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# Finding and eliminating bottlenecks in flotation plants

Rob Coleman – Account Director

April 8, 2016

# Today's speaker

Rob Coleman

- 20 years in the Mineral Processing industry
- PhD in Flotation modelling and simulation
- Benchmarked and optimized flotation operations globally working for AMIRA, The JKMRC, JKTech and Outotec
- Presented and published papers at major Mineral Processing conferences
- Originally from South Africa, now based in Brisbane, Australia.



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# Ask yourself this…

Is your flotation plant performing at the optimum level?

Has your flotation plant been measured in the last 6 months?

Do you know where to look to make improvements?

If you answered “NO” to any of these questions, you NEED to watch this…

I guarantee your flotation plant is not running as well as it could…



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# Challenges

Common challenges found on operating flotation plants include:

- Ore type
- Throughput
- Concentrate quality requirements
- Pulp chemistry
- Worn parts or old technology

Affecting the performance parameters:

- Reduce residence time
- Reduce recovery
- Lower concentrate grade
- Increase operating costs



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# Agenda

- Types of opportunities that exist
- Understanding the equipment
- Flotation control
- Maintenance
- Modernizations
- Identifying issues and making improvements



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# Types of opportunities to improve profit

- Cost saving – reducing the operating cost
- Higher revenue – improving efficiency and availability

ECONOMIC AND ENVIRONMENTAL BENEFITS

**2 459 150**
€ / ANNUM

**$CO_2e$ -574**
TONS / ANNUM

**574** tons of $CO^2e$ reduction equals to

x 10 **121** CARS REMOVED FROM THE STREETS

x 1000 **14 705** PLANTED TREES

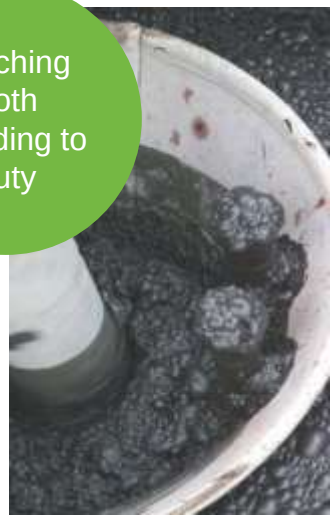
x 100 **2 483** AIR MILES

| | As is € | Upgrade | Difference | Value € |
|---|---|---|---|---|
| Increased recovery | 196 748 698 € | 199 063 388 € | 1 783 t/a | 2 314 691 € |
| Decreased power cost | 518 359 € | 373 899 € | 1 445 MWh/a | 144 460 € |

