

Condition Driven Planning and
Operating standards from
instability to stability at Medium
sized gold mine.

BY RENIAS TIRIVABAYA

INTRODUCTION

- ▶ The case study is of a Gold Mine in Zimbabwe
- ▶ It's a narrow gold mine
- ▶ Has been failing to meet K P I budgeted performance since reopening in 2009

KPI Performance over a 1Yr Period(2013)

KPI	Plan/Budget	Actual Achieved	Variance(%)
Milled Tons	116,307	82,055	(29)
ROM grades(g/t)	2.77	2.50	(10)
Recovery(%)	90	86	(4)
Gold Produced (kgs)	290	180	(38)
Cash Cost/Oz (USD)	1214	2195	(81)

INTERVENTION METHODOLOGY

- ▶ Three step Gap Analysis
- ▶ What to change: Understanding the undesirable effects(UDEs)
- ▶ What to change to. Understanding the future reality(FR)
- ▶ How to cuase the change: Change management

Current Reality Solutions

- ▶ **Mine planning: a look at the planning process indicated the following**
- ▶ **Average mining width of 1.4m is used across the whole mine**
- ▶ **An average production rate is used for all machines mine wide**
- ▶ **Average insitu metal block grades are used for all planning purposes and performance measurement**
- ▶ **Functional approach in the budgeting process**

Typical Production Schedule

STOPING SCHEDULE AUGUST 2013

STOPE	Reef Plane	Tonnes (t)	Miner	Au (g/t)	Content (g)	m/no..	Classification
3-12L 219	F/WEST	553	HOVE	4.55	2516.15	1	HIGH
4-10L 374	F/WEST	553	MANGENA	1.92	1061.76	2	LOW
TOTAL		1106		3.24	3577.91		
6-00L 164S	ORANGE	553	MALUNGA	2.13	1178.16	3	LOW
6-00L 560	W1N	553	MUSIYIWA	2.68	1482.38	4	HIGH
6+14L 248S	GREEN	553	MALUNGA	2.04	1128.38	5	LOW
6+14N 560N	W1N	553	MUSIYIWA	2.86	1581.94	6	HIGH
7+14L 380	PURPLE	1106	MALUNGA	3.92	4336.50	7&8	HIGH
7+14L 632	W1N	553	MUSIYIWA	2.39	1321.97	9	LOW
8+20L 642	W1N	553	MUSIYIWA	5.96	3296.63	10	HIGH
TOTAL		4425		3.24	14325.94		
GRAND TOTAL		5531		3.24	17903.85		
OUNCES (Oz)					574.80		

