

Best Practices for Adapting Manufacturing Documentation

A Major Qualifying Project Report

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Abstract

This study compiled a set of best practices for adapting documentation through interviews with professionals in the manufacturing industry. It illustrated how many companies across the United States structure their documentation adaptation process, the common strengths and challenges they face, and the influence of federal regulations on their decisions. Best practices related to knowledge management, quality control, distribution, and technical writing were then applied to the adaptation of a Matisse operation manual chapter into an SSOP for use at a Frito-Lay manufacturing plant.

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Introduction

The manufacturing industry regularly makes modifications to processes or machinery to fulfill production needs. Crucial to ensure a smooth management of change is the effective transfer of knowledge through adapting documentation for new purposes, drawing from existing material to create new documents for new objectives.

Documentation adaptation can respond to a variety of needs, such as:

- The need to make documents by third parties fit the organization's language and style.
- The need to account for modifications made to a process or to equipment.
- The need to combine information from multiple documents into a single document.
- The need to simplify or abridge content from the original document for a new audience.

In all these cases, documentation adaptation provides organizations with a document that fits a new purpose or audience, and facilitates knowledge management—effective documentation, training, and collaboration across various departments. But while documentation adaptation is routine in the manufacturing industry, very little research exists that explores the adaptation process from a technical writing perspective, or that examines the intersection of collaborative company processes, federal regulations, and documentation best practices. How do companies approach documentation adaptation, and what are the challenges associated with it?

To understand what makes good documentation adaptation and how to produce documents that ensure replicability, facilitate training, enforce both company and federal standards for quality and safety, and reduce the complexity of implementing future adaptations, a detailed analysis of all the factors at play is required.

This report compiles a set of best practices for adapting documentation in the manufacturing industry and applies them to a real-world case. Through literary research and interviews with employees from Shell Catalysts, Frito-Lay, Rogers Corporation, and Waters Corporation, this report illustrates the ways that many companies across the United States structure their documentation adaptation process, the common strengths and challenges they face, and the influence of federal regulations on their decisions. The compiled best practices were then applied to the adaptation of a Matisse SSOP for use at a Frito-Lay manufacturing plant.

These key learnings paint a picture of the current state of the industry's practices when it comes to documentation, and can assist future technical writers, engineers, designers, and managers to streamline their documentation adaptation process for more effective knowledge management.

Background

Documentation is a crucial tool for company productivity. In the manufacturing industry, it allows for the effective transfer of knowledge both internally and externally to a company, through training, operations, quality management, maintenance, record-keeping or customer support, among many others.

The International Organization for Standardization (ISO) defines the main objectives for maintaining documentation as follows: “(1) Communication of information: As a tool for information transmission and communication (...) (2) Evidence of conformity: Provision of evidence that what was planned has actually been done. (3) Knowledge sharing. (4) To disseminate and preserve the organization’s experiences.”

The documentation process grows more complex, however, when accounting for adaptations: instances where one document requires a complete overhaul to meet a new objective. This chapter explores what documentation adaptation means in the manufacturing industry, who are its key players, and what educational resources are lacking when it comes to this process. It also sets the stage for a practical application of documentation adaptation best practices.

Documentation Adaptation in Manufacturing

Manufacturing companies might require documentation adaptation for a variety of reasons. Companies often receive documents from third parties such as vendors or federal entities with important information that must be shared with employees, or might compile documents internally from various departments covering topics such as safety, processing, management or human resources that need to be made easily accessible. These documents might require adaptation to fit an organization’s language, style, and format—especially when regulations for documentation exist. Adaptations often seek to combine information from many different documents into a single document, or to simplify or abridge content for a new audience.

Changes in manufacturing, even at the smallest scale—such as raising the temperature of an oven by five degrees or changing the flow rate of a process stream—cause a chain reaction. Similarly, a piece of equipment might be modified or replaced, requiring a different procedure. Operators must then be re-trained with these changes in mind, management must be aware of the how and why of the change, and standard operating procedures must be updated.

Who is Responsible for Documentation Adaptation?

A facility that operates effectively will have a documentation process in place to guide the preparation of standard operating procedures, manuals, maintenance procedures, cleaning and sanitization procedures, and any other documentation required on the production floor.

Most companies, in accordance with standards such as ISO-9001 (the ISO standard that establishes QMS requirements) or internal standards, will have a quality management system (QMS) to organize, edit and distribute documentation such as standard operation procedures and operation, training, and maintenance manuals. A crucial part of a QMS is document control, particularly when changes to standard operating procedures have a direct effect on the product being manufactured.

Larger, more established companies are more likely to have a team of technical writers to support the QMS documentation process. But for a variety of reasons, many companies are motivated to add documentation to the duties of other employees, rather than employ specialized writers to focus on these duties. As a result, technical writers are scarce in the process end of many companies, including many globally-established companies. In these cases, documentation adaptation is the responsibility of engineers with little to no technical writing training, in between their many other duties on the production floor.

Lack of Adaptation Resources

Despite documentation adaptation being a regular occurrence at companies, resources that focus specifically on best practices for documentation adaptation, taking into account collaborative company processes and federal regulations, are scarce. A vast spectrum of experiences throughout the manufacturing industry has yet to be recorded.

A more detailed examination, drawing from industry experience, would provide companies with a blueprint to produce adaptations that ensure replicability, facilitate training, enforce both company and federal standards for quality and safety, and establish a smooth and efficient documentation process for the future.

Practical Application of Best Practices

I applied the concepts from this study to a real-life adaptation case, which showcases one of many situations in which an organization may require documentation adaptation.

Frito-Lay's Randolph manufacturing plant, located in Randolph, Massachusetts, produces Stacy's Pita Chips, Stacy's Pita Thins, and Stacy's Bagel Bites, with a variety of flavorings and package sizes. With the purpose of increasing the throughput of the line and making it more

cost-efficient, the plant made a major modification to its manufacturing process in late 2020, installing a Matisse Ultrasonic Cutter in its Thins line. This piece of equipment was customized by Matisse at Frito-Lay's request, with the blade angle modified to fit manufacturing requirements. This change was not reflected in the ultrasonic cutter operation manual provided by Matisse.

Sanitors need a Sanitation Standard Operating Procedure (SSOP) that accounts for these physical modifications to the machine and for a specific regulation Frito-Lay put in place to protect the ultrasonic cutter from corrosion on the long term: the complete absence of water from the cleaning process. Matisse's operation manual's sanitation chapter also lacks important safety information, diagrams, and pictures, and does not follow Frito-Lay's official format, which requires information such as the date of preparation, relevant approvals, and revision history.

Currently, many different sanitors at Frito-Lay carry out cleaning and sanitization once a week, based on training they received from engineers and Matisse vendors, with varying duration and approaches. An SSOP would enforce the standardization of this process and allow sanitors to carry out their role more effectively. This is particularly important at a food manufacturing plant such as Frito-Lay, where equipment must meet U.S. Food and Drug Administration (FDA) food safety standards.

Methodology

The goal of this study was to identify the best practices that lead to successful documentation adaptation. Through (1) interviews, (2) literature review, (3) observation and task analysis, and (4) documentation analysis, I compiled a list of best practices and applied them to a real-world scenario.

Interviews

I decided to carry out interviews as the primary source of information for this study because interviews allowed me to gather a wealth of facts and stories about the documentation adaptation process. The interviewees are professionals in the manufacturing industry who participate in and have intimate knowledge of the documentation and QMS at their organizations. While technical writers could provide an in-depth look at the writing and revision process, people in other roles, such as engineers, managers or operators, offer just as much insight into the process of distributing and applying documentation. Both perspectives provide an understanding of the challenges and strategies that surround documentation adaptation.

I included the full names, roles, and company names of the interviewees in this report. I did this because the names of these professionals carry weight in their industry, and because showcasing differences based on company size, products, positions, and levels of expertise paints an accurate picture of how diverse groups collaborate to prepare adapted documentation.

Interview questions related to documentation adaptation at their current or previous employers, and their experience (direct or indirect) with adapting documentation. A full list of interview questions can be found in Appendix II. Among these questions were the following:

- Could you tell me about an adaptation that took place at your company?
- Did you assist in preparing documentation for this process?
- What federal, local or company standards do you follow?
- Are there any challenges associated with following these standards?
- Did any unique strategies develop for preparing this sort of documentation?

I invited four interviewees to participate in the study: Don Bernard, Lance Young, Ross Storey, and Jody Zolli.

Don Bernard, Senior Product Specialist for Bakery Products at Frito-Lay

An important perspective to include in this investigation was that of someone overseeing the design and implementation of factory processes at a managerial level and taking part in the preparation of documentation associated with these processes.

As part of Frito-Lay's Research & Development department, Don Bernard oversaw the design and modification of manufacturing processes for multiple successful Frito-Lay brands, and was closely involved in adapting existing documentation to suit Frito-Lay's standards for training and operations. This made him an ideal interviewee for this study, providing insight into large-scale documentation processes at the intersection of design and operations.

Lance Young, Principal Innovator at Rogers Corporation

Another important perspective to include was that of an engineer actively participating in documentation management. This would illustrate what happens when the roles of writer and engineer overlap, and the challenges associated with this phenomenon.

Although primarily a process engineer in most of his roles, both at small companies and large corporations such as GE or CoorsTech, Lance Young has often shouldered additional responsibilities in quality management, preparing, adapting, and revising documentation. His familiarity with operations and experience with QMS implementation would be a great asset to this study.

Ross Storey, Senior Catalyst Consultant at Shell Catalysts & Technologies

Engineers may also be involved in mobilizing teams for documentation adaptation at a greater scale, both inward and outward-facing, in global corporations implementing changes across various sites.

Ross Storey has worked in the petrochemical industry for 28 years, with experience in production, research and development, and production engineering. In his current role, he prepares startup procedures, reference manuals, training packages, marketing packages, process hazard analysis reviews, and change-management documentation. He is also responsible for their implementation. His technical service work with Shell has led him to seventeen countries, and provides a uniquely global perspective of different documentation approaches and challenges both within and outside of the U.S.

Jody Zolli, Principal Technical Writer at Waters Corporation

To understand a more technical approach to documentation adaptation, I sought to interview an experienced technical writer in the manufacturing industry.

As a technical writer, Jody Zolli's work has focused mostly on developing and maintaining documentation for customer service at Waters Corporation and in other organizations for her previous roles. Her experience collaborating with engineers as a technical writer in a variety of contexts makes her a great source of knowledge regarding the minutiae of

adapting, maintaining, and tracking documentation, and the knowledge management strategies needed for effective communication throughout the adaptation process.

Literature Review

I sought further information about trends throughout the manufacturing and technical writing industries, documentation guidelines, and federal standards, to provide context to interview responses. I carried out literary research through WPI's Gordon Library, drawing from a variety of databases such as Engineering Village, IEE and Google Scholar, on the following topics. My findings were split across three different topics: staffing concerns and improving methods of collaboration, quality management systems and cloud implementation, and regulations and guidance on documentation.

Staffing Concerns and Improving Methods of Collaboration

To place interview responses within the wider context of the industry, I looked at reports that feature statistics from the last few years regarding staffing and employment trends, which compile fascinating findings from industry research. I also looked to studies that identified common obstacles for better company performance, articles exploring the collaboration between writers and other experts in industrial settings, and proposals for incorporating existing methodologies from other fields to the area of documentation.

I referenced the following texts:

- “U.S. Manufacturing Growth & Outlook in 2021” by TERRA Staffing Group.
- “Two Million Vacant Manufacturing Jobs by 2025... How Can We Tackle the Skills Gap?” from GlobalTranz.
- “The Effects of Understaffing on Individual and Group Performance in Professional and Trade Occupations” by Ganster et al.
- “Fertile grounds: What interviews of working professionals can tell us about perceptions of technical communication and the viability of technical communication as a field” by Rosselot-Meritt.
- “Application of agile methodology at industrial manufacturing as part of the Industry 4.0” by Kovalev et al.
- “Streamlining Enterprise Records Management with Lean Six Sigma” by Brett et al.

Quality Management Systems and Cloud Implementation

A major part of documentation adaptation is the organizational framework in which it takes place, so I studied reports that illustrate trends in the manufacturing industry's adoption of cloud technology, particularly in relation to QMS, and I also looked at studies that analyzed the impact of QMS implementation on company performance.

I referenced the following texts:

- “How Cloud Computing Enables Modern Manufacturing” by Ezell et al.
- “Can you meet customer demand for cloud computing?” by McCaffrey et al.
- “Impact of Industry 4.0/ICTs, Lean Six Sigma and quality management systems on organisational performance” by Yadav et al.

Regulations and Guidance on Documentation

Government bodies such as the FDA provide several guidelines regarding documentation, and I drew from them to illustrate some of these standards. This guidance has been further fleshed out by researchers in studies examining common pitfalls in manufacturing documentation and their psychological and social effects.

I referenced the following texts:

- “Documents, Change Control and Records” by the U.S. Food and Drug Administration.
- “Effective manual cleaning procedures—development, documentation, performance, and maintenance” by Pluta et al.
- “Fundamentals of an effective corporate safety culture” by Gembalska-Kwiecień.
- “Augmentation of information in educational objects: Effectiveness of arrows and pictures as information for actions in instructional objects” by Pekerti.

Practical Application Research

I applied the best practices compiled through interviews and literary research to the adaptation of a Matisse operation manual’s sanitation chapter into an SSOP for Frito-Lay. In addition to studying the adaptation process itself, I needed to gather information specific to the sanitation process the operation manual describes. While the information I gained through observation, task analysis, and documentation analysis does not necessarily apply to the general knowledge of adaptation, it was crucial research to execute the adaptation correctly.

Observation and Task Analysis

Observation was crucial to properly understand the cleaning and sanitization process of the ultrasonic cutter. I visited Frito-Lay’s Randolph manufacturing plant multiple times to understand how the Pita Thins manufacturing process works. These visits included conversations with supply chain managers on site, operators, and sanitors, to better understand the challenges presented by the cleaning and sanitization process, particularly due to food safety regulations.

