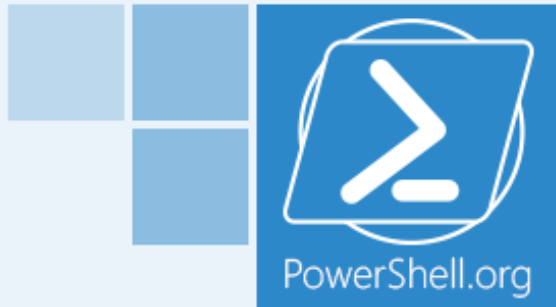


The Community Book of PowerShell Practices

compiled by
Don Jones
and Matt Penny



The Community Book of PowerShell Practices

by Don Jones, Matt Penny
and the Windows PowerShell Community

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Foreward

During the 2013 Scripting Games, it became apparent that a great many folks in the PowerShell community have vastly different ideas about what's "right and wrong" in the world of PowerShell scripting. Some folks down-scored techniques that others praised, and vice-versa.

After the Games, PowerShell.org ran a series of "Great Debate" blog posts, outlining some of the more controversial issues and asking for community input. The catch is the input had to not only state what the person thought was best, but very specifically *why* they thought that.

This book, which will likely be an ongoing effort, is a compilation of those Debates' comments, formed as a "best practices" guide that is based on community input.

It's important to realize that practices are *not* hard-and-fast rules. Best practices are the things you *usually* do as a starting point, and deviate from when it's appropriate. You should understand that these practices were formed primarily by people who are writing scripts to manage their own environment, and who are often pressed for time. They are not developing commercial software, they rarely have the luxury of extended test-and-develop cycles, and for the most part are not professional software developers. Their perspective definitely drives what they consider "best" and "worst," but if you are working from a different perspective then you'll have to take all of this with a grain of salt.

The format of the headings was inspired by reading Steven Feuerstein's excellent book 'Oracle PL/SQL Best Practices'

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Writing Help and Comments

DOC-01 Write comment-based help

You should always write comment-based help in your scripts and functions.

Comment-based help is formatted as follows:

```
function your-function {  
<#  
.SYNOPSIS  
A brief description of the function or script.  
  
.DESCRIPTION  
A longer description  
  
.PARAMETER FirstParameter  
Description of each of the parameters  
  
.PARAMETER FirstParameter  
Description of each of the parameters  
  
.INPUTS  
Description of objects that can be piped to the script  
  
.OUTPUTS  
Description of objects that are output by the script  
  
.EXAMPLE  
Example of how to run the script  
  
.LINK  
Links to further documentation  
  
.NOTES  
Detail on what the script does, if this is needed  
#>
```

Comment-based help is displayed when the user types ‘help <your-function>’

Your help should be *helpful*. That is, if you’ve written a tool called “Get-LOBAppUser”, don’t write help that merely says, “Gets LOB App Users.” Duh.

Further information: You can get more on the use of comment-based help by typing ‘help about_Comment_Based_Help’ within Powershell.

DOC-02 Describe each parameter

Your help should describe the proper use of each parameter in the comment-based help.

DOC-03 Provide usage examples

Your help should provide examples for each major use case.

A ‘usage example’ is just an example of what you would type in to Powershell to run the script – this can be cut and pasted from the command line.

DOC-04 Use the Notes section for detail on how the tool works

If you need to explain some of the detail about how the tool works, do so in the Notes section.

DOC-05 Keep your language simple

Comment-based help should be written in simple language.

You're not writing a thesis for your college Technical Writing class - you're writing something that describes how a function works. Avoid grandiloquent, multisyllabic verbiage and phrasing. In other words, *put the thesaurus down*. You're not impressing anyone.

If you're writing in what is, for you, a foreign language, simpler words and simpler sentence structures are better, and more likely to make sense to a native reader.

Be complete, but be concise.

DOC-06 Comment your code

Inline comments are also useful.

Keep in mind that these should explain the working of the code, but not how to use the tool itself, since an ordinary user won't see inline comments. Try to put a small block of inline comment before each functional hunk of your code.