Planning Parameters

25 shifts in a month

25 tonnes per machine shift

89% extraction

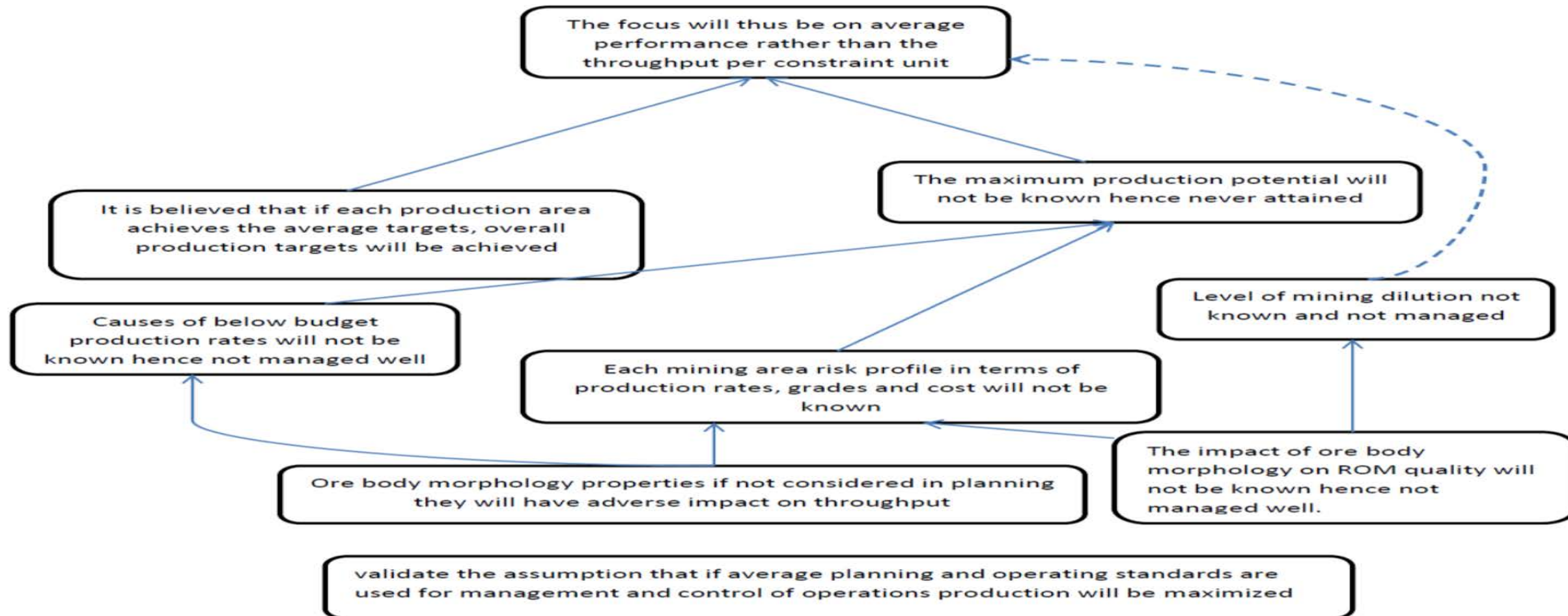
Mining width of 1.40m

1.2m drill still used

What We Learn from the Schedule

- ▶ The schedule does not show the differences in ore body morphology
- ▶ That is reef width is ignored in preference of mining width
- ▶ Production rates are similar all over the mine
- ▶ But average mining conditions do not exist in reality.....Do they from your experiences???

Mine Planning Solution Validation



Ore Body Classification

GOLD RESERVES AS AT 31 DECEMBER 2013 CUT OFF GRADE OF 2.52g/t				
		PROVEN		
REEF	BLOCK	TONNAGE	GRADE	CONTENT
W1 NORTH	8+20/578S	0	3.09	0
	8+20/578N	0	4.59	0
	8+20/608N	0	3.39	0
	8+20/656N	161	5.96	956.58
	6+14/550N	0	2.84	0
	7-00/662N	1159	3.62	4195.58
	6+14/632N	2099	2.66	5583.34

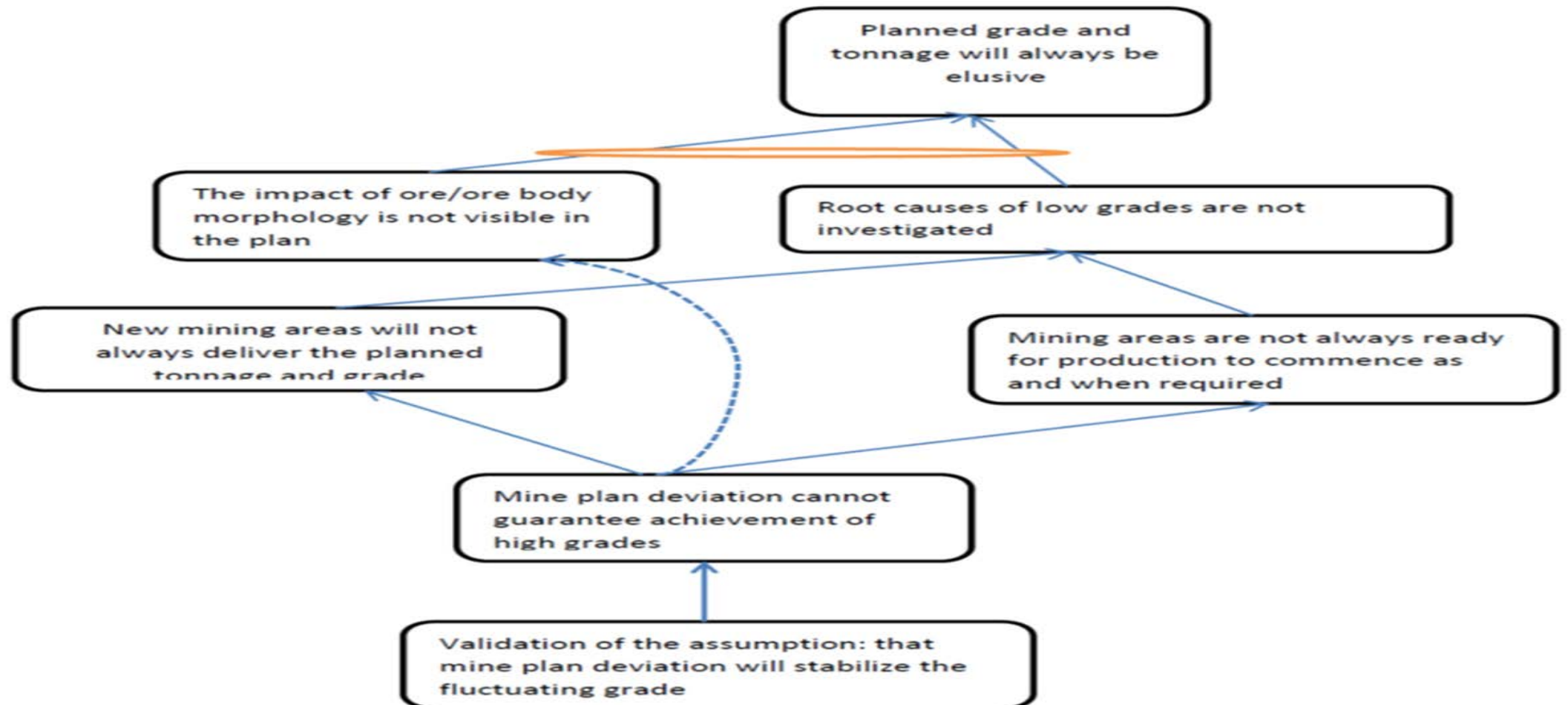
Ore body Classification Cont.

