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Zinc & Silver of India

Implicit Modelling - A Modern Approach in Resource Evaluation, Hindustan Zinc Limited, Rajasthan, India.

Kuldeep Singh Solanki
Manish Tomar
Praveen Sharma

20th December 2022

Overview

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- HZL Exploration Vision
- Resource Estimation – Building Blocks
- Types of 3D Modelling
- Implicit Modeling v/s Explicit Modeling
- The Process
- Case study- Rajpura Dariba Mines
- Conclusion
- Public Reporting

Rajpura Dariba Shaft

HZL Exploration Vision

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Annual Drilling **+500 Km**

Established Sate of Art Geo-chem Lab

Borehole EM **+10 holes**

Annual Spending Rs. **+325Cr**

"… committed to replenish every ton of ore mined through zero harm, digital intervention and state-of-art technology."

2002: 154Mt

2011: 313Mt

2022: 448Mt

HZL R&R as on 1-04-2022

HZL Assets	Reserve				Resource				R &R			
	Mt	Zn %	Pb %	Ag g/t	Mt	Zn %	Pb %	Ag g/t	Mt	Zn %	Pb %	Ag g/t
Rampura Agucha	47.0	11.8	1.3	44	27.90	9.2	3.1	85	74.9	10.8	2.0	59
Kayad	2	7.6	0.9	18	5.0	7.3	1.0	18	6.9	7.4	1.0	18
Sindesar Khurd	45.4	3	2	100	59.3	3.8	2.1	107	104.7	3.5	2.1	104
Rajpura Dariba	29	4.9	1.6	60	38.9	6.4	1.9	93	67.8	5.8	1.8	79
Zawar Mines	38	2.8	1.2	23	116.1	3.5	2.1	32	154.0	3.4	1.9	30
Bamnia Kalan					39.5	3.4	1.3	44	39.5	3.4	1.3	44
Total	**161.1**	**5.92**	**1.52**	**57**	**287**	**4.6**	**2.0**	**62**	447.8	5.1	1.9	61

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Resource Estimation - Building Blocks

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Resource Modelling & Reconciliation

Kriging Neighbourhood Analysis

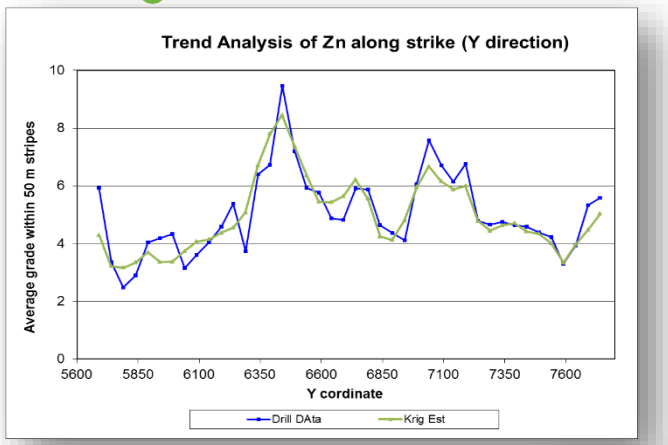
Exploratory Data Analysis

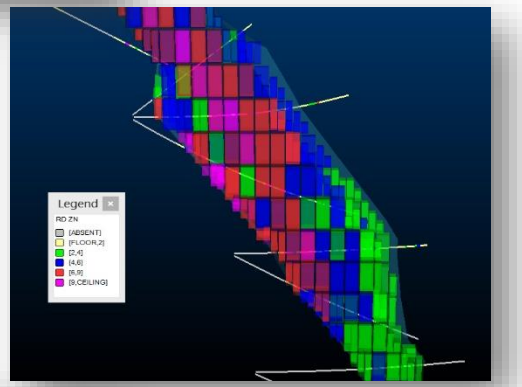
Development Mineralised Envelop

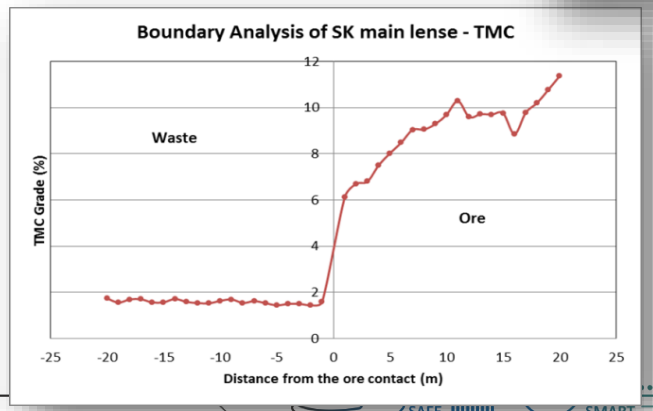
Post Drilling Activity (Logging, sampling, Assaying etc...)

Exploration Drilling

Exploration Target Generation







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Types of 3D Modelling

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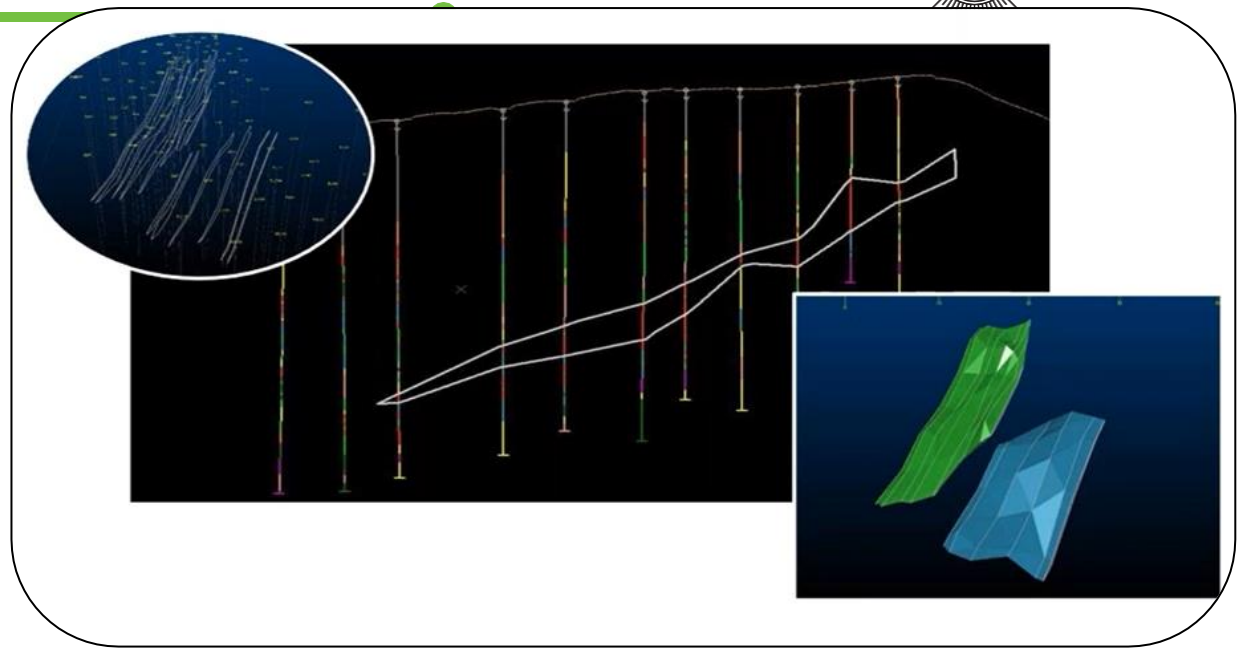
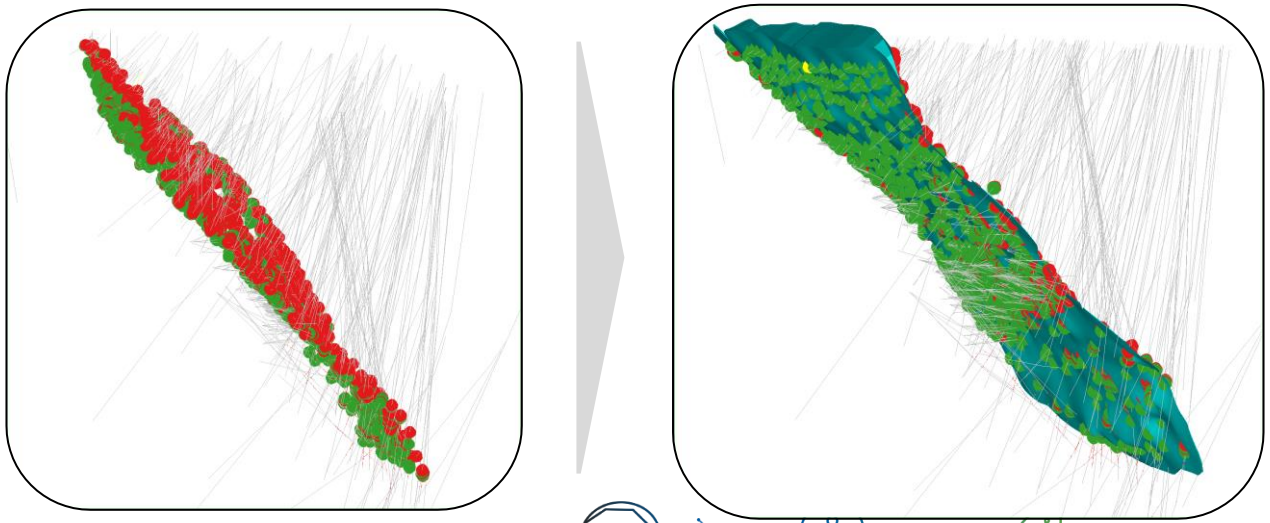
Explicit Model

