



Identifying Critical Spare Parts & Recommending Stock levels – JIG & DMS Plants



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Agenda

- Purpose of Project
- Value Add of Project
- 5 Steps Followed – AS&R Asset Criticality Tool utilised
 1. System Criticality
 2. Asset Criticality
 3. Search for Spares - Sources of Information
 4. Material Criticality
 5. Service Levels & Duplication
- Example of the Tool used
- Consequences & Likelihood tables
- Rates worked at
- Final List - Stats
- Assumption, Decisions, Inclusion & Exclusions
- Sources of Information
- Learnings & Recommendations
- Special Thanks



Purpose of Project

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- Identify Critical Spares to part level(BOM) and specify the stock levels to be kept on-site.

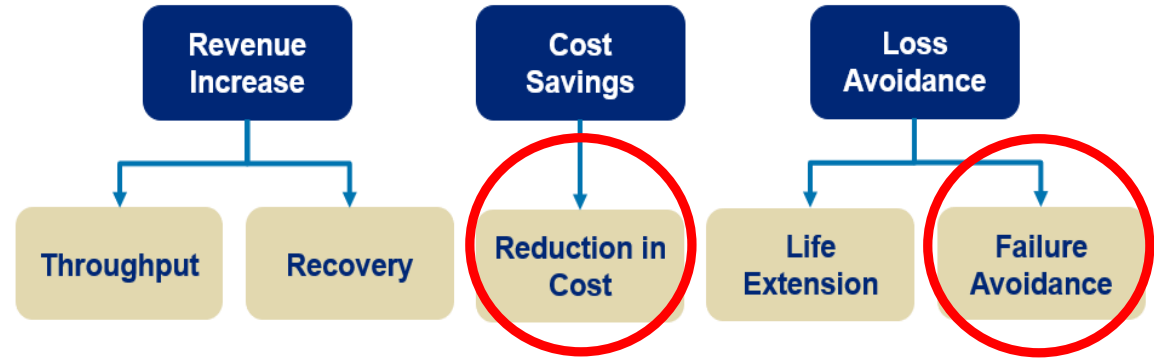


Value Proposition of Project

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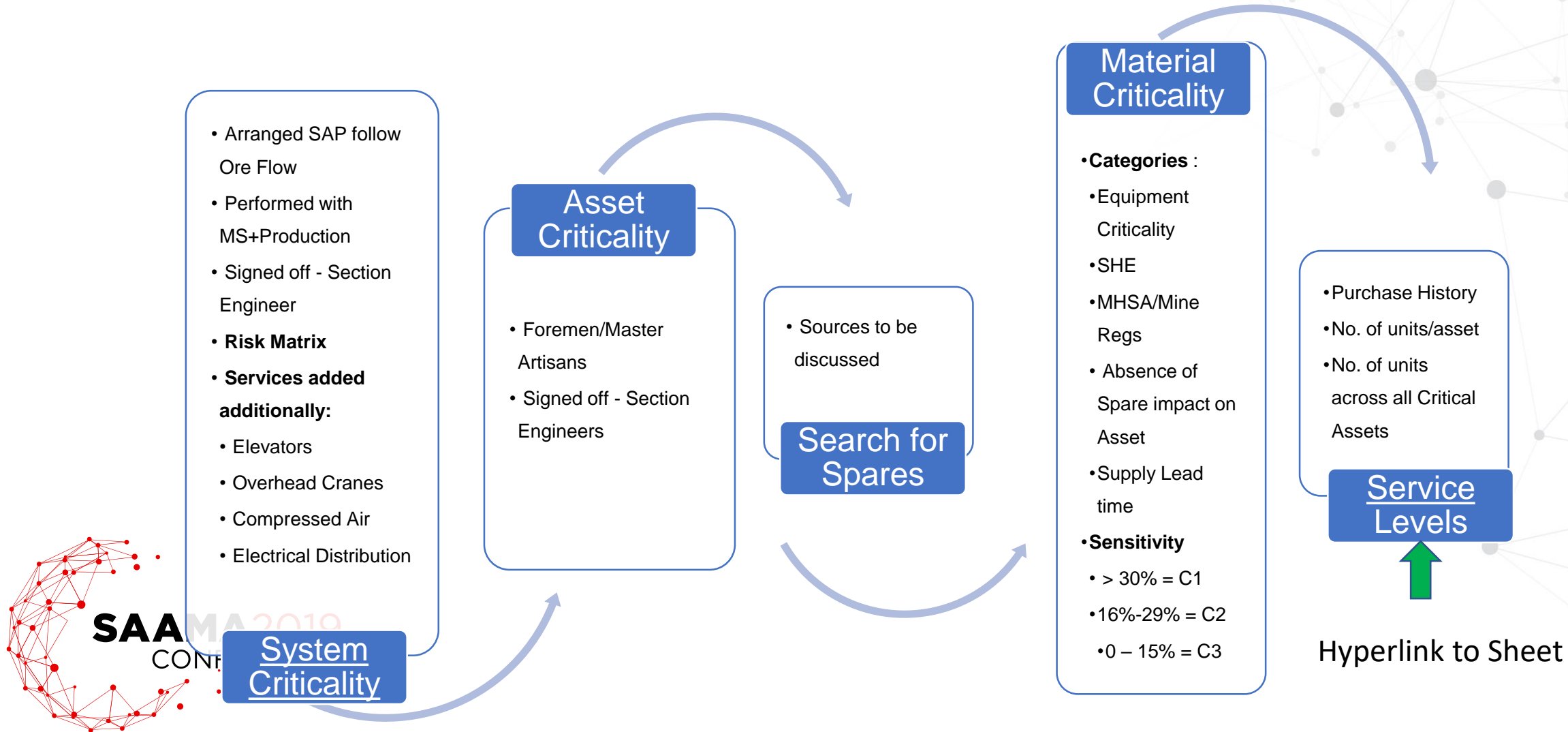
NB Only if spares are listed and kept on stock, will project add value

