This green paper is taken from the book *SharePoint 2010 Workflows in Action* from Manning Publications. The author discusses a workflow and how it relates to your business processes. Further, he shows how workflows function within the SharePoint platform, along with the architecture of a SharePoint workflow. For the table of contents, the author forum, and other resources, go to [http://manning.com/wicklund/](http://manning.com/wicklund/).

Business processes surround us every day. The average employee is affected by them daily. Whether you like it or not, the company you work for is heavily dependent upon process to get stuff done and be profitable. Even someone who makes burgers at a fast food joint has to follow a specific process that will take that burger from nothing, into something that is delicious and nutritious.

Workflows are a system that manages the execution of a business process. They solve many of the most troubling problems that face a business process. The burger joint example is pretty simple, but there’s no doubt that large companies have very complicated business processes and it can be quite difficult to know how where in the process they are, or who the process may be waiting on.

Also, consider how business processes often get bogged down because of poor communication. Does your business process live and die entirely in email? This is very common. Email has become the dumping ground for everything from conversations, decisions, tasks, documents, and so on. Consider a process that runs when a new person is hired into your company. That employee needs a new account, email, badge, phone number, benefits, direct deposit, contracts, and so on. Getting all that accomplished in many cases involves many people, and they all go back and forth via email. Inevitably some things get lost. Email works for small companies, but what if you onboard 50 people per day? A system that will manage all these activities is needed or confusion and inefficiencies will certainly rear their ugly heads. A workflow is needed.

This article takes you through more detail on what a workflow is and how it relates to you business processes. Moreover, we’ll talk about how workflows function within the SharePoint platform, along with the architecture of a SharePoint workflow.

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**What is a Workflow?**

A workflow is primarily described as a process that manages the flow of work between individuals, offices, departments, and entire companies. Everybody works when they go to the office, but some work depends on other people or systems before that work can get completed. As these recurring dependencies are identified in a company, a business process emerges. Business processes run all over a company. Most business processes are commonplace among even very different companies.

Take, for instance, a business process that manages expense reports. Most companies need a defined business process to manage the submission and approval of an employee's monthly expenses. The flow of work here (Figure 1) involves an employee who tracks their expenses and then submits those expenses electronically. The flow then rests on some sort of business logic that determines who needs to approve the expenses and, after it is approved, somehow that individual needs to get reimbursed. A workflow will help negotiate the execution of the steps in a process like this.

[Figure 1 A workflow is most generically described as a business process. This example shows a common workflow that manages an expense reporting business process.]

Business processes are running in a company regardless if there is a workflow that manages them. Some business processes are very ad hoc and easy for humans to manage. Others are much more complicated and difficult for people to keep their heads around. It’s with these more complicated business processes where workflows really show their value to a company.

Workflows can bring value to a company by providing insight into where in the business process the flow of work is currently executing. Workflows can also help a company automate their business processes. Consider the expense report example again. Maybe your business process allows for all food expenses fewer than one hundred dollars to be automatically approved and sent to accounts payable for reimbursement. A workflow could manage this business logic and automatically approve the expense, without needing to get your manager in the loop.

Workflows are also really good at managing parallel processes or when multiple instances of work are all running at the same time. A manufacturing company would appreciate workflows because there are many processes that all run in parallel and, at the end, all finally come together as the final product. A car manufacturer could have a workflow that keeps an eye on the engine construction, and another for the frame, and another for the interior, and so on. Then a parent workflow could manage all of the "child" workflows and start another process as a dependant one finishes.

It is easy to see that there is a lot of value from investing in workflows to facilitate managing and automating your company's business processes. Essentially, doing something that can help to minimize human dependencies
as they pertain to business processes always saves company money. Human costs are always the most expensive investment a company makes, so let's make the people in our organizations work as efficiently and effectively as possible. That is the nature of why workflows are so important.

