THE RAMP INDEX:
NON-DESTRUCTIVE TESTING GOES TO THE NEXT LEVEL

So you want to maximize asset quality and longevity. To progress from confidence, to certainty. With Repeatable, Actionable, Meaningful and Preventative data. Well, join the club. Eddyfi Technologies Datalliance is a holistic, innovative, data-driven lifecycle NDT optimization program that promises to help your business go Beyond Current.
CONTENTS

Foreword .......................................................... 3
Introduction ...................................................... 5
What is the RAMP Index? ................................. 6
What is the Eddyfi Technologies Datalliance? ..... 7
R / Repeatable .................................................. 8
A / Actionable .................................................. 11
M / Meaningful ............................................... 14
P / Preventative ............................................... 17
What’s Next: Datalliance ................................. 20
Lifecycle Optimization ................................. 21
Beyond Current .............................................. 22
The idea for RAMP came from two converging episodes.

First, I received a call from a customer, a high-ranking shipping exec. He wanted to know what the standard was for a specific NDT result in his industry—in essence, the norm organizations like his should use to measure significant deviation.

“You’re asking for the magic number,” I said.

“Exactly.”

“Let me get back to you,” I replied. I had no idea what to tell him.

Then, about a week later, I stopped in at our main manufacturing facility, where a crack team of engineers was documenting the specs for a new Inuktun Versatrax™ crawler system. Something on the monitor screen caught my eye.

“Why is this screw shown as 1.003 inches long?”

“Because that’s its length.”

I stared at them.

Someone chimed in, “We measured it.”

“Guys, this is a bolt in the casing. Why on earth would we need an extra three one-thousandth of an inch of metal?”

But of course, the answer was obvious. They had measured the bolt to three decimal places because they’re engineers, and because they can. Presumably, it was a matter of pride to out-detail the bolt manufacturer’s supplier specs. Never mind that nobody cares. Or that basic business logic tells us this little scientific flourish of theirs would translate into a pointless additional expense, in perpetuity, for the purchaser.
“Think about it,” I said. “Are we seriously going to order one-and-a-quarter-inch screws—screws that are actually somewhere between 1.24991 and 1.25009 inches in length—and cut them down to 1.003 inches, because that’s how long this prototype happens to be?!”

Now it was their turn to stare at me. I left them to discuss the merits of rational procurement processes.

Walking back upstairs, I pondered my own lesson. I could hardly blame them. After all, their job is to do precision machining and assembly using the highest quality components and the maximum rigor. And anyway, it was only a screw.

But there was a principle at work here. Clearly, it’s possible to be too precise.

And if you add scale to the equation, the additional cost in time and effort could be highly significant. With no meaningful upside benefit when it came to controlling future risk...

I thought again about my marine shipping customer.

I still didn’t have a magic number for him.

But there might be a way to get it.

C. Senych

Craig Senych
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As every engineer knows, accuracy and precision define very different concepts. Especially when it comes to reliable measurement and data collection.

Accuracy refers to how close measurements are to a ‘true’ value, while precision refers to how close those measurements are to each other. Those of us in the business of Non-Destructive Testing (NDT) need both, all day long.

If you’re collecting data to regularly assess changes and conditions, or to monitor processes such as the aging of fixed assets, it’s essential that your systems are not only correct (accurate), but also consistent (precise) and comparable over time.

Let’s start with accuracy. No mystery there. Eddyfi Technologies’ unique Nukitun Multi-Mission Modular (IM3™) technology makes it easier to obtain accurate data, even when faced with challenges like confined space entry. IM3™ allows operators to gain access under the harshest conditions to carry out inspections—internal, external, even underwater—that are imperative for the safety and maintenance of infrastructure. Integrating visual analysis, ultrasonic scanning, and/or any of Eddyfi Technologies’ extensive range of industry-leading sensors further enhances and ensures data accuracy.

Precision is a much more challenging question. Knowing how many decimal places to include in a result is business-critical, since making that decision once locks it into the system. Each time the test is reproduced the measurement value must be compatible in order to be comparable. And every digit we include, meaningful or not, comes at a cost.
In theory, it may be necessary to determine the precision of a measurement by reproducing it several times to understand its standard deviation. Using four decimal places to denote results is meaningless if repeated measurements indicate that at most only the first decimal place is valid.