- 1.1 Mean Time To Repair
- 1.2 Production losses
- 1.3 Failure Avoidance – Components about to fail, replaced timeously, jobs scheduled
- 1.2 Anglo American’s vision for asset-care(P101 target) achieved, i.e. liners
- 1.3 Possible reduction in squirrel stores – Trust in stores could be rebuilt
- 1.4 Reduced Safety risk – Preventing temptation to bridge out, i.e. probes
- 1.5 Reduced Non-compliance risk – i.e. trip-wires
- 1.6 Artisan Overtime Costs



Criticality Process

Anglo American Criticality Analysis Tool utilized – FMECA process →



Consequence & Likelihood tables

| Consequence Table | | | | | | | | | | | | | | | | | |
|-------------------------------------|-------------------------|----------------------|---|----------------------------------|-----------------------|---|--------------------------------|-----------------------|---|---|--|---|--|---|---|--|--|
| Consequence Categories | | | | | | | | | | | | | | | | | |
| Operational (Economic) Consequences | | | | | | | | | | Social and Environmental (non-economic) Consequences | | | | | | | |
| Capital Expenditure | Project Schedule | JIG Prod days | Operating cost | Production volumes | JIG Prod days | Revenue | JIG Prod days | Safety | Health | Environmental (On Site) | Environmental (Off Site) | Community (Measured or Perceived) | Community (Trust & Support) | Compliance / Compliance | | | |
| Budget 2018 | 1 300 000 000.00 | | 810.77 | 12 163 331 536.00 | 31 000 000.00 | 810.77 | 10 472 000 000.00 | 810.77 | | | | | | | | | |
| Consequence Ranking | 1 | Minor | Impact on capital expenditure < 18% | Impact on schedule < 2.5% | Less than 0.6% | Less than 0.6% Production Time < 5 min @ 100% Production Volume < 122 Tons | Impact on revenue < 0.25% | | Low level short term subjective inconvenience or symptoms. Typically a first aid and no medical treatment. | Reversible health effects of little concern, requiring first aid treatment at most. Can include minor irritations of eyes, throat, nose and/or skin, or minor uncustomed muscular discomfort | Near-source confined and promptly reversible impact (typically a shift) e.g. noisy idler that is identified and changed out in a shift or small hydrocarbon spill on hardstand area. | Not Applicable | Temporary and insignificant social impact in a local community | Tangible expressions of trust/mistrust amongst a handful of community members and/or Key civil/political stakeholder(s) express support/dissatisfaction informally. | Non-conformance with internal requirement with very low potential for impact. Non-compliance with external/community commitment goes unnoticed by external parties, requiring minimal effort to correct. | Correspondence Impact of work One off media, N | |
| | Less than | 20 800 000.00 | | 20.27 | 73 019 349.22 | 186 000.00 | 4.86 | 26 180 000.00 | 2.03 | | | | | | | | |