I dedicated one seven-hour visit to observing the cleaning and sanitization process for the ultrasonic cutter, carefully examining the sanitor, equipment, and cleaning supplies, and documenting the entire process in writing and photographs. I asked questions and requested clarification about different steps in the process to understand the reasoning behind them. The answers to these questions allowed me to better understand the objectives and priorities of the process, and make note of what would be important for a sanitor to learn from the SSOP.

Documentation Analysis

Frito-Lay provided me with an electronic copy of the operation manual for the ultrasonic cutter. I also received copies of the following documents:

- A Frito-Lay SSOP for a water jet cutter previously in use.
- An abridged Frito-Lay SSOP for the waterjet cutter, which was placed next to the line for easy access.
- A Frito-Lay SSOP for dry cleaning, unrelated to this line but deemed by management to be an example of how to meet documentation standards correctly.
- A Frito-Lay SSOP template used by management to train operators, sanitors and engineers in documentation.

I examined these documents to understand the equipment and Frito-Lay's requirements for document structure, layout, and style. I also identified issues in the ultrasonic cutter manual's sanitation chapter that would need to be changed in the adaptation. These issues can be classified into three different categories:

- **Modifications:** Changes required due to modifications to the machinery.
- **Clarifications:** Changes required because the original text was difficult to understand or information was missing.
- **Style:** Stylistic changes required to meet Frito-Lay's template or technical writing standards.

Results

This chapter features detailed results of the interviews, literature review, observation and task analysis, and documentation analysis described in *Methodology*.

Interviews

What follows is a compilation of interview learnings for each interviewee. While most interviewees provided verbal answers to questions during video calls, one interviewee provided written answers to the interview questions. Full transcripts of all interviews can be found in Appendix III.

Don Bernard, Senior Product Specialist for Bakery Products at Frito-Lay

In his role as Senior Product Specialist, Bernard led the implementation of new technologies for many Frito-Lay manufacturing lines, acting as a mediator between different departments and ensuring effective knowledge transference from vendors and engineers to the operators and sanitors who handle equipment on a daily basis after installation. Bernard described the process, saying, “[The vendors] give us the document and the instruments, the mechanics of how this thing works; it’s their operations manual that they built for the unit. We also asked them to do operator training initially, on how to start the equipment and how to shut it down safely.”

An important part of this training is adapting the vendors’ documentation for the use of employees: changing formatting, structure, vocabulary, and more. Bernard helped guide this process. He explained, “For new vendors who come in, and new vendors dealing with their first time training, I will give them a model of what their training document should look like and what information should be in it... I do have examples of SOP documents that they will be expected to try and simulate. Now, how well they do depends on how well they understand technical writing and what I’m actually asking them to do.”

Bernard noted that some vendors are better at adapting documents than others, and provided an example of a company that stands out in this regard. “They have their own technical writers in their company. I give them a model of what I want, and they will do a really good job of repeating it and giving me exactly what I mean. So some companies are better than others, but it’s usually from experience working with Frito-Lay, because Frito-Lay does have unique requirements. I think we’re probably a little more detail-oriented than a lot of companies in terms of getting our SOPs and our safety documents understood and well documented.”

“Operator training can’t be too strongly technical; we like it to be easy-to-understand language... You have to actually have pictures with it... A lot of our operators don’t understand

the detail of step-by-step I'm talking about. I'm not just saying turn this on—you have to show them turn this on by pushing this button until you see it go red. That's the kind of detail you need to get for operators to function properly and safely. And a lot of vendors don't understand that we need to give that type of detail to operators. They think 'oh if you push a button, they know what it means to push a button.' Well, not necessarily."

Sometimes, writers aren't as thorough as Frito-Lay needs them to be, and company writers do the adaptation instead. Frito-Lay doesn't have its own team of technical writers, so it relies on outside contractors. Although Frito-Lay isn't beholden to any specific technical writing company, Bernard pointed to three different companies he typically relies on, because there are benefits to familiarity. "The ones that we work with on a usual basis understand the 'Frito-Lay Way' already now, so it's preferable to go to a company like GPS out of Michigan. They've probably written 50 to 60% of our documents, and they know what Frito-Lay requires, and so it's good working with them, and they understand our processes now because they've been on our processing floors quite often." Some of Frito-Lay's requirements, gathered through my previous experiences with the company, include using the word "team" instead of "employees" and "opportunities" instead of "challenges."

"When technical writers do their job," Bernard explained, "they're on site and actually following the operators around, especially the operator experts. And they're taking pictures and discussing with them all the details of what they're doing and why they're doing it, and how they're doing it safely, and what are the pitfalls for not doing it safely." The issue of safety is chief among his concerns when putting together adapted documentation. "Safety is a big part of why we do these documentations, and safety is a big part of our training program, because a lot of our equipment is very dangerous to work with, and if our operators don't understand that—hopefully we have enough safeguards so the operators can't get themselves in trouble—but at the same time we hope that they have enough training to make sure they're set up safely... OSHA will certainly require us to do certain levels of safety on all our equipment... We have a safety department within our engineering group and they have a list of safety requirements that are specific to Frito-Lay... We will definitely share that with the technical writers, to make sure safety is in place."

When contractors aren't available, Bernard adapts the document himself. "When I'm out on the field with a vendor and don't have a technical writer with me, I will go ahead and be the technical writer. To do the best I can, I imagine what a technical writer would do. I'm not by trade a technical writer but I've worked with technical writers on other documentation that I've done, and I kind of know how to phrase things and how things need to be presented for it to be a good training document."

He recounted his personal process for adapting documents: "I looked at what the vendor manuals were presenting as the SOPs for learning about their equipment, and I put it into

‘Frito-Lay Standard Language’ and operator training, with a lot of visuals and explanations of ‘this is what I’m talking about’ and ‘this is what it will look like when it’s actually running.’”

Bernard remarked that Frito-Lay hopes to eventually innovate the way they make documentation available to operators. “Instead of just doing SOPs with pictures and words, we’re actually looking at turning our SOPs into actual videos. So we’re trying to go back and take all our SOPs, and use those as sort of a script to follow an operator with a camera and have them actually do the step on camera, and then we have the words around the screen of what the stuff is, but they actually see them doing it on a video. So we’re trying to get to that next level of training documentation and training materials, and hopefully in the near future we’ll have all of our documents not just in a written document but also in a video that goes along with a written document. So that way we can be a little more in depth and hopefully precise in the training that we want to do.”

Lance Young, Principal Innovator at Rogers Corporation

Lance Young’s experience with documentation adaptation spans many different subsections of the manufacturing industry. He noted that in all his manufacturing roles since the beginning of his career, “I’ve been at least partially responsible or totally responsible for periodically reviewing documents, updating documents, writing new ones. I usually then submit them and go through the quality management system or document control system, it would get approved, and then we would train people.”

Most of the adaptations Young has dealt with have had to do with updates to processes or equipment, which require updating old procedures with information from new documents to fit new systems. “If you get a brand new piece of equipment and then you’re adapting it to a new kind of system, usually you have a procedure that you would conform to... You would probably take certain pieces of the equipment manual that would go in there, and you’d work with maintenance people and people who are trained on how to operate it—the engineers are usually a bit part of it—so then you would take all of that and put it in the right format.”

Young noted that about 75% of the companies he worked at were ISO 9001-compliant, requiring some sort of QMS. As a result of his years of work in positions adjacent to quality management, Young had a lot to say about the systems organizations use to keep track of changes and adaptations, particularly in companies with heightened regulatory requirements, such as the food or aerospace industry. “A big part of a quality management system is document control. The basics of document control is you say what you’re going to do, and then you do it, and a big part of that is making sure that you control your documentation... So if you make an update, it goes through some sort of approval process and then it gets authorized, and then it’s important that those procedures or forms get communicated, and that people get trained from them.”

A company can purchase many different types of software, but that isn't always necessary; smaller companies will often just put together forms, Microsoft Excel or Microsoft Word files and keep them updated. A place that takes document control seriously, Young said, provides a short description of what was changed and why with every document revision.

This revision control process changes depending on the manufacturing sector. Young gave the example of the semiconductor industry, whose revision process is very strict, not because of outside regulations but because companies worry about changing anything that could affect their customers' process. Similarly, aerospace and food companies might have heightened concerns about doing anything that could affect customer experience.

Young listed a few challenges related to adaptation that he has met time and time again across the industry. The first was lack of training. "As long as you have a basic [revision] control system, it works out fine. But if the operators aren't trained to it, then it's 'why are they using an old revision?' Well, they only had the old revision out on the floor. So now a lot of places basically try to limit that and have operators go to the electronic version, because that's easier to make sure that the most recent version is out there. But places that don't have as much resources, it's usually a little tougher... You can have a great document control system, but if you don't train your employees, your operators, or whoever needs to be informed, then it's useless."

The second issue Young shared was understaffing, which has been a constant throughout the different positions he has had. When he started his career, he said, "I heard stories—like legends—of there being robust engineering groups with technicians, technical writers and all this stuff, and almost every place that I've worked at, it's engineers now have to do everything. All the writing, all the admin stuff... maybe it's just companies that I've worked for, but like a lot of industries, they've collapsed jobs down to where, and it tends to be engineers, are doing like four or five people's jobs now."

He told a story about working at General Electric. "It was two of us who were running these two production lines, and we kind of covered for each other. And I was running around, and one of the lead operators told me—he was laughing—'You look all stressed out.' And I'm like, 'Yeah, I'm trying to get all this stuff done, it's almost too much.' And he started laughing. And I'm like, 'Why, why is it so funny?' And he's like, 'Well, you and [another engineer]... it used to be a team of ten people. Now it's you two.'" He said that ten years ago, there were ten people doing everything that you two guys do right now. That tells you a little bit about how a lot of the technology and computers and all this, awesome, great. But the productivity gains... they haven't been shared with the workers. It just makes the company more productive."

Lack of manpower, Young said, has an effect on documentation quality. "Document control is almost always run in most manufacturing places by the quality department. So does the quality department have enough people, are they stretched too thin?"

On the more technical side, a third issue is wordy documentation, which limits the usefulness of procedures. Like Barnard, Young was adamant about the importance of adapting documentation for easy readability. “Engineers love to sound smart, they’ll use really big words,” Young said. “And I’ve personally reviewed many, many procedures, and one of the things that I’ve done is make sure that they’re in plain, easy to understand language. Because if you’re using a lot of big terms, not everyone has an engineering degree or that background.”

It’s not only a vocabulary issue, Young clarified. It’s often over-explanation. “You want somebody to be able to absorb it quickly. So that’s where having pictures is super, super important, and being able to point out things... Sometimes you can simplify it if you just take a really good picture and you label it, and you’re like 1, 2, 3, 4, and then you can say ‘press this for this,’ ‘that for that,’ ‘that for the next thing.’” The goal is to minimize the amount of time it takes a person to get the information they need. Drawing from many different documents when adapting documentation, Young said, is particularly helpful to more thoroughly capture complex procedures. “If a procedure or something has a troubleshooting section, sometimes that’s something you tuck into the back of a procedure, or sometimes they put it right in it.”

When asked about the move towards turning SOPs into videos, Young had a different perspective than Bernard. Although he had heard many speak of the advantages of such a system, he was skeptical of both its feasibility and its usefulness. “I worked in a very large chemical plant, where you couldn’t bring any electronics into a certain area because the atmosphere’s slightly explosive, or it could be. So unless you have a mil spec, non-explosive phone... But you also have certain government facilities and things where you can’t bring in a phone and computers are super locked down and you can’t do anything with it. They probably won’t be moving to videos anytime soon.” Either way, he said, “Unless you have like a really ruggedized tablet or PC or something, I’d prefer, honestly, a piece of paper when you’re underneath the piece of equipment, referring to it and trying to look at a diagram.”

Ross Storey, Senior Catalyst Consultant at Shell Catalysts & Technologies

Ross Storey’s work at Shell led him to witness many instances requiring documentation adaptation. One of them was a case in the 2000s, when Shell modified its ethylene oxide process in mobile labs around the globe. This required labs to be outfitted with new, dedicated oxygen analyzers, which connected to automated isolation and shutdown processes to protect against flammable leaks.

“Obviously, a change of this magnitude and importance required accurate communication to the laboratory operating staff and engineers who might be present in the lab during operation... It was important that any training manuals and operating manuals reflected this change,” Storey said. Shell’s Mobile Lab Operations Manual had to be adapted to account for the existence of the new oxygen analyzer and to discuss what to do if it triggered a lab shutdown and

closure of isolation valves, as well as update quarterly and annual preventive maintenance actions, such as testing.

Storey took part in the management of change process that happened across all of Shell's ethylene oxide labs—a uniquely interdepartmental process. “There is a formal management of change process that kicks off with a trained employee in the area of change having authorization to initiate a change. Using standardized documentation, there is a process to follow for naming the change, gathering subject-matter experts for discussion of the change, and a formal process hazard analysis (HAZOP) conducted on the change where all aspects of chemical, reaction, temperature, pressure, and flow impacts are studied, one-by-one. Once that process is done, the change is reviewed by a trained reviewer (that is often my role), and then signed off by all participants. Only then can equipment be purchased and change installation begin.”

Afterwards, a process called ‘Pre-Startup Safety Review’ begins. Storey explained, “This process involves ensuring closure and completion of all actions that were found during the HAZOP and ensuring operating procedures, training manuals, and maintenance procedures are updated. In addition, it creates its own action items for update of any Process and Instrumentation (P&ID) drawings and for a formal notification of startup of the change. Finally, all documentation is saved in a specially-nominated management of change database, which can be searched by change name, date, completion status, department, and people responsible for sign-off.”

Both in this role and in a previous one, Storey's responsibilities involved ensuring that the organizational structure carried out the adaptation correctly, analyzing potential changes before they are adopted in the adapted document, documenting changes for review, reviewing the new document before startup, and communicating the changes to the staff through SOPs, manuals or training guides.

