Advisian's "Vulnerability Study"

How we assist Clients to quickly understand, mitigate and prioritise plant improvements

NEPIC Asset Management Conference 2018

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Today's Agenda

Understanding People

Understanding Functions

How Functions become failed

How this is used to explore unreliability

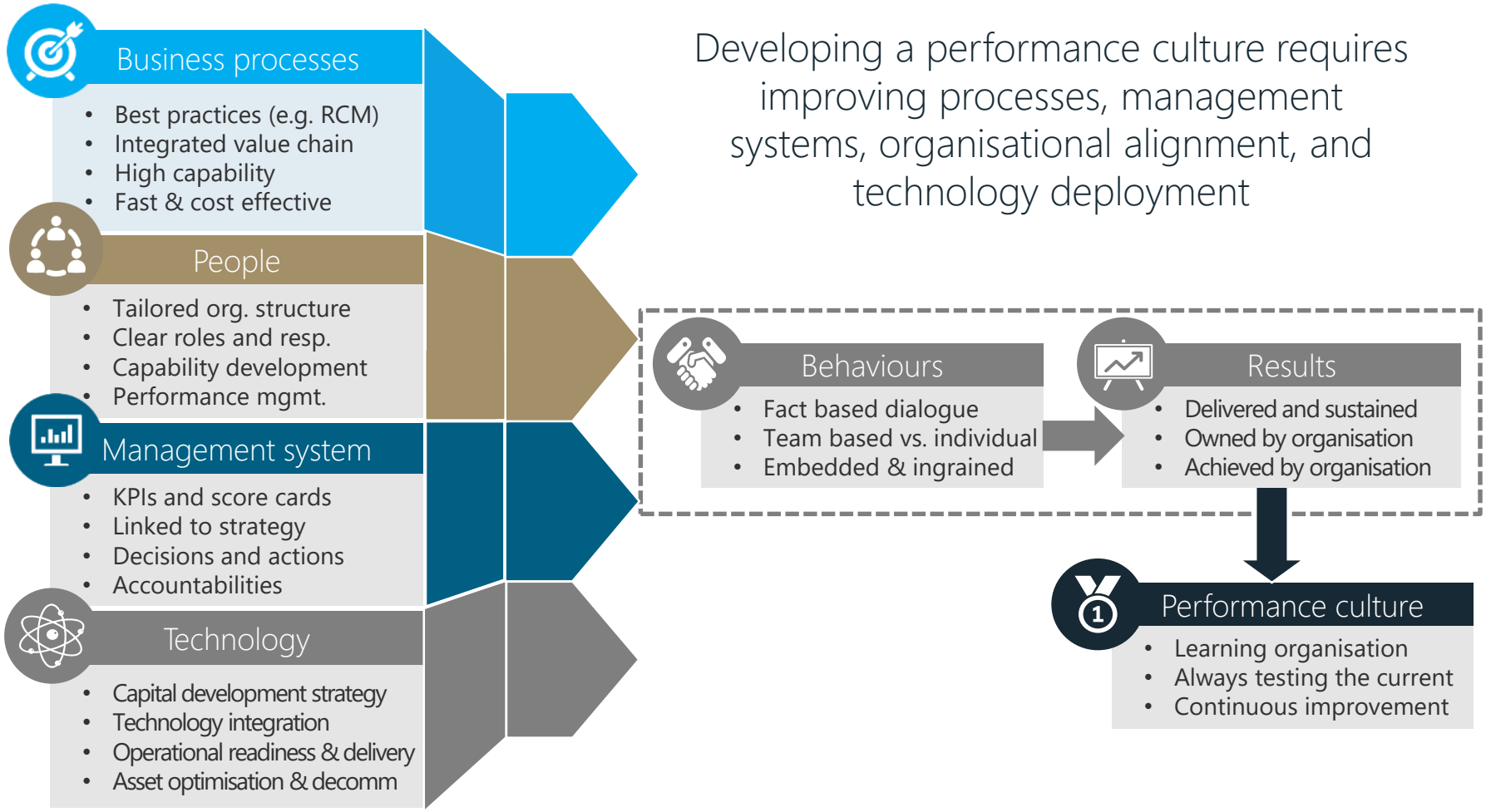
Typical findings

A recent study

How it was conducted

Selected outputs

We must always remember that what your people do (particularly the front line) determines your success……



Why do people behave the way that they do?