**How Does SharePoint Help?**

A SharePoint workflow is a piece of functionality you can attach to SharePoint objects that have a business process surrounding them. An object in SharePoint is something like a document or an item in a list like an announcement or task. For example, one of the workflows that you get when you install SharePoint is the Approval workflow. You can attach this workflow to a document in a document library and specify individuals who need to approve the document for use before some other action can occur.

**SharePoint Document Libraries**

SharePoint, in addition to being a collaboration platform (teammates sharing information with each other), is also a document management system. A document library in SharePoint is the tool you can use to upload documents into SharePoint.

A common case for this in the business world is again the expense report system (Figure 1). Within SharePoint, users can upload their expense reports into a document library. The upload action will kick off the Approval workflow on the document, and a series of individuals will get an email stating they now need to approve the expense report. When all those individuals have approved the expense report, the document could be routed to the payroll team site where a payroll officer handles the actual processing of the expense report.

A SharePoint Workflow, like the document Approval workflow that was just described, could be set up to manage the business process from start to finish. The workflow will handle all user interaction within the system. It will also manage the point of execution in the workflow. Additionally, SharePoint will provide an out-of-box user interface that reports on the state of the workflow or, more specifically, who the workflow may be waiting on before it can continue, or if it has finished executing.

This out-of-box experience that SharePoint provides is a really compelling reason to manage your business processes within SharePoint itself. I say this because SharePoint provides a user interface and other workflow fundamentals like security, reporting, and logging. These features make SharePoint workflows and your business processes a powerful combination.

Another great strength of SharePoint workflows is that individuals who are not technically savvy can configure their workflows directly through the browser window. Consider the expense report system again. If a company was to build this system from scratch, it would cost them much more time and money because they would not have all the fundamental components that SharePoint provides out of box. Rather, you can empower your end users to build these business processes and, at the most basic level, all they will need is a browser and possibly just a few minutes of their time. That's what I call cost effective!

**Figure 2** To manage workflows on a list or library, go to that list or library's Settings page

Notice how on a document library that contains some expense reports you can manage the settings of that library (Figure 2). Once in the settings, there's a Workflow Settings link under the Permissions and Management...
heading. This workflow settings page (Figure 3) is where you can add a workflow to a library. Simply select Add a Workflow and choose the one you want. It’s that easy!

**Workflows**

<table>
<thead>
<tr>
<th>Workflow Name (click to change settings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial Approval Workflow</td>
</tr>
</tbody>
</table>

- Add a workflow
- Remove a workflow
- View workflow reports

Figure 3 Once within the Settings Page of a list or library, you can then add a workflow onto that list or library

After the workflow has been added to the library, and the workflow process has been initiated, a new column (Figure 4) will show on the document on which the workflow process is running. This column will track the execution point on the workflow. The workflow may be halfway through the process and is waiting on some user interaction. Maybe a manager needs to approve the expense before it can continue. This status would show up in the new column as "Pending Manager Approval" or something else that accurately describes what the workflow is currently doing. Once the workflow has finished, "Completed" will show in this column.

So far we’ve been discussing what a workflow is from a business perspective and how that workflow can execute within SharePoint. The truth is this only scratches the surface of the foundation that SharePoint workflows sits upon.

**SharePoint as a Technology Platform**

SharePoint workflows leverage a separate platform called Windows Workflow Foundation (WF), which is a part of the .NET 3.5 application development framework. This foundation has many applications totally unrelated to SharePoint – in fact, you can use WF to build all sorts of workflow-enabled business applications that never touch or interact with SharePoint. However, SharePoint brings a very valuable benefit to an application developer in that it provides a robust user interface and implements the necessary persistence services required to run Workflow Foundation workflows. This means that SharePoint will manage the persistence of that workflow if it goes idle and provide a user interface that end users can use to start and stop workflows and review the status of workflow execution. For example, the expense report workflow needs to be persisted as it waits managerial approval.

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SharePoint also has out of box workflows built on top of the programming layer (Figure 5) and with tools like SharePoint Designer you can customize those workflows, if they don't meet your requirements. If you determine that a custom workflow is necessary, it is important to consider what type of workflow your custom workflow will need.