# Biggest opportunities on sites

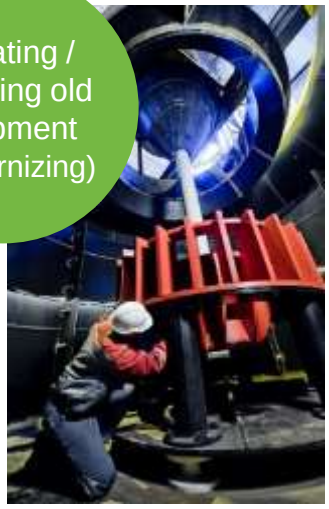
Flotation cell maintenance practices

Matching froth crowding to duty



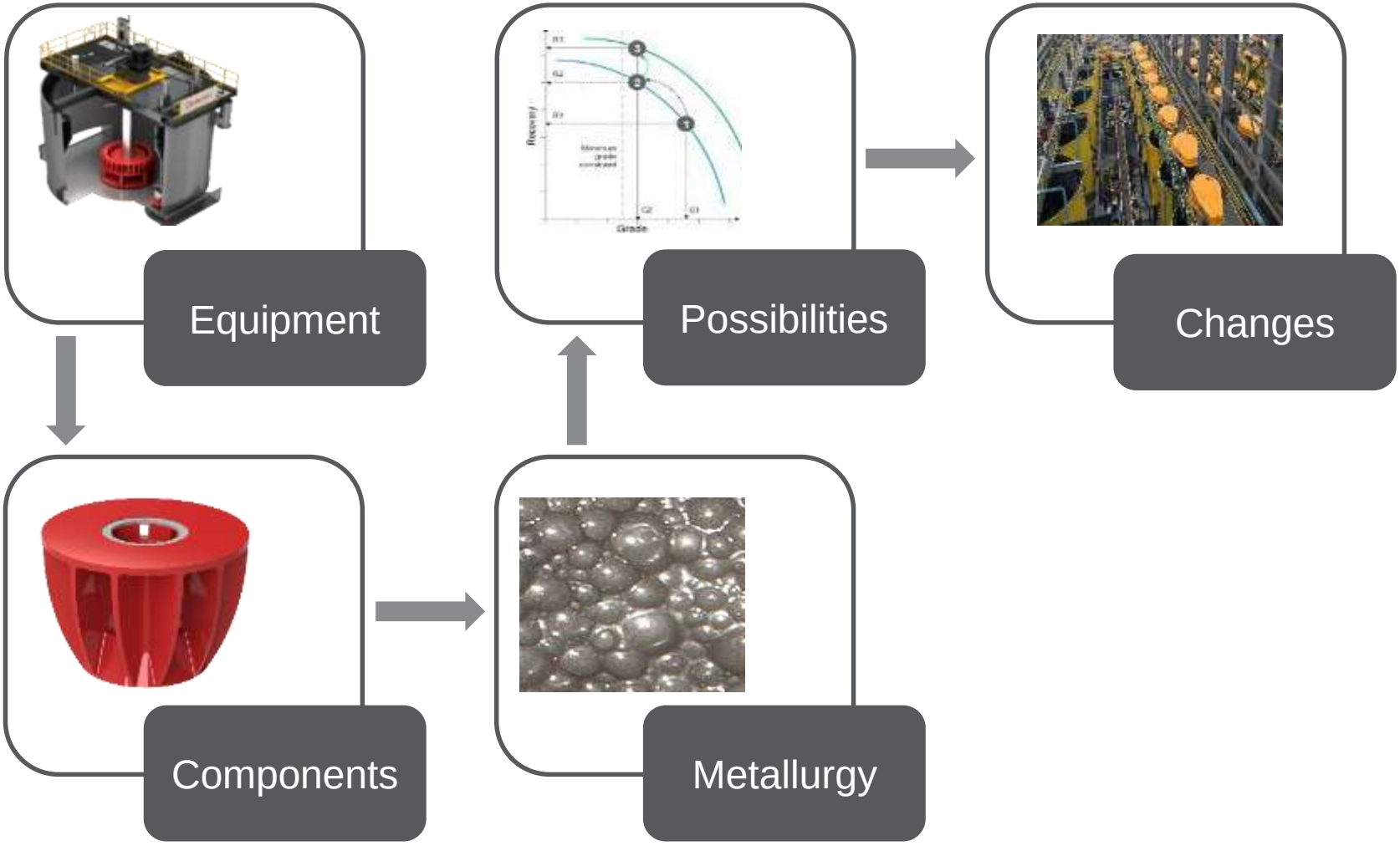
Improving circuit control

Updating / replacing old equipment (modernizing)



Empowering / up-skilling site people

# Understanding these opportunities



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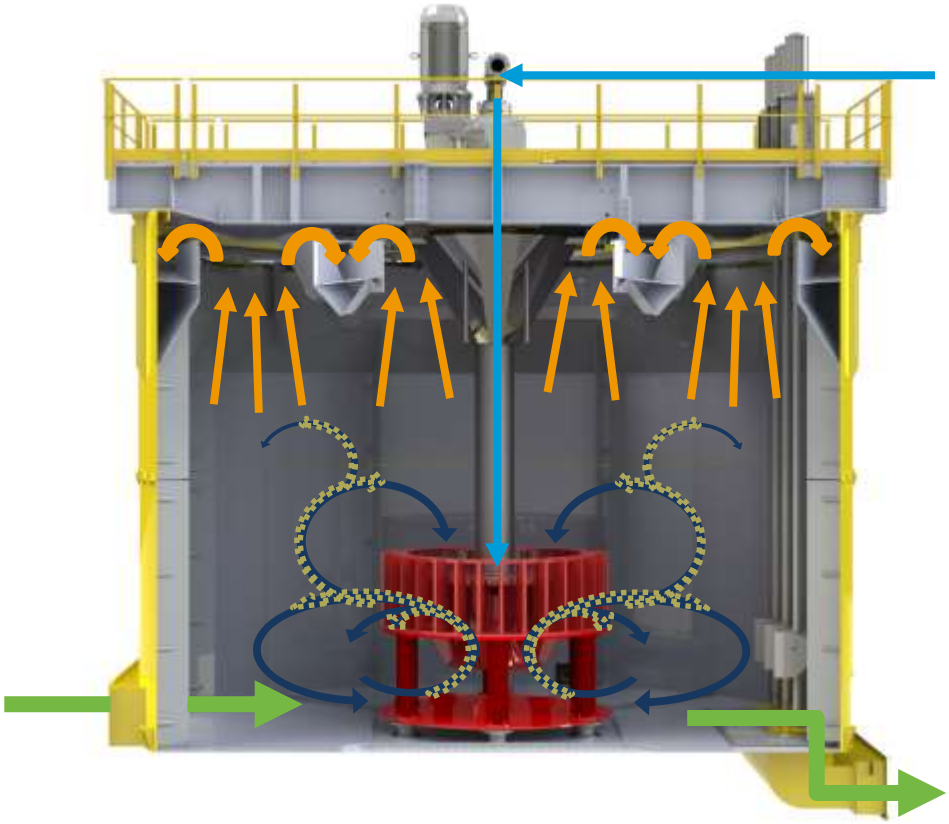
# Requirements of a flotation machine



- Slurry
- Air
- Bubbles
- Particles
- Froth

# Types of flotation equipment

- Mechanical flotation cells – about 90% of installed capacity
  - TankCell®, U-Cells and R-cells - Outotec
  - Wemco, Dorr-Oliver, FFE Minerals - FLSmidth
  - RCS – Metso
  - BGRIMM
  - Woodgrove SFR
- Pneumatic flotation cells
  - Column cells
  - Jameson cells
- Flash flotation machines
  - SkimAir® - Outotec

