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DUE DILIGENCE ENGINEERS

OPERATIONS DUE DILIGENCE

BEST PRACTICE MODEL.

How to Make Your Operations the Best They Can Be.

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EXECUTIVE SUMMARY

Senior decision makers are always seeking improvements to efficiency and productivity in operations, including mines, plants and other systems. Staff are encouraged to present them. But the value of the proposed upgrades is often not transparently presented in a way that can be readily interpreted by management, shareholders, boards, accountants and lawyers.

This paper provides a summary of the challenges faced by managers of operations and how R2A's proven Operations Due Diligence approach provides an effective way forward. R2A's method enables the key operational vulnerabilities to be transparently identified and presented in a manner that is readily understood by all stakeholders.

Operations Due Diligence has been successfully applied by R2A for coal mines, a water treatment and power station plant upgrade options analysis, gas distribution, freeway tolling systems, essential services supply networks, bank and broker computer centres, waste recycling facilities and a network black start requirements.

> **R2A'S PROVEN OPERATIONS DUE DILIGENCE EFFECTIVELY COMMUNICATES IMPROVEMENT BENEFITS.**

INTRODUCTION

TIP

Starting with the right questions will enable the preparation of a comprehensive proposal.

Transparency in decision-making in complex technological enterprises is often difficult. Requests for greater system, plant or network reliability is often seen as 'gold plating' by financial markets and shareholders, and yet the failure to have sufficient redundancy can result in the catastrophic loss of shareholder funds and community devastation.

The sorts of questions often asked of R2A include:

1. We know that there are off-site issues that can seriously affect our product delivery processes.
2. We do not have direct control over these off-site resources. How can we communicate our concerns to those responsible in a way that motivates action?
3. Our engineers have recommended new plant upgrades. We recognise that their arguments are based on good engineering practice but we can't see a robust connection to future profitability. How can these recommendations be transparently assessed?
4. How do we include off-site threats in a meaningful way in our overall plant availability model?
5. We have had reliability studies completed on our plant. But there are some credible, critical issues that are considered to be so unlikely they don't seem to rate any attention. We know that if one happens, the business will be critically exposed. How do we demonstrate the importance of these to the board in a constructive way?
6. We have spent a great deal of time and effort on reliability studies. But we don't feel they are contextually sound and have no process to test this. Is there a way this can be addressed?

The R2A top-down Operations Due Diligence process specifically addresses these questions and enables a persuasive argument to be presented for proposed upgrades. It also ensures that the outcomes are aligned with the values and goals of the organisation.

THE LIMITATIONS OF CONVENTIONAL RELIABILITY ANALYSIS

Conventional asset availability management has been traditionally done 'stair-wise' (bottom-up) outside the context of the enterprise risk framework. Analysis is focused almost exclusively on the physical characteristics of the system.

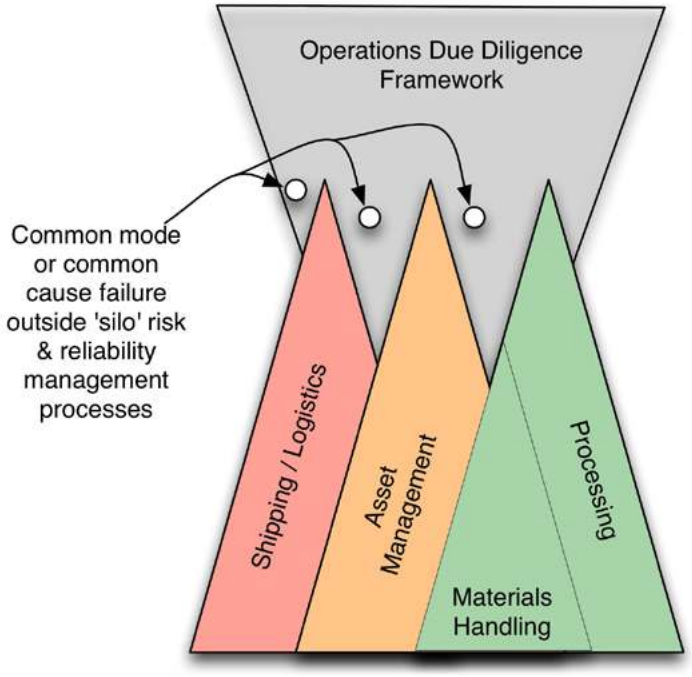
Bottom-up analysis has a number of shortcomings from the decision makers' viewpoint. From an organisational viewpoint, all causes of system failure are important, including factors such as external effects (for example, materials supply interruptions, power failures, bushfires, floods, staff sickness) and accidents (for example, fires, materials handling, vehicle collisions, operator errors).

