Shutdowns, Turnarounds and Outages: Key Performance Drivers and Best Practices that Drive Top Quartile Outcomes

August 2023

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Executive Summary

The most expensive, complex projects that operating facilities such as refineries and petrochemical plants regularly undertake are major shutdowns, turnarounds, or outages (commonly referred to as STOs). This paper will focus on the practices and approaches that the top STO performers utilize to achieve predictable, competitive outcomes on these capital- and resource-intensive events. Being a top quartile performer at both STO preparation as well as execution has a meaningful impact on the company bottom line and the achievement of operational excellence. Indeed, these highly complex events require the contribution and dedication of functions and resources from across the entire site organization.

Background

AP-Networks is the world leader in STO preparation technology and services, enabling the industry's top performers with cutting edge digital platforms and tools and paring them with the leading, experienced experts in STO readiness and practices. With these capabilities, AP-Networks has been able to develop the largest, most robust STO database in the world, with a dataset that includes STO events from onshore & offshore upstream facilities, gas processing, refining, petro- and agro- chemicals, power generation, and more. This database is continuously updated with new STO data originating from individual readiness and post-STO assessments that AP-Networks conducts on an ongoing basis as well as site and corporate STO benchmarking initiatives from across the world.

With this data collection process, AP-Networks also have compiled the ***practices*** employed by STO teams and operating facilities to achieve their respective STO outcomes. Because this quantitative data is augmented with face-to-face team member interviews, we are able to arrive at unique insights into the effectiveness of specific practices that are used to plan and execute STO events. In terms of identifying the performance drivers, understanding the characteristics of these practices is critical. What are the teams doing to achieve success or failure? What does the data say are the practices that organizations need to focus on in order to achieve top quartile STO performance? What are some examples of analytic or predictive tools that are being used by top quartile performers to achieve and maintain success?

What does the data say about STO Performance?

STOs are periodic planned events for performing maintenance work as well as the installation or tie-in of capital projects. They impact the bottom line through the cost of the event, the Lost Profit Opportunity (LPO) due to the facility being offline, and the potential harm to plant reliability if the STO is performed poorly — not to mention the potential for significant safety and environmental incidents.

Across industry, AP-Networks sees many opportunities for STO performance improvement. Currently, fewer than five percent of global STO events achieve all targets in the business value chain. As shown in Figure 1, more than 50 percent of STO events exceed their planned cost and duration targets by 10 percent,

and 24 percent of STO events exceed planned cost or durations by 30 percent or more and are classified as *train wrecks*.

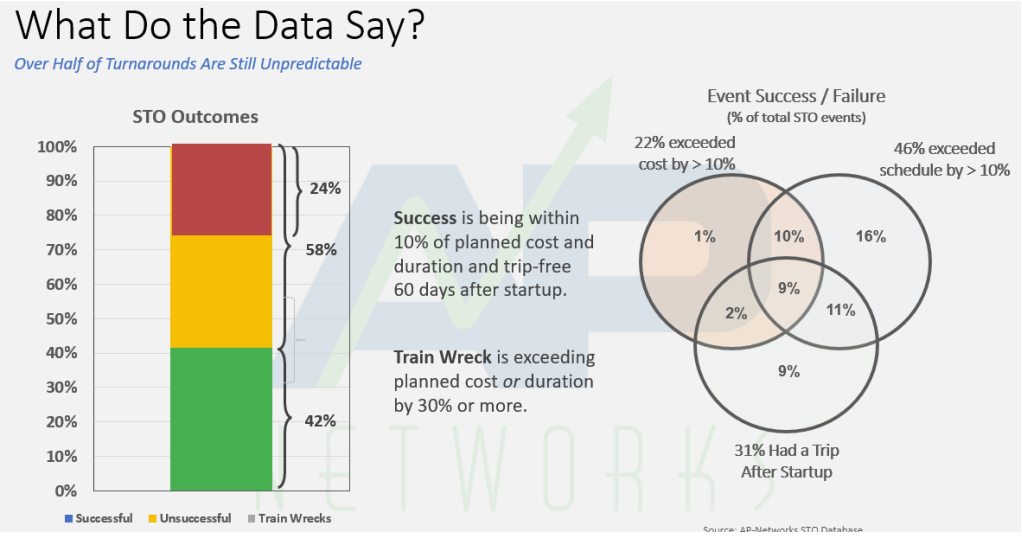


Figure 1 – What The Data Say about STO Outcomes

Key Leading Indicators Driving STO Outcomes

When evaluating and determining what practices drive stronger STO performance outcomes, it is important to recognize that some performance drivers afford more opportunity for the team to influence the outcome than others. For evaluating team control, AP-Networks uses the paradigm shown in Figure 2.

