Tackling Obsolescence in Test and Measurement Equipment

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WHAT IS OBSOLESCENCE?

Most manufacturers rely on a number of different technologies to produce their products. These technologies might be used for automation, testing and quality assurance, or could even be embedded in the product itself. If any one of them becomes unavailable, production could be interrupted, with a possible loss of sales.

It's possible to mitigate against technology availability by stockpiling parts or having a support agreement with an acceptable guaranteed response time. This is a day-to-day operational concern.

However, in the longer term, all technologies eventually become obsolete. At Argenta, we consider a technology to be obsolete when it is either no longer sold and/or supported by its manufacturer, or when it is no longer cost effective to repair and maintain.

WHAT CAUSES OBSOLESCENCE?

Obsolescence arises for a number of reasons.

Technology vendors continuously evolve their products to take advantage of new innovations, in an effort to outpace their competitors. An older model might be replaced with something more capable, more reliable, cheaper or more compact.

Sometimes a product might be updated to comply with a new standard, as happened when National Instruments migrated from SCXI to PXI. Other times, a technology might need to be redesigned because its components themselves become obsolete. In rare cases, a vendor might go into liquidation, be acquired, or otherwise restructure in a way that results in them discontinuing a product. Demand for a technology could simply dry up, making it unviable to provide it any longer.

It's impractical and unprofitable for vendors to support all of their past technologies indefinitely.

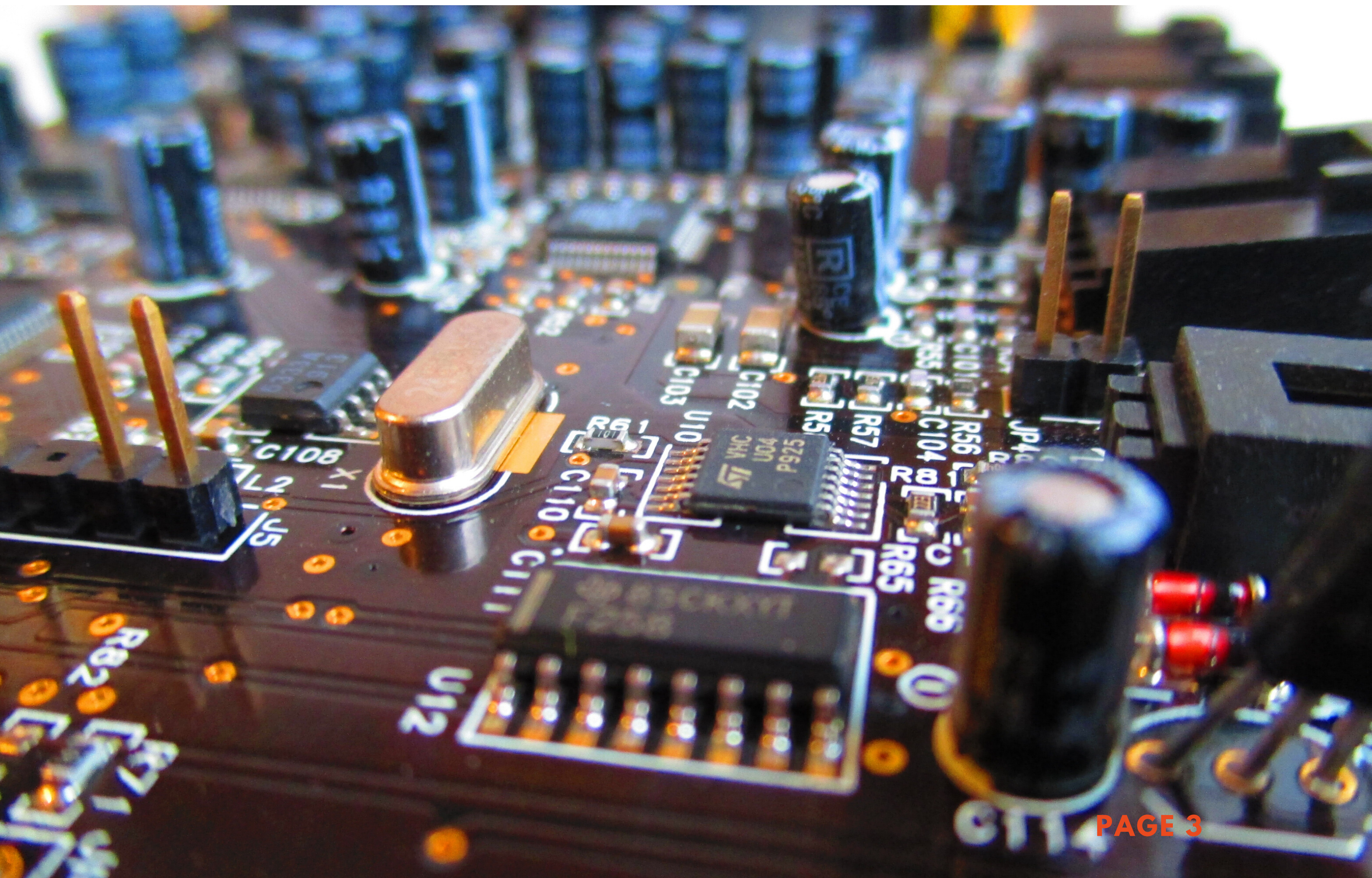
WHAT ARE THE COSTS AND RISKS OF OBSOLESCENCE?

