

My name is Jack Hay

The title of my presentation is “Staying lean with Electronic Work Instructions”

Today I’ll be discussing the use of work instructions and their role in lean manufacturing

Staying Lean with Work Instructions

- Definition of work instruction
- Why we use work instructions
- Methods of creating work instructions
- Glean gold from your work instructions

Today I want to touch on 4 primary areas.

We'll look at a simple definition of work instructions to put some boundary on where they start and where they end.

We'll discuss why work instructions are used. This won't be a sanitized, academic summary, but more anecdotal or honest about why our firms use them.

We'll look at the methods used to create and maintain documents using traditional tools and new tools

Finally, we'll look at how to glean gold from the instructions. If I do anything today I want to shift people away from thinking of instructions as a cost center.

Intellectually, we know that information has value, but somewhere along the line that understanding and priorities don't always get aligned.

Working Definition

- Many vernaculars
- Systems to schedule resources: parts, people, work center
- The work instruction is a description of what the operator needs to do



Again, the first thing I wan to do is articulate what I mean by work instruction. There are many different vernaculars: MPI, PI, work instruction, etc. But, if we keep it in duckies and horsies then what we are talking about is:
when we have scheduled resources (including parts, people, station) (that could be done formally through systems, or looking across the room to see who is available) the work instruction tells someone what to do.

Work Instruction Structure

- We haven't said what types of information are included in WI
- Every company has information for manual processes
 - Tribal knowledge
 - 'Ask Phil' when tribal knowledge fails
 - Engineering drawings or exploded views
 - Step-by-step instructions in Word, Excel, PowerPoint, Visio
- Which is best?

Now, we haven't said what types of information are included in the WI; we'll get to that in a few minutes.

Everyone that manufactures something has work instructions. Period.

It may be in somebody's head, on a napkin, a drawing, but materials don't spontaneously assemble, and operators don't randomly put parts together.

The typical form of the information we hear are: [LIST]

All of these have their pros and cons.

I was working with a customer 2 weeks ago in Phoenix. The operator was doing a build that was being documented, but parts weren't going together right. "we have a lot of tribal knowledge here. But, I wasn't in the tribe that did this one."

⇒Tribal knowledge is volatile, so it is something to watch closely

So, which is best?

It is tempting to answer this without thinking, but I think 100% of companies would say written, step-by-step. Then why do so few companies actually have written procs?

Do We Need Written WI's?

- Sympathetic nervous system: YES
- Why are so few processes documented?
 - No single specific answer
 - Some companies we talk to don't know 'why'
 - General answer is customer driven, but may include agencies like FDA
- Observation: Work instructions are an after thought (except in contract mfg companies)

Do we need WI's?

The answer is probably an automatic response to the question, "of course".

But if that is the case then why are so few processes actually documented?

We have found no specific answer to that question

Some companies don't know why.

When they actually do exist, the answer is generally because of a customer requirement. Not because they see the instruction as having inherent value to the company.

As a casual observation across the pool of companies work instructions are generally an after thought. Products are designed, they have drawings, market analysis, even user manuals, but work instructions are often an after thought.

So, what drives the need?

Internal Failure and Inspection Costs



Continue our walk down an anecdotal path.

When internal failures or inspection costs hit some threshold then something changes. This is often when we get a call.

Some obvious ones include defects, rework, or scrap. We all understand those. But some are less visible to mfg. Rush delivery costs, lost sales, customer complaints.

What these all have in common for the company are lost profits. For example, if a single part goes back to be reworked then I can't be working on the next piece. They all take time to correct and there is no possible way to get back the time lost on fixing.

Moving along my thought process, if I didn't have these costs I wouldn't need WI's

Preventative Costs

- New product review
- Quality planning
- Supplier surveys
- Kaisen events
- Quality improvement projects
- Training
- **Work instructions**



To reduce those internal costs due to defects in mfg, there are preventative measures that can be put in place.