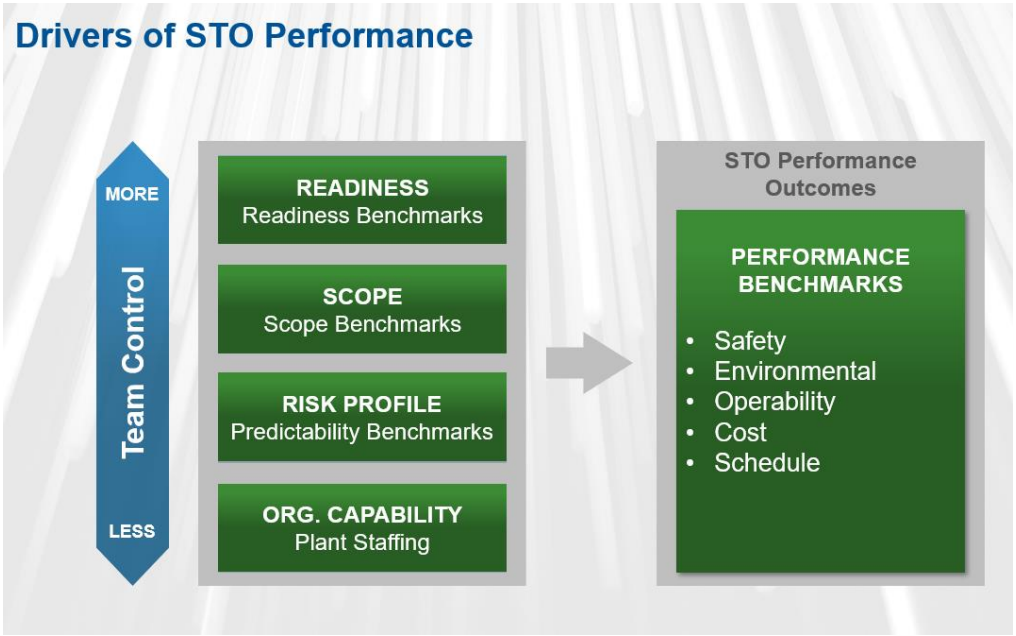


Figure 2 - Key Leading Indicators Driving STO Outcomes

AP-Network's data shows that STO performance outcomes in terms of safety, cost, schedule, and operability are not random. Rather, **the outcomes are predictable** during the planning and preparation

phases, prior to execution when the right measures are used. Leading indicators- such as the level of scope definition and completeness of planning, the event's inherent risk characteristics, have a quantifiable effect on STO outcomes, as shown in Figure 2. There are varying degrees, however, to which these leading indicators are controllable. In this paper we will discuss what are these controllable and uncontrollable factors, and how we can use analytical predictive tools to understand their effects on STO outcomes.

1) Uncontrollable Leading Indicators: Organizational Capability

Let us first look at the factors that most STO Teams have *little or no control over*; the category that provides the team with the least control is ***Organizational Capability***. This is because the size of the plant is a direct factor of the total number of staff working at the facility and is outside the control of the STO team. The key elements of organizational capability are: Leadership, Shared Mindset, Management Practices, Capacity for Change and most importantly: available resources, both in terms of headcount and represented skillsets. In this paper, we will focus on resources, i.e., plant staffing.

For the top performers, STOs are a site priority and multiple disciplines are required to work together for success. In other words, STO preparation is a site-wide effort and the STO department coordinates this effort. The typical refinery or petrochemical facility STO teams consist of representatives from operations, maintenance, inspection engineering, reliability, process engineering, turnaround planning, materials management, safety, environmental and shared services like contracts and procurement. There are STO core teams, STO steering teams and STO strategy teams. Each has its own responsibilities and demographics. Well-aligned teams are required in the STO environment because the work is fast-paced and individuals are co-dependent on one another to process information and prepare for STO execution.

Organizational Capabilities Analysis

AP-Networks are able to leverage our STO database – the largest collection of planned and actual event data in the world spanning 2,500+ observations from Industry - to evaluate the size of the upcoming events against the site's ability to effectively plan for those events. In other words, this analysis gives us the ability to determine whether the workload associated with STO event preparations will exceed the site's organizational capabilities during the planning and execution cycle.

The industry data shows a clear association between number of plant staffing levels and the probability of turnaround cost and schedule overruns. By evaluating and analyzing the number of plant personnel on site, we can determine whether the site has the capacity to plan and execute a highly complex STO effectively and identify the "critical zone" that drives cost and schedule overruns.

So how do sites determine the resource requirements and ensure the right staffing are committed for STO preparation and execution?

Without sufficient resources, it is impossible to achieve best-in-class outcomes. To achieve a high state of readiness, it is vital that STO teams have the right people in place to successfully prepare for their event. In order to determine the resource requirements for completing both STO preparation and execution activities, site leadership must develop a detailed resource plan and matrix to quantify the optimum head count and the particular mix of expertise the STO team needs to meet their specific long-range planning needs, as illustrated in Figure 3. The plan is based on the requirements laid out by the STO work process which includes percentage of time requirements for all resources (e.g., Operations resources). The STO Event Manager and Steering Team will use the resource matrix to get commitment for resources to meet

the event's requirements. This resource matrix is communicated to functional managers to ensure that they plan for the required contributions and time commitment from their resources.

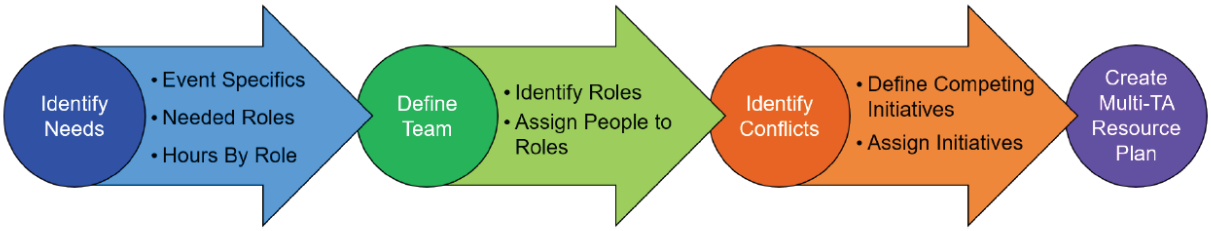


Figure 3: STO Resource Plan Road Map

2) Uncontrollable Leading Indicators: STO Inherent Risks

Another factor in the category that provides the team with little control are the many of the factors that contribute to the event's ***inherent risk profile or characteristics***. A few examples of inherent risks the team may have little to no ability to influence include:

- The volume of capital project work that must be integrated into the STO event;
- Characteristics of the site plot plan such as congestion in work areas;
- The interval between similar STOs which often have regulatory influences for opening and inspecting pressure equipment and impact the organizational memory for performing the event;
- Skilled craftworker and resource availability in the region.

Although the level of control that the STO organization has over these characteristics is very limited – such as qualified labor availability, material condition of the plant, equipment congestion, etc. – the examination and understanding of these inherent risks enables the quantification of their effect on STO outcomes. This in turn provides us with a gauge of the likelihood of meeting STO targets.

So how do we go about quantifying these STO risk characteristics?