Unplanned downtime can be extremely costly to a business, with fixed costs still being incurred but no product being produced for sale.

If a company is using technology that is no longer supported by its vendor, there may still be support available from independent companies. However, this is likely to come at a cost: as most manufacturers migrate to officially supported technology, the support ecosystem around older models shrinks, and it becomes harder (and more expensive) to find the skills required. Ultimately, the ecosystem collapses because there are not enough paying customers to sustain it. There may be additional risks, too. If you're buying proprietary parts from a third party, without any support from the original vendor, you're exposed if those parts don't perform as expected, or fail prematurely.

If an unsupported technology breaks and cannot be repaired or replaced, it might be necessary to carry out an emergency upgrade. That could be an extensive project, with a duration of weeks for a simple test rig, or months for something more complex. During that time, the production line could be down, or might require significant reorganisation to continue producing. Manufacturers typically optimise their resources to maximise uptime and productivity, and unexpected long interruptions can be extremely disruptive to their business.

For internet-enabled technologies, there are additional security risks. During a technology's lifetime, the vendor may issue security patches. When a vendor is no longer supporting a product, vulnerabilities may continue to be discovered and publicised, but they won't be fixed.



MINIMISING DISRUPTION

For a manufacturer, it is important to minimise disruption to the production line. Obsolescence threatens uptime, but so too does an upgrade project.

MINIMISING DISRUPTION CAUSED BY OBSOLESCENCE

Technology vendors understand that obsolescence may be painful for customers. Vendors will typically give notice that a product is going to be discontinued and may offer a transition period where support is available. They may also offer guidance on upgrading to a newer technology that is as close to backwards-compatible as possible. It is important, then, that manufacturers develop a close relationship with their technology suppliers, so they receive these messages and have an opportunity to ask their questions.

In some cases, the vendor will enable customers to buy spare parts, either for stockpiling at the customer’s site, or for warehousing by the technology vendor. This can help to buy more time for an orderly upgrade, but it is only a short-term measure. Sooner or later, the stocks will run out. At the same time, money is tied up in obsolete technology that might not be needed, depending on how long the upgrade takes.

When a vendor declares a technology is end-of-life, there may be third-party companies that continue to support it. It may be helpful to enter into a support agreement with one, but this too can only be a short-term measure. Parts eventually run out, and support agreements for obsolete technologies may be expensive.

