



Ronin[®]

Propriety Products



A guide to understand the fundamentals of the

ART Inventory Management System

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Inventory Management

Good Inventory Management, Stock Control and Accountability is core to any income statement and balance sheet and is an often neglected, yet effective means of achieving efficiency and adding profitability to the business.

For almost 20 years Ronin has been supplying Inventory Management Solutions into almost every bulk handling industry and in all of these industries we have been successful in assisting with the implementation of global inventory management systems.

We call our system ART®



A successful Inventory Management system requires several components, these are:

- *Clear business approach to inventory management, its structure and rules.*
- *The accurate measurement of stores and stockpiles and the users confidence therein.*
- *The regularity of and period between measurements.*
- *The time involved in the correlation of data and report generation.*
- *The accuracy of correlating data.*

Most bulk commodity businesses, be they either hard or soft related, operate very efficiently within their separate silos of operation yet somehow these efficiencies do not transfer through to the income statement or balance sheet.

Each one of these units has an organic inventory reconciliation, accountability function, so that monthly production, processing, distribution is measured and assessed, internally by each unit.

Usually this function is performed by an element of the business which performs another more vital function and as such the stock count, reconciliation function is considered a secondary or lesser function, or as a nonessential task, as not being part of 'main effort' and therefore where the least amount of effort and resources are expended.

This places the stockpiled, stored product in limbo, as the product is effectively in transit, on its way to another element of the business or to an entirely new owner and therefore its ownership and the business entity accountable for it, is somewhat ambiguous.

Ronin[®] ART[®]



A successful inventory management system needs to be operated as a core business

function. It should be operated by a dedicated small team of experienced personnel, responsible to the whole businesses and not to an individual unit of the business, with a clear strategy, strong management support and defined acceptable margins of error (AME's).

As a solutions provider Ronin doesn't focus solely on accuracy, we focus on trust. We want the system user to trust the information presented to them via the system.

Therefore accuracy is a byproduct of trust and the businesses inventory management team determines the requisite accuracy that ART[®] must produce.

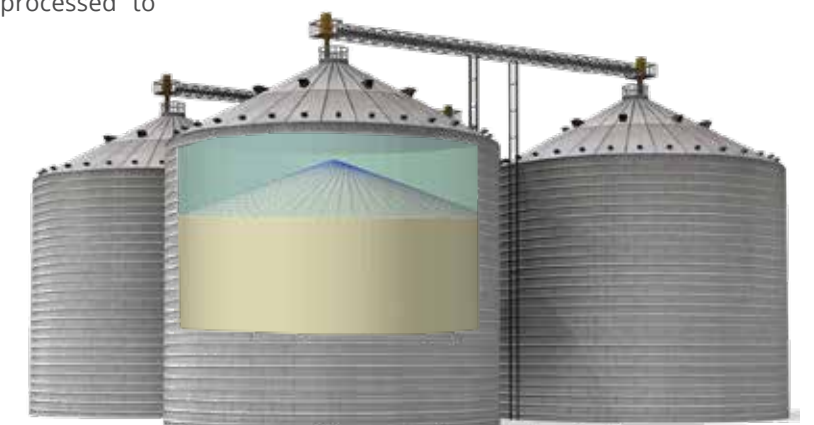
If the user has trust in the system, then the focus of the user is on resolving inventory problems that the system has pointed out to them, rather than spending time and effort confirming that the data is correct or incorrect.

So we've included some diagnostics and configurations that allow ART[®] to not only be accurate but to also create trust with the user by evaluating the information before it's processed to the user.

These include the following:

- *Standard and bespoke configurations for the creation of any storage vessel or platform be they vertical or horizontal stores, to irregular outdoor stock & stack piles, to regulars silo complexes, to remote strategic stores, we've either got a standard configuration or can make one to suite.*
- *As part of this configuration we remove all unnecessary static structures like walls and roofs, conveyors and pillars, so that we don't confuse them as stock.*
- *Similarly we can separate stores virtually into separate stores within stores or alternatively separate and report dead stock or sacrificial beds as well as inactive stock.*
- *In order not to respond to temporary structures like vehicles or people in the loading area we*
- *operate a profile conformity and spike filter*
- *Finally we diagnose the resulting information to satisfy ourselves that it's sufficiently representative of product profile before we process it to the user.*

This is all done automatically, on site, by the ART[®] system.



