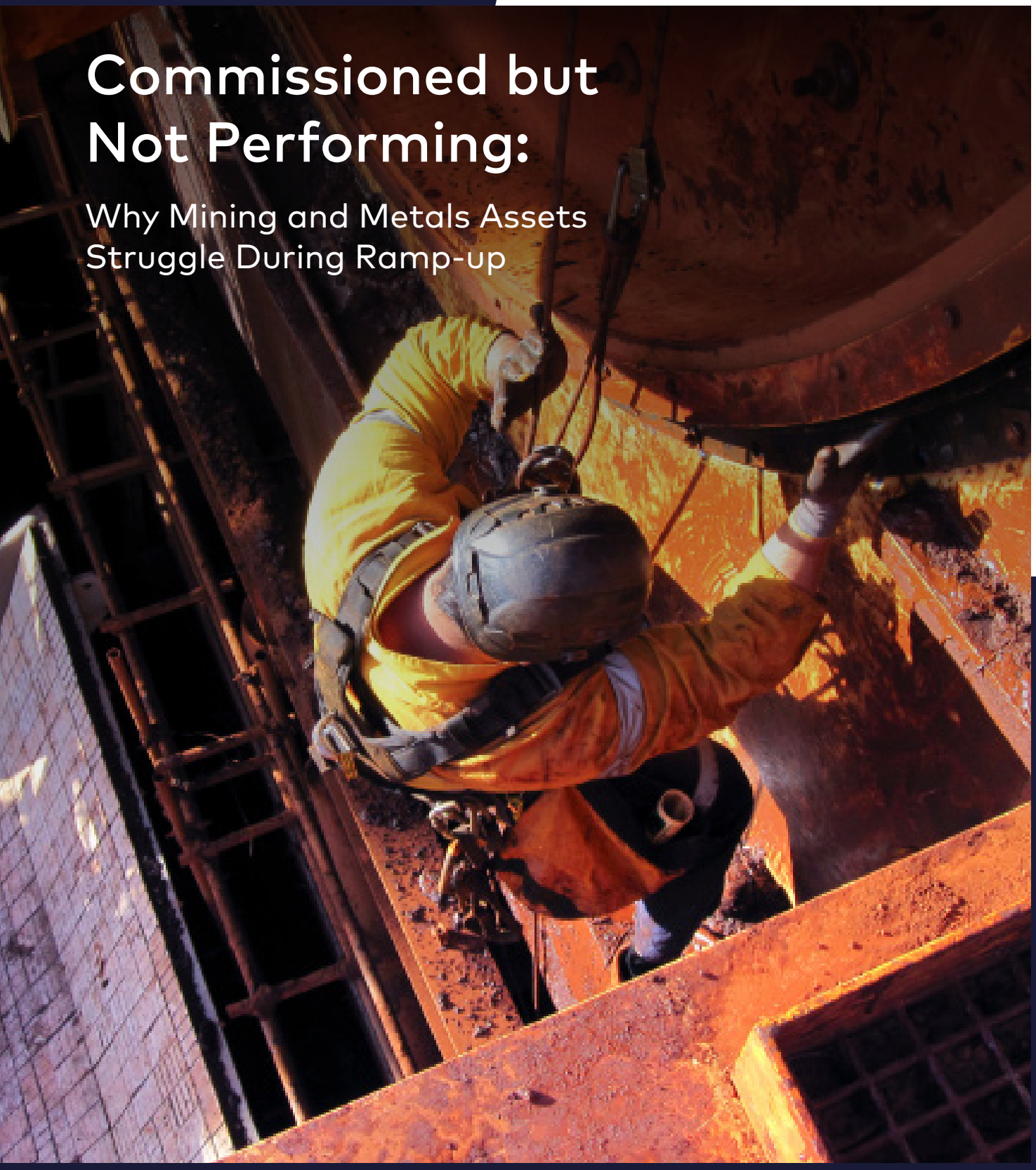
Commissioned but Not Performing:

Why Mining and Metals Assets Struggle During Ramp-up



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Protect. Transform. Sustain.

Completing commissioning does not demonstrate that a new operation can deliver its investment case. Whether the operation can deliver its investment case is established during start-up and ramp-up, when the owner must convert a technically complete asset into a safe, stable and self-sustaining operation.