The primary reason…..

Because they think they are doing what the Boss (you) wants….

A secondary reason…….

Because there's some sort of measurement system in place that is rewarding or facilitating their actions…….

A third reason……..

Because they asked a question before yet nothing changed……..

A fourth reason…….

Because despite knowing the solution, they have no power to enact it……

Understanding how to approach the topic of “Human Factors”

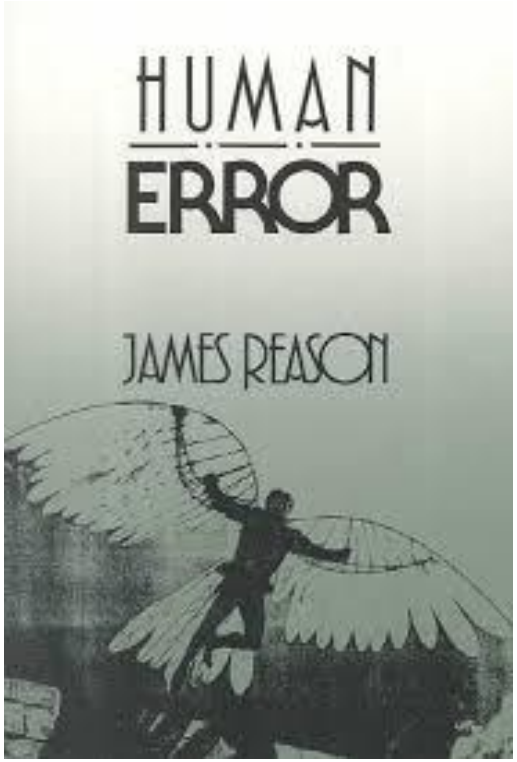
We have found the approach to Human Factors devised by Reason to be invaluable

Prof James T Reason PhD

Emeritus Professor at Manchester University Dept of Psychology

Wrote the book shown in 1990 which includes an excellent methodological process for understanding why mistakes happen and what can be done to prevent them

Probably most widely known for the “Swiss Cheese” description concerning the design of Accident Barriers



Reason breaks Human Error down into 4 broad classifications of type

Anthropometric factors: Errors that occur because a person (or part of a person, such as a hand or arm):

