



Spectrum

Summer 2023 | Issue 106

The Chaos Theory of Maintenance Management



Balanced by the
components method

and more inside >

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Conference '23

Tauranga | May 9th–11th

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Spectrum

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*QR code reading app need on your device first.



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Issue 106

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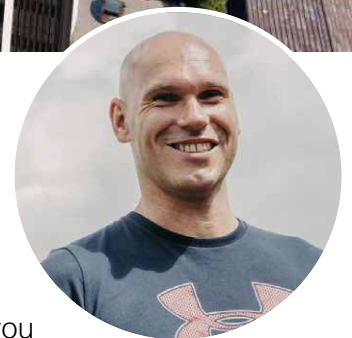
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PRESIDENTS' REPORT

By Tim Murdoch, VANZ President



Conference 2023 has been confirmed for May 9-11 at Trinity Wharf Tauranga. This looks to be an amazing venue with a great view of the harbour, great layout and central to Tauranga township, Mount Maunganui and the Tauranga airport.

The conference committee have been hard at work organising all the details that go in to creating a successful conference and we are looking forward to bringing it all together for you.

Make sure you book in early to ensure you get a room at the hotel and take advantage of the promotional code **VANZ** when booking, this code will give you a discounted rate.

If you've had an interesting find related to condition monitoring or a problem that is proving difficult to

solve, I'd like to challenge you to write a presentation about it and present it at the conference this year. It doesn't have to be long, 15 min would work in well. Email papers@vanz.org.nz with your interest in presenting a paper.

Conference 2023 has been confirmed for May 9–11 at Trinity Wharf Tauranga. This looks to be an amazing venue.

If you or your company would like to exhibit with us this year we have a few options available, please email secretary@vanz.org.nz we would love to have you there.

I hope you have all been able to take some time off to relax and unwind, I'd like to say the sun will be shining but you never know at summer time in New Zealand.

Happy New Year from myself and the VANZ committee. ■



VANZ
PRESENTS

Conference '23

'PEOPLE AND THEIR SKILLS DRIVING INDUSTRY'

Trinity Wharf Hotel Tauranga

MAY 9TH, 10TH, and 11TH 2023

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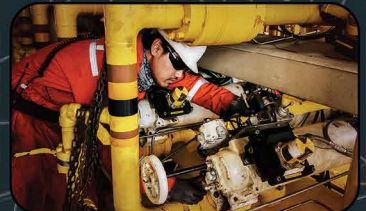


Knowledge is power.
Knowledge shared is power multiplied!

VANZ is looking for papers for the 34th annual conference in Tauranga,

Are you able to assist? If you think you can own your craft.

We want to hear from you. It might simply be 15 minutes of discussion (or longer if you like). It's up to you. Contact us today... papers@vanz.org.nz



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Conference '23

'PEOPLE AND THEIR SKILLS DRIVING INDUSTRY'

Trinity Wharf Hotel Tauranga

MAY 9TH, 10TH, and 11TH 2023

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TUE, MAY 9TH

All conference pricing excludes GST.

| Package | PRICE PER PERSON |
|---|-------------------|
| Condition Monitoring Hands On | \$200 |
| Condition Monitoring Hands On – Attendance to verified apprentices / trades trainees / university | FREE! FREE |
| Asset Management | \$350 |

2-Day Registration

WED, MAY 10TH - THU, MAY 11TH

| Package | PRICE PER PERSON |
|--|-----------------------|
| 2-Day Conference | \$900 |
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TUE, MAY 9TH - THU, MAY 11TH

| Package | PRICE PER PERSON |
|------------------|------------------|
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Note. Day 2 and 3 registrations includes the annual dinner for the delegate.

There will be provision for extra annual dinner attendee purchases at \$125 per person.

Complimentary parking at available at the venue. All conference papers will be available to download from www.vanz.org.nz.
One year membership with VANZ is included with Main Conference attendee pass.



For further info or to secure your position please contact our conference team: email us at conference@vanz.org.nz

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| Official role at the opening of the conference and five minute speaking opportunity | | | |
| Trade stand that offers sponsors the opportunity to showcase products, services and ideas | Premium | Standard | Table |
| Signage opportunities at conference & dinner | | | |
| Pre conference Spectrum advertising opportunities (early registrations only) | ✓ | | |
| Acknowledgement as sponsor & vendor | ✓ | ✓ | |
| Company literature in delegates goodie bags | ✓ | ✓ | |
| Brand on conference programme (early registrations 1 month before event) | ✓ | ✓ | ✓ |
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| Logo on VANZ conference publications & website*** | ✓ | ✓ | ✓ |
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| Conference entry for staff | x2 | x1 | x1 |

| | |
|--------------------------------|------------------|
| Booth size (Platinum and Gold) | 1.8 x 3.0 metres |
| Booth size (Silver) | 1.2 x 2.4 metres |
| Table top size (Bronze) | 1.8 x 0.6 metres |

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 Example: Gold 2 delegates, Silver 1 delegate, Bronze 1 delegate. There will be provision for extra annual dinner attendee purchases at \$125 per person.

ACCOMMODATION

For the conference, we've secured rooms at Trinity Wharf Tauranga for a great rate if you need to book accommodation separately, but it's only for a limited time and availability will reduce closer to the conference date.

Phone Trinity Wharf on **07 577 8700**, visit www.trinitywharf.co.nz or scan the QR code to link directly to their booking site.

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MEMBERSHIP

Full year membership for 2023/24 is still only \$100/pp

It's easy to renew! Visit www.vanz.org.nz

If you purchase a Main Conference attendee pass, your membership for the next 12 months is automatically included and updated in that price.



For further info or to secure your position please contact our conference team: email us at conference@vanz.org.nz

BlueScope Steel lubrication codes

BlueScope Steel has a Standard for describing the lubricants that we use. A key reason for having this Standard is that the names of the lubricants do not change, even if the supplier does.