The ART System



Accuracy

Accuracy is also dependent upon the measuring instrument. Selecting the correct instrument depends upon several factors, being:

1. Whether the store is vertical or horizontal?
2. How is the store filled & discharged?
3. Is the store under roof or open air?
4. What product is being measured?
5. What area does the store cover?
6. How dense must the scan be?
7. What is the required scan frequency?
8. What is the target scan time?
9. How many instruments per store?
10. Can instruments be shared between stores?

Bearing in mind that the more dense that the scan is, the more representative the scan is of the profile, then the better the accuracy, however the greater the scan density is, the longer the scan will take.



Image 1 Laser Scanner Manufacturing

Image 2 Silo Inventory Systems

Image 3 Mine Inventory Audits

Image 4 Warehouse Inventory Systems

Image 5 UAV Inventory Audits : Mines

Image 6 AIMS Lidar Audits : Ports

Experience

Ronin manufactures a range of laser scanners to complement the ART[®] system. These all-weather EX or ATEX certified scanners include:

- ART[®] single point,
- ART+[®] 2D (220° x 1° *)
- ART Lite+[®] portable 2D (220° x 1° *)
- Artemis[®] 42 / 300 3D, (220° x 360° *)
- Artemis[®] Lidar H | M70 | LT15 3D (220° x 360° *)
- AIMS[®] Rig Lidar 3D

* Plot pattern/scan density configurable.



Silo



Warehouse



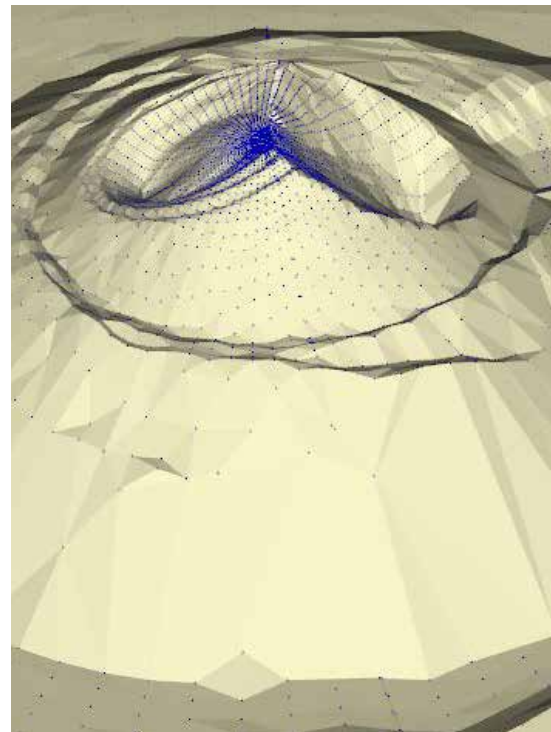
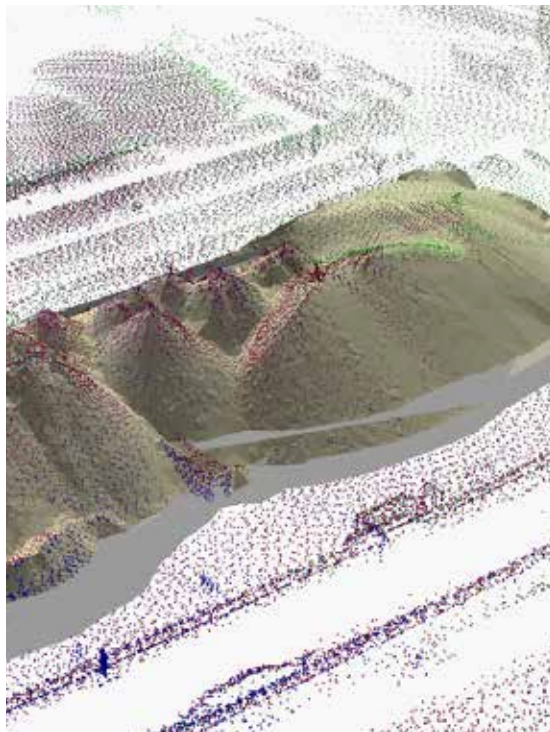
Dome



Stockpile



Survey



Adaptation

Depending on the application, the ART[®] system also integrates with 3rd party instruments such as ultrasound and radar.

