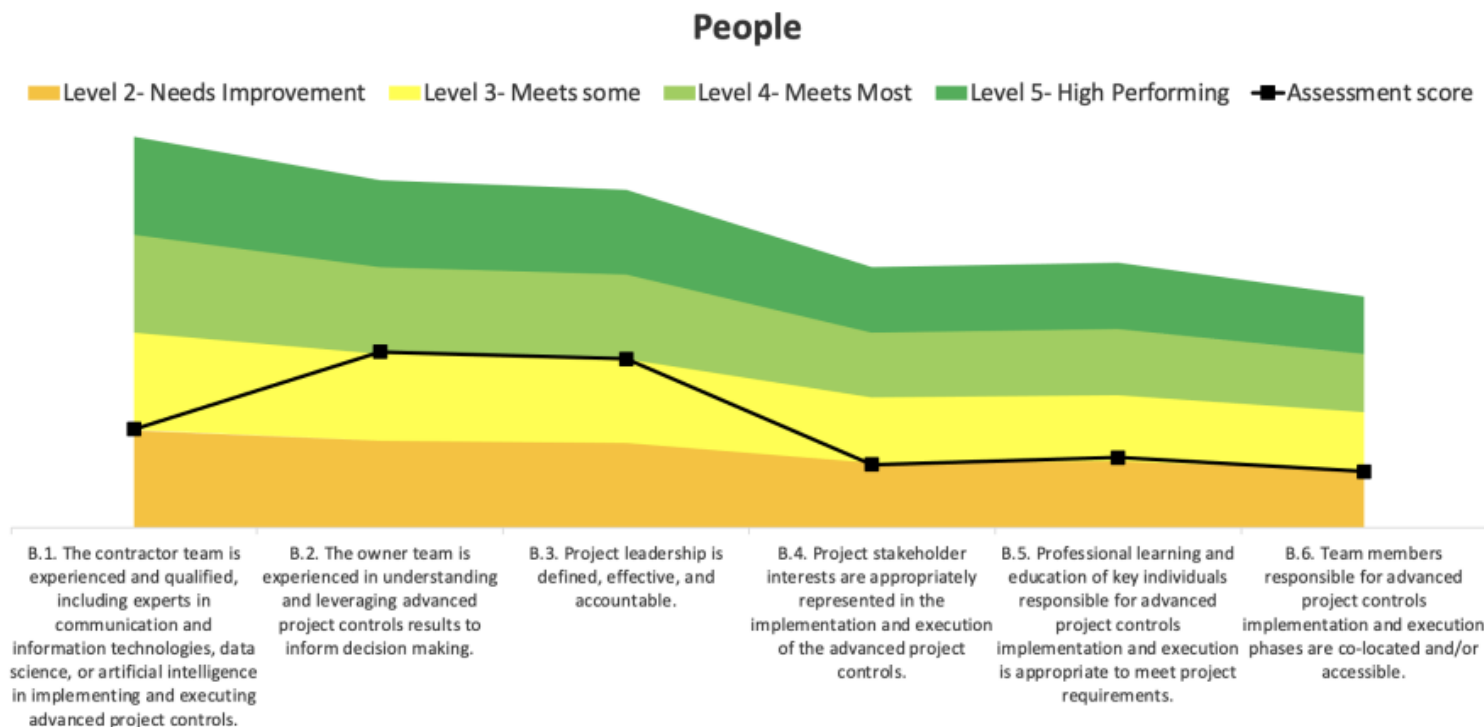


Figure 7. Category-Specific Factor Ratings

Project Controls Readiness Checklist Tool

Project controls readiness checklist tool

- ❑ The Project Controls Readiness Checklist Tool defines the **fundamentals** for an effective controls function and assesses the goodness of its principles, processes and procedures, and implementation.
- ❑ This **tool expanded** during **RT-402's research** from the observation that the **CII body of knowledge does not contain guidance on**
how to establish an effective mechanism of project controls.
- ❑ The Checklist Tool contains **40 elements** grouped by category into **basis** of
 1. decision,
 2. basis of design, and
 3. execution approach.

See Table 5.

Appendix IV provides the **definition** of each element.