For example we used to get an oil called Mobilgear 630 from Mobil. In its place we now use a product from BP called Energear GR-XP 220. Instead of having to relearn the product names each time we change supplier, we must use our own Standard. Under the BlueScope system, these products are both known as L12.

The codes start with either a **G** for greases, an **L** for lubricating oils, or an **A** for aerosols.

The numbers that come after this letter define which oil, grease or aerosol it is. Our BP lubricants come from the store with these codes on them, so start learning and using the codes rather than the product names. It will be so much easier for you in the future. Lube codes will soon appear on all lubricants on site

To assist, there is a conversion table on page 10. Any schedules, standard jobs or job packages that use product names should be updated to use the lube codes instead. The BSL Lube Standard and lubricant details are available on the intranet at: <http://stlwtp.bsl.net/User%20Pages/FPOWER/lubepage2.htm> ■

A full table of codes is shown on page 10. >



Above: G for greases.



Above: L for lubricants.



Above: A for aerosols.

■ Article prepared by Bluescope Steel.

EDITORS' CORNER

A very Happy New Year to all our readers/VANZ members/advertisers! Here's hoping the festive season was a chance for a good break with fun, sun and family. We are now gearing up for this year's conference with committee members buzzing around like busy bees trying to organise venues, accommodation, presenters and everything else that goes into putting together a conference!

In this issue you can read up about The Chaos Theory of Maintenance Management by Craig Carlyle, also an article from Ray Beebe on

Balancing by the Components Method and check out the President's Report for some pearls of wisdom.

Puzzle your post-holiday brain with the first quiz of the year from Carl and many thanks go to our advertisers who continue to support us, it's very much appreciated as we head into 2023 and gear up for another conference.

Best wishes for a prosperous new year and happy reading! ■



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BlueScope Steel Lubrication Codes

| BSL Code | BP Product Name | Previous Product | BSL Description |
|-----------|---------------------------------|---------------------------|---|
| AP3 | | MX CP 40 Aerosol | Dewatering & Protective Coating Fluid |
| AP4 | | MX MAXSOLVE 200 Aerosol | Penetrating Dewatering Lubricating & Rust Preventative |
| AP5 | | MX SS 113A Aerosol | Contact Cleaner |
| G 7/0 | Energrease LS EP 0 | M/lux EP 0 | Lithium Base EP Grease |
| G 7/00 | SEMI-FLUID GREASE | | Lithium Base EP Grease |
| G 7/000 | Use G7/000 | M/lux EP 023 | Lithium Base EP Grease |
| G 7/1 | Energrease LS EP 1 | M/lux EP 1 | Lithium Base EP Grease |
| G 7/2 | Energrease LS EP 2 | M/lux EP 2 | Lithium Base EP Grease |
| G7B/2 | Optimol PD2 | | Lithium Base EP Grease |
| G 7M/1 | BP Mine Grease LM EP 680 | | Lithium Complex Grease |
| G 8AM/1 | Use G7M/1 | Mine Grease 681 | Lithium Complex Grease |
| G 8CT/2 | Energrease LC2-T | | Lithium Complex Grease |
| G 8C/2 | Use G8CT/2 | M/grease HP | Lithium Complex Grease |
| G 8CM/2 | Energrease LC2-M | Mobilgrease Special | special purpose lithium moly grease sliding oscillation |
| G11B | | M/Lith SHC 460 | Lithium Complex Grease |
| G11C | | Mobilith SHC 220 | general purpose lithium grease & medium speed brgs |
| G11D | | Mobilith SHC 100 | spec purpose synth oil for high speed bearings |
| G12/1 | | M/lux EP 111 | Flexible Coupling Grease |
| G22S/L | Molub-alloy MGOA | Gearlube 375 NC spray | Open Gear Lube |
| G33 | | MX Drill Tap Comp | Drilling & Tapping Compound |
| L 5A | Bartran 68 | DTE 26 | Mineral Hydraulic Oil |
| L 5C | Bartran 32 | DTE 24 | Hydraulic mineral oil |
| L 5E | Bartran HV 15 | DTE 11M | Mineral Hydraulic Oil |
| L 5G | Bartran 100 | DTE 27 | Mineral Hydraulic Oil |
| L 5K | Bartran 46 | DTE 25 | Mineral Hydraulic Oil |
| L 6 | Visco3000 | XHP Plus 15W40 | Internal Combustion Engine Oil |
| L 7 | NG440 | Pegasus 705 | Internal Combustion Engine Oil |
| L 8/15W40 | BP Mine Multi 15W-40 | Delvac MX 15W40 | Internal Combustion Engine Oil |
| L 8/30 | Vanellus C3 Mono 30 | Delvac 1330 | Internal Combustion Engine Oil |
| L 9 | ICRK 134 | M/gard 448 | Internal Combustion Engine Oil |
| L10/20W30 | | M/Land Sup Universal | Internal Combustion Engine Oil |
| L10/40 | Vanellus DD40 | Delvac 1240D | Internal Combustion Engine Oil |
| L11 | Energear GR-XP 460 | M/gear 634 | Extreme Pressure Gear Oil |
| L12 | Energear GR-XP 220 | M/gear 630 | Extreme Pressure Gear Oil |
| L13 | Energear GR-XP 150 | M/gear 629 | Extreme Pressure Gear Oil |
| L14 | | Visrex 69 | Extreme Pressure Gear Oil |
| L16 | Energear GR-XP 680 | M/gear 636 | Extreme Pressure Gear Oil |
| L17 | Energear GR-XP 320 | M/gear 632 | Extreme Pressure Gear Oil |
| L22 | THB 32 | DTE Oil Light | Turbine Oil |
| L22A | THB 46 | DTE Oil Medium | Turbine Oil |
| L23 | THB 68 | DTE Oil Heavy Medium | Turbine Oil |
| L24 | THB 100 | DTE Oil Heavy | Turbine Oil |
| L25 | THB 150 | DTE Oil Extra Heavy | Turbine Oil |
| L26 | Spemo HB 460 | Mill Oil 2150 | Morgoil Bearing Circulating Oil |
| L26A | Spemo HB 370 | Mill Oil 1900 | Morgoil Bearing Circulating Oil |
| L27 | Spemo HB 320 | Mill Oil 1500 | Morgoil Bearing Circulating Oil |
| L28 | Spemo HB 220 | Mill Oil 1000 | Morgoil Bearing Circulating Oil |
| L31A | JS-HA | M/lect 45 | Transformer Oil |
| L34L | Maccurat 68 | Vactra No.2 | Machine Tool Tableway & Hydraulic Oil |
| L36C | Enersyn RC-S 68 | | spec purpose synth oil |
| L37C | Use L36C | SHC 626 | spec purpose synth oil |
| L39 | Bartran HV 15 | Velocite D | Lubricating oil, special purpose, flushing |
| L44 | Hysol X | | cutting fluid |
| L47B | | Hydrolubric hydraulic oil | Soluble Synthetic hydraulic oil |
| L50 | Rustilo DWX32 | M/arma 245 | Penetrating Oil |
| L55/140 | Hypogear 85W-140 | M/lube HD 85W-140 | Hypoid Gear Oil |
| L56/30 | Autran TO 430 | M/Trans HD 30 | Autrans Transmission Oil |
| L62 | | Mist Lube 34 | Mist Oil |
| L63E | | QK Ferrocode 366 K2-50 | Anti-Corrosion Oil |
| L63L | | M/arma 633 | Anti-Corrosion Oil |
| L63W | Rustilo 150 | | Anti-Corrosion Oil |
| L65A | Autran DX II | ATF 220 | Auto Transmission Oil |
| L65B | Tractran TF10 | Mobilfluid 424 | Transmission / Hydraulic fluid |
| L65D | Autran DX III | ATF | Auto Transmission Oil Holden |
| L68/A | BP Industrial Blue QB Degreaser | Degreaser Blue | Degreaser |
| L70 | Universal Brake Fluid | Brake Fluid | Heavy Duty Brake Fluid |
| L79 | | Lubricating fluid | Lubricating fluid water glycol |
| L82 | Hyspin SN | Qk Quinto 822-300 | Synthetic Ester Fluid |

