EBOOK

A PART NUMBER ANTHOLOGY

GRABCAD

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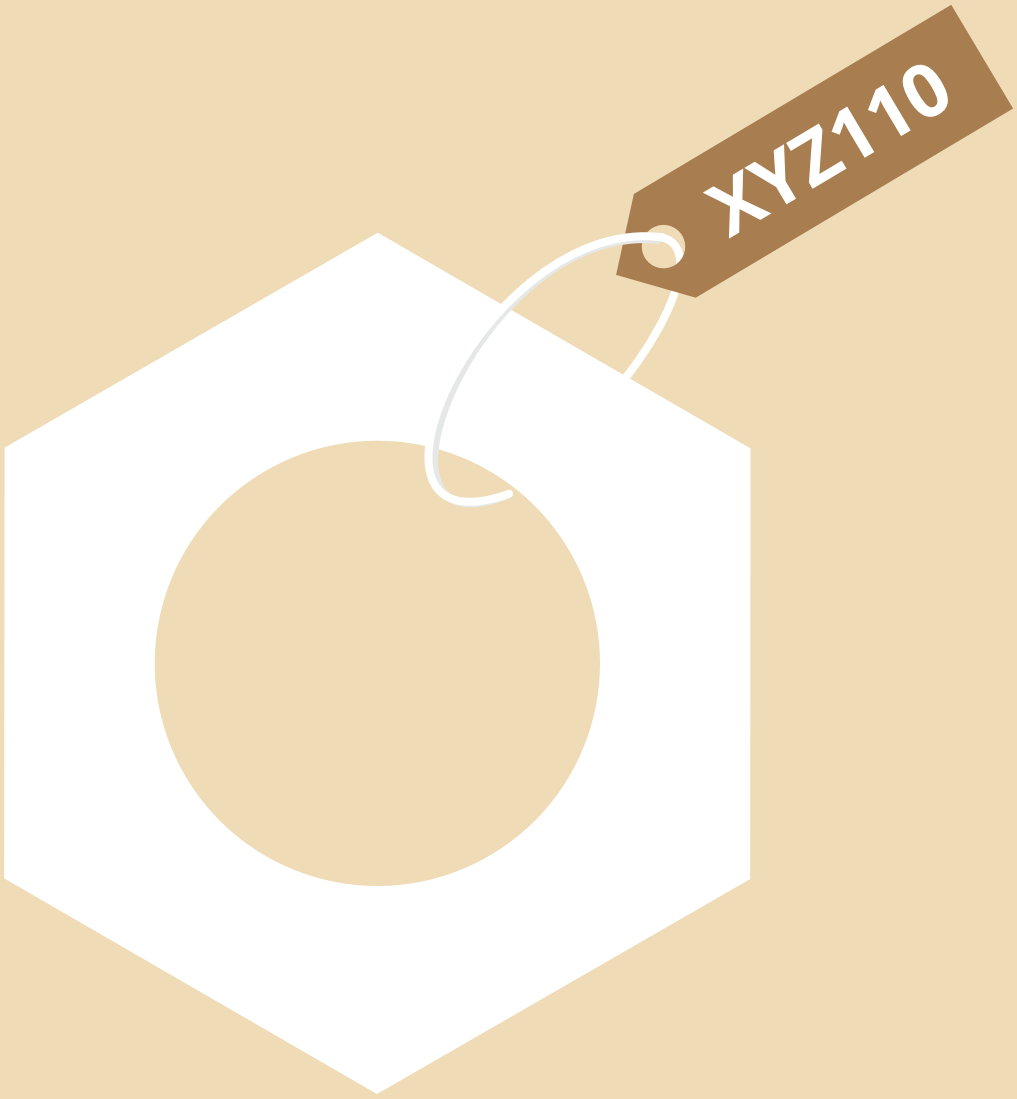
Introduction

Part numbering. For most engineers, this two-word phrase is all it takes to conjure up especially strong feelings about what it means to be “right”, and what it means to be very, very “wrong.”

Intelligent numbering? Generic numbering? Pick a side that’s burned you the least and stick to it. It’s a cold world out there for fence sitters. Ask us how we know (or just read the final chapter).

As is true with all questions metaphysical, it helps to write your thoughts down. So we did. And then we invited a free and open dialogue. Sometimes you disagreed with us, sometimes you didn’t, and sometimes you simply commiserated.

When it was all said and done, we assembled this anthology. At the end of each chapter you’ll find our favorite snippets from the discussion, from author and reader alike. And if you’re not satisfied with where we left it, you know how to get a hold of us.