In addition, common mode failures are influenced by physical co-location and will only be identified if different systems are analysed together, rather than in isolation. Also there are often functional relationships that aren't clear from a low-level hardware description.

These factors are external to the traditional scope of availability analyses but can have a disproportionate effect, as the damaged caused can be severe, leading to much longer downtimes than simple equipment failures.

> CONVENTIONAL BOTTOM-UP ASSET AVAILABILITY ANALYSIS HAS A NUMBER OF SHORTCOMINGS AND FACTORS WHEN NOT CONSIDERED CAN LEAD TO MUCH LONGER DOWNTIMES.

THE LIMITATIONS OF CONVENTIONAL RELIABILITY ANALYSIS



BOTTOM-UP SILOS MISS COMMON MODE FAILURES

Further, in large organisations, analyses tend to follow the organisational structure, with separate models produced for each department then being combined to produce the overall model. This can have the effect of lower levels focusing on what is important to the department, rather than the organisation as a whole, and omission of issues that fall outside individual departments – particularly common cause vulnerabilities. This is depicted in the figure above.

BOTTOM-UP ANALYSIS CAUSE & EFFECT DIFFICULT TO SEE

A full bottom-up analysis is voluminous – usually requiring significant further analysis to identify issues of concern. The final conclusions are produced from what can appear to be an abstract collection of data, with direct connections between cause and effect difficult to see. Decision makers are required to trust the results of such an analysis, allocating resources without a clear, contextual understanding of the issues.

HOW R2A CAN HELP

R2A's top-down Operations Due Diligence process provides a completeness check to ensure that all credible external and on-site common mode threats are identified for large complex operations (including plants, mines, distribution/ supply networks). From a criticality viewpoint, any credible event than can cause long outages will be of primary concern to senior decision makers.

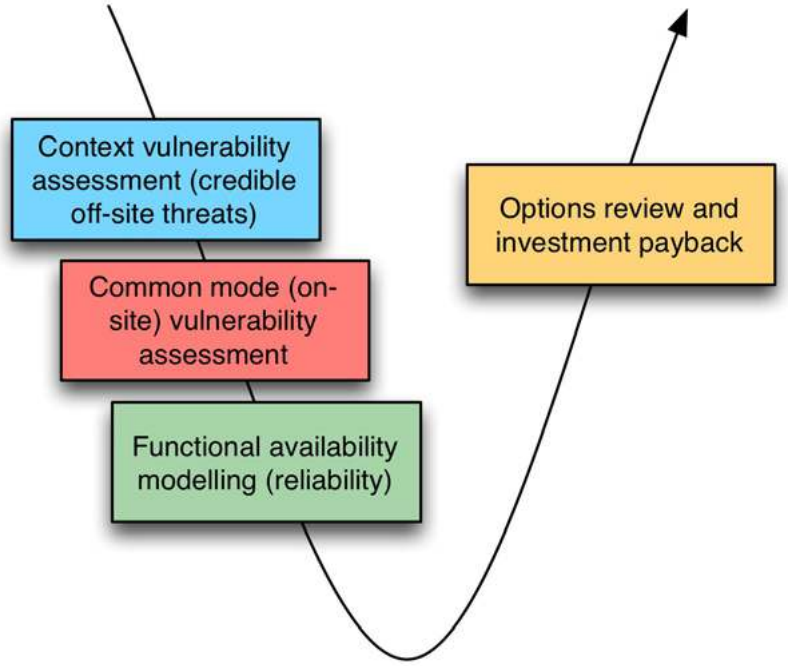
In addition, high-level availability modelling focuses on identifying the independent elements within the system so that senior decision makers are made aware of critical process bottlenecks that could constrain the business.

