INDUSTRIAL WORKFLOWS & THE DINNER PARTY

A Recipe for Capturing Knowledge & Taking Action

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It’s Sunday morning and there’s a party at your place next weekend.

Family, friends, and other nocturnal creatures will be landing on your doorstep. Where is your workflow? From in-laws to governance laws we are constantly adapting to changes in our operating environment whether it is the purchase of a new corporate asset, the pursuit of the Golden Batch, or the wrench thrown into our plans by an unannounced visitor. One thing is certain: change.

Written procedure documents are too rigid to adapt to the demands placed on today’s operations environment. By the time they are published, something will have changed, rendering them useless. As a consequence, human instinct turns to ad hoc processes and we drift from the fidelity of the original procedure document.

Software based workflow allows us to turn procedural documents into “live” orchestrations of people, processes, and machines. It also enables us to capture knowledge that otherwise leaves the building when our experts retire or take leave.

Need more reasons to take a closer look at industrial workflow? How about more agile processes, the ability to monitor long running processes, an audit trail, and confirmation of conformance?

Workflow is a key element of the “Act” in the Anticipate | Collaborate | Act philosophy of the Intuition™ software family. Intuition is a family of software and technologies for the process industries. Intuition Executive provides site and enterprise access to production and operating information, in context, and enables advanced visualization and integration of applications for managing, monitoring and optimizing operations and collaborating across functions or geographic boundaries.
Frozen pizza just won’t cut it. What do you do? The difference between disaster and delectable is all in the planning. Likewise, the same can be said about operational excellence.

To get started, let’s stir up some questions and pre-heat the planning process.

• What should we cook?
• Who are we going to invite?
• Is there a theme to this party?
• What food and decorating supplies do we need?
• When do we need to start cooking?
• Where will the guests sit?
• Do the guests have any food allergies?
• Where should we put that cat that likes to eat expensive leather shoes?

Twenty hungry people are coming to your dinner party next week.
Once this set of steps has been completed we can move on to menu planning. We now know how many people will be attending and their dietary restrictions.

1. Retrieve food allergies from the guest list.
2. Determine how many people are attending.
3. Create a menu.
4. Create an inventory of supplies.
5. Create a shopping list.
6. Schedule time for shopping (and plan a route if your list requires multiple stores).
7. Schedule cooking and baking.
8. Schedule decorating tasks.

Shop before you cook, figure out dietary restrictions before you create a menu, cook before the guests arrive, etc. As we think through all of these rules we are in essence creating a workflow that could be generalized and applied to any dinner party.
A workflow is a sequence of actions that represent a work process.

Each workflow can include things like decisions, email notification, task creation, analysis execution, web service execution, and other activities. A simple workflow might email someone when a tank has exceeded a low limit (we’ll demonstrate later how notification is really just a special case of workflow). A complex workflow might perform a large number of tasks and collect input from a variety of experts.

Workflow is also referred to as “orchestration” which conjures up images of a conductor leading a team of musicians through a concert. Likewise, in an industrial setting, workflow leads a team of individuals through a procedure. The procedure is defined by the experts who know the most about the particular manufacturing process.

Using our event planning example we can describe the invitation process in a workflow diagram, shown to the left.

<< Figure 1: The invitation steps shown in a workflow diagram
WHAT IS A WORKFLOW?

Production Planning Workflow

- Create List: Equipment List
- Schedule Production Delivery
- Equipment List: Schedule Equipment
- Equipment schedule & maintenance restrictions noted
- Complete task

In an industrial setting, the invitation workflow is analogous to a production planning process where equipment is scheduled. Instead of allergies we’re interested in maintenance restrictions on the equipment. I.e. is the equipment scheduled for an outage?

<< Figure 2: The steps in production planning are very similar to those in our invitation workflow.

What about decisions? Sometimes we need to change the actions that the workflow performs based on input from an earlier step. Using the food preparation procedure we can see how the existence of a nut allergy alters the flow of actions (see Figure 3, page 7).
Many types of procedures can be orchestrated using workflow. Here are some other possibilities.

**Upstream O&G**
- Well test and well model validation
- Well and field surveillance
- Pressure transient analysis
- PCP or ESP performance calculations and notifications
- Routine maintenance calibrations such as PCP bucket tests

**Transformer monitoring**
- Bearing oil & temperature monitoring
- Vibration analysis
- Turbine monitoring

**Operations/Maintenance**
- Startup/shutdown procedures for equipment
- Electronic shift log and shift handover process
- Work order process (detect a fault, verify with engineer, raise work order if none present)
- Maintenance requests & responses
Procedure documents have been around for a long time, so why should we care about workflow? There are many reasons why. Let’s take a closer look.