Part Revisions: Deal or No Deal

Ed Lopategui

Parts don't have revisions. Such a broad statement seems a little absurd especially considering today's available software technology, but it's nonetheless a long-held tenet of engineering configuration management.

While it might appear outlandish to set such a seemingly arbitrary restriction on engineering process, there are sound reasons why the advice holds true. But before you make a unilateral decision never to revise a part, let's understand just why such thinking became an accepted standard. Then you can make judicious and informed decisions with your own engineering design.

What do we mean when we say parts don't have revisions?

A part is identified by a Part Identification Number (PIN), aka the part number. If you were holding the part in your hand, this is what would be physically emblazoned upon it. A part is also accompanied by documentation that plainly and precisely describes the part model. In many cases, the documentation is a fully di-

mensioned engineering drawing, though these days it might also be Product Manufacturing Information (PMI), if you're riding the technology wave. In the case of a drawing, the documentation also carries an identifying number. While it may be tempting to make the part and drawing numbers the same, such an approach aims to misbehave. For example, a drawing is often changed for very different reasons than the part it describes, often in a fashion that has no impact on design. In addition, drawings may describe multiple parts. In other words, drawing and part life cycles are unique, so the identification number for each must also be unique.

Documentation can be revised, but the part itself should not. If a part changes, the revised part is issued a new part number. In the case of PMI, where the "documentation" portion is integral to the part, revisions are more esoteric. Allowable PMI revisions in that case depend on whether the documentation portion is being updated or the part model is being physically changed.

Why can't parts be revised?

It's all about how parts are consumed in manufacturing. Parts are ordered, processed, and stocked by part number, not revision. Issuing a new part number for changes addresses the following:

- **Existing Stock:** The prior part didn't just spontaneously cease to exist; it's still in inventory and it may continue to live on in products that may already be sold, delivered, or in use. It's important to distinguish between these to control how the change might or might not be propagated.

- **Alternate Uses:** If a part is used in multiple applications, then a favorable change for one application may be detrimental to the second. It's critical to keep such histories separate and distinct.

- **Failure Modes:** If two parts carry the same identification, but are functionally different, or are used for different purposes, confusion is inevitable. Confusion can lead to failure and liability.

Exception for Interchangeability

It might seem costly to constantly issue new part numbers for every tweak and adjustment. Especially if a change in a component part causes the next higher assembly to behave differently and propagate additional part number changes. This is where interchangeability comes into play, more commonly known as the "Three F's:"

- **Form:** The physical nature of the part, including its strengths and weakness, structural or otherwise.

- **Fit:** How the part interacts with other parts.

- **Function:** What the part actually does.

The interchangeability rule states if a part modification does not appreciably affect the form, fit, and function of the part, then the modification is deemed interchangeable. Here, a new part number is not required. In other words, if you were to blindly reach in a bucket with both versions of the part, it wouldn't matter at all which you would pull out. As you can imagine, few changes are truly considered interchangeable. When traversing a change up an assembly structure, engineering judgment is used to determine the point of interchangeability (i.e. where part numbers stop changing).

Other Options

Someone might guess that if a part is identified with the part number and the revision level, then the problem is solved. But that's not the case. Instead, revision level has become nothing more than an extension of the part number, so the manufactur-

ing impact is the same as if everything was not interchangeable! Additionally, most manufacturing processes don't accept such a concept because parts are not ordered, processed, and stocked by revision level.

One permissible use of revisions is pre-production. Many changes occur while a part is in the concept stage. Without a supply chain consideration, it’s okay to revise parts, as long as you don’t intend to use the prior part revisions in production.

Remember

Deal—When to revise a part:
Interchangeable modifications
Pre-production parts

No Deal—When to issue a new part number:
Non-interchangeable modifications
New applications for an existing part

DISCUSSION

Dean:

This is a paper-based (old school) method of operation. The industry is headed toward MBD (model-based definition, or MBE, model-based enterprise), in which a single file defines the cad model, GD&T, drawing, material/coating info, FEA model, CFD model, marketing plan, assembly procedure, costing details, eBOM, CAM file, assembly video, and anything else you can think of in a single open-source format (HTML or pdf) that can be opened on a cell phone or any other device. This MBD is eluded to in MIL-STD-31000A and ASME Y14.41. All that to say that this article describes a paper-based system that has been around since the 50's, which is being phased out. Many companies have already moved towards "rev-locking" their designs, which is a partial solution to MBD. Once industry software solutions are mature enough, it will be easy to complete the jump and have a single file design--hence, no need to track multiple files describing a single part or assembly...and no dash numbers.

