

FOSS

FOSS



ebook

Making the most of connectivity

A guide for users of analytical solutions
in the grain and milling industry

March 2018

ANALYTICS BEYOND MEASURE

INTRODUCTION

At the time of writing, global cereal production for the 2017/18 season is projected to rise to an all-time high of *3 331 million tonnes, improving on the previous season by 0.6 percent. Yet, cereal utilization is also projected to increase by 1.2 percent. Add in some unpredictable factors such as changing weather patterns, falling protein levels and trade restrictions and the result is by no means a foregone conclusion for a stable and adequate supply of grain-based products in the years to come.

Ever since their introduction in the 1980's, near infrared (NIR) instruments have played a big

**FAO cereal supply and demand*

part in helping the grain and milling industry to keep up with demand, both in terms of quality control and, increasingly, by ensuring supply chain business efficiency based on consistent data and transparent control systems. Now, recent developments in internet technology are providing new opportunities to do even more quite literally at the click of a mouse button.

So whether you are considering getting into networked instruments for the first time or interested in the latest generation of connectivity tools, this e-book aims to bring you right up-to-date with the advantages, the considerations and the options available.

Let's raise the bar even higher. Every grain counts.

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What's new about connectivity?

The story of grain analysis with near infrared is one of continuous improvement.

When the grain industry discovered near infrared analysis in the early 1980s it revolutionized grain quality control overnight. With data on key parameters such as moisture and protein available in minutes at the touch of a button, users of NIR equipment could check, pay the right price, segregate and generally handle grain in a faster and more efficient way to the benefit of the entire global grain supply chain.

But there was yet another bonus in store

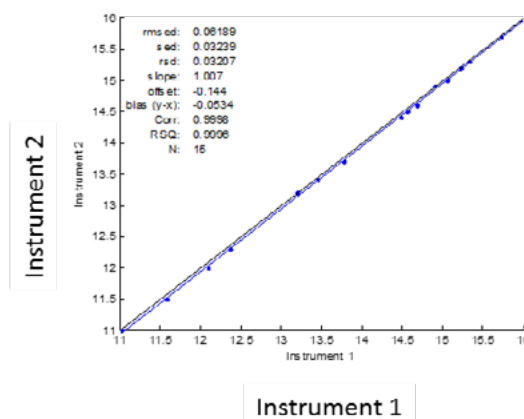
Many organisations found that by linking analytical instruments in grain networks to a control hub they could gather valuable data from multiple analysers in one place. A while later, networking software was developed that not only allowed grain handlers to collect data, but also to remotely configure instruments for example, with calibration updates.

As anyone who has had to look after a number of instruments will testify, keeping them all in check and up to date, especially across different geographic locations, can be a time-consuming task. The ability to do it once from a desktop can be safely said to have saved thousands of man-hours, not to mention flight tickets and CO₂ emissions.

Transferability improving reliability

In step with developments in networks, the reliability of results on an instrument-to-instrument basis also

- ▶ SED
 - ▶ The standard deviation of differences in predictions between instrument 1 and instrument 2
- ▶ Bias
 - ▶ Systematic difference in predictions between instrument 1 and instrument 2



The standard deviation of differences in predictions between instruments and the bias or systematic differences in predictions are key measures of calibration transferability.

improved through so-called transferability of hardware and calibrations. Transferability is measured on an instrument level and on a prediction level. Repeatability, accuracy of measurements and comparisons from one instrument unit to another are important on an instrument level. On a prediction (calibration) level, the standard deviation of differences in predictions between instruments and the bias or systematic difference in predictions between instruments are key measures. Correspondingly, transferability is affected by both the instrument hardware, for example, the optics and the sample presentation and by the calibration model.



As anyone who has had to look after a number of instruments will testify, keeping them all in check and up to date, especially across different geographic locations, can be a time-consuming task.

New connectivity options improving operating procedures

So what now - with transferability improving all the time, why do we need tools to keep an eye on everything?

If we start to look beyond the instrument box itself, it becomes clear that more gains are to be made. One of the areas that can gain more is standard operating procedures.