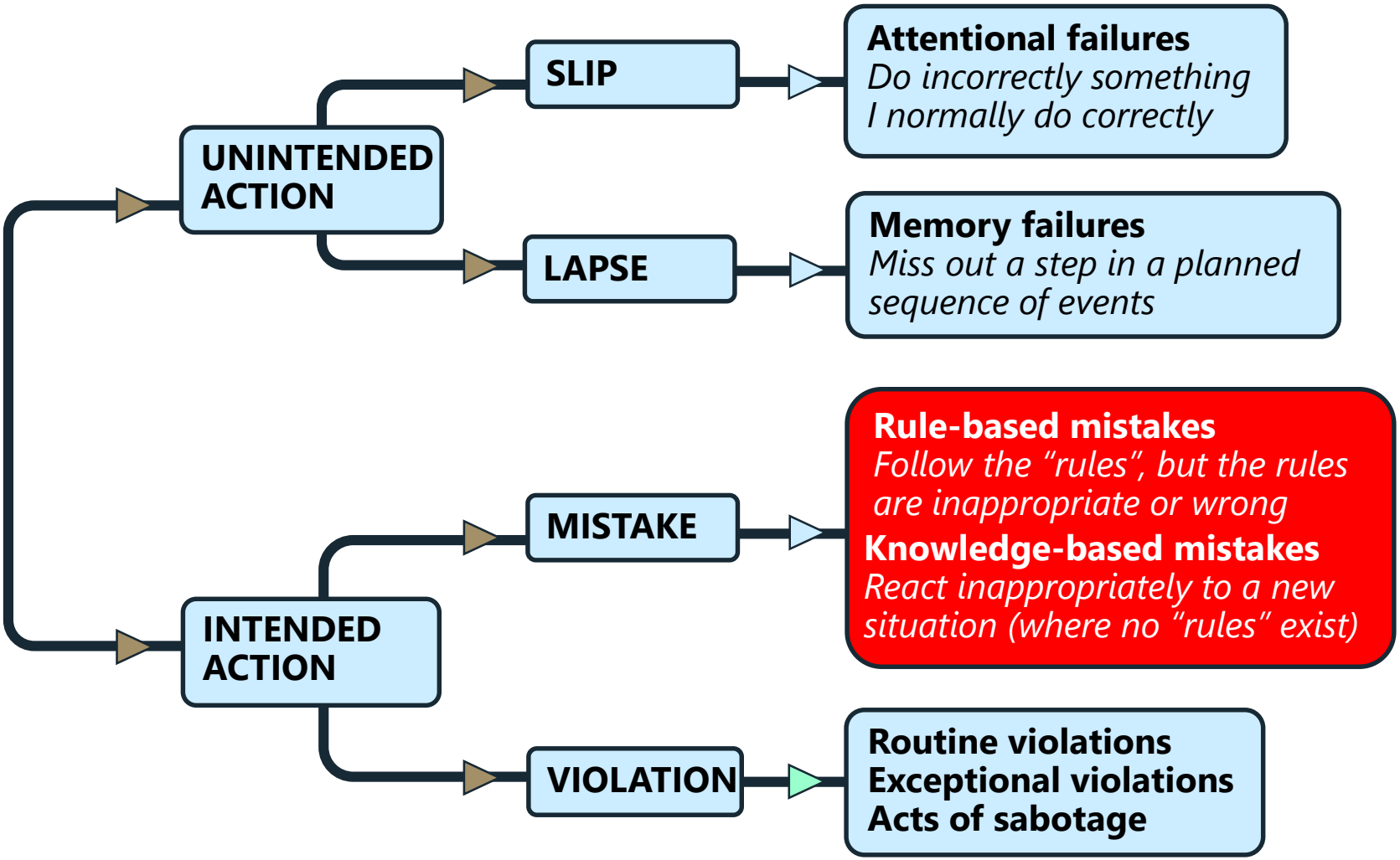
- simply cannot fit into the space available to do something
- cannot reach something
- is not strong enough to lift or move something

Human sensory factors: Errors that occur because a person cannot see (field of view, colour schemes), or cannot hear (background noise levels)

Physiological factors: Errors that occur because of environmental stresses which reduce human performance (temperature, vibration, tiredness, humidity)

Psychological factors: this is our interest today……

Reason calls these Psychological Errors "Unsafe Acts" and differentiates between them



How to test whether your front-line staff have the “right rules” in place

The Reliability Centred Maintenance (RCM) Process is the "Gold Standard" for developing reliability actions

1. What do we want the asset to do?
2. How can it fail?
3. What causes the functional failures?
4. What happens when a failure occurs?
5. How much does each failure matter?
6. Can we predict or prevent failure and should we be doing so?
7. How should we manage the failure if prediction or prevention is not an option?

We noticed over the years, having led hundreds of RCM Implementations, that when we asked the question "What was the biggest benefit of the study?" it was almost always a question of Function

Either revealing something unknown…

Or something that had been forgotten…

Or something that was never true….