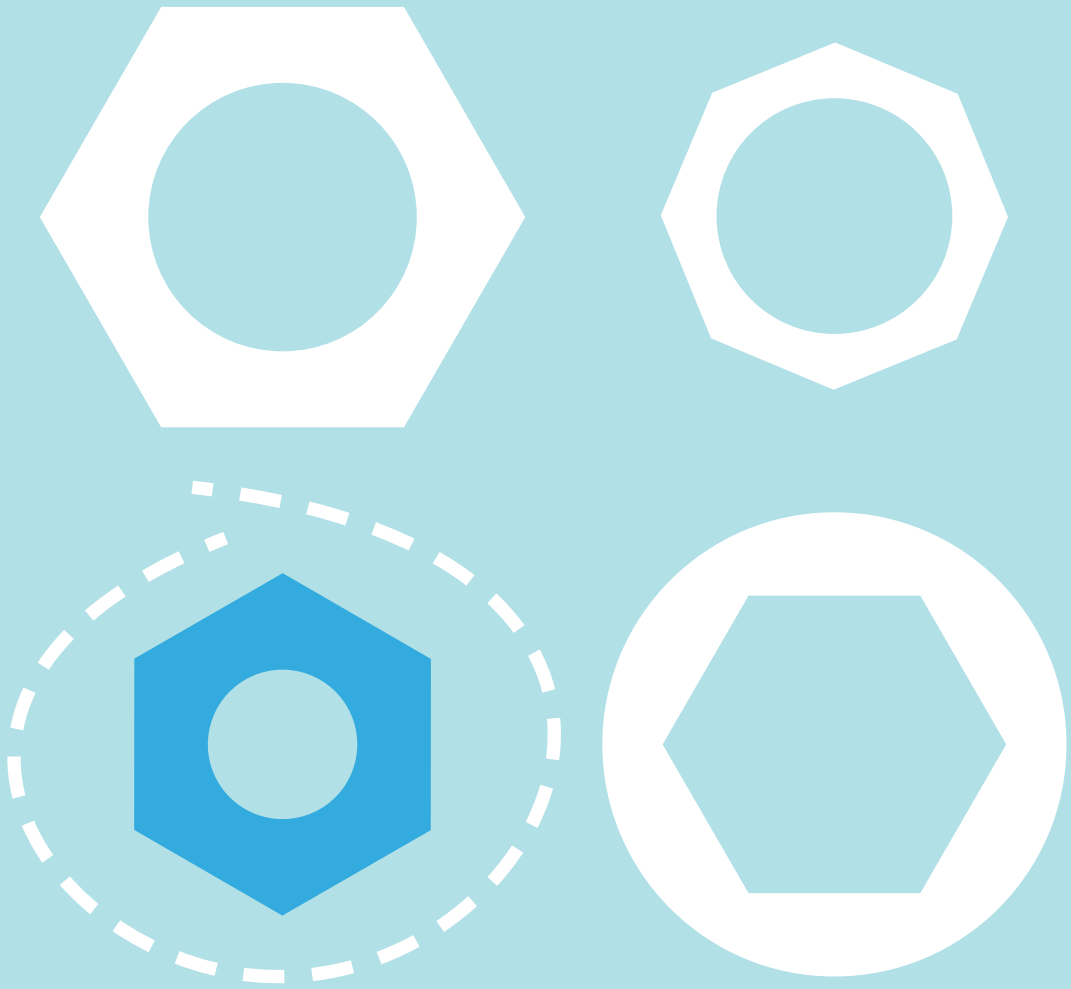
Ed Lopategui:

Dean, thanks for the thoughtful comment.While I agree that MBD is the future, I'd caution to say that the future is very much a work in progress. People are likely to get a little upset about either half of that sentence, depending on their perspective.

More importantly, the problems I describe aren't an artifact of documentation, they are fundamental configuration management issues.

Two parts carrying the same identification but with different form, fit, and function is a problem. That's true whether the part is defined on dusty prints sitting in a file cabinet, or an open source container on your shiny new smart implant. It's not about the number of files, it's about interchangeability and the consequences that follow.

The universal all-encompassing (and even open source!) format that you mention is often promised and certainly desired, but no one has yet delivered. We still have a long way to go. One day...



Supplier Part Numbers: Hidden Surprises

Ed Lopategui

Somewhere lurking in your Bill of Material (BOM), there just might be a hidden surprise, and not the good kind of surprise with cake and balloons.