The inherent risks can be modeled using the AP-Networks Industry data-driven **Risk Manager** tool, which analyzes the inherent risks to any given STO event and provides the typical range of outcomes for industry STOs with the same characteristics, as shown in Figure 4. With the range of typical industry outcomes identified, the quantified ***readiness*** can be used to provide a specific, probabilistic outcome scenario based on actual industry STO readiness and outcome data, as well as the likely outcome scenario if readiness is improved to an optimal level. We will come back to the topic of readiness shortly.

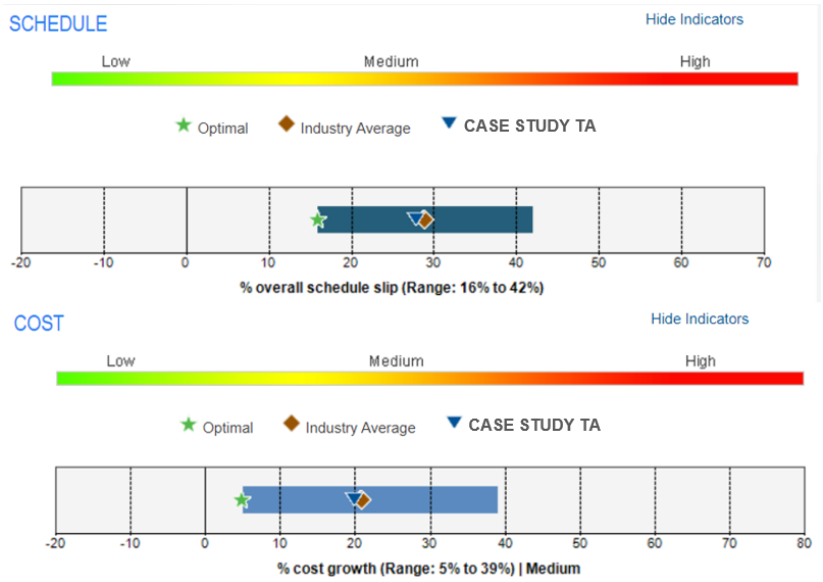


Figure 4: Risk Profile with Readiness Driven-Outcome Markers

3) Semi-Uncontrollable Leading Indicators: STO Scope

Going back to Figure 1, the third category, **Scope**, does provide the team with *some moderate level of influence* and in many cases, there is some ability to move particular work scope activity or equipment to routine maintenance that can be executed during normal operation. There is also team influence on the effectiveness of scope challenge and scope freeze by employing strong control and discipline. However, there is always *some scope that must be executed,* which is recognized as a key driver of the STO event itself.

Getting the work scope right is essential to STO performance, since scope serves as the foundation for cost, schedule, and plant reliability. Minimizing the amount of scope and the level of scope growth during the STO execution window is the primary driver of competitiveness.

It also takes strong commitment from leadership and the preparation team for the prevention of unnecessary change to the scope.

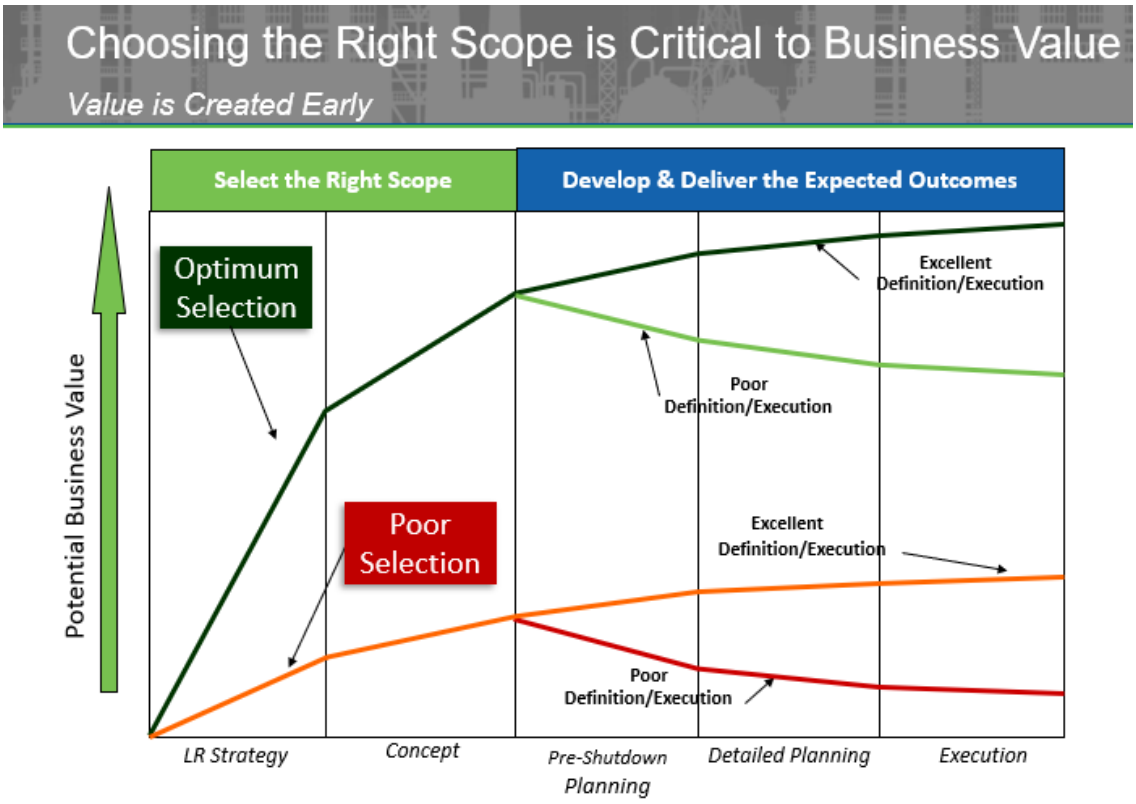


Figure 5: Choosing the Right Scope Influence Business Value

As seen from the Figure 5 above, choosing the "Right Scope" is critical to business value, as value is created in the early phases of a STO, through scope selection. Optimum selection of scope early on, coupled with excellent Definition / Execution, can have significant impact on execution efficiency and the STO performance outcome. In contrast, bad decisions or preparation gaps early on, can have a significant impact on the outcome. If scope selection is not optimum, unnecessary work will be performed having a negative impact on the outcome event if the team demonstrates excellent definition and execution. Therefore, making the right decision on scoping early on can have a huge effect on the eventual outcome.