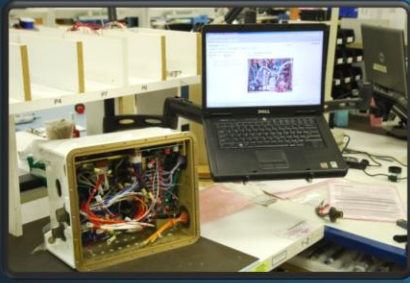
They all have costs, so they are not free.

Some are done on the front end: Product review, quality planning, supplier surveys. Some are on the back end when things don't go quite right: Kaisen, quality projects, training, and work instructions.

These are all important, but I'm going to talk only about the role of work instructions.

Perceived Tradeoff Between Quality and Shipping

Do we spend time putting quality systems in place or getting product on the truck?



As I have presented the problem, the process that is going on here is one of an optimization.

See, in a lot of our companies things are not ideal: they don't have a quality department, document control department, rigid boundaries between design and manufacturing engineering.

Optimization

- Premise: If work instructions are considered a cost center
- Clause: Then, we balance internal failure and inspection costs against cost of documenting processes

One customer had to send a service tech to China to install a \$2 spring on a \$250,000 instrument

If the work instructions are considered a cost center. That is an 'IF'

Then there is a balance between internal failure and inspection costs.

As one example, consider this company that shipped product to China...

That is when we often get a call. That much seems logical, but, it often does not lead to a sale. Customers are often in a state of crisis and are reacting, not planning. They are not looking for instructions as a tangible asset; just something to make the immediate problem go away. There is a lot of work at this point because we need to move them from seeing the instructions as a cost center to something more tangible.

This co later sold themselves because the value was in the process.

In an Ideal World...

1. I have up-to-date instructions that allow my operators to make product right every time
2. I have no internal failures

Q: Why don't companies do this?

A: The cost of writing in existing tools outweighed the internal failure costs

"In Excel can easily spend 80-100 hours on one [10 page] document. But, we have 1000 products"

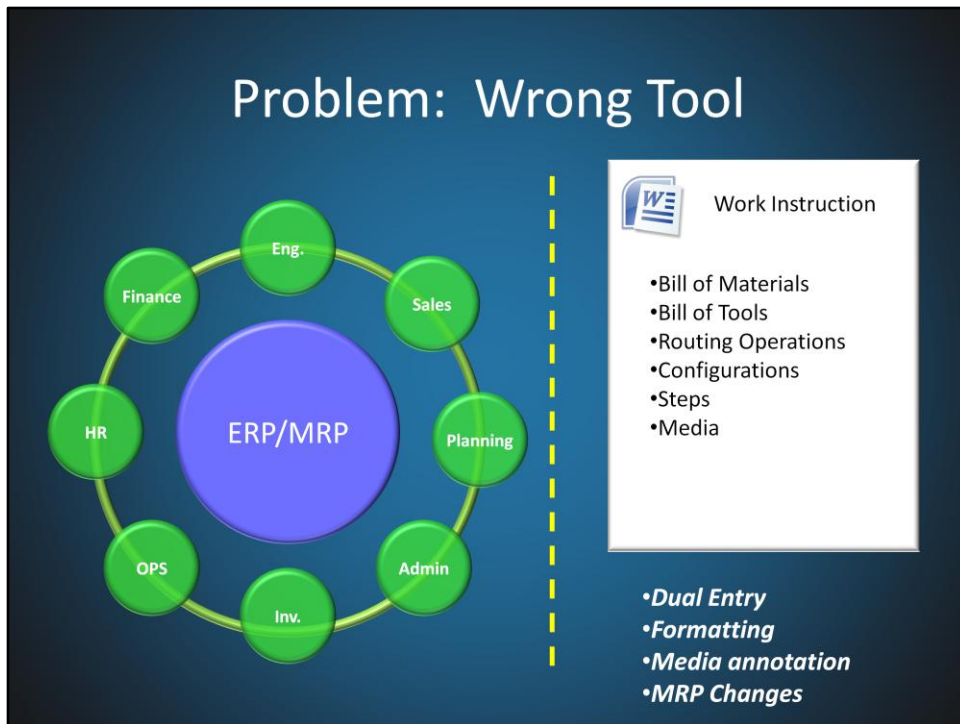
I'm going to make a statement. Perhaps some will agree with me some may disagree, but