We're talking about the type of surprise that you probably hate; one that costs you time and money (not to mention a little aggravation). The puzzling truth is that surprise can hide in plain sight, in something you might think as rather ordinary: the supplier part number. But what impact could something as simple as a part number really have, after all?

You'll find most good configuration management practice is careful to differentiate between Internal Part Numbers (IPN) and Manufacturer Part Numbers (MPN) aka supplier part numbers. Internal part numbers are uniquely defined and controlled by your company. Supplier part numbers are not. Whether or not you have control over a part number is rather important, which is why the prevailing recommendation is to keep supplier part numbers out of your BOM. There are some exceptions of course, including parts defined by a recognized industry or international standard such as the National Aerospace Standards (NAS) or the former

military standards. Supplier part numbers can be added as meta-data, included in auxiliary reference columns, or digitally associated to the supplier numbers within your BOM Management or Enterprise Resource Planning (ERP) tool. But why? The underlying strategy is to isolate the engineering design from supply chain requirements. You don't want to be constantly updating the former to keep up with the latter.

With that in mind, below are some of the hidden surprises you might discover:

- **Supplier Part Number Changes:** Each supplier, like your own company, maintains their own internally developed part numbering system. At any time, that system can change in whole or in part, for reasons that will not at all be transparent to you. Due to mergers and acquisitions or internal process change, it's not all that uncommon for supplier part numbers to change or be re-characterized entirely. If you're carrying such supplier part numbers directly in your BOM, you'll have a really bad day chasing down changes that have nothing to do with your design.

- **Fighting Internal Process:** It's important to maintain consistency in your company numbering methodology. While we'll leave the quasi-religious debate over using intelligent or gener-

ic numbering systems for some future blog post or three, the point is you probably have tools to help support your company's numbering system. Accommodating a wide variety of foreign part numbers is not worth the hassle, it's better to abstract that information as part of your supply chain management.

- **Supplier / Source Changes:** Depending on your specific requirements, many parts can be sourced by multiple suppliers.. Alternates and substitutes may be available and their relative supply will ebb and flow over time. Trying to keep up with this in a BOM is not a constructive use of your time. The sourcing and substitution information can be associated to your internal number. Additionally, as your requirements change you can leverage your internal number into a full source control or even a selected item designation for more tightly controlling eligible parts from a design context, if the application demands.

- **Numbering Collisions:** In all of their seemingly infinite variety, supplier part numbers might seem like snowflakes. But part numbers in fact are not snowflakes. As many companies have adopted generic numbering methodologies, the chances of collisions in some circles have actually increased. The last thing you need to deal with is pulling apart the overlap of two completely different parts, one of which has nothing to do with your design.

So next time you think about straight up popping a supplier part number into your BOM and think nothing of it, keep the above in mind. You just might be in for a surprise.

What's the Great Part Number Debate?

Ed Lopategui

What's in a part number? That which we call a part by any other number should assemble as easily? Every company struggles with defining part numbers. Should you use an intelligent numbering system that embeds important identifying information or go with easy-to-mange generic numbers? Choosing between these opposing methodologies might seem intimidating; solid arguments exist for either approach. Crowning a winner is not going to be constructive, but understanding how the underlying issues affect your company certainly will be.

Creation and Data Entry

Generating a new number should be easy, even for the new intern. Nothing is easier than a system-assigned generic number. PDM/PLM systems default to a generic numbering system, but that is neither a recommendation nor a limitation. Most modern systems can accommodate intelligent numbering without heavy customization and/or manual entry. If you choose to embed intelligent information, you are trading the simplicity of creating a part number for a downstream benefit, so weigh that benefit

carefully. Consider the part number is often what you start with on new design.

How much will you know at that stage and how certain are you about it? Could that information change in the future? Such considerations will help determine what information, if any, is truly practical to embed in an intelligent number.

Longevity and Legacies

You want your part numbers to last. Intelligent numbering systems tend to break down over time, especially if the intelligence is used for complex categorization. It probably won't be tomorrow, or next week, but a couple of years from now, someone will likely be staring at a screen and shaking their fist at you because something doesn't quite fit. The more complicated the system, the higher the likelihood it will break down. But well-planned systems can last: vehicle VIN numbers lasted 30 years before requiring minor revision in 2008. Once again, this is another balancing act. But before you get too caught up on planning for infinite longevity, keep in mind all of it may come crashing down come a merger or acquisition. Also, don't forget about the part numbers you already have; you just might be stuck with them.