Manually drawn polyline on sections and plans which can be stitched together to form a wireframe volume or surface.

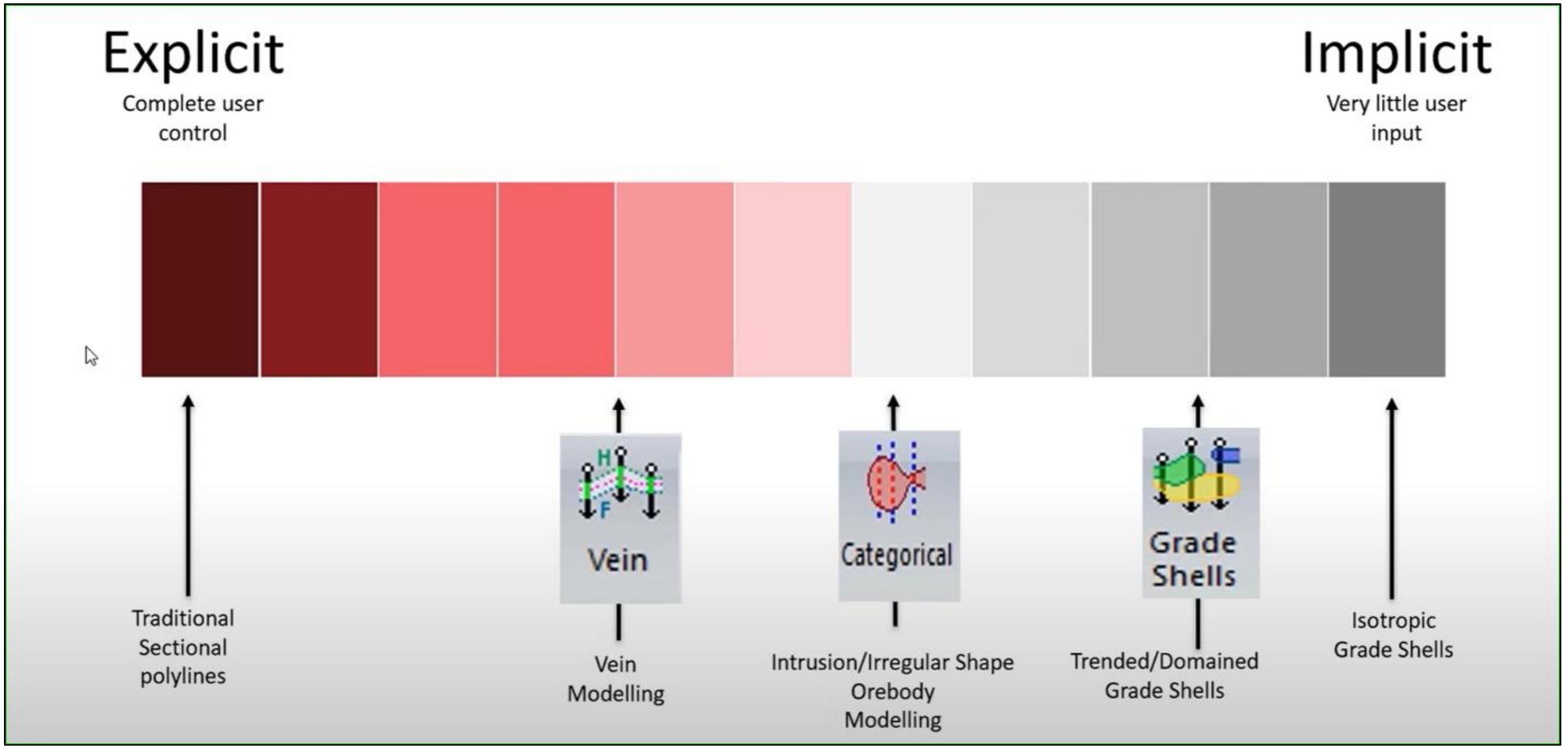


Implicit Model

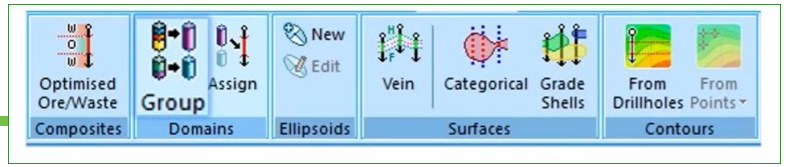
Use of mathematical tools to derive a model from data.



