



**IGF**

INTERGOVERNMENTAL FORUM  
on Mining, Minerals, Metals and  
Sustainable Development

**IGF CASE STUDY**

# Leveraging Technologies for Gender Equality in Mining Communities

Case studies from the  
Democratic Republic  
of the Congo,  
South Africa,  
and Peru



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## Introduction

Historically, access to technology and technical infrastructure has been deeply gendered, characterized by women having lower access than men (World Wide Web Foundation, 2015). The reasons behind these lower numbers are multifaceted and complex, ranging across less access to the Internet and devices, lower digital literacy, cultural norms and stereotypes, and a lack of access to science, technology, engineering, and mathematics (STEM) education (World Economic Forum, 2020).

This disparity is compounded in mining communities, where recent research shows that women are disproportionately affected by mining activities—they often bear the brunt of impacts while lacking access to positive opportunities created by the presence of large-scale mining (Sinclair, 2021). Global mining activities are increasingly taking place in remote jurisdictions where host communities, as a baseline, have fewer socio-economic opportunities and limited technological infrastructure support from local government institutions (Collier, 2017). These factors are added barriers to ensuring that women in mine-host communities have equal access to technology and technological infrastructure.

Within the global mining sector, recent research by the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) presented in *Women and the Mine of the Future: Global Report* confirms that women are underrepresented in STEM education programs across the countries included in the study (IGF, 2023).<sup>1</sup> In a sector that benefits from rapid advances in disruptive technologies and innovations that improve mining processes, safety, and profitability, very little consideration is given to including women

in employment and training opportunities in mining and its related supply chains.

With mining technology developing at a rapid pace, operations are starting up in increasingly remote areas where mining companies need to install technological infrastructure such as high-speed Internet and satellite services to stay abreast of developments in mining technologies. As a result, large-scale mines are often the first stakeholders to bring technologies such as mobile phone reception and Internet connectivity into an area (Collier, 2017). This trend is not dissimilar to mining companies providing roads and/or electricity to rural areas where there was previously no adequate access to these services. Whereas it has become an accepted practice for mining companies to share these traditional infrastructure services with host communities, sharing access to technological infrastructure with host communities is a more recent development, with some successful case studies emerging, as exemplified in this report. This practice is currently in its infancy, and current emerging programs focus on providing access to all host community members, not women in particular.

The COVID-19 pandemic and its related restrictions on in-person meetings served as an impetus for mining companies to supplement traditional stakeholder engagement activities with digital means of engaging with host communities. To enable this engagement practically and equitably, mines had to consider sustainable ways to share technological infrastructure and tools with host communities and employees. One of the case studies presented in this paper (the Umoja application) was, in part, the result of the implementing company looking for solutions to engage meaningfully with employees during the pandemic. One of the lessons learned during the pandemic

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<sup>1</sup> The report collected data from Argentina, Australia, Brazil, Canada, Chile, Colombia, Ghana, Mongolia, Peru, South Africa, Sweden, and Zambia.



is that digital engagement cannot and should not be expected to replace in-person engagement between mining companies and host communities; rather, it should supplement in-person contact and make existing practices more transparent.

The programs in this case study focus on emerging collaborations between mines, host communities, local employees, and other stakeholders that are sharing technology and technological infrastructure to improve the lives of those impacted by mining. This research has indicated that while programs might not be initially designed exclusively for women, an unintended consequence of making the technology available to all is that women who are traditionally underserved in technology and technological infrastructure benefit from its presence. The case studies examined herein also consider how governments can encourage and support the extractive companies operating in their jurisdictions in sharing

access to technologies and technological infrastructure for the greater benefit of host communities.

In particular, this report illustrates how mining companies in South Africa and the Democratic Republic of the Congo (DRC) are sharing technological infrastructure with local communities and how partners are collaborating in Peru to add stakeholder voices to mining-related impact measurements.

## An Overview of Case Studies

The following tables provide an overview of the case studies included in this publication where digital technologies are being used to improve engagement with—and quality of life of—mine-host communities and local employees, with a focus on female participation.