Readability

Readability is absolutely critical, people need to quickly parse through a large amount of part numbers every day and short-term retention is important. Generic numbering tends to be less readable without some designed structure or variation (i.e. breaking up long series of numbers with letters or dashes at fixed positions). It's the reason you might remember a telephone number with an area code, but not your license plate, despite a smaller namespace. Intelligent numbers can have readability issues for the very same reasons, or if they just get too long.

Uniqueness

Two parts with the same number is trouble. Some argue that only generic numbers ensure uniqueness - but that's not really true. You can get the same uniqueness guarantee with the right PDM/PLM system for intelligent numbering. Generic numbers, which tend to be shorter, can actually increase the chance of overlap with respect to mergers and acquisitions or cause confusion with similar supplier part numbers. Nothing ensures uniqueness in this scenario, but the larger the namespace the lower the chance for a collision. But once again longer part numbers degrade readability.

Interpretation

Every time a part is handled, sorted, searched, or otherwise used an interpretation cost is involved. In other words, it's the time needed to understand whether you are dealing with the right part. Intelligent part numbers can reduce this interpretation cost, provided the user understands the identification system. In the right conditions, parts can be recognized at a glance. Take caution, however. If the cost of maintaining the intelligent system exceeds the interpretation cost, it's self-defeating. Generic numbers, on the other hand, can increase interpretation costs, since differences have to be queried in the system. Generic part interpretation can be enhanced with classification systems, but they also add cost.

Balancing all these diverse factors is difficult, because no solution is optimal for every company. Here are some final tips to help you make prudent decisions:

- Understand your PDM/PLM system part number generation capabilities.

- Understand the limitations of any other systems that interact with your parts.

- Go through every activity that requires interpreting part numbers and understand what system access is available, and how the interfaces work. This will provide a good basis for your interpretation cost.

- Understand how easy/difficult it is for a new employee to interpret a part number.

DISCUSSION

Ken Schnautz:
Our company has been around for about twelve years, and during the first ten, we had all sorts of part numbers passing through engineering, inventory, and sales. We had part numbers, assembly numbers, drawing numbers... all based on job numbers, or product names, supplier item names or numbers. It was a mess.

About two years ago, (when I started) we finally got deeply involved in engineering design and recognized the need to make a company-wide item numbering scheme. After a few intense debates and many meetings later, we settled on a generic sequential numbering plan. Each item is assigned an eight digit number- starting at 10000001 and counting up.

All items share the same pool of item numbers. This is where it gets both ugly and beautiful. Parts are items. Assemblies are items. Drawings are items. Documents, forms, templates, finished goods, even electronic firmware, physical media, and printed drawings. They ALL are created equal using sequential item numbers.

There is absolutely no room for inference when reading a part number. If I gave you a number, e.g., 10001221 - you don't know what it is. It could be a drawing, or a part. You have to look it up! The best tool to date has been Arena PLM (sorry... I don't plan on making this an Arena commercial). It's a cloud-based service that we use to assign our part numbers, track BOMs, ECOs, revisions, file references... you get the gist.

Approximately 2500 item numbers later (1.5 years), we're glad we made the switch. I have to admit, I've spent days explaining the scheme during the first few months to various groups (engineering, purchasing, sales...) but it's been a great fit so far. Having the new PLM has forced us to take better control of our documentation. Nothing leaves engineering unless it's released in the PLM system.

Granted, the PLM system has a few kinks (inability to add old-revision parts to new BOMs), but that is a separate issue that we will have to resolve by creating new items in lieu of revisions.

All in all, the move to generic item numbering and the fact that ALL items (drawings, parts, assemblies, media, etc.) share a pool of item numbers has been the best thing to happen to our company's docu-

ment control. The only complaint I’ve heard lately is that we should have chosen seven digits instead of eight. :)

---- and for those that are curious, we are a industrial product development group. So we do product designs that include custom welded metal, machined metal, injection-molded plastic, machined plastic, cable assemblies/harnesses, printed circuit board assemblies (we have part numbers for each pcb, resistor, capacitor, IC, ...), software, firmware, ... the works.---

The One True Part Number System

Ed Lopategui

The debate around part number systems is often reduced to a pitched battle of absolutes, pitting the cold simplicity of the Generic Numbering Coalition (GNC), against the historically focused Confederacy of Intelligent Numbers (CIN). There's no shortage of arguments about one approach over the other. But you don't have to play that game; there are always other possibilities. Let's understand why.