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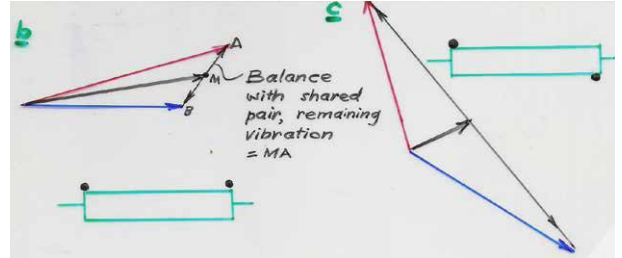
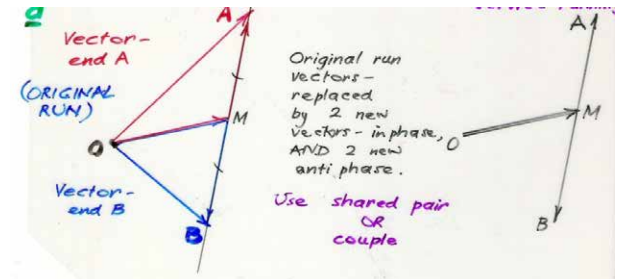
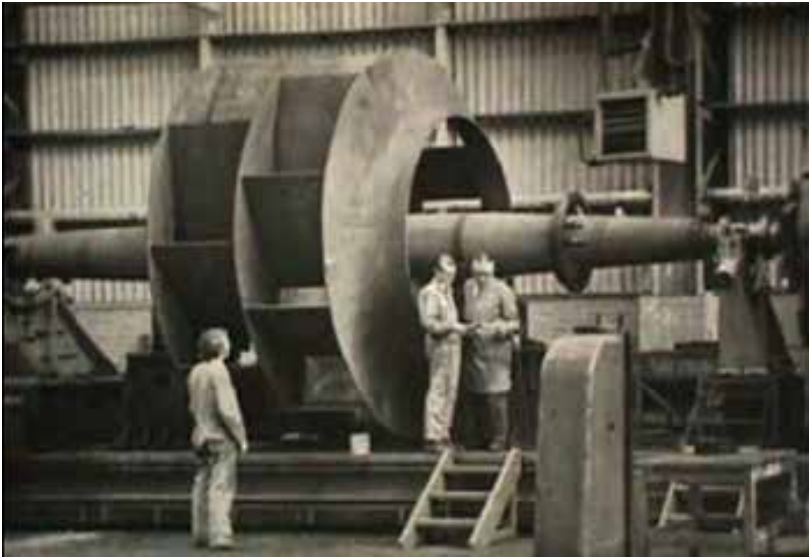
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Top above: Fig.1, Above: Fig.2.

Balancing by the components method

My biggest success in balancing a large fan was a few years ago, but what I learnt may be of interest to people doing balancing today.

It was a constant speed 590 r/min boiler ID fan, double entry impeller, 11 ft diameter, 21.5 tons mass, 2370 h.p. (Love those old units - but it was in the pre-SI days here in Australia).

The impeller was too long to be treated as a single plane, but too short for two-plane treatment. There are 16 of these fans, and a rotor and impeller are shown in a lathe. U-bolt clamps mounted on the inlet flaring were used as trial masses. These were placed in the same angular position on each end.