**TABLE 1. South Africa: Connecting communities**

<b>Commodity</b>	Platinum-group metals
<b>Country</b>	South Africa
<b>Company</b>	Ivanhoe Mines and its subsidiary Ivanplats
<b>Gender disaggregated data available</b>	Limited
<b>Technological assets shared</b>	Digital infrastructure and custom software
<b>Description</b>	Launched in 2017, the Maru a Mokopane project provides the host communities of Ivanplats' Platreef Mine in Mokopane, Limpopo province, with free access to Wi-Fi at 20 hotspots around the mine. Wi-Fi use is capped at a cut-off point for each user. Maru a Mokopane has 30,400 registered users, of whom approximately 42% are female. During the rollout of the project the mine employed 40 young people from host communities on a contract basis to provide digital literacy training to potential users. Community members use the platform to communicate with the mine, view job and procurement opportunities, and raise concerns.



<b>Community benefits</b>	<ul style="list-style-type: none"> <li>• Digital inclusivity</li> <li>• Digital literacy</li> <li>• Online engagement</li> <li>• Transparent procurement and recruitment processes</li> </ul>
<b>Shared or custom infrastructure for communities</b>	Custom, leveraging off what is publicly and privately available
<b>Mandated by government</b>	No
<b>Key success factors</b>	<ul style="list-style-type: none"> <li>• Digital literacy training was included in the rollout.</li> <li>• Hotspots at key community infrastructure points, such as clinics and schools, imply collaboration with the community.</li> <li>• A scaled approach meant sustainability throughout COVID-19 lockdowns and disruptions.</li> <li>• The existing national network infrastructure in communities could be leveraged for installing hotspots.</li> </ul>
<b>Key lessons</b>	<ul style="list-style-type: none"> <li>• Remaining potential to partner with government digital channels in the area</li> </ul>

Source: Interview with Daphney Tsatsi, Communication Officer, Ivanplats.

**TABLE 2.** Peru: Understanding stakeholder voices

<b>Commodity</b>	Copper
<b>Country</b>	Peru
<b>Company</b>	Collaboration lead – National Service for Environmental Certification of Sustainable Investments in Peru (SENACE)
<b>Gender disaggregated data available</b>	Yes
<b>Technological assets shared</b>	Digital engagement tools (voice and SMS)



<b>Description</b>	Ulula, a specialist digital platform service provider, in partnership with SENACE, the Canadian International Resources and Development Institute, Simon Fraser University's Co-Lab Peru project, and the Centre for Analysis and Conflict Resolution at Pontificia Universidad Catolica of Peru, deployed Ulula's digital engagement platform in the copper mining region of Junin in Peru. The program was co-designed by leading and community stakeholders leveraging interactive voice response (IVR) and SMS technology in a low-literacy and low-connectivity area. The tools of the program included messages in local languages to raise awareness of human rights among community members in mining communities, a two-way support line for recourse in grievances, and a news broadcast of events related to mining development in the area. Over 40% of participants in the pilot were women receiving messages about their rights as mining stakeholders and having access to a two-way channel to voice issues.
<b>Community benefits</b>	<ul style="list-style-type: none"> <li>• Collaborative engagement and participation in impact identification and management</li> <li>• Human rights awareness</li> <li>• A grievance redress mechanism</li> </ul>
<b>Shared or custom infrastructure for communities</b>	Custom platform, leveraging the public network infrastructure
<b>Mandated by government</b>	No
<b>Key success factors</b>	<ul style="list-style-type: none"> <li>• Collaborative design that included local stakeholders</li> <li>• Using technology that end users have access to and are familiar with</li> <li>• A multi-partnership initiative</li> </ul>
<b>Key lessons</b>	<ul style="list-style-type: none"> <li>• Remaining potential to onboard local mining companies and government agencies as partners</li> </ul>

Source: Interviews with Vera Belazelkoska, Director of Programs, Ulula, and Andres Mauricio Fernandez, Technology for Human Rights, Ulula.