Production below plan defers revenue, consumes working capital and prolongs dependence on project teams, equipment vendors and contractors. In North America, constrained labor markets, remote logistics, seasonal conditions and regulatory and stakeholder commitments can increase this exposure.

Our view is that ramp-up should be managed as an owner-led, evidence-based progression.

Production should increase only when the current operating stage is stable and the organization has demonstrated that it can manage the risks and complexity associated with the next stage.

Commissioning demonstrates that the asset has been installed and tested. Ramp-up demonstrates that the operating organization can safely and sustainably manage it under actual production conditions.



Our Point of View

Ramp-up should be managed according to four principles:

Evidence before progression. Completion of actions, documents and training is not sufficient unless people, equipment and operating systems can perform under actual conditions.

Safety and production managed together. Effective control of activity-based and process risks is a condition of increasing production or operating complexity.

One integrated operating plan. Production, maintenance, workforce, contractor, supply-chain and external requirements should be managed through a common plan and operating rhythm.

Capability matched to the phase. Start-up requires risk recognition, troubleshooting and abnormal-condition management. Stable operation requires repeatable systems, reliability and continuous improvement.



The value at risk during ramp-up

First production does not establish that the asset is delivering its investment case.

> Value is realized only when saleable output can be sustained at the required rate, quality and cost.

McNulty's review of 81 mineral-processing plant ramp-ups found that only 23, or 28%, followed the best-performing Series 1A ramp-up profile [1]. The remaining operations experienced slower or less stable production development. The causes included differences in process maturity, design, equipment, feed characteristics and operating performance. The study nevertheless demonstrates the variability in the path from first production and achievement of sustained design performance.

Ore variability, equipment reliability, weather and technology maturity can affect ramp-up. Where these factors are reasonably foreseeable, the ramp-up plan should define how the operation will detect, control and respond to them. If foreseeable variation repeatedly destabilizes production, the operation has not yet demonstrated the control or capability required for that condition.

1 ILLUSTRATIVE VALUE AT RISK

Consider an operation designed to produce one million tonnes per year with an assumed contribution of US$100 per tonne.

If it operates at 70% rather than 100% of design capacity for six months:

- Planned production for the period: 500,000 tonnes
- Production at 70% capacity: 350,000 tonnes
- Production shortfall: 150,000 tonnes
- Deferred or foregone contribution: US$15 million
- Average exposure for each additional month at this performance: US$2.5 million

This excludes additional maintenance, energy, reagents, vendor support, contractor costs, off-specification production and working-capital requirements.

Some production may be recovered later. Some may not be recoverable because of mine-life limitations, infrastructure constraints, market conditions or contractual commitments. Even when the tonnes are recovered, the delay reduces their present value.

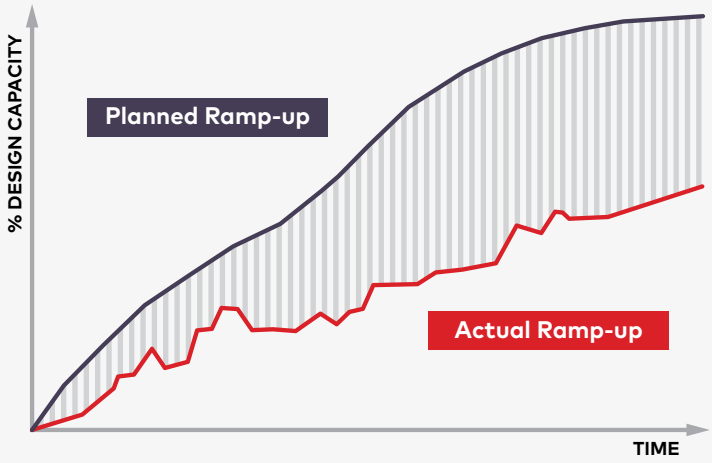


Figure 1. Illustrative planned and actual ramp-up profiles. The area between the curves represents production and value deferred or potentially lost during ramp-up.