In practice, you don’t need a high definition video capture to see a hole in the top of a corroded vessel; just getting a standard camera-mounted crawler up there will do the trick. On the other hand, detecting defects in a ship’s hull in total darkness and severe weather conditions, through variable layers of marine growth and protective paint, will require ultra high-resolution scans.

So, determining the optimum precision of various real-time measurements will depend on the situation. But where protecting assets or preventing disaster depends on decisions determined by reproducing directly comparable test results to calculate ratios or differences over time, it’s about accuracy with precision.

Welcome to the eBook. Let’s RAMP up together.

To be REPEATABLE, and therefore ACTIONABLE, measurements must be MEANINGFUL in order to be PREVENTATIVE.
It is projected that by 2025 as much as 75% of NDT measurement will be executed remotely. With Eddyfi Technologies’ Inuktun product line, we are uniquely positioned as a leading inspection solutions provider to support this accelerating global shift.

Today, Eddyfi Technologies’ core offering of powerful, remote robotic inspection technologies include OnSite Standard Products, OnDemand Specialty Systems and OnSpec Custom Solutions. Every one of our Inuktun vehicles and components carries the promise of our proprietary Multi-Mission Modular design.

IM3™ reflects our mission and vision of enabling all our customers to transform the future in, of and for their business. What drives us is the determination to provide service providers, industry operators and stakeholders with unmatched confidence in the precision and reliability of their data collection results. This is the motivation for the RAMP Index and our larger Datalliance program.

Datalliance is an industry first—a top-level exchange with customer partners interested in collaborating to optimize the complete data collection lifecycle. To see how things are currently being done and do it better. To rest assured of having mitigated human, environmental and business risk. Of having prevented and/or prepared for the unexpected.

Opening a data dialogue will deepen our relationship, driving significant efficiencies and investment returns. With RAMP (Repeatability, Actionability, Meaningfulness and Preventiveness) as a measurement framework for ensuring positive NDT outcomes.
Repeatability goes straight to the heart of accuracy plus precision: namely, if you aren’t measuring exactly the same spot over time, how can you determine what’s changing?

It’s obvious that, in order to be useful, measurements must reflect the real or ‘true’ value. That’s why cameras, sensors, probes and scanners from industry leaders like Eddyfi Technologies are designed to yield the most accurate testing results of their kind.

What’s less obvious, is that transporting and deploying those sophisticated sensors in human hands can, in itself, make it challenging to obtain those same reliable results repeatably. By definition, handheld NDT requires mapping and reproducing human movements and data collection systems, in order to properly assess changing conditions or monitor the aging of fixed assets over time. Otherwise, results will not be comparable. That’s why inspectors take pains to ensure they can measure the very same place again the next time—even drawing physical gridlines on a target inspection area.

Now think how much greater that challenge becomes when an inspection must be done remotely—in a confined space with obstructed entry, or underwater. Reproducing a precise testing protocol may be almost impossible.

By contrast, the precise positioning capability of robotic systems can effectively remove basic repeatability challenges from the equation. Eddyfi Technologies’ unique IM3™ technology makes it easy to obtain repeatable data, even under the harshest conditions—again and again. Precisely.
REPEATABLE INSPECTION

While rope access will always be possible in the splash zone areas, our adaptable robotic solutions are demonstrating their value when it comes to safety, economy and ability to operate continuously. Remote Visual Inspection (RVI) performed in the volatile offshore environment affords objective data through high definition video footage, with ICON™ software identifying vehicle location and the option to tag areas of interest for comparative analysis and audit purposes.

Robotic crawlers like the Inuktun MiniMag™ solve the challenges faced with moving sensors and tools in offshore environments and have been designed with harsh settings in mind. Our Alternating Current Field Measurement (ACFM®) inspection technology is robotically deployed and serves as a method to semi-autonomously detect cracks in a range of subsea geometries including fillet, circumferential and full penetration welds in pipes and plates. This OnSpec Custom Solution is used to inspect many shallow water structures with the ACFM technique; the sensitivity is such that surface breaking defects of 10mm long by 1mm deep can be detected easily when and for non-conductive coatings up to 2mm thick (the usual reporting threshold being 20mm long by 2mm deep). It provides the critical data owners and operators need to fully understand remaining useful life conditions and proactively prepare maintenance or repair activities—year over year, with remotely operated inspections on repeat.