With the developments in internet and networking technology of recent years, a raft of new connectivity functionality has recently become available providing new possibilities to literally 'keep an eye' on the performance of the instrument remotely and check how it is being used without actually having to see or touch the instrument.

Remote diagnostics give the central manager a complete picture of how everything is performing, which unit might need attention and how instruments are being used. This last aspect is particularly important for organisations wanting to ensure that operators, who may often be unskilled seasonal staff, follow standard operating procedures to the letter. Unfortunately, no amount of sticky yellow notes can ensure that a temporary operator does exactly as he should when measuring samples.

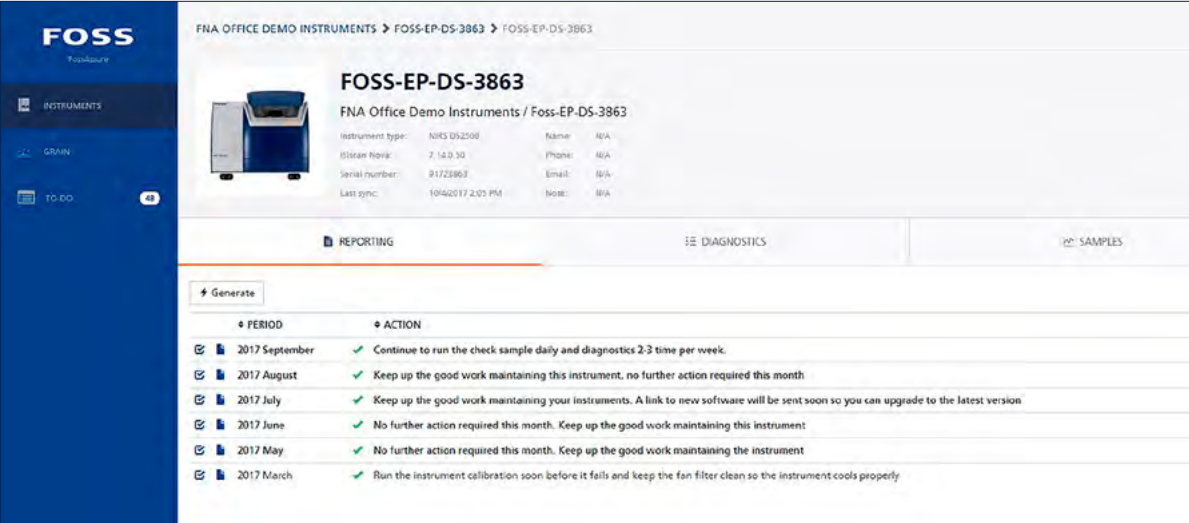
Via connectivity, all measuring operations become transparent and an odd-ball test, an operating mistake or

suspect instrument behavior becomes visible and thereby rectifiable. The manager is now empowered to raise the bar across all measuring units both in terms of the instrument performance and the way those instruments are used.

Managing calibrations made easier

Another area to gain from new connectivity options is calibration management. Once again, given the transferability now achieved with NIR instruments and calibrations, one can argue why it is necessary at all, but no matter how good the transferability, factors such as harvest conditions and use of new grain varieties will always be able to throw a curve ball at the tightest analytical operation set-up.

This requires network managers to be light on their feet keeping all instruments up to date and measuring



The screenshot displays the FOSS software interface for instrument management. The left sidebar contains navigation options: INSTRUMENTS, GRAIN, and TO DO (with a notification badge). The main content area shows the instrument details for 'FOSS-EP-DS-3863', including its type (NIRS DS2500), IP address (7.14.0.30), and serial number (91728603). Below this, there are tabs for REPORTING, DIAGNOSTICS, and SAMPLES. The REPORTING tab is active, showing a table of maintenance actions:

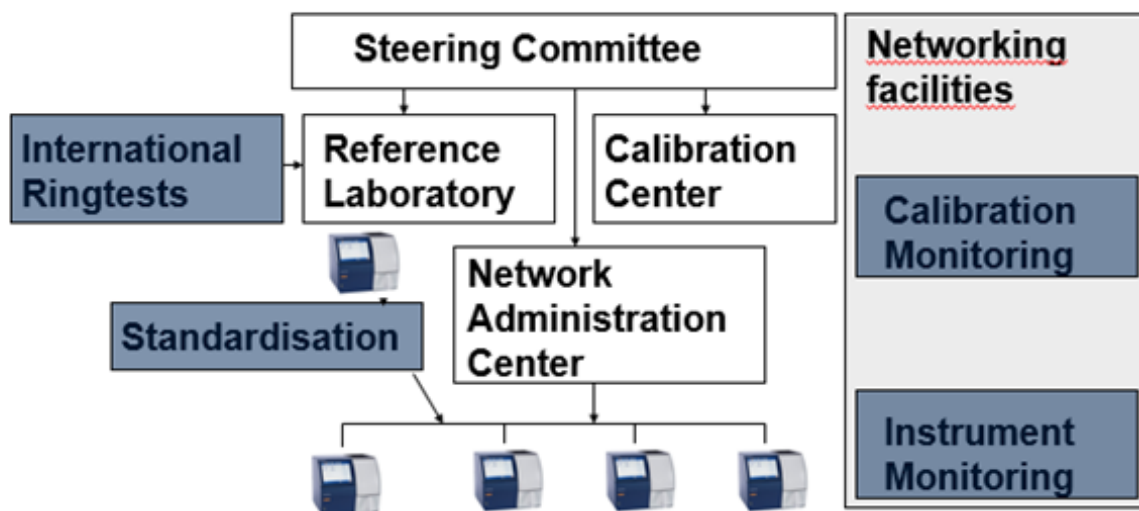
PERIOD	ACTION
2017 September	Continue to run the check sample daily and diagnostics 2-3 time per week.
2017 August	Keep up the good work maintaining this instrument, no further action required this month.
2017 July	Keep up the good work maintaining your instruments. A link to new software will be sent soon so you can upgrade to the latest version.
2017 June	No further action required this month. Keep up the good work maintaining this instrument.
2017 May	No further action required this month. Keep up the good work maintaining the instrument.
2017 March	Run the instrument calibration soon before it fails and keep the fan filter clean so the instrument cools properly.

Another area to gain from new connectivity options is calibration management.

the same. They need to work as part of a team with other players in the network including instrument owners, reference laboratories and steering committees responsible for approving any adjustments that might be made to a calibration.

Networking and software tools now make it simple for everyone to get round the table regardless of location and discuss and review possible adjustments to calibrations. The significance of doing this correctly, transparently and with professionalism is made clear by the financial aspects of trading grain.

If a 1,000 tonne load of barley is downgraded from malt to feed quality, it has a big impact on different players in the supply chain. People need to check why the decision is made and above all, they must be able to rely on the



Connectivity provides the basis for effective and transparent controls on grain measurements.

integrity of the measurement system. This is especially the case when a change is made to a calibration during the busy harvest period with corresponding repercussions for a farmer's next delivery.

To illustrate, let's take a typical network setup using the latest in connectivity functionality in a system like the FOSS NetGrain system.

The parties involved in the network are the instrument owners, a reference laboratory, a network manager and a steering group that agrees on any calibration adjustments.

Instrument owners are required to send sample sets pre harvest to the reference lab for alignment against a master instrument. They then send in further sample-sets to the lab during the harvest, but otherwise, they don't do anything except use the instrument.

The reference lab performs reference tests and enters data for both reference tests into the FOSS NetGrain system where it is automatically collected with other data such as the NIR tests made at the grain receival sites.

Keeping an eye on it all is the network manager. With a clear graphical interface and data on all sorts of factors such as location, corn variety, NIR test, reference test, farmer and so on, they can easily overview the results. For instance, they can evaluate if something is just a strange

result due to operator error or is it the start of a trend due to a new corn variety. Putting data and experience together, the network manager can then engage in effective dialogue with the reference lab to implement further checks. If it appears that an adjustment to a calibration is required, the same data snapshot is shared with steering group members to come to an informed decision.

Using connectivity facilities, the network manager can ripple any required calibration adjustment throughout the population of instruments from their desktop.

Transparent system

Last but not least, the transparency of the system plays a vital role in supply chain trust and efficiency. Even though very few adjustments may be made during a harvest, the fact that all relevant data is always easily available, that everything is recorded and that decisions are made based on shared reliable data, allows everyone involved to trust the system.