Or something that had been superceded

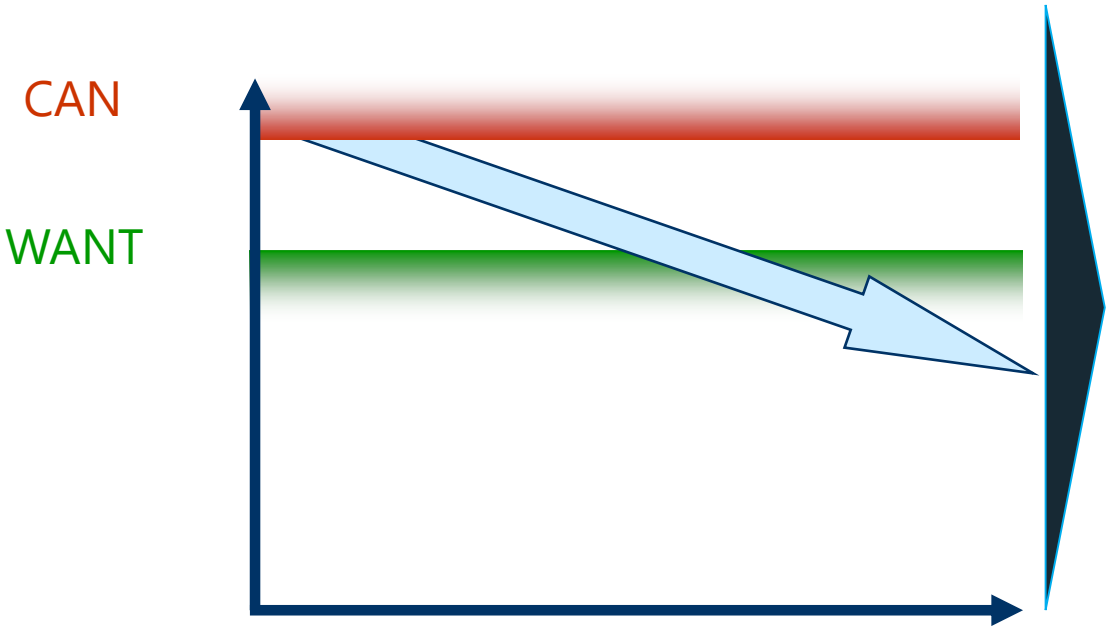
The most important step is the clarification of Function……

This is called the Bauhaus Design Principle (Form follows Function) and is a remarkably useful mental model

Experience has shown that assets become “failed” (no longer able to do what the Users want) – for 4 broad reasons

Why Do Assets Fail? – Part 1, the 2nd law of Thermodynamics….

What the asset is capable of doing deteriorates as time goes by

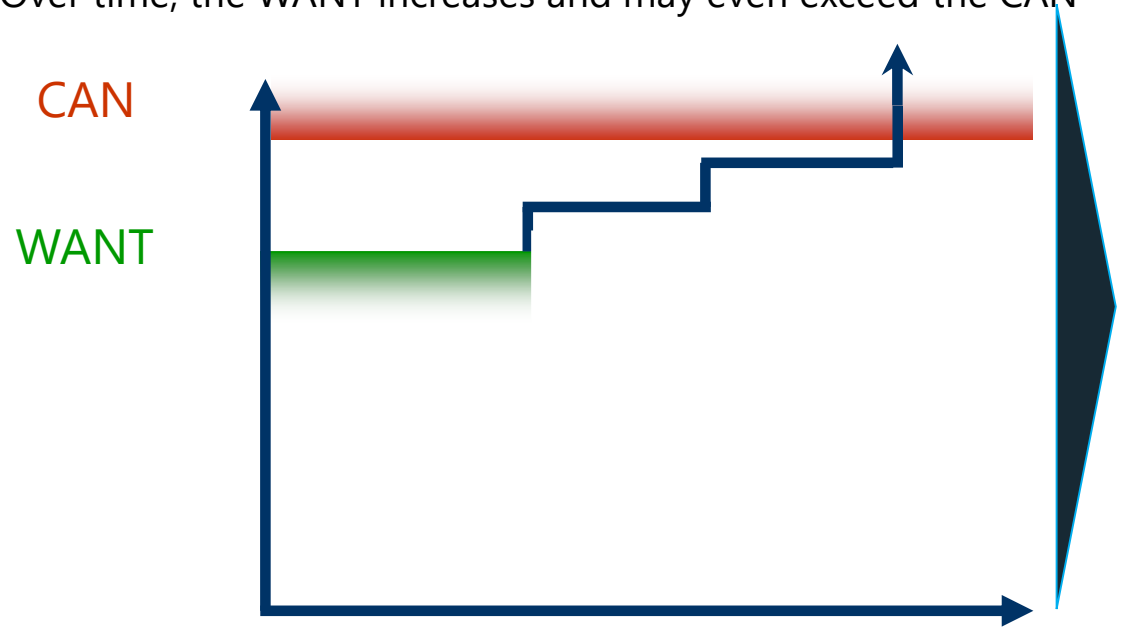


"ROGUES GALLERY"
- Erosion
- Fatigue
- Oxidation
- Corrosion
- Lack of lubrication
- Dirt Ingress
- "Wear & Tear"
- Build up of dirt or debris
- Equipment disassembly

For example – consider a pump's impeller wearing. We can tolerate a certain amount (from Can down to Want) but we must restore performance before it falls further – in other words, we need a maintenance task