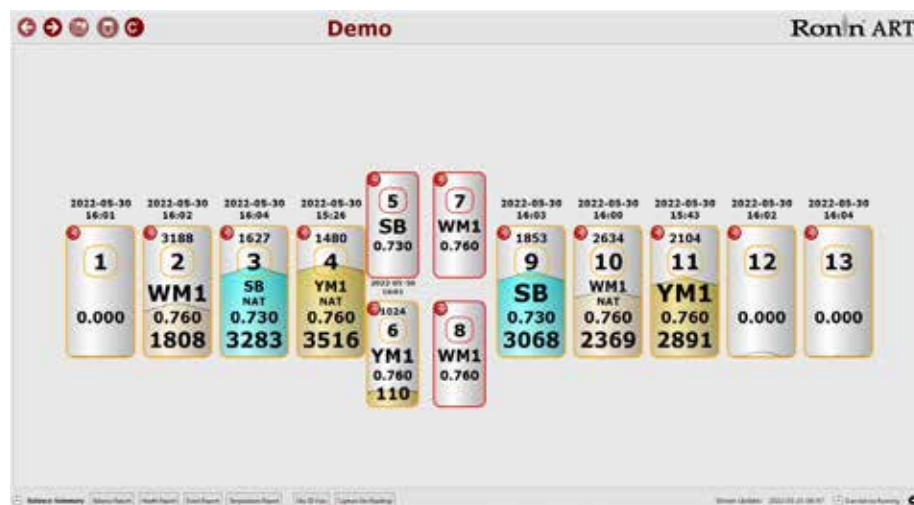
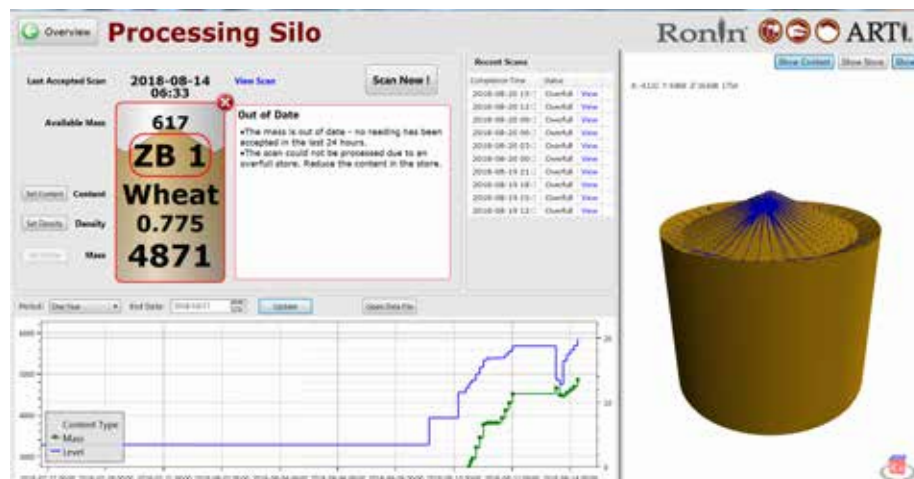
Additionally ART[®] accepts 3rd party survey data, with a large library of conversions, allowing for photogrammetry/LIDAR data to be utilised as well.

Equally important are measurement frequency and reporting period. The reporting period is the time period between stock reconciliations, if the ART[®] system is reconciled against a facilities receipts & dispatch tally, and this tally is available on a daily or per shift basis, then we consider this the reporting period, in other words the shortest period between reconcilable events.

At the end of each reporting period a stock report is automatically generated and distributed.