CHAPTER 2

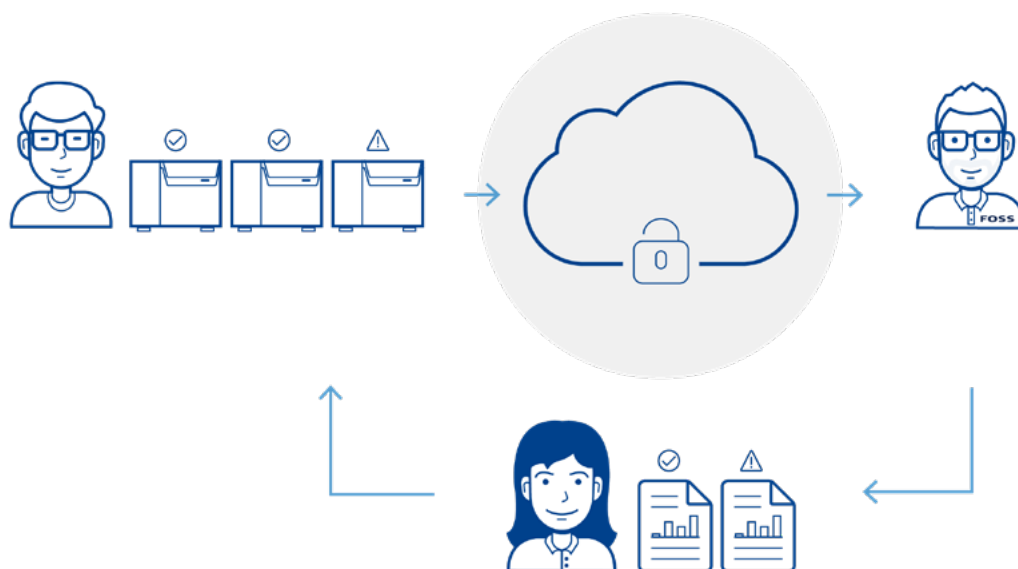
Connectivity for everyone

For those operating instruments as standalone units, there are three main advantages.

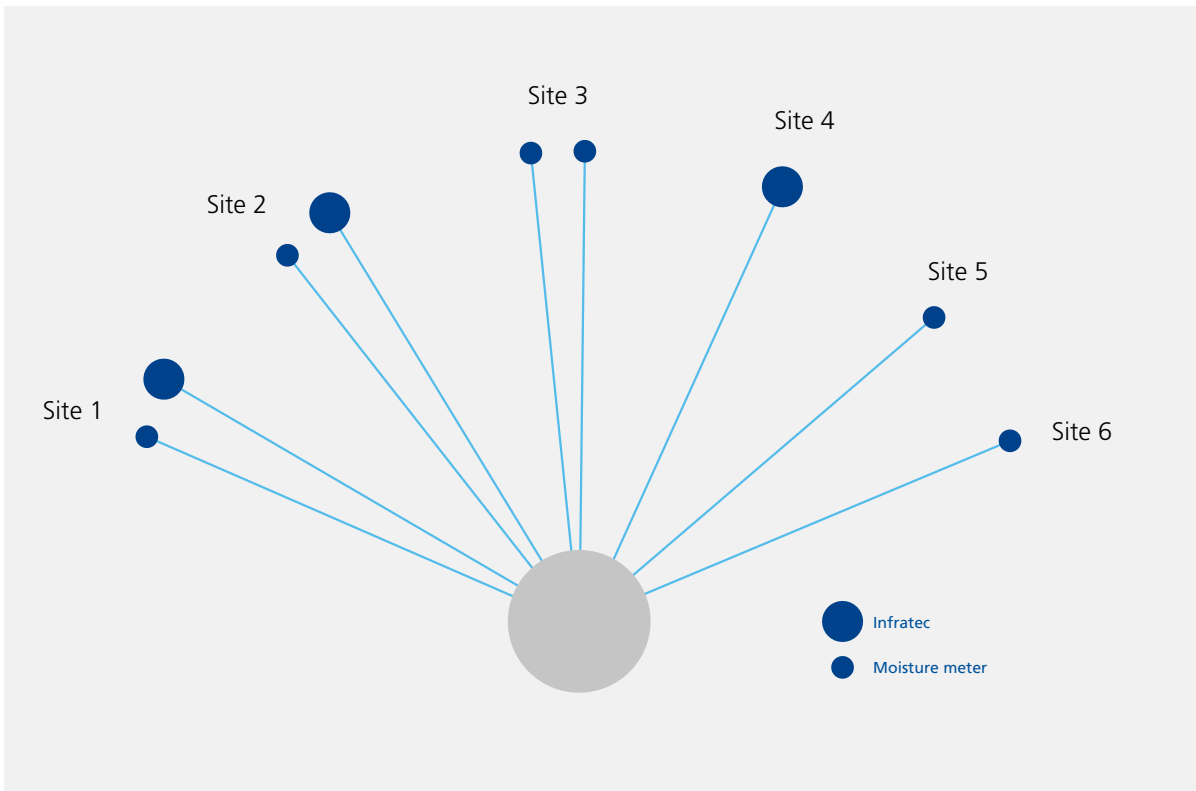
Firstly, for traceability and peace of mind, all data is always safely backed up in a cloud-based server.