Why Do Assets Fail? – Part 2, the desire to make (or save) money

Over time, the WANT increases and may even exceed the CAN



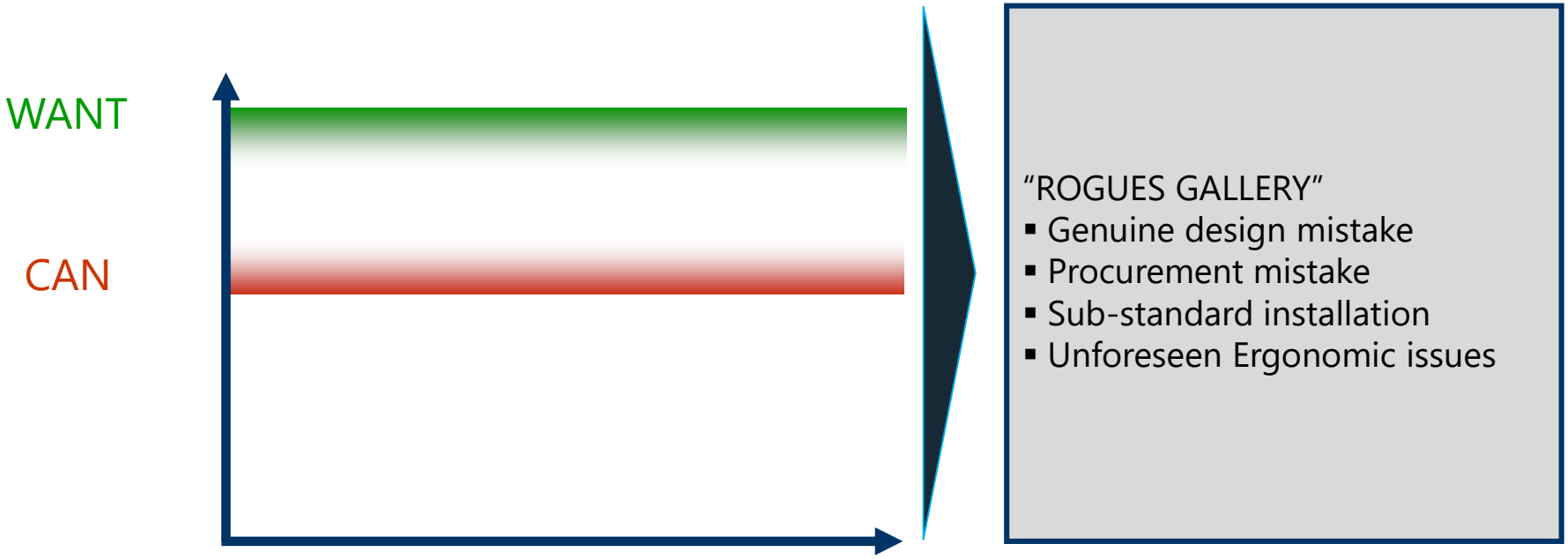
"ROGUES GALLERY"

- Pushing for extra performance
- Ignorance of original basis of design
- Problems and changes further up the supply chain

Back to our pump, in this case, the Operations team have repeatedly increased water flow to boost production – now they feel that the pump is unreliable "and maintenance should do something"….

Why Do Assets Fail? – Part 3, 'Wrong from the start'