RAMPING UP: While this OnSpec Custom Solution is primarily used in the offshore energy sector for onboard NDT, the options are seemingly endless with different configurations mobilized by Inuktun robotic crawlers. We’re just getting started.
Real RAMP Results

Remote data collection employing the TSC Amigo 2™ and subsea ACFM probe revealed two surface breaking cracks in a steel weld. The butterfly loop shown on the right quickly identified when the probe passed over a crack, making detection simple. The signal information further provided length and depth details, affording the comparative data to continuously monitor changes over time.
**ACTIONABLE**

It’s not enough for data simply to be accurate, precise and repeatable. To be useful, it must be indicative. In other words, it should provide enough information to determine Fitness-For-Service (FFS). It must be Actionable.

Whether the primary goal of an inspection process is to ensure safety, check standards compliance or assess maintenance needs, or whether it’s a matter of slowing degradation, controlling risk or even preventing disaster, identifying necessary actions depends on being able to calculate the forward lifespan of infrastructure. The size and location of a crack, the remaining thickness of a pipe or vessel wall, the percentage of metal loss in a tank floor—all provide information that can be used to calculate remaining life.

Collecting the data consistently and comparing NDT results over time is what allows that calculation to be made, prompting answers to the critical question: what is the required action to be taken? Once we know that, we can move on to material business decisions about how best to go about it, and when.

IM3™ technology allows operators to gain access, again and again, under the harshest conditions, in order to carry out the inspections required to calculate remaining life. No matter where that testing takes us.

The data will tell us where to go next.
ACTIONABLE RESULTS

Nothing speaks more directly to actionability than obtaining accurate, repeatable testing data where none has previously been available. From idea to proof of concept, preliminary design and manufactured prototype, we managed to solve a seemingly impossible problem for a global leader in water, waste and energy management solutions—and, at the same time, pull off a couple of ‘firsts’.

This OnSpec custom crawler (left) enabled our client to conduct, for the first time ever, a comprehensive visual inspection of the primary tanks at a decommissioned nuclear production complex.

As detailed in an article published by the US Office of Environmental Management, Eddyfi Technologies’ deployment of sensors in refractory air slots provided engineers a never-before-seen view—along with an unprecedented capability to make mission-critical decisions and take confident, data-driven ACTION, in pursuit of their ultimate prevention goal: “to support extended service lives of the double-shell tanks.”

RAMPING UP: Among the initial actions to be taken, based on the results of this first-ever confined space deployment of a truly marsupial robotic system, is to upgrade the crawler with other NDT technologies to support even more comprehensive inspections.
Real RAMP Results

High quality video footage collected remotely enabled engineers to conclude that the refractory air slots, primary tank bottom steel plate and exterior surface were all structurally sound; no signs of ongoing or aggressive corrosion were present and the debris noted in the air slots didn’t impact the tank integrity.
As odd as it sounds, accurate test results can be repeatable and even actionable, without being truly meaningful. In fact, it happens more often than you might think. So, what makes data meaningful? First and foremost, it must relate to the entire asset under assessment.

Meaningful data is comprehensive data. It provides information on all aspects, regions of interest and critical areas: inner and outer diameter pipelines, weld and base metal, nozzles and main line, tank floor and tank shell... you get the idea. Repeatable and actionable data are great, but if you can only make FFS calculations based on 10% of a complex asset’s critical areas, it’s meaningless.

Of course, remote robotics can make this data more meaningful by providing access to those areas. And now, with Eddyfi Technologies’ Inuktun product line, we can integrate best-of-class remote operation and control, and unique IM3™ system design, with world-leading NDT data collection capabilities. Making it not only possible to obtain accurate data, but meaningful—wherever the asset, whatever the conditions. To assess the inaccessible.

And inspect the unexpected.
MEANINGFUL DATA

Routine inspection maintenance programs for ferrous assets like storage tanks, pressure vessels and wind towers typically require assessment within confined spaces, just out of reach or at staggering heights. Employing a miniature magnetic crawler like the Inuktun MaggHD™ enables RVI with high definition video footage. Even inexperienced users can quickly and precisely operate the familiar controls to robotically assess potential damage mechanisms otherwise out of sight. The value in robotically gathering this qualitative data is exponential when you add quantitative information.