Secondly, when you need support, you can give access to the instrument's inner secrets to the support person (see chapter 4 for the specific benefits).

And thirdly, you can view results from the convenience of your desktop, for example if you want to avoid those repeated trips from the office to the control room at the weighing station. You can also do this without interrupting testing operations.



As shown in the graphic, the instrument owner connects the instrument to a cloud-based system. All result data is automatically stored and this can be accessed remotely by an NIR expert who can use the data to issue periodic reports on the instrument performance to the instrument owner.



Build your own network

The latest connectivity tools and services make it simple for any NIR user to build a network of instruments that are all under the watchful eye of an administrator. It is also possible to combine different instrument types, for example to gather data from a standard grain analyser and moisture meters all in one place. As shown in the illustration, a meter can be added at a new receival site or integrated alongside an existing grain analyser to expand moisture-testing capacity

CHAPTER 3

Connectivity for flour milling, case story: Know where you are with NIR

Near infrared analysis (NIR) has become indispensable to modern food manufacturing, but how can NIR users ensure that their growing fleets of NIR instruments are all working just right, all of the time?

Bay State Milling Company found the answer in the form of a system called FossAssure.

Bay State Milling Company currently has 16 NIR flour instruments at different sites in the USA. All are maintained for top performance, and like most modern NIR instruments today, they are highly stable. Nonetheless, they still need a watchful eye to check that everything is running perfectly day-in, day-out in the often dusty and vibration-prone milling environments in which they need to operate.

With this goal in mind, quality controllers from Bay State Milling Company teamed-up with developers at FOSS to help devise the FOSS system that today is called FossAssure. It has provided operational benefits and peace of mind, while also laying the ground for continuous improvement of quality control procedures.

24/7 performance

The instruments in use are FOSS NIRS™ DS2500 analysers, which are used primarily for measuring key quality control parameters of flour such as moisture, protein and ash.

“We selected the instrument for its accuracy and precision and we have been extremely pleased with that decision”, says Jennifer Robinson, VP of Corporate Quality Assurance. “However, that instrument is only going to perform as well as it’s maintained. I am interested in the health of my instruments – are we running preventative maintenance and do we have any problems with vibration and temperature?”



Temperature fluctuations and dusty mill environments are just some of the more obvious threats to performance of NIR instruments.

Under one virtual roof

With the FossAssure system, the instruments are monitored by FOSS support staff to check that they are performing consistently. Monthly performance reports include alerts on potential issues before they can affect instrument performance and cause expensive downtime. Based on diagnostic checks, the support person can also determine the stability of instruments in compliance with official standards.

With regular insight into the family of instruments, the support person quickly became a trusted contact, familiar with the Bay State Milling Company organisation, the

sites and the instruments and fully informed to be able to make the right recommendations. “It’s challenging to stay connected with all 16 instruments,” adds Robinson. “A value for me is that I know an expert at FOSS is reviewing the performance of my instruments and I get a summarised report that tells me if everything is fine or if there are some concerns.”