Based on AP-Network database, Industry has still been struggling with scope growth for more than a decade as shown in Figure 6. When data for the last three years is examined, Industry average scope growth from scope freeze through startup is 22 percent. In contrast, top quartile performers experience scope growth of only 8 percent. This gap tells us that there is much more that can be done as an Industry to optimize STO scope.

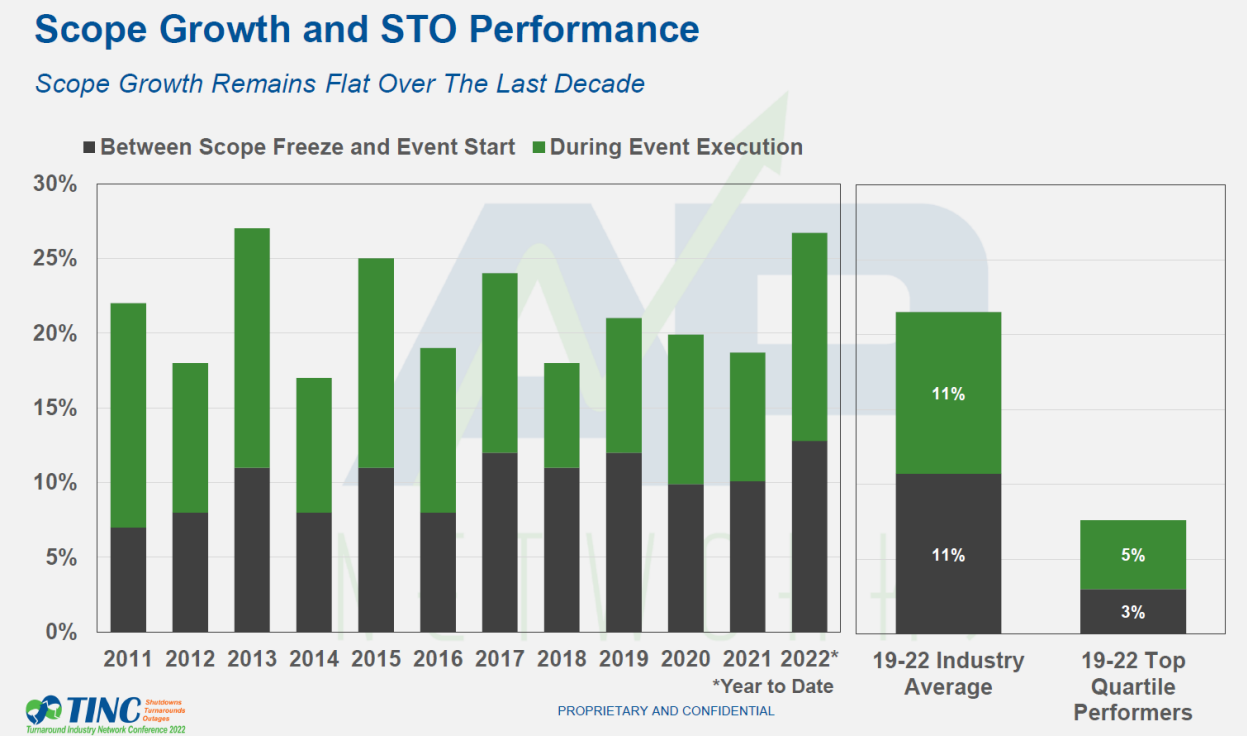


Figure 6: Scope Growth and STO Performance

Risk Based Scope Review (RBSR)

One practice used by Industry to optimize scope is to conduct a **Risk Based Scope Review (RBSR)**. RBSR is a fact-based, logical approach to scope evaluation and that provides the team with a structured approach to scope decision making.

RBSR has several benefits. An effective RBSR workshop will help the team to: 1) define optimal STO scope using historical data and fact-based methods, 2) improve startup and run time reliability and 3) gain buy-in to the final STO scope from all departments.

AP-Networks conducts RBSR workshops frequently, and they provide a structured approach to arrive at scope optimization. An RBSR workshop coupled with AP-Networks' Risk Based Selection Tool (RBST) is a powerful combination. It brings together the elements of failure likelihood and event consequences to quantify a plant's exposure to the risks associated with a specific piece of equipment. With risks quantified, management can make informed decisions on STO scope. Reductions of 15 percent or more in overall STO costs are typical when a structured RBSR process is used. The RBSR process versus the traditional scope challenge method is outlined in Figure 7 below.