Project controls readiness checklist tool

Table 5. Project Controls Readiness Components

Sections	Category	Elements
Basis of Decision	A. Project Controls Objectives	A.1. Project Controls Principles
		A.2. Contracting Principles
		A.3. Risk Management Principles
	B. Project Controls Strategy	B.1. Scope Definition
		B.2. Cost Estimating
		B.3. Planning & Scheduling
		B.4. Risk Management
		B.5. Advanced Work Packaging
		B.6. Project Controls Deliverables
		B.7. Benchmarking
	C. Infrastructure	C.1. Systems and Tools
		C.2. Information Integration
		C.3. Workflow

Project controls readiness checklist tool

Table 5. Project Controls Readiness Components

Sections	Category	Elements
Basis of Design	D. Project Information	D.1. Project Objectives
		D.2. Location Information
	E. Estimating	E.1. Estimating and Control Budget
		E.2. Code of Accounts
		E.3. Compliance with Accounting Requirements
		E.4. Cost Performance Measurement and Forecasting
	F. Scheduling	F.1. Master Schedule
		F.2. Work Breakdown Structure
		F.3. Planning Network Model
		F.4. Prioritization of Critical Activities
		F.5. Resource Management
		F.6. Rules of Credit
		F.7. Progress Measurement and Forecasting
	G. Change Management	G.1. Change Management
	H. Risk Management	H.1. Contingency and Allowances Management
		H.2. Price Escalation
		H.3. Management of Reserves
	I. Supply Chain Management	I.1. Equipment Prioritization
		I.2. Engineering Deliverables Support
		I.3. Package Engineering and Oversight

Project controls readiness checklist tool

Execution Approach	J. Performance and Status Reporting	J.1. Advanced Visuals
		J.2. Status Reporting
	K. Construction	K.1. Construction Work Packs
		K.2. Constraint Management
	L. Commissioning and Startup	L.1. Pre-Commissioning
		L.2. Commissioning and Startup
	M. Closeout	M.1. Project Closeout

Project controls readiness checklist tool

- ☐ Based on such definitions, the **tool requires** the evaluation of each element based on three-levels of increased readiness:
 - 1—major deficiencies;
 - 2—some deficiencies; and
 - 3—complete definition.
- ☐ Users can **manually assess** project controls readiness with the **unrated forms** in **Appendix V**.

In addition, **evaluation comments**, such as **actionable items**, should be **noted for each element**.

See **Figure 8**.

Project controls readiness checklist tool

Basis of Decision				
A. Project Controls Objectives	Assessment Levels			Comments
	1	2	3	
A.1. Project Controls Principles	☐	☐	☐	
A.2. Contracting Principles	☐	☐	☐	
A.3. Risk Management Principles	☐	☐	☐	

Assessment Levels: 1 = Major Deficiencies; 2 = Some Deficiencies; 3 = Complete Definition

Figure 8 Project Controls Readiness Components

Appendix

- ❑ **Appendix IV** – Project Controls Readiness Element Definitions (Project Controls Readiness Checklist Tool)
- ❑ **Appendix V** – Unrated Project Controls Assessment Forms (Project Controls Readiness Checklist Tool)

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Technology Practices Maturity Rating Tool

Technology practices maturity rating tool

❑ The Technology Practices Maturity Rating Tool contains **21 practices**

grouped into **five sub-processes**:

1. technology architecture,
2. workflow,
3. data collection,
4. monitoring and intelligence, and
5. reporting.

See Table 6.

❑ **Appendix VI** contains the definition of each technology practice along with its **five-level maturity rating description**.

Technology practices maturity rating tool

Table 6. Subprocesses and Practices

Subprocess	Practices
Technology Architecture	Technology design
	Seamless integration and sharing
	Data validation
	Visualization
	Automated payments
Workflow	Common coding structure
	Task-level work definition
	Work scheduling within reporting intervals
	KPIs and leading indicators
Data Collection	Frequencies of data collection
	Engineering data collection
	Procurement data collection
	Field data collection
Monitoring and Intelligence	Fined-grained data analysis
	Project-level analytics & recommendations
	Portfolio-level analytics & recommendations
	Alerts and escalation
	Evidence-driven decisions
	Decisions enabled at lowest-possible level
Reporting	Automated generation of reports
	Prioritized reporting

Technology practices maturity rating tool

❑ The **Maturity Rating Tool** enables the evaluation of the maturity level associated with each practice based on this five-level scale:

1—not yet started;

2—very low;

3—low;

4—high; and

5—very high.