The GNC was founded on the philosophy that part numbers are inconsequential. Part numbers are merely unique markers that point to a collection of metadata, and people shouldn't bother with them. Let the machines do the work, keep humans and their fat-fingering ways out of the loop. After all, even the most elaborately designed intelligent part-numbering system is a temporary triumph, which will succumb to degradation, confusion, and irrelevancy over time.

CIN, on the other hand, upholds a humanistic appreciation of history. Part numbers are important; they will always be the subject of conversation, collaboration, and argument between humans and not systems. And to facilitate those interactions, part num-

bers must provide some system-independent context in of themselves because there comes a time we have to look up from our screens and communicate one on one. The only way to build such a context is to architect a recognizable system, and one that lasts.

Which System is Best?

Neither. Both approaches are myopic because they are extremes that wholly ignore the other's chief advantage. A balance is needed. A hybrid methodology. But it's much more than just crafting a semi-intelligent system and calling it a day. In order to understand precisely why, consider the following engineering realities:

- Defining a part number should never be an obstacle. An idea should not be derailed merely because a person has to sit around and think about what a number should be or how to get it properly assigned.

- Flexibility is Key. This is especially important for new design. Sometimes you don't know what you're building until you build it. Don't force decisions that don't have immediate answers. If your part numbering system has rigid classification you may find yourself stuck. The most resilient rules are not absolutes, but can bend when the situation requires.

- You should be able to remember several part numbers. If you can't, then congratulations -you've built a system to welcome our new robot overlords, but not for people to use.

- Realize the system is not ubiquitous. Relying on the system for certain information is necessary, but understand there will always be gaps in the system. We tend to oversell the utility of mobile tablets, phones, etc. in this regard. The reality is we're going to talk about parts in dark corners devoid of technology. In the hall, on a phone, under a plane, in an adhoc meeting side-bar, or in the vice president's office. In none of these situations does everyone in the room have the luxury to sift through a device and sort some classification, just to tell two numbers apart. It's best to think of it almost from a military standpoint - what do you need when you're pinned and comms are down?

- Out of the Box (OOTB) tool behavior or current systems should not limit your solution. You need to fight the limitations to balance your objectives. But only if it makes sense.

But how do we incorporate all of this into something viable? Here's a thought: how about creating an evolutionary system:

- Use a temporary pool of simple numbers to remove obstacles when working fast and loose, especially in early-stage design.

- Allow for easy re-identification (you'll have to fight the tool here).

- Design gaps in numbering to permit grouping some numbers together when it makes sense to do so.

- Let the numbers evolve as the design matures, and solidify those numbers into something that is meaningful through a release process.

- Construct them with just enough information and structure for readability, keeping digits in groups of 5 or less.

- Weigh each piece of intelligence carefully, and focus on properties that are both a) useful and b) immutable.

- Consider three bits of information a maximum and not a goal.

If you can balance the above guidelines just right, you might have a winner on your hands.

DISCUSSION

JeffMirisola

No. Just no.

All you've done here is add in layers of management to, ultimately, get to an intelligent numbering system which, in the end, is destined to fail on some front.

Let's step back and look at it from a different angle: I just got a job at XYZ Corp working on a project and I know that I need a 1/2" thick UHMW wear pad. The most logical thing for me to do is go into whatever MRP/ERP system the company has and look up 'wear pad'. I certainly wouldn't pull out whatever cipher was given to me so that I could go through all the codes to find out if such a part already existed. So, given that logic, I don't care about the part's number, I care about its description and the two shouldn't be the same - i.e. the part number shouldn't be some cryptic description, that's what the description is for. Granted, this requires some sort of intelligence in the company's naming convention (Noun, adjective, further descriptor), but that's a lot easier to deal with than some alpha-numeric code that requires a code breaking class at Quantico.

I realize that some people have differing opinions and, like me, they aren't going to be talked into going to the other side, and that's fine. I just know that I will forever find intelligent part numbers to be dumb.

Klaus Brettschneider

Great piece Ed, especially the point that a balance is needed.

As a system integrator, I am a GNC advocate. But I accept history and established work processes and it is more important to pick the fights where processes can be improved and where they can be won. Usually it helps to distinguish what is needed to classify/characterize a part and what is needed to identify it. A discussion around the difference and the concepts behind will lead to a balance.

One of my golden rules: “Never question smart numbers when the number system inventor is in the room.”

PS: I’m constantly afraid to meet a smart number system one day what is smarter than I. ;-)