We’ve achieved this with the successful integration of our Eddyfi Sharck™ probe for detection and measurement of cracks in carbon steel with the MaggHD. With manned inspections typically requiring an initial scan of a region of interest before returning to investigate any anomalies found, RVI and Tangential Eddy Current Array (TECA™) testing can be performed simultaneously. This electromagnetic testing technology not only provides defect depth and length measurements but also delivers C-scan imaging with real-time lift-off monitoring and compensation. When it comes to meaningful data results, the MaggHD with Sharck probe provide information on the weld and base metal, inspection at eye level and out of sight—waist level and beyond—inside and outside assets. It ultimately presents the specific dataset required in order to deliver meaningful results for assets under examination, empowering owners and operators to fully understand remaining useful life conditions and plan business activities accordingly.

RAMPING UP: As we continue to evolve the synergies among complimentary technologies, we’re taking advanced NDT into inspection zones previously accessible through our remotely operated robotic capabilities.
Real RAMP Results

Robotically collected data from the Sharck probe analyzing a previously inaccessible welded plate revealed three cracks found as indicated with the colors for signal amplitude change on the first C-scan. The second C-scan was generated simultaneously and shows the beginning and end of each crack in blue and red, respectively. This comprehensive data shows the whole picture.
Only data that is Repeatable, Actionable and Meaningful can be Preventative.

If all three of the above criteria are met, then the information can be used to ensure proper maintenance is performed, in time to prevent future problems. Across industries, all over the world, all kinds of assets are being extended beyond their planned lifespan—saving businesses millions or billions (!) of dollars. Gaining even a single additional year of use can present a significant financial advantage.

But having the ability to reliably perform calculations on remaining life, to detect maintenance and safety issues, to assess risk and spot danger before it occurs, is about more than cost savings and operating efficiencies.

It’s about staying Beyond Current.

That’s why, more than anything else, the RAMP index is really a measure of assurance. How confident do you need to be—not just in the accuracy of your data, but in its power of prevention? So you can sleep at night.

And see far, in advance.
PREVENTATIVE OUTCOMES

Mitigating human and environmental risk is at the core of NDT, and the safety of freight transportation systems is no exception. Regular assessment of railcars to identify mechanical and structural damage or defects is mandated by governing bodies. Industry is already starting to see the shift from manual inspection to robotic solutions, with a priority to eliminate Confined Space Entry (CSE).

The Inuktun MaggHD™ is routinely deployed to inspect all ferrous internal surfaces of railcar carriages, monitoring specified parameters related to railcar health, liner integrity and general degradation. Close Visual Inspection (CVI) is invaluable for understanding the condition of welds, endcaps, sumps and surfaces. Operators can detect before and look after with the regular availability of visual data: recorded, repeatable results that are actionable, collecting specified data that is meaningful and enabling preventative outcomes. Our combined solution keeps you rolling.

RAMPING UP: Recent advancements further opens opportunities for remote inspections beyond the rail industry.
Real RAMP Results

The following visuals remotely collected during a scheduled railcar inspection identified the presence of general degradation on the otherwise unseen internal surface; however, it was within the acceptable range. Regular monitoring of conditions helps engineers determine remaining useful life and preventative outcomes.
WHAT'S NEXT FOR DATALLIANCE

The RAMP Index is a measure of confidence, a gauge of optimal NDT systems, procedures and data collection. This is a direct reflection of our Datalliance vision: helping you see how things are currently being done, so you can do it better, and rest assured of having mitigated human, environmental and business risk—having prevented and/or prepared for the unexpected.

You can expect to hear more about our larger Datalliance program: a forward-looking, innovative top-level discussion with customer partners interested in collaborating to optimize their data collection processes and results. Opening a data dialogue will deepen our relationship, driving significant efficiencies and investment returns.

This eBook introduces RAMP (Repeatability, Actionability, Meaningfulness and Preventiveness) as a measurement framework for ensuring positive NDT outcomes. Specific articles will follow, examining each stage of the Datalliance Lifecycle (see next page), and how RAMP results close the loop from Equipment, Deployment and Support, through Analysis and Reporting, to Optimization.

In the end, Datalliance is about you—transforming the future, with confidence.

And sleeping soundly at night.
RAMP (Repeatable, Actionable, Meaningful, Preventative) NDT Inspection Results
LEARN MORE ABOUT THE RAMP INDEX AND HOW JOINING OUR DATALLIANCE ENABLES YOU TO STAY BEYOND CURRENT…

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