This process took place in two of Shell's main offices: in Houston, Texas, and in Moerdijk, the Netherlands. As a petrochemical company based in the U.S., Shell is beholden to many federal regulations related to change management, which fall under Process Safety Management, governed under CFR 1910.199. But the adapted documents had to be distributed to employees in many other countries. “Some of those locations are offices rather than chemical plants or R&D sites. This meant they might not have local infrastructure for the full PSM [Process Safety Management]-type of Management of Change... Another difficulty can be ensuring that employees in far-off offices or even stationed alone have access to training on the change-management process itself. On a site-by-site basis, many companies, including Shell, do this well. For our technical service group, we made specific training sessions for isolated engineers and operators using existing infrastructure based out of the Houston office.”

Even before the COVID-19 pandemic, Shell had already found ways to connect employees in remote locations, using the ethylene oxide catalyst group as a center for training and storage of information. “Expansions in virtual presence allowed us to gather subject-matter experts and trained change-management personnel, usually via Skype or [Microsoft] Teams applications. This means pictures and video can be shared, drawings can be reviewed, and (for example) an electrical engineer can be consulted in the Netherlands for an implementation happening in Nanhai, China.” This process, Storey said, “allowed centralization of training and storage from the Houston office and helps ensure that the entire global team is functioning with a like-understanding of how to manage change. Further, it allows us to check in cross-regionally as the work is happening in order that we keep each area focuses on what compliance with the standards means.”

During the last 25 years, Storey witnessed the “culture” of Process Safety Management as put forth under the OSHA guidelines expand worldwide. “There is a slow consensus building globally on how to manage these topics.” But that doesn’t mean it’s everywhere. Some major industrial countries still don’t have proper processes in place—particularly in places with “extremely hierarchical leadership structures where employees may feel that highlighting a concern could cause ‘loss of face’ for the manager. In Shell, we discuss this concept openly, even with employees from countries that have such a culture. We utilize additional caution and even our own vetting process of companies doing business in those locations.”

Jody Zolli, Principal Technical Writer at Waters Corporation

As a technical writer, Jody Zolli has worked for companies of various sizes across various industries. Zolli found that the right revision system makes it so that multiple adaptations are only a few clicks away.

For example, when it comes to customer user guides, several products might share sets of information. A good content management system allows documents to be reused in multiple places if necessary, and software like Adobe FrameMaker—which allows for reuse and conditionalization of content—helps streamline the process. Zolli shared that when she worked at EdgeGravity, “I had an 800 page documentation set, but there were only 400 unique pages because I did so much sharing and conditionalization. And that way, if I changed [something] in one place it would be updated everywhere, which is ideal because that’s one of the challenges of maintaining documentation is that if you have the same information in multiple places it can get out of sync.”

Waters Corporation, where Zolli currently works, uses a revision system called SDL Tridion that allows easy reuse and adaptation of different texts. “You create a project and in that project you create a deliverable,” Zolli explains. “So we go in, we use an XML editor to create

individual help topics and then you organize them into a table of contents, you organize them into a body of work, and you can publish that to many different output formats.” Final versions of each file can be published for a release, and then those files can be moved to a new release—freezing files for legal and historical purposes before making any further changes.

All of these documents are tracked through a database, where content is reviewed, approved and published. This makes documentation quality management and distribution quick and thorough. They also follow FDA standards, due to products such as mass spectrometers being used for food and pharmaceutical production. “When the equipment is installed, it needs to be verified in a very specific way. Every time you change something in the equipment you need to note it in a notebook or otherwise log it, and any time.”

“I think companies typically shortchange documentation because they don’t value it,” she shared, and gave the example of her time at EdgeGravity—previously known as Vidscale before it was acquired by Ericsson. “I was the first writer there. When I got there the ratio was maybe one writer to maybe 25 developers, and then I was eventually able to hire a second writer, but at the end of my time there it was two writers to 100 developers. So the ratio of developers to writers actually doubled, and really all we could do for documentation was just get the minimum out... It was complete, it was accurate, it was on time, but we couldn’t do any of that wonderful, elegant stuff like giving people context, how to use things, when to use things, why to use things, which things to use together.”

This severely limits what writers can do, and when it comes to adaptation, could dramatically decrease documentation quality by limiting the amount of time writers can dedicate to sourcing information from other documents or preparing supplemental pictures or diagrams. “It’s a shame, because if you have just like 10% more time to think about what you’re doing, you can think about smarter ways to do it, and you can think about things that customers will really benefit from... I do know that customers don’t curl up with a technical manual the way we’d like them to, but I also understand that if you are able to anticipate their needs and meet their needs the first time they look, they will develop trust in the documentation and return to the documentation.”

Company politics and bureaucracy have a large effect on writing productivity. Many of the adaptations she worked on weren’t related to process improvement at all. “It happens due to acquisitions,” she explained. “A company gets acquired and then you need to rebrand their documentation, which may include a change to the look and feel, terminology, of course the copyright page, and that doesn’t really add value... And that’s such a shame.” Looking back, she said, only one of the companies she worked for in the last 35 years still exists under the same name. “It’s a dog-eat-dog world.”

Similarly, relationships with other departments can limit writers’ ability to work efficiently. “I’ve worked many places where you can’t get the tool you need, or you can’t get the

support you need, or you can't get the equipment you need, or mostly you can't get the manpower you need." She gave an example: her department identified a third party software that would assist them in tracking and delivering documentation and unanimously agreed it would be the perfect solution to current pressing challenges. However, they needed the IT department to approve and obtain this software, and the IT department decided "we'd rather not buy somebody else's system, we'd rather build our own." With an already overworked IT department not seeing this concern as a priority, they were six months behind in adopting this technology at the time of this interview.

In documentation adaptation, where consulting experts are a key part of studying the original document, lack of communication between writers and people directly involved in the process poses a significant challenge. "In the past, when we used something called the waterfall process—everything would be designed, then everything would be built, then everything would be tested, then everything would be documented—the developers would literally throw something over the wall to the tech writers and then they would move on to something new. And then when you contacted them for review edits or something, they couldn't remember—like that was weeks ago or months ago! They couldn't remember what they did and they couldn't answer your questions. So it was very frustrating.

"In my experience, often writers need more from developers than developers need from writers," Zolli said. "When they see us coming they see us as a time sink, as a drain on their energy and their resources. So my goal has been to reduce that unequal dependence that we have between writers and developers.

"The past ten years or so, I've been working with the engineering team, following something called Agile methodology. So we're doing Agile, and one of the challenges of Agile for technical writers is you really need to embed yourself on the development team. You need to be at all the standups, you need to be at their refinement sessions, at their demos, at their retrospectives, at their planning sessions... it's very time consuming. However, it can really legitimize you as a member of the team.... I have found that when I am a full participant in the Agile process, I gain respect that I wouldn't have gotten otherwise, when I'm part of the conversations they're having about the product under design, I have a deeper understanding of the product and how it operates and why they made particular design decisions, and I don't think that would be available in any other way.

"Our skills as technical communicators are halfway to other roles... A lot of people think technical writing is a dead end, but you actually have many skills that are widely applicable within the industry as it stands but also outside of the industry."

Zolli explained that her employer is currently moving away from printed documentation and aiming to make all documentation available, both to staff and customers, online. Not only does this move help the organization keep a fresh look for its customers, but it also allows for

features such as audit logs, which automatically record changes made in cloud apps on an uneditable log.

Literature Review

Many of the interviewees made reference to issues in the manufacturing industry, federal standards, or business strategies that were worth investigating in more depth to provide context to the interview responses. This section provides the results of my literature review, exploring industry concerns with staffing and methods of collaboration, cloud implementation within the manufacturing industry, and federal guidelines for documentation.

Staffing Concerns and Improving Methods of Collaboration

Understaffing has consistently been an area of concern in the area of manufacturing in the last decade. A study by the Manufacturing Institute and Deloitte Consulting LLP found that approximately 60% of unfilled manufacturing jobs in 2015 were due to a shortage of applicants with STEM skills. Still, forecasts pointed to a 2.4% growth in U.S. manufacturing for 2020 and 1.9% in 2021, with productivity increasing. (TERRA Staffing Group et al., 2021)

This staff shortage has led to manufacturing employees routinely working overtime at an average of 17% more hours than employees in other industries. Executives back then expected the problem to worsen over the next few years, with “even more severe staffing difficulties by 2020.” (Two Million Vacant Manufacturing Jobs by 2025, 2015)

Moderate understaffing can lead to the scope of individuals’ responsibilities expanding, which on the one hand can sometimes “result in higher levels of individual motivation and performance,” but on the other hand “may lead to lower levels of aggregate group output.” Understaffing has been shown to have particularly damaging effects on the productivity of operators and engineers on the floor, where they are required to complete more varied tasks but are unable to fully commit to any of them. (Ganster et al., 1995)

The technical writing industry, on the other hand, is expected to grow. In 2016, the U.S. Bureau of Labor Statistics projected that the demand for technical writing would grow 11% by 2026. Whether or not this increase will take place within the manufacturing industry relies on the industry’s ability to navigate common obstacles when it comes to technical writers: perception of their role, skill diversification, and organizational size.

Many companies do not hire technical writers due to a lack of knowledge of what their role actually implies, or out of concern that writers would not be an efficient investment. “Functionally it would be very difficult for us to have a singular person do that because one person would then be pulled by the various departments,” one manufacturing executive asserted,

explaining why their company did not see hiring technical writers as a feasible endeavor. Training other staff in writing is often easier than attempting to educate writers on aspects of many different roles across a company.

On the other hand, some technical writers believe that "maintaining cognitive distance from the product or process" is important to their role, allowing them to maintain an outsider's perspective so that language is more accessible. But interfacing with people who have the necessary information can be a challenge. Some "have to be cornered to get them to pay attention." This is particularly a challenge in small organizations, where writers would have the added obstacle of competing priorities, limiting their ability to give all projects enough time. (Rosselot-Merritt, 2020)

Agile methodology has been suggested as a way to bridge the gap between writers and other contributors to documentation adaptation, as it has proven efficient for collaborative software development work across cross-functional teams. Developers using Agile methods meet daily in a brief session to minimize up-front planning and meet goals in small increments, by identifying needs and obstacles and addressing them on a daily basis. Incorporating a modified version of Agile to the manufacturing industry could aid in the process of documentation adaptation, as gathering the necessary information for an adaptation often requires the efforts of a cross-functional team. Online task management platforms can assist in organizing this information. (Kovalev et al., 2020)

Such an approach could be combined with a methodology such as Lean Six Sigma—the application of lean techniques to increase speed and reduce waste and process complexity—to streamline the records management processes and to improve the ways information flows into, through, and out of organizations. A key principle of Six Sigma, DMAIC (Define, Measure, Analyze, Improve, Control) can be applied to define the scope of records (often simultaneous, multimedia, incorporating both printed and electronic documents), measure current performance, analyze potential bottlenecks and opportunities, improve by implementing recommended solutions, and place necessary controls to maintain those improvements on the long term. (Brett et al., 2005)

Quality Management Systems and Cloud Implementation

Implementing a QMS significantly increases productivity at manufacturing firms, particularly in the early stages of operation. When combined with quality improvement methodologies such as Lean Six Sigma, the rate of improvement is even greater. QMS is at its least productive when managers do not understand it properly or know how it can benefit the company. (Yadav et al., 2020)

Paired with the right QMS and document processor, cloud implementation facilitates access to different streams of information and easily allows for its integration—a crucial tool when it comes to documentation adaptation. It allows teams to contribute to and reuse content with ease, while also documenting important changes for quality management and making it available to a wider audience, if necessary. But not all companies have taken advantage of this option.

A 2017 study found that 66% of manufacturing enterprises from 17 countries had implemented the cloud, with cloud-hosted services predicted to account for nearly half of all manufacturers' organization-level software by 2023. (Ezell et al., 2020) "More large enterprises are likely to move workloads away from traditional and virtualized environments toward the cloud — at a rate and pace that is expected to be far quicker than in the past," a 2016 survey by McKinsey's IT-as-a-Service Cloud and Enterprise Cloud Infrastructure found. "Large enterprises are expected to significantly increase their adoption of private cloud services as well."

This prediction turned out to be correct: During the first quarter of 2020, the cloud transition was accelerated by the COVID-19 pandemic, with cloud spending rising 37% to \$29 billion. Gartner theorized that "despite the inevitable economic downturn in the wake of the pandemic, cloud spending is estimated to rise 19%."

But although transitioning to the cloud can make documentation adaptation easier, by virtue of its ability to connect documentation, do away with redundancy and enforce quality control, it should not be a decision made lightly. Companies should ask themselves: Do they have the right technology to support this model? Are employees prepared to manage this system? And does the organizational structure support using this system for collaboration across different teams? (McCaffrey et al., 2020)

Regulations and Guidance on Documentation

The FDA offers some requirements for documentation (Tartal, n.d.):

Document approval. Ideally, the same person who approved the original document should approve the adaptation, as they would best understand the impact of the changes made. In the case of the adaptation of a document not prepared within the company, this designated approver might be someone familiar with the original document received.

Document distribution. Obsolete documents should be promptly removed to prevent their unintended use, while new documents should be made easily available “at all locations for which they are designated, used, or otherwise necessary” in a timely manner. “FDA has had many experiences where manufacturers made corrections to documents, but the changes were

not communicated in a timely manner to the personnel utilizing the documents. The result of these untimely communications was the production of defective devices.”

Document revisions. Change records should include a description of changes, an identification of other documents that might be affected by the change, signatures of approving individuals, the approval date, and the date that the new document becomes effective.

Other FDA and technical writing suggestions for effective documentation can be summarized as follows:

Language: Procedures should use precise scientific and technical principles, but should also be practical and logical, written in accessible and easily understandable language. Some of these technical details include process parameters, tool settings, amounts and times.

Specificity: While procedures should be thorough, there is an inherent variability to certain processes, such as cleaning. When establishing these steps, "technical aspects must be chosen considering the inherent variability of manual cleaning procedures and must be robust enough to ensure the inherent variability will not result in inadequate cleaning." Some procedures might include excessive steps to compensate for this variability from one operator to another and ensure consistent quality.

Verification: Visual verification of procedures is not enough— it should be confirmed in writing by the operator after inspection and also by a second witness. "All personnel including operators, verifiers, and quality unit personnel involved with equipment inspection should have inspection training."