DOC-07 Don't over-comment

Don't precede each line of code with a comment - doing so breaks up the code and makes it harder to follow. *Don't* restate the obvious:

```
# Get the WMI BIOS object from the computer
Get-WmiObject -Class Win32_BIOS -ComputerName $computer
```

Duh. A well-written PowerShell command, with full command and parameter names, can be pretty self-explanatory. Don't comment-explain it unless it *isn't* self-explanatory. Comments should describe the *logic* of your code, not attempt to document what each command is going to do.

Another example:

```
#####
#
# PREPARE VARIABLES
#
#####
$computers = @()
```

Really? Five lines of comment to one line of functional code? That is not okay. It actually makes the code harder to read. It doesn't add value - anyone looking at the code can *tell* that a variable is being set up for something. It's just noise.



As a note, within the context of the Scripting Games, be really careful about adding help that explains that you took a particular approach because such-and-such other approach wouldn't work. If you write that, you'd better be correct. If you're not, expect to fail without explanation.

Versioning

VER-01 Write for the lowest version of PowerShell that you can

As a rule, write for the lowest PowerShell version that you can, especially with scripts that you plan to share with others. Doing so provides the broadest compatibility for other folks.

That said, don't sacrifice functionality or performance just to stick with an older version. If you *can* safely write for a higher version (meaning you've deployed it everywhere the script will need to run), then take advantage of that version. Keep in mind that some newer features that *seem* like window dressing might actually have underlying performance benefits. For example, in PowerShell v3:

```
Get-Service | Where-Object -FilterScript { $_.Status -eq 'Running' }
```

Will run significantly slower than:

```
Get-Service | Where Status -eq Running
```

because of the way the two different syntaxes have to be processed under the hood.

Further information: You can get some detail on the differences between versions of Powershell by typing 'help about_Windows_PowerShell_2.0' (or _3.0 or 4.0) in Powershell



In the context of the Scripting Games, don't ever down-score someone for writing to a particular version, so long as they've documented it, unless the scenario explicitly states that a particular version must be used.

VER-02 Document the version of PowerShell the script was written for

All that said, make sure you specify the version of PowerShell you wrote for by using an appropriate '#requires' statement:

```
#requires -version 3.0
```

The #requires statement will prevent the script from running on the wrong version of PowerShell.



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Performance

PERF-01 If performance matters, test it

PowerShell comes equipped with 3.2 million performance quirks. Approximately.

For example, the first line below executes a lot faster than the second:

```
[void]Do-Something  
  
Do-Something | Out-Null
```

If you're aware of multiple techniques to accomplish something, and you're writing a production script that will be dealing with large data sets (meaning performance will become a cumulative factor), then *test* the performance using Measure-Command or some other tool.



In the context of the Scripting Games, if performance is a stated goal, then it's fine to down-score someone for using a technique that's demonstrably slower than an alternative, but *never* down-grade for personal, subjective, or aesthetic reasons.

PERF-02 Consider trade-offs between performance and readability

Performance is not the only reason you write a script. If a script is expected to deal with ten pieces of data, a 30% performance improvement will not add up to a lot of actual time. It's okay to use a slower-performing technique that is easier to read, understand, and maintain - although "easier" is a *very* subjective term. Of the two commands above, any given person might select *either* of them as being "easier" to understand or read.

This is an important area for people in the PowerShell community. While everyone agrees that aesthetics are important - they help make scripts more readable, more maintainable, and so on - performance can also be important. However, the advantages of a *really tiny performance gain* do not always outweigh the "soft" advantages of nice aesthetics.

For example:

```
$content = Get-Content file.txt  
ForEach ($line in $content) {  
    Do-Something -input $line  
}
```

Most folks will agree that the basic aesthetics of that example are good. This snippet uses a native PowerShell approach, is easy to follow, and because it uses a structural programming approach, is easy to expand (say, if you needed to execute several commands again each line of content). However, this approach *could* offer extremely poor performance. If file.txt was a few hundred kilobytes, no problem; if it was several hundred *megabytes*, potential problem. Get-Content is forced to read the entire file into memory at once, storing it in memory (in the \$content variable).

Now consider this alternate approach:

```
Get-Content file.txt |  
ForEach-Object -Process {  
    Do-Something -input $_  
}
```

```
}
```

As described elsewhere in this guide, many folks in the community would dislike this approach for aesthetic reasons. However, this approach has the advantage of utilizing PowerShell's pipeline to "stream" the content in file.txt. Provided that the fictional "Do-Something" command isn't blocking the pipeline (a la Sort-Object), the shell can send lines of content (String objects, technically) through the pipeline in a continuous stream, rather than having to buffer them all into memory.

