Collaborative Measurements Control System Engineering

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Working in a control system suppliers environment, the pace of development seems breathtaking-fast. Skills and tools developed yesterday have a threat of obsolescence today. This is very much true of all measurement and control systems that have been touched by software, which seems like every aspect of measurement and control systems.

And in this world of constant change, we still carry on with some age old legacy concepts. Some of these are very 'key concepts' and should be changed with utmost care and some have already lived past their expiry dates.

The purpose of this paper is to explore the possibility of using distributed intelligence in modern control systems and fieldbus-PlantWeb technologies to further

- Make utmost use of field measurement in the PlantWeb architecture.
- Increase over all control system reliability-availability.
- Delay shutdown decisions in plants.
- Decrease field-engineering effort (slight increase in control room and plant web engineering).
- Decrease field E&C time.

The paper does not focus on any advanced control strategies that could be possible by using such collaborative measurements.

So let's start with the first concept which has been referred to as collaborative measurements. What are these collaborative measurements?

Collaborative Measurement

Imagine that in a distillation column there are two thermocouples measuring temperatures at approximately the same location and can be said to collaborate each other. Hence, we can call this a collaborative measurement.

Now let us take two temperatures (bottom temperatures) in a distillation column and a level measurement. When the level is normal, the two temperatures are same or have a fixed relationship between them. TI1 is placed at a lower level in the column (near bottom) and TC2 is at a higher level (and used for Temp. control). Now TC2 is generally used for control. We can safely say that if Level is normal, and TC2 is under maintenance, TI1 can be used for control (with a minor adjustment to Setpoint if required). Thus Level and Thermocouple TI1 put together can "collaborate" the measurement of Temperature-measurement TC2.

Further in a column, the bottom Level and a temperature at a higher level can also collaborate the temperature measurement at TC2.

These are simple examples used to demonstrate the meaning of collaborative measurement.

New Definition, so what … We have known about this for a very long time…

Using Collaborative Measurements: Traditional Methods
Since a very long time, if thermowell sizes were same, the first thing done if an element were to fail was to swap the elements (either during the shutdown caused by the failure) or by a planned outage or having the loop in manual and doing the swap.
At times, we have also used our ingenuity and just swapped the wires at the analog inputs and tuned control setpoints to have the plant up and running in a very short time. And hopefully, in all that chaos, someone had the presence of mind to record the swap on the wiring diagrams. Of course, procurement actions are promptly taken and so on and so forth.

Modern use: now what if we have already added a collaborative measurement strategy which says that if level is not low and TC2 is not available then TI1 can be a valid measurement. We alarm the operator that TC2 is not available, fine tune the setpoint if required… All this occurs automatically and there is no outage or disturbance that could result in quality issues.

This can be achieved with our DeltaV control system in today's environment. Add a little bit of engineering and we can do this…
So far so good…

Gen Y PlantWeb
In today's environment, everyone has a fair idea of fieldbus technology. Add PlantWeb concepts and we have more robustness build into the system and so on…

The Emerson PlantWeb architecture with its link active scheduler (LAS) provides capability of control from field. Failure in the control room need not adversely affect the plant functioning. In short, critical control can move back to the field.

Now moving ahead if we were to add the traditional methods of collaborative measurements to the PlantWeb architecture, then we would have increased the robustness of the system, over the usage of collaborative measurements described above.

This would mean adding a few more blocks to the firmware of final control elements of the PlantWeb architecture to enable it to do these logical evaluations and select the available primary/collaborated measurement.

Wireless PlantWeb technologies could remove some of the limitations in the PlantWeb cable and increase robustness even further.

Gen Y Fieldbus Engineering Standards Redefined

We can obviously see that where collaborative measurements exist, we can do away with multiple measurements. If we have a collaborative measurement on a temperature, we could have a duplex TC with only one connected to a converter / transmitter. The second one is available for rewiring in case the necessity arises.

Let us look at the various advantages:

1. Gen Y PlantWeb becomes more cost effective versus a traditional system. Cost savings include:
    a. Reduction in cost of one Transmitter / converter channel.
    b. Reduction in field wiring, lowered E&C costs.
    c. Lower cable tray, conduit and other accessory requirements.
    d. Lower engineering and drawing costs.
    e. Lower Schedule requirements (less time required for E&C).
2. Increased control system availability, or more robust system. Failure of the TC does not cause major disturbance. Operator and maintenance staff have time to attend to the measurement.
3. Increased life of the TC. Generally on failure of one element, the TC would probably be replaced in next shutdown or a shutdown planned for such replacement. This need not be done now. Since the element is duplex, a simple wire swap does the job and a replacement need not be planned unless both elements fail.

In hindsight, it seems that we should have changed engineering standards to use collaborative measurements a long time ago. In some aspects of engineering, we are still stuck in the pneumatic era and we need to broaden our vision to make complete use of the modern tools available at our disposal.