Context: Operators should clearly understand the potential ramifications of inadequate work, as well as the specific details of the procedure being performed. "There is no flexibility in performance, and operators must understand why there is no flexibility." (Pluta et al., 2009) A big part of this can be involving employees in the development of the documents that provide this context. It has been found that employees' participation in developing in-house standards and documentation related to health and safety, results in improved health and safety practices across the board. (Gembalska-Kwiecień, 2017)

Visual information: A study on the effectiveness of arrows and pictures found that providing participants with a picture improved their efficiency and accuracy during the assembly and operation of equipment. "Combinations of pictorial information with text-only information facilitate significant improvements on both novel assembly and operating tasks. If financial cost is a major constraint, then a text instruction manual should at least include a picture of the assembled object or pictures of sub-assembled objects. Simple augmentation

using information such as arrows has been found to be very cost effective compared to augmenting instructional objects with audios or videos." (Pekerti, 2013)

Practical Application Research

Observation and task analysis, as well as a careful analysis of documentation provided by Frito-Lay, enabled me to obtain a thorough understanding of the ultrasonic cutter cleaning process and the necessary changes that needed to be made to the written procedure for the adapted SSOP.

This section includes a detailed explanation of what I observed at the Randolph manufacturing plant, as well as an overview of the issues presented by the documentation I analyzed, and how this informed the steps I took in adapting the SSOP. The full breakdown of my approach to this adaptation and how it was carried out is in *Practical Application: Adapted SSOP*, later in this report. The full adapted document can be found in Appendix V.

Observation and Task Analysis

Although I carried out several visits to Frito-Lay's Randolph manufacturing plant in order to observe how the ultrasonic cutter worked, I dedicated one seven-hour visit on February 21, 2021, to observe the sanitation process. The Randolph plant carries out sanitation over the weekends, with one entire day dedicated to sanitizing mechanical equipment. I shadowed a sanitor as he carried out the process, asking questions and observing his actions closely.

My resulting notes were by no means a fully accurate account of the process, and they would later be run through sanitors and managers to confirm their accuracy. The process of setting up and closing the equipment was only partially carried out while I was there, due to a scheduling change that led the cleaning of other equipment to have been done prior to my arrival, rather than after, as would normally be the case. This led to some discrepancies in my understanding of the order in which steps normally took place. Certain terms also had to be changed to reflect how operators and sanitors commonly refer to equipment.

There were some discrepancies between how people had described the process to me beforehand and how this sanitor carried it out. There were also some discrepancies in the way sanitors normally carried out the process when it came to safety and thoroughness. It was also clear that although one or two sanitors had had conversations with Research & Development and understood the mechanics and sanitation requirements of the machine, they were the only ones trained so thoroughly on this equipment. Other sanitors did not have access to the full manual provided by Matisse and only trained through word of mouth, increasing the likelihood of them carrying out the process imperfectly.

Even managers, whose goal was to make the sanitation process more efficient, were not aware of exactly how sanitation was being carried out. All these issues had to be addressed in the final adapted document.

Documentation Analysis

Upon examining the documents provided by Frito-Lay, I found that the SSOPs previously in use were themselves adapted documents, adapted from the manufacturers' own manuals in accordance to Frito-Lay's template and requirements.

However, the existence of two different versions points to the inadequacy of the longer water jet SSOP for quick reference by sanitors on site. The longer document provided more detailed information, but lacked the photographs or easy-to-read instructions included in the abridged version. The abridged version, meanwhile, lacked many important elements from the longer document, such as a list of materials and safety warnings. It was easy to see how there could have been discrepancies in the ways employees in different departments or with different exposure to either document understood the sanitation process.

The documentation training document and dry cleaning SSOP allowed me to understand Frito-Lay's standards for structure, layout, and style. As expected, the ultrasonic cutter SSOP would have to incorporate improvements on many different fronts.

Some of what the operation manual said did not match what I was told during my conversations with sanitors about how they had been trained by Research & Development. For example, the operation manual frequently makes reference to the use of water, while sanitors were told repeatedly to not involve water in any step of the sanitation procedure. This change and many others were likely due to Frito-Lay highly prioritizing making equipment last, and knowing from experience that additional hazards could arise from misunderstandings. It is also important to note that the operation manual was not prepared while taking into consideration the modifications made to the ultrasonic cutter by Matisse upon Frito-Lay's request, so there are mechanical differences that were not accounted for in sanitation.

I identified issues in the ultrasonic cutter manual's sanitation chapter and categorized them into "Modifications," "Clarifications," or "Style." What follows is a list of issues, as they were recorded at the time:

Modifications:

- Incorporate lock pin change. Frito-Lay and Matisse modified the equipment so the lock pin no longer moves into the same position the user manual illustrates.
- Remove any mention of water. Frito-Lay determined that the equipment is sensitive and should not be cleaned with water.

- Note that cleaner should be added to the blades. The user manual makes no mention of how to clean the blades.
- Remove any mention of “white bristle brush.” Frito-Lay determined that a brush could harm the equipment over time.

Clarifications:

- Include prep conveyor belts. The user manual mentions opening the cutter doors, but does not say that the conveyor belts need to be open to do this properly. Add pictures and text clarifying this.
- Specify which doors need to be closed. The user manual says “Close all doors” – but does not specify which or where they are. Add pictures and text clarifying this.
- Specify which emergency stop pushbuttons. The user manual says “Pull all emergency stop pushbuttons” – but does not specify which or where they are. Add pictures and text clarifying this.
- Explain how the ‘Alarms page’ should look. The user manual asks users to verify that there are no alarms, but does not say what the page should look like in this case, or clarify what one should do if there are alarms.
- Explain top-bottom procedure for air blowing. Air blowing must happen from top to bottom to efficiently remove impurities.
- Mention ladder. The equipment is tall and sanitors must climb to be able to access surfaces near the top.
- Remove acronyms such as “HMI.” HMI is not defined in this chapter of the user manual and would not be a familiar term for sanitors.
- Include pictures of the guillotine guard to ensure the user knows what it looks like.
- Include a picture of the sanitation page to show what it looks like.

Style:

- Follow Frito-Lay’s template for dry cleaning.
- Improve phrasing in the Safety Requirements section.
- Make the caution warnings stand out visually.
- Standardize the user interface style for steps involving screens.

My approach to addressing each of these cases was fully informed by the best practices learned through the interview and literature review outlined earlier in this chapter, and is outlined in *Practical Application: Adapted SSOP*.

Conclusions

Best practices for documentation adaptation cover many different areas, but interviewee responses provided a particular wealth of information when it came to quality management, collaboration and overlap for documentation adaptation, and the different challenges associated with adaptation.

Quality Management

Enforcing quality is a crucial part of adapting documentation; in fact, it is practically impossible to identify the need for adaptations and track their progress without quality management. In this section, I explore this topic on three different fronts: QMS, federal and company documentation standards, and additional efforts to improve document quality.

Quality Management Systems

The documentation process happens within the framework of a QMS—that is, a system that organizes, curates and categorizes documents within a company, and enables users to access and navigate through documents with ease. QMS implementation significantly increases productivity, particularly in the early stages of operation, and can take many different forms.

The most basic form of a document control system requires that whenever a document is updated, the user should update the document with a description of what specifically was changed, when it was changed, and why. Small companies might simply use Microsoft Word or Microsoft Excel sheets with custom templates to keep track of their documentation, while larger companies might purchase more advanced software. Companies may employ formal documentation management systems such as Microsoft SharePoint, Rubex, Tridion and SeedDMS to track revisions and supervise document quality, or simply use shared folders with labeled revisions.

For adapted documents, software like Adobe FrameMaker allows for easy management of frequent revisions by many different people, publication to a variety of output formats, and the reuse or conditionalization of content. This is particularly useful for companies where the team using the QMS is large, and the complexity of collaboration requires these additional tools. A smaller company with less documentation needs might find new software and the training it entails to be an unnecessary time expense.

Many of these documents must be available to employees both on the cloud and in physical form. Although cloud-hosting services haven't been implemented across the entire manufacturing industry, the number of companies who have is quickly rising. The COVID-19

pandemic has only contributed to this acceleration, proving the efficiency of quick access and easy logging of revisions.

Still, transitioning from traditional systems to the cloud should be done thoughtfully, evaluating whether the technology, training and organizational structure currently in place is in shape to support this system—or if further improvements are needed to make it feasible.

Documentation Standards

ISO does not have tight requirements regarding documentation, but government organizations such as the FDA offer guidelines which are often reflected in the company policies of certain manufacturing sectors, such as food, pharmaceutical, aerospace, and semiconductor manufacturing.

Process of record is highly important to uphold product quality and safety. Any changes to documentation must be carefully logged, including a description of changes, an identification of other documents that might be affected by the change, signatures of approving individuals, the approval date, and the date that the new document becomes effective. Designated approvers for adapted documentation are, ideally, the same individuals who took part in the preparation or approval of the original document, as they better understand the impact of the changes made and can outline next steps for implementation and distribution.

Companies have their own style guides for technical content, with procedures and vocabulary specific to the company. Frito-Lay, for example, prioritizes the inclusion of visual cues such as photos or diagrams, as well as specific explanations of what processes should look like. They also include guidance on Frito-Lay’s preferred vocabulary—such as usage of the word “team” instead of “employees,” and “opportunities” instead of “challenges.” In the case of Waters Corporation, style guides include strategies for when and how to reuse content, a spelling quick reference guide and terminology list.

Quality Standards

Experience has shown that documentation adaptation can go beyond simply modifying a document for new applications, but can actually improve the content and delivery of the text by adopting certain practices, such as improving language, providing context, and including visuals.

Documents should be written in accessible and easy-to-understand language, without losing technical specificity. The effectiveness of procedures and the likelihood of them being followed in full increases when accounting for variability between operators, and when providing explanations of reasoning behind certain instructions.

Photographs, diagrams, and labels can minimize the amount of time it takes a person to understand how to do something. Training writers to include more visual information may decrease the amount of text necessary, thereby decreasing the number of pages of the document and increasing the likelihood of easy replicability.

Collaboration and Overlap

Revisions don't happen in isolation. Adapting documentation can happen at all stages of the manufacturing process, and involves a lot of back and forth between the many different parties involved. While it might be easy to assign roles to these parties, such as “engineer” or “technical writer,” the reality is that many companies either never made the move towards hiring staff specifically for documentation or quality management purposes, or have collapsed jobs down to where engineers fulfill those roles on top of their usual ones. The terms “writer” and “operator” do not necessarily imply that this is the primary role of that person within the company, but rather the role they occupy specifically in the process of preparing documentation.

Collaboration Between Operators and Writers

Even in cases where companies have not hired technical writers, this does not mean that technical writers are entirely absent from the manufacturing scene. Technical writers are sometimes contracted to adapt documentation to the company's specific style and format. This often involves going on site, following operators around, taking pictures, and asking questions—such as the reasons behind certain steps, how steps are carried out, and what are the risks of not following certain protocols. Companies often favor writers from trusted writing firms who have experience with company style and standards.

Collaboration Between Writers and Vendors

In other cases, writers adapt documentation prepared by vendors providing machinery for the lines. Vendors may receive a model from the company requesting a certain format, especially when it relates to training. But the writing styles or quality standards of vendors and the company don't always line up. Documentation often lacks accessible language and only provides surface-level explanations, requiring further adaptation for company use.

Collaboration Across Borders

Adapting documentation often becomes the subject of collaboration between branches in different countries. But not all locations have access to the same resources, which could easily lead to differences in procedure, quality, and understanding, if not correctly handled. A centralized approach, with personnel from various locations flocking to a centralized source for training on how to approach documentation, helps companies ensure that the same quality and safety standards are upheld globally.

Challenges and Key Learnings

Among the main challenges faced by companies carrying out documentation adaptation are understaffing, lack of access and training, and the need to build stronger relationships in cross-functional teams.

Understaffing

Understaffing accounts for one of the most pressing challenges employees face in the manufacturing industry, with staff in this sector working 17% more overtime hours than those in other industries. But the industry productivity continues to grow. This has direct and rapid consequences on the state of documentation management. Although some organizations can operate smoothly with a small, well-trained team, time limits the degree of complexity of documentation adaptation, and can easily lead to mistakes in documentation, revision tracking, distribution or training. Operators and engineers on the floor must now complete more varied tasks, but often find themselves unable to fully commit to any of them, and documentation loses priority. Writers barely get to churn out the highest-priority documents, and lack of time limits documentation thoroughness, while less urgent but nonetheless important documents are never worked on.

This begs the question: would we be adapting documentation much more, and much better, if writers simply had the time to give projects the necessary focus?

Depending on the company, the solution may or may not be to hire technical writers. While some companies can greatly benefit from a team dedicated to uphold quality and scope of documentation across the board, others find that decentralization is a better response to the varied nature of documentation across the company. In these cases, training engineers or operators on documentation is a more practical approach. But this should be taken into account when assigning staff responsibilities and determining the amount of new hires, to allow designated writers enough time to dedicate to documentation on top of their other roles.

Access & Training

Another issue at the forefront of adapting documentation is access. In a company with a smoothly functioning QMS, new documentation can be easily rolled out and any updates to documents quickly replace older versions. However, access and training play an important part in this process.

If employees aren't trained to use the revision control system, or documents are not made available to them for easy adaptability, inconsistencies can quickly multiply throughout the system and result in defective products. Physical copies of documents, particularly those for processes happening on the manufacturing floor, must be updated quickly and efficiently to

prevent operators from working with different versions. Many companies are trying to shift away from physical copies to avoid this issue and ensure that the only version available is the most recent one, but this is not always possible—especially when dealing with factory processes, where physical copies are easier to handle.

Another important factor is that documentation adaptation often benefits from including information from other sources to provide readers with a more nuanced picture. Sometimes, important information is stored separately, making it difficult to access and rendering the document less efficient. An effective adaptation pulls from various sources to provide context, reducing the amount of documents a person needs to peruse. This highlights the importance of a good QMS; if documents are not easy to access or their relevance is unclear, it can be difficult to identify resources to draw from for a more complete adaptation.