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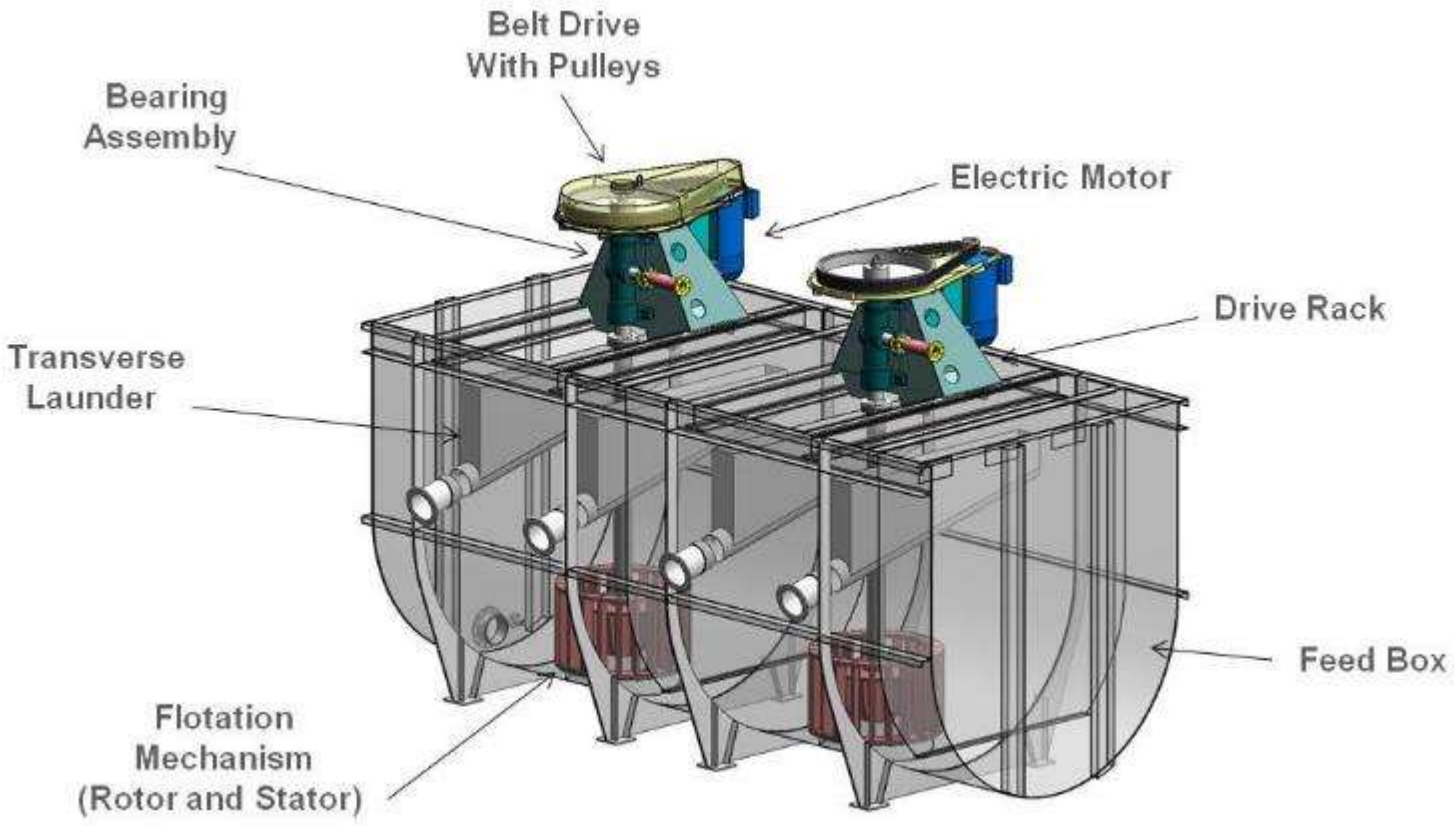
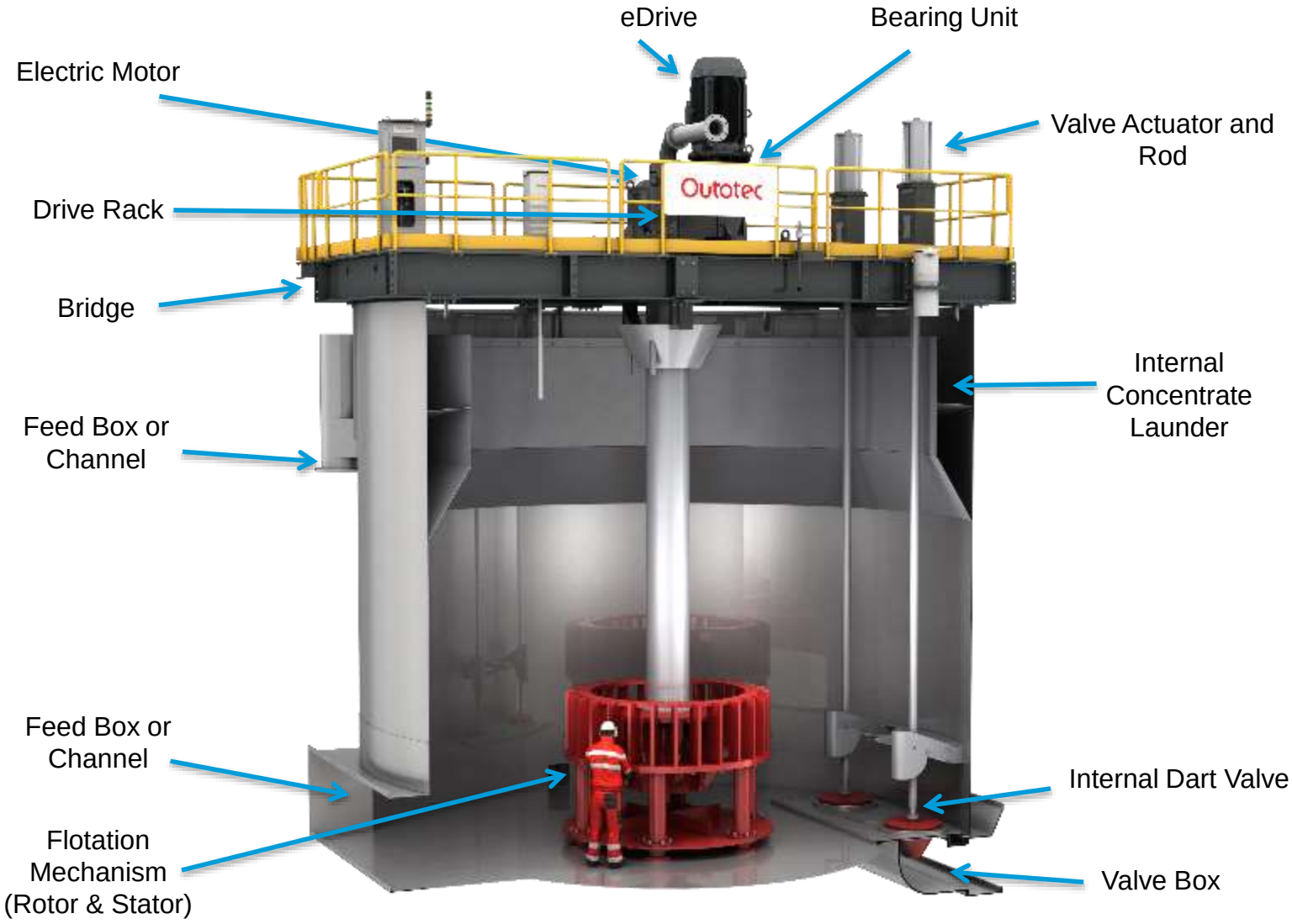
# Conventional cell