Implicit Modeling v/s Explicit Modeling



The Process



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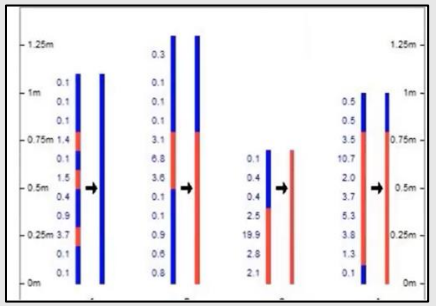
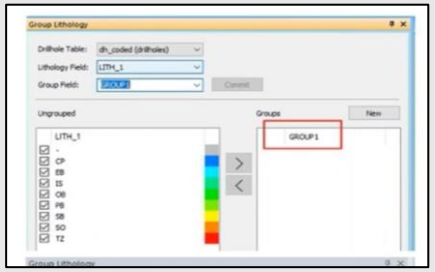
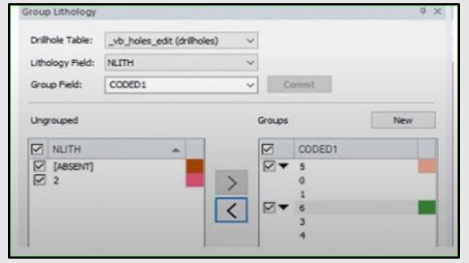
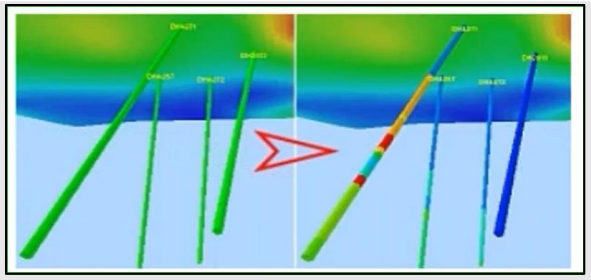
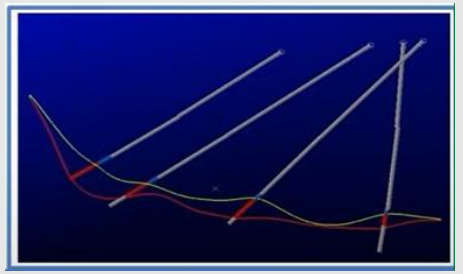
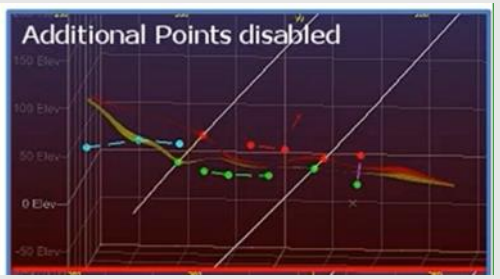
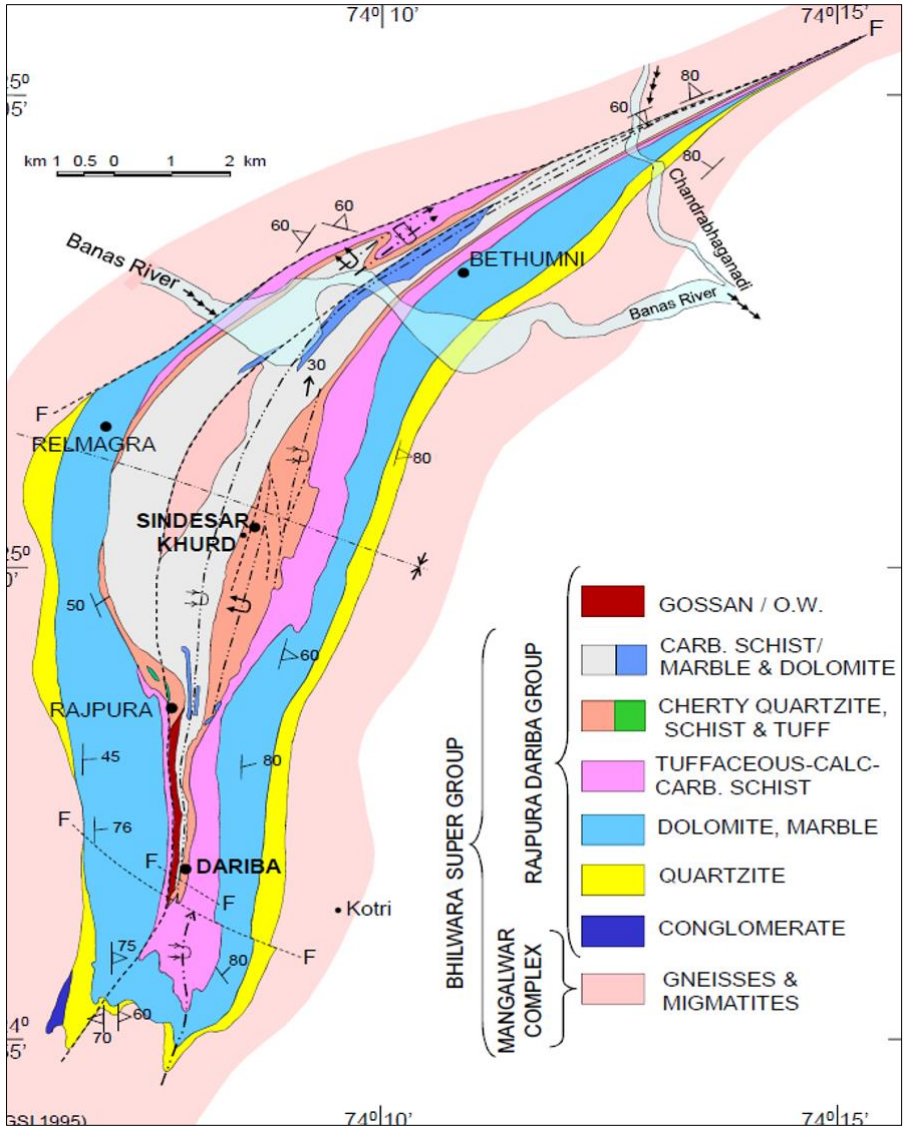
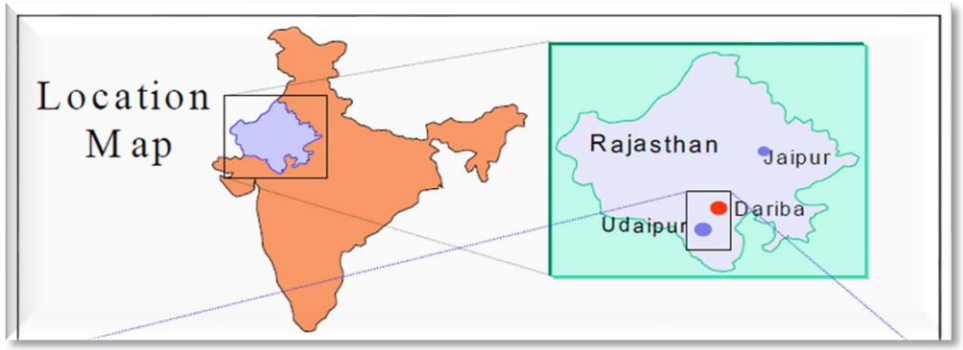
Step-1	<u>Composting:</u> • Composites Drill hole data by optimizing the composite interval using Ore and waste criteria.	
Step-2	<u>Group:</u> • Define groups containing one or more lithology values (Mostly in Case of Multiple vein)	 
Step-3	<u>Assign:</u> • Used to interactively apply lithological values held within a drillhole object to displayed sample intervals.	
Step-4	<u>Vein Modelling:</u> • Lock to contact points using uncertainty control • Handles drilling data with mixed orientations. • Include/ exclude individual contact points • Customise vein boundaries as per geological knowledge • Control of pinch out without vein entries	 

Rajpura Dariba Zn-Pb Deposit, HZL





- The Rajpura Dariba Lead-Zinc Mine is located in Rajsamand district of Rajasthan.
- It is lenticular ore body comprising of two lenses – Main lens, and East lens. Main lens is divided by two barren zones and forms three lodes viz. South, Main, and North Lode.
- The Lodes extends over a strike length 2550m in N-S direction with a average width of 15m and a general dip of 65 to 70 degrees towards east.