**TABLE 3. DRC: Engaging mining employees**

<b>Commodity</b>	Copper and cobalt
<b>Country</b>	DRC
<b>Company</b>	Glencore and its subsidiary Kamoto Copper Company (KCC)
<b>Gender disaggregated data available</b>	Limited



<b>Technological assets shared</b>	<ul style="list-style-type: none"> <li>• Digital infrastructure</li> <li>• Digital hardware (smartphones)</li> <li>• Digital software</li> </ul>
<b>Description</b>	<p>At KCC in the DRC, Glencore partnered with Vodacom Business and Standard Bank to create the Umoja App for employees, which is enabled by the Wyzetalk platform. Umoja means “unity” in Swahili and offers KCC employees a tool that provides real-time information, human resources and payroll details, training, and employee feedback. Umoja is designed to address structural communication challenges prevalent in the business, as well as the larger community. Full-time employees are given a smartphone, data bundles, and solar chargers. In addition, Vodacom invested in upgrading the network infrastructure in Kolwezi, where the Kamoto mine is situated. A secondary benefit is that employees’ families have access to a smartphone and data bundles provided by the company outside of working hours, providing digital inclusivity for people who did not have access before.</p>
<b>Community benefits</b>	<ul style="list-style-type: none"> <li>• Digital inclusivity</li> <li>• Digital literacy</li> <li>• Online engagement</li> <li>• Transparent human resources management and issue management</li> <li>• Health and safety education</li> </ul>
<b>Shared or custom infrastructure for communities</b>	Custom platform, leveraging public network infrastructure
<b>Mandated by government</b>	No
<b>Key success factors</b>	<ul style="list-style-type: none"> <li>• A multi-partnership initiative with key investment by a mining company</li> <li>• A commitment to strengthening various aspects of digital connectivity: hardware, software, and telecommunication infrastructure</li> </ul>
<b>Key lessons</b>	<ul style="list-style-type: none"> <li>• Glencore is rolling out Umoja at its other mine (Mutanda Mining) in the DRC.</li> </ul>

Source: Interviews with Andy Wilson, Vodacom for Business, and Tshene Omambo Wedi, Regional Communications Manager, Glencore.



## Case Study 1: Connecting communities in rural South Africa<sup>2</sup>

Ivanplats Pty Ltd is a subsidiary of Ivanhoe Mines Ltd and is developing the Platreef platinum-group metals mine in rural Mokopane, Limpopo, South Africa. This mechanized underground mine is in its final development phase, with its first production date estimated for the fourth quarter of 2024 (Ivanhoe Mines, 2023). The surface infrastructure of the mine has a small footprint, with over 190,000 people living in 20 host communities in the surrounding area (Digby Wells Environmental, 2013). The company has been exploring for metals in the region since 1998 and has been engaging with host communities through various means throughout the exploration and feasibility phases of mine development.

As construction of the mine intensified in 2017 and more opportunities became available to host community members for employment and development programs, Ivanplats identified a need to engage with community members on an individual basis. Stakeholders viewed the existing systems of placing job postings on notice boards and communicating through civic or traditional groups as lacking in transparency.

With transparency in mind, Ivanplats created a program called Maru a Mokopane (the literal translation in Sepedi is “the clouds of Mokopane”), in which a browser-based application was developed for community members to easily and in real time find information about the mine and send the mine a message. To enable community members to use the application, the mine partnered with the Bonega Communities Trust to sponsor 20 free Wi-Fi hotspots at key community infrastructure points, such as schools and/or clinics. This infrastructure enabled community members to browse the app and enquire about opportunities (The Southern African Institute of Mining and Metallurgy, 2017).

The activation of the program was strongly supported by digital literacy training, without which the uptake would undoubtedly have been slower. This training involved employing 40 unemployed young people on a contract basis for 12 months to be available at the hotspot areas to educate community members on how to connect to the hotspot, how to use the app, and how to use their free daily data allocation to browse the Internet. These digital ambassadors, of which approximately a third are female, underwent a rigorous training program, were mentored throughout the period, and were paid per user who completed the online onboarding module.

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<sup>2</sup> Unless otherwise noted, the main source of information for this case study was an interview with Daphney Tsatsi, Communication Officer, Ivanplats.



