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Feature Article

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The overland conveyor at the Hidden Valley follows the site's torturous contours providing a vital link between the pit and processing plant. (image ref. IMG: PNG_256.jpg)

Innovative conveyor upgrades improve safety and throughput at PNG gold mine

Harmony Gold Mining Company was first registered in 1950 with a single mine lease and poured its first gold in 1954. In the current year, the company aims to produce 1.45 million ounces of gold. Harmony has thirteen operations and is South Africa's largest gold producer, with one mine in Papua New Guinea. Situated some 210 km northwest of Port Moresby, the Hidden Valley gold and silver mine is Harmony's third largest operation.

Hidden Valley is an open pit mine, located in New Guinea's high lying Morobe Province at an altitude of around 2500 metres. Access from Port Moresby involves a 45-minute domestic flight to a small airstrip near the town of Bulolo at an elevation of 700m, followed by a steep, 2-hour climb in a 4WD bus to the Hidden Valley mine site. The mine consists of three main lodes: Hidden Valley - Kaveroi (HVK), the two main lodes, mined as a single pit, and Hamata. The processing plant is located near the Hamata mining area.

Processing Business Unit Manager, Geoffrey Atkinson, is responsible for the mine's processing and fixed plant maintenance. His 400 strong team maintains site services, as well as the operations - from primary crushing all the way through to processing and smelting. A veteran of the mining industry, Atkinson started his career as a tradesman fitter and has worked on all aspects of plant maintenance across Australia and New Guinea within a diverse range of commodities - gold, coal, silver, lead, zinc and uranium.



Geoff Atkinson
(image ref. IMG: PNG_216.jpg)

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The Kaveroi pit at the Hidden Valley gold mine. (image ref. IMG: PNG_236.JPG)

Hidden Valley Kaveroi goes through two-stage crushing, before being transported by the conveyor onto the coarse ore stockpile at the processing plant. It then undergoes grinding, flotation, concentrated leach and CCD. Conventional gravity and CIL circuits are used for gold and a Merrill Crowe circuit for silver extraction.

“Our mine has a target gold production of 200,000 ounces per annum, which was achieved last year.” he said.

The Hidden Valley Kaveroi pit is located about 5km away from the processing plant which is situated adjacent to the Hamata orebody. There's a steep and winding access road between the pit and plant that crosses the Watut River.

Because of the high annual rainfall (up to 3m pa) the river is subject to short flooding events. Operating heavily laden haul trucks along this road when it is wet is certainly not the preferred means of ore transportation.

The pit is also linked to the processing plant via a 5.4km overland pipe conveyor. ROM feed from

Haul trucks or conveyor?

“The overland conveyor is pivotal to our operations,” said Atkinson. “Our only other option is to haul from the top to the bottom, which comes at a huge cost and increased risk.”



The overland conveyor minimises the use of heavy haul trucks on the road between the pit and processing plant (Image ref. IMG: PNG_168.jpg)

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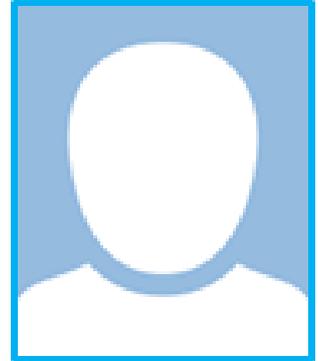
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Harmony Gold's Executive General Manager for Engineering and Asset Management - Stan Bierschenk, is a seasoned mining professional with a background in electrical and mechanical engineering. He has been with Harmony and associated companies including African Rainbow Minerals and AngloGold since around 1984. Bierschenk is responsible for the company's South East Asia – Engineering and Assets as well as assisting with studies for future development projects.



Stan Bierschenk
*(place holder only –
professional shot to come)*

“The road from the mining area up at the Hidden Valley Kaveroi orebody is very hilly, dropping about 400m in altitude from the Hidden Valley crushers down into the Watut Valley and then back up the other side to the plant.” said Bierschenk. “After weighing up various options, an overland conveyor was determined to be the preferred ore transportation mode, and a tube or pipe conveyor was chosen because it can handle the vertical as well as horizontal changes in direction presented by the region's topography.”