- ▶ Ore body morphology throughput drivers are not considered in ore body classification
- ▶ These are reef width, dip, Geotechnical conditions
- ▶ Reef width just used in tonnage estimations but ignored in operations planning and control

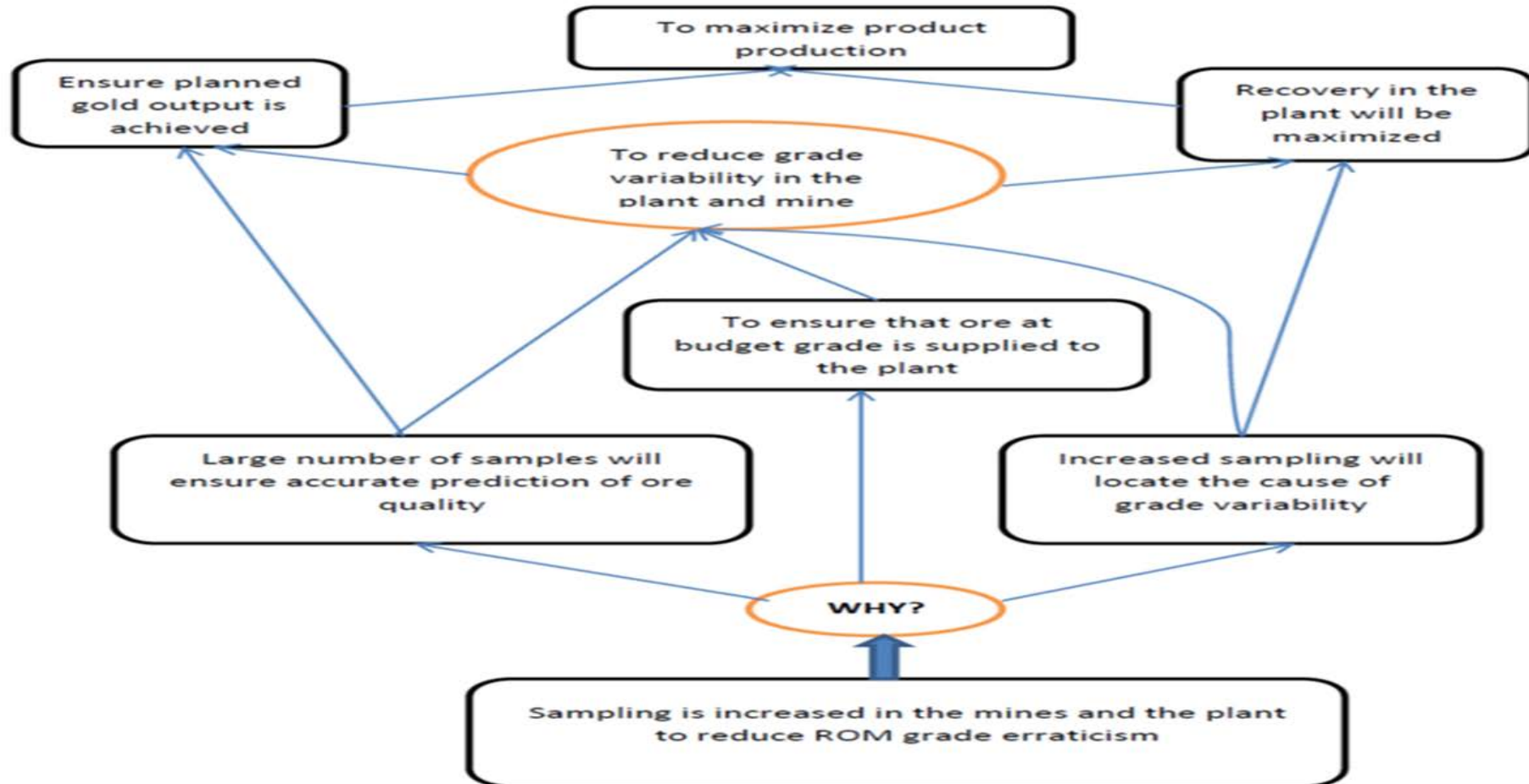
Mine Plan Deviation

- ▶ Once tonnage and grade calls are not achieved there