There are two types of workflows that the WF architecture and SharePoint support. It can either be a sequential workflow or a state machine workflow. Each type serves a unique purpose in what kinds of business processes it can support. However, before we dig into the differences between these two types, let’s first take a look at the architecture of this foundation we’re building upon...

**Windows Workflow Foundation Architecture**

The WF architecture is built upon three main tiers of services: the hosting layer (1st tier), runtime layer (2nd tier), and programming layer (3rd tier). You could say that SharePoint workflows sit on top of the 3rd tier’s services as its foundation. Things such as the out-of-box workflows, SharePoint Designer workflows, Visual Studio workflows, and our expense report example all would build on top of this foundation. Figure 5 shows how this looks.

![Figure 5 SharePoint workflows build upon the three layers of the Windows Workflow Foundation architecture. The programming layer is the interface between SharePoint and WF and resides on top of the core layers that manage the runtime and hosting.](image)

**Hosting Layer**

Every workflow needs a host process to run in. A workflow in and of itself is not an application. Similarly, if you install the .NET framework on a server, you don't have a line of business application when you click finish on the install wizard. WF acts as a platform you build upon. However, there are a few things that WF requires the application to implement from a hosting perspective to "keep the lights on," you could say.

Part of what is required of the application is the host process, as mentioned. Another aspect that the application must provide is persistence capabilities. Consider that a workflow is typically long running, meaning that it may start and then go dormant for a while, possibly even many months. The state of the workflow needs to be persisted while the workflow is waiting for some action to occur, and when that action occurs, the workflow should resume where it left off.

WF has some canned persistence objects a developer can use. For instance, the SQLWorkflowPersistanceService class will help facilitate the serialization of the state of the workflow and store that state within a SQL database while the workflow goes dormant or idle. This is very similar to what SharePoint does, except, with SharePoint the service is already set up and the developer doesn't need to concern himself with it. Notice in Figure 6 the Communication and Persistence bubble. At a high level, this is what part of the hosting layer is responsible for.
Another area of responsibility for the Hosting Layer is to provide timers and tracking capabilities. As mentioned, a workflow may go dormant as it waits for an outside action to occur. In addition to an outside action, it may instead be simply time bound. For example, maybe the expense report workflow assigns a task to the manager to approve the report, but that task goes 7 days without being completed. At that point, the workflow "wakes up" and reassigns the task to someone in payroll. This also relates to tracking, in that you'll want to know, or track, where in the process the workflow is currently executing. In a nutshell, this is part of the responsibility of the timer and tracking aspect of the host process. Transactions are another important aspect of the hosting framework, in that you can leverage transactions to roll back a workflow to a previous state if an error occurs, for example.

**Runtime Layer**
This layer represents all core services that come with WF. For instance, the tracking, scheduling, and persistence services at runtime are performing WF critical activities that negotiate the workflow's execution and life cycle. This layer has interfaces that the hosting layer uses to connect the outside world to the WF engine.

**Programming Layer**
The programming layer is the Developer's favorite layer and, especially for SharePoint Developers, is all they'll typically need to worry themselves with. This layer has out-of-box activities that can perform various actions in the workflow and allow for custom activities and rules that workflows interact with.

**Types of Workflows**
The way in which a workflow will execute from one step in the process to another falls in one of two categories. A workflow is either sequential, in that the steps within the workflow execute sequentially one after another, or a workflow is a state machine where it executes in no particular order. A sequential workflow always progresses forward and never goes back to a previous step (Figure 6).

![Figure 6 Sample "Sequential" Workflow that always advances forward in the process, never backwards](image)

A State Machine on the other hand has no such constraint but rather moves from one state to another, until some logic concludes the workflow has completed. A good example of this is a bug tracking workflow that tracks bugs in a computer program (Figure 7). When the workflow first starts the bug may be placed into a "Pending"
state, where it waits for a developer to be assigned to the bug and start working on the bug. Thereafter, the developer starts working on the bug and fixes it, putting the bug into a "Fixed" state. When a bug is fixed, a tester goes to confirm the resolution of the bug, in which time he finds that it was not fixed and places the bug back in a "Pending" state. This ability to go back in time or to a previous state is only available with State Machine workflows.