## Positive Unintended Outcomes: Digital inclusivity

The initial goal of Maru a Mokopane was to engage in a transparent manner with individual members of Ivanplats' host communities, but it quickly evolved into a powerful tool for facilitating digital inclusivity and connecting host communities to online opportunities unrelated to the mine. User analytics show that community members preferred to access online sites that provided them opportunities to improve their lives, such as educational, entrepreneurial, business, and finance sites. This finding implied that users who had been previously excluded from these opportunities in the digital world now had access through their daily data allocation.

## The Power of Stakeholder Data to Inform Better Decision Making

As the program progressed, there was healthy skepticism as to who would use the app most and what users would use their daily data allocation for. Assumptions

were that young males would dominate the user statistics and that social media and entertainment sites would be most frequently visited. Aggregated results from over 30,400 users tell a different story:

- Most users are within the age group of 16 to 39 years.
- Women account for 42% of registered users.
- Over 7,405 Curriculum Vitae (CVs) have been uploaded and verified, and the app is actively being used to apply for opportunities at the mine; 41% of applications are from female users.
- The most frequently visited pages on the Maru a Mokopane app are job searches, procurement, training, and development opportunities.
- The most frequently visited pages on the web (using the daily data allocation) are university sites, education, online courses and development, bursaries, learnership and internship opportunities, and job search sites.



Photo: Digital literacy training was an essential part of activating the Maru a Mokopane program (Courtesy of Ivanplats).





Platreef Mines' host communities have been using Maru a Mokopane for over 6 years, and over that period, user behaviour data has resulted in fine-tuning and improving the system. The functionality to apply for jobs at the mine through the app has been added, as well as a business directory to help publicize goods and services from local businesses.

Throughout the implementation of the program, efforts were made to collaborate with other stakeholders. One such partnership is with a local Internet service provider who has contracted a few qualifying community members to help service the free Wi-Fi hotspots. For longer-term sustainability, the company has approached

several other partners, including financial institutions and local government, to incorporate public service functionalities and financial services into the app. While engagements are ongoing, as yet, no real progress has been made to integrate local government priorities and/or financial services into the program. The main reason for that lack of progress is that the program was started as a privately funded initiative, and other partners prefer to put their resources into their own initiatives.

## LESSONS LEARNED

1. The real power of a mine in enabling digital connectivity is not only in improving transparent stakeholder communication but also in providing willing users access to an online world of education, work, and business opportunities.
2. The importance of a digital activation program that is responsive to the local languages and cultural practices is well illustrated by using digital ambassadors to support users in signing up and using the program.
3. Technological infrastructure does not have to be shared to be effective; investment in bespoke community digital infrastructure can have far-reaching positive economic development effects, which may be difficult to quantify but are no less real.
4. Engagement with regional and local governments to share not only technological infrastructure but also software must be supported by the central government, particularly mining ministries.
5. At the policy and regulatory level, a mandate and incentives from government to include shared digital infrastructure in local content policies and/or formal corporate social responsibility commitments will encourage mining companies to view digital inclusivity as a viable social development option.



## Case Study 2: Understanding mining stakeholder voices in rural Peru<sup>3</sup>

Internet connectivity is not an option for most stakeholders impacted by large-scale mining. This is often due to various factors, such as a lack of basic technological infrastructure in the region that mining companies can leverage, as well as access to devices. For stakeholders living in Peru's copper mining region of Junin Province, where several mining companies are in various phases of completing or updating their environmental and social impact assessments (ESIAs), browsing the Internet for more information about mining impacts is not an option. Although Peru has made great strides in Internet penetration as a country since 2015, up from 40.9% to 65.3% in 2022, Internet access in rural areas is still underserved, whereas most stakeholders have access to mobile voice technology in the region (International Telecommunications Union, 2020).

Robust public participation about the impacts of mining on stakeholders is an important factor in obtaining and maintaining the social licence to operate. Historically, in Peru, the mining sector has failed to engage to a level where a trust

relationship between stakeholders can be built, as illustrated by the estimate that up to 64% of socio-economic conflict in 2022 was related to the mining industry (World Bank, 2021). In Junin Province, other barriers to participation in public consultations on the impacts of mining include low literacy rates, poor connectivity, low levels of trust between stakeholders and mining, and social and cultural factors excluding women and other vulnerable groups from participation.