The **descriptions** for each maturity level are specific to each practice.

Appendix VII quantifies the maturity ratings or weights of **each practice**.

Technology practices maturity rating tool

- ❑ Based on **such weights**, the **percentage of influence** of the technology sub-processes on an APC function was determined to be:
 1. technology architecture 23 percent;
 2. workflow 22.1 percent;
 3. data collection 20.6 percent;
 4. monitoring and intelligence 21.1 percent; and
 5. reporting 13.2 percent.
- ❑ To provide a clear, straightforward scale for evaluation, the maximum rating was set to 1,000, which indicates the existence of a high-performing and optimum APC function,
while the minimum rating is 0, indicating the implementation of advanced technologies has yet to start.

Technology practices maturity rating tool

- ☐ The remainder of this section discusses the **MS Excel™ tool** and its functions.
- ☐ **If users do not use** the spreadsheet,
they can **manually assess** the maturity of the technology practices
using the **weights in Appendix VII**
to fill out the **unrated forms** in **Appendix VIII** and the practice
definitions in Appendix VI.

Appendix

- ❑ **Appendix VI** - Technology Practice Definitions & Maturity Criteria (Technology Practices Maturity Rating Tool)
- ❑ **Appendix VII** – Technology Practices Maturity Ratings (Technology Practices Maturity Rating Tool)
- ❑ **Appendix VIII** - Unrated Technology Practices Assessment Forms (Technology Practices Maturity Rating Tool)

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Appendix

- ❑ **Appendix VI** - Technology Practice Definitions & Maturity Criteria (Technology Practices Maturity Rating Tool)
- ❑ **Appendix VII** – Technology Practices Maturity Ratings (Technology Practices Maturity Rating Tool)
- ❑ **Appendix VIII** - Unrated Technology Practices Assessment Forms (Technology Practices Maturity Rating Tool)

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Technology practices maturity rating tool

❑ The Maturity Rating Tool is divided into five tabs:

- 1) Introduction,
- 2) User Guide,
- 3) Input,
- 4) Output, and
- 5) Chart.

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- ☐ In the **Input tab**, users are asked to assess the maturity of the **21 technology practices** based on a **five-level rating**.
- ☐ If a **practice is not applicable**, the user should select **N/A**.
- ☐ The **Output tab** illustrates the maturity of each **sub-process** and **corresponding** practices.
- ☐ The **Chart tab** illustrates such support with a **spider net chart**.

❑ The user rates each of the 21 practices with respect to their level of maturity as follows:

1. The user rates each practice.

❖ **See Figure 9.** The **rating system** is straightforward, ranging from 1 to 5 according to the practice-specific rating descriptions in **Appendix VI**.

GO BACK TO
PREVIOUS PAGE

CONTINUE TO
NEXT PAGE

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	Maturity Level					
	1	2	3	4	5	N/A
1. Technology Architecture						
1.1 Technology design	○	○	○	○	○	○

Figure 9. Input

- ❑ The user rates each of the 21 practices with respect to their level of maturity as follows:
- 2. By hovering over a practice cell, a pop up window with the description of the practice will appear.
- ❖ See **Figure 10**. Alternatively, **Appendix VI** contains the definition of each practice.

	Maturity Level			
	1	2	3	4
1. Technology Architecture				
1.1 Technology design	A technology architecture has been designed to enable seamless and secure data/information integration, sharing, storage, and access. Data structure and information communication protocols are established and align with project objectives and scope (e.g. metrics, KPIs). Data consistency requirements across project phases are defined and implemented.			