Common causes of start-up delays and unstable ramp-up

Unstable ramp-up is rarely the result of one technical failure. It generally reflects interactions between the asset, operating organization and pressure to progress. Three recurring conditions are typically present.

- **The asset is not yet operating as an integrated system:** Equipment, process design, ore characteristics, control systems, maintenance strategies, operating data and supporting infrastructure may function individually but not yet operate reliably together. Problems that were not apparent during commissioning can emerge when the full operation is placed under sustained production conditions.
- **The operating organization is not yet self-sufficient:** Roles may be filled and training completed, but the operation may still depend on a limited number of experienced personnel, equipment vendors, contractors or project-team members to diagnose problems and make decisions. Canadian labor-market evidence illustrates this constraint: five of six indicators monitored by the Mining Industry Human Resources Council continued to signal a tight mining labor market in 2024 [2].
- **Production advances faster than control and capability:** Schedule or commercial pressure may lead the operation to increase throughput, fleet size, shifts or operating complexity before equipment, critical controls, workforce capability and management systems are stable at the current level. Remote logistics, extreme weather, supply-chain limitations and regulatory, Indigenous, community and customer commitments may introduce further dependencies that need to be incorporated into the ramp-up plan.

These conditions indicate that the operation is not yet managing the asset, organization and operating environment as one system.

Planning ramp-up in stages

A credible ramp-up plan links production increases to evidence that the current operating stage is stable and the organization is ready for greater complexity. A monthly production curve is an important planning tool, but it does not define the conditions under which the operation should progress.

The Construction Industry Institute describes start-up as a sequence extending from pre-commissioning and commissioning through material introduction, operating tests, performance verification and commercial operation [3]. For mining and metals operations, the stages should correspond to material changes in how the asset is operated.

A processing facility may progress by circuit, feed rate, process inventory or product specification. A mine may introduce production areas, stopes, benches, fleet units, shifts, haulage routes or blasting activities in stages.

Stage	Principal objective	What the stage should establish
Establish control	Operate the asset within a limited and understood scope	Critical controls function, operating limits are understood, data are reliable and personnel can manage normal and credible abnormal conditions
Increase and integrate	Increase production and operating complexity in controlled increments	Performance is stable at the current level, principal constraints are understood and production, maintenance and support functions operate as one system
Demonstrate and sustain	Confirm repeatable performance and transition to normal operations	Production, quality, reliability, cost and safety performance can be sustained without uncontrolled temporary measures or disproportionate specialist support

Staged progression is not intended to slow production. It controls exposure while the operation develops knowledge and capability. Each stage establishes an operating baseline against which the effect of the next change can be assessed. When several significant variables are increased simultaneously, it becomes more difficult to distinguish the cause of instability from its symptoms.

The stages should reflect meaningful changes in operating configuration or risk. They should not be based on arbitrary production percentages unless those percentages correspond to such changes.



2 EVIDENCE REQUIRED BEFORE PROGRESSION

Before increasing production or operating complexity, leaders should confirm that:

1. Performance at the current level is stable and repeatable.
2. Critical controls are verified and operating limits are respected.
3. The principal equipment, process and organizational constraints are understood and recurring failures are reducing.
4. Workforce capability, maintenance support, operating systems and data are adequate for the next stage.
5. Temporary arrangements and external commitments are controlled, and the accountable operating leader has reviewed the evidence and authorized progression.

Safety is a condition of progression

Safety should be incorporated into each ramp-up stage and its progression criteria. Risk controls need to remain effective as operating scope, throughput, process inventory, fleet size, contractors and shifts change.

For mining operations, progression may involve introducing new mining areas, fleet units, shifts, haulage routes or blasting activities. Before doing so, the owner should confirm that principal hazards, critical controls, supervision, workforce capability and emergency arrangements remain suitable for the expanded operating scope.

For processing plants, smelters and refineries, start-up and changes in throughput or process inventory introduce transient conditions, changing temperatures and pressures, temporary configurations and frequent operating intervention. The U.S. Chemical Safety Board's 2018 Safety Digest cites a 2010 refining-industry study reporting that approximately 50% of process-safety incidents occurred during start-ups, shutdowns and other infrequent operating events [4].

An operation that cannot control these foreseeable conditions is not ready to progress.