Practical gains

Without FossAssure Robinson would need to be much more ‘hands-on’, having to do manual checks at different sites as well as having to pull reports and review the information.

While a lamp failure, temperature fluctuations and dusty mill environments are some of the more obvious threats to performance, another factor is how standard operating procedures are being performed. For instance, filters and sample cups need to be cleaned correctly and diagnostics need to be run based on detailed company-wide procedures for how operators should use the instruments.

It is here that the connectivity aspect of the FossAssure program is a huge asset. “Over the 24 years I have been working with quality control, the development of networking software is one of the biggest developments,” says Robinson. “I can sit at my desk and see if a site is running ok, if diagnostics are being performed and so on.”

And, should Bay State Milling Company need to call about a problem, then, it is to someone who is intimately familiar with the instruments because the support staff is not starting from ground level on policies, maintenance and so on.

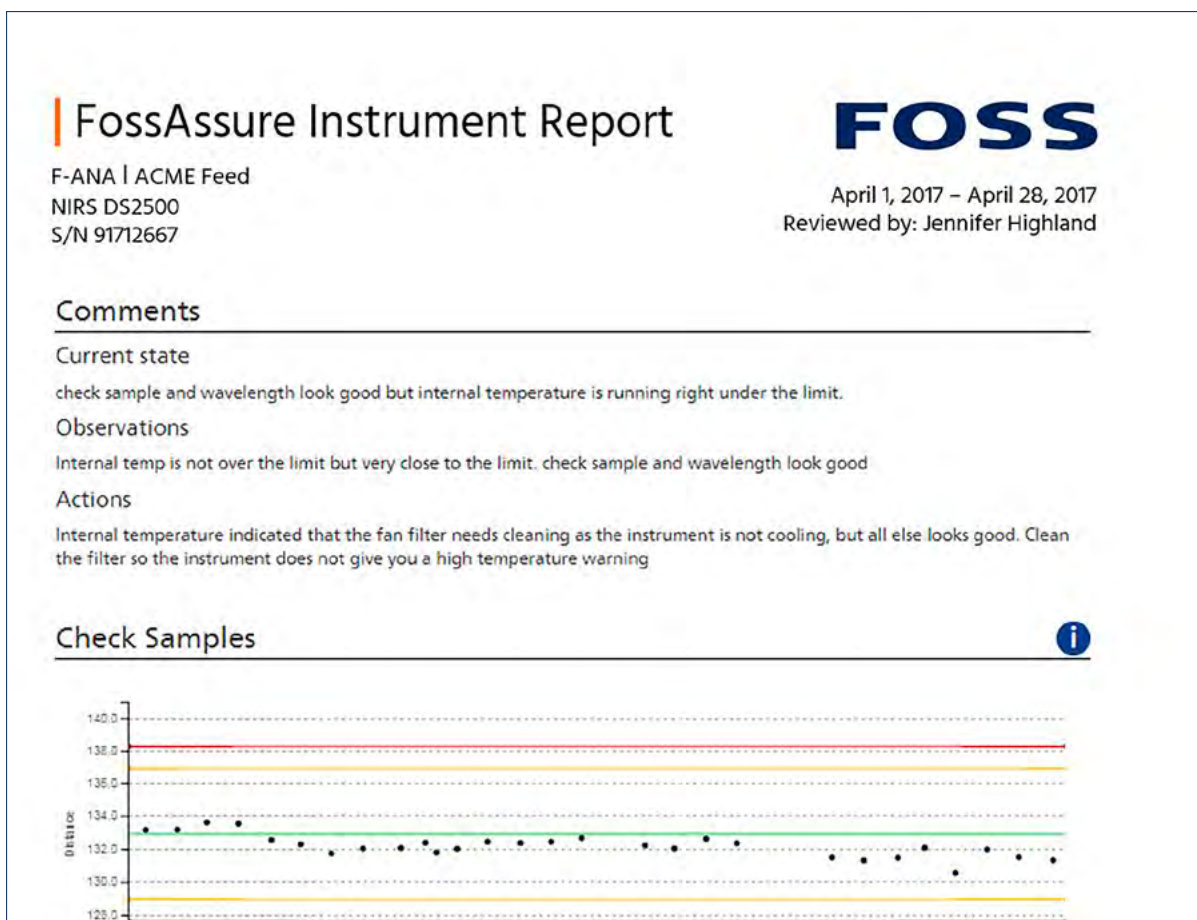
With relevant data available, it is quick and simple to zoom in on the issue. “A challenge I have often encountered is that when you are working within the plant and the instrument seems to be working ok, then everyone is happy,” says Robinson. “But when you start getting out of spec results you get challenged - is it the process or is it the instrument? With FossAssure, we can point to and demonstrate that the instrument is not the source of the issue. It gives peace of mind, because I know that someone with the right education is keeping an eye on the instruments and how they are running.”