Figure 10. Practice Definition Pop-Up

☐ The user rates each of the 21 practices with respect to their level of maturity as follows:

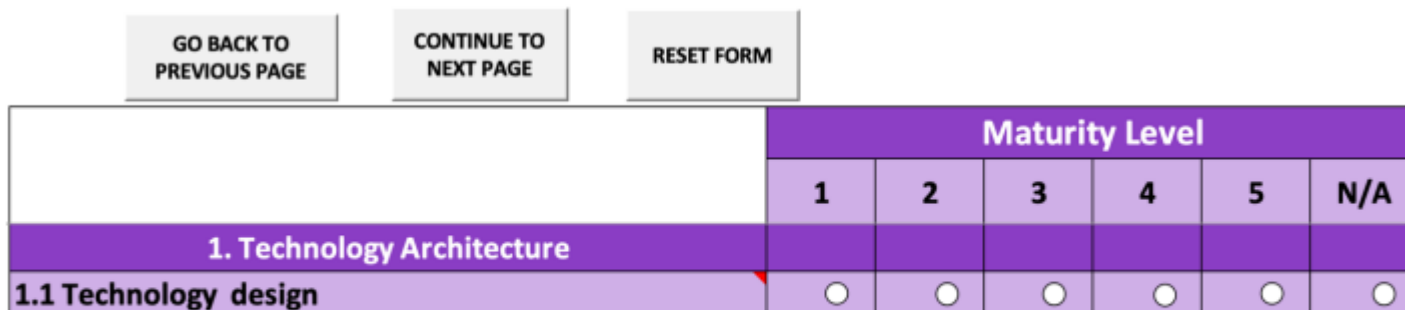
3. If a practice is **not applicable**, the user should select **N/A**.

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- ❑ The user rates each of the 21 practices with respect to their level of maturity as follows:

4. To **start over**, the user can click the Reset Form button in the **Input tab**.

❖ **See Figure 9.**



	Maturity Level					
	1	2	3	4	5	N/A
1. Technology Architecture						
1.1 Technology design	☐	☐	☐	☐	☐	☐

Figure 9. Input

- ❑ The **Output tab** provides visuals of the **technology maturity**.
- ❑ It **summarizes** the total and process-specific maturities as a **percentage of the rating** of their practices. See **Figure 11**.

	Maturity Level				
	Level 1 Not yet started	Level 2 Very Poor	Level 3 Poor	Level 4 Good	Level 5 Very Good
1. Technology Architecture				65%	
2. Workflow			35%		
3. Data collection					76%
4. Monitoring and Intelligence				58%	
5. Reporting			38%		

Figure 11. Subprocesses Rating

- ❑ It also provides a **visual assessment** of the maturity of the practices within each sub-process. See **Figure 12**.
- ❑ The dropdown menu enables changing such visuals by sub-process.