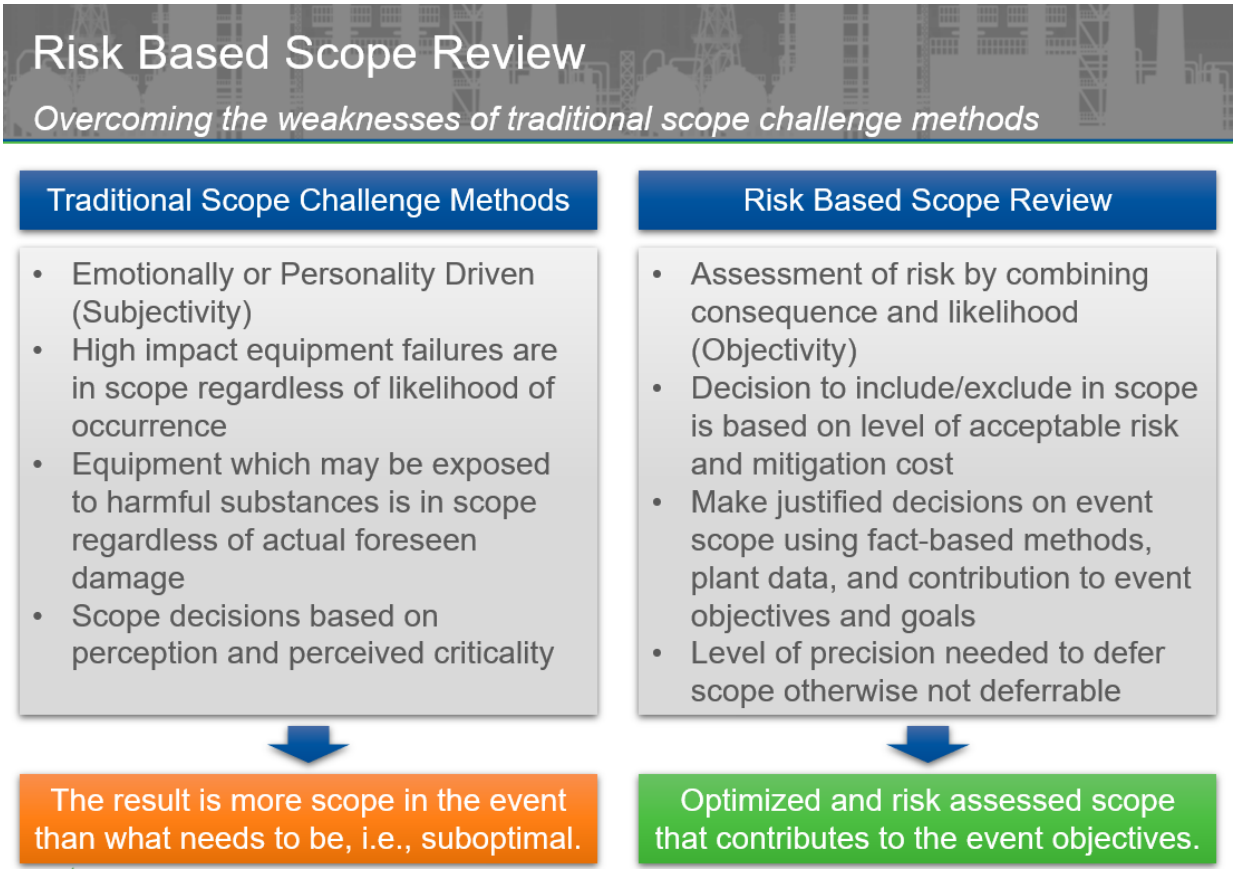


Figure 7: Risk Based Scope Review Process and Methodology

RBSRs require historical reliability and integrity data to determine specific equipment and asset risks, and all major scope stakeholders must contribute to the analysis.

Turnaround Scope Index (TSI)

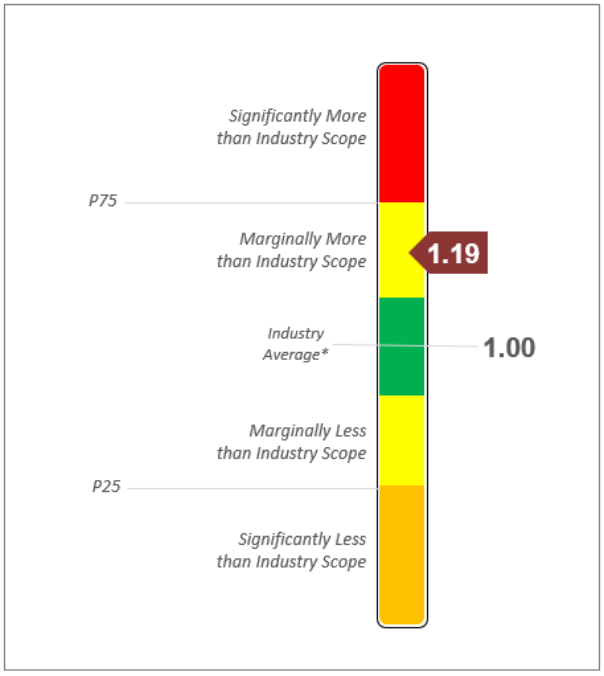
Some facilities or organizations may not have access to robust historical data required to perform an RBSR. Another valuable practice is Turnaround Scope Indexing which allows a STO to benchmark its specific scope to Industry for similar STOs and for the same process unit types.

Using its broad STO database, several years ago AP-Networks began offering a new scope benchmarking methodology. The Turnaround Scope Index (TSI), as shown in Figure 8, is now used by many Industry leaders at several points during the planning process to ensure that scope selection is competitive with peers and does not include what may be unnecessary work.

For detailed hardware specific and equipment-level examination of scope, a key challenge has been the efficient compilation and loading of large amounts of equipment data. Traditionally, this process could take weeks to collect the data, format it for use, upload, and complete the necessary data validation to ensure correctness. Over the last two years, AP-Networks has developed the first of its kind Artificial Intelligence-based data ingestion engine for STO data. It allows uploads of raw source documentation from the STO planning function with Machine Learning techniques that quickly populates AP-Networks cloud-based data tables for evaluation.

Scope Index: FCC & Alky Turnaround Maintenance Scope

Event Maintenance Scope Is Marginally More Than Industry



Equipment Count Compared With Industry

Equipment Type	FCC & Alky	Comparison
Mechanical	57	Significantly More
Rotating	17	Average
Heaters	N_3	Marginally Less
Exchangers	N_4	Marginally More
Valves	N_5	Significantly More
Instruments	N_6	Significantly More
Piping	N_7	Significantly Less
Electrical	N_8	Significantly More

Figure 8: Turnaround Scope Index (TSI) Methodology

The TSI fills a long-standing knowledge gap and puts a powerful new type of analysis in the hands of Industry that has never before been available. With the TSI, AP-Networks has provided industry with the ability to benchmark process unit specific STO scope relative to Industry norms. As mentioned, organizations can substantially improve STO performance and realize cost savings through scope optimization, and TSI benchmarking helps STO teams empirically and quantitatively demonstrate these savings relative to their Industry peers:

- Effectively benchmarking STO scope, labor hours, costs, and schedule relative to Industry peers helps companies achieve the best possible STO performance despite today's ever-changing cost drivers for STOs.
- Based on the STO scope, AP-Networks employs advanced statistical tools to quantify STO labor hours, STO costs, and STO execution duration relative to Industry peers.
- The analysis helps STO teams understand STO cost and schedule risks for the planned scope of STOs and establishes reasonably competitive targets.
- Combine with risk and organizational capabilities analysis to ensure long-range planning targets are realistic and achievable.
- Industry STO benchmarking and statistical analysis of performance metrics are essential in today's fast-changing environment to stay competitive.