In an ideal world I would have up-to-date work instructions that allow my workers to make my product right every time

So, I said I would come back to the question of why companies don't have documented work instructions. The answer is simple. The cost of creating work instructions using conventional tools is far too great. Those costs just swamp the cost of the failures they are trying to mitigate.

Something we will often hear is "In excel..."

Why does it take 100 hours to create pictorial work instructions?



The problem comes back to the nature of the tools being used.

By a show of hands, how many of you work for companies that use Word, Excel, PowerPoint, Visio

Those are good tools. I use them every day. I used PowerPoint for this presentation. But I would never use it to document an assembly process. It just wasn't designed for that task.

Here's what's going on:

ERP does a lot for the business, but all accounting. Little for work instructions. I can maintain inventory, boms, for instance. We may have routings in the system so I can account for the cost of operations in making product all the way down to overhead A, B, or C for a work station.

What it doesn't do is: easily connect to the systems we all said we use for documenting processes.

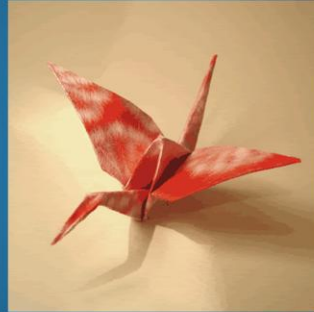
So, in a work instruction I typically have: BOM, BOT, Routing, Configurations, Steps, Media.

I have dual entry, formatting time, annotations in an archaic system, and when MRP changes nothing happens to my document. How many engineers have mastered the task of sizing pictures and handling wrapping in Word?

We have had a small number (perhaps 6) customers that did time trials for creating work instructions prior to purchasing our enterprise product. Ours is one of many in its class. What I am comparing are classes of software. The class we fall into stores information in a very different way than you would in Word or Excel. I've only heard

What Goes into a Work Instruction

- Novick and Morse, *Memory & Cognition* 2000, 28 (7), 1242-1256
- Studied importance of media in learning a process
- Text only, text with final picture, or picture at each step?
- Accuracy, time, and recollection were studied



Just as a little more ammunition to what I said, our customers all say they want lots of pictures in their instructions.

There is an intuition that pictures help operators. However, the conventional tools make our lives miserable if we want to use lots of pictures.

This has actually been documented in a scientific way as shown by Novick and Morse. They looked at accuracy and time required to do a series of steps. They gave the study groups text-only, text with final picture, and picture with each step.

Results =>much more accurate and fast with step by step instructions with a picture at each step.

If you want just text, Word, Excel are probably just fine. IF you are only going to have text.

Solution: New Tools for 21st Century

1. New tools significantly reduce time to author and maintain work instructions (50-90%)
2. Encourage extensive use of media
3. Don't view work instructions as a cost center
 - Because the cost center has a negative impact on profit (at least on the surface) it is a likely target for rollbacks and layoffs when budgets are cut
 - Re-examine the value proposition for work instructions

New tools that are out there just to address manufacturing instructions provide a lot more than just a better mouse trap for creating instructions.

True these packages can significantly reduce the amount of time it takes to capture information and create the first version of instructions. But, we need to look deeper than just the time savings for the engineer. Intellectually, we know that saving time for the engineer is a good thing. But, I'll tell you anecdotally what I see at a lot of companies. "I'm already paying for the engineer, so it doesn't matter how much time you save for him."

NO! Look deeper. Don't view the instructions as a cost center. We'll conclude with examples of this in a minute. But, let's finish up with some functional benefits of changing the way data is handled.