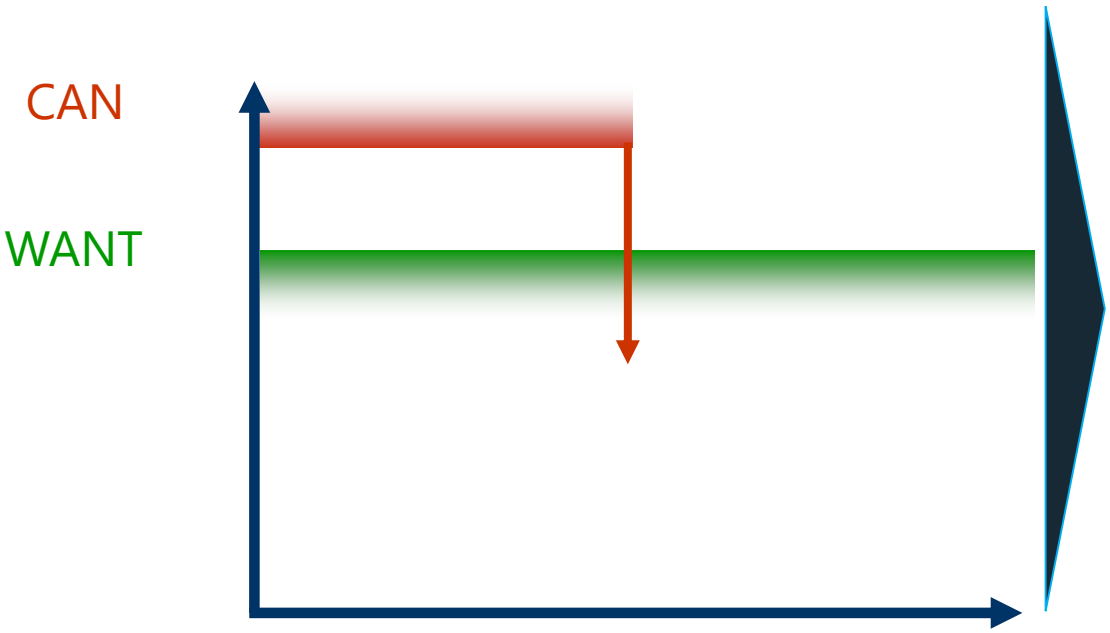
From DAY ONE the equipment is incapable of doing what we want it to do



In this case we have a situation where the function wasn't clearly communicated to the designer and he bought a pump which was attractively priced……

Why Do Assets Fail? – Part 4, the man/machine interface (and everyone can have a "bad day", it's what makes us Human!)

Some form of Human Involvement causes the Asset to be incapable of doing what we want it to do



"ROGUES GALLERY"

- Insufficient training
- Operating Procedure deficiencies
- Good Intentions
- Mistakes
- Deliberate Violations

Finally, during a cleaning of the tank, the low level switch transmitter was accidentally damaged, but, fearing the consequences, the damage went unreported…..

If you do this functional analysis with your front-line staff, you will be amazed at what emerges

Facilitator

Operations Supervisor

Maintenance Supervisor

Operators

Technicians

Specialists

Two quick examples from an extensive library of experience

England Chemical Works
Ice Plant Failures
The “rules” were wrong
Avoided £1.5m capex
Boosted output by £1m/yr

England Chemical Works
Drum Shaker design
Function found to be superfluous
Removed a 6 monthly outage
Avoided potential exposure to Class A Carcinogen

How our implementation of RCM changed into a “Vulnerability Study”

Examples like these prompted us to reshape a classic RCM into a "Vulnerability Study"

A Classic RCM begins by the Users selecting an asset to analyse and then proceeding sequentially through the 7 Questions

This can take a long time and be resource intensive

There's always the danger that the "wrong" asset may be chosen for review – leading to wasted time and expense

A much better solution is to analyse the whole plant (or production line, or process) from the top level and only asking Question 1 about all of the assets

The writing of the operating context and the use of that to determine an agreed list of functions is where you will capture most of the value and where you will discover most of the places where Reason's "Rule Based" and "Knowledge Based" mistakes could occur

Performing a Vulnerability Study on a large Chemical Plant

For the Vulnerability Study we broke the Plant into 4 systems and added a 5th (at Site Director request!)

A group of people who knew the asset best sat down to review the Operating Context; develop the Functions and then discuss the reasons which cause those Functions to fail.

They discussed the cost of those issues and decided what might be done to either remove them completely or at least mitigate their consequences

A rough Business Case was determined for each issue which will allow the Site to prioritise the actions identified

1. Monomer Feed
2. Polymerisation including the Degasser
3. Processing and Packaging following degassing
4. Special Formulation plant
5. Monomer Thermal Converter

Initial results show that the group have performed the most thorough review ever undertaken into plant performance

Number of Issues revealed	Root Causes identified	Actions Planned	Covered by Existing Initiatives?	New discoveries
143	173	214	52	162

The results clearly demonstrate how deeply the team evaluated the Plant over the 10 days of workshops

The next step will prioritise the 214 actions. These will be grouped into projects and then launched