4) Controllable Leading Indicators: Readiness

Although each STO event is characterized by a set of inherent, uncontrollable factors that affect its outcome, the preparation team must regularly deal with a myriad of factors that are controllable and have a profound impact on the event's predictability and competitiveness. AP-Networks has defined 21 areas that are critical to the upfront preparation for a STO as mentioned in the previous section; collectively known as **Readiness**. Please refer to Figure 9 for the 21 areas critical for STO planning and preparation.

Readiness is the category that provides the team with the ***most influence,*** and it consists of the plan and particular activities the team utilizes to prepare for the event. The quality of the team's planning and preparation is generally within their own control. Figure 1 shows that scope definition and planning practices are not only well within the control of the STO organization, but they are also leading indicators of STO success. In other words, the STO team has control over how they go about planning and preparing for their STO. The best in-class organizations effectively use a formal, gated and phased work process as a road map for STO preparation and execution. In addition, they achieve integration and organizational alignment around their objectives, scope, plans, and execution strategies through the effective use of their work process and its alignment and ability to "flange up" with other organizational processes.

So how can the state of readiness of a STO team be quantified and measured to ensure it is optimal?

With this question in mind, AP-Networks developed the previously mentioned Turnaround Readiness Index (TRI). With more than 20 years of application across industry, the TRI is well established and has become the industry standard measure of a STO team's state of readiness. It consists of two primary components: planning status and team alignment and is measured by application of AP-Networks' Turnaround Readiness Pyramid Tool, which measures the current state of preparation across the 21 areas that are critical to the upfront preparation for a STO. These areas can be broadly categorized as strategic, tactical, or execution in nature. To measure and quantify readiness with the TRI score, preparation team members complete a brief, objective self-evaluation with quantified criteria using the Readiness Pyramid Tool. This provides a real-time measure of planning status, team alignment, and the TRI as shown in Figure 9 and Figure 10 respectively.

Figure 9: AP-Networks Turnaround Readiness Pyramid

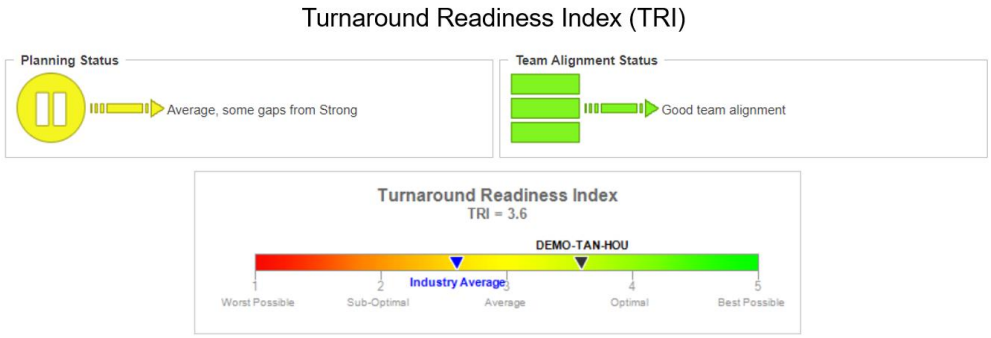


Figure 10: Turnaround Readiness Index (TRI)

With more than 20 years of application, the TRI measure has been proven to be a strong predictor of STO performance outcome. Higher TRI scores lead to both improved outcome predictability as well as improved competitiveness relative to industry, and this has been proven across thousands of STO events as shown in Figure 11.

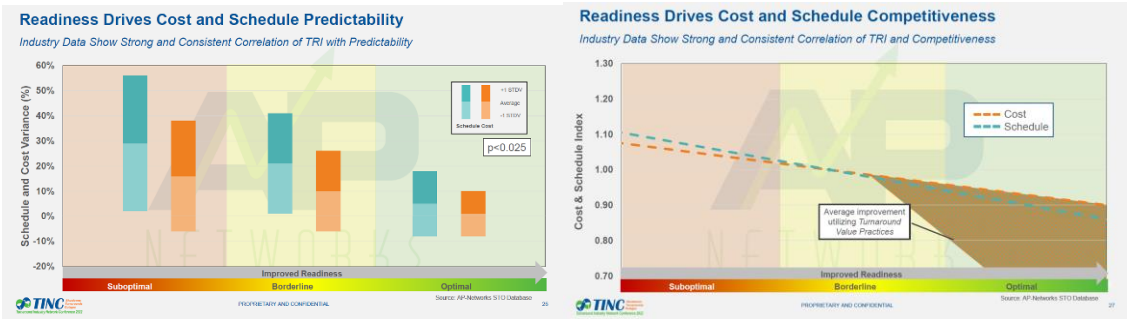


Figure 11: STO Readiness Drives STO Predictability and Competitiveness

The Importance of Effective Risk Management

Achieving an optimal TRI is only one side of the story. An active approach to risk management must also be applied to ensure any significant threats to success are identified and addressed through prudent mitigation and contingency planning.

