

Innovation on the final frontier: mining asteroids in space

Technological advances, courageous innovation set to unlock galaxy's riches

By Dr Adriana Marais, Head of Innovation at SAP Africa

For most, an area much smaller than the surface of the planet Earth is considered home. For many, Earth is their favourite planet- as I once heard an astronaut say at an astrobiology conference. But for those few who feel a curiosity, an affinity and indeed a sense of belonging with that overwhelming majority of what is beyond, Earth is but a pale blue dot in a universe of starstuff waiting to be known.

Our increasingly complex use of natural resources is making a strong call for fast-tracked exploration and mining in space. At the turn of the last century, fewer than a dozen materials were in wide use, among them wood, brick, iron, copper, gold, silver, and a few plastics. In contrast, a single modern computer chip uses more than 60 different elements of varying scarcity. Increased societal demand and insufficient recycling of rare resources is putting pressure on local supply chains, which in future could slow down growth and expansion as demand outstrips supply. Most importantly, there is only so much stress our unique biosphere here on Earth can take- all living systems share the same set of finite resources, while human population and associated material needs grows exponentially.

Asteroid mining has been heralded as one of the world's first multi-trillion dollar industries with the potential to transform the global economy in the 21st century. One near-Earth asteroid that caught the eye of astronomers and prospectors, Anteros, is so packed with rare minerals that it has been valued at \$5.57tn, or more than twice the GDP of the entire African continent.

Global innovators reaching for the stars

Leaders in the aerospace industry including Virgin Galactic, SpaceX, Boeing, Lockheed Martin, Deep Space Industries and Planetary Resources, amongst others, are making strides towards initiating an off-Earth economy, and the extraction of resources in space is an essential step towards this future. While bringing asteroid resources back home will contribute to the cost-effectiveness of initial missions, the real potential of asteroid mining is in realising humanity's next great ambition: the exploration and settlement of space. In combination with technologies such as 3D printing, resources extracted from asteroids can be used to create tools, machines, and even habitats, making crewed space exploration and the establishment of the first extra-terrestrial research settlements feasible.

The most important resource for space exploration is water, which aside from its uses in life support and food cultivation also can be broken up into its constituent parts - hydrogen and oxygen - to create rocket fuel and breathable air. This is an essential step to extending the range of crewed space travel: water currently costs around \$50m per tonne to launch into space, so finding and extracting water found in space will essentially turn asteroids into fuel stops for crewed space missions.

A new way of prospecting

In a collaboration with MineRP, SAP Africa participated in a series of co-innovation projects that sought to integrate technical and business planning processes in the mining industry. By broadly grouping the industry into two domains - the science of mining and the business of mining - we jointly developed solutions that overcome the disconnect between technical and financial planning by enabling companies to run fully simulated financing and technical planning scenarios.

We focused on the [SHEPHERD](#) asteroid retrieval conceptualisation, a leading contender in terms of mission design which focuses on encapsulating each asteroid for resource utilisation extraction, which is essential for providing protection from loose rubble and dust, capturing volatiles from icy objects, and enabling the use of reactive gasses in processing the asteroid material. Spectral analysis of metals extracted can provide a real-time profit estimate,

powered by SAP's digital core and supported by advanced real-time analytics. By looking at criteria such as the estimated content - type, grade and volume - of an asteroid, as well as the feasibility of its extraction plan and the energy required to enter or exit Earth's orbit, mining prospectors can make accurate predictions of profitability to ensure no efforts are wasted.

At the upcoming Singularity Summit, some of the biggest minds on the continent will gather to discuss how new emerging technologies can unlock the next era of human achievement and prosperity. In a first on African soil, the summit will showcase advanced technologies and discuss existing best practices in the fields of healthcare, cyberspace, AI, robotics, big data, finance and design. Humankind is at a crossroads, and the decisions we take now will echo for generations to come.

Space mining - and traditional mining - are similarly at a crossroads. Without proper and accurate modelling and simulation, both industries will fail to attract the investment they need to sustain and grow. But by bringing together the science and business of mining through the use of technology, the mining industry can continue to innovate and support humanity's greatest ambitions. **