The tools for capturing knowledge, creating instructions, and maintaining those instructions is obviously a central element to these packages, but with integration to other systems work instructions can be flagged when a bom changes, for instance. So, when BOMs change they automatically change in the work instruction, but the authors get notification that things have changed.

Work instructions can be configured automatically for work orders that have options.

Let's put the nerd caps on!

Data Model

- Data for WI fits a model that can be stored in a relational database
- Leverage data from other systems



So how do these packages handle data?

The data is stored in databases.

The data model is so closely related to what exists in MRP for boms that those are brought in as the backbone.

The double gear in this picture is a subassembly.

The single gears below it are the “buy” or “piece” parts.

A subassembly can have another sub as a child on the tree, so any number of levels are supported.

Tools can be added to a process

Operations can be added to the subassembly via a routing from MRP, or manually created.

The operations have steps underneath them that direct the operator

The steps then have media below them.

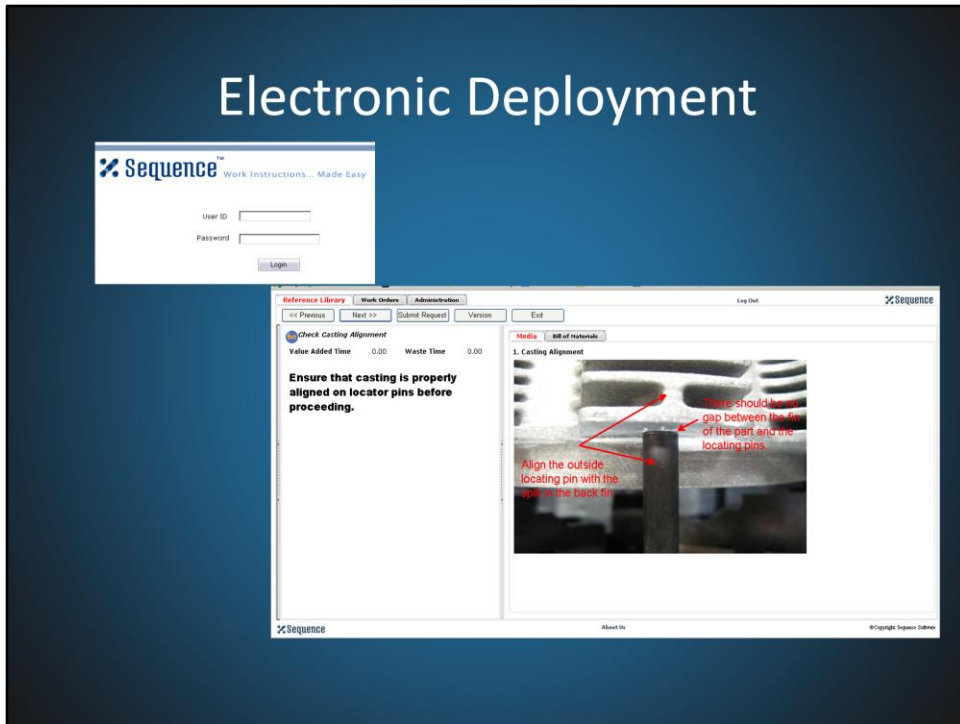
See, the job of the engineer has been reduced to merely putting the right information in the right order on the tree. Just get the right information on the tree.

Packages differentiate on functions for capturing media, integrated editors, amount of integration possible with external systems and that sort of thing.

But this class of software will store data like we see here.

As you can imagine this makes it easy for engineers to move objects around, rebalance, reorder, etc.