A stock report details the following per store:

- *Date and time of last measurement.*
- *Measurement status.*
- *Commodity type & grade assigned to the store.*
- *Bulk density assigned to the commodity type & grade.*
- *Constituent values assigned to the commodity type & grade (if available).*
- *Tons per store & sub stores as per the commodity type & grade.*
- *Surplus/deficit of the store & sub stores (sub stores are either virtual stores, or stores defined as dead stock, sacrificial beds or inactive/unreachable stores)*
- *The stock report also details the following:*
- *Total tons per commodity type & grade.*



Reporting

The measurement period is the time period between measurements per store and can range from 1 minute to 1 day. If a 1.5 million m² facility is measured by means of a drone then it is only practical that, due to flight and process time, that 1-2 measurements per day can be achieved, similarly the measurement period is dictated by the scan time of the applied instrument.

Ideally the measurement period should reflect the percentage of change that can occur in a store in a given time period and should ideally be $\pm 1.5\%$ of the total store potential per unit of time. In that if an 8000 m³ store has a load rate of 80 m³ per hour, then ideally the store should be measured every hour. The measurement period is important, not only in tracking the change occurring in the store but also in case the measurement is not accepted by ART[®].

If the measurement of a store is not accepted by ART[®], due to environmental or meteorological conditions such as excessive dust or rain, then the measurement is not used, the store reports the last good measurement (date and time stamped) and reports the status of the store as 'out of date' and the systems starts the next scheduled measurement.

Although, in the case of an extensive storm or continuous

fill event, there may only be an opportunity for 1 or 2 successful measurement within the reporting period, hence the reason for several measurements in a reporting period.

At the end of each measurement the processed point cloud and resultant profile is stored per store and the volume and mass as well as date and time of scan is recorded. All storage facilities are dynamic, the total level of stock per facility and the levels of stock per store are in a constant state of change. Most businesses reconcile stock on a monthly or weekly basis, unfortunately this doesn't allow for discrepancies to be timeously recognised and resolved.

The measurement period and reporting period combined with the stock report allows the inventory team to identify when a discrepancy occurs and whether this discrepancy falls within its AME's. Should the report highlight a discrepancy outside of the AME's then the inventory team can quickly determine in which store and which commodity type & grade the discrepancy occurred in, they should also be able to determine which measurement reflects the discrepancy and therefore isolate a specific area, time period and product flow to investigate and resolve the discrepancy.

Correlation



Correlation provides both context and a point of reference to the stock report, the concept being that the stock reported by ART[®] and the stock reported by the facility should be within tolerance of each other in order for both reports to be correct, as such both data sets act as reference for the other and if different should both be interrogated for errors.

Therefore system accuracy, which can range from 95% to 99.5% is all dependent upon the design of the system as determined by the inventory management team, when selecting measuring instruments, deciding upon scan times, defining reporting period and establishing their AME's and SOP's.

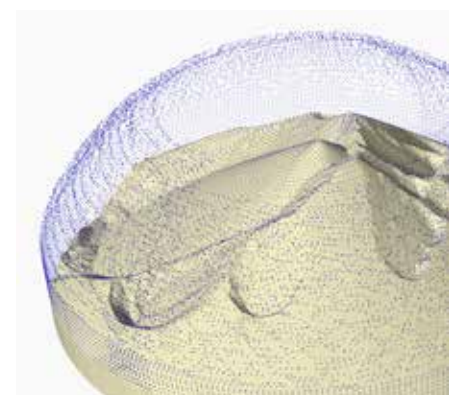
To assist in the reconciliation of data, ART[®] can automatically receive the tally outputs of the facilities receipts & dispatch scales and we can do this for a range of scales over several protocols.

However most of our customers have sophisticated stock accounting systems which provide a greater depth of information and with which we share data by means of a system generated .csv/txt/html file which is either pushed or pulled, depending on the customer, to and from their network and the ART[®] system.

ART[®] is installed on a dedicated PC located on the storage facility, all of our measuring devices require 24V DC, communicate via Ethernet over a TCP/IP network and are either EX or ATEX certified (depending on model specs)

The ART[®] system consist of AIMS[®] which is the core of the system and is our data acquisition, processing, configuration and archiving platform and is installed alongside ART[®] on the site PC.

All of measuring devices are operationally reliant upon AIMS[®] and cannot operate in a standalone capacity. AIMS[®] is the administrative interface with the system, through which all configurations support and diagnostics is conducted. AIMS[®] has an on-board diagnostic tool through which all remote/ direct support can be rendered. Survey data can be uploaded / downloaded here and profiles can be edited by administrators.