“You can put 14-15 thousand tonnes per day over the conveyor, but if you wanted to use trucks to move this amount of ore, the number of trips would be significant,” he continued. “We use the road to transport all materials, fuel, reagents and our employees to and from the mill. We only use the road for hauling, if the overland conveyor is out of service for lengthy periods and then only with consent from the Mineral Resources Authority. This would not be considered as a permanent solution, as the road would become too congested. It's just not practical.”

Conveyor reliability has been a challenge

The overland conveyor, known as the OLC, snakes down the mountain following its contours. But if the conveyor stops, only the coarse ore stockpile at the processing plant with a capacity of around 60 thousand tonnes keeps operations going. Once the stockpile is depleted, the processing plant grinds to a halt.



Considered to be the most critical piece of equipment on site – without the OLC running, production is soon impacted. *(Image ref. IMG: PNG_241.jpg)*

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“When you are milling 14,000 tonnes a day, there is a maximum of 4.5 days of milling without the overland conveyor,” said Bierschenk. “The OLC needs to stay ahead of the mill, and so it is the most important piece of equipment on the mine.”

“The cost impact of OLC downtime is dependent on when it affects the running of the SAG mill, in terms of direct cost it is in the order of US\$40,000 per hour or US\$1 million per day” explained Atkinson. “There’s also the company risk in terms of missing our targets and damaging market perceptions.”

Since the facility was originally commissioned, the OLC has been hampered by operational issues that led to unexpected downtime and increased maintenance expenditure.

“We were experiencing longitudinal cracks on the pulley side of the belt. Once that happens and you get water ingress, you lose adhesion between the steel cords and the rubber. We were only getting a three-year belt life when we expected five.” said Bierschenk. “Although the risk was not to the integrity or failure of the OLC, it was impacting the conveyor’s availability and utilisation.”

Metso engaged to improve the OLC

Between 2018 and 2019, Metso worked with the Harmony Gold team to resolve the problems and significantly improve the availability of the OLC.

“After discussing different belt options with Metso, rather than just replacing the belt with a slightly thicker one, we thought we should understand the impact of such a change on the conveyor. We engaged consultants to help us review the engineering of the entire conveyor system to see if the drives, structures and braking could handle a heavier belt. In consultation with Metso, they confirmed that the conveyor could in fact handle the heavier belt, which is how we arrived at the belt we have at the moment.” said Bierschenk.

“Once we had decided on the belt construction, and where it would be manufactured, we sent a consultant to Metso’s production facility to conduct a rigorous assessment of its quality and controls. This ultimately resulted in the delivery of a belt that will give us a five-year life span”.

The project was tackled in two parts: improving the engineering of the belt and implementing a solution for less frequent and safer belt change-outs.



Metso’ General Manager, Conveyor & Lining Services - David Gilmore discusses conveyor performance with Harmony’s Conveyor Belt Specialist - Peter Noimbil (Image ref. IMG: PNG_165.jpg)

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Phase 1: Belt engineering

The conveyor is unusual as it utilises pipe belt technology. The belt opens to receive feed and then curls to form a pipe to convey the material before opening to discharge. The belt on Hidden Valley's OLC was sometimes twisting preventing it from opening and closing, as well as 'pulling out' of its guide rollers. When this happened, it would result in prolonged downtime, causing large production losses.

Metso engineering staff used their experience, knowledge and engineering know-how to develop a new belt that's rigid enough to resist twisting but flexible enough to form a pipe. Metso designed the belt construction, then oversaw its manufacture and delivery to site.

"I was really impressed with the first X-ray of the belt," said Atkinson. "it really opened my eyes to the quality of the work that was done."

Phase 2: Turnkey solution for belt change-outs

Previously, belt change-outs were limited to sections of 800m for each 5-day (120h) shutdown. The limitations on the length of belt to be installed meant that either longer or more frequent shutdowns were required when more than 800m needed changing, increasing cost and HSE exposure, as well as reducing productivity.

"Once we had a thicker and stiffer belt, the question that we asked ourselves was – How can we change our systems so that we can replace a greater length of belt in a 5-day shutdown?" said Bierschenk.

"Because we have 10.8 km of total belt length and were only getting a 3-year lifespan, we were changing 800m sections far too often - and we can't really afford the downtime," he continued. "Our two conveyor belt specialists had previously worked on operations where 'belt-flaking' was used to change-out longer sections of belt, so I asked Metso and GHD to assist in the design of a new splicing station. With Metso's help, we were able to develop a system that allows us to change out 3.5 km or more of belt at a time."