Conventional Method – Explicit Modelling

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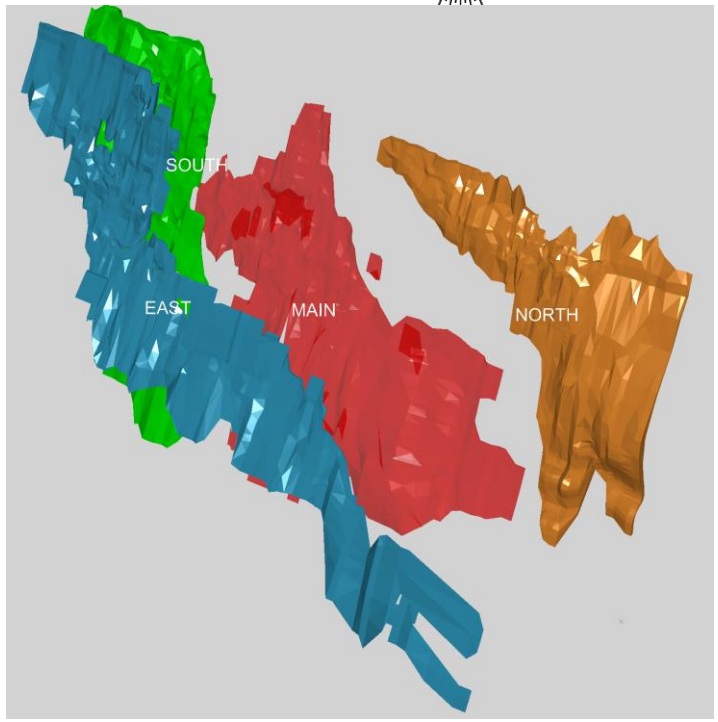
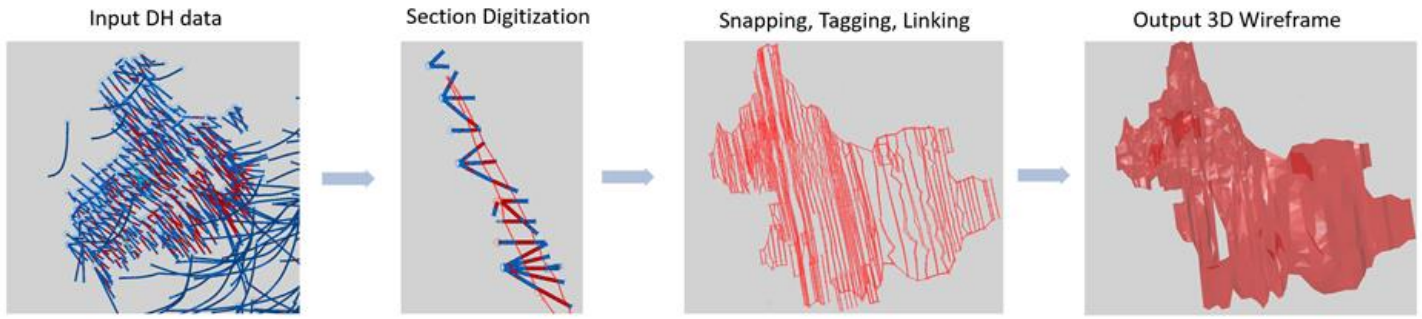
- Orebody solid wireframe models for all four LODES of Rajpura deposit are constructed explicitly in Datamine Studio RM.
- The ore is defined at 3% TMC (Zn+Pb) geological cut-off with 3m minimum mining width, and maximum internal waste parting of 1.5m
- All sections are digitized based on above criteria and closed polyline are constructed at 25 m interval.
- These sections are manually stitched together to form a 3D wireframe model.
- Addition of new information like drilling , mapping will follow the above process every time.



Solid Models of RD Deposit Lodes by traditional approach- Explicit Modelling



A Modern Approach – Implicit Modelling

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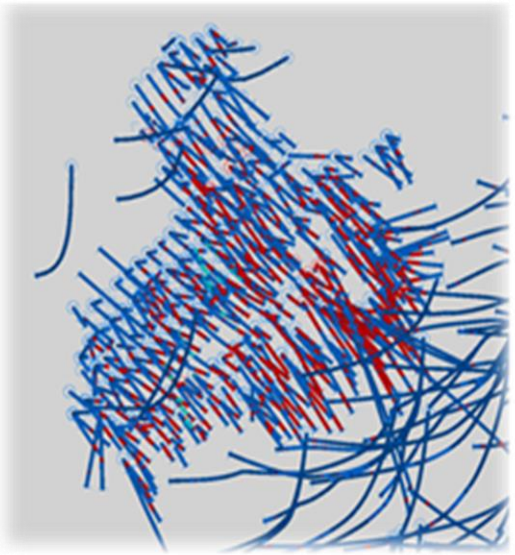

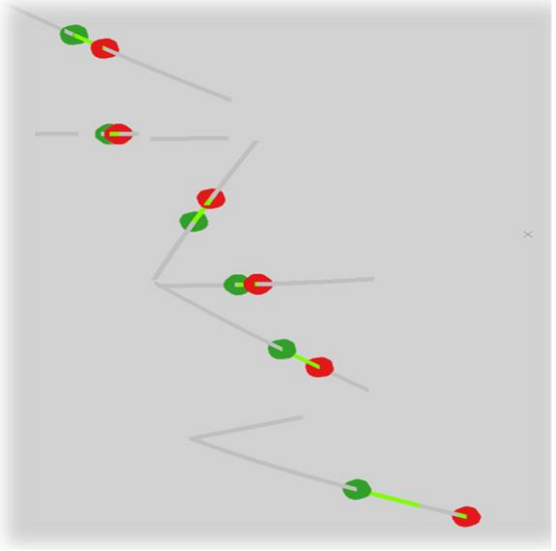

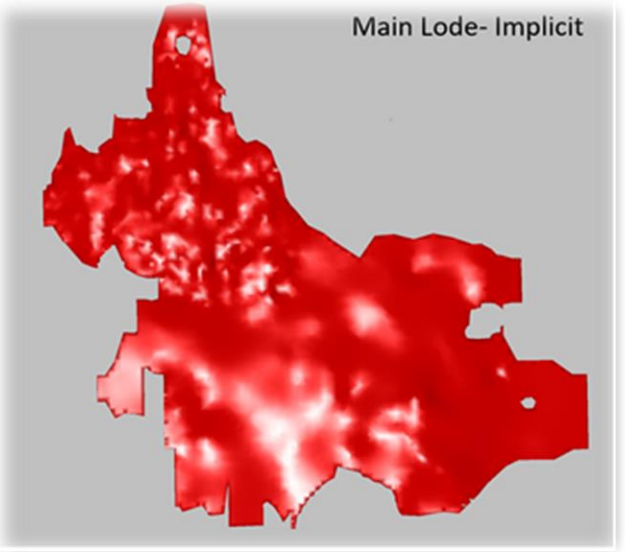

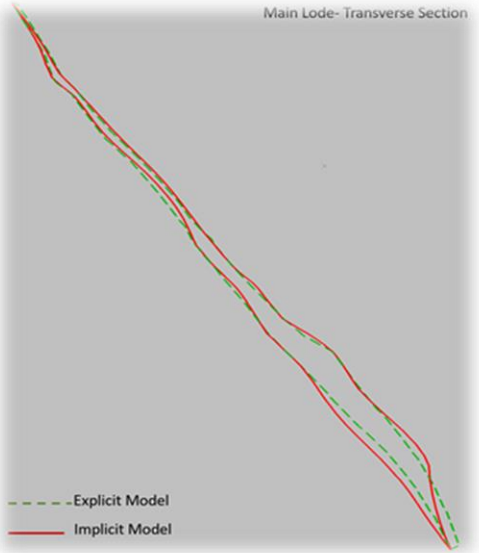

Data Preparations

An implicit modelling technique is available in Datamine Studio RM.

De-surveyed /holes 3d drill hole file is used as input file after data validation.

Compositing (COMPSE)

The input drill hole data is coded with Ore/Waste unique codes e.g., 1,0 for ore zones and waste.

These coded are the used by the software to run the algorithm for constructing 3D model

Vein Modelling

In Datamine Vein Modelling tool is used to model hanging wall (HW) and/or footwall (FW) surfaces based on input sample values. The output will be a vein type or lensoidal structure.