We used a velocity transducer to measure the vibration amplitude at each bearing. The instrumentation read in displacement. Phase was measured with a stroboscope, tuned to the value of maximum vibration. As described in my first book, the original vectors at ends A and B were as shown in the sketch. (Fig.1)

These can be resolved into in-phase components and anti-phase components. Here the two in-phase components were a little greater than the anti-phase, so balancing proceeded using a shared pair of masses, with the usual vector plotting. After fixing of the calculated masses, the vibration would be expected to be anti-phase, with the corresponding

residual vibration to scale of components MA, MB. If this level was not acceptable, the process could be repeated, but with masses in anti-phase configuration.

If the original vectors were much larger in anti-phase than in-phase, then the pair of masses would be placed on the impeller, one on each end as before, but 180degrees apart in phase to give a couple effect: the right hand situation in this sketch (Fig.2). This method is essentially the same as balancing a flexible rotor with a limited choice of balancing planes. The vibration at around the first critical speed would be mostly in-phase, and near the second critical speed, mostly anti-phase.

The end result for a rigid rotor could be achieved also by a two-plane balance, the "Thearle" method, as used in today's portable equipments. However, this needs an extra run to speed, and it may be more economic to use the components method, and return for the second stage if necessary.

Welding was not allowed on this alloy steel impeller, so holes had to be drilled to bolt on the balance masses. The first hole took over an hour – what a hard steel we thought. The fitter got a new drill – and it took only 5 minutes for the second hole! ■

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Lubricant Bar Application

Safe, Efficient Bar Insertion

While the kiln rotates, the operator simply inserts the recommended number of lube bars in the filler bar gaps between the tire and the shell. Insertion involves placing a whole bar between the filler bars or pads at the 5 or 7 o'clock positions. This should be done every quarter turn of the kiln as it travels through one full revolution.



For further information go to www.lubricationengineers.co.nz or Call Chris 021 385 487



The Chaos Theory of

Maintenance Management

The fact that you have read past the title suggests that a nerve is already twitching when maintenance and chaos is used in the same sentence. Let's just leave it out there that perhaps the non-performance (in actual, management or political terms) of your maintenance department has irked you at some time.

So why is it that so many maintenance departments in industry become embroiled in stress, finger pointing and sweaty KPI's? What makes plant reliability so difficult to manage?

Simple. Humans.

Even more than that, maintenance engineering humans. We will come back to that thought later.

I have spent many years guiding sites and companies towards maintenance excellence and have been fortunate to be involved in success stories

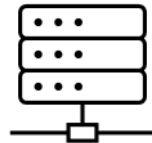
measured in reliability, profits and satisfaction. But I have also seen efforts doomed to failure from the outset or railroaded by changes in management. So what makes the difference?

Systems and processes

I have seen attempts, (some of them lauded internationally) that start out with the highest academic processes and the sexiest 3 letter acronyms. High Priests and converts spout dramatic factors from on high whilst gathering their medals.

Continued on page 16 >

NZ Made Battery Powered Wireless Machine Condition Monitoring System



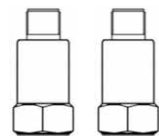
Your data hub

System integration via
OPC-UA or MODBUS

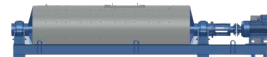
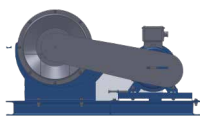


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The acid test is when you scratch the surface of the site 1-2 years later; are the maintenance plans really being actioned? Is life continuously learning and improving? Far too often the answer is a resounding NO.

It is one thing to create fabulous maintenance plans and even better if you install a flash computerised maintenance management system to run them, but it is the systems and processes of running your maintenance management that true success will live and die by.

Back to the humans. After meticulous study of mislaid perfect plans, I have made an earth shattering psychological discovery. I will call it "The Carlyle Effect" (all modesty intended). Here it is:

Maintenance Engineers do not like being systemised.

It's true. If you work in a manufacturing process you get it; the need to have systems and processes to prevent chaos.

Continued on page 18 >

Interested in joining **VANZ**

Anyone with an interest in the area of mechanical and electrical machine condition monitoring, to facilitate predictive asset management is eligible to join VANZ.

In-house technicians, consulting engineers, suppliers and distributors of specialised equipment, engineering students can all contribute and gain from membership.