The key outcome of the review is to ensure that there is a focus on credible critical issues so that all reasonable practicable precautions are in place for each. The analysis is aligned with the organisational values and goals using a transparent process that is easy to present.

> **OPERATIONS DUE DILIGENCE ENSURES THERE IS A FOCUS ON CREDIBLE CRITICAL ISSUES SO ALL PRECAUTIONS ARE IN PLACE.**

THE PROCESS

The Operations Due Diligence 4-stage top-down process is shown below:



1. Context Vulnerability Assessment

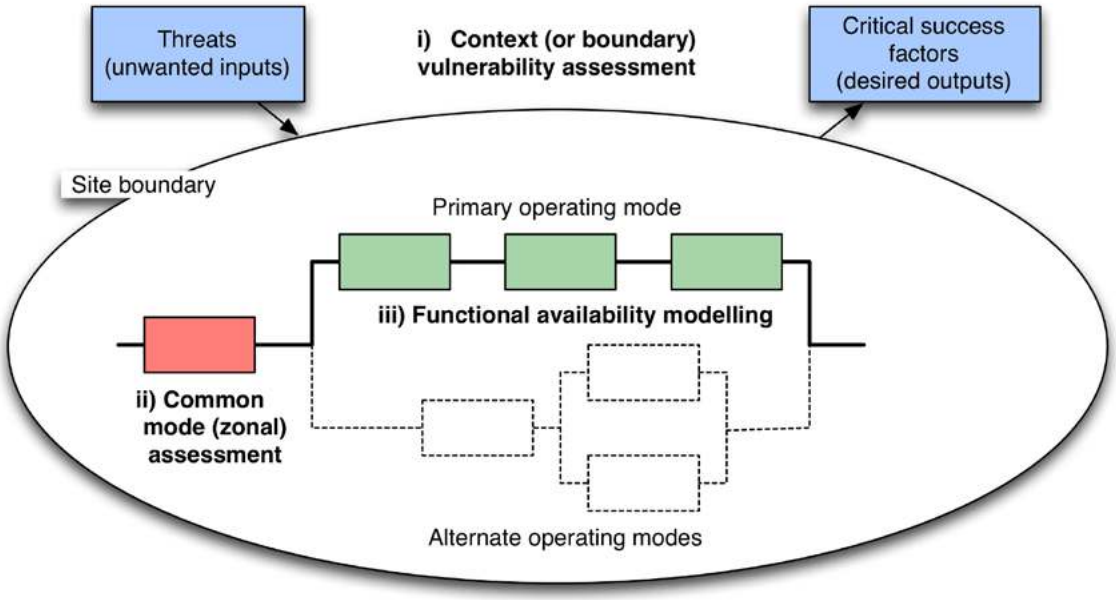
This is a high-level context (boundary) analysis providing a strategic completeness check of potential vulnerabilities. It examines the credible boundary (external to the site/plant) that can critically impact on the operations. It simply asks two questions: "What are we trying to achieve" (that is, what required outcomes need protection) and "what are the credible threats to these aims?".

2. Common Mode (Zonal) Vulnerability Assessment

This is a geographic or zonal risk 'completeness' assessment undertaken by examining each major element in its geographic, community and environmental context. It identifies site-specific issues such as critical common mode and common cause failures including fires/explosions, pipe failures and power failure. These are typical common mode failures for which organisations purchase insurance, especially for fires and explosions. By focussing on failure modes that affect multiple sections of the plant or process, or which don't fit into the silos defined by the organisation, risks are defined within the context of the boundary vulnerability analysis. This leads naturally to the preliminary segmentation of the plant or process into functional sections affected by different common mode failures, rather than accepting, without testing, the organisational silos defined prior to the study.