Model Validation

Validation of new implicit model against the previous explicit model through visual display and statistical validation suggest that it is matching very well.

Comparison between Output Implicit vs Implicit Models

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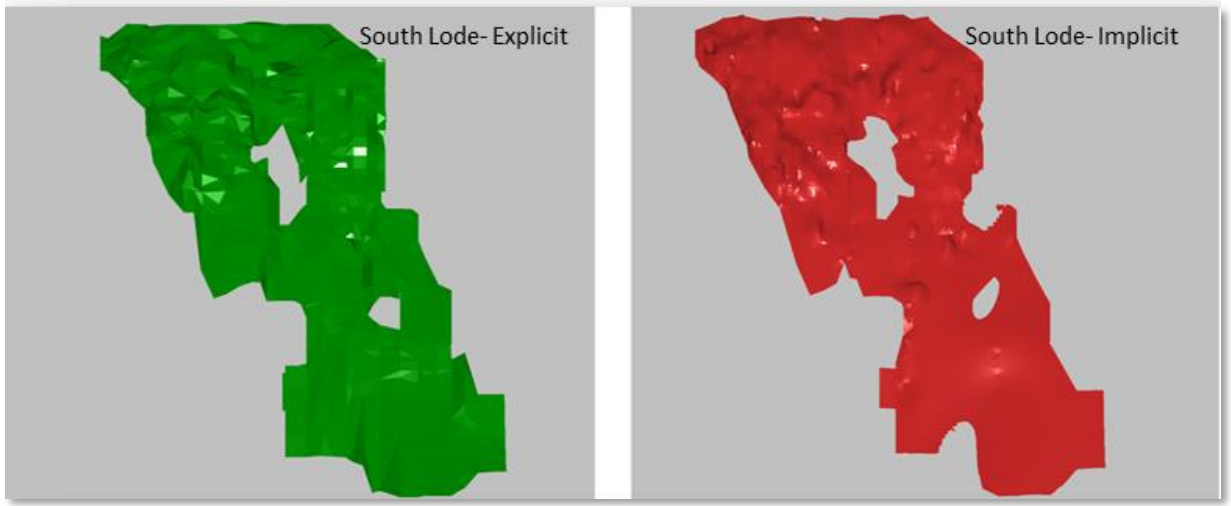

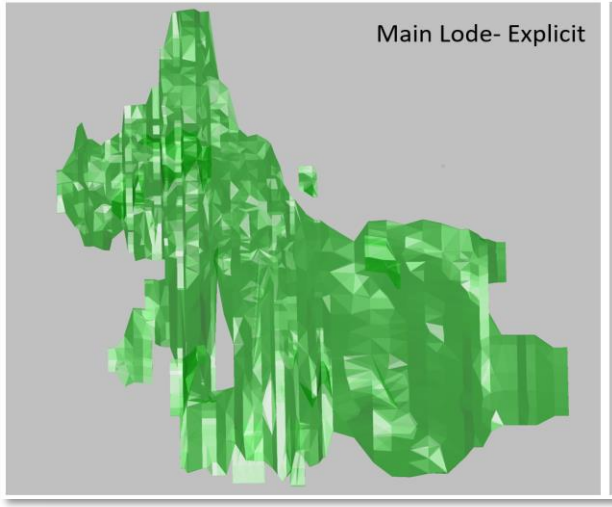

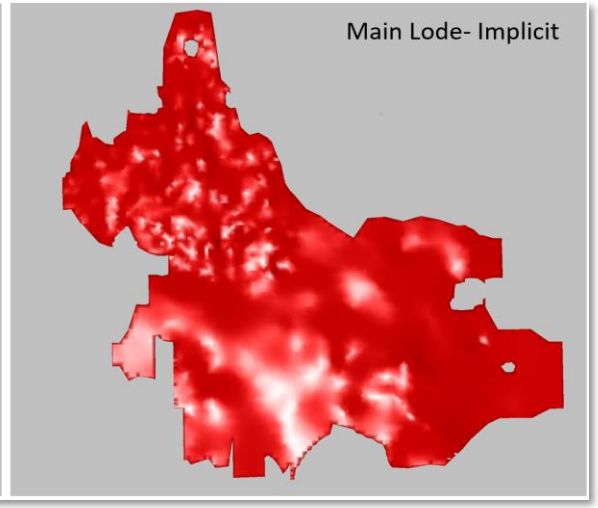

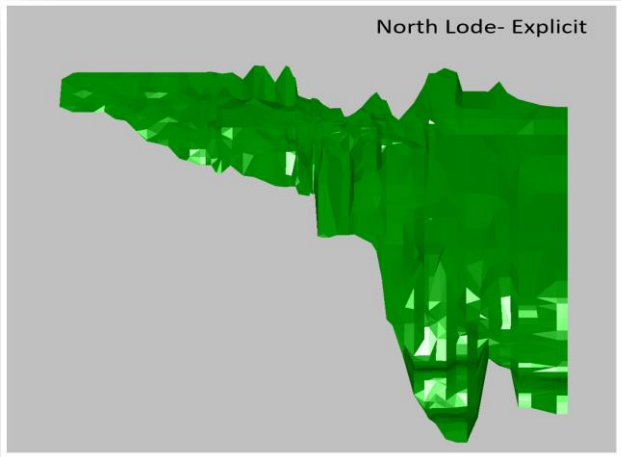

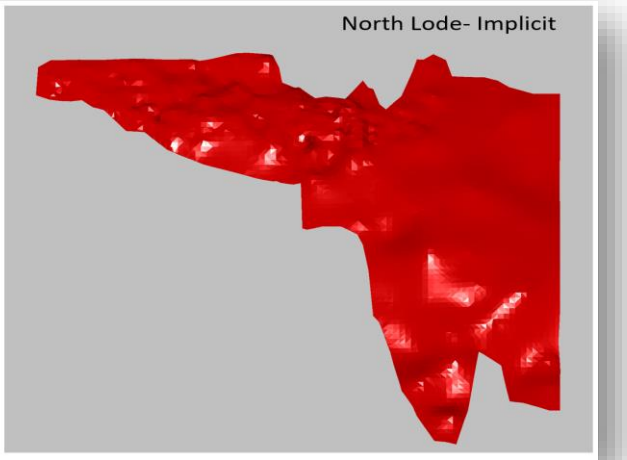

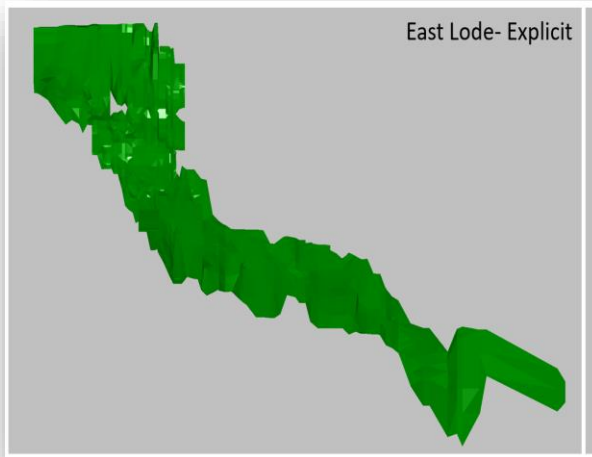

The comparison considering the shape, volume, and geometry between implicit models and explicit models suggest that overall shape of orebody model reconciled very well volume difference between implicit models and explicit wireframes was under tolerance limit under ±2%.

The implicit models reduce the time substantially, it reduced from 40-50 days to 10 days. Update can be done in hours.