is a tendency to deviate from the mine plan in order to stabilize the operation
- ▶ Machines are added in unplanned blocks
- ▶ Machines are moved to high grade stopes
- ▶ Below is a look at the underlying assumptions for mine plan deviation

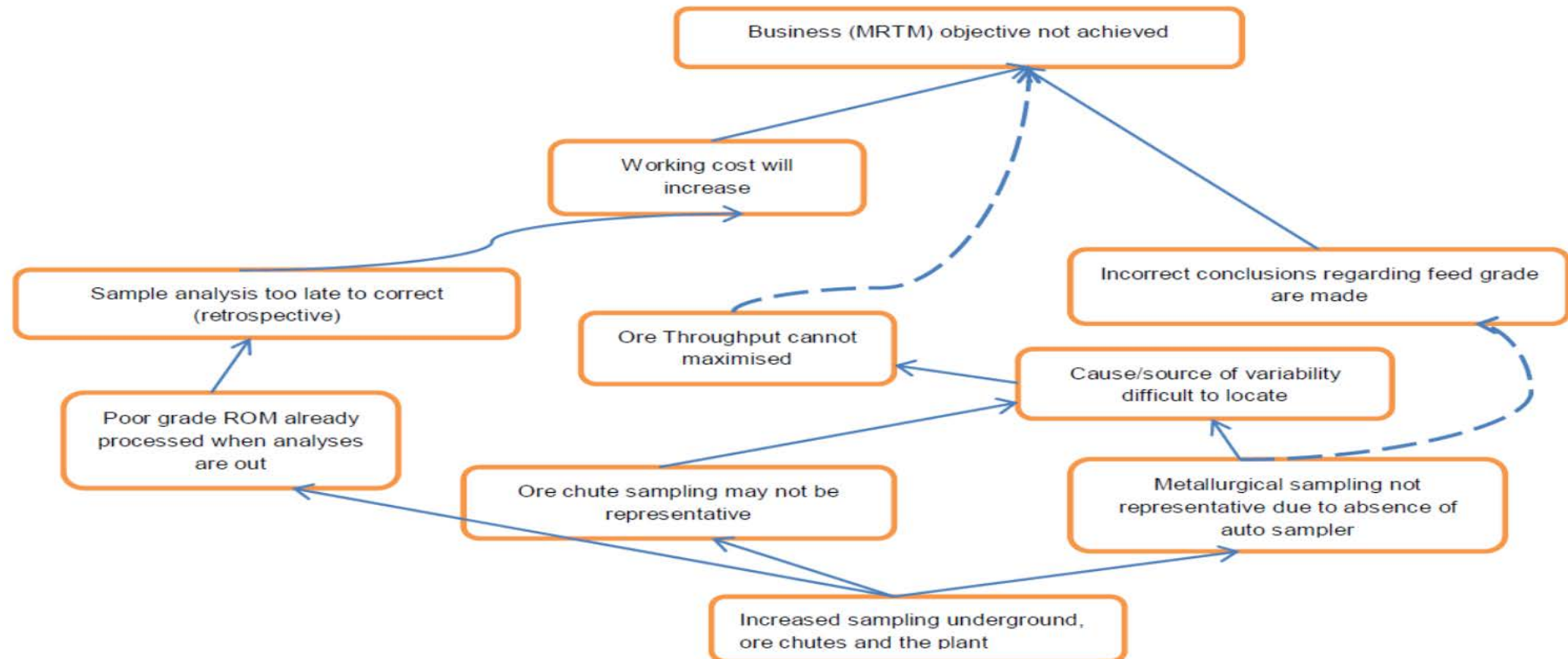
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Increased Sampling