Metso delivered a turnkey solution with a completely different philosophy to belt changeouts. The project started with the development of a change-out methodology and engineering assessment. This was followed by belt change-out equipment design and engineering certification, then manufacture and transport to site. Metso conducted on-site installation and commissioning providing service technicians as required.

Staff benefits from outside engagement

Harmony Gold has a strong policy of local workforce inclusion. Around 96% of Hidden Valley's more than 1200 staff come from local communities – so training and development is a major focus of the operation.

"Many of the locals have never worked in a mine before, so our training teams help them to reach a capable level," said Atkinson. "It's all about supporting sustainability in the local community."

Mechanical foreman and conveyor maintenance specialist - Robin Mali, described the Metso engagement as an opportunity to learn and improve skills.

"Getting experienced staff from Metso to come here was also beneficial in relation to how much we could learn from them about the conveyor and how to maintain it," he said.



Robin Mali
(Image ref. IMG: PNG_234.jpg)

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Less belt maintenance leads to significant financial benefits

Prior to the new belt and change-out methodology, the 3-month average availability for the OLC was 75.9%. Since the upgrade, this has improved to 95.1% – an increase of 19.2%.

“Previously, to change out 3.5 km of belt would have taken a total of 20 days, doing 800 m at a time.” said Bierschenk. “Now we can do it in a single 5-day shutdown, which means that we have reduced belt change-out time by 15 days per year.”

Metso’s Pinch Drive Change Out System reduced four 5-day shutdowns to one. With the cost of a shutdown being estimated at US\$2 million, the project delivers direct maintenance cost savings of around 6 million dollars per annum. According to Bierschenk, these savings are eclipsed by the gains in production delivered through better OLC availability.

“At around US\$1 million in gold production per day, that means we would have increased annual production value by around US\$15 million through this improvement alone.”

Improved site safety



Belt change outs are heavy physical work that can expose maintenance staff to many hazards (*Image ref. IMG: PNG_043.jpg*)

“The safety of our people is the most important focus area in our business. Maintenance of any kind has inherent hazards,” explained Bierschenk. “With belt change-outs you’ve got moving parts, and work that is physical and potentially dangerous for the 20-30 people involved. Anything we can do to reduce maintenance time also reduces the exposure of our people to hazards.”

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“A belt change-out is a difficult job – it is very physically demanding and stressful,” said Mali, “Doing the change-outs only once a year is a great safety improvement.”



A key success factor of the project was a practical, consultative approach to problem solving (Image ref. IMG: PNG_043.jpg)

Expectations exceeded

Bierschenk and Atkinson feel very positive towards the services provide by Metso.

“It’s certainly one of the best relationships I’ve seen between staff and contractors on a site,” said Bierschenk. “With the whole team from Metso that have come to site at various times, it has always been positive, constructive and engaging. Everyone worked towards the success of the project.

“The focus on detail was the key,” added Bierschenk. “From the very beginning, the amount of detail and effort that went into creating something that would work – from the proposal through to the design, the project management, belt flaking and pulling in of over 3000m – I believe that contributed to the success of this project.”

David Gilmore, General Manager Conveyor & Lining Services at Metso, is also pleased with the result: “I am really happy that we have been able to leverage the profound know-how and experience of our teams to help Harmony Gold achieve such a significant improvement. We’re really looking forward to playing a part in taking their conveyor throughput to the next level.”



David Gilmore
(place holder only –
professional shot to come)

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Looking forward

Harmony Gold has plans for further OLC improvement.

“We would like to get the belt up to its nameplate throughput of 800 tonnes per hour which would be a major benefit, should we ever decide to extend the life of the mine,” said Bierschenk.

“One of the reasons we need higher throughput is that the ore grade doesn't always maintain its consistency, so higher throughput gives us a buffer to make sure we can achieve our targets. We also want to figure out how we can reduce the amount of idler maintenance that we need to do, or to better detect idler problems in the earlier stages before they fail.

To achieve these goals, I've no doubt we will be engaging Metso again.”

Metso is a world-leading industrial company offering equipment and services for the sustainable processing and flow of natural resources in the mining, aggregates, recycling and process industries. With our unique knowledge and innovative solutions, we help our customers improve their operational efficiency, reduce risks and increase profitability. Metso is listed on the Nasdaq Helsinki in Finland and had sales of about EUR 3.6 billion in 2019. Metso employs over 15,000 people in more than 50 countries.

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