Conclusion

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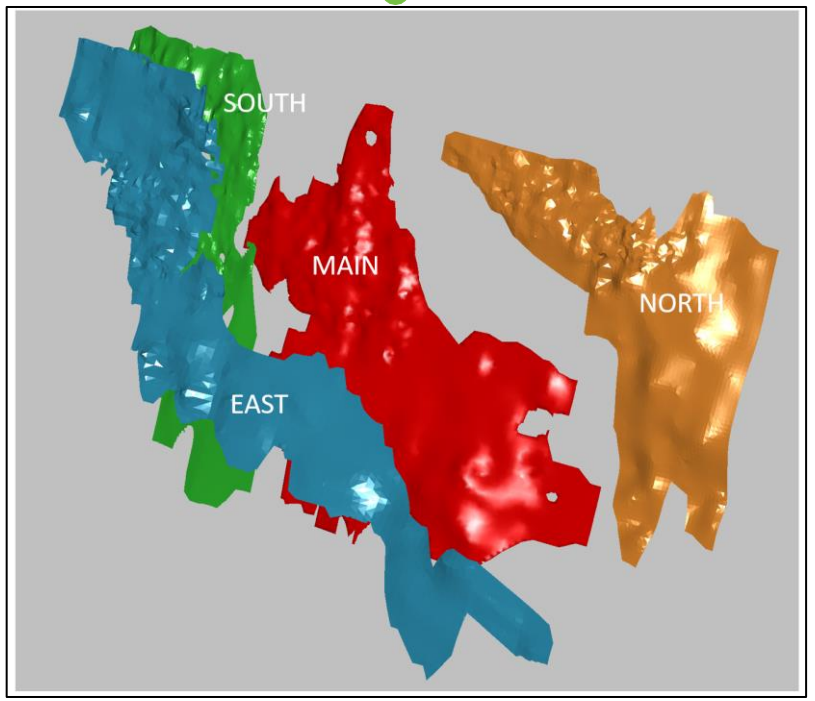
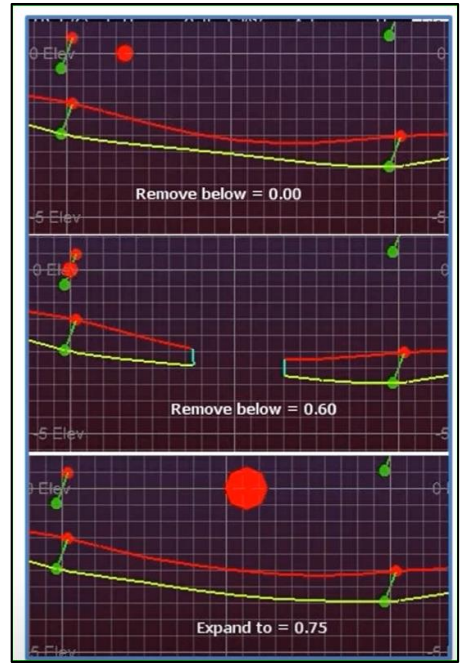
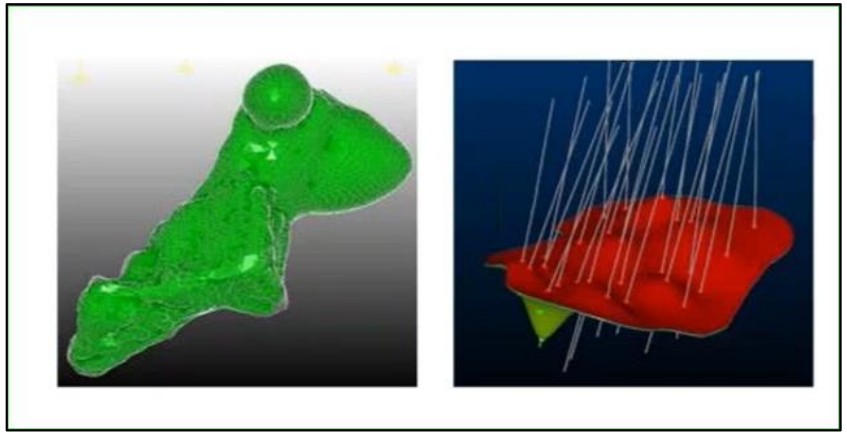
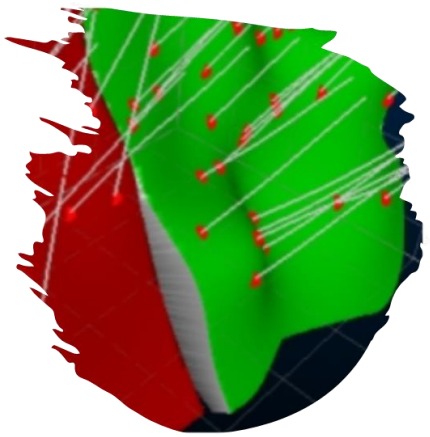
- **Lowers geological risk** by allowing the users to freedom with more controls to quickly build a valid geological model.
- Updating the geological model with additional drilling or sampling requires **takes less efforts and time**.
- Output models reproduced with **recorded** set of **input parameters** and a more hands-on approach of section analysis and editing.
- Implicit solid models **do not require** wireframe **validation** since they have neither openings, non self-intersecting or duplicate faces/shared edges.
- Techniques allows the geologist **to focus** their attention on **understanding the geology**.









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Public Reporting – Purposes

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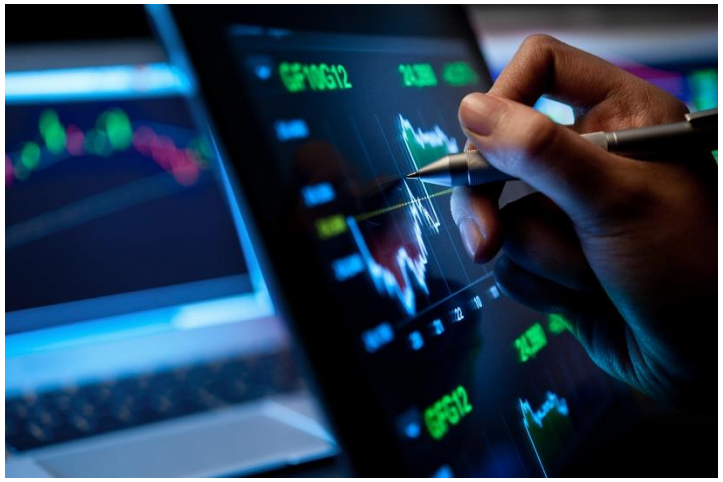
1. **Disclosure for companies listed on securities exchanges**
   - Information for (potential) investors



2. **Governmental, inter-governmental, or NGO reporting of mineral resource estimates and forecasts**
   - Understanding inventory to underpin minerals policies,
   - Attract inward investment and exploration activity

Codes are part of a bigger regulatory environment

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CRIRSCO

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crirsco
COMMITTEE FOR MINERAL RESERVES INTERNATIONAL REPORTING STANDARDS