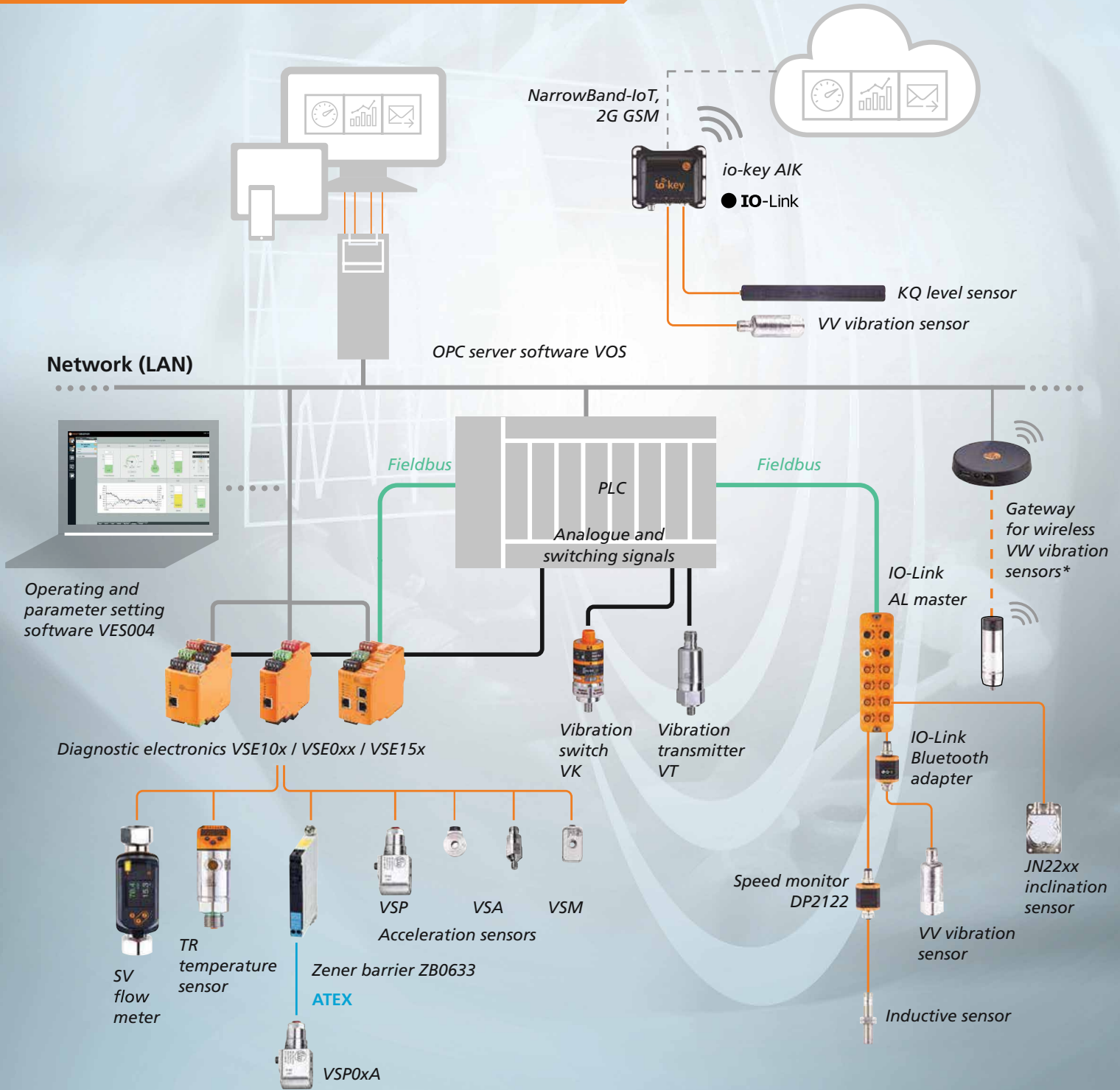
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Even tradesmen working in engineering manufacturing get it; there is a plan – I need to work to it.

But your average run of the mill Maintenance Department tradesman is hard coded to lean towards chaos. Leave him to graze naturally and he will devolve to firefighting and squeaky door priorities as quick as look at you. Give him a maintenance schedule and he will quickly shovel the hard jobs to the backlog and wonder off to do the favoured jobs. And when something does break, watch him squeal onto the job, sirens and lights blazing, to save the day with his mission critical skills.

Smaller sites will display the “irreplaceable engineer” syndrome; Mr. Fixit who may appear to have the site running perfectly, but has all the info locked in his head. What value does he REALLY offer you?

By the same genetic path that drew him to like fixing broken things, he is averse to being told what to do and when to do it. He wants to make his own choices.

Sound familiar?

Let me elucidate further by couching maintenance management in manufacturing (widget) terms: You manage a team of blue (maintenance) widget makers:

- Your customers don't really understand blue widgets but they do like red (non maintenance) so they flood you with red widget orders.
- No one seems to care that you make more red widgets than blue.
- You have a backlog of widgets that you will never achieve.
- Your customers don't have a lot of faith in your widget making ability and would go elsewhere if they could.
- There is no formal widget making schedule. It pretty much works on who's yelling at you the loudest.
- You spend most of your time explaining to customers why the promised widgets were not made or why they broke straight away.
- Your widget makers spend most of their time waiting for widget parts or access to the widget making machines.
- You need a massive store of widget parts because you never know which widget you might need to work on next.
- If you did give your widget makers a list of widgets to make they would pick out the nice-to-do widgets and leave the rest for the “back log”.
- Some widget makers ignore the widget schedule

and just make what they think is best.

- Some widget makers have learnt lots about making widgets over the years but they keep it all in their heads as their own little insurance scheme.
- Your budget is grossly overspent and you are unable to make all the blue widgets you need.
- You seem to be forever repeating the same widget making mistakes.
- The Chief widget maker can never retire as the place won't run without him.

This is the Chaos Theory of Maintenance Management and unfortunately I bet you recognise it. You certainly wouldn't last long in business running processes like this. So why do we accept it in maintenance management? If you are happy with chaos theory in your process, stop reading now, I am happy for you. Maybe not happy for your shareholders, but you go for it! While it lasts. My apologies to our maintenance engineering humans. There is nothing wrong with them, not in the slightest. It's just that the very skill set that makes them good reactive maintenance engineers almost precludes them from accepting proactive systems and processes.

There is however absolutely no reason in the modern environment that the maintenance function cannot be run with the same accuracy, predictability and transparency as a manufacturing process. The good news is that it also does not require expensive resources and is simple to achieve.

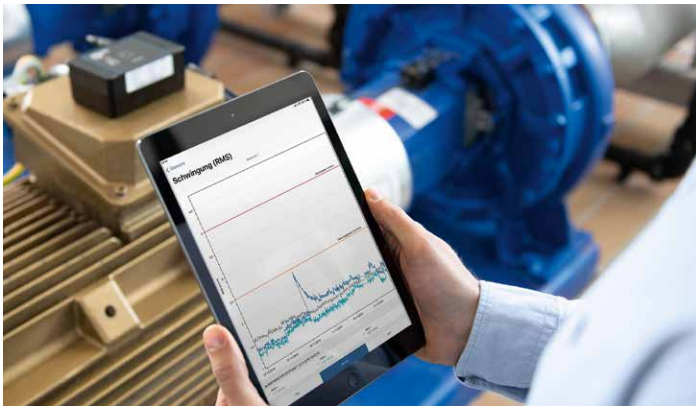
The reason why even the holiest systems will devolve to this level is the lack of formalised systems and processes. All it takes is negative culture and weak management to quickly undo years of positive work.