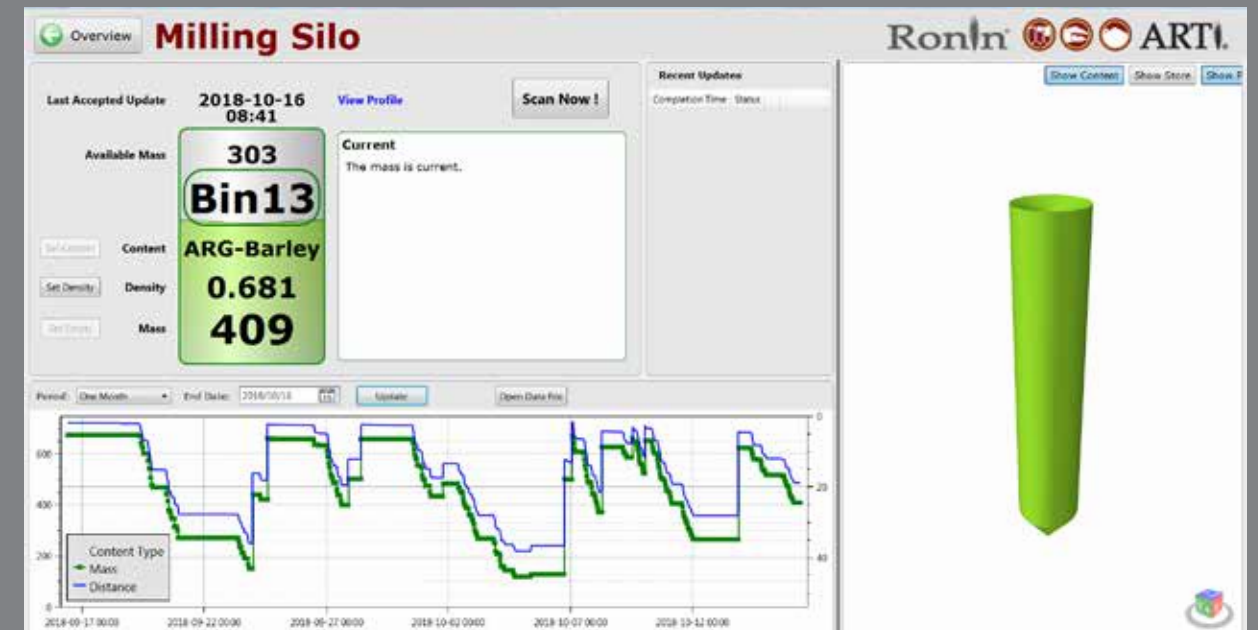


ART[®] Dashboard

The user interface is via an ART[®] dashboard which provides a simplified mimic panel of the site detailing each store on the facility. Each store is displayed in a size and shape relative to the store and details the following:

- Bin number/name
- Content type and grade
- Applied kg/hl
- Current stored tons
- Space available in tons
- Colour coded Content type and grade bar graph, with actual product profile
- Date and time of last measurement
- Store status. Each store has an individual store page, where all of the above plus the following is available:
- 3D display of store and profile for current and previous 10 measurements, with point cloud option.
- Histogram of store volume and mass with linear readout, with period selection and zoom (exportable)
- Change content type function (dependent on user level)
- Status explanation and diagnostics
- Profile cross section with linear margin of Y vs. Z

The dashboard also has pop up tables with the same format as the stock report but with current information as well as a scan status display (if applicable). Additionally dashboard has options to generate either a stock report, events reports or health report. The health report details specific system generated messages that assist in identifying potential weaknesses within the system and should be used for preventative maintenance purposes.