Electronic Deployment

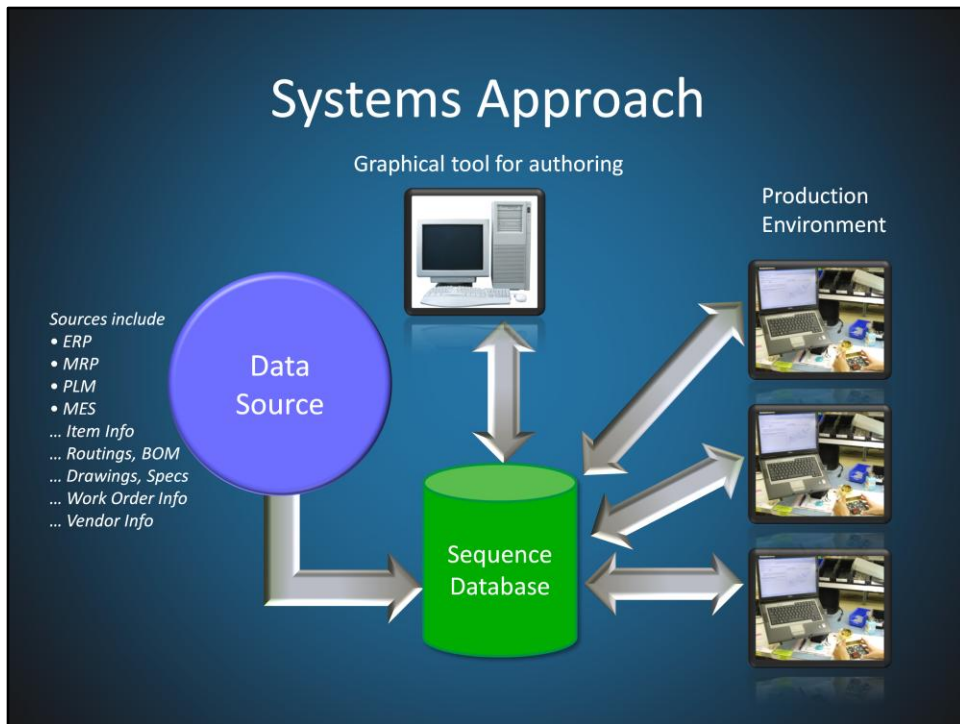


The electronic deployment looks something like this.

This is a single step at some point in the process.

The HTML is generated through code and is automatically formatted using the editor.

If the engineer or author approves a new set of instructions, then the next time a user accesses that information in the web interface they are guaranteed to see the new published version.



See with the systems approach we can go a lot deeper.

In our case we can integrate to just about any external system: ERP, MRP, PLM, MES. Heck, we can pull data from Excel documents into SQL.

That data is the backbone around which users can generate instructions using a windows application

These systems then allow users to control the documentation through approvals
They can export the data using templates to PDF's. The export is completely automatic; the user says which data, which format and presses a button.

Alternatively, the data is now stored in a format that allows users to access the data electronically.

In our package the users can log in by part number or work order number and step through the instructions almost like a powerpoint presentation.

Case Study I: Hayward

- Corporate User of Sequence
 - Nashville, TN
 - Clemmons, NC
 - Pomona, CA
 - N. Kingstown, RI
- Successfully used Sequence to transfer products from other manufacturing facilities in both US and Canada to Nashville facility
- Nashville plant revenues up \$9M in last 2 years



Hayward has realized huge benefits in transferring product lines to their plant in Nashville.

They go on site at an acquisition and document the process over a couple days. Then transfer the information back to Nashville.

Case Study II: AS&E

- Data capture for production record book for the customer.
- 15% reduction in new product deployment and engineering time
- 240+ man hours per month reduction in administrative labor (1.5 people per 8 hour shift)



“Revenue per employee, an efficiency metric, reached \$590,000 in FY 2010, \$45,000 more than the previous year.”

–2010 Annual Report

This company uses our software in production to collect information from operators at many steps. That data becomes part of the PRB for that device.

They have reduced new product development time by 15%

They have reduced significantly the administrative time that used to be tied to work instructions.

They have not laid any persons off, but reassigned them to higher-value tasks.

Summary

- Work instructions are used to mitigate internal costs of failure or meet customer requirements
- Many companies view work instructions as a cost center, but really they should be considered a tangible asset