# TankCell®



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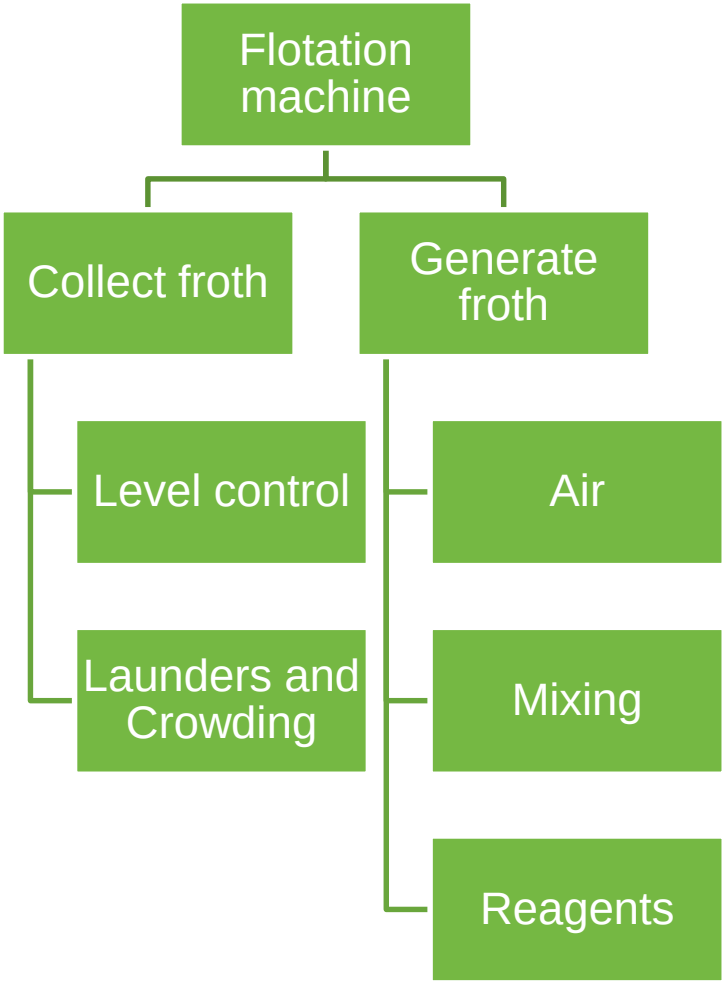
# Launders and crowding

- Flotation machine focused on the pulp zone
- The froth is critical
- Froth zone has a effect on grade and plant operability
- Opportunities exist to improve froth collection

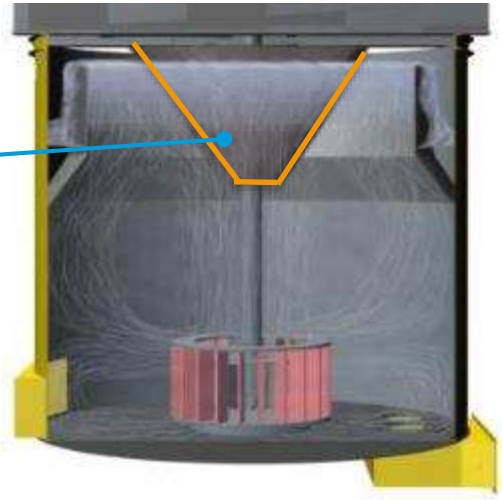


# Launders and crowding

- Changing tank top configuration changes performance.

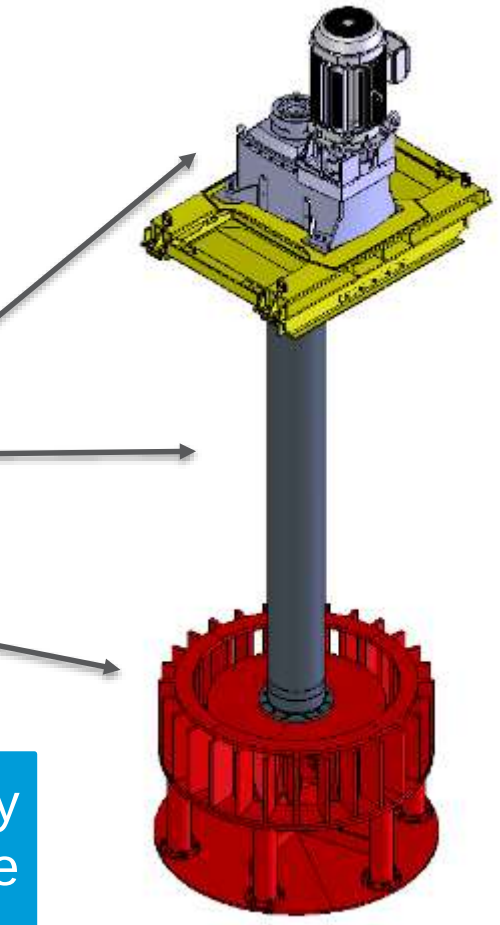
- If large amounts of froth
  - More area
  - More lip length
  - Little or no crowding

- If small amounts of froth
  - Less area
  - Less lip length
  - More crowding



# Flotation mechanism

- Heart of the flotation cell
- Consists of
  - Drive – belt or gearbox option
  - Lower shaft
  - Rotor and stator



Opportunities exist to reduce energy consumption, reduce wear and improve process performance (recovery)



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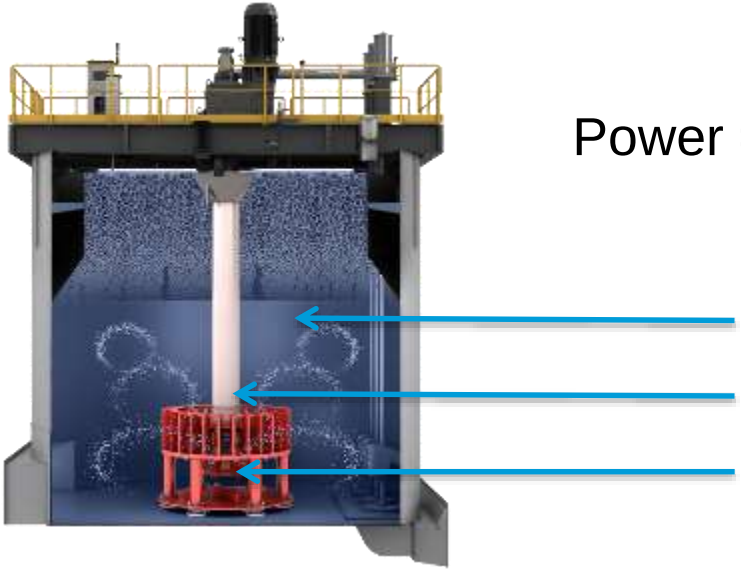
# Reducing wear and energy consumption



