UNIFIED CONDITION MONITORING

Benefits of Automated Vibration Data Collection Capability

JUDE IYINBOR, CENG.

Universal Condition Monitoring:

Benefits of Automated Vibration Data Collection Capability

by Jude Iyinbor, CEng.

Introduction

Over the past three decades, maintenance and reliability professionals have wished and yearned for an improved machinery condition monitoring tool that is smart enough to safely collect, process and analyze almost any form of data holistically. A tool that is not just another "shinny" piece of software that takes up space on your computer. A tool that is reliable in solving the complex issue of how condition monitoring data is maximized to reap turbocharged ROI, yet simple to use and easy to integrate into existing outfits. Well, "your wish is our command", Unified Condition Monitoring (UCM) is a disruptive technological tool that allows machinery fault identification using all forms of available data, to be carried out on a single seamless interface with a robust multi-prong approach (Oil, Analysis data, Vibration data, Telemetry, and other Process parameters) for improved machinery reliability and fantastic ROI.

Time to ditch the ineffective method of various condition monitoring data been collected and analyzed by different third-party vendors and across different platforms. Thus, making the entire process cumbersome with machinery data dispersed across different locations and the great twin challenges of synergy and harmonization that comes with the old way of handling data. From experience, we have seen numerous cases where preventable catastrophic failures have been missed due to valuable data sprinkled across multiple platforms. Sometime ago, a client was trying to use Oil Analysis to corroborate an impending failure on a Gearbox after Vibration Analysis showed Gear-related activities. It was challenging for the customer as a different vendor was handling that program and did not set it up properly for Wear Metal Analysis. This type of issue is eliminated under the UCM tool as all available data for any given machine is present in one interface and used to make decisions about the health condition of the machine.

A great part of the Unified Condition Monitoring Tool, is the integration of vibration data analysis aspect that offers a distinctive approach towards big data in terms of measuring, collecting, storing, transferring, and critically analyzing machinery vibration data. This approach goes beyond traditional data collection and analysis techniques as complex FFT spectral plots are easily separated automatically into meaningful fault identification peaks and trended for clarity when making decisions.

Critical machines can now be monitored safely while in operation as permanently mounted accelerometers are able to collect data frequently without the safety risk of personnel coming close to massive moving machines during field operations.

The UCM vibration data analysis tool has the flexibility to be able to use your existing accelerometers or other safety compliant and accredited accelerometers.

Vibration Data collection is one of the most important steps in analyzing machinery vibration to be able to make informed decision about the health status of any given rotating equipment. If this is done right, every other aspect like analysis, recommendation and reporting becomes very effective. It involves the ability to safely collect vibration data from a given machinery under normal operating condition. This is useful for the purpose of analysis of the health condition of the equipment and provision of suitable corresponding recommendation to any anomalies.

Without an efficient vibration data collection method, it will not be possible to optimize a Predictive Maintenance Program to reap valuable rewards such as fault identification without unnecessary intrusion into machinery internals, fault prediction, machinery reliability improvement, and reduction in downtimes.

The primary benefits of utilizing Unified Condition Monitoring tool to automatically collect vibration data is reviewed against the limitations of traditional manual method in this article.

Methods of Vibration Data Collection

Manual Method Using Conventional Technologies

This entails the use of trained personnel to download routes manually from a software on a computer onto a data collector. The data collector is then carried around the plant (from one machine to the other) and used to collect data from each designated location on a machine. Data is collected on the average interval of once per month or quarter while under normal operating condition. After data has been collected, the device is connected to a computer and the routes uploaded back into the software for analysis. As depicted in figure 1, this method relies on a lot of manual involvement by trained personnel to ensure the process is efficient. Data collected is commonly exported and sent by email to other stakeholders who may not have access to the local computer where the software is installed.

Automated Method Using UCM Technology

Accelerometers are permanently mounted on machines and terminated into Data Acquisition Units which collect and process data at designated intervals (every minute, hourly, daily, weekly, etc. depending on the criticality of the machine). As shown in figure 2, this method has a simplified layout with less personnel involvement in the day-to-day operations of the process. Data collected can be made available instantly online for all stakeholders to view. The UCM tool allows for other types of condition monitoring data (oil analysis, oil property and contamination sensors, telemetry, process data, etc.) to be collected and processed for a more robust and efficient analysis. The UCM tool also goes a step further to provide first pass analysis using advanced Machine Learning Artificial Intelligence algorithms.

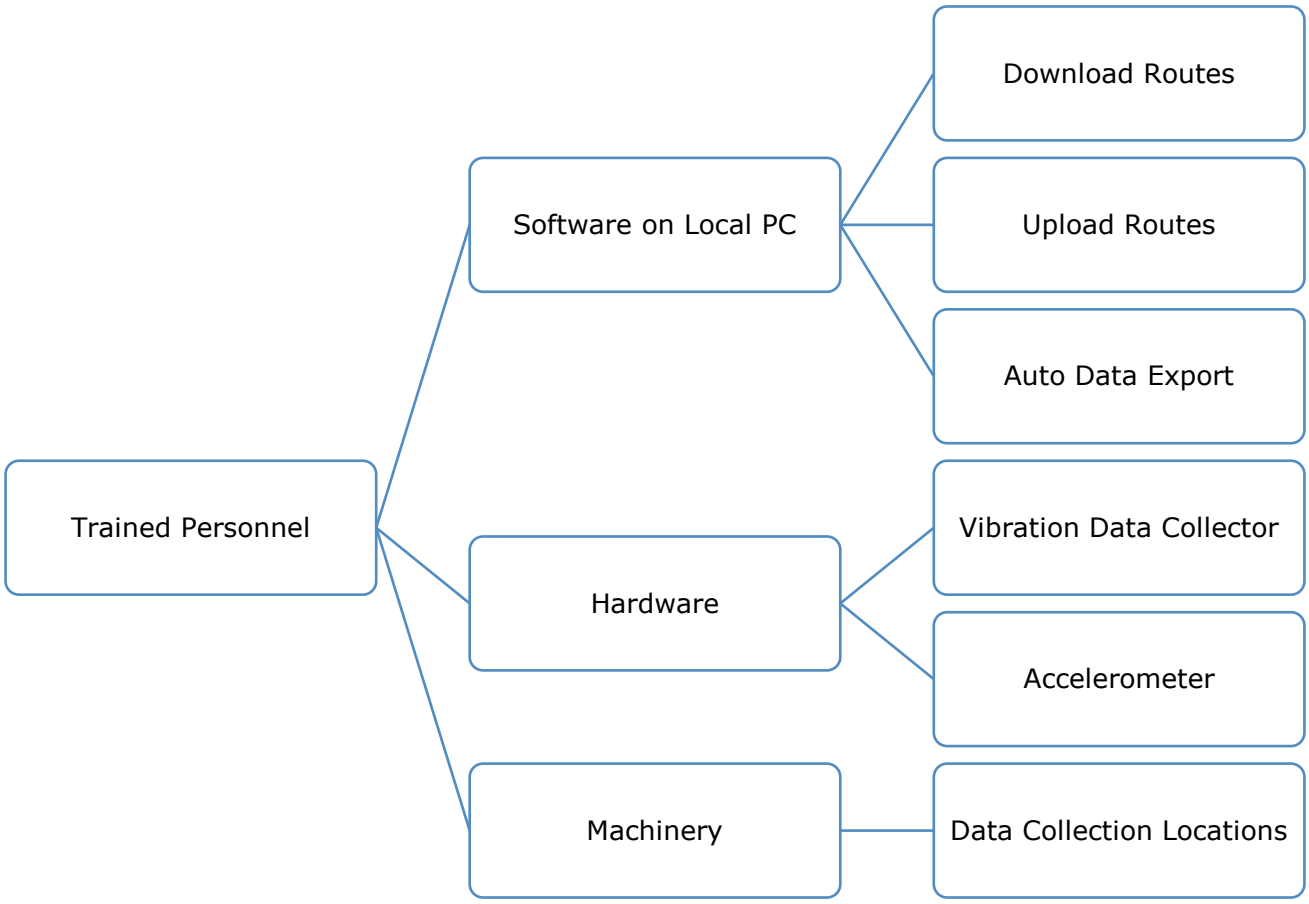

Figure 1: Manual Data Collection method involves personnel to manually interact with various parts of the process

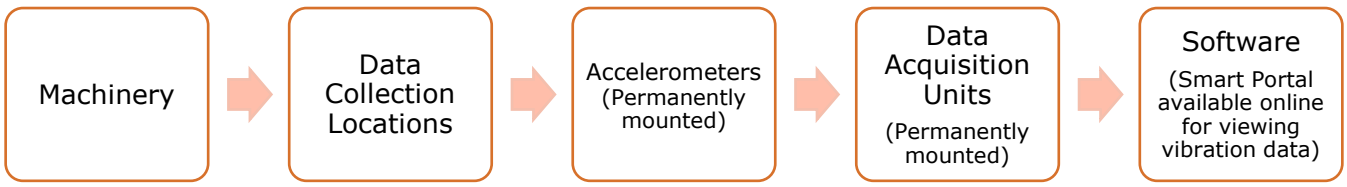

Figure 2: The UCM Automated Vibration Data Collection method is simplified with no need for personnel

Main Differences

The primary differences between the traditional manual method and UCM automated vibration data collection tools are highlighted in the discussion table below:

Difference	Manual Method	UCM Automated Tool
Medium of accomplishing data collection task	Requires a team of trained personnel, hardware and software.	Uses a smart system of hardware and software.
Frequency of Routine Data Collection	Usually once a month on the average.	Every minute, hourly, weekly depending on the criticality of the machine.
Digital Acquisition Unit	Mobile handheld data collector (single / double / multi-channel).	Permanently mounted multi-channel digital acquisition units.
Accelerometer	A single handheld accelerometer carried from one machine to the other and moved from one data collection point to the other.	Permanently mounted accelerometers fixed to the designated data collection points.
Availability of collected data	Data is available via the software on the local computer on site after performing a manual route upload. Data can also be sent to other locations by exporting, emailing and re-importing it into replica databases. Some products allow the use of network versions that can make database sharing possible.	Data is available automatically to multiple locations through the use smart applications and the internet. Depending on connectivity, data can sometimes be available in as close as possible to real time.

Table 1: Primary differences between manual and automated methods

Benefits of Automated Vibration Data Collection Capability of UCM

1. Cost Effectiveness

The UCM automated method of collecting data offers a lot of positives in terms of cost effectiveness as investment cost of running an efficient vibration program is reduced significantly by leveraging on simple automated systems.

The cost involves initial setup cost for hardware and software. Once the system is up and running, it works efficiently. The total cost is lower in the long term when comparing with the traditional manual method (whose cost includes investing in hardware, software, software upgrades, personnel wages, and training cost as well as the time associated with bringing in new personnel if experienced personnel leave the role). Furthermore, the margin in cost difference becomes greater if the cost associated with the manual method is scaled up when considering a scenario of collecting data at more frequent intervals such as weekly or even daily. On the contrary, such a high data collection interval is standard for UCM automated vibration data collection method with no additional cost or personnel.

2. Frequency

Collecting data monthly does not always give a warning for some types of machine faults especially if such machines are in operation for the best part of the month. Experience has shown that so many catastrophic machinery failures have occurred after being analyzed as satisfactory a month before. This is due to inability of the manual method of data collection to cope with more frequent collection rates without extreme costs for personnel to collect and analyze data at a very short interval.

The UCM automated Vibration data collection method on the other hand is better suited to this. It is designed to collect data as frequently as desired (every second, every minute, hourly, weekly, etc.) depending on the nature and criticality of the machine. This makes it possible to be able to provide adequate warning interval about an impending fault and monitor changes in trends over a period. Thus, it is possible to plan maintenance and repair activities as well as order parts and spares in preparation for a controlled shutdown and overhaul. This implies that secondary damage from in-service catastrophic failure can be avoided.

3. Quality of Data

Analysis of data collected is based on the premise that the data is collected from the same location every time. This is certainly the case with UCM automated vibration data collection method as accelerometers are permanently mounted on designated data collection points. This eliminates any errors due to mobile handheld units not properly mounted or in some cases mounted on the wrong machine / location by personnel using the manual method. There has been a lot of costly errors due to false analysis because of collecting data from the wrong machine or not consistently following best practices using the traditional manual handheld method. Also, during shift changes, different personnel may decide to collect the data from a different location due to convenience especially if the designated location is not marked or tagged with steel identification plates. Using the UCM automated vibration data collection method removes any doubt about the repeatability and quality of the data.

4. Ability to collect other types of data

The UCM tool can collect other forms of condition monitoring data such as Oil Analysis data, oil property and contamination sensors, Telemetry, and Process data (temperature, pressure, etc.). This is very advantageous as all forms of data are utilized simultaneously in deciding about the health status of any given machine. It reduces the number of third-party vendors or applications required to collect various kinds of data. It enables smarter and more effective analysis of condition monitoring data making Predictive Maintenance Programs more valuable than just another tick in the box.

5. Time Saving

The time to record vibration data is proportional to the Lines of Resolution divided by the Upper Frequency limit of the spectra captured [G. Senapaty and S. Rao, 2018]. This time record is common to both the manual and UCM automated vibration data collection method. However, the automated method can offer time saving by its ability to collect data from multiple points

simultaneously without having to manually go from one point to another or walk around the facility from one machine to another. Also, it avoids the time it takes to setup the point manually on the data collector upon arrival in front of the machine.

Let's consider a case scenario where it takes 50 seconds to collect all the parameters at a location on machine #1. Let's say machine #1 has 8 data collection points and there are about 50 machines on site with similar data collection points.

Using the manual method in theory, it will take (50*8*50) about 20,000 seconds, or more than five hours. This is without considering the time it takes to walk from one machine to the other and the time it takes to setup the data collector and position the accelerometer on the correct location.

On the contrary, using UCM automated vibration data collection method in theory, it will take (50*50) about 2,500 seconds (less than an hour) assuming all 8 points per machine are collected synchronously using multi-channel digital acquisition units. This means it takes 8 times less to collect the same amount of data. Further time saving is achieved as the automated method cuts out the time it takes to walk around from one machine to the other and the additional time used for setting up the data collector and handheld accelerometer. Using the UCM automated method frees up more time for other activities ensuring the effective use of time.

6. Simplification of Vibration Data Collection Process

The process of vibration data collection is simplified using the UCM automated vibration data collection method. Permanently mounted hardware and software are used to collect data independently with no frequent additional assistance from site personnel. As opposed to the manual method, there is no need to manually download routes or machinery models into a handheld device and then carry it around a plant from one machine to the other. There

is no need to manually setup at each machine and ensure that the data location points line up with the highlighted machine on the data collector.

Uploading the data manually back into the database is also not necessary with the UCM automated vibration data collection method. There has been previous experience where a delay in uploading vibration data for several days had caused a machine failure to go unnoticed and unprevented. Upon data review, it was discovered that the signs of deterioration were present, and that catastrophic failure could have been prevented if the data was uploaded immediately after collection. With the UCM automated vibration data collection method, there are no gaps and no delays in getting data ready for analysis after collection. The method is simplified and does not involve a lot of multiple interactions with different aspects of the process as would normally be the case with the manual method (see figures 1 and 2 above).

7. Safety

The UCM automated vibration data collection method helps to improve the safety of the entire vibration data collection process. The risk of personnel and handheld data collectors getting entangled with rotating parts due to requirements for machines to be in operation while collecting vibration data is eliminated as no personnel is required when using UCM automated vibration data collection method. When using the manual method, there are machinery areas that are inaccessible due to the dangers of trying to get so close to a rotating part just to collect vibration data. This is not the case with the UCM automated vibration data collection tool as permanently mounted accelerometers are installed on the desired locations when the machine is offline (Locked Out and Tagged Out). Upon startup vibration data is immediately and continuously captured (at desired intervals) without the need for any personnel to come close to the machine. The risk of encountering very cold surfaces (frost bite) or very hot surface (burns) because of machine contact with personnel is eliminated with the use of the UCM automated vibration data collection tool.

8. Convenience

There is no requirement to install software on a local computer on site when using UCM automated vibration data collection method. Data is collected and stored inside the hardware, then transferred and processed through a central portal online. This means, there is no need to update software on local computers which can add significantly to the cost of the program if using the manual method.

9. Data Storage

With the UCM automated vibration data collection tool, data is stored in the digital acquisition units which are well equipped with very large capacities to hold data. Data is then automatically transferred to servers and data centers where they are stored for a very long time. This unique tool is robust and never deletes any useful historic data. With manual method, there is a limitation of storage space based on the storage capacity of the local computer on site where the software is installed. With the manual method, databases must be manually archived and stored separately with restrictive access to historical data which is sometimes required when carrying out vibration analysis.

10. Big Data Processing

The UCM automated vibration data collection system goes beyond just collecting a lot of data. The tool can easily handle large amounts of data collected because of high sampling interval on machines. It utilizes advanced Machine Learning Artificial Intelligence algorithms to learn from various types of data collected and support decision-making by carrying out first pass analysis. It can discern frequency peaks from complex FFT, split up meaningful fault identification frequency peaks, compute trends, check alarm limits, and use complex pattern recognition techniques on machines having anomalies from the vibration data collected. This helps to improve the data analysis, recommendation, and reporting processes respectively. Your analysts can

spend more time diagnosing alarming trends than collecting and reviewing individual FTT's.

11. Efficiency Transfer

With all the above-mentioned benefits comes a significant gain in time and elimination of needing personnel to manually collect data. This efficiency can be transferred into other useful tasks. Such as spending more time analyzing actual vibration data and planning other maintenance activities. We have experienced a couple of instances where clients have complained about collecting a lot of vibration data manually, but not having the time to analyze them leading to undetected preventable failure. With even further implications like unplanned shutdowns and loss of revenue. Some plant managers complain about technicians spending too much time collecting vibration data and falling behind when it comes to other maintenance and repair tasks. With the UCM automated vibration data collection tool, these issues with time spent collecting vibration data manually is eliminated without any significant increase in cost. Technicians and Vibration Analysts can finally now focus on what they know how to do best and allow the unique UCM automated vibration data collection tool do the heavy lifting.

Conclusion

A lot of programs fail to deliver value due to the use of wrong tools and disjointed approach to managing condition monitoring data. Program failure can also be attributed to the challenges of interfacing with multiple vendors across multiple platforms just to be able to access and utilize valuable data. Using the UCM automated vibration data collection tool makes it possible to administer an advanced condition monitoring program that delivers tremendous value at the fraction of the cost of using traditional methods. The UCM automated vibration data collection method has a lot of benefits over the traditional manual method. These benefits (such as cost effectiveness, better data collection frequency, quality, ability to collect other types of data, time saving, safety, convenience, data storage and big data processing) are

essential in the optimization of any vibration monitoring program and maximizing ROI. I always say that every job or task becomes more effective to deliver with the right tools in your toolbox. If a Condition Monitoring Program is not delivering, it is best to check if the right tool is being used. The UCM automated vibration data collection tool is a highly recommended efficient asset in any toolbox.

Reference

G Senapaty and S Rao (2018): Vibration Based Condition Monitoring of Rotating Machinery; MATEC Web of Conferences

Brain Teasers: Check your Comprehension

Q1: Which one of the following employs a single handheld accelerometer carried from one machine to the other and moved from one data collection point to the other? (A): Manual collection method (B): UCM method (C): Not sure

Q2: Using UCM method it is possible to collect data as frequently as desired (every second, every minute, hourly, weekly) (A): True (B): Not sure (C): False

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