In order to improve maintenance management performance for the long term, the site must develop the maintenance scheduling systems and processes as a primary step before attempting to introduce maintenance planning disciplines. Put another way, why have a plan if you are not going to action it?

Put in the simplest terms, a truly successful maintenance management system will aim to put the right man on the right job at the right time with the right resources. This is the essential difference between Maintenance Planning and Maintenance Scheduling.

Let me describe a healthy maintenance management system:

- It has well developed maintenance plans utilising just-in-time resourcing instead of high inventory stores.



- Maintenance plans are fully optimised and bankable, based on evolved condition prediction and trades-confirmed resource requirements.
- Maintenance is the priority because our maintenance plans have evolved away from feel good periodic checks to optimised invasion points.
- The maintenance scheduling function adds approved non maintenance and corrective maintenance tasks to the existing planned maintenance schedule.
- The schedule is a reality driven rolling document that reflects the real site capability (Reality Schedule), (normally on a week by week basis). The reality schedule does not have nice-to-do tasks but only tasks expected to be auctioned.
- The tradesmen understand and work to a 100% schedule achievement. Non achievement is the exception, not the rule.
- There is NO backlog. How can you do a job last week? Unachieved tasks are put back into the forward schedule.
- The operation understands the professionalism of the maintenance plans and processes and

considers the schedule as bankable. They strive to make the plant available as the consequences of deferral are understood.

Sound wacky? Think about it in terms of running a manufacturing process. Strangely, the hardest thing to achieve above is the man management, which is where your systems and processes meet culture and management. It looks hard so it must be. Damn right. Moving site cultures away from comfort points is always going to stand on some toes. This may sound like total fantasy on your site but the challenge to you is to stand up and make it happen. If making the journey to maintenance excellence appeals to you, here are my top five foundation steps to success:

“ Give him a maintenance schedule and he will quickly shovel the hard jobs to the backlog and wonder off to do the favoured jobs. ”

1. Publicly state that you are going to create a professional and proactive maintenance function.
2. Define the difference between maintenance and non-maintenance tasks. (What are you here to do?)

Continued on page 21 >

TEST YOUR KNOWLEDGE - PART 70 OF A SERIES

- 1 An overhung fan was field-balanced in a single plane, and the vibration levels were reduced significantly through this process. The phase angles between the two bearings (horizontal plane) were approximately 30 degrees apart at the start of the balancing. There were no machine resonances encountered. How do you think the phase angles might compare at the completion of the balancing?**

 - a The phase angles will most-likely be less than 30 degrees apart
 - b The phase angles will most-likely be about the same (i.e. 30 degrees apart)
 - c The phase angles will most-likely be more than 30 degrees apart
 - d The phase angles will be equal

- 2 Which of the following is true about Acoustic Emission (AE)?**

 - a It can be used to determine the location of a stress event in a material
 - b It can be used for material mechanical performance evaluation
 - c It can be used for structural health monitoring (SHM)
 - d All of the above

- 3 The plummer block bearings of a fan running at 3,500 rpm were not mounted in the same plane; this caused the vibration levels to be elevated. The vibration spectral signatures collected from the housings were quite different to those collected at an earlier time when the fan was unbalanced due to a worn impeller. Which of the following might describe the vibration spectra recorded from the misaligned housings?**

 - a A single peak at running speed (1x)
 - b Vibration peaks at 1x, 2x, 3x, with the biggest peak being at 2 x running speed
 - c High vibration at blade pass (8x)
 - d A and C

- 4 Measurements created with the goal of detecting rolling-element bearing defects will often require the user to select a high-pass filter for the conditioning signals. What considerations might you make when choosing the correct filter?**

 - a The shaft rotational speed
 - b The frequency response of the bearing housing
 - c The bearing type (e.g. taper-roller, deep-groove ball, cylindrical roller etc)
 - d Any or all of the above

- 5 A grease-lubricated rolling element bearing deteriorated due to EDM damage. When the damaged bearing is removed, what colour is the grease most-likely to be?**

 - a black
 - b white
 - c purple
 - d orange

- 6 A structure was found to be resonant, so it was decided to add weight to it to change the natural frequency. If the weight was doubled, what effect is this likely to have on the natural frequency? (Assume that the stiffness remains unchanged).**

 - a The natural frequency will double
 - b The natural frequency will increase by about 30 percent
 - c The natural frequency will halve
 - d The natural frequency will decrease by about 30 percent

- 7 An ICP accelerometer is permanently mounted, with the cabling running back to a bnc fitting inside a junction box. There are some doubts as to whether the cabling or transducer are functioning correctly. Which of the following instruments would you use to test the circuit?**

 - a A megger tester
 - b A volt-meter
 - c An earth-leakage meter
 - d A bias voltage tester

- 8 Which of the following machines would you be most-likely to encounter a condition known as rotating stall?**

 - a Centrifugal fan
 - b Roots blower
 - c Vane compressor
 - d Ford Falcon

Answers on page 24



9 Which of the following instruments might be deployed in a “sound bath”?

- a Tibetan singing bowl
- b Gong
- c Bell
- d All of the above

10 You notice that the circular exhaust stacks atop the buildings on a manufacturing facility have spiral flutes welded to them. What are the purpose of

these flutes?