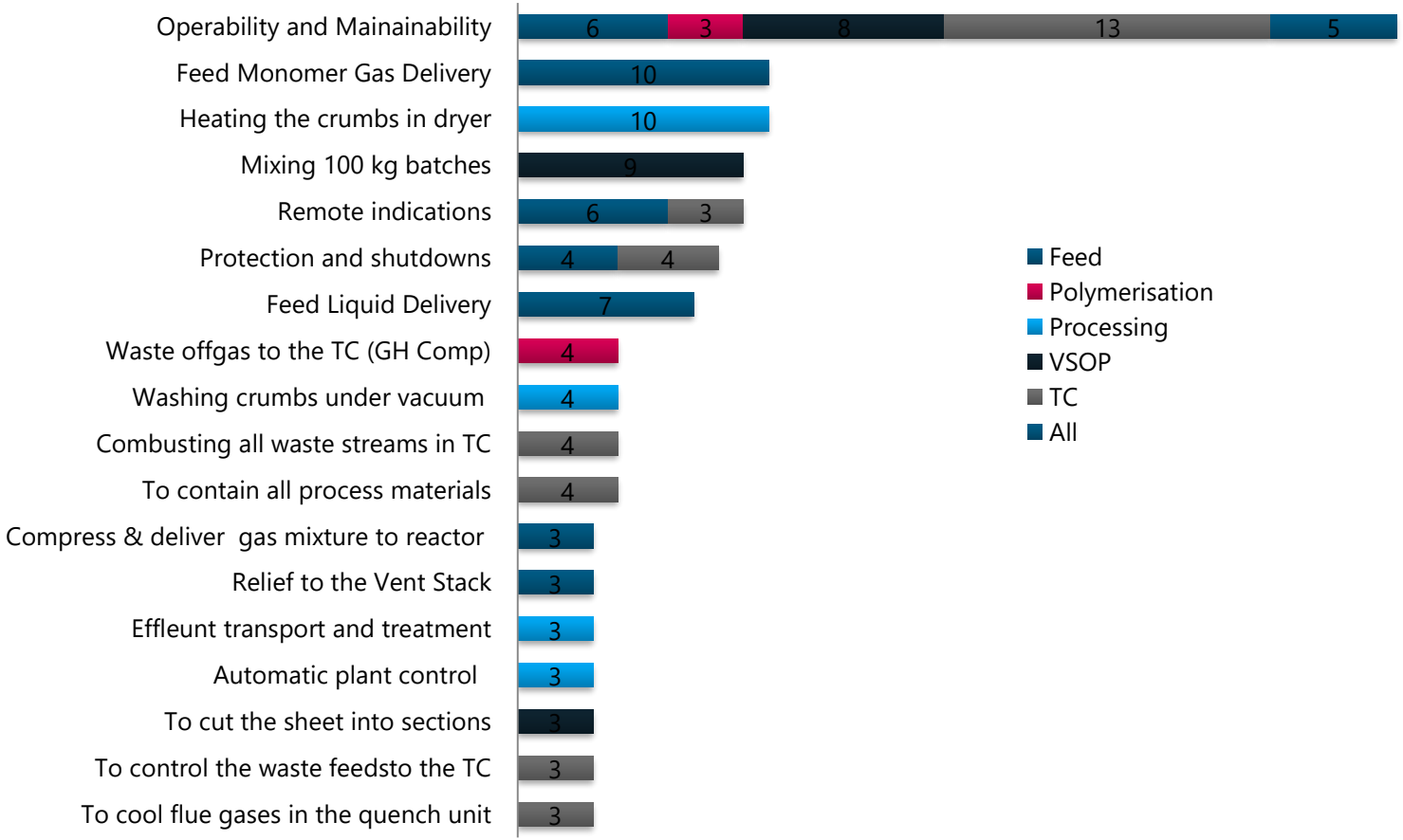
The projects will integrate into the standard “rituals” within the Reliability Stream of IPMS (the Plant’s Management System)

Only 25% of the reliability issues raised are currently addressed

What has emerged from the Study and how does it impact Plant Expansion?