MINIMISING DISRUPTION CAUSED BY UPGRADE PROJECTS

There are several risks and costs associated with carrying out an upgrade project on a key technology.
They include:

- **The cost of reduced capacity.** Closing down part of the production line for an upgrade will reduce the capacity at that point, and potentially at other points. It may be possible to mitigate this risk by overproducing in advance of the upgrade, so that other machines can continue to process the work in progress as normal during the upgrade.
- **The risk of delay.** There are always uncertainties in an upgrade project, so it could take longer than expected. Prioritise those aspects of the new solution that carry the highest element of risk, because these are likely to require the most work.
- **The risk of inadequacy.** There is a risk that the new technology can't do what you wanted it to, leaving you exposed if you discover that late in the upgrade process. It is important to carry out testing and familiarisation projects with the new technology offline before attempting to incorporate it in the production line.

To minimise the risk, work with experienced integrators who can identify and resolve issues as early in the project as possible.

Where duplicate equipment is available, downtime can be minimised by upgrading one machine at a time, so that the remaining equipment can sustain production in the meantime. Running the new and old equipment in parallel can help to validate the new equipment is performing as expected.

USING ABSTRACTION LAYERS TO STREAMLINE UPGRADES

When test hardware becomes obsolete, it can be difficult to modify the software solution to accommodate newer technology if the data acquisition code is not separated effectively from the other elements of the system. Even in a well-structured application where the relevant code is easy to find, it can involve extensive testing to be sure there are no side effects from changing it.

We recommend abstracting the data acquisition layer from the measurement layer, so that each can be updated independently. The data acquisition layer should be responsible for interfacing with the test hardware and receiving its data, and for providing the data to the measurement layer for interpretation and reporting.

Should the hardware protocols change, or the signals need to be handled differently, the changes can be made in the data acquisition layer and the measurement layer can continue using the data it receives without needing any modification or validation.

Hardware obsolescence and the resulting changes in data acquisition are inevitable, so isolating the data acquisition layer helps to future-proof test equipment.

CASE STUDY: UPGRADING TO PXI

At the end of 2018, National Instruments (NI) discontinued the proprietary SCXI range of test equipment, replacing it with industry standard PXI equipment. NI are active members of the PXI Systems Alliance, who are committed to the research and development of the platform.

Argenta helped a company in the aerospace industry to upgrade a number of test rigs from SCXI to PXI. The company works on refurbishing fuel systems for jet engines. Testing is essential to ensure the safety-critical parts meet the performance requirements.

The first step was to understand the equivalent PXI modules for the SCXI modules that are now obsolete. National Instruments provides a guide to suitable replacement products, but SCXI and PXI are mechanically and electrically different so compromise is sometimes required. Replacement modules may have different channel counts and measurement ranges, for example. For more complex set-ups, Argenta's experts can offer advice to help choose the right replacement.

For the digital I/O and analogue output, Argenta found PXI modules that were suitable with only minor changes to the wiring and LabVIEW software.

The two signal types that proved more challenging were the analogue input and frequency acquisition. The test rig was using the SCXI 1100, which is a 32 channel analogue input module.The PXI equivalent is the PXIe 4302, which is a 32 channel filtered analogue input module. There were three important differences between the modules from a hardware perspective:

- The SCXI module supported breakout boards, making it much easier to investigate wiring issues comfortably, by using a long cable to bring the breakout board away from the chassis. With PXI, terminal blocks are used, which means the wiring remains close to the chassis, and the shielding on the terminal block must be removed to test with a multimeter.
- The newer PXI rack we used (the PXIe-1065) is bigger than the SCXI chassis. In space constrained environments, changes in the form factor may be important.
- The newer PXIe 4302 module can measure current or voltage, depending on the terminal block you use. However, the SCXI module was able to measure both, with the signal type selected in software. To switch from a combination of current and voltage under SCXI to a single signal type with PXI may require duplicate modules and/or reconfiguration in the software.

