Troubleshooting Manufacturing Processes

03/29/2019

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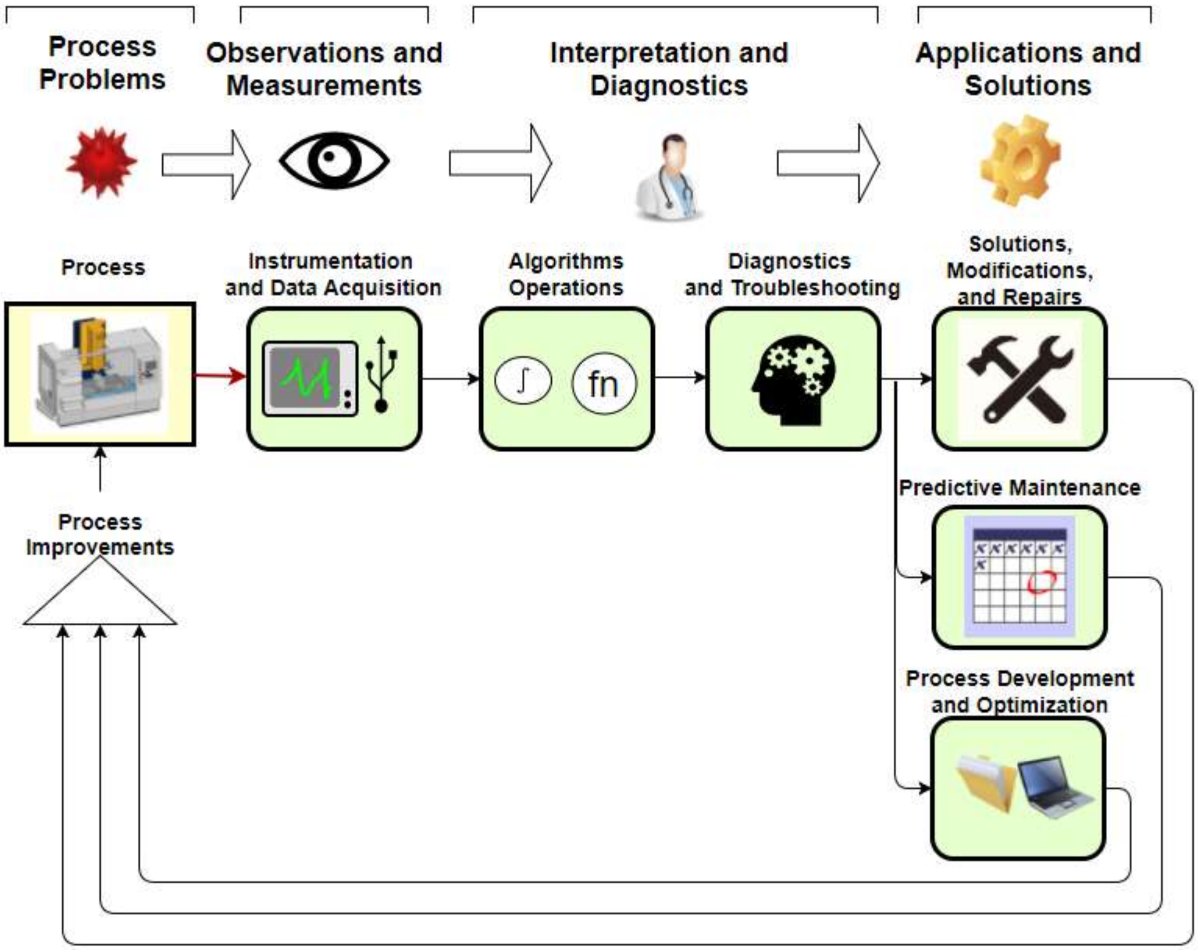
Recent technological advances have drastically reduced the cost of computation, networking, and instrumentation, while simultaneously improving their performance. In a manufacturing environment, the question is how to most effectively utilize these innovations to boost efficiency, streamline troubleshooting, and increase up-time. Our team's goal is to pair advanced instrumentation and data acquisition with engineering insight to meet the needs of modern manufacturing.

In our experience, troubleshooting and process optimization is a four step process as illustrated below. First, the problem must be identified. Then, relevant observations and measurements should be made. As in gear manufacturing, the Slone laser measures the profile, pitch errors, and lead errors to name a few. These measurements must be processed and interpreted to provide a diagnosis. In msny cases this is a formulation of an algorithm to transfer the measurement data into the frequency or time domain depending on the errors witnessed. This algorithm then leads to the solution phase. A solution must be developed to resolve the problem. This maybe lead to a modal analysis, thermal deflection error budget, or an error budget analysis. While this formula or method may seem simple, insight and experience play a crucial role in rapidly answering such questions as, "What data should be taken?" "What structural characteristic could cause this phenomenon?" or even, "What tools and training are required to extract particular process data?"

TROUBLESHOOTING AND IMPROVEMENT OF MANUFACTURING PROCESSESES



Observations and Measurements

Our team has successfully implemented solutions for a wide range of manufacturing problems by adhering rigorously to the scientific method: Observe, hypothesize, and test. When confronting a troublesome process, the first step is to ask the question, "How did it do that?" "What are the kinematics involved in making the work piece??"

Our team's strength derives heavily from our ability to rapidly synthesize and test considered hypotheses. Our strongly held conviction is that all data must count. Without exception, no data is taken except to prove out a reasoned hypothesis which fits the observed phenomenon. Our group is experienced in the use of in-process gaging and metrology to evaluate parts. Additionally, we offer a full suite of instrumentation and data acquisition tools. Whether the problem stems from thermal growth, misalignments, spindle errors, bearing noise, structural vibration, or servo instability, our group has the tools to measure and identify the problem.

Interpretations and Diagnostics

One of the most crucial steps in a troubleshooting process is the handling and interpretation of data. It is no trivial operation to take measurements from a workpiece or instrumented process, and relate them to particular machine characteristics. For instance, observing undulations in a workpiece or monitoring vibration during a grind cycle is an important first step. However, these efforts are futile unless the measurements can be definitively linked to a particular component within a machine. This principle is particularly true in the generation of gears. The complex grinding kinematics of this process can make it difficult to identify by which axis or component is to blame for a particular error. Careful data collection and properly developed algorithms to allow this to be done in a straight forward manner.

Applications and Solutions

Of course, successful troubleshooting does not end with diagnosis. Over decades of application, our team has developed numerous strategies for addressing a wide variety of manufacturing problems. Our emphasis is on timely, cost-effective results. Our experience lies with the entire machine tool domain; ie, kinematic errors, stable and unstable vibrations, thermal stability, and optimized servo control.

These results lead a a wide variety of possible solutions. Examples are; developing a thermally stable machine through controlled thermal variations or through software, application of vibration damping in critical components, kinematic errors compensation, and optimum servo tuning to name a few.

Feedback Loop of Effective Process Design

Our team is experienced in metrology, data acquisition, computation, applications and engineered solutions. It is our experience that each of these disciplines must work in concert for effective troubleshooting. With these competencies under one roof, we can provide rapid resolution to immediate manufacturing problems. Additionally, our data collection and reduction techniques may also be leveraged for process optimization studies, as well as preventative maintenance plans. An effective system of metrology, diagnostics, and applications paves the way for the development of more robust, innovative, and cost-effective manufacturing.