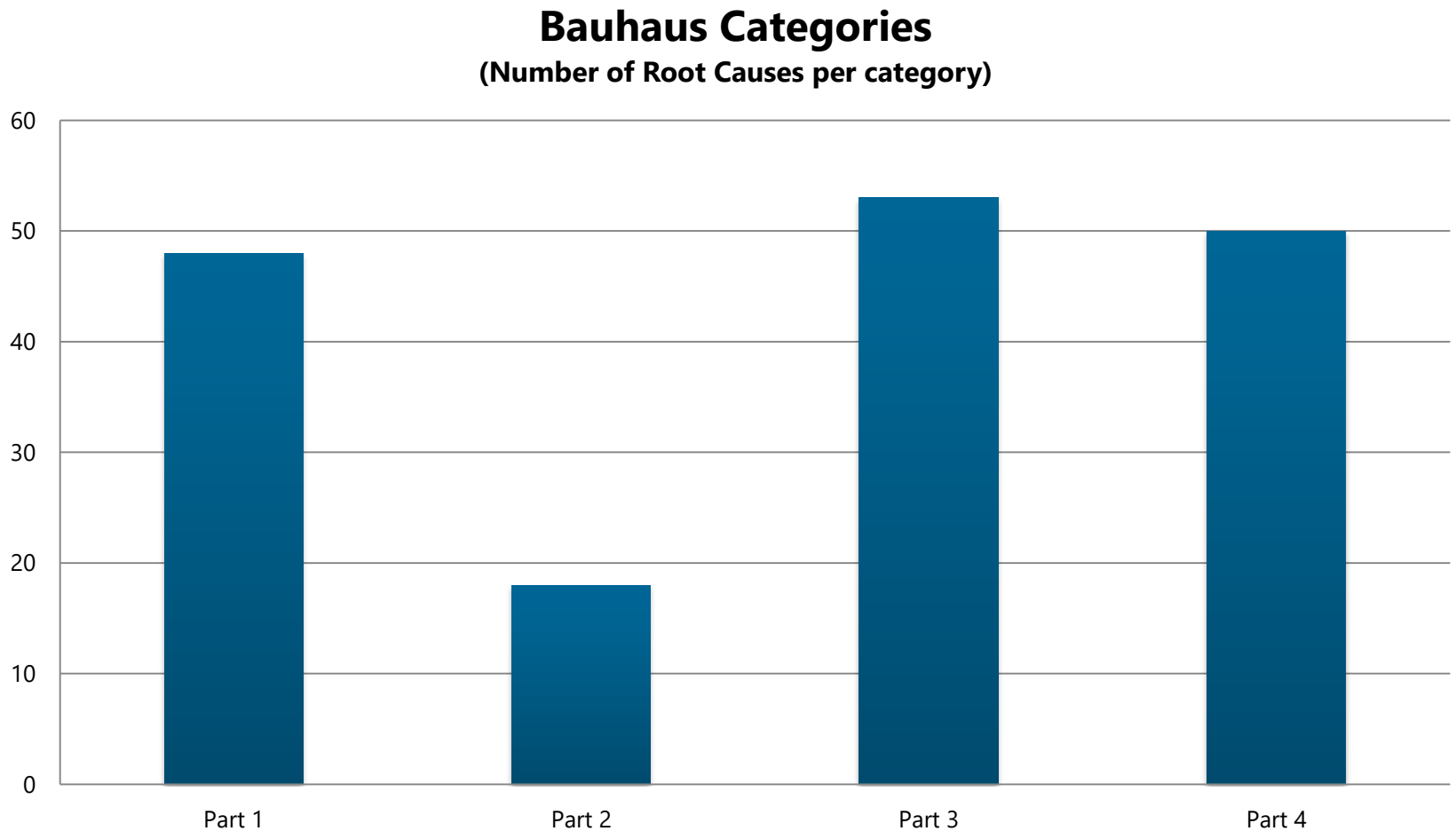
The outputs of the study have been shared with the expansion team and give clear guidance

Number of Issues per Function, showing functions with more than 2 issues



Source: Advisian analysis of Vulnerability Study

Decomposing the issues into the Bauhaus categories reveals how improvement has to be collaborative



We believe that this process has enabled us to create an improvement programme that will deliver breakthrough performance*

* Site Director promise to Global EVP Ops

Contact details

If you would like to find out more about this approach, or discuss issues raised in this short paper, please get in touch. I would love to hear from you.

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