For frequency measurement on the SCXI platform you would typically use the SCXI 1326, which is an 8 channel frequency input module. There is no direct replacement for the SCXI 1326. To acquire frequency on the PXI platform we used the PXI 6624, which provided 8 counters. This module was used to periodically read the pulse count, which was converted into a frequency and finally to engineering units. Significant software changes and minor wiring changes were required to make this possible, but it resulted in an accurate measurement that worked across the application for both data visualisation and control requirements.

Argenta worked closely with the aerospace company to minimise the extent of rewiring and the downtime when the test rigs were swapped out. The new technology was validated by testing units with the old equipment, replacing it, and then testing units with the new equipment and comparing results.

Although this was a like-for-like technology migration, there are potential accuracy improvements in the newer equipment, and the company now has a more flexible platform for meeting future requirements. There are 450 PXI modules available from NI, including field programmable gate arrays (FPGAs) for deterministic fast signal processing and control, Controller Area Network (CAN) for automotive testing, and radio frequency measurement and simulation. Additional expansion can be achieved by connecting multiple PXI chassis together. Because PXI is an industry standard, other suppliers also make modules compatible with the NI platform.

CASE STUDY: UPGRADING TO COMPACTRIO

Greenbank develops systems for measuring the fuel supply and combustion process in a power station. One of their products PFMS uses electrostatic technology to monitor the flow of particles in the pipes from the pulveriser mills to the burners. By understanding how the fuel is being distributed to the burners, power stations can optimise their burning process and energy generation.

The Greenbank systems have a Compact FieldPoint (cFP) from National Instruments embedded in them, and that was discontinued in 2018. The cFP platform was replaced by the CompactRIO family, as described in National Instruments' notice here. The new technology offers faster performance and more memory at a similar price point to the older solution.

It was easy for Greenbank to incorporate the new technology because the company had taken a proactive approach: Two years before the upgrade became necessary, Greenbank had identified that its software wasn't flexible enough and the measurement code was intricately connected to the data acquisition code.

Argenta worked with Greenbank to modernise the software so that a Hardware Abstraction Layer (HAL) was implemented to abstract the acquisition code from the measurement code. Operating at arms' length, the measurement code doesn't need to know how the data is acquired: it just receives the data from the HAL and processes it. Any changes to the data acquisition can be carried out in the data acquisition code without needing to touch the measurement code. Because the end product needs to be customised to the power stations' requirements, the software uses configuration files to map channels to particular functions without the need for any software development.

As a result of the HAL, the Greenbank solution has been tested successfully using CompactRIO without the need for extensive software updates. In the future, the solution can be supplied to Greenbank's customers with CompactRIO incorporated in it.

CONCLUSION

When technologies used in manufacturing become obsolete, it puts the entire production process at risk. There are two ways to manage obsolescence. First, there is the tactical approach of ensuring you have spares in the warehouse and a support relationship that can fix any issues arising.

This tactical approach can buy more time for a planned transition but can only ever be a short-term measure. Secondly, there is the strategic approach, which involves assessing the capabilities of the obsolete technology and implementing a replacement. Often, there is not a like-for-like replacement, so some engineering will be required, and strong project management will be essential to minimise downtime and keep the project on track.

To reduce the risk resulting from obsolescence, software should be developed with a HAL to abstract the data acquisition from the measurement layer, so that data acquisition can be updated independently in the future.

To minimise the risk involved in upgrade projects, work with a partner that can bring in-depth technical expertise, experience in similar migrations, and solid project management skills. Doing so can reduce the risk of project overrun on the upgrade and help to identify the smoothest upgrade path where a like-for-like replacement is not available.

Chris Woodhams, MD of Argenta presenting at GDevCon#2

ABOUT ARGENTA

Argenta is a leading provider of product reliability and process improvement solutions. Argenta has worked on projects to help manufacturers to update their test, measurement and monitoring solutions as a result of obsolescence. Argenta is a National Instruments Alliance Partner, experienced in working with LabVIEW and National Instruments hardware platforms.

Argenta can assess your requirements and capabilities, propose modern alternatives to obsolete technologies, implement HALs where required, and integrate the complete solution, spanning hardware and software.

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