Building Relationships

Technical writers sometimes face challenges due to the nature of their responsibilities. While their role does not require them to be spread out across many different areas, as is the case for engineers who are also writers, technical writers often struggle to establish good communication with experts on the processes they write about. While some technical writers believe that an outsider's perspective keeps writing more objective, interfacing with people who have the necessary information can be a challenge. The unequal dependence between writers and technical experts can make it difficult for writers to understand changing processes enough to write about them and make the necessary revisions to documentation in a timely manner.

Efforts to bridge this gap have been made by implementing strategies such as Agile methodology, a set of practices used in software development to collaborate and organize work in cross-functional teams. Embedding a writer in a technical team on a daily basis allows technical writers to follow up with teammates quickly and efficiently, and often gives them the ability to answer any questions about the product or process themselves, due to their familiarity with it.

Such an approach could be combined with online task management platforms and other methodologies such as Lean Six Sigma, to streamline the records management processes and improve the ways information flows into, through, and out of organizations. Additionally, involving operators or engineers in document adaptation allows employees to better understand the importance of standards for quality and safety, thereby increasing the effectiveness of the documents' implementation.

Recommendations

I arranged the conclusions of this study into a set of best practices for adapting documentation in manufacturing industries:

- **Establish rapport.** Establish positive relationships with experts, through formal collaborative methodologies or personal connection, for better flow of information.
- **Observe.** Observe how the original document is used and ask questions from experts, particularly regarding sources of dissatisfaction, potential risks, and alternate outcomes.
- **Provide context.** If necessary, draw from more than one document to centralize information and establish understanding about the reasons behind provided information.
- **Keep language accessible.** Use language that is both precise and easy to understand.
- **Provide visuals.** Incorporate pictures, labels, and diagrams to streamline information.
- **Ensure distribution.** Ensure that there is an efficient system of distribution for the adaptation to replace the original document.
- **Track revisions.** Keep a record of all revisions, with detailed explanations of what was changed, why, who performed the change, and who authorized it.

The following chapter offers an example of how these best practices may be applied, through my adaptation of a chapter of a Matisse operation manual for use as an SSOP at a Frito-Lay manufacturing plant.

Practical Application: Adapted SSOP

I applied the compiled best practices for documentation adaptation to the adaptation of a Matisse operation manual's sanitation chapter into an SSOP. Every step of this adaptation was informed by the best practices, but I also based some additional modifications on Frito-Lay's feedback and standards, as well as technical writing best practices.

In this chapter, I explain how I applied each best practice, providing some examples and identifying challenges that arose throughout the process. The complete original document can be found in Appendix IV, and the complete adapted document can be found in Appendix V.

Establish Rapport

In my initial conversations with the Frito-Lay team, managers and sanitors communicated four main needs they believed the adapted document should meet. These were:

- To account for mechanical modifications to the ultrasonic cutter,
- To remove any mention of water from the cleaning and sanitation process,
- To include photographs,
- To follow Frito-Lay's template for SSOPs.

Identifying these priorities guided my approach to the adaptation, allowed me to identify other areas that could be improved, and directed my search for other sources of information. It also helped establish common ground with the managers, who were eager to see the documentation adaptation completed so they could meet their own goals.

Another important factor was holding frank conversations with one of the sanitors during my observation of the process, getting to know them and their concerns related to documentation. For example, the sanitor mentioned that the rolls of Wypall towels used to clean the ultrasonic were sometimes left on dirty surfaces during storage, rendering them inappropriate for use during the cleaning procedure. This issue was mostly passed on through word of mouth between sanitors, but I made sure to record it in the adaptation as seen in Figure 1, because the effectiveness of the process relies on this information.

1.1 Gather all tools and supplies.
1.1.1 Make sure Wypall towels are clean.

Figure 1. New step added to the adapted document to ensure Wypall towel cleanliness.

These conversations also led me to note the importance of top-to-bottom air blowing, and how important using a ladder was to both the sanitors and the managers to ensure their safety. I

made sure to photograph these steps. Figure 2 shows how they form part of the overall procedure.

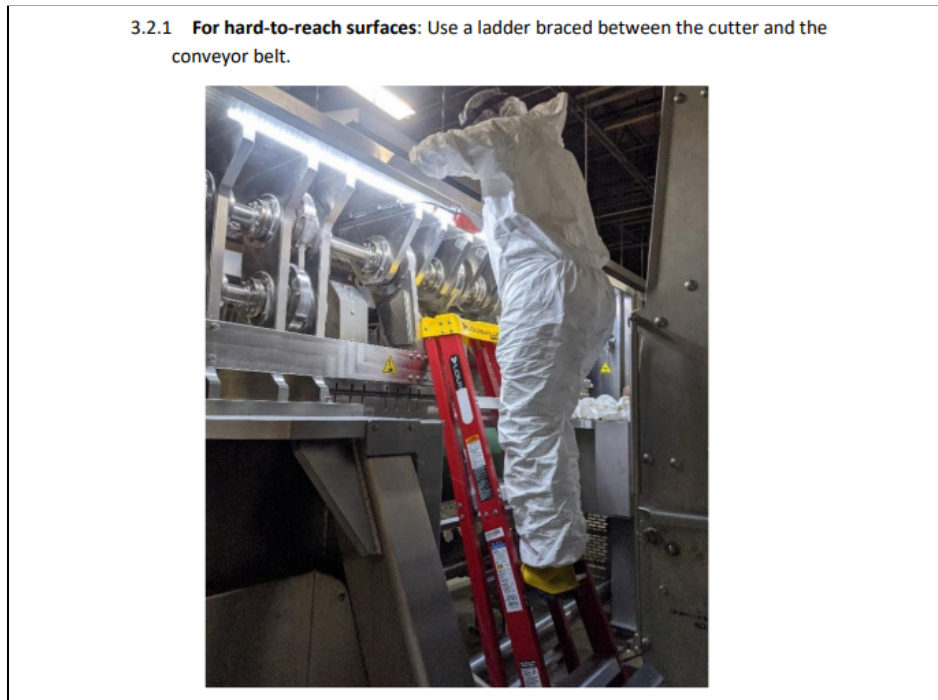


Figure 2. Description and photograph of ladder position in the adapted document.

Observe

The original document featured very little explanation as to the physical steps one would have to carry out to perform the cleaning and sanitization process. I watched the sanitor and made sure to ask any questions that would inform how I framed information in the adapted document. Some examples of these questions are:

- Why is this task necessary?
- How long does it normally take you to complete this task?
- What is the most challenging part of this task?
- What do you think sanitors should know about this task?
- What are some of the safety concerns related to this task?

While not all the answers to these questions would go on to be a part of the SSOP, understanding the importance of a task and issues associated with it helped me prioritize what to communicate about each step. I took detailed notes, including both my observations and the answers to these questions, which I later consolidated into a draft of a procedure to clarify my understanding of the steps.

Figure 3 shows the steps to cleaning and sanitation as I saw them or as they were recounted to me, including notes and caution warnings:

Tools and materials

- Flashlight/headlamp
- Plastic coverings
- Air gun
- DrySan Duo 2-in-1 cleaner and sanitizer
- Paper towels
- Ladder
- Plastic scraper
- Cut-resistant gloves
- ATP swab
- ATP detection system

CAUTION: Do **NOT** use anything other than paper towels and a plastic scraper to scrub during cleaning, as this could permanently scratch the equipment and lead to rusting.

Procedure

1. Set up the equipment:

- a. On the ultrasonic cutter screen, ensure the blade is powered off. Press UNLOCK.
- b. Open all doors: two doors on either side of the blade, and two doors on the sides, by the floor.
- c. Open both adjacent conveyor belts. Make sure all conveyor belts are locked and labeled.
- d. Using plastic covering, cover the two motors underneath the cutter and the control box and screen. This protects equipment from water from adjacent areas.
- e. Lock blade using the lock bar. Turn lock pin.

CAUTION: Ensure the blade is fully locked and powered off before cleaning!

2. Clean off dust:

- a. Using an air gun, blow dust off from the top to the bottom of the cutter.
- b. Make sure paper towels are clean, as they are sometimes left on dirty surfaces. Using a dry paper towel, wipe down outside surfaces.
- c. Blow again with the air gun.

3. Deep clean:

- a. From top to bottom of the equipment, spray DrySan Duo onto surfaces and rub off grime using paper towels.
- b. Pull towels between wheels/shafts to dislodge dust and clean the area.
- c. Do multiple wipes of each area, 2-3 times, or until clean.

NOTE: Do **NOT** set the DrySan Duo bottle down on the machinery, as it could carry in contamination.

- i. For hard-to-reach surfaces: Use a ladder braced between the cutter and the conveyor belt.
- ii. For inside surfaces: Spray and soak for about 2 minutes, then wipe down with paper towels. If there is clumping, remove clumps using a plastic scraper
- iii. For the blade: clean from the top. You **MUST** wear cut-resistant gloves.
- iv. For the conveyor belt: Turn on the belt on the screen, spray and wipe the belt as it moves. Make sure DrySan Duo drips onto the brush beneath the belt as it cannot be directly cleaned.

4. Final clean:

- a. Wipe down all surfaces with dry paper towels to dislodge any remaining dirt.
- b. Using the air gun, blow on all surfaces to dislodge any remaining dirt.
- c. Wipe down the conveyor belt one last time, then turn the belt off using the screen.

5. ATP test:

- a. Bring ATP swab tube and ATP detection system directly next to the conveyor belt.
- b. **QUICKLY** pull on one side of the ATP swab tube to uncover the swab.
- c. **QUICKLY** rub swab across a 1 x 1 inch section of the conveyor belt, four times up and down and four times across.
- d. Insert tube, swab-down, into the hole at the top of the ATP detection system. Wait a moment for the reading.
 - i. **If screen displays FAIL:** Repeat cleaning and sanitation procedure.
 - ii. **If screen displays PASS:** Proceed to Step 6 (Close equipment).

6. Close equipment:

- a. Unlock the lock pin, and push the lock bar upwards to unlock the blade.
- b. Unlock and close adjacent conveyor belts.
- c. Close all doors.
- d. Press LOCK on the screen.

Figure 3. Procedure prepared based on notes from observation.

These steps are much different from the order of steps in the finished adapted document, and there are some mistakes which were later clarified with feedback from a manager and sanitor. For example, the process I outlined here for preparing the equipment lacked references to screens, which must be addressed before opening any doors. I also originally used the term “paper towels,” but was later told to change this to “Wypall towels,” as this term is more accurate.

Although this procedure was incomplete, processing the information I observed allowed me to better understand what was happening. I also took detailed photographs of every step, which would later go on to be a part of the SSOP.

Provide Context

Some of the information that was not clear enough from the original document could be drawn from other sources. For example, the original document lacked any specific safety information or directions about where things were. This was because the user manual’s sanitation chapter assumed the reader had read chapters before it—but when on the floor, it would be impractical for sanitors to read the entire user manual to understand basic information about the equipment.

Because of this, I drew from other chapters of the user manual to include information and photographs in one place, such as the chapter titled “Overview of the Machine” to provide a photograph of the entire cutter, the “User Interface” chapter to illustrate what the screen looks like at different stages of the process, and the “Safety” chapter to explain the importance of certain safety steps. This made it so that a sanitor could quickly internalize all relevant information about the equipment while reading the procedure.

However, in some cases, including all this adjacent information was not possible. I originally intended to include the entire ATP procedure as one of the steps, but a Frito-Lay manager indicated that I should remove it, as sanitors are trained in ATP early on and should know it by memory. While I felt that the adapted document should include all information in the same place, I deferred to the company policy. Instead, the SSOP now includes standard Frito-Lay language referencing an ATP procedure elsewhere, as seen in Figure 4.

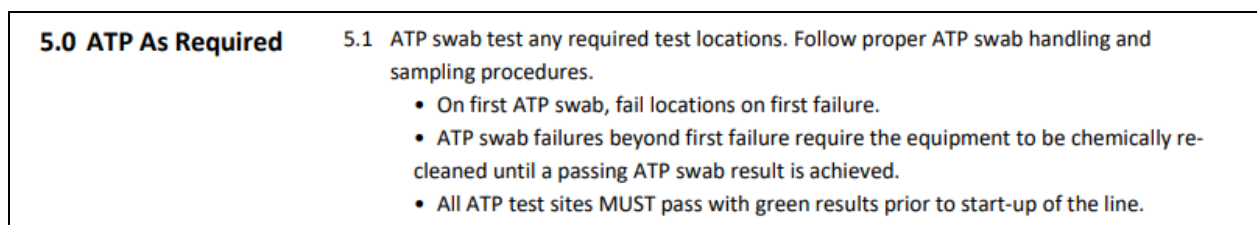


Figure 4. ATP section in the adapted document, featuring a standard Frito-Lay description.

Keep Language Accessible

The language of the original manual was simple, but often too vague to accurately convey the steps required. There were some acronyms defined earlier in the user manual that would be unintelligible to someone simply reading that chapter, such as “HMI.” I removed this.

Some instructions were too vague, such as “it is possible to activate the Roller Conveyor”—how does one activate it, and where?

Other steps lacked explanations of alternate outcomes—such as one asking users to verify that there are no alarms before proceeding. The operation manual did not explain how to verify this, or what one should do if there are alarms. As a result of my conversations with the manager, I was able to provide a short explanation, shown in Figure 5.

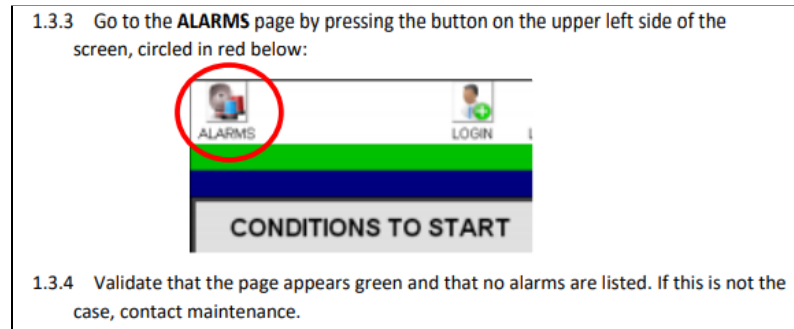


Figure 5. Added explanation about the Alarms page in the adapted document.

The overall structure of the procedure also lacked clarity. There were 26 steps with no breaks to indicate different stages of the procedure, which was confusing and difficult to digest with a quick look. I followed the technical writing convention of limiting sections to 7 ± 2 steps, which helped make the entire procedure digestible. Short titles at the top of each block of information allow the reader to quickly visualize the progression of the steps.

I also changed the conventions used for user interface instructions as seen in Figure 6, moving away from quotation marks to using bolded button names, as per the Microsoft Style Guide. These standardized conventions have been designed to make instructions related to UI easier to follow.

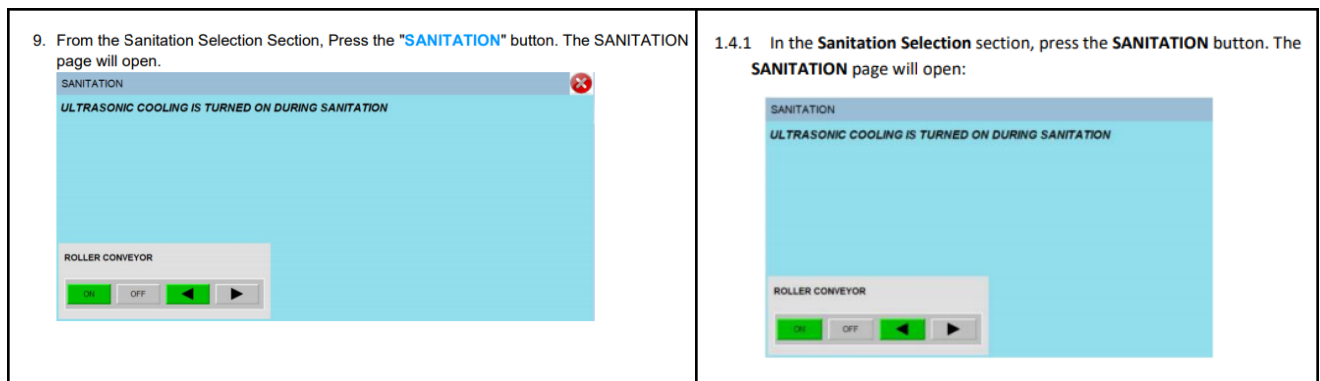


Figure 6. Comparison of the user interface notation of the original and adapted documents.


However, there were times when I had to decide between language standards and the template that Frito-Lay had already provided me with, which included standard text used across all of their documentation. While I did make some minor grammar modifications, text at the beginning and at the end of the document had to follow a certain format, limiting my ability to make language simpler, clearer and more concise.

Provide Visuals


An important part of this procedure was to include easy-to-follow photographs for most steps, as the original document had no photographs at all. This was particularly important considering the mechanical modifications that had been made to the machine, of which there was no accessible record for sanitators. If they were to follow the user manual’s indications for locking the machine, for example—although it should be noted that this information is in a separate chapter of the user manual—they would be unable to do so, because the position of the lock pin has changed. Combined with full images of the equipment and screens taken from the original document, it was easier to illustrate how different steps take place. Figure 7 shows an example.

2.2 Remove loose particles:

2.2.1 Using an air gun, blow air over the machine to remove particles from the top to the bottom of the cutter, including the gullotine and roller.



2.2.2 Using a Wypall towel, wipe down outside surfaces to loosen debris.



2.2.3 Blow air over all surfaces with the air gun.

Figure 7. The initial steps of “Remove loose particles” featured in the adapted document

I also included arrows or circles where they might help a sanitor easily identify what to press or what part of the machine to attend to. For example, the user manual instructed one to “Close all doors,” but did not specify which doors or where they are. I indicated the location of these doors using arrows in Figure 8.

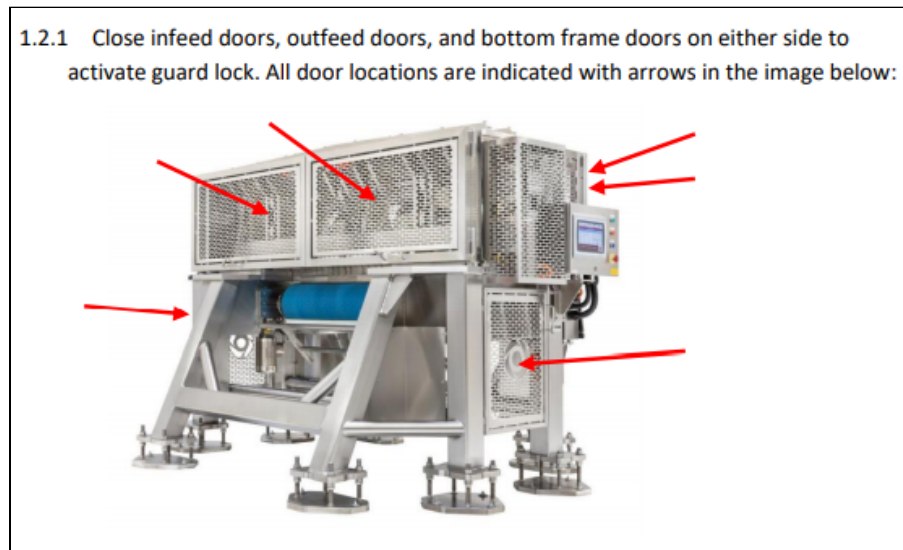


Figure 8. Example of an image featuring arrows, from the adapted document.

Another important visual feature was to make warnings stand out to the reader, highlighting the importance of a safe and correct procedure. This is not only for aesthetic purposes, but follows Frito-Lay’s standards for health and safety. I did this by using red boxes for warnings and important notes, such as the one in Figure 9.

3.2 Do multiple wipes of each area, 2-3 times or until clean.

CAUTION: Never use anything other than Wypall towels and a plastic scraper to scrub during cleaning, as this could permanently scratch the equipment and lead to rusting.



Figure 9. Caution box in the adapted document.

Ensure Distribution

Currently, Frito-Lay has not distributed the sanitation chapter of the ultrasonic cutter user manual among its staff, because it does not offer an accurate explanation of the process. Sanitors instead rely on word of mouth, which can be dangerous for replicability and quality.

In the past, other machinery documentation at this plant has been too difficult to quickly go over visually on the operating floor, so an abridged version was made and placed near the equipment. However, this abridged version lacked the specificity and safety warnings of the original document.

With this more complete yet visually stimulating document, this issue should not appear in the implementation of this adaptation. Frito-Lay intends to make the adapted SSOP available to sanitors now that it follows the correct format, conventions, and procedure.

Track Revisions

A crucial quality safeguard missing for the ultrasonic cutter operation manual was a way to track any revisions made to the document. This adapted document includes a box for revisions to be logged, including a record of what changes were made and why, and who approved them, which can be seen in Figure 10.

M. Revision History			
Revision #	Date	Changes	Name

N. Approvals			
Name (print)	Title	Signature	Date

Figure 10. Revision history and approval boxes in the adapted document.

On my end, I also kept detailed record of different drafts and ran them through a manager and a sanitor, receiving written feedback that I then incorporated into my next draft. This document will receive their full approval before incorporation, and any future changes made to it will be logged in the tables provided.

References

- Brett, C., Queen, P. (2005). Streamlining Enterprise Records Management with Lean Six Sigma. *ManagementWise: The Information Management Journal*, November/December 2005.
- Ezell, S., & Swanson, B. (2017). *How Cloud Computing Enables Modern Manufacturing*. The Information Technology and Innovation Foundation.
- Ganster, Daniel & Dwyer, Dale. (1995). The Effects of Understaffing on Individual and Group Performance in Professional and Trade Occupations. *Journal of Management - J MANAGE*. 21. 175-190. 10.1177/014920639502100201.
- Gembalska-Kwiecień, A. (2017). Fundamentals of an effective corporate safety culture. *Ekonomia i Prawo*, 16(4), 401–411.10.12775/EiP.2017.028
- International Organization for Standardization. (2015). *Guidance on the requirements for Documented Information of ISO 9001:2015*.
- Kovalev, I., Kvashnin, D., Chervonnova, N., & Nikich, A. (2020). Application of agile methodology at industrial manufacturing as part of the Industry 4.0. *IOP Conference Series. Materials Science and Engineering*, 971(5). 10.1088/1757-899X/971/5/052034
- Matisse (2020). "Equipment: High Speed Inline Guillotine (GH41)."
- McCaffrey, M., Palladino, J. T., Dempsey, C., Bhardwaj, S. C. (2020). Can you meet customer demand for cloud computing? PricewaterhouseCoopers. Retrieved April 20, 2021, from <https://www.pwc.com/us/en/industries/tmt/library/covid19-cloud-infrastructure.html>
- Pekerti, A. (2013). Augmentation of information in educational objects: Effectiveness of arrows and pictures as information for actions in instructional objects. *Australasian Journal of Educational Technology*, 29(6). 10.14742/ajet.312

- Pluta, P., & Hall, W. (2009). Effective manual cleaning procedures—development, documentation, performance, and maintenance. *Journal of GXP Compliance*, 13(4), 23–.
- Rosselot-Merritt, J. (2020). Fertile grounds: What interviews of working professionals can tell us about perceptions of technical communication and the viability of technical communication as a field. *Technical Communication*, 67(1), 38-62.
- Tartal, J. (n.d.). Documents, Change Control and Records. U.S. Food & Drug Administration.
- TERRA Staffing Group, & Dacorogna, K. (2021). U.S. Manufacturing Growth & Outlook in 2021. Retrieved from <https://www.terrastaffinggroup.com/resources/blog/us-manufacturing-growth/>
- Two Million Vacant Manufacturing Jobs by 2025...How Can We Tackle the Skills Gap? (2015). Retrieved April 19, 2021, from <https://www.globaltranz.com/manufacturing-jobs-skills-gap/>
- Yadav, N., Shankar, R., & Singh, S. (2020). Impact of Industry 4.0/ICTs, Lean Six Sigma and quality management systems on organisational performance. *TQM Journal*, 32(4), 815–835. 10.1108/TQM-10-2019-0251

Appendices

Appendix I. Informed Consent Agreement for Participation in a Research Study

Investigator: Nasim Mansuri

Contact Information: nmansuri@wpi.edu, (508) 873 5395

Title of Research Study: Best Practices for Adapting Manufacturing Documentation

Introduction: You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: This study aims to illustrate how companies approach adapting process documentation across the manufacturing and adjacent industries. This information will be gathered through interviews with engineers, technical writers and other professionals in the manufacturing industry and related fields.

Procedures to be followed: You are being invited to participate in a 30-minute interview with Nasim Mansuri over Zoom. Questions will address process adaptations you have witnessed at your company and your experience (direct or indirect) with adapting documentation and/or documenting adaptations.

Risks to study participants: Your interview responses may be featured in the report alongside your name, role and company, or as combined findings along with responses from other interviewees, all of which will be searchable on the internet. While you will not be expected to share any confidential information, and you may skip any questions you do not want to answer, you are encouraged to speak to your employer if you feel there is risk of a potential breach of confidentiality.

Benefits to research participants and others: There is very little existing research that looks at this area of technical writing. Your name and experience will be featured in this study, and will become a valuable resource for companies to streamline their documentation process and adapt processes for more effective knowledge management.

Record keeping and confidentiality: Your interview responses will be recorded in audio, video or written form. The final report will feature direct quotes alongside your name, role and company, or as combined findings along with responses from other interviewees. This final report will be searchable on the internet. All contact information, addresses and audio or video interview recordings will not be made available to the public, and will be stored privately on a secure WPI server.

For more information about this research, contact: Student Investigator Nasim Mansuri, Tel. 508 873 5395, Email: nmansuri@wpi.edu; IRB Manager Ruth McKeogh, Tel. 508 831- 6699, Email: irb@wpi.edu; or the Human Protection Administrator Gabriel Johnson, Tel. 508-831-4989, Email: gjohnson@wpi.edu.

Your participation in this research is voluntary. You do not give up any of your legal rights by signing this statement. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

Study Participant Signature

Date (MM/DD/YYYY)

Study Participant Name (Please print)

Signature of Person who explained this study

Date (MM/DD/YYYY)

Appendix II. Interview Questions

1. What is your name, company, and role?
2. How long have you been in this role? How long have you worked in this company?
3. What sorts of documentation do you regularly prepare?
4. Could you tell me about an adaptation to a process, machinery or product that took place at your company?
5. What role did you play in this adaptation process?
6. Did you assist in preparing documentation for this process?
7. What federal, local or company standards do you follow?
8. Are there any challenges associated with following these standards?
9. Was any existing documentation adapted for the new process/machine/product?
10. What were the steps for this adaptation process? Who was involved?
11. What would have made this process easier?
12. Did any unique strategies develop at your company for preparing this sort of documentation?
13. Do you have any potential interviewees you can recommend?
14. In the case of any follow-up questions on my end, could we schedule a second interview in a couple of months?

Appendix III. Interview Transcripts

Don Barnard Transcript

Q: What is your official title/role?

A: Senior Product Specialist for Bakery Products. The group I work in is called Manufacturing and Operations Support. And in my group we have products that we're responsible, or brands that we're responsible, in terms of performance, quality, safety, operator training, all aspects of that product we try to manage and basically oversee and make sure it's all being executed. So one of my products is Stacy's, of course—that's a big product. I also do Grandma's, I do baked Lays, Pretzels, and I'm brand manager for a lot of different brands, which is kind of unusual, there's also a brand manager for potato chips in our groups, a brand manager for doritos and tostitos, and a brand manager for Cheetos and Sunchips. But I have most everything else. Mine are all 200 million dollar brands, so my portfolio is broad-based, but it's not as big as some of what my other colleagues support.

Q: So how many years have you been doing this?

A: 39 years I've been at Frito-Lay. I started off my first 15 years in R&D, and I've been working for the last 25 years or so in operations. I started off as a trainee in potato chips, and over the years I started adding all the big brands one at a time... pretzels, baked lays, and it sort of just grew once we got Stacy's in 2007, I took on Stacy's. I've been growing my career that way, in how many brands I support. It's a strictly technical role that I have; I don't manage people, other than I do work with a lot of operators in the field, and the operators that I train are often trainers, so in that way I sometimes do work with my trainers, who I do manage and support, and get them into better and better positions and to more training programs... but they're not actually reporting to me.

Q: When vendors provide you with machinery, what sorts of documentation do they provide?

A: Well, of course they give us the document and the instruments, the mechanics of how this thing works, it's their operations manual that they built for the unit. We also asked them to do operator training initially, on how to start the equipment and how to shut it down safely. I gave them some guidance in that, in how to have all that training be done. Because operator training can't be too strongly technical; we like it to be easy to understand language and picture and kind of like a "show me" kind of thing, not just "here's a piece of paper, learn how to do it". You have to actually have pictures with it, maybe even do on the floor demonstrations of how to work it, and then from there you let them go ahead and operate it. So we have some requirements on how operator training should happen, and I gave them some guidance on that, and to a certain extent they followed it—I don't know if they were as thorough as I would like them to be. That's why

we still need to go back and do some additional documentation on operator SOPs for this equipment, and we'll probably do that hopefully sometime next year when we get more money.

Q: For repairing, those procedures—is that something you do, or do you have people who do that?

A: Both. It depends on the situation. When I'm out on the field like this with a vendor, and don't have a technical writer with me, I will go ahead and be the technical writer to do the best I can that I imagine a technical writer would do. I'm not by trade a technical writer but I've worked with technical writers on other documentation that I've done, and I kind of know how to phrase things and how things need to be presented for it to be a good training document. I did do a lot of the training for Stacy's; I wrote the SOPs and how things work and how to troubleshoot, and I did most of the initial documentation back in 2009 when we first started doing the automation. I did all the training on the automation that we put in in Stacy's, and I read all the documents, and I wrote the documents from the vendor manuals. I looked at the vendor manuals, I looked at what they were presenting as the SOPs for learning about their equipment, and I put it into "Frito-Lay Standard Language" and operator training, with a lot of visuals and explanations of this is what I'm talking about, this is what it will look like when it's actually running.

So I did that initially, but then around 2012 we came back into Stacy's with a technical writer, and we took all our training documents and we formalized it into our protocol you may see that we call Tools Guide, so we developed a Tools Guide that has job aides, SOPs, troubleshooting guides, all in one manual for the entire operation, including simple things such as how to move a rack of bread and how to put it next to the cutter. So we would basically detail and put in an SOP every single action an operator does on the floor. So everything they do we put into words and pictures and put it into our Tools Guide. So that way, in the future, a new person comes in, a new employee starts training and they can just go to the Tools Guide and they can see everything their new job is going to require them to do, and how to do it. We often do train the trainer sessions, which I have done several times for Stacy's—I was supposed to do one next year but I will not be doing it because I will be retiring in about 3 weeks—so this train your trainer session is where we take our Tools Guides and teach the on site trainers how to work with these materials in order to train new people. So we train trainers. And that's part of what my job is, to make sure that there's a capability for training new hires at every site on every brand that I work on.

Q: Do the technical writers work for—

A: They're an outside company. There are 2 or 3 companies that we use on an ongoing basis, one out of Boston, one out of Michigan somewhere, and another one out of Tennessee. We have three different companies that we typically rely on, but we're also open to any site that has a local technical writing company they work with, we'll consider them as well. We're not beholden to any particular technical writing company. But I will say that the ones that we work with on a usual basis, they understand the Frito-Lay Way already now, so it's preferable to go to a

company like GPS out of Michigan. They've probably written 50-60% of our documents, and they know that Frito-Lay requires, and so it's good working with them, and they understand our processes now because they've been on our processing floors quite often. And when technical writers do their job, they're on site and actually following the operators around, especially the operator experts, and they're taking pictures and discussing with them all the details of what they're doing and why they're doing it, and how they're doing it safely, and what are the pitfalls for not doing it safety. Safety is a big part of why we do these documentations, and safety is a big part of our training program ,because a lot of our equipment is very dangerous to work with, and if our operators don't understand that – hopefully we have enough safeguards so the operators can't get themselves in trouble—but at the same time we hope that they have enough training to make sure they're set up safely.

Q: The standards that you have, are they informed by any kind of federal standards or safety standards?

A: OSHA certainly has a play in this. OSHA will certainly require us to do certain levels of safety on all our equipment. Frito-Lay also learn where there are issues, if we see an operator get themselves in trouble or get hurt the way they did something, we always will go figure out why that happened and what we will do to stop that from happening next time. So we continue to refine and hopefully get safer and safer as we go down the road. And I'll also say, those learnings do get passed on to the next generation of equipment, and we know better what to do to safely disarm the next piece of equipment, based on our pitfalls that we learned from a previous piece of equipment.

Q: Do you have a document that you share with technical writers as an example? Do you have a series of guidelines?

A: We have a safety department within our engineering group and they have a list of safety requirements that are specific to Frito-Lay. I don't particularly have it, and I don't think we share them with technical writers, but I know that safety is on our mind on the projects that I work on, and certainly when we do the technical writing on that equipment, we will definitely share that with the technical writers, to make sure safety is in place.

Q: And on the stylistic side? Is that just something that they pick up as they go, or do you have something that you show them?

A: For instance, for new vendors who come in, and new vendors are dealing with their first time training, I will give them a model of what their training document should look like and what information should be in it. So yes, I do have examples of SOP documents that they will be expected to try and simulate. Now how well they do depends on how well they understand technical writing and what I'm actually asking them to do. Some are better than others. There's a company I had in Pennsylvania, Reading Bakery Systems, that does a lot of work with Frito-Lay,

and they have their own technical writers in their company and I had to give them a model of what I want, and they will do a really good job of repeating it and giving me exactly what I mean. So some companies are better than others, but it's usually from experience of working with Frito-Lay, because Frito-Lay does have unique requirements. I think we're probably a little more detail-oriented than a lot of companies in terms of getting our SOPs and our safety documents understood and well documented.

Q: Do you think it would be possible for me to take a look at what you send to companies?

A: To tell you the truth, you could probably get it from Stacy's. Just take one of the tool guide SOPs and look at the SOP, how to start up an oven, and the SOP will list the objective, and list step by step with pictures of how to run the oIT screen, if there are any mechanical set ups you need to do in terms of opening vents or closing doors or anything like that, it will all be there in the document and that's what I will give the vendor, "here's our SOP with all of the details" and step by step. And a lot of our operators don't understand the detail of step by step I'm talking about. I'm not just saying turn this on—you have to show them turn this on by pushing this button until you see it go red. That's the kind of detail you need to get for operators to function properly and safely. And a lot of vendors don't understand that we need to give that type of detail to operators. They think oh if you push a button, they know what it means to push a button. Well, not necessarily.

Q: I did take a look at the manual they had for the ultrasonic—I was trying to get information just for my calculations [for another project] but it didn't have all of it. But it makes sense that if that was just a version that was abridged.

A: I probably agree that when I gave the vendor that I wanted a training document, I was not totally pleased with what I got back. It was not in my mind totally adequate. But we did do on-the-floor demonstrations and we did work with them on that. I think Maria—Maria is a real fab operator, and I think she caught on; she's who I worked with in the past on SOPs. And she really understand the SOP process and how to make the SOPs. And with Maria's help we were able to get some of that detail by working with them on the floor, but it wasn't in the document at all, and that's what we still need to get into the document. There's still work to do.

Q: Are there any other challenges you feel are worth mentioning?

A: I'll just tell you, Frito-Lay is right now going through a generation change, or a step function change in how we do training, and we're looking at instead of just doing SOPs with pictures and words, we're actually looking at turning our SOPs into actual videos. So we're trying to go back and take all our SOPs and use those as sort of a script to follow an operator with a camera and have them actually do the step on camera, and then we have the words around the screen of what the stuff is, but they actually see them doing it on a video. So we're trying to get to that next level of training documentation and training materials, and hopefully in the near future we'll

have all of our documents not just in a written document but also in a video that goes along with a written document. So that way we can be a little more in depth and hopefully precise in the training that we want to do.

Lance Young Transcript

A: So my degree, I have a bachelor's in science and materials engineering from the New Mexico Institute of Technology—it's mostly a science and engineering school back home in New Mexico. My first job was working as a process engineer for a battery startup called Valence technology where I helped to scale up from R&D to full-scale manufacturing making [unintelligible] cathode material. I did that for a number of years. Then I moved to the East Coast and my next engineering job was I worked for [unintelligible] as a process engineer, where they make both plasma spray systems but also plasma spray materials and I was the process engineer for like 3 or 4 major product lines. I did that for a few years, left the long island area, moved to upstate New York, I worked for GE advanced materials right as they sold it off it became momentum performance materials.

I worked as a performance engineer there for a bit of time, then my wife Tara worked with some friends that I worked with on my first battery job. They started up a battery company where I helped to be the main point of contact for technology transfer projects to consult and build a number of battery factories in Europe and China. I traveled back and forth internationally for about six years, so I was an engineering manager there. So I did that, and I went back to GE briefly. I worked in their energy storage business and I was a manufacturing engineer there. That was kind of a short one, they hired some folks and decided to close the division about 6 months later.

Then that's what brought me up to the Worcester area. I started as a process engineer and then I was the engineering supervisor shortly after I started working at Coors Tech. I worked for the semiconductor division within Coors Tech, they make parts for the semiconductor OEM manufacturing. They make the machines that make the chips. Then I went to work for CeraNova as the ceramics manufacturing process engineer. It's a small company, I wore a whole bunch of different hats, I had to implement the quality management students and did manufacturing maintenance and a bunch of different random things. I worked for them for a few years, and a little over a year now, I've worked as a principal innovator for Rogers corporation, for their materials company. They have their fingers in a lot of different pies, but I work in what they call one of their innovation centers in Burlington MA. So right now I work in the magnetics group and we make some ceramic materials but a lot of different cutting-edge magnetic stuff. That's what I do now.

Q: That's a very interesting career. Based on that, I guess one of the things that I'm asking about is instances where there was an adaptation done to a process, a change of some sort, and then how you changed the documentation for that.

A: Yes. So probably 75% of the places where I've worked have been ISO 9001 compliant. So that usually means that you have some sort of basis of a quality management system. And a big part of a quality management system is document control. The basics of document control is you

say what you're going to do, and then you do it, and a big part of that is making sure that you control your documentation, whether it's forms, operating procedures, there's kind of a couple different varieties, but those are the two big ones for manufacturing purposes. And that you have rev control on that. So if you make an update, it goes through some sort of approval process and then it gets authorized, and then it's important that those procedures or forms get communicated, and that people get trained from them.

So you can have a great document control system, but if you don't train your employees, your operators, or whoever needs to be informed, then it's useless. In all of the manufacturing roles that I've had, I've been at least partially responsible or totally responsible for periodically reviewing documents, updating documents, writing new ones, I usually then submit them and go through the quality management system or document control system, it would get approved, and then we would train people. So in some cases, exactly what you're asking is commonly done. Any company that has any sort of regulatory requirements, where there's like the FDA or Aerospace or anything like that, I imagine there's requirements that you have a document control system.

So, for instance, there's been many pieces of equipment that we've changed or added a different process to, where we had to update something. So if you have a starting document you'd usually just alter it, change it a little bit, and I would say that is kind of the standard process used in any place that has a good document control quality management system. If it's more informal, I'm not quite sure... we usually institute even a basic kind of revisions system. So if you get a brand new piece of equipment and then you're adapting it to a new kind of system, usually you have a procedure that you would conform to. So you'd start with that, you would probably take certain pieces of the equipment manual that would go in there, and you'd work with maintenance people and people who are trained on how to operate it—the engineers are usually a bit part of it—so then you would take all of that and put it in the right format.

Q: Do you normally have any sort of documents, style guides? You talked about a revision system too. What would that look like?

A: So there's actually a bunch of electronic packages, even if it gets above like... a small company you can probably put together something that's just forms, and it's almost an electronic package, it can just be some excel sheets or word sheets that you're keeping updated. That's sort of the most basic method these days for keeping control of the revs. But almost anything above a very small company will have some sort of document rev system, and there are so many different ones. There's certain quality management packages, that's usually a portion of it. I'm trying to remember the name of one of them I've used a couple of times. It's escaping me at the moment. We were instituting a new one at Coors Tech when I worked there that was a lot better than the old one. The old one was very basic. But basically it's a secured location for the different revisions, and you can usually go back and only one of them is marked active. It's usually

custom-made software. You could probably do a Google search and if you looked up “document control systems” there’s like 40, 50 of them, it wouldn’t surprise me.

Now with style guides, usually there’s a template. Sometimes it’s not like a tightly controlled document, sometimes it is. I’ve seen it both ways. It’s usually more the content. Certain companies have things laid out in particular ways they like it. But like ISO requirements they don’t require.. the standard has changed over the years a lot. Now current standard, the 9001 2015 standard, they require only a few things, but they don’t have like particular styles. It’s kind of whatever works for the company. I mean, there’s also some companies have more than just operating procedures. Sometimes they’re called like “job cards” and it’s another type of form or procedure that’s more compact, and sometimes is actually right there at the piece of equipment or the process, just to make it easy for operators to quickly remind themselves of what they’re doing.

Q: Do you find that there’s any challenges associated with, whether it’s complying to any of these standards, or just in general?

A: I mean it’s important that... I would say that the thing I’ve seen companies get in the most trouble for, like when they get audited (and I’m speaking mostly ISO 9001 audits; I’ve helped out with a few other audits, but that’s the most common one I’ve been through).

Q: How common are those audits?

A: Well if you’re ISO 9001 compliant, you basically get audited.. I think the smaller audit is every year, and a major audit every 5 years. The thing that has gotten companies where they get a finding in the audit usually has to do with training. So the documentation is usually.. as long as you have a basic rev control system, it works out fine. But if the operators aren’t trained to it, then it’s “why are they using an old revision?” Well, they only had the old revision out on the floor. So now a lot of places basically try to limit that and have operators go to the electronic version, because that’s easier to make sure that the most recent version is out there. But places that don’t have as much resources, it’s usually a little tougher.

Q: So it’s not actually as much in the writing, but in the distribution of it.

A: Yeah. The writing varies a lot. I’ve seen some procedures that were written really well. I’ve seen ones that were not written as well. Not easy for people to understand. I would say one common thing, especially because engineers do so much of the writing, and engineers love to sound smart, they’ll use really big words. And I’ve personally reviewed many, many procedures, and one of the things that I’ve done is make sure that they’re in plain, easy to understand language. Because if you’re using a lot of big terms, not everyone has an engineering degree or that background. Not to say that you need one, but some people’s reading skills are not so great. So I would say that’s maybe something that is not a compliance issue, but making a procedure as

easy as possible for anyone to understand is sometimes hard. So that's something that I've personally mentored a lot of younger engineers and folks on where they ask me "why did you change the way I referenced this?" and I'm like "it's because you need to make sure that anybody can easily read it and understand. Because if they don't understand it, then it's not a good procedure."

Q: Have you seen any movement towards getting rid of written procedure altogether and replacing them with video? Because I was speaking to someone last week and they were talking about doing a complete overhaul and just replacing everything with video.

A: Yeah. Well, that is actually something that I've heard about from other companies, but I have not personally seen it implemented. I definitely see how that would be really useful, but then it also requires that there be either a locked-down ipad, some sort of tablet, computer or something where I can tell you personally, there's been times where I've been trying to figure out how to run a piece of equipment, and especially—maybe not so much for running, but let's say maintenance—unless you have like a really ruggedized tablet or PC or something, I'd prefer honestly a piece of paper when you're underneath the piece of equipment, referring to it and trying to look at a diagram. Like if you have something cool... that was something I was excited about when Google did the Google Glasses—that was something that I've heard that there are companies that have started using things like them, where they're looking through an eyepiece and, especially for maintenance people that would be amazing, you have a procedure right in front of your eyes while you're working on it. That would be game-changing in my mind. But I've never personally seen it done. I've talked to people who are like we want to do something like that. But it requires... everybody wants to be a youtube star these days, so a lot of people have some decent video editing skills, but it takes a lot of work to make something look nice. Everybody wants to do it, I've heard companies talk about it, but I think it's going to take a little while.

Q: Yeah, I definitely share that point of view. I wouldn't want to get my phone dirty while looking through stuff.

A: Yeah. I worked, now this is quite a few years ago, but I worked in a very large chemical plant, where you couldn't bring any electronics into a certain area because the atmosphere's slightly explosive, or it could be. So unless you have a mil spec, non explosive phone... everybody had pagers, so you'd basically leave your phone in your office or in your car, and then they'd page you. So there's certain places where that's more common. But you also have certain government facilities and things where you can't bring in a phone and computers are super locked down and you can't do anything with it. They probably won't be moving to videos anytime soon.

Q: That makes sense. How often did you see technical writers, and in how many cases were they actually working with the company versus working for an external company?

A: Zero. It's always been.... So I started my engineering career when I got out of school in 2001, and I heard stories—like legends—of there being robust engineering groups with technicians, technical writers and all this stuff, and almost every place that I've worked at, it's engineers now have to do everything. All the writing, all the admin stuff... maybe it's just companies that I've worked for, but like a lot of industries, they've collapsed jobs down to where, and it tends to be engineers, are doing like four or five people's jobs now. Like when I worked at GE the first time, it was a big chemical plant, it was two of us who were running these two production lines, and we kind of covered for each other. And I was running around, and one of the lead operators was told me, he was laughing "you look all stressed out." And I'm like "yeah, I'm trying to get all this stuff done, it's almost too much." And he started laughing. And I'm like "Why, why is it so funny?" And he's like "Well, you and Sean... it used to be a team of 10 people. Now it's you two." He said that 10 years ago, there were ten people doing everything that you two guys do right now. That tells you a little bit about how a lot of the technology and computers and all this, awesome, great. But the productivity gains has mostly been... they haven't been shared with the workers, let's say, or engineers or anybody. It just makes the company more productive.

Q: You mentioned the issue with engineers trying to do all the technical writing. Big words. I'm guessing bad grammar is also an issue. Are there other things that aren't maybe as obvious?

A: So a big part of writing really good procedures, I feel like, I'm going to use a simple term here: being too wordy. It's not necessarily a vocabulary issue; it's you can also over explain something. Because you want it to be quick. You want somebody to be able to absorb it quickly. So that's where having pictures are super super important, and being able to point out things... it really, it takes, it's like a lot of the time when I've written procedures in the past, I kind of go through my head first and I write down all the steps. And if it's something that I know well, I'll sit down and write down all the steps, and then I'll go do it, and sometimes you forget something and you add in a couple extra steps. And it's kind of like you refine it a few times. I've even found myself where I'm trying to explain how to do a particular... it's like "you turn this part on, you start this part of the system, you go check the temperature, you make sure the pressure's in line and then you do something else" so sometimes you can simplify it if you just take a really good picture and you label it, and you're like 1, 2, 3, 4, and then you can say "press this for this" "that for that" "that for the next thing".

I think that's something that's really important because you want to minimize the amount of time that it takes a person to get good information on how to run something or do something. But you also want to make sure it's thorough. So sometimes that's also like, I haven't seen it as much, but if a procedure or something has like a troubleshooting section, sometimes that's something you tuck into the back of a procedure, sometimes they put it right in it. To me, if you constantly have to do troubleshooting in a procedure, that that means that something is wrong with the process. And you need to fix that. Or maybe that's just the process, it's really twitchy, so then that should all be in the body of the work. So it's also knowing the process.

I mean that's been most of my job; I've been in more production, process sort of engineering roles than anything else. And a lot of it is figuring out what's the best way to do something, but then it's also... like you can figure out a really great way of doing something and make a process better, but if it becomes a difficult thing for operators to do, then it's really not an improvement. If it takes an engineer—and not to say, I've known operators and maintenance guys who are like “get the engineer out of here, he's terrible, you guys don't know how to do anything useful.” But if it takes someone extremely skilled to do something... and maybe you shave off some time and the quality's a little better, but if it takes an extremely skilled individual, then maybe the process isn't the best process for manufacturability.

Q: Do you think there's issues in going, so if you have multiple revisions of something, going from different people doing different revisions, do you ever feel like information gets lost in the process of doing multiple revisions?

A: That's interesting. I've seen this handled better in some ways than others. Part of a document control system is when you edit a document, there's supposed to be a short description of why you changed it and what you changed. Sometimes it says updated document pages 2, 5, and 8. It doesn't give you any description. So if a place takes those steps seriously, and gives an actual explanation of why something is done, or ‘see technical report,’ that's also okay. As long as there's some linkage that says why did we change this. Some places are good at it, some places are not.

A lot of it has to do, the document control is almost always run in most manufacturing places by the quality department. So does the quality department have enough people, are they stretched too thin? Honestly, manufacturing these days, it's almost always you can look at major non-conformances and things like that are because either your quality department isn't big enough, or you don't have enough support, or sometimes you can have a very small quality department but everybody is really well trained and they have a quality mindset. That would also work. But if a process is highly dependent on.. if it has very tight specs... the quality department is almost always going to be really really busy. And/or engineers.

It's highly dependent on the company and the manufacturing sector. Like semiconductor requirements are crazy high, and it's not because of any regulatory thing a lot of the time, it's because they're scared about changing anything that will affect their customers' process. So like process of record is something that's a terminology and is very big in semiconductor manufacturing, which basically means they don't want you changing anything unless it's absolutely necessary. I think the military also has certain processes, I think they call them frozen processes, I'm not as familiar with biotech stuff but all the FDA requirements, I have friends from college that work for Boeing... so if they go down through their manufacturing process and something comes up, changing all of that, if it's a major change, is like a nightmare.

Ross Storey Transcript

Q: What is your name, company, and role?

A: Ross Storey, Shell Catalysts & Technologies LP, Sr. Technical Service Consultant, EO Catalyst.

Q: How long have you been in this role? How long have you worked in this company?

A: I have worked in the petrochemical industry for 28 years (since August 1992). Initial roles were in production engineering for an ethylene cracker, research & development for specialty ethoxylated alcohols (“polyols”) and then production engineering for Ethylene Oxide (EO). That third role also involved a 3-years overseas assignment in Maracaibo, Venezuela.

Shell Catalysts & Technologies LP is a wholly owned subsidiary of Royal Dutch Shell plc. My involvement in EO Catalyst technical service (various roles) will complete 20 years this coming Friday. My technical service work has been conducted in the United States, Canada, Mexico, Venezuela, Brasil, Netherlands, Germany, Belgium, Russia, Turkey, United Arab Emirates, Saudi Arabia, India, Singapore, Taiwan, Japan, Macau, and “mainland” China.

Q:What sorts of documentation do you regularly prepare?

A: In my role, I prepare catalyst startup procedures, reference manuals for catalyst and reactor inspections, reference materials for training of new technical service engineers, training slide packages for catalyst customers, marketing slide packages for customers, process hazard analysis reviews for mobile laboratories, catalyst startup and testing reports, and change-management documentation to properly communicate changes that occur.

Q: Could you tell me about an adaptation to a process, machinery or product that took place at your company? What role did you play in this adaptation process?

A: There are many such examples, but I will pick one. We operate a mobile laboratory. These laboratories get sent to working EO plants and help measure chemical composition of process gases both before and after an EO reactor in order to verify performance optimization and lowest-possible Carbon Dioxide by-product. Because the mobile labs are stationed near process areas where there are not normally flammable gases present, but such gases could become present, they are configured with extensive gas detection equipment and automatic shutdown controls and logic.

In the early 2000s, it became apparent that some plants were backing up their process air utilities with nitrogen, in case of loss of air service. The mobile labs connect to “plant air” in order to operate some equipment. The labs already had an interior oxygen concentration detector and both alarms and a full shutdown in case of low atmospheric oxygen. There are other barriers to

low oxygen concentration inside the labs, including sizing calculations or air-interchange rates from the air conditioner/heater, and extensive hydrocarbon detection equipment in case of leaks. Still, the concern was if there were to be any chance, however, small of nitrogen building up inside the labs if arriving in the plant air header. In response to this, each lab was outfitted with a second dedicated oxygen analyzer which connected to automated isolation and shutdown processes with “fail-closed” valves in case of total loss of power.

Obviously, a change of this magnitude and importance required accurate communication to the laboratory operating staff and engineers who might be present in the lab during operation. It also needed to undergo a full engineering hazard analysis before approval and installation. And finally, it needed to be part of standard preventive maintenance schedules so both the analyzers and the shutdown equipment would always work in the field. Adding to that, it was important that any training manuals and operating manuals reflected this change.

Q: Did you assist in preparing documentation for this process?

A: Yes.

Q: What federal, local or company standards do you follow?

A: In the petrochemical industry in the United States, there are federal regulations involving “Change Management” that come under a guideline called Process Safety Management. Although I do not keep the exact number memorize, a simple search of the OSHA website reveals that it is governed under CFR 1910.199. A link is here: <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.119> And with higher-level information here: <https://www.osha.gov/Publications/osha3133.html>

I was involved (at a previous job and employer) in the roll-out of “management of change” policies to help ensure an organizational structure that properly analyzes potential changes before they are adopted, documents those changes for review, reviews the changes before startup, and communicates the changes to the staff involved both before startup and on an ongoing basis afterwards (operating procedures, manuals, or training guides). This is also a process to which Shell Catalysts & Technologies adheres.

During the last 25 years, I have witnessed the “culture” of Process Safety Management as put forth under the OSHA guidelines seep out into the operations and management culture in other countries as well. Many, especially in the European Union, have their own sets of regulations of change management, which tend to be similar to OSHA’s guidelines. There is a slow consensus building globally on how to manage these topics. That said, people in our industry have observed that there are some major industrialized countries that still do not do this as well as others. We utilize additional caution and even our own vetting process of companies doing business in those locations. For purposes of this interview, I will not name those countries here.

Q: Are there any challenges associated with following these standards?

A: There are some difficulties. Language is one barrier when documenting and communicating changes that affect global teams. Another challenge can be safety culture in particular countries, especially those who have extremely hierarchical leadership structures where employees may feel that highlighting a concern could cause “loss of face” for the manager. In Shell, we discuss this concept openly, even with employees from countries that have such a culture.

Another difficulty can be ensuring that employees in far-off offices or even stationed alone have access to training on the change-management process itself. On a site-by-site basis, many companies, including Shell, do this well. For our technical service group, we made specific training sessions for isolated engineers and operators using existing infrastructure based out of the Houston office. This took a lot of organizational work (much of it on my part), but it has been done. Fortunately, there is a real sense of support from Shell management and the Health/Safety/Environmental department to make resources available for such individual training necessities due to the globalized structure of the catalyst and technical service group. That level of support and understanding is really appreciated and is not taken for granted.

Q: Was any existing documentation adapted for the new process/machine/product?

A: Yes. There was an existing Mobile Lab Operations Manual, which needed to get an update in order to mention the existence of the new Oxygen concentration analyzer and to discuss what to do if it alarmed and what to do if it triggered a lab shutdown and closure of isolation valves. In addition, that same manual details both the quarterly and annual preventive maintenance actions, which include testing of this analyzer and testing of the safety shutdown (interlock) system.

Q: What were the steps for this adaptation process? Who was involved?

A: There is a formal “Management of Change” process that kicks off with a trained employee in the area of change having authorization to initiate a change. Using standardized documentation, there is a process to follow for naming the change, gathering subject-matter experts for discussion of the change, and a formal process hazard analysis (HAZOP) conducted on the change where all aspects of chemical, reaction, temperature, pressure, and flow impacts are studied, one-by-one. Once that process is done, the change is reviewed by a trained reviewer (that is often my role), and then signed off by all participants. Only then can equipment be purchased and change installation begin. Once installed but before startup, there is another formal process, called “Pre-Startup Safety Review” that happens. This process involves ensuring closure and completion of all actions that were found during the HAZOP and ensuring operating procedures, training manuals, and maintenance procedures are updated. In addition, it creates its own action items for update of any Process and Instrumentation (P&