$$\text{Power} = N_p.\rho.N^3.D^5$$

$N_p$ = power number for mechanism

$\rho$ = pulp density

N = rotational speed

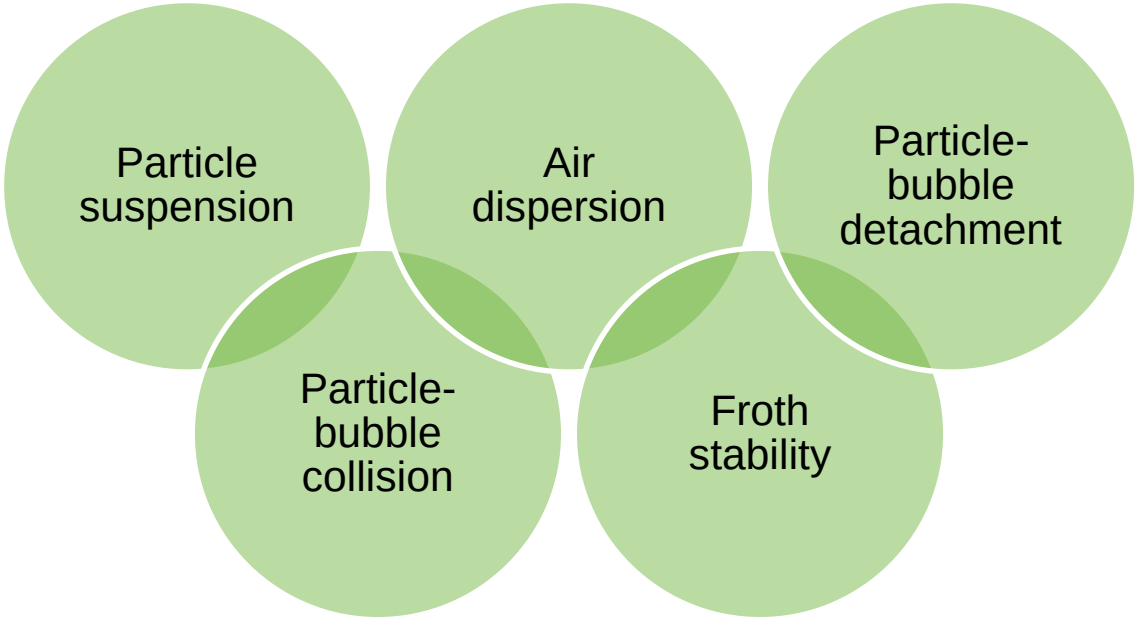
D = impeller diameter

- More efficient rotor-stator arrangements allow rotational speed (or rotor diameter) to be reduced - this can reduce power
- Wear is proportional to rotor speed: slower speed = longer wear life

10% lower rotation speed equals 25% power saving

# Improving process recovery

- The mixing affects major sub processes:




- Change mechanism and/or rotation speed to optimize



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# Flotation control

1. **Manual operation**

   Grade-recovery curve determines flotation performance

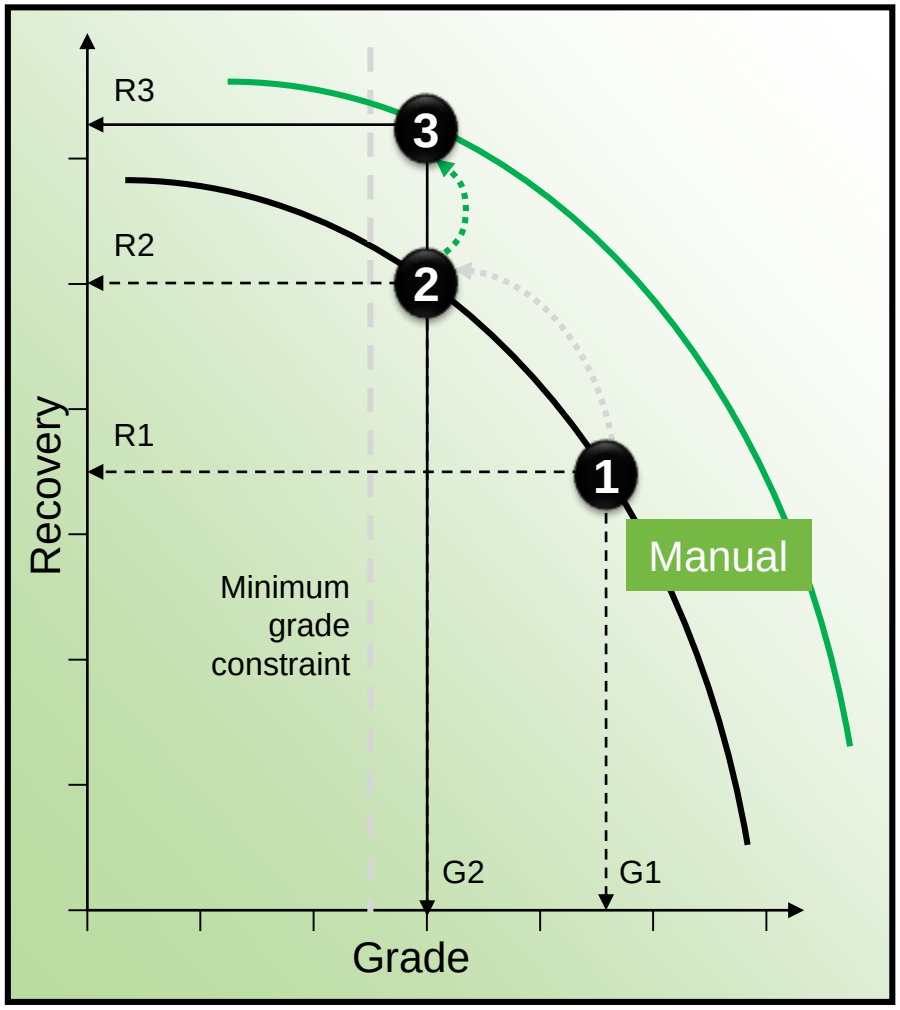
2. **Stabilization**

   Ability to run process closer to target

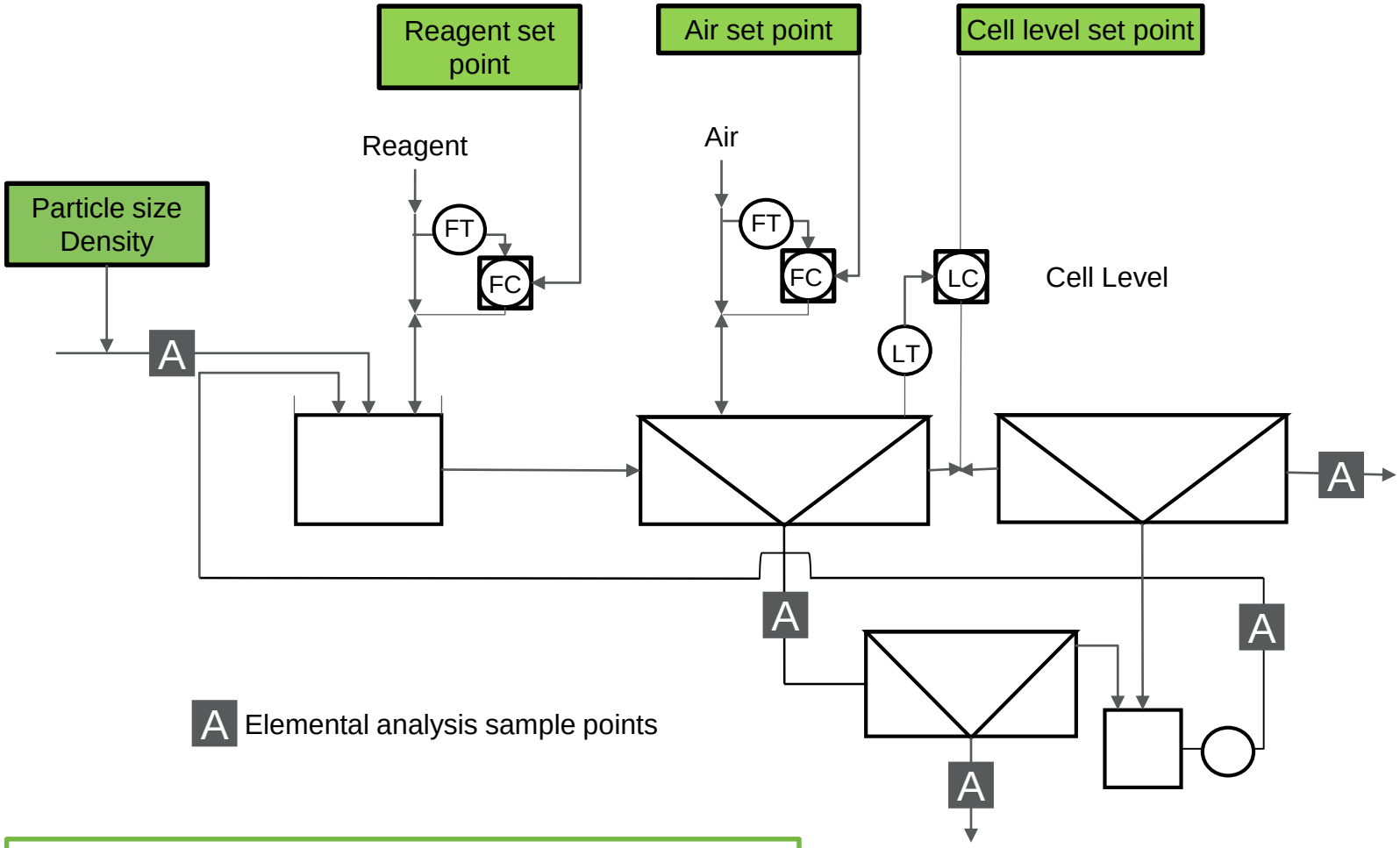
3. **Optimization**

   Higher recovery because of better process conditions (less turbulence, constant mass pull etc.).

**Typical recovery increase 1-3%**



# Basic flotation control




An example of base-layer control loops in the flotation process

# Air control

- Air is the most important operating variable
- Each cell has an air flow meter
- Air is produced by the low pressure blowers
- Air control has a major effect on grade and recovery

# Air control

# Level control

- Controlling the pulp level (or froth depth) is an important tool in controlling cell operation
- Level is measured with a mechanical or ultrasonic level transducer
- The discharge valve(s) are controlled by a feedback loop to maintain level

Poor level control setup makes cells difficult to operate and affects grade and recovery produced