Some would argue that this second approach is always a poor one, and that if performance is an issue then you should devolve from a PowerShell-native approach into a lower-level .NET Framework approach:

```
$sr = New-Object -Type System.IO.StreamReader -Arg file.txt
while ($sr.Peek() -ge 0) {
    $line = $sr.ReadLine()
    Do-Something -input $line
}
```

There are myriad variations to this approach, of course, but it solves the performance problem by reading one line at a time, instead of buffering the entire file into memory. It maintains the structured programming approach of the first example, at the expense of using a potentially harder-to-follow .NET Framework model instead of native PowerShell commands. Many regard this third example as an intermediate step, and suggest that a truly beneficial approach would be to write PowerShell commands as "wrappers" around the .NET code. For example (noting that this fourth example uses fictional commands by way of illustration):

```
$handle = Open-TextFile file.txt
while (-not Test-TextFile -handle $handle) {
    Do-Something -input (Read-TextFile -handle $handle)
}
```

This example reverts back to a native PowerShell approach, using commands and parameters. The proposed commands (Open-TextFile, Test-TextFile, and Read-TextFile) are just wrappers around .NET Framework classes, such as the StreamReader class shown in the third example.

You will generally find that it *is* possible to conform with the community's general aesthetic preferences while still maintaining a good level of performance. Doing so may require more work - such as writing PowerShell wrapper commands around underlying .NET Framework classes. Most would argue that, for a tool that is intended for long-term use, the additional work is a worthwhile investment.

The moral here is that both aesthetic and performance are important considerations, and without some work context, neither is inherently more important than the other. It is often possible, with the right technique, to satisfy *both*. As a *general* practice, you should avoid giving up on aesthetics *solely* because of performance concerns - when possible, make the effort to satisfy both performance and aesthetics.



In the context of the Scripting Games, *do not* penalize entries for using a particular aesthetic approach on the grounds of poor performance, unless the Games assignment explicitly makes performance a goal and sets up a scenario where performance would be a problem. In other words, don't penalize someone because "if such-and-such were true, performance would be bad," unless it's made clear that such-and-such is in fact true.

Aesthetics

READ-01 Indent your code

Consider this code example:

```
if ($this -gt $that) {  
    Do-Something -with $that  
}
```

And now consider this one:

```
if ($this -gt $that)  
{  
    Do-Something -with $that  
}
```

Neither of these is better than the other. Ask 100 coders which they prefer and you'll get roughly half liking either one. Now, when you start dealing with commands that accept script blocks as parameters, things can get trickier because of the way PowerShell parses syntax. "Wrong" is wrong. With scripting constructs, like the two examples above, there's *no functional difference*.

Continuing in that vein, understand that the following are basically guidelines from mass consensus; they're not hard-and-fast rules. That said, there are arguments in favor of these, and you should consider the arguments before dismissing these ideas.

First, *format your code properly*. The convention is to indent within constructs, to make it clearer what "belongs to" the construct.

```
ForEach ($computer in $computers) {  
    Do-This  
    Get-Those  
}
```

You will probably be reviled if you don't format carefully.



In the context of the Scripting Games, don't down-score someone for using an approach that *you personally* don't like to use for aesthetic reasons. If performance is a stated goal, then it's fine to down-score someone for using a technique that's demonstrably slower than an alternative, but *never* down-grade for personal, subjective, or aesthetic reasons.

READ-02 Avoid backticks

Consider this:

```
Get-WmiObject -Class Win32_LogicalDisk `  
    -Filter "DriveType=3" `  
    -ComputerName SERVER2
```

In general, the community feels you should avoid using those backticks as "line continuation characters" when possible. They're hard to read, easy to miss, and easy to mis-type. Also, if you add an extra whitespace after the

backtick in the above example, then the command won't work. The resulting error is hard to correlate to the actual problem, making debugging the issue harder.

Here's an alternative:

```
$params = @{Class=Win32_LogicalDisk;  
            Filter='DriveType=3';  
            ComputerName=SERVER2}  
Get-WmiObject @params
```

The technique is called *splatting*. It lets you get the same nice, broken-out formatting without using the backtick. You can also line break after almost any comma, pipe character, or semicolon without using a backtick.