![State Machine Workflow Diagram](image)

Figure 7 This sample workflow needs a State Machine because in many different instances it may need to go back a step or repeat the whole process entirely.

Obviously, some business processes require a state machine and others don't. It is important to think through your business process requirements before you start building a custom workflow, because it is difficult to change course after you have already started down a path. As you progress through this book you'll notice that some workflow tools can only do sequential workflows (as is the case with SharePoint Designer), whereas other tools can do both types. If you start building a workflow with a tool and that tool doesn't support state machines you may find yourself starting over, if later down the road you realize you need to change course. So the bottom line is, think carefully through which type you need before you start.

**Workflow Enabled SharePoint Objects**

There are many different types of objects within SharePoint. Objects come in many forms such as lists, list items, libraries, documents, forms, content types, site columns, views, web parts, sites, and site collections. Going back to our expense report example, the workflow runs on a document that was uploaded in the document library. In addition to documents, there are several other types of SharePoint objects that workflows can execute on.

**List Items**

Just like documents, generic SharePoint list items can have a workflow running on them. For instance, you could set up an approval process on an Announcements list. With this setup, announcements won't show to end users until they're approved. Another great use of list items is on task lists and issues list (both are out-of-box SharePoint list types). When a task or issue is assigned to someone, and that individual resolves the task or issue, a workflow might forward the task to another individual who is responsible to verify its completion before it can be
finalized or completed. If that individual finds an error, the workflow could reassign the list item back to the original user. Figure 8 shows the workflows menu item on a list item. Through this menu item, you can start a new workflow instance on the item.

Figure 8 To start a workflow on a list item or document, click the drop down on that item, and then select the Workflows menu item to take you to a page where you can initiate a new workflow instance.

**InfoPath Forms**

Technically an InfoPath form (Figure 9) is a document and would fall into the document library category of SharePoint objects that has already been discussed. However, there is also great value in calling them out separately. It is commonplace to attach a workflow to a form. Take, for instance, the expense report system again. Oftentimes, a company will want a standard template that their employees must use when filling out an expense report. This template usually has unique needs or must look a certain way that is unique for that company. The Microsoft Office InfoPath 2010 client application is a great tool to build forms with that your users can fill out.

Figure 9 InfoPath Forms are a great avenue to take to develop custom forms for your workflows. This example shows the InfoPath Office client in Design mode.

The strength of InfoPath is its ability to make form creation easy for even novice users. If you’re familiar with Microsoft Word, you stand a good chance to catch on to InfoPath quite well. With InfoPath you have tons of flexibility to make a form that meets your needs. You have far more user interface flexibility with InfoPath than say if you used an Excel Document. Also, just like Microsoft Office documents, workflows can be bound to an InfoPath

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form, and when the user fills out all the appropriate areas within the form, the workflow can manage the business process behind it and get that form approved or denied.

**Content Types**

Content Types within SharePoint are a way to package up pieces of metadata and make those metadata collections reusable. For instance, let’s say you wanted three columns on every list or library in your site collection. Rather than go to each list, and add each column manually, you can create a content type that has those three columns within it and then just add the content type to the lists or libraries. This can be a big time saver and it also allows for a lot of reuse benefits when changes to the content type need to be made later.

As far as workflows go, you can also add a workflow into a content type. Just like adding columns into a content type saves time, so does putting the workflow in that same content type. Additionally, a content type can have one or many workflows assigned to it. So, if you have a complex business process with many types of workflows that all need to execute simultaneously, deploying that workflow to a Content Type may be a good idea. When a workflow is deployed onto a content type, new instances of that workflow can be initiated wherever list items of that content type exist, no matter what SharePoint list they reside in. So in some sense, this introduces some reusability into your workflow across more than just one list.

Notice the new expense report drop down (Figure 10).