It is estimated that over USD 12 billion in mining developments have been put on hold in Peru due to social conflicts in recent years (World Bank, 2021). For this reason, and due to increased awareness of the importance of inclusive engagement during all phases of a mine's life cycle, SENACE partnered with the following stakeholders to pilot a technological solution to address the lack of citizen participation in the region:

- Canadian International Resources and Development Institute,
- Centre for Analysis and Conflict Resolution at the Pontificia Universidad Catolica of Peru,
- Ulula digital platform for deployment of stakeholder-voice technology, and
- Local stakeholders in Junin Province to develop and provide feedback on the pilot.

<sup>3</sup> Unless otherwise noted, the main sources of information for this case study were interviews with Vera Belazelkoska, Director of Programs, Ulula, and Andres Mauricio Fernandez, Technology for Human Rights, Ulula.



The focus of the pilot program was to advance citizens' participation in consultative processes in mining and assure an impartial ESIA of the mining project's impact, with a focus on community. Ulula's digital platform was selected to provide the technology for the pilot, as it provides an anonymous, secure, and language-agnostic channel for stakeholders to participate regardless of literacy status. It also caters to the devices and the level of connectivity that community members were already using. The specific objective of using Ulula's technology in this setting was to test the applicability of digital tools in low-connectivity settings where access to advanced digital technologies is limited, literacy levels are low, and women's perspectives are underrepresented.

The project directly and indirectly impacted 1,300 individuals; of these, approximately 1,000 were community members living within the mining region. The balance was composed of state and non-state actors, such as members of civil society groups or academics. Over a 4-month period, approximately 100 digital engagements took place, and approximately 40% of the participating community members were female.

## Co-Design Is Key to Success

The tools used during the pilot were anchored in SENACE's strategic mandate to further participate in the Peruvian mining sector. The channels to deliver the tools were SMS (for stakeholders who are literate) and IVR, available in both Spanish and Quechua. Stakeholders did not need to use a smartphone to access information. Specific tools included

- a community survey about mining impact perceptions;
- a two-way support line where community members could ask questions about mining-related

impacts and receive answers from a case manager; and

- a library of pre-recorded short and simple messages about rights, laws, channels for recourse, and community events related to mining investment.

The approach, channels, and tools were collaboratively designed during various working sessions attended by community members (including women), industry experts, and academics. The results and recommendations of the work sessions were re-incorporated into the design of the project before the official launch of the pilot.



Photos: Co-designing the voice and SMS participation system in Peru (Courtesy of Ulula).



## Women Constituted Almost Half of Users

As stated, there were over 1,000 digital engagements within the platform in the 4-month pilot project, of which approximately 40% were initiated by women. In addition, women constituted approximately 50% of those consulted in the co-design of the project (of civic, government, and academic stakeholders). Considering that, globally, women in low- and middle-income countries are 10% less likely to own any type of mobile phone than men (Rowntree & Shanahan, 2020), the uptake of the pilot program by women in the province can be considered equitable. The implication of this finding for SENACE and the program partners is that IVR and SMS can be considered a viable option to boost the inclusion of women in important consultative processes that impact their communities. Apart from women's participation in the pilot, another finding indicates that at the level of interaction with the system employed by women, approximately one third of users kept returning to the tools in multiple ways. This engagement included accessing information about the projects, then returning to submit a question and/or complaint, and returning again to participate

in the community perception survey. Of the third of users who returned multiple times, women were highly represented. This finding could indicate that women find value in information shared via a digital platform and are likely to re-engage multiple times when information is shared digitally.