For U.S. facilities covered by OSHA's Process Safety Management requirements, a pre-start-up safety review (PSSR) provides an important decision point before hazardous materials or energy are introduced[5]. However, the PSSR should not be treated as the final safety review for the full ramp-up. Further risk-based reviews may be required before material changes in throughput, inventory, pressure, temperature, feed composition or operating configuration.

Capability requirements change during ramp-up

Filled roles and completed training do not demonstrate that the organization can manage start-up.

Personnel must demonstrate that they can recognize deteriorating conditions, understand operating limits and critical controls, troubleshoot unfamiliar problems and make sound decisions under production pressure.

These capabilities should be demonstrated through supervised operation, field observation, simulations, scenario exercises and performance under actual start-up conditions. This is particularly important where several shifts depend on a limited number of experienced supervisors, tradespeople or technical specialists.

As the operation stabilizes, capability requirements shift from troubleshooting and intensive specialist support toward standard work, planning, reliability improvement, cost control and continuous improvement. The ramp-up plan should provide for this progression.



Regaining control of an underperforming ramp-up



1. Establish control

When ramp-up falls behind, the owner should first establish an objective view of production, recovery, quality, equipment reliability, safety performance, workforce capability, maintenance backlog, temporary arrangements and external dependencies.

The operation may need to hold or temporarily reduce production while it confirms the safe operating envelope and establishes a repeatable operating baseline. The purpose is to distinguish symptoms from causes and identify the constraints that materially affect safe and stable performance.



2. Focus on the constraints that matter

Resources should first address constraints that prevent safe operation, limit stable production, create recurring failures, prevent progression or materially affect project value. Lower-value optimization should not displace the work required for safe and repeatable performance.

Production, maintenance, technical services, safety, workforce, supply chain, contractors and external commitments should be managed through one owner-led operating rhythm. This requires an accountable operating leader, clear decision rights, consistent operating data and regular review of risk, value, capability and progression decisions.

The operating rhythm should also address the behaviors created by production pressure. Personnel should be able to report instability, ineffective controls and emerging risks without being treated as obstructing the ramp-up. Temporary arrangements should have defined owners, conditions and expiry dates so that they do not become accepted operating practice.



3. Rebuild progression around evidence

The original ramp-up schedule may no longer be credible once actual operating performance is understood. The revised plan should be based on demonstrated capability, known constraints and realistic recovery actions rather than on preserving an obsolete schedule.

Project personnel, vendors and contractors may continue to provide support, but their involvement should have a defined purpose and exit plan. Support should be reduced only as the operating organization demonstrates that it can diagnose problems, maintain the asset, manage its systems and make operating decisions independently.

An owner-operator perspective

Our approach is informed by experience in owner and operator roles as well as advisory work. It places emphasis on the operating conditions, decisions and capabilities that must remain after temporary project, contractor and vendor support is withdrawn.

Conclusion

Start-up and ramp-up are where the investment case is tested under actual operating conditions. Owners protect value by establishing control, addressing the constraints that materially affect safe and stable performance, and increasing production only when the operation has demonstrated that it can sustain the next stage.

Call to action: For an asset that is commissioned but not performing to plan, the immediate priority is to establish an objective view of operating control, material constraints and organizational capability, and to reset the ramp-up plan around demonstrated performance. dss+ works with owner teams to complete this assessment and translate it into a focused recovery plan for safe, stable and sustainable performance.

References

[1] Terry McNulty, "Plant Ramp-Up Profiles: An Update with Emphasis on Process Development," Canadian Institute of Mining, Metallurgy and Petroleum, 2014.

[2] Mining Industry Human Resources Council, "Canadian Mining Outlook 2024," 2024.

[3] Construction Industry Institute, Planning Construction Activity to Support the Startup Process, Publication RS6-9, Research Team RT-006e, February 1, 1990

[4] U.S. Chemical Safety and Hazard Investigation Board, Safety Digest: CSB Investigations of Incidents During Startups and Shutdowns, 2018.

[5] U.S. Department of Labor, Occupational Safety and Health Administration, Process Safety Management of Highly Hazardous Chemicals, 29 CFR §1910.119(i), "Pre-startup safety review."

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