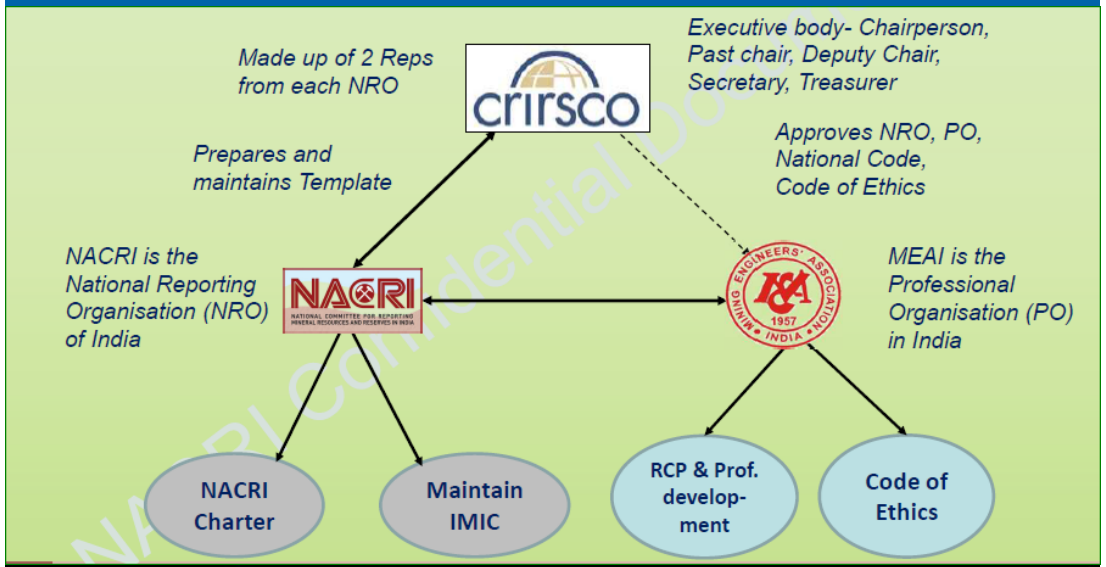
It was formed to promote International Best Practices in the Reporting of Mineral Exploration Results, Mineral resource and Mineral Reserves.

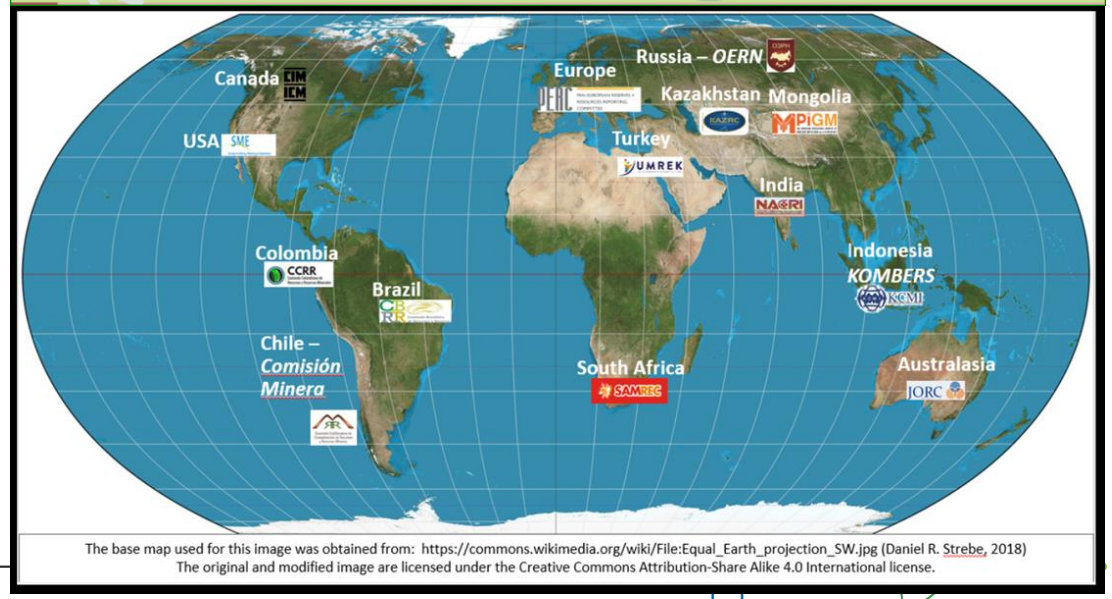
The National Committee for Reporting Mineral Resources and Reserves in India (NACRI) was formed as an independent body on 19th November 2015 under the guidance of MEAI.

NACRI prepared The Indian Mineral Industry Code for reporting Mineral Resources and Reserves in India **(IMIC)**