The backtick is not universally hated - but it can be inconvenient. If you *have* to use it for line breaks, well then, use it. Just try not to have to.

Output

OUT-01 Don't use write-host unless writing to the host is the only goal

It is generally accepted that you should never use Write-Host to create any script output whatsoever, unless your script (or function, or whatever) uses the Show verb (as in, Show-Performance). That verb explicitly means “show on the screen, with no other possibilities.” Like Show-Command.

OUT-02 Use write-verbose to give information to someone running your script

Verbose output is generally held to be output that is useful or anyone running the script, providing status information (“now attempting to connect to SERVER1”) or progress information (“10% complete”).

OUT-03 Use write-debug to give information to someone maintaining your script

Debug output is generally held to be output that is useful for script debugging (“Now entering main loop,” “Result was null, skipping to end of loop”), since it also creates a breakpoint prompt.

OUT-04 Use [CmdletBinding()] if you are using write-debug or write-verbose

Both Verbose and Debug output are off by default, and when you use Write-Verbose or Write-Debug, it should be in a script or function that uses the [CmdletBinding()] declaration, which automatically enables the switch.

The CmdletBinding attribute is specified on the first line of the script or function. After the name and inline help, but before the parameter definition:

```
function your-function {  
    <#  
    <Comment-based help>  
    #>  
    [CmdletBinding()]  
    Param( [String] $Parameter1)
```

Tools vs. Controller?

TOOL-01 Decide whether you're coding a 'tool' or a 'controller script'

For this discussion, it's important to have some agreed-upon terminology. While the terminology here isn't used universally, the community generally agrees that several types of "script" exist:

- Some scripts contain *tools*, when are meant to be reusable. These are typically functions or advanced functions, and they are typically contained in a script module or in a function library of some kind. These tools are designed for a high level of re-use.
- Some scripts are *controllers*, meaning they are intended to utilize one or more tools (functions, commands, etc) to automate a specific business process. A script is not intended to be reusable; it is intended to make use of reuse by leveraging functions and other commands

For example, you might write a "New-CorpUser" script, which provisions new users. In it, you might call numerous commands and functions to create a user account, mailbox-enable them, provision a home folder, and so on. Those discrete tasks might also be used in other processes, so you build them as functions. The script is only intended to automate that one process, and so it doesn't need to exhibit reusability concepts. It's a standalone thing.

Controllers, on the other hand, often produce output directly to the screen (when designed for interactive use), or may log to a file (when designed to run unattended).

TOOL-02 Make your code modular

Generally, people tend to feel that most *working code* - that is, your code which does things - should be modularized into functions and ideally stored in script modules.

That makes those functions more easily re-used. Those functions should exhibit a high level of reusability, such as accepting input only via parameters and producing output only as objects to the pipeline

TOOL-03 Make tools as re-usable as possible

Tools should accept input from parameters and should (in most cases) produce any output to the pipeline; this approach helps maximize reusability.

TOOL-04 Use PowerShell standard cmdlet naming

Use the verb-noun convention, and use the PowerShell standard verbs.

You can get a list of the verbs by typing 'get-verb' at the command line.

TOOL-05 Use PowerShell standard parameter naming

Tools should be consistent with PowerShell native cmdlets in regards parameter naming.

For example, use `$ComputerName` and `$ServerInstance` rather than something like `$Param_Computer` and `$InstanceName`

TOOL-06 Tools should output raw data

The community generally agrees that tools should output raw data. That is, their output should be manipulated as little as possible. If a tool retrieves information represented in bytes, it should output bytes, rather than converting that value to another unit of measure. Having a tool output less-manipulated data helps the tool remain reusable in a larger number of situations.

TOOL-07 Controllers should typically output formatted data

Controllers, on the other hand, may reformat or manipulate data because controllers do not aim to be reusable; they instead aim to do as good a job as possible at a particular task.

For example, a function named `Get-DiskInfo` would return disk sizing information in bytes, because that's the most-granular unit of measurement the operating system offers. A controller that was creating an inventory of free disk space might translate that into gigabytes, because that unit of measurement is the most convenient for the people who will view the inventory report.