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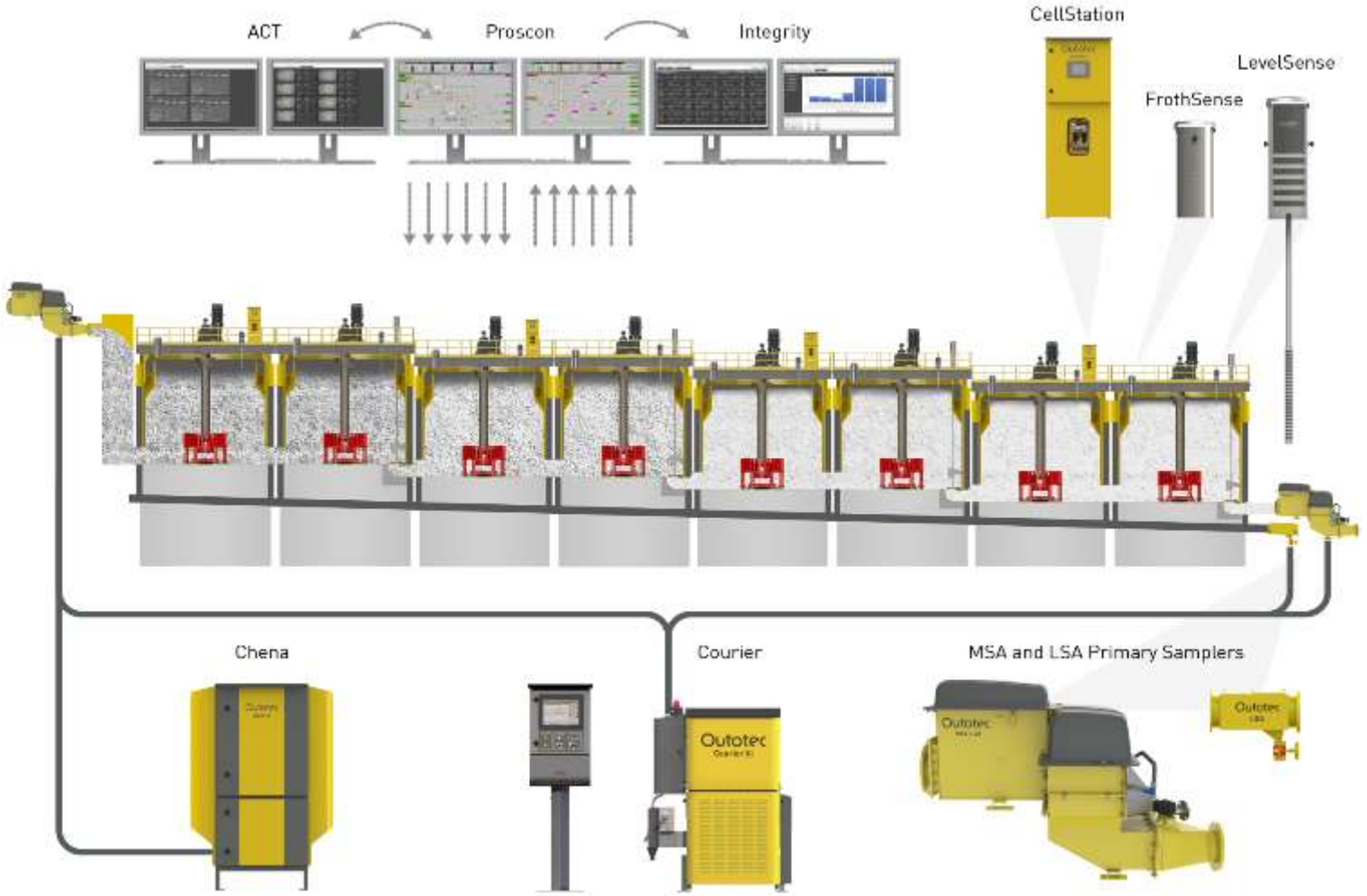
# Level control

# Control: There are many tools that can help



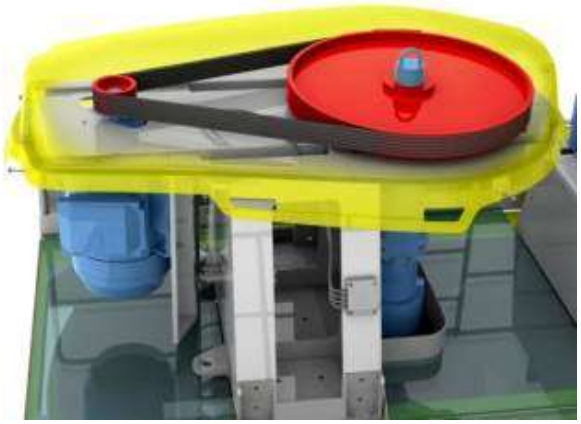
# Importance of maintenance

Equipment is designed to operate a certain way - production may suffer if it doesn't

Different groups on site (maintenance, operations, metallurgy) have different ways of looking at machines

Need improved equipment monitoring and to quantify the impact of poor condition on production to justify changes

Regular maintenance inspections and tracking equipment condition is a good start



# Importance of maintenance



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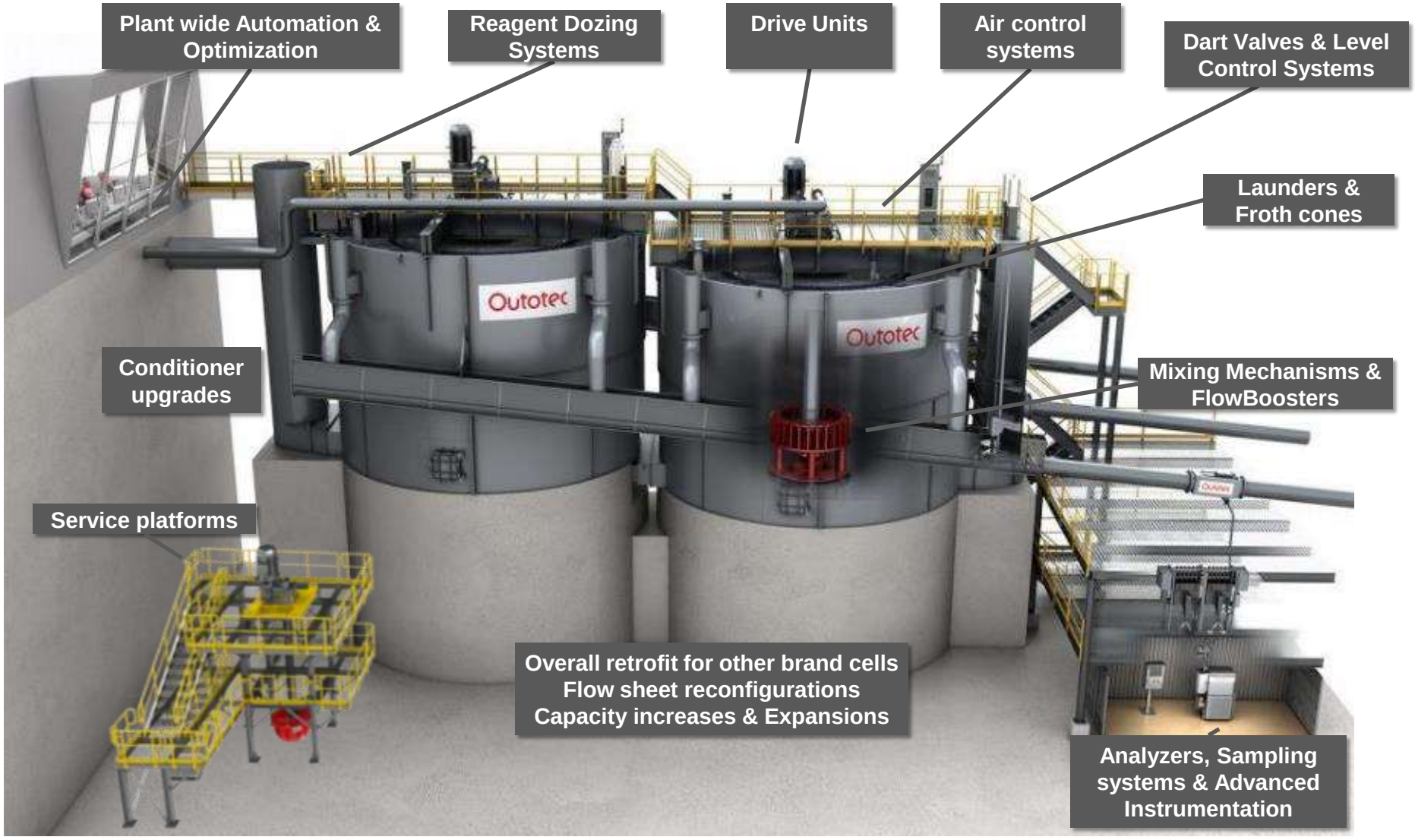
# General modernization opportunities