The three pillars of continuous improvement

Keeping not just one, but the whole family of instruments running at top performance is now a practical everyday reality that lays the ground for further improvement of quality control procedures.

For others considering a similar set-up for their analytical operations, Robinson describes three steps. First, select an instrument you can trust to deliver accurate results consistently. Second, maintain it with FossAssure.

And third, develop robust policies and procedures for maintaining performance across a group of instruments, taking advantage of the knowledge and expertise that FOSS has to offer. “In this way, you can put yourself into a positive cycle of positive improvement,” she concludes.



Networking instruments makes it simple to gather data for periodic reports on performance.

CHAPTER 4

Five ways to get better support via connectivity

Connectivity is a great boost to instrument uptime and better support, for instance, here are five examples of how support staff can provide a higher level of service:

1. They can monitor performance of instruments from their desktop, saving time and transport costs.
2. They can gather data for monthly reports at the click of a mouse, saving quality control managers the job
3. They can anticipate issues and order the right parts upfront to avoid unplanned downtime.
4. They can take control of the instrument and computer interface to help identify issues avoiding the need for an on-site NIR expert.
5. They can build up an intimate knowledge of your analytical instrument setup, so if you need to call someone they know a lot already and can zoom in on an issue quickly.



Connectivity is a great boost to instrument uptime and support.

NIR reference data-sets made easy with connected instruments

Connectivity is not only relevant for operating NIR instruments, but also for the way NIR instruments are calibrated against reference measurements based on chemical analysis methods.

Collecting reference results for calibration or calibration checks can be a time-consuming business, not just in terms of the actual measurement, but in recording and handling the reference result data.

Connect your reference method to a network and you can save time loading new sample sets to your NIR instruments for calibration adjustment or development. You can also keep an eye on the performance of your reference instruments and keep all reference data safe in one place.

The following video animation provides an example for reference tests based on the Dumas method. Connecting an instrument called Dumatec to a network allows users to:

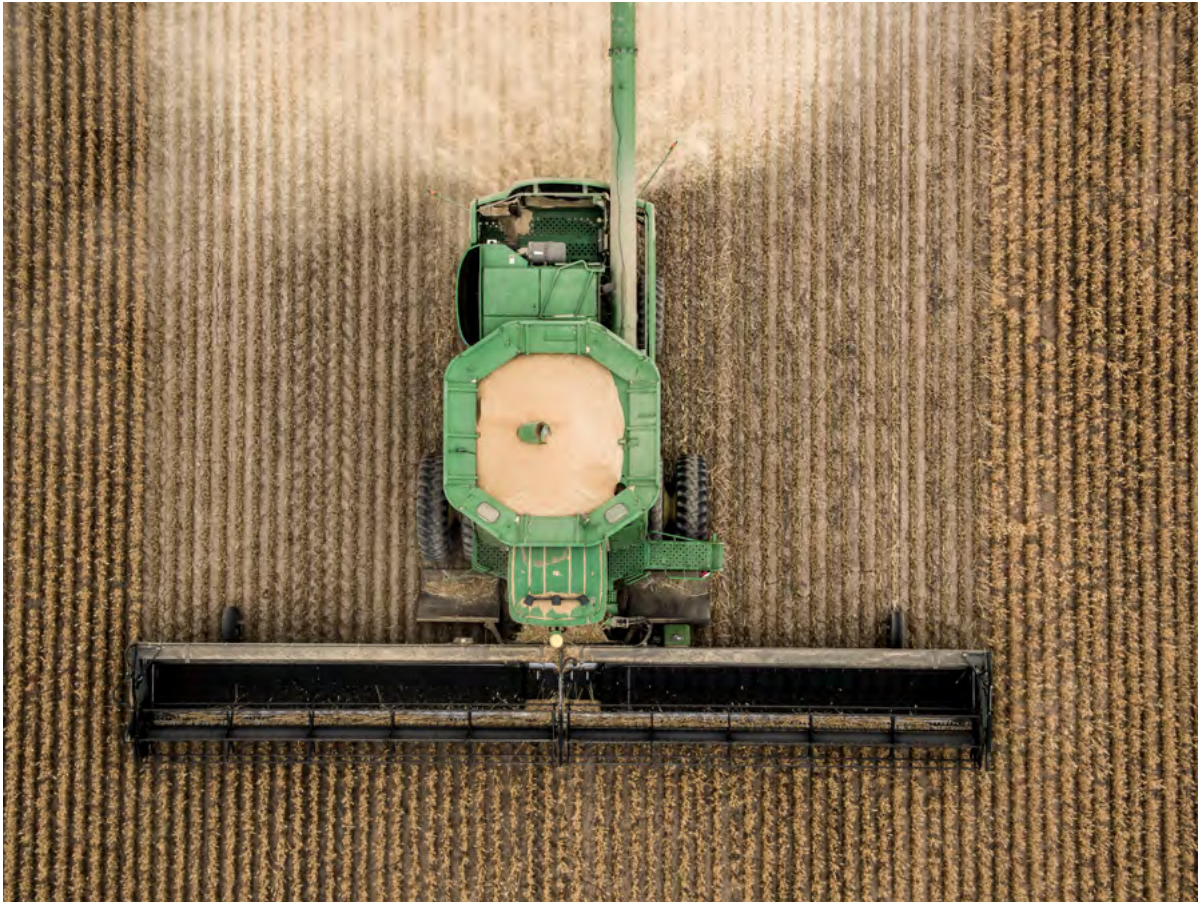
- Handle reference data at the click of a button
- Keep an eye on the performance of Dumatec instruments from anywhere with a connection
- Secure all data on the FossManager™ server for consistent operations and traceability



CHAPTER 6

Connectivity service offerings

Whether you are already into networking or getting started, the following FOSS products are relevant:



A range of services are available to help make your daily operations as simple as possible.

FossManager™ enables you to connect your instruments to the internet. Take advantage of a range of digital services designed to make your daily operations as simple as possible.

FossAssure™ covers a range of digital services designed to make your daily operations as simple as possible.

By using remote instrument monitoring, you can rest assured that your instruments perform consistently and deliver reliable results to avoid out-of-spec products. Receive monthly performance reports with alerts on



potential issues before they affect your instruments' performance and cause expensive downtime.

Based on diagnostics, we validate the stability of your instruments in compliance with official standards.

FOSS NetGrain™ is a networking tool using the latest in connectivity technology to make it simple for different players in the supply chain to discuss and review possible adjustments to calibrations.

More about **FOSS**
connectivity services [here](#)

Infratec™ NOVA is the 'best-in-class' whole grain analyser using globally recognised near-infrared transmittance technology to simultaneously test multiple parameters (moisture, protein, oil, starch, etc.) in a

broad range of grain and oilseed commodities. True networking and identical instruments reduce instrument management work required for consistent test results throughout grain receival networks.



Dumatec™ 8000 gives busy laboratories reliable Dumas results in just three minutes at a low cost per sample. It can be connected to a network to save time loading new sample sets to your near infrared (NIR) instruments for calibration adjustment or development. You can also keep an eye on the performance of your Dumatec and keep all reference data safe in one place.





NIRS™ DS2500 analyser helps millers to boost yield by offering unsurpassed, rapid analysis of Ash in addition to reliable flour analysis for Protein and Moisture. Factory standardised instruments give you top data transferability, which helps when sharing calibrations. This makes the NIRS™ DS2500 a perfect unit to include in a network of instruments where calibration updates and monitoring are controlled centrally.