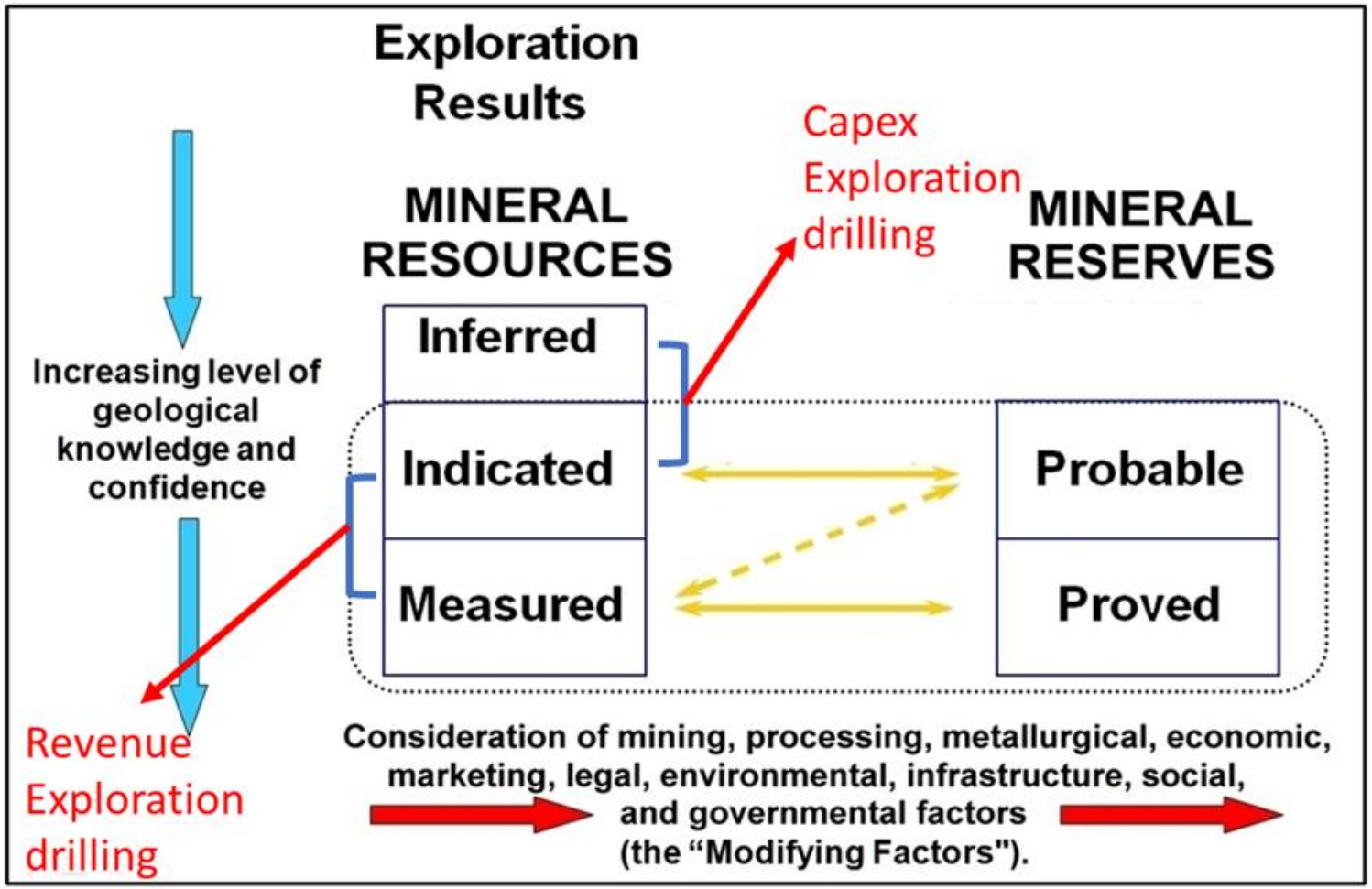
Approved by CRIRSCO on 1-Aug-2019

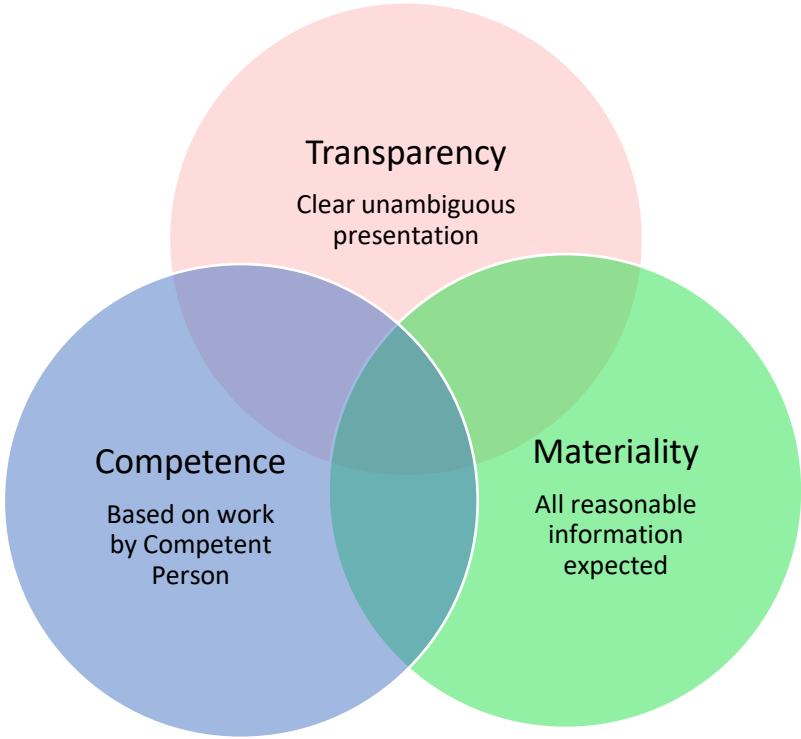
CRIRSCO-NACRI-MEAI Management Structure



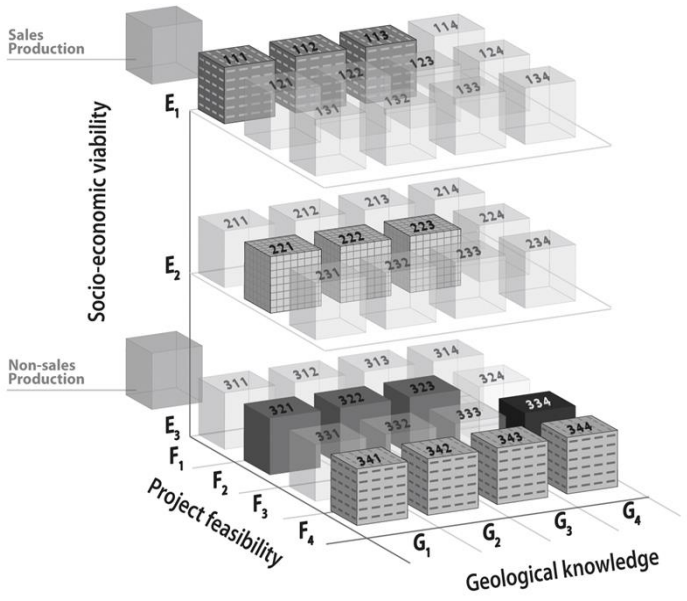


CRIRSCO Template





UNFC



Generic, Principle based

3 Axis

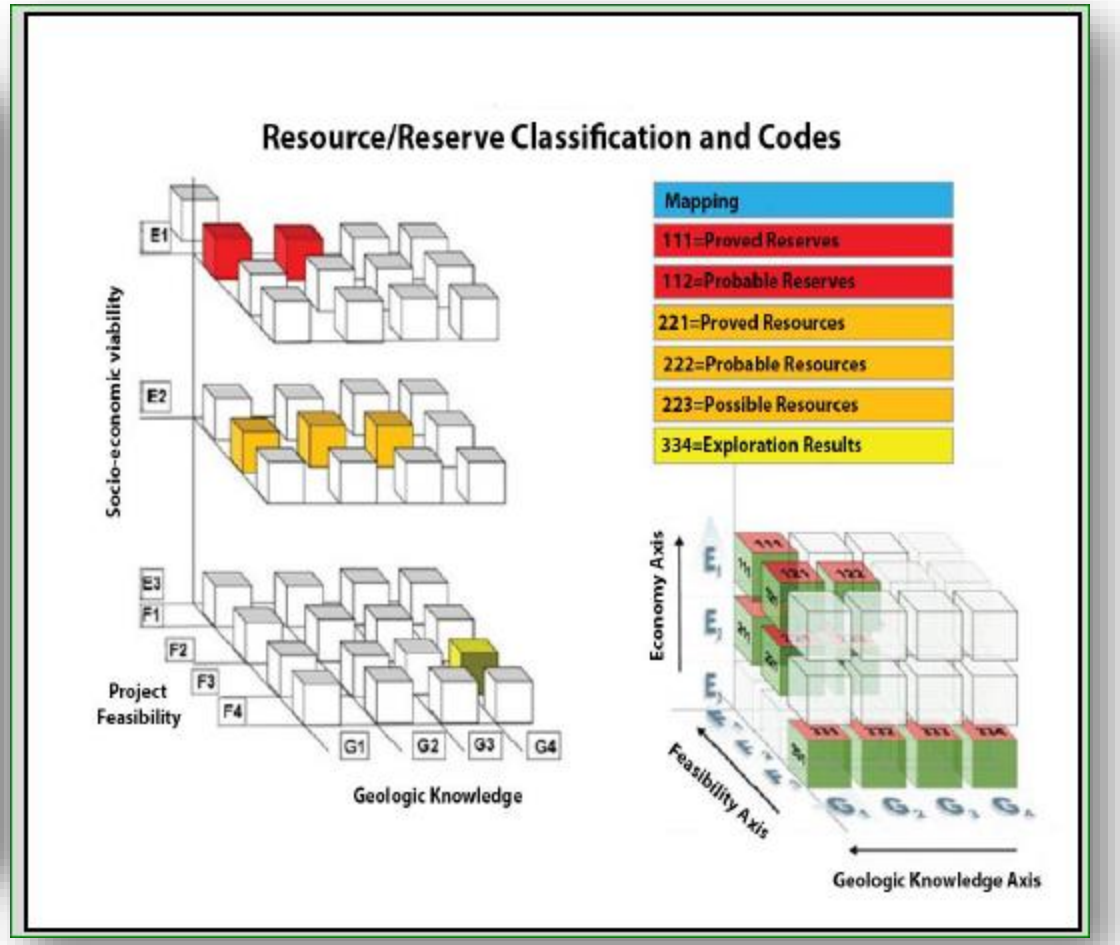
Economic and social,

Feasibility and project status

Geological

Numerical code

Applied directly or as harmonizing tool



CRIRSCO Template v/s UNFC - 2009

CRIRSCO Template		UNFC-2009 "minimum" Categories			UNFC-2009 Class
Mineral Reserve	Proved	E1	F1	G1	Commercial Projects
	Probable			G2	
Mineral Resource	Measured	E2	F2	G1	Potentially Commercial Projects
	Indicated			G2	
	Inferred			G3	
Exploration Results		E3	F3	G4	Exploration Projects

Thanks for patient listening