SENACE plays an important role in the independence of the ESIA processes in Peru. SENACE is a non-political office, separate from the Ministry of Mines in Peru, but the level of its public funding determines the activities it can engage in. Ensuring sustained funding for SENACE and similar organizations with community engagement programs is key. Due to political shifts and limited funding, the pilot did not scale with the involvement of SENACE or state actors. However, Peruvian mining companies that were engaged during the industry consultations for this pilot extended their engagement with Ulula since communities on their own are unlikely to be able to carry the costs associated with these types of programs. Since then, the digital tools have been used by workers and community members at three major mining operations in Peru, with close to 50,000 workers and community members engaged.

### LESSONS LEARNED

1. Co-designing solutions with the end users in mind leads to more sustainable outcomes and larger uptake and re-engagement.
2. In a digital age, literacy, language, and Internet access should not be considered barriers to digital engagement with mining stakeholders. On the contrary, they are enablers.
3. Voice technology is a viable option in areas where literacy levels might create a barrier to the use of other types of digital engagement tools.
4. A thorough understanding of current technologies used by stakeholders, specifically women in the target host communities, is key to successful adaptation.
5. In the absence of mining companies taking direct action to enable the use of technology and technological infrastructure, civic society, academia, and para-governmental agencies play an important role in piloting use cases that governments can support and mining companies can adopt.



### Case Study 3: Digital employee engagement in the DRC<sup>4</sup>

KCC is adjacent to the city of Kolwezi in the Lualaba Province of the DRC and is one of the world's leading producers of copper and cobalt. It is a large, geographically spread-out operation with a mostly local workforce. During the COVID-19 pandemic, the management at KCC realized how difficult it was to communicate in real time with thousands of frontline mine workers without the necessary tools and connectivity.

It is estimated that approximately 23% of the population in the DRC has used the Internet in the last 3 months (International Telecommunications Union, 2020) and that only 48% of the population of the DRC have regular access to cellular mobile connection (We are Social & Meltwater, 2023). It is within the context of this challenging lack of access to digital infrastructure that KCC set out to pioneer an employee engagement program to address structural communication challenges prevalent not only in the workforce but also in the broader community.

### The Power of Partnerships

Through a unique partnership between Vodacom, Glencore, Standard Bank, and Wyzetalk (a specialist digital employee engagement company) and thousands of hours of applied design thinking to address structural and logistical challenges, the concept of the Umoja Application was born. Umoja ("unity" in Swahili) offers KCC employees a tool that provides real-time employee feedback on a range of topics.

In implementing the Umoja project, several challenges had to be addressed, including a lack of smartphone ownership in the workforce, inadequate telecommunications networks in the region, the low digital literacy of the workforce, and safety and security concerns in distributing thousands of smartphones simultaneously. These challenges were carefully considered and planned for during the rollout period, which included procuring and distributing 6,500 smartphones to KCC permanent employees. To achieve this, approximately 12 temporary distribution centres were set up where employees could collect their phones and receive basic training in how to operate the app.

Another challenge to the implementation of the program was the cost and availability of data to enable employees to seamlessly use

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<sup>4</sup> Unless otherwise noted, the main sources of information for this case study were interviews with Andy Wilson, Vodacom for Business, and Tshene Omambo Wedi, Regional Communications Manager, Glencore.



the app's features. To overcome this, KCC provides each employee with a data bundle that can be used to access app features and use the Internet for other purposes during off-work times. In parallel, project partner Vodacom Business invested in strengthening the cellular infrastructure in Kolwezi and surrounding areas to accommodate the increased user traffic resulting from the program.

One of the features that makes the app unique is that it leverages already developed best-in-class systems, such as Standard Bank's OneHub platform for administrative capabilities and Wyzetalk's digital employee engagement user interface experience. One of the success factors in deploying the app relatively quickly after concept development is that experts in different aspects of digital technologies are all contributing their expertise.

To date, employee features include health and safety guides, as well as self-service human resources tasks such as salary queries, submitting leave applications and logging issues, employee feedback, online training, medical checks, and security

updates. The usage and retention rates are high—over 90%—as it is the main avenue through which KCC currently engages with its employees. As employees continually provide feedback, new features are planned and tested.