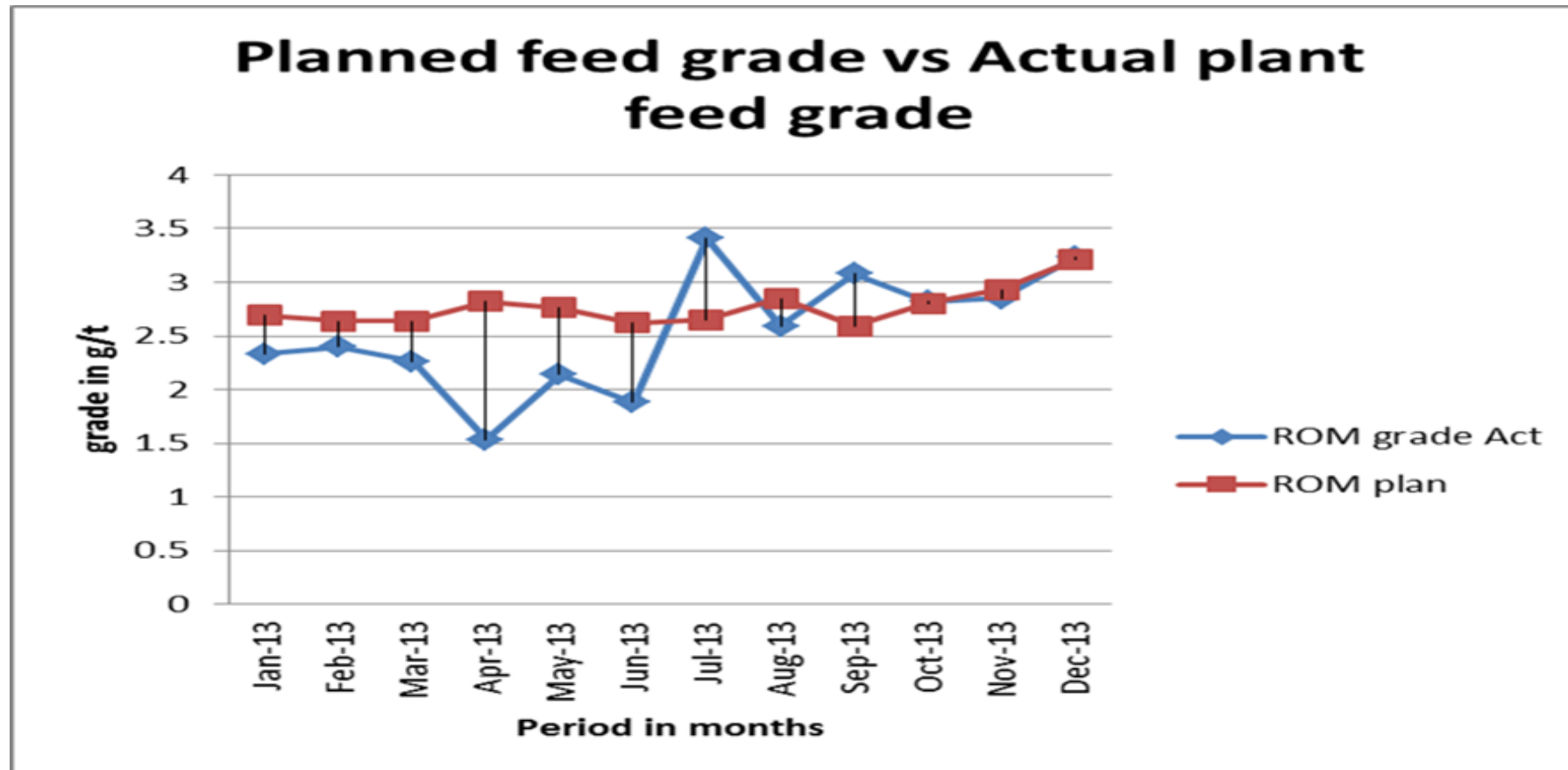
Increased Sampling effectiveness



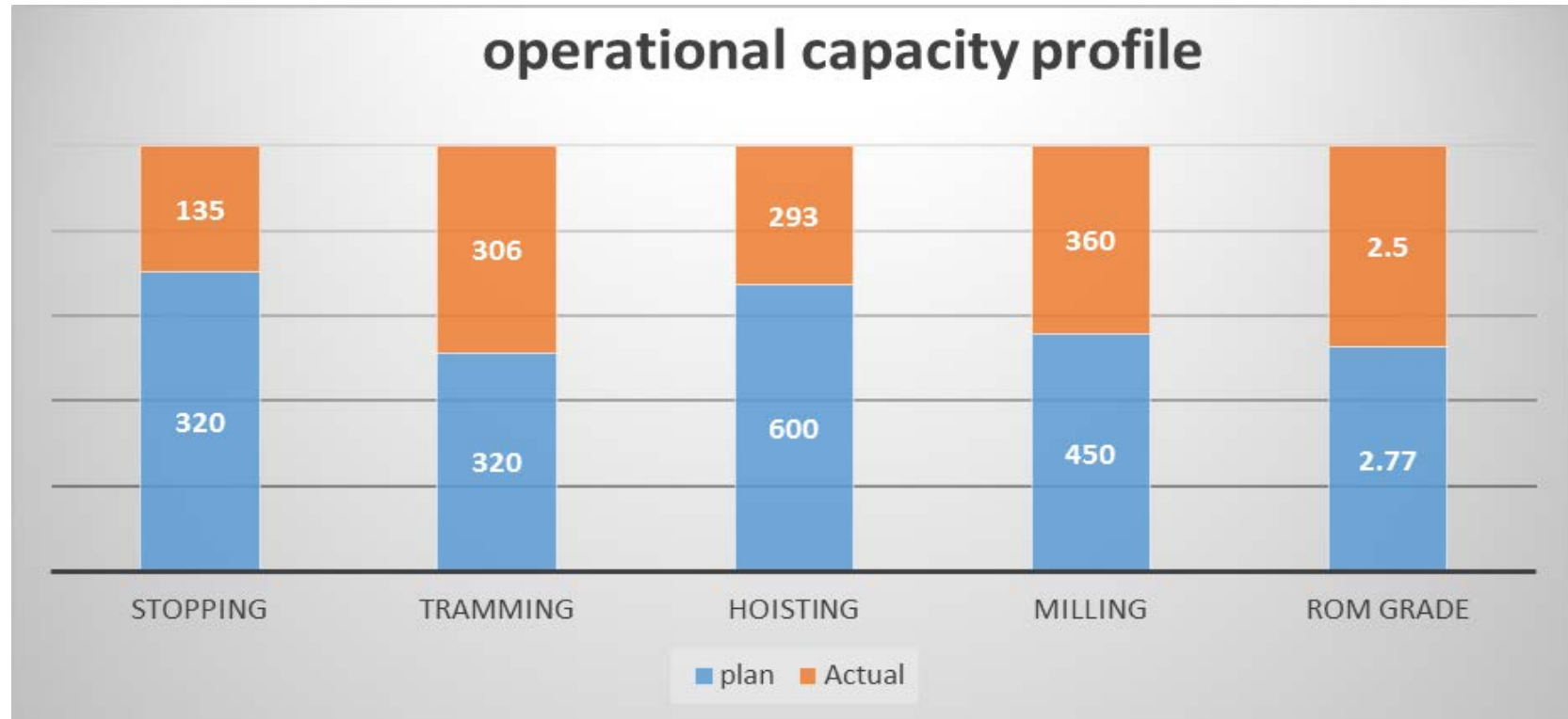
Laboratory practices

- ▶ Priority samples are Priority
- ▶ Stope and box grab samples have a 24hr turn around
- ▶ Analytical results are received when the ore has already been milled,
- ▶ Difficult to predict the quality of ore send to the process plant
- ▶ Sample analysis is thus retrospective
- ▶ Many a times the system self corrects before the cause has been identified