- a To strengthen and protect the stacks in the event of an earthquake
- b To reduce the visual impact of the stacks
- c The flutes are there to dissipate heat generated by the process gasses
- d To minimise the likelihood of the development of vortices / vibration / resonant responses that might arise due to wind effects on the stack

The Chaos Theory of

Maintenance Management

Continued from page 19 >

- 3. Engage support for your processes from the highest level of your operation.
- 4. Make sure you are rewarding your staff for success, not failure.
- 5. Engage the entire operation in your systems and processes. Formalise it, Live it, breathe it, back it.

The journey from “ok” to “excellence” is not that difficult and does not take a lot of expense, training, resources or tools. It takes the cheapest, most effective resource out there, ATTITUDE.

There are some distinct steps along the way and embedded cultures that you might have to stomp on, but the rewards are enormous, in dollar and self esteem terms. If I haven't touched a nerve, then good

on you. You either have your act together and are already a white knight of engineering, or are blissfully unaware of a world outside of the trench.

If you work in isolation, a great starting point is by talking to your peers and mentors at the Maintenance Engineering Society (MESNZ). MESNZ strives to support and lift the game of maintenance engineers in New Zealand.

That is why MESNZ receives my full support. MESNZ seeks to encourage engineers to share their experience and achievements. The society achieves this by recounting its collective experiences and inspirations to maintenance engineers throughout the country, via print, mentoring, the National Maintenance Engineering Conference or connecting companies with practitioners. ■

WORD BUILDER

How many words of three or more letters can you make, using each letter only once? Plurals are allowed, but no foreign words or words beginning with a capital. There is at least one 5 letter word.

16 - Good | 24 - Very Good | 30+ - Excellent

| | | | | |
|---|---|---|---|---|
| C | E | T | A | H |
|---|---|---|---|---|

There is 4 possible 5 letter words above. Can you find them?

WORD MARCH

Draw a path from one square to another to find the secret nine letter word. You may move in any direction. Each square can only be used once.

There are approx. 68 words (four letters or more) that can be made from the combination of letters below. How many can you make?

Solution on page 24.

| | | |
|---|---|---|
| E | U | E |
| Q | T | C |
| I | N | H |

Nine letter word is... _____

SODUKU

To solve, each number from 1 to 9 must appear once in:

- Each of the nine vertical columns
- Each of the nine horizontal rows
- Each of the nine 3 x 3 boxes

No number can be repeated twice in a box, row or column. Why not time yourself? **We've started it off for you...**

| | | | | | | | | |
|---|---|---|---|---|---|---|--|-----|
| 6 | | | | | | | | |
| | | 4 | 1 | 6 | 2 | 9 | | |
| 2 | | | | 3 | | | | 7 |
| | 9 | | | | | | | 6 3 |
| | | | | 1 | 3 | | | 7 |
| | 6 | | | | | | | |
| 9 | | 6 | | | 5 | | | |
| 8 | 5 | | 7 | | 6 | 4 | | |
| | 7 | | | | | | | 2 |

Missed an issue of Spectrum?

No worries. Head on-line to www.vanz.org.nz to find back issues of the magazine to catch up on.

Or, simply scan the QR code here to link your device directly to the VANZ website. There you will find back issues of Spectrum available to view*.

* A QR code reading app will need to be installed on your device first.



Rethinking the House of Reliability...

What are the events in history that have caused us to perform the way we do? Why is it we respond to a specific way to performance needs or machines failure? How have we got to where we are today? How can we use discovered failure patterns to redefine where we need to be? In this special issue, we explore the present changes in technology and machinery how do we begin to identify the right order for all of the required pieces within our maintenance organisations?




The First Century Restart
Over the last three decades the vibration and condition monitoring industry has witnessed many changes. While these changes have been technical in nature, some have required a change in the way we think about reliability. The industry has moved from a focus on reactive maintenance to a more proactive approach. This has led to a focus on predictive maintenance and the use of advanced sensors and data analysis tools. The industry has also seen a shift in the way we think about reliability, with a focus on the overall health of the system rather than just the individual components. This has led to a focus on the overall health of the system rather than just the individual components. This has led to a focus on the overall health of the system rather than just the individual components.

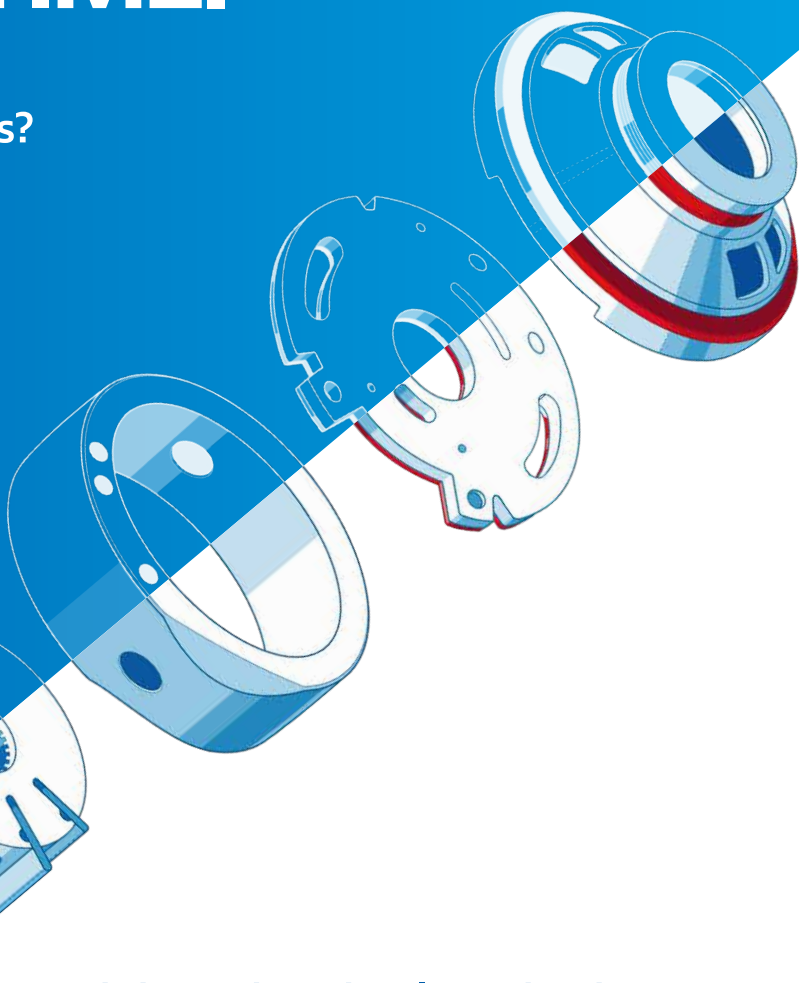
Over the last three decades the vibration and condition monitoring industry has witnessed many changes. Some have resulted in greater analytical performance today than in earlier times.