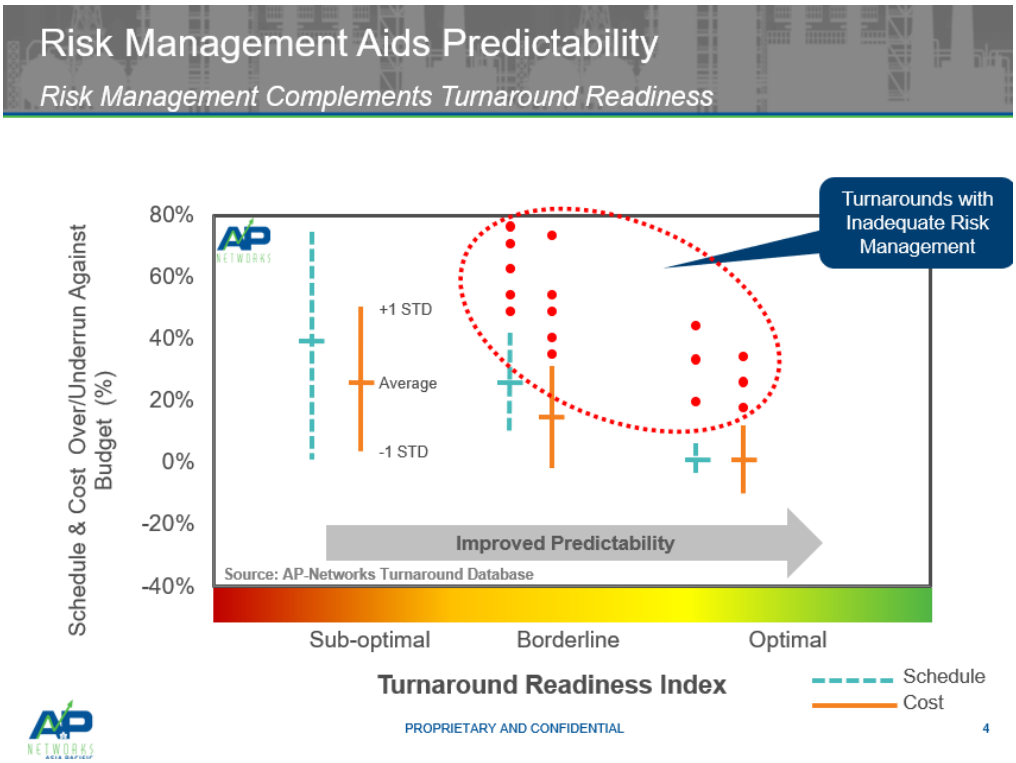


Figure 12: Risk Management Impact STO Predictability

AP-Networks Industry data in Figure 12 shows that, on occasion, some STO events achieve optimal Readiness, but they still overrun their cost and schedule targets. Back at Figure 1, we saw that only about 40 percent of STO are successful in meeting their budget and schedule within +/-10 percent and 24 percent were trains wrecks with cost and/or schedule overrun greater than 30 percent. These train wrecks typically had some form of risk management in place but it ultimately was ineffective and had limited to no impact on the outcome.

These STO events, despite the high level of readiness, were impacted by high severity negative performance issues which were not identified before the event so they could be managed through proactive mitigation or contingency planning.

Our work with industry has shown that only about **20 percent of preparation teams fully implement an effective risk management process**. That is, the risks are not only identified and evaluated, but they are assigned formal owners with tactical action-based response plans developed with performance monitoring.

So what are the best practices when it comes to ensuring that risk management is effective?

For the risk analysis and management to be effective, we need to ensure that there is a systemic process of identifying, scoring (assessing probability and impact), and developing response plans (with accountable party and due dates for completion). These plans are documented, shared, and reviewed by both steering and preparation teams with regular updates. Additionally, once the STO is completed, the organization needs to ensure that there is a continuous improvement initiative through the use of a formal Lessons Learned tracking system, i.e., there is a disciplined and consistent identification of opportunities for improvement to the preparation and execution processes. Most importantly, these improvements must be successfully acted upon. The project or STO team must develop the action plan and manage the specific actions required to implement and sustain improvements.

Based on the above requirements, AP-Networks has worked with hundreds of project and STO teams to help embed risk management using our **PYXIS** tool see Figure 13. The tools allow teams to: identify, evaluate and register risks and key information, assess probability, impact, severity, and manageability, track risk line items, mitigation and contingency action plans, with access to the database of most common industry risks for pre-populating the STO event's risk register.

PYXIS is a comprehensive risk management system with a workshop mode for initial identification of risk items. For any given STO event, it can be pre-populated with known industry risks from the AP-Networks database. All risk items are evaluated by probability, impact, severity, and manageability by applying an organization's already existing probability x impact grid. Once populated, the initial risk severity level is baselined and leadership can track its reduction over time as mitigation and contingency action items are completed. Action items are assigned to individual owners with start and due dates, and they fully integrated with action items from the STO work process.

ID	Risk Name	Type	Current Risk Severity	Current Likelihood Ratin	Current Impact Ratin	Residual Likelihood Rati	Residual Impact Rati	Residual Risk Severity	Manageabili
1	Lack of effective com	Threat	L L	Low	Low	Very Low	Low	VL L	
2	Lack of support servi	Opportunity	M M	Medium	Medium	Medium	Low	M L	
3	Unclear authority anc	Threat	M L	Medium	Low	Very Low	Low	VL L	
4	Misalignment of func	Threat	H VH	High	Very High	Medium	High	M H	
5	Limited planning resc	Opportunity	H H	High	High	Medium	High	M H	
6	Poor scheduling metl	Opportunity	L M	Low	Medium	Low	Medium	L M	
7	Inadequate cost tracl	Opportunity	M VH	Medium	Very High	Medium	Medium	M M	
8	Scope changes and a	Threat	H L	High	Low	Low	Low	L L	

Figure 13: AP-Networks State-of-the-Art Cloud Based Risk Management Toolkit

In summary, what are the Top Quartile Organizations Doing to Achieve Consistent, High-Performance STO Outcomes?

By using the Turnaround Readiness Pyramid tool and its robust STO preparation and outcome data collection processes, AP-Networks has conducted research to identify the practices that the top quartile teams use to achieve predictable high-performance STO outcomes. First, from its database of more than 2,500 STOs, those events which achieved the top 25 percent of outcomes in terms of absolute cost and schedule outcome relative to industry average were identified. Taking this top quartile dataset, research was conducted to identify the characteristics of these teams and their preparation processes and practices that consistently appeared in the data and are highly correlated with the associated outcomes. Below are the identified practices that consistently appeared in the data.

