Codelco Chuquicamata advanced analytics in the concentrator

IMPLEMENTED 2020–2026 · MINING AND RESOURCES · CHILE · BAND C · CLAIMED ONLY
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Chile's state copper miner uses machine learning in an operations centre to advise the Chuquicamata concentrator, and says output rose more than 2%.

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NOTICE WORDING LAST UPDATED 16 NOVEMBER 2026

AT A GLANCE

AI used: Machine learning advice from an operations centre for a copper concentrator.

Implemented: 2020–2026. Grade: band C, Process change, Claimed only.

Headline result, as reported: Codelco says AI raised Chuquicamata output by more than 2%, about 8,000 more tonnes of fine copper, an estimated benefit of about US$80 million a year; company figures

1 · The case

The facts, as reported by the 3 sources listed at the end. Where a source is silent, the field says "Not reported".

Organisation

Codelco. Chilean state-owned copper producer. The case covers the Chuquicamata division's concentrator and its Integrated Operations Centre. Headcount or turnover: Not reported in the sources used. Canvas block: 4. Operations and process. Also 6. Data and technology.

Business challenge

The challenge. Codelco says it wants to raise the processing capacity of the plant so it can treat more ore and produce more copper, as part of its digital transformation.

How it was addressed. Engineers in Chuquicamata's Integrated Operations Centre use artificial intelligence and machine learning on large volumes of data about the mineral and each stage of the concentrator. The team gives the operation information to optimise decisions and adapt how processes run. Codelco says AI has been used in the company since 2020. [1] [2] [3]

Who implemented it

In-house (In-house): Engineers in the Integrated Operations Centre build and use the analytics. No vendor or consultancy is named in the sources used.

Technology (SEAM pillar E)

SEAM types: T8 Predictive / ML models. Deployment: Not reported. Vendors and products: Not reported.

Where it was built in: Machine learning on mineral and process data from each stage of the Chuquicamata concentrator, used by engineers in the Integrated Operations Centre to advise operations.

What changed

Before: Not reported. After: Codelco says the use of AI has raised the operation's production by more than 2%, about 8,000 tonnes of fine copper, an estimated benefit of about US$80 million a year (2022). Codelco's later work includes a machine-learning recommender to raise water recovery in high-capacity thickeners at Chuquicamata (2025). [1] [2] [3]

What it cost

Not reported

What it saved

By Codelco's account, an estimated benefit of about US$80 million a year from the Chuquicamata gain (2022). REDIMIN reports Codelco ran more than 20 AI and analytics initiatives in 2025 with accumulated benefits above US$90 million; the calculation method is not published in the sources. [1] [2] [3]

Governance and control

Not reported. The sources describe engineers in an operations centre providing information to the operation; they do not describe approval, monitoring or assurance arrangements.

S2 · Accountable owner · Not reported
Not reported.

A1 · Safe use · Not reported
Not reported.

A2 · Human in the loop · Claimed
An engineering team in the operations centre gives information to operations to support decisions, by Codelco's account. [1]

A3 · Monitoring and assurance · Not reported
Not reported.

A4 · Vendor AI · Not reported
Not reported.

A5 · Agent controls · Not reported
Not reported.

A6 · Standards and regulation · Not reported
Not reported.

What worked, what did not, what is unproven

WORKED

– Codelco reports a production gain of more than 2% at Chuquicamata and an industry association award for the project.

– Codelco has extended machine learning to water recovery at Chuquicamata, per El Dínamo.

– REDIMIN reports about 200 sensors at the El Teniente concentrator flagged events that could have caused losses above US$11 million.

DID NOT

– Not reported: the sources describe no failures. REDIMIN says the El Teniente AI and robotic arm trial is still at test stage.

UNPROVEN

– The baseline and method behind the 2% production gain and US$80 million benefit.

– How much of the gain comes from AI and how much from other changes at the plant.

– Whether results transfer to other divisions; Codelco itself named transfer to the whole corporation as the next challenge.

Timeline

2020 Codelco starts using AI in its operations, per its 2022 release [1]

Aug 2022 Codelco says Chuquicamata's advanced analytics raised production by more than 2%; the project wins an industry association award [1]

Oct 2025 Codelco presents a machine-learning recommender for water recovery in Chuquicamata thickeners at Water Congress 2025 [2]

Sept 2026 REDIMIN reports more than 20 AI and analytics initiatives in 2025 with benefits above US$90 million, and a trial of AI and a robotic arm at El Teniente [3]

2 · Grade and SEAM assessment

MarLuc's opinion, made on the evidence above. How cases are graded: marluc.co.uk/case-studies/how-we-rate

Level of change and impact

Claimed: Not applicable. Grade: C, Process change. Proof: Claimed only. Level of change: Process change.

Process change (Level 2, band C). The operations centre uses model output to run a plant process differently; results are Codelco's own.

Graded C, marker Claimed only. A team in the operations centre uses machine learning to adjust concentrator running, and Codelco reports a production gain, but the figures are its own and the method is not published.

The SEAM view and lessons learnt

The reported gain is a single before-and-after figure from the company, with no baseline published, so the AI's share cannot be separated from ore, maintenance or other plant changes. A leadership team copying this should ask how model advice is checked before operators act on

1. Publish the baseline and method behind any production gain claimed for AI.
2. Put model advice in front of engineers in an operations centre before automating control.
3. Track benefits per initiative so each can be audited.

Evidence

Score 0 of 4. Self-reported: Codelco's release and trade press repeating Codelco's figures; both in Spanish, translated. No independent evaluation.

Evaluation method. Self-reported company figures: a Codelco release giving a production gain and estimated annual benefit; no baseline or method published.

Sources disagree. Not reported

Status. Ongoing: REDIMIN reports Codelco planned to double its AI and analytics projects in 2026.

3 · Original sources

Read these in full. To challenge a fact or a grade, use the contact form at marluc.co.uk or the link on https://marluc.co.uk/case-studies/codelco-chuquicamata-advanced-analytics

[1] Codelco: Industriales de Antofagasta reconocen a Chuquicamata por su Aporte Tecnológico de Analítica Avanzada
https://codelco.com/prensa/2022/industriales-de-antofagasta-reconocen-a-chuquicamata-por-su-aporte

[2] El Dínamo: Codelco destaca en Water Congress 2025 por su avanzada gestión hídrica mediante herramientas digitales e inteligencia artificial
https://www.eldinamo.cl/innovacion/2025/10/21/codelco-destaca-en-water-congress-2025-por-su-avanzada-gestion-hidrica-mediante-herramientas-digitales-e-inteligencia-artificial/

[3] REDIMIN: MinerIA del futuro: la inteligencia artificial ya entra en la producción minera chilena
https://www.redimin.cl/mineria-del-futuro-la-inteligencia-artificial-ya-entra-en-la-produccion-minera-chilena

Codelco website: https://www.codelco.com

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