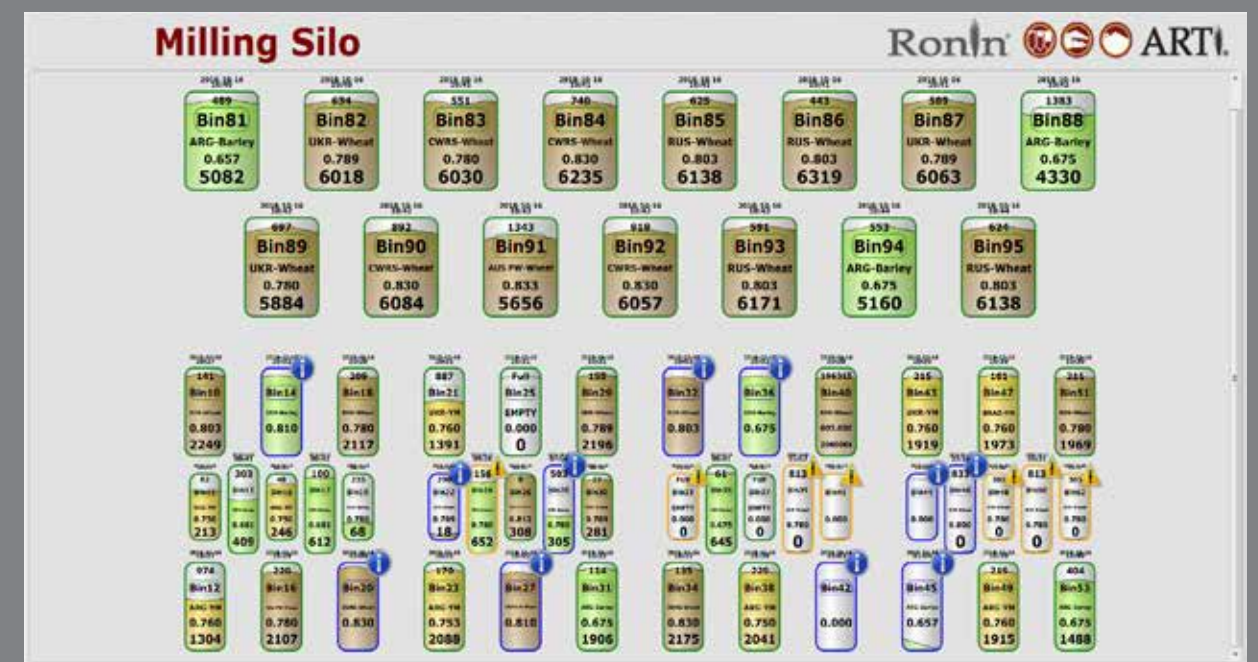


The store status is a time based analysis of how correct the information displayed in the dashboard is. If the border surrounding the bin is green, then the system is fine and the date and time of the reported mass is current.

If the border is orange then an event has occurred, whether it is system or environmentally related, which has prohibited the store from updating and that the reported mass is that of the last accepted measurement and potentially out of date. Additionally the orange status tells the user that the event is probably of a temporary nature and or that it is less than 6 hours old.

If the border is red then the last reported mass is older than 6 hours and or that the event has not resolved itself and that support is required. These statuses are reported in the stock report and the time periods are configurable.

ART[®] maintains a 3 levels of access for users, managers and administrators and all systems interactions are recorded in the events reports for transparency and accountability purposes. Access per level is configured in AIMS[®].





When we talk to our customers about Real Time Inventory Management, much of the initial conversation is all about accuracy. Most businesses assume that highly accurate measurement of stock is the key to successful inventory management and whilst this certainly helps it is by no means 'in and of itself' the complete solution.

The assumption is that you need to be highly accurate, because this is where all other attempts have failed in the past, when actually most of those attempts would have failed because they didn't include many of the system features listed above.

Accuracy is a function of both cost and time and so while you can achieve an accuracy of 99%, being able to do this 100% of the time, in all conditions, comes at a cost, in both time and money and for Many of our customers, they are initially not in a position to exploit such accuracies as their management systems are not yet equal to the task.