| | 2 | Medium | Impact on capital expenditure 18% - 5% | Impact on schedule 2.5% - 7.5% | 0.6% to 2.5% | 0.6% to 2.5% Production Time 5min to 1hr @ 100% Production Volume 122T to 1 460T | Impact on revenue 0.25% - 1% | | Reversible injuries requiring treatment, but does not lead to restricted duties. Typically a medical treatment. | Reversible health effects of concern that would typically result in medical treatment. Can include temperature effects; travel effects; stress and sunburn | Near source confined and short-term reversible impact (typically a week) e.g. dust event where visible dust is observed from site or a reoccurring issue | Near source confined and promptly reversible impact (typically a shift) | Temporary and significant social impact in a local community OR Temporary and insignificant social impact in a regional community | Tangible expressions of trust/mistrust amongst a few community members and/or Key civil/political stakeholder(s) express support/dissatisfaction informally. | Non-compliance with external or non-conformance with internal requirement with low potential for impact. Non-compliance with community commitment, requiring limited effort to correct. | Impact Significant | |
| | More than | 20 800 000.00 | | 20.27 | 73 019 349.22 | 186 000.00 | 4.86 | 26 180 000.00 | 2.03 | | | | | | | | |
| | Less than | 65 000 000.00 | | 60.81 | 304 249 788.40 | 775 000.00 | 20.27 | 104 720 000.00 | 8.11 | | | | | | | | |
| | 3 | Serious | Impact on capital expenditure is 5% - 10% | Impact on schedule is 7.5% - 15% | 2.5% to 7.5% | 2.5% to 7.5% Production Time 1h to 10hr @ 100% Production Volume 1460T to 14 580T | Impact on revenue is 1% - 3.5% | | Reversible injury or moderate irreversible damage or impairment to one or more persons. Typically a lost time injury. | Severe reversible effects of concern that would typically result in a lost time illness. Can include acute/short-term effects associated with extreme temperature effects; or musculo-skeletal effects; vibration effects; nervous system effects; some infectious diseases; and non-falciparum malaria | Near source confined and medium-term recovery impact (typically a month) e.g. large spill or contamination into PWCS water management system that requires clean up or equipment failure resulting in a loss of yard sprays. | Near source confined and short-term reversible impact (typically a week). | Permanent and insignificant social impact in a local community OR Temporary and significant social impact in a regional community | Tangible expressions of trust /mistrust amongst some community members and/or Key civil/political stakeholder(s) threaten to oppose or disengage/ strengthen offers to support or engage | Non-compliance with external or non-conformance with internal requirement with moderate potential for impact. Moderate penalties for breach of legislation, contract, permit or licence. Non-compliance with community commitment reported formally, requiring significant effort to correct. | Impact Community which if not Public | |
| More than | 65 000 000.00 | | 60.81 | 304 249 788.40 | 775 000.00 | 20.27 | 104 720 000.00 | 8.11 | | | | | | | | | |
| Less than | 130 000 000.00 | | 121.62 | 312 749 365.20 | 2 325 000.00 | 60.81 | 366 520 000.00 | 28.38 | | | | | | | | | |
| | | | | | | | | | | | | | | | | Breach of licences, legislation, regulation or repeated non-compliance | |