## The Multiplier Effect on Local Communities

Anecdotal evidence of the usage of Umoja and the newly distributed smartphones is emerging. One of the secondary use cases is that more and more employees are reporting that their children are able to access the Internet at home for the first time because their parents received a smartphone at work and have data to share with the family. In the words of two female users of Umoja:

“Umoja has become like my eyes, and I use it to keep abreast of everything that’s going on in the company. As an operator, it’s my duty to be informed about safety at work, and thanks to Umoja, I’m always aware of work incidents that occur on other sites.” — Dede Kadita Ilunga (KOV) operator

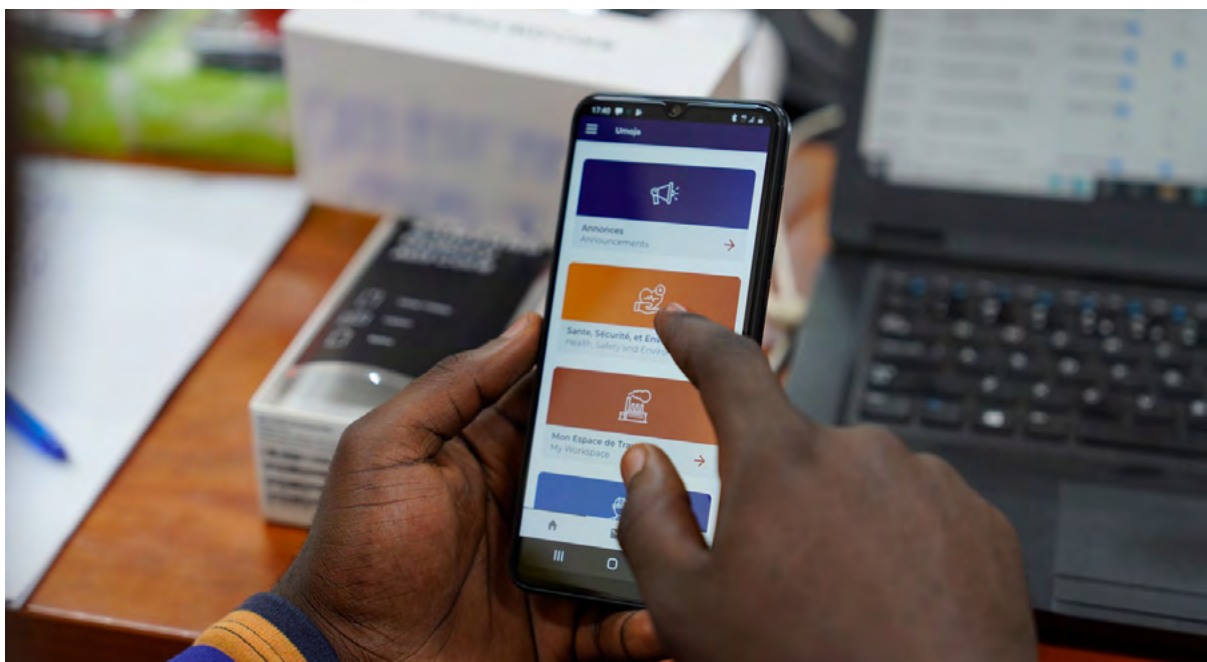


Photo: The Umoja app digital interface (Courtesy of Glencore).



“Thanks to Umoja, I’m able to get an idea of my salary at the end of each month, so I don’t have to go to the Human Resources office, which is located far away from our town office. I can read each week’s safety theme from home and also share it with my children because there are topics like energy insulation that don’t just concern the workplace but also our homes, where fires can occur because of poorly arranged wires.”— Tshikuta Kabeya Carole (Storekeeper)

Glencore is currently expanding the Umoja program to its other operations in the DRC.

## LESSONS LEARNED

1. Providing multifaceted technological access to employees and host communities, including hardware, software, telecommunications infrastructure, training, and cost implications, must be taken into account.
2. Leveraging the capabilities of mature partners can fast-track programs and be key success factors.
3. Secondary uses of employee-intended programs can have powerful, positive impacts that are difficult to quantify.
4. It is important to focus on key business needs in technological advancement, achieve success, and then expand to other societal needs.



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### IISD

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