**Knowledge Capture**

The single most compelling attribute of workflow is its ability to capture expert knowledge. Any given operating environment will have a handful of experts who have a “feel” for the manufacturing process. This is known as tacit knowledge and it is akin to driving a car or riding a bike. It is learned through experience and is hard to transfer to junior team members. So what happens when these experts retire, go on vacation, or are in short supply? We want to capture their expert knowledge and retain it as a corporate asset.

First, the expert describes an ad hoc process using a workflow authoring tool. These tools enable us to “see” the workflow in a very graphical way, and provide functionality to describe the workflow using drag-and-drop. So for example, you can create a sequence of steps easily — no need for programming. Instead, you select actions such as email notification from a palette and add them to the sequence.

Then, the workflow is published to Intuition Executive. From this point forward, the process is activated whenever certain conditions are met and the necessary participants are notified when action is required. Expert knowledge is effectively captured and ‘replayed’. Now our expert can take a much needed vacation.
Relevancy

First off, documents fall out of date. It’s like the old hiker’s saying, “Trust the terrain, not the map.”

It is quite common for documentation to lose touch with reality (not to mention SAT NAVs or GPS). Operating conditions change after the procedure was created, new systems are added, assets are bought and sold, and more efficient processes are discovered. Written documents simply cannot keep up.

When operating conditions change and invalidate the written procedure, people naturally find workarounds. This effectively negates the benefit of creating a procedure in the first place. Workflows on the other hand allow us to keep the procedure up to date. Users can maintain the workflow in an editor, make changes, and then put it online. Participants of the workflow do not need to read an updated procedure manual because the system becomes the manual and guides them through the process by notifying them when action is required.

Guidelines vs. Procedures

Documented procedures are not always followed. There is a big difference between a document which simply describes a process and a workflow that both describes and implements a process. It’s common to see a set of standard operating procedure (SOP) manuals on the shelf with a thick coat of dust. Although the intent is not to create optional guidelines, documented procedures do just this.

Intuition Executive workflow can improve this situation immensely by codifying SOPs. This elevates the SOP from an optional set of guidelines to a “live” orchestration of people and processes. People are notified when they need to take action and acknowledge when tasks are completed.
Auditing & Conformance

Was a procedure actually followed? When was the procedure initiated and completed? Who was responsible for performing the actions in the procedure? Manual processes are used today to answer these questions but they are time intensive and not applied consistently.

Software based workflow is auditable, provides a rich history of what actions were performed, by whom, and when. It’s consistent.

Long Running Procedures

Long running procedures are difficult to track. Sometimes we have complex procedures that span multiple shifts and therefore many people are involved. For example, a maintenance process might require input from multiple teams and take place over multiple shifts. Purchasing procedures that require input from multiple departments can also stay in flight for a long time. Manual and paper-based processes require managers to “babysit” the procedure.

Workflow engines are built to monitor short and long running procedures. Workflows can be created with built-in escalation procedures to handle cases where someone has not responded to a critical task. Task reminders and notifications are day-to-day features of a workflow.
Take Action Faster

Manual and partially automated procedures strive to bring corrective actions to bear but are ultimately limited by the overhead required to implement them. The process is typically championed by a supervisor who is tasked with multiple responsibilities. Ultimately this becomes a bottleneck to scalability and corrective actions are delayed because the champion can only juggle a finite set of tasks during the day. The longer the corrective actions are delayed, the longer production will be lost.

Intuition’s automated workflow system raises the alert as soon as a triggering condition is detected. This engages the necessary resources as quick as possible and allows for escalation in case someone is busy, on vacation, or simply unable to respond. Another key aspect of a workflow system is the ability to monitor “in-flight” workflows to determine which procedures are currently in progress and how far along they are. With this kind of visibility into our procedures we can see where the bottlenecks are and remove them in order to bring production back to optimal levels.
You’ve probably been here before.

There is an event of some kind that is very important to you. Maybe you want to know when a temperature or pressure has exceeded a threshold. Perhaps it is a precursor to an expensive maintenance situation, a fault condition, or a handicap to production. This is what is called a “trigger” because it initiates a notification, usually an e-mail or text message. What follows is an ad hoc analysis to determine if this is really something that warrants further attention. It generally looks like this.

Once you receive the email, you dig deeper into the process data yourself or ask a specialist to do some follow up work. Perhaps the next step is simply to check and see if the tank belongs to a unit that is currently shut down. If the unit is shut down then we can ignore the condition because the tank is allowed to reach an empty state. If it’s not shut down it could herald an impending trip. So if this is always the first thing we check, why not include it in the workflow?