![Image](image_url)

*Figure 10 Workflows oftentimes run on a content type. As you add content types to a list or library, more options appear in the New drop down to select which content type to use.*

This demonstrates how you can use content types to allow for several different expense report templates to be available, possibly one for each department in the company. The form and/or workflow for the HR department’s expense reports may be different than the workflow for the Sales department, in which case using two different content types would allow the user to choose which form and workflow is right for them.

**SharePoint Sites**

One final area that you can bind a workflow to is on a SharePoint site itself. Whereas all the other SharePoint object examples boiled down to a list item of some sort (whether it be a document, form, or content type), a workflow deployed onto a site can run actions on and react to events across lists, document libraries, and items in that site. For example, take a site that has many document libraries and many documents in each. A workflow that would be well suited to running at the site level could check each document within that site and ensure that the documents have been routed for approval and that none have been declined. A new item has been added into the Site Actions menu to configure these Site wide workflows. Workflows can execute across an entire SharePoint site and are initiated from the Site Actions menu.

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What's new for Workflows with SharePoint 2010

With the release of SharePoint 2010, there is a host of new workflow functionalities available. This is especially true for custom workflows, where a few of the new features radically make developing workflows much easier. Take, for example, the introduction of Reusable Workflow. With 2010, workflows can now be deployed in a reusable fashion from within SharePoint Designer, which enables users of Designer to be much more efficient in their work. In the 2007 product, they used to have to literally recreate each workflow onto every list instance that they wanted it to be deployed onto. Now with 2010, a workflow only needs to be created and maintained in one place, and it can be installed onto many lists and receive updates if the original workflow is edited. In addition to reusable workflows, there are many more great enhancements that have been made to workflows in the 2010 release. Some of the key improvements follow.

Office Visio 2010 SharePoint Workflows

Bar none, the new functionality in Office Visio 2010 will bring the most smiles for SharePoint Business Analysts. With Visio 2010, you can now model out your SharePoint workflows and leverage that model to help elicit business approval. The best part is that, after you've solidified that high level flow, you can export the workflow as a template and import it into SharePoint Designer and start building out the steps! This will greatly improve the efficiency of requirements gathering and translation to developers.

Customizing the Out-of-Box Workflows

Have you ever used an out-of-box workflow in SharePoint 2007, but it didn't quite do just what you needed it to do? If this statement is true for you, you'll be pleased to hear that these out of box workflows can be customized in SharePoint Designer 2010 (Figure 11).

Figure 11 Editing the Out-of-Box Approval workflow in SharePoint Designer 2010

Whether it is an existing instance of an out-of-box workflow or if you want to create a new workflow off the out-of-box template, there exists now this flexibility in the 2010 product.
New Actions and Conditions Available in SharePoint Designer

There’s a host of new out-of-box conditions and actions available in SharePoint Designer 2010. A couple of the highlights are that you can now manage permissions in a workflow (just think of the possibilities here!) and interface with Records center to accommodate retention policies.

Reusable Workflows

As mentioned in the introduction to this subtopic, reusable workflows can now be created and deployed to the site or site collection level and be consumed by various objects within that scope. The major benefit here is that you no longer need to maintain more than one copy of the same workflow.

Site Workflows

Site Workflows takes the concept of reusable workflows a step further. In addition to a workflow's capability to run on a list, library, or list item within a site, a Site Workflow can run on the site itself. A good business example of this is a workflow that needs to ensure that all documents on the entire site, regardless of the list where they reside, have been approved. A site workflow could iterate through all the libraries and check if each document has been approved or not. There is a host of other applications for deploying a workflow within this scope as well.

Task Processing Customization

In most workflows, tasks are delegated to certain individuals. When a task is assigned, the workflow will typically wait for an action to occur upon that task, in which case the workflow will resume processing. In SharePoint 2007, the nature of this task processing was pretty static, meaning that you could not alter the way the out-of-box workflows handled tasks and events associated with them. However, in SharePoint 2010, you can now fully customize what actions you want when various task events occur. A few of these events are when a task is assigned, expired, deleted, and completed. Now, when each of these events occurs, you can inject your own custom activities to change the way the task processing flows.