Top Quartile Practices

1. **The preparation team achieves an optimal level of Readiness.** The Turnaround Readiness Index (TRI) is high. The top quartile teams are able to achieve high measures of both planning status and team alignment in their TRI scores during STO preparation. TRI is measured on a 1 to 5 scale, and the top performing teams achieve scores of 3.5 or more. Analysis of the TRI score has shown that optimal performance is generally achieved when the score is between 3.5 to 3.8.

2. **The organization recognizes the business value of STOs.** STOs are a business priority for the organization, and this mindset trickles down from company leadership to operating facilities. It is recognized that being a STO top performer provides a competitive edge and enhances the bottom line.

3. **There is a robust governance and work process in place.** Teams are held accountable for complying to this process, and there is an assurance program being followed which leads to consistent, high levels of readiness and the timely, quality achievement of preparation milestones. It is a reflection of a company and site culture that promotes understanding the value of disciplined preparation and compliance with the work process. Critical success factors for achieving desirable STO outcomes involve both the quality of the work process and the quality of its implementation. By harnessing AP-Networks **NaviTrack**, our industry standard work process deployment tool, STO teams can effectively track progress of all activities and deliverables and improve the likelihood of meeting the STO planning milestones and deliverables.

4. **All pre-STO and capital construction work is scheduled and tracked to completion**. This pre-work is completed in advance of shutdown to ensure no spillover into STO execution. The **Capital Project Network (CPN**) from AP-Networks houses a world-class array of experience-based tools (including **NaviTrack**) and best practices to drive best-in-class decision-making and the achievement of successful capital project outcomes, and ultimately ensuring that all required pre-turnaround and capital construction work to be completed before STO execution starts.

5. **The scope definition and control process are effective**. The draft scope list is objectively reviewed and challenged, leading to a disciplined scope freeze. A **Risk-Based Scope Review (RBSR)** methodology is used to optimize the work scope and align it with an organization's risk tolerance and the original premises of the STO event. Additionally, the STO teams could also augment their scope optimization process by undertaking **Turnaround Scope Index (TSI)** benchmarking to compare the initial work scope to similar sized units in Industry.

6. **Capital integration is addressed early.** Capital projects often have components which must be constructed or installed during STO execution. These projects have their own objectives, budgets, timelines, and dedicated resources which may or may not align well with the objectives of the STO outage itself. Top performers define the capital integration strategy with capital and STO work processes that inform each other and mutually align for successful achievement of all performance objectives. AP-Networks has developed **iNTrack**, our first digital tool of its kind, creating a digital, dynamic handshake between project and STO work processes. It allows for a free flow of information between projects and STOs, facilitating the creation of preparation and execution plans that seamlessly integrate project and STO scopes of work and execution plans.

7. **Risk exposure is identified with severity quantified, and formal tracking of mitigation and contingency action items is implemented**. Even with high levels of readiness, STOs can miss their objectives if a serious threat is not identified and addressed. Top performers will populate a consolidate risk register with risks line items from all disciplines. Specific action items to reduce overall severity will be assigned to specific owners and completion of these actions is tracked along with work process activities.

8. **Operations resources are full-time dedicated members of the STO preparation team.** It is common practice that operations resources are tasked with developing STO shutdown and startup plans, decontamination/clearing and isolation plans during any downtime periods while performing shiftwork. However, this usually results in distractions, lack of focus and team alignment with the STO preparation team, and late completion of key deliverables. Top performers recognize the need to make operations planning a full-time role with resources assigned and dedicated early.

9. **Continuous improvement is achieved through a formal Lessons Learned tracking system** which takes advantage of the downtime between STO events to implement improvements. Similar to the risk identification and management process, top performers have a formal system of identifying the actions worth repeating that contributed to strong performance, as well as the opportunities for improvement. Some improvements may require significant modification to existing processes, so the interval period can be used for formal implementation of improvement plans. Like risk actions, lessons learned actions should be assigned and tracked to completion beginning in the post execution phase and continuing through into early long range planning (LRP) of the next STO event. AP-Networks' **LLern**—the only lessons learned management system in the industry—software designed to ensure full realization of improvement opportunities across the entire organization. LLern takes the static lessons learned list and transforms it into an active ongoing resolution engine for continuous improvement. Using dynamic registers, LLern enables the STO

team and entire site to actualize improvements by identifying and tracking lessons learned items and assigning their resolution to individuals across the organization.

10. **Realistic targets for STO success by setting achievable objectives and goals**. Top performers recognize that the estimated cost and schedule durations should commensurate with the work scope to be executed, while at the same time meeting the STO goals. AP-Networks Cost and Schedule Effectiveness models benchmark STO team's cost estimate and schedule duration to similar STO events in Industry. Our benchmarking products allow STO Teams to establish effective STO event cost and schedule target against industry for events with similar characteristics, to check the realism of team's current estimates, and to assess the risk/probability of meeting their STO event targets.

About the Authors

Mike O'Kane is the Global Director for Asset Performance Networks, based out of the company's office in Houston, Texas. His experience encompasses more than two decades in the refining and power industries, as well as work in process improvement and business performance consulting. In his current role, Mike shares responsibility for the development and ongoing improvement of the company's products and services, encompassing software, benchmarking, and consulting solutions.

Daniel Phan is currently a Regional Manager with Asset Performance Networks Asia Pacific Pte Ltd in Singapore. He has more than 20 years of experience in plant STO and project management consultancy in the oil & gas, petrochemical, maritime industries.

AP-Networks is the trusted leader for improving asset and operational performance in petroleum, chemical, mining, agricultural and other manufacturing companies worldwide. AP-Networks works with the client's most critical assets—their people, processes, and production facilities—in order to help them achieve safe, competitive, predictable outcomes on their high-risk events—namely capital projects and STO.

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