THE PROCESS

The figure below describes the integration of the first three steps of the process.



3. Functional Availability Modelling

The key concept here is to divide the system or process under consideration into sub-systems that are independent of each other and that all the interested parties can picture and agree represents the system as a whole. Block diagrams are a simple way of representing complex systems diagrammatically and can be used for both risk and availability studies.

Care must be taken when constructing models, as physical layout may not represent the functional arrangement. For instance, if two power feeds are physically in parallel but, alone, neither can supply enough power for the process, they are functionally in series. Critical process components show up as bottlenecks in the block diagram, as do any common mode failures identified in the previous step.

THE PROCESS

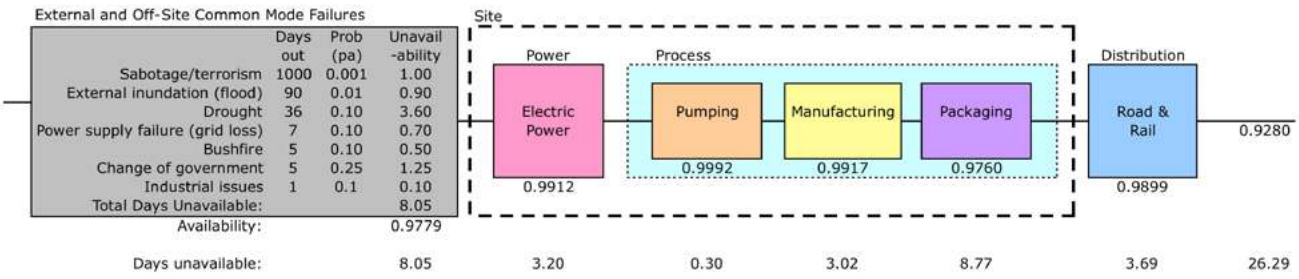
4. Options Review, Investment Payback and Recommendations:

Options to address the identified concerns are developed in consultation with stakeholders. Where different options are available, further modelling is conducted to determine which options should be recommended to management.

The key to all this work is the way in which results are presented to decision makers. There is no single 'right' way. It depends on the organisation and the services provided. The diagram below shows a demonstration model in a format that has often proved effective.

To the left are the external off site threats that constrain the entire business. Senior decision makers usually assess these items by 'days out'. This is a measure of criticality, which is related to the type of business under consideration. If more than a week would cause a catastrophe, then all the credible issues that can cause more than a seven day outage must be (seen to be) addressed.

Each of the primary on-site elements is considered further by delving into each individually. Again, the common mode failures for that process are identified and again, from a criticality viewpoint, any credible event than can cause long outages will be of primary concern to senior decision makers.



CONCLUSION

TIP

A top-down analysis approach will enable operational vulnerabilities to be fully understood and accurately addressed.

Organisations seek to achieve optimum efficiency and productivity in the operation of their plants, mines or networks. They also aim to eliminate incidents that put the organisation's operations at risk.

For operational vulnerabilities to be truly understood, they need to be analysed top-down in the context of the organisational goals.

The R2A Operations Due Diligence model does this and also provides a complete picture of the plant or process for Boards and Senior Decision makers. Transparency in decision making is achieved.

WHERE TO NEXT

If you would like to know more about how to manage operations due diligence in your business you can:

1. **Contact R2A** to organise a briefing for your executive management team.
2. **Book** an In-House Course or arrange a Private Briefing with your Legal Counsel and R2A.
3. Buy a copy of the 9th edition of the R2A text, Risk & Reliability: Engineering Due Diligence. **Order online here.**
4. **Receive** R2A's email newsletter
5. Attend the two day Engineering Due Diligence workshop presented by Richard Robinson. **Book online.**
6. **Attend** the one day Defensible Risk Management Techniques course presented by Richard Robinson on behalf of Engineering Education Australia.
7. **Enrol** in the Introduction to Risk and Due Diligence Postgraduate Unit at Swinburne.

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