An intermediate step is useful for tools that are packaged in script modules: views. By building a manifest for the module, you can have the module also include a custom `.format.ps1xml` view definition file. The view can specify manipulated data values, such as the default view used by PowerShell to display the output of `Get-Process`. The view does not manipulate the underlying data, leaving the raw data available for any purpose.

The Purity Laws

PURE-01 Use native PowerShell where possible

PURE-02 If you can't use just PowerShell, use .net, external commands or COM objects, in that order of preference

First, at the end of the day, *get the job done the best way you can*. Utilize whatever means you have at your disposal, and focus on the techniques you already know, because you'll spend less time coding that way.

That said, there are advantages to sticking with "PowerShell native." In general, folks tend to prefer that you accomplish tasks using the following, in order of preference:

1. PowerShell cmdlets, functions, and other "native" elements. These are (or can be) very well documented right within the shell itself, can (and should) use consistent naming and operation, and are generally more discoverable and easier to understand by someone else.
2. .NET Framework classes, methods, properties, and so on. While not documented in-shell, they at least stay "inside the boundaries" of .NET, and .NET Framework classes are typically well-documented online.
3. External commands, like Cacs.exe or PathPing.exe. While not documented in-shell, most tools do offer help displays, and most (especially ones that ship with the OS or server product) have numerous online examples.
4. COM objects. These are rarely well-documented, making them harder for someone else to research and understand. They do not always work flawlessly in PowerShell, as they must be used through .NET's Interop layer, which isn't 100% perfect.

PURE-03 Document why you haven't used PowerShell

So when is it okay to move from one item on this list to another? Obviously, if a task *can't* be accomplished with a more-preferred way, you move on to a less-preferred way.

If a less-preferred approach offers far superior performance, and performance is a potential issue, then go for the better-performing approach. For example, Robocopy is superior in nearly every way to Copy-Item, and there are probably numerous circumstances where Robocopy would do a much better job.

Document the reason for using tools other than PowerShell in your comments.

PURE-04 Wrap other tools in an advanced function or cmdlet

That said, you truly become a better PowerShell person if you take the time to *wrap* a less-preferred way in an advanced function or cmdlet. Then you get the best of both worlds: the ability to reach outside the shell itself for functionality, while keeping the advantages of native commands.

Ignorance, however, is no excuse. If you've written some big wrapper function around Ping.exe simply because you were unaware of Test-Connection, then you've wasted a lot of time, and that is not commendable. Before you move on to a less-preferred approach, make sure the shell doesn't already have a way to do what you're after.

Pipelines vs. Constructs

PIPE-01 Avoid using pipelines in scripts

Consider this:

```
Get-Content computer-names.txt |  
ForEach-Object -Process {  
    Get-WmiObject -Class Win32_BIOS -ComputerName $_  
}
```

And now this alternative:

```
$computers = Get-Content computer-names.txt  
foreach ($computer in $computers) {  
    Get-WmiObject -Class Win32_BIOS -ComputerName $computer  
}
```

The world definitely prefers the latter approach *in a script or function*. Constructs nearly always exhibit higher performance than pipeline-only approaches. Constructs also offer far more flexibility, especially when you're looping through multiple commands. Error handling becomes far easier and more structured with the latter approach, as does debugging.

On the command-line, by yourself, do whichever you prefer. It's as you move into a script - an inherently more structured environment - that you want to start shifting to a more programming-style approach.

One-Liners



In the context of the Scripting Games, if you are asked to do something as a “one-liner,” that means a single, continuous pipeline. Using semicolons to jam multiple “lines” into a single “line” does not count.

If someone is asking for a one-liner, they’re doing it to test a certain type of PowerShell mettle. Mashing multiple lines together by means of semicolons does not fulfill the intent of the question.

“The PowerShell Way”

There *is no one, true way* to do anything in PowerShell. To resurrect a previous pair of examples:

```
[void]Do-Something
```

```
Do-Something | Out-Null
```

Same end effect, but some folks will argue that the first command is more “programmer-y” and less “PowerShell-y.” The first example runs faster, however, so there’s more than an aesthetic difference here.

It’s important to note that although PowerShell isn’t a programming language, it - like most good shells - does *contain* a programming language. It’s okay to use it. It’s fine to use more programming-style approaches. Don’t dismiss a technique or approach because 'it looks like programming' to you, and because you aren’t a programmer and don’t want to be one. You might actually be missing out on something.