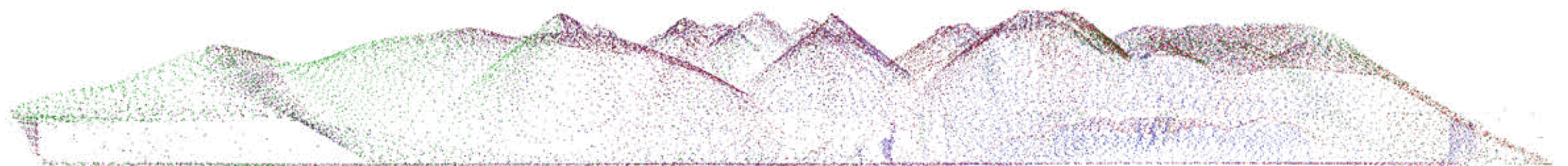
The ART[®] system can readily achieve repeatable accuracies of 99.5%, which equates to half a ton in a hundred tons, a negligible amount, or 500 tons in a hundred thousand tons, a more significant number.

The objective of the ART[®] system is not to simply report these number but to help the customer manage these numbers, to reduce deficits and to nurture surpluses, to identify where and why discrepancies are occurring and to assist in addressing these problems.

Our approach to Real Time Inventory Management is to apply a holistic solution, to consider all of the variables of the customer's inventory platform, to develop a goal orientated plan with a small team of dedicated employees. This plan defines the final objective of the system and establishes initial acceptable margins of error for the ART[®] system. The objective of the team is to achieve these AME's and then to make them tighter, through the application of better operating procedures or management oversight, all of which can be measured as increased accuracy on the ART[®] system.

As such, we don't believe that ART[®] can solve your problems and increase your profitability, but we do believe that you can use ART[®] to resolve your problems and increase your profitability.

Alignment



References



Northam Platinum
Chrome Pad



EXXARO Coal
Discard Coal



CGSS Egypt
23 Sites | 276 Silo Bins



Fluor | Anglo American Peru
Copper Mine

Al Khaleej Sugar
1 Million Ton facility



AFGRI
*71 Sites | 1472 Silo Bins
35 sites | 151 Bunkers*



Illovo Sugar Noodsberg



Over the past 20 years Ronin sold various ART® systems and audit services into the following international industries:

- Grain Silo
- Grain Milling and Processing
- Sugar
- Fertiliser
- Mining (Iron | Coal | Manganese | Chrome | Sulphur | Copper | others)
- Ports

1D **ART**⁺ Single Point Measurement for Small silo bins.

Bin Shape Floor Type

2D **ART**⁺ 2D Laser Measurement for Medium silo bins.

Bin Shape Floor Type

3D **Artemis**⁺ 3D Laser Measurement for Small to Large silo bins.

Bin Shape Floor Type

3D **Artemis**⁺ 3D Laser Measurement for Bulk stored in Warehouses

3D **Artemis**⁺ 3D Laser Measurement for Bulk stored in Partitioned Bunker Warehouses

3D **Artemis**⁺ 3D Laser Measurement for Mining Stockpiles

Solution Design

Ronin considers every project as a solution. No single facility is 100% the same. Our hardware design is tailored towards the storage area or silo bin dynamics which have a great influence on flow dynamics and general inventory housekeeping. Then there is product behaviour and its effect on the laser.

Considering any new project, the following forms part of the site and application evaluation.

- Do we have a similar project from the past that we could learn from?
- Is it a zoned environment?
- How dynamic is the floor | laydown area?
- Bin | Warehouse roof structure and /or other possible mounting areas.
- How dynamic is the fill and discharge process?
- Determine if it will be a 1D, 2D or 3D solution.
- Determine the laser type to go on the 1D, 2D or 3D measuring device.
- Identify power and network connectivity options.
- Software and PC requirements
- Data and report outputs required.
- Product data.



Livox Lidar Avia



Livox Lidar mid-70



Jenoptik LDM42



Jenoptik LDM302

Contact Ronin



T: +27 (0) 11 608 3666
E: office@thisisronin.com
W: www.thisisronin.com

Ronin House
No1 Nobel Avenue
Modderfontein
Gauteng
1645



T: +27 (0) 35 753 1383
E: officerb@thisisronin.com
W: www.thisisronin.com

Ronin IMS
Unit F01
Mzingazi Office Park
Mzingazi Golf Estate, Meerensee
Richards Bay, South Africa
3901





Inventory
Management



Grain
Handling



Precision
Agriculture



Construction
Machine Control



Portside
Services



Mining
Digitisation