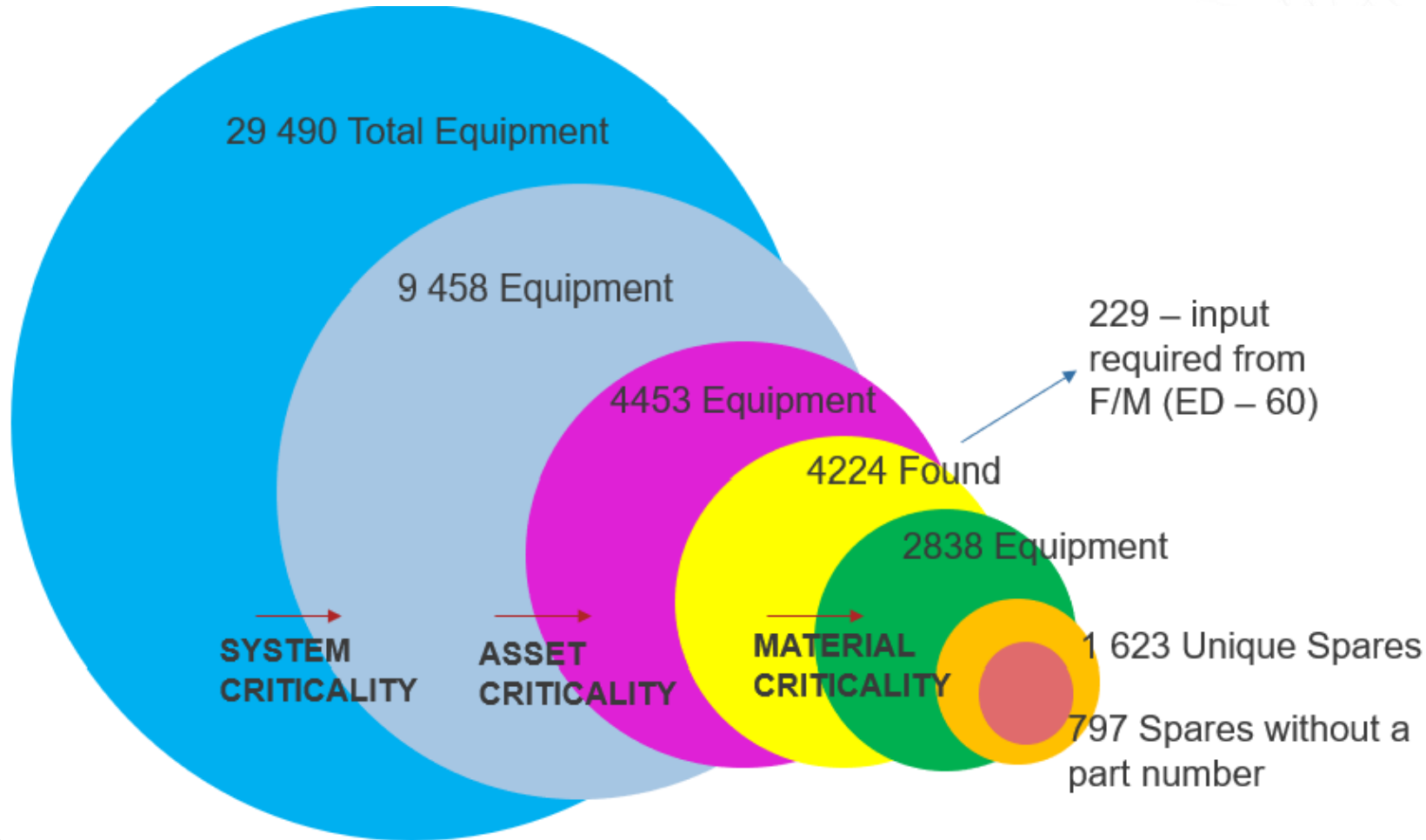
Consequence & Likelihood tables

| <i>Risk Acceptance Threshold</i> | | | |
|---|--|---------------------------------------|--|
| Critical | Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention. | | |
| High | Risks that exceed the risk acceptance threshold and require proactive management. | | |
| Moderate | Risks that lie on the risk acceptance threshold and require active monitoring. | | |
| Low | Risks that are below the risk acceptance threshold and do not require active management. | | |
| Risk = consequence x likelihood | | | |
| The fundamental rule is to define the consequence first, as different consequences have different likelihood. | | | |
| Likelihood | Likelihood Description | Frequency | Substance Exposure |
| most certain | Recurring event during the life-time of an operation/ project | Occurs more than twice a year | Frequent (daily) exposure at > 10 x OEL |
| Likely | Event that may occur frequently during the life-time of an operation/project. | Typically occurs once or twice a year | Frequent (daily) exposure at > OEL |
| Possible | Event that may occur during the life-time of an operation/project. | Typically occurs in 1 – 10 years | Frequent (daily) exposure at > 50% of OEL Infrequent exposure at > OEL |