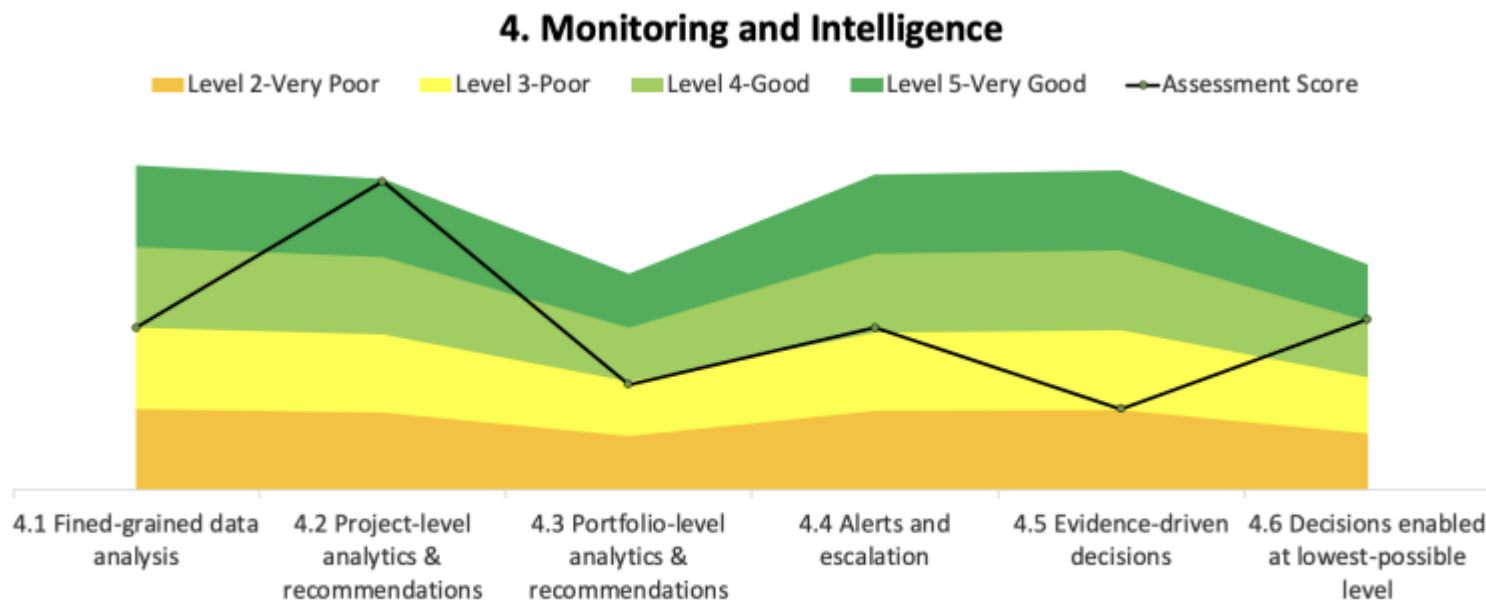


Figure 12. Subprocess-Specific Practice Ratings

Methodology

Research Team 402

Rodolfo Gonzalez, *Occidental Petroleum Corporation (Chair)*

Brian Petty, *Hargrove Engineers + Constructors (Co-Chair)*

***David Grau**, *Arizona State University (Principal Investigator)*

Glen Watson, *ExxonMobil*

Samer Alsharif, *DTE Energy*

Norberto Pazos, *Techint Engineering & Construction*

Daniel Goldsmith, *U.S. Department of Energy*

Nathan Buehler, *Oracle USA, Inc.*

Francois Lombard, *Technip Energies, Inc.*

Flobert Tiam, *INEOS Olefins & Polymers USA*

Joshua Lavers, *Black & Veatch*

Neerav Mehta, *Larsen & Toubro Limited*

Cindy Gonzales, *AdvanSix*

Eric Matthews, *U.S. Department of State*

Alex Koeberlein, *Southern Company*

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Jake Machnik, *Matrix Service Company*

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Methodology

Table 3. Research Methods

Resource	Methods
Project Controls Readiness Checklist Tool	SMEs' input and workshops
Work Environment Assessment Rating Tool (**)	SMEs' input and workshops
Technology Practices Maturity Rating Tool	Case studies & workshops

(**) Work environment factors were adopted from the Integrated Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR)

Table 4. Case Studies

	Sector	Role	Functions & Frequencies
1	Power	Owner	Daily progress & actuals; weekly schedule & cost analyses
2	Infrastructure	Contractor	Daily progress & production; weekly schedule & cost analyses
3	Oil and gas	Owner	Real-time and daily field updates; weekly reporting across functions with daily analyses based on criticality
4	Oil and gas	Contractor	Daily production, resources, and productivity; weekly schedule & cost analyses
5	Infrastructure	Contractor	Daily production, resources, and productivity; weekly schedule & cost analyses
6	Infrastructure	Contractor	Daily procurement reporting with schedule updating; daily field production, resources, and productivity; weekly schedule & cost analyses
7	Oil and gas	Contractor	Daily upstream fabrication updates; hourly to daily field production and work hours; weekly schedule & cost analyses
8	Oil and gas	Service Provider	Automated collection of actuals/quantities (with reality capture); automated payments & blockchain records
9	Oil and gas	Contractor	Daily field reporting moving with instant monitoring of critical and near-critical paths and instant safety alerts; weekly reporting of engineering, procurement, and construction; prescriptive strategic recommendations with AI support, for example on new contractors or fabrication vendors and locations. Comprehensive digitization effort.
10	Software engineering	Information Systems within Owner Company	Daily software project updates
11	Oil and gas	Owner	Percent completed on field tasks hourly; daily cost, schedule, performance metrics, productivity, and indirect ratios
12	Infrastructure	Contractor	Real-time equipment monitoring with daily field progress
13	Oil and gas	Contractor	Daily fabrication updates; real-time field progress
14	Semiconductor	Consultant	Real-time monitoring of semiconductor production variance and corresponding controls

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