Viewing Workflow Status with Visio Web Access

A neat new reporting feature that is available in SharePoint Server Enterprise edition is the ability to view a workflow's status through a Visio diagram. If you first build your workflow in Office Visio 2010 and then import that workflow into SharePoint Designer, you can enable Visio web access on that workflow. Throughout the workflow’s lifecycle, the Visio diagram will dynamically update to reflect where the workflow is currently executing. Notice the green checkboxes in Figure 12.

![Workflow status can now be consumed through a dynamic Visio 2010 diagram](image)

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You can see the path that the workflow has taken and where it is executing. In this case, it has finished executing.

**Importing SharePoint Designer Workflows in Visual Studio**

A stunning new feature that comes with 2010 is the ability to export a SharePoint Designer workflow and thereafter import that workflow into Visual Studio (Figure 10).

Figure 10 Visual Studio 2010 comes with a new ability to import a workflow created in SharePoint Designer

This is very powerful because, oftentimes, you may first create a workflow in SharePoint Designer since it is such an easy tool to use. However, after a year or so goes by, you may realize that your business requirements have changed and become more complicated, necessitating a Visual Studio workflow. In SharePoint 2007, you would have had to recreate the SharePoint Designer workflow from scratch within Visual Studio, but now, because of the new export/import functionality, you won't lose those valuable man hours that it took to build the Designer workflow.

**Visual Studio 2010 Environment Improvements**

There’s no doubt that building custom workflows within Visual Studio has gotten dramatically easier with the 2010 releases of SharePoint and Visual Studio. Many would consider that most of the effort to build Visual Studio 2008 workflows in SharePoint 2007 was around the packaging and deployment of the workflow itself. You can build all the features, DDFs, manifests, keys, tokens, GUIDs, and everything else by hand! This is no more with Visual Studio 2010 – all the necessary features and solution packages necessary to deploy the workflow into SharePoint are generated for you manually. Just right click and deploy!

**Pluggable Workflows**

In SharePoint 2007, there was no easy way for running workflows to receive updates from the outside world. With the new pluggable capabilities that come with SharePoint 2010, workflows can now execute up to a certain point, and then wait for information from an external process. The developer simply needs to implement an event handler or web service of some sort to handle the request of the external process and thereafter respond by calling into a method within the workflow itself, informing it to continue processing.

**New Event Handlers**

A couple new event handlers are present within SharePoint 2010, and that's the ability to react to a workflow’s initialization or completion. These handlers may be external to the workflow or embedded within the workflow.
itself. For instance, you may want to fire some code that logs in a centralized repository every time a workflow of a certain type has been started and when it is completed. With these new event handlers, this is easily possible.

**Summary**

There are many powerful reasons why SharePoint workflows are a great tool to automate, track, and organize your company’s business processes. Automating many of your most common business processes including expense reporting systems, paid time off requests, and capital expenditure requests is easily feasible within SharePoint and by doing so it is easy to see how you can add lots of value to your organization.

SharePoint workflows can execute on list items, documents, forms, content types, and even across an entire site or site collection within SharePoint. The boundaries are almost limitless in where you can take this technology and platform. Without even thinking too hard, you can put to use several compelling out-of-box workflows that come with SharePoint, and introduce immediate value into your SharePoint sites. If those workflows don't meet your business's unique needs, there's a host of workflow customization tools available like Visio diagramming, SharePoint Designer, InfoPath forms, and Visual Studio.

In that regard too, the 2010 release of SharePoint has introduced a slew of new functionality that greatly improves how workflows are architected on SharePoint. A great improvement in 2010 is the ability to create reusable workflows. With SharePoint Designer 2007, you literally had to recreate a workflow on every list in your entire farm that you needed that workflow to execute. This was terribly inefficient and costly. Now, you can publish workflows globally, which is a great time saver and drives a lot of consistency.