| Unlikely | Event that is unlikely to occur during the life-time of an operation/project. | Typically occurs in 10 – 100 years | Frequent (daily) exposure at > 10% OEL Infrequent exposure at > 50% of OEL |
| Rare | Event that is very unlikely to occur during the life-time of an operation/project. | Greater than 100 year event | Frequent (daily) exposure at < 10% of OEL Infrequent exposure at > 10% of OEL |

Rates worked at – how long will this take me?

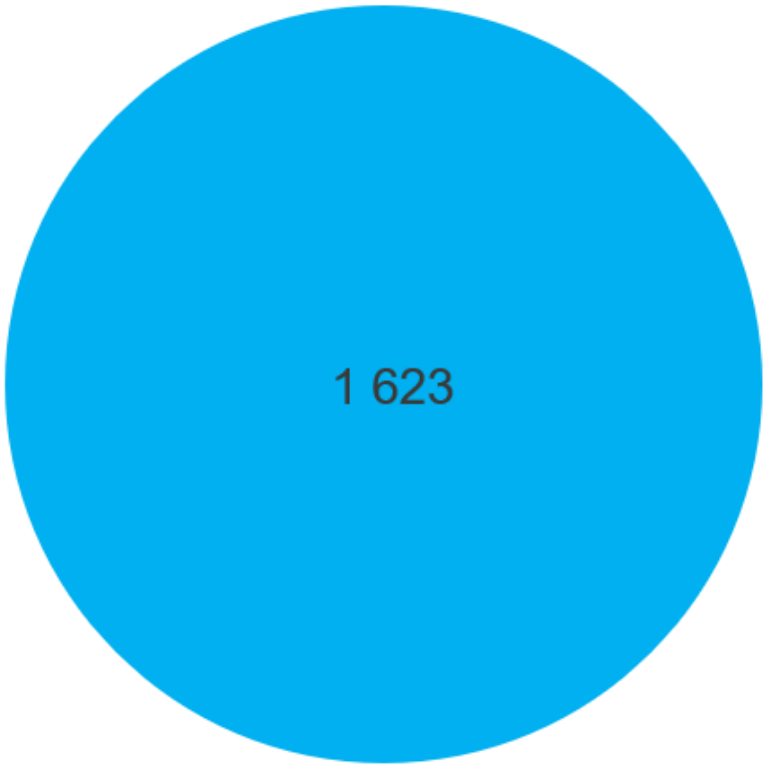
| | Planned | Actual | Reason |
|---------------------------------------|-----------------------|-------------------------------------|--|
| Identification of System level | +/- 16min/system line | 15min/line – JIG 6min/line – DMS | <ul style="list-style-type: none"> Initially failures/consequences were discussions Failure causes & impact understood 2nd time round |
| Identification of Asset level | 0.4min/asset line | 1.03min/line | <ul style="list-style-type: none"> More assets than estimated |
| Identifying Spares of Critical Assets | 0.68min/asset line | 1.62min/line | <ul style="list-style-type: none"> Time taken to search for spares unknown |