Clayton's Spanner is a leading provider of vibration and condition monitoring solutions. We have a long history of providing reliable and accurate data to our customers. Our solutions are designed to help you identify and solve problems before they become major issues. We have a proven track record of helping our customers improve their equipment reliability and reduce their downtime. We are proud to be a part of the industry and to continue to provide the best solutions for our customers.




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- Oil drain intervals
- Filter life

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Spectrum



The official journal of the Vibrations Association of New Zealand (VANZ)



Our quarterly magazine includes:

- Papers from conference reprinted
- Conference information
- Articles and reports from industry leaders
- Presidents report
- Notices
- Committee reports
- Interactive activities *and much more...*



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|---|---|---|--|---|
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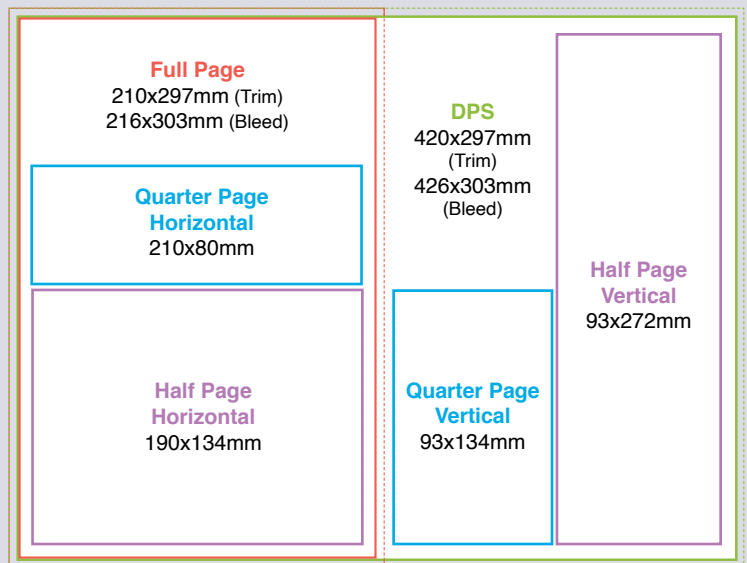
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Articles for upcoming issues of Spectrum are welcomed by the editor. Copy to be supplied preferably in Microsoft Word, but PDF file format is also acceptable. Please email spectrumeditor@vanz.org.nz with your submission or should you require further information.



Word March: technique | Word Builder: teach, cheat, tache, theca
1C, 2D, 3B, 4D, 5A, 6D, 7D, 8A, 9D, 10D
Answers to Carlton Technology Quiz 70:

Knowledge is power. Knowledge shared is power multiplied!

– Robert Boyce

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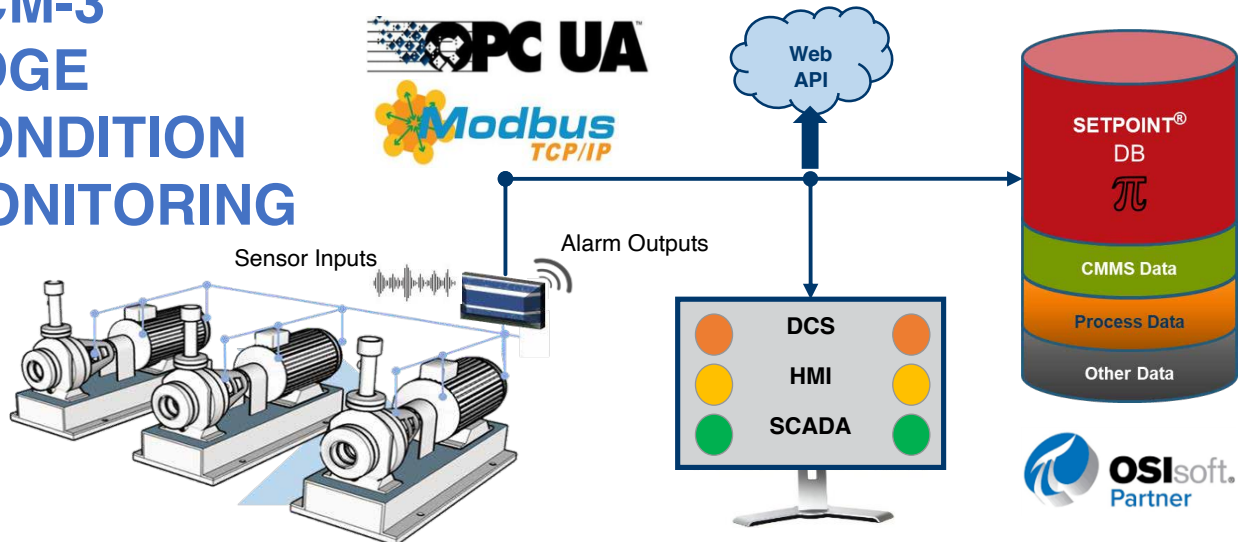
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