- Flotation cell technology has come a long way in the last 20 years
- Newer cells generally larger, more efficient mixing and air dispersion and better control
- Older equipment usually requires higher maintenance – higher operating costs
- Cost benefit analysis of existing install against replacing it with fewer larger cells
- http://www.outotec.com/Flotation-modernization-guidebook/

# General modernization opportunities



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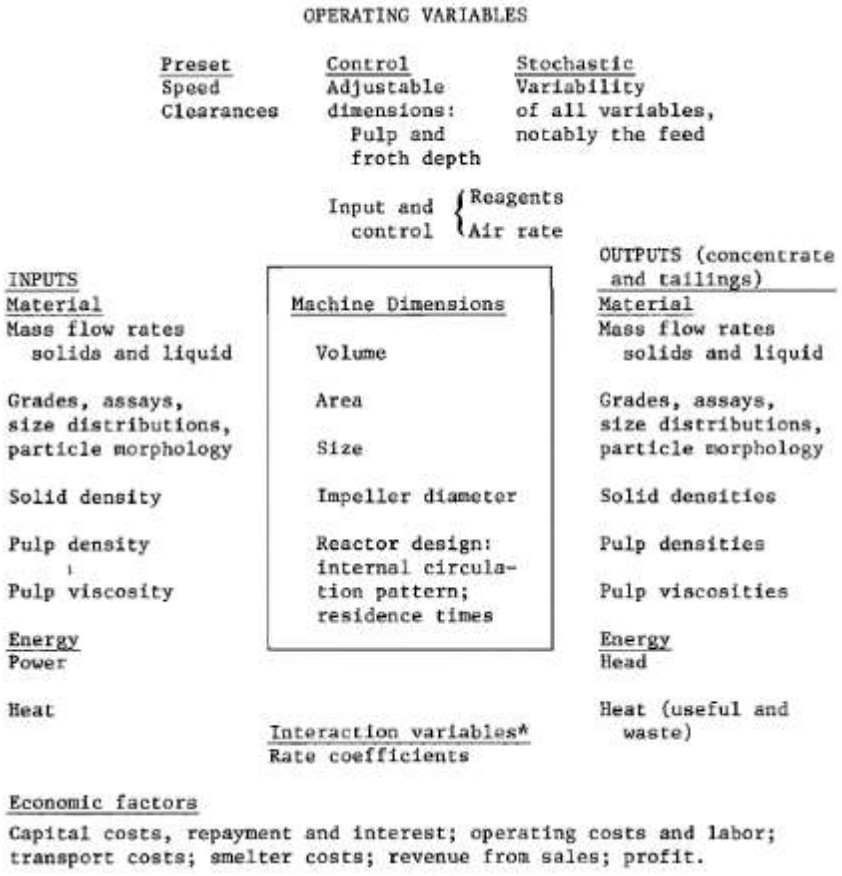
# Identifying problems

- Flotation is a complex process with many variables




Harris, 1975

# Identifying problems

- Complex process so not easy to find cause
- Various techniques exist depending on nature of problem
- Conduct sampling campaign of operating equipment coupled with laboratory flotation tests on circuit feed
- Results of the survey combined with kinetic data give good picture of how equipment is working
- Generate information to predict effects of changes so that changes can be assessed to see if financially viable

# Case study – Cobar Mine, Australia

- Challenge - existing scavenger circuit - 30 old small flotation cells requiring significant maintenance to operate properly
- Solution - replace with 3 x TankCell-30
- Benefits – higher recovery, improved control, lower maintenance and reduced energy consumption (3 x 45kW vs 6 x 30kW)

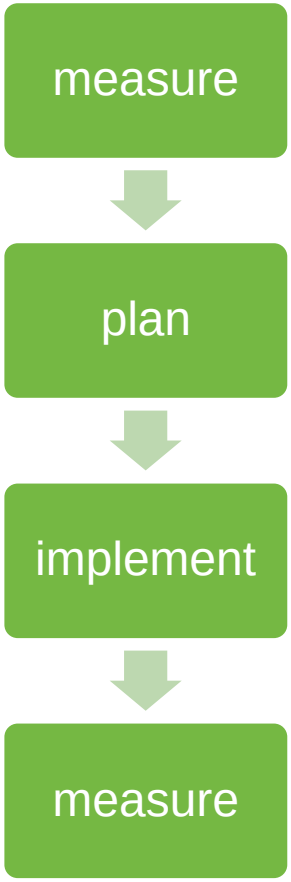
Before installation

Outotec TankCells during installation

After installation

# Summary

- Complexity of flotation plants
- Options for improving performance
- Basics first
  → maintenance
  → process control
- You can’t change what you can’t measure!



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# References / further reading


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# Webinar's to come

If you enjoyed today's talk there are more detailed sessions planned on each of the topics touched on here today

| | |
|---|---|
| April 29 | Optimizing froth area of the flotation cell – froth crowding and launder arrangement |
| June 3 | Best maintenance practices to give best metallurgical performance in flotation – flotation maintenance practices |
| July 8 | Boosting flotation productivity with modern technology – modernization and upgrade opportunities |
| August 5 | Stabilization versus optimization – insights to flotation process |



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# Contact us


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