Final List Stats - JIG



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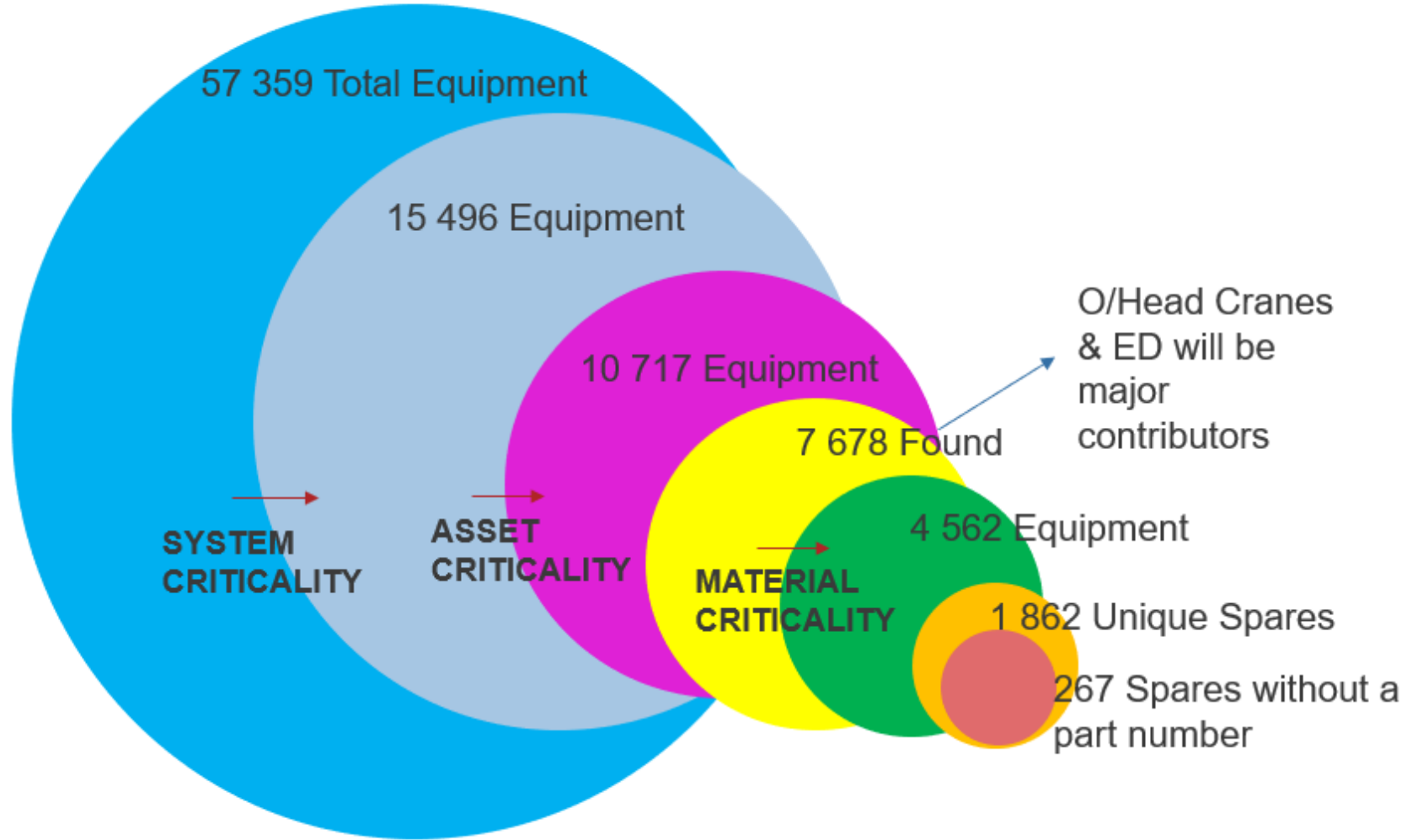
Total New, Unique C1Spares -