Current Solutions Results



Capacity profile



Mineral Resource Throughput Management Objectives: What to change to

- ▶ Three key MRTM objectives were identified
- ▶ Supply adequate ROM to the plant timeously and consistently
- ▶ Supply the ROM at the planned/ optimum grade
- ▶ Manage cost to sustainable levels

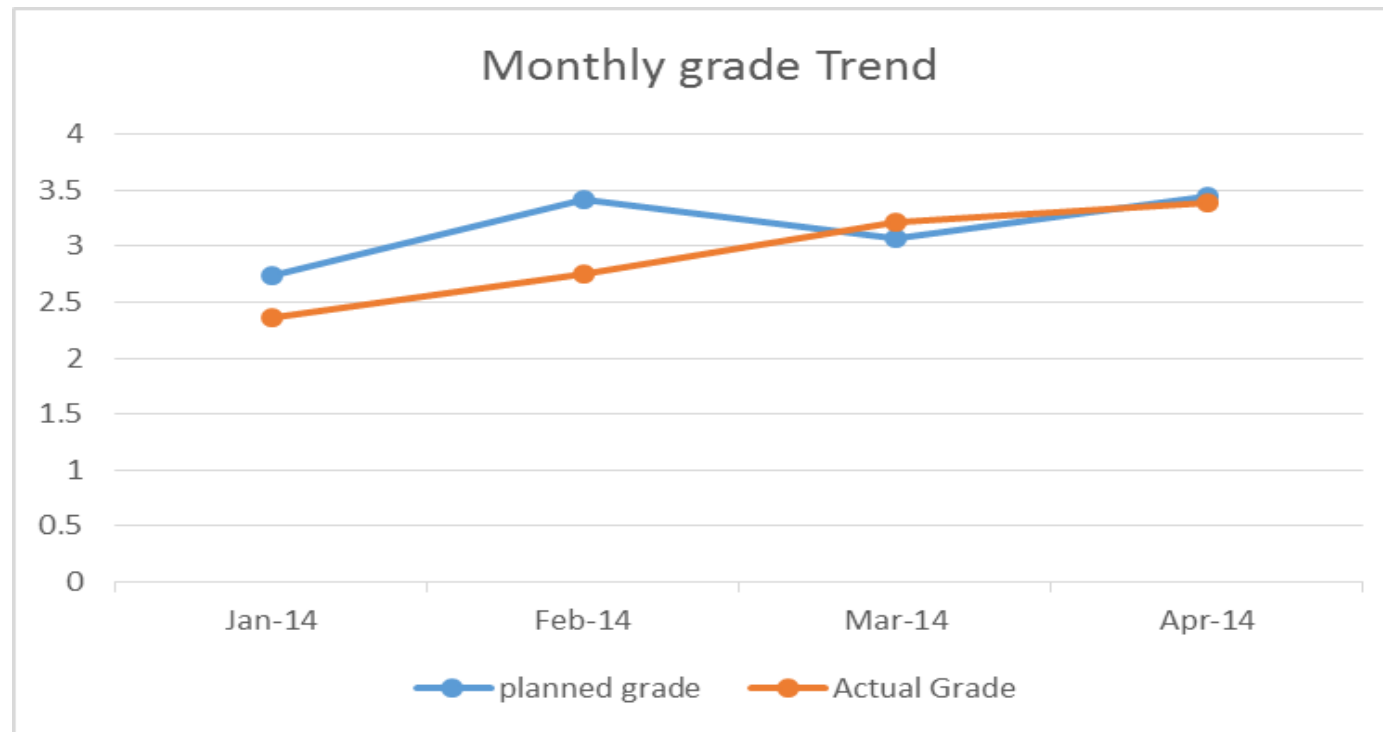
MRTM Necessary Conditions

- ▶ MRTM necessary conditions: what needs to be in place to ensure the UDEs can be sustainably managed
- ▶ Understanding of mining production variability, interdependencies and capacities
- ▶ Knowledge of the impact of the ore body character on the system as a whole
- ▶ Robust grade control system

Solutions

- ▶ Plan stope to generate adequate ROM inclusive of buffer for the mill
- ▶ Ensure that there is spare equipped ends to take care of “murphy” such as a misfire, FOG incident, etc.
- ▶ Grade control protocol to incorporate orebody morphology e.g. reef width against an average mining width
- ▶ Prioritise underground samples for effective ore classification rather than the ROM of mine only which you cant use to redirect ore to say a low grade stock pile or to waste stock pile

Results of Interventions





The end

Thank you

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