Trapping and Capturing Errors

ERR-01 Use -ErrorAction Stop when calling cmdlets

When trapping an error, try to use **-ErrorAction Stop** on cmdlets to generate terminating, trappable exceptions.

ERR-02 Use \$ErrorActionPreference='Stop'/'Continue' when calling non-cmdlets

When executing something other than a cmdlet, set **\$ErrorActionPreference='Stop'** before executing, and re-set to **Continue** afterwards. If you're concerned about using **-ErrorAction** because it will bail on the entire pipeline, then you've probably over-constructed the pipeline. Consider using a more scripting-construct-style approach, because those approaches are inherently better for automated error handling.

Ideally, whatever command or code you think might bomb should be dealing with *one* thing: querying one computer, deleting one file, updating one user. That way, if an error occurs, you can handle it and then get on with the next thing.

ERR-03 Avoid using flags to handle errors

Try to avoid setting flags:

```
Try {
    $continue = $true
    Do-Something -ErrorAction Stop
} Catch {
    $continue = $false
}

if ($continue) {
    Do-This
    Set-That
    Get-Those
}
```

Instead, put the entire “transaction” into the Try block:

```
Try {
    Do-Something -ErrorAction Stop
    Do-This
    Set-That
    Get-Those
} Catch {
    Handle-Error
}
```

It's a lot easier to follow the logic.

ERR-04 Avoid using \$?

When you need to examine the error that occurred, try to avoid using **\$?**. It actually doesn't mean an error did or did not occur; it's reporting whether or not the last-run command *considered itself to have completed successfully*. You get no details on what happened.

ERR-05 Avoid testing for a null variable as an error condition

Also try to avoid testing for a null variable as an error condition:


```
$user = Get-ADUser -Identity DonJ
if ($user) {
    $user | Do-Something
} else {
    Write-Warning "Could not get user $user"
}
```

There are times and technologies where that's the only approach that will work, especially if the command you're running won't produce a terminating, trappable exception. But it's a logically contorted approach, and it can make debugging trickier.

ERR-06 Copy \$Error[0] to your own variable

Within a Catch block, `$_` will contain the last error that occurred, as will `$Error[0]`. Use either - but immediately copy them into your own variable, as executing additional commands can cause `$_` to get "hijacked" or `$Error[0]` to contain a different error.

It isn't necessary to clear `$Error` in most cases. `$Error[0]` will be the last error, and PowerShell will maintain the rest of the `$Error` collection automatically.

Wasted Effort

WAST-01 Don't re-invent the wheel

There are a number of approaches in PowerShell that will “get the job done.” However, wasted effort on your part is *never* commendable. When your wasted effort further involves poor aesthetics or less-preferred approaches, then you should expect members of the community to be less-than-welcoming of your product.

For example:

```
Function Ping-Computer ($computername) {  
    $ping = Get-WmiObject Win32_PingStatus -filter "Address='$computername'"  
    if ($ping.StatusCode -eq 0) {  
        return $true  
    } else {  
        return $false  
    }  
}
```

This function has a few problems. One, it uses the **Return** keyword, which some people find problematic (not a huge majority, but they do exist) because it's really a kind of “syntax sugar.” They would argue that you should use Write-Output instead. Second, the parameter block is not explicitly declared; the shortcut declaration here is less preferred. Third, the command verb (“Ping”) isn't an approved PowerShell command verb.

Fourth, and more to the point, there's no reason whatsoever to write this function in PowerShell v2 or later. Simply use:

```
Test-Connection $computername -Quiet
```

This built-in command accomplishes the exact same task with less work on your part - e.g., you don't have to write your own function.

It has been argued by some that, “I didn't know such-and-such existed, so I wrote my own.” That argument typically fails with the community, which tends to feel that ignorance is no excuse. Before making the effort to write some function or other unit of code, *find out* if the shell can already do that. Ask around. And, if you end up writing your own, be open to someone pointing out a built-in way to accomplish it, thus rendering your work “wasted effort.”

WAST-02 Report bugs to Microsoft

An exception: if you know that a built-in technique doesn't work properly (e.g., it is buggy or doesn't accomplish the exact task), then obviously it's fine to re-invent the wheel. However, in cases where you're doing so to avoid a bug or design flaw, then you should - as an upstanding member of the community - report the bug on Connect.Microsoft.com also.