Total Old, Unique C1Spares

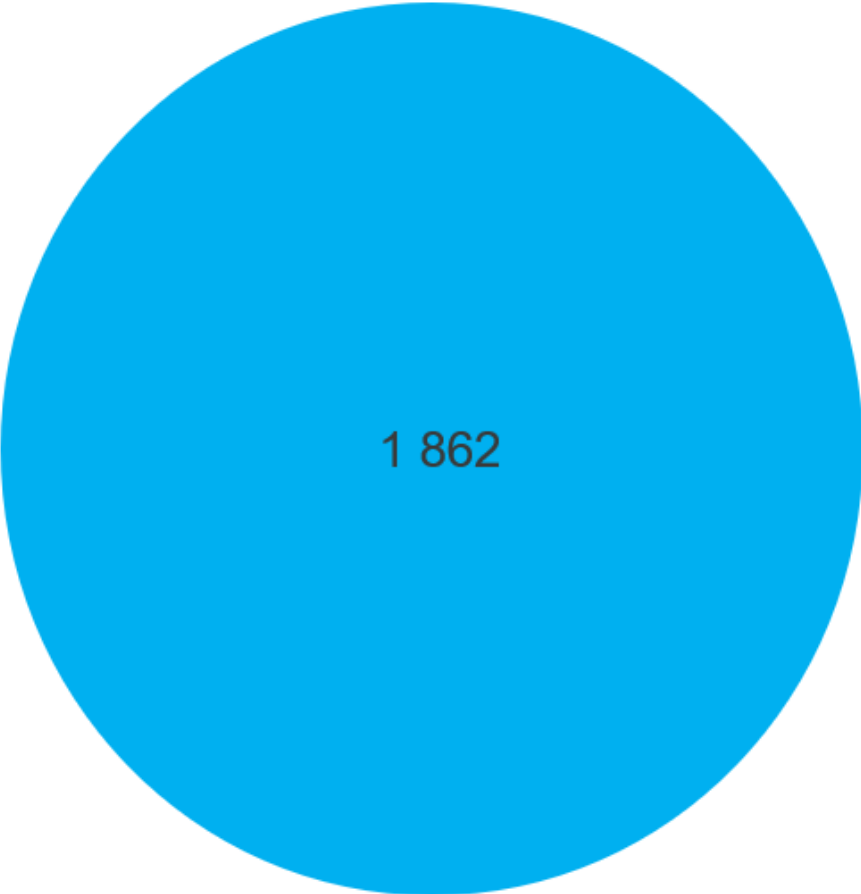


Final List Stats - DMS



Final List Stats - DMS

Total New, Unique C1Spares



Total Old C1Spares



Assumptions & Decisions

1. Failure scenarios -
 - Worst possible
 - Most likely
2. Systems = Dam walls bursting, Conveyor structures burning down
3. Assets = Pump or Gearbox failures
4. Consequence and Likelihood if:
 - No maintenance was performed
 - No spare kept on site
 - Installed redundancy considered
 - Hard Controls considered, i.e. fire suppression, temperature probes
5. Assets Critical on Safety, Low on Production, not taken forward
6. Smallest maintainable item, i.e. Crusher up to O-rings, Gearboxes up to Gearbox
7. Do you consider Fire Suppression parts? Yes you should. In this case stock kept by Contractor
8. Equipment not considered critical: Walkways, Lights, Guards, Platforms, Cable racks
9. JIG – Assume Link One Manuals are correct data unless informed otherwise
10. DMS – Assume SAP orders are most recent and correct
11. P101 targets, is it best practice to run the machine without that spare? If the spare is not there, impact on asset?
12. Stock level recommendations, consider:
 - 12.1 Same spare used on different places
 - 12.2 Realistic number of spares replaced in one go

Sources of Information

1. Equipment changed without updating Master Data at Drawing Office
2. Link One very useful tool when used correctly
3. Pulley Register, Plumber-block & adaptor sleeve registers – Drawing office & reliability engineers
4. Service Equipment, i.e NB Overhead Cranes, Electrical Distribution & C&I obtained from Foremen, Artisans, Contractors – Often overlooked
5. Links to existing SAP Functional Locations



Learnings & Recommendations

1. NB NB - Update Link One/Master Data for Sustainability – One source of information
2. Linking correct spares to Functional Locations on SAP
3. Specifically - Add Electrical Distribution & Overhead Cranes Technical Information to SAP and Link One
4. Pre-populating with possible failures & consequences prior to confirming with client worked better
5. Measure time worked - Actual times will assist greatly with future work

Support Equipment



Critical Equipment

Special Thanks

Team members - **Scheepers Schoeman & Darius Booyens** for putting in 15hr days

Gordian – **Jelmen Grundel** for Optimizing Stock levels



Thank you

Any Questions?