Figure 4: Notification is a simple form of workflow

Figure 5: What happens next? Capture it in a workflow.
This is the “good stuff” where workflow is concerned. It is the steps that follow the trigger that we are keenly interested in. The simple notification that we saw initially is actually a workflow begging to be written. If it is important enough to email someone and have a proper diagnostic performed, it must be important enough to capture in a workflow. This will ensure that the actions that follow are executed consistently no matter who is performing them.

Intuition Executive enables users to do just this. The system provides the tools and engine to link triggers to workflows. This allows us to describe a wide variety of work processes and activate them on common triggers. This can be as simple as an e-mail notification or a series of steps that orchestrate a team of individuals.

Standard workflow systems typically require workflows to be activated explicitly. For example, the default engine included with SharePoint can run a workflow when an item is added to a list, when a list entry is changed, or manually invoked. Intuition Executive Event Notifier takes this one step further by linking workflows to OPC UA Events. So, for example, using the Intuition Stream Processor one can register a data pattern which is used to generate an event. The data pattern could be a limit check, calculation, or other kind of pattern match against incoming real-time data or events.

![Figure 6: Intuition Event Notifier links triggers to workflows](image-url)
Workflow authoring tools allow the user to “draw” the steps from start to finish. The output is a descriptive script that a workflow engine can execute.

Intuition Executive leverages the open-standard based Microsoft Windows Workflow Foundation (WF) that is standard to SharePoint. This engine is at the heart of the platform and automates the execution of workflows. Here are some reasons why this is a good thing:

- Users have the flexibility to choose from a variety of workflow authoring tools, choosing the one that best suits their needs.
- Integration with Active Directory. This enables browsing for groups or users when creating e-mail notifications, task list entries, etc.
- An extensible mechanism to “plug-in” new workflow activity libraries. This is handy for situations where you need to include a non- SOA based legacy system that doesn’t support existing workflow data access mechanisms.
- Integration with SharePoint 2010
- Extensible auditing interface

Intuition Executive takes things one step further, enhancing the out-of-the-box Microsoft Windows Workflow Foundation functionality to deliver operational excellence. Here are some of the enhancements Intuition Executive adds:

**Intuition Executive workflow activities**

We created product-specific workflow activities (for example, accessing the Intuition model, executing analyses, etc.) that are not part of the default SharePoint workflow engine.

**Special purpose workflow hosts**

Intuition Executive leverages the SharePoint workflow engine, but also hosts a separate instance for system workflows. This isolates the load between human-centric workflows and analysis based workflows.
Trigger workflows from events
The Intuition Event Notifier matches system events to workflows. The basic workflow functionality within SharePoint can only trigger events by list actions. Intuition Executive is able to trigger events based on arbitrary OPC UA events.

The Intuition family does not prescribe “one size fits all” architecture for workflow and is authoring tool agnostic. Although we use WF at the core, WF also acts as an excellent launch pad for external workflows and can host workflows authored by other tools, such as K2 and Nintex. Enterprise workflow systems can be called upon through WF activity. Figure 7 shows an example where a KPI, process value, or other real-time data pattern triggers a workflow to start. The workflow then calls upon another workflow in an enterprise workflow engine, external to Intuition Executive. This is a typical kind of “distributed workflow” that involves multiple engines.

<< Figure 7: Distributed workflow initiated via Intuition Event Notifier
CONCLUSION:
LIFE IS BETTER WITH WORKFLOW

Simply put, a procedure document intends to make things better. Workflow, on the other hand, is a commitment. Here is a quick summary of the benefits of workflow.

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<tbody>
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<td>Critical operating knowledge is lost when experts retire, move to another position in the organization, or simply go on vacation.</td>
<td>Workflow allows us to capture expert knowledge and “replay” it in the expert’s absence. It is also a valuable tool to transfer knowledge to junior team members.</td>
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<td>Operating conditions change after the procedure document was created: New systems are added, assets are bought and sold, and processes change. Written procedure documents fall out of date.</td>
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<td>the loop” as fast as possible to minimize production loss.</td>
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Many of the procedures we perform on a regular basis are great candidates for workflow orchestration. Start capturing this hard earned knowledge today so that it can be established as standard processes, audited, and shared with junior team members. Procedures are valuable corporate assets. Intuition Executive triggers workflows based on events or conditions and ensures action is taken to close the loop.

And, by the way, aside from some bickering between the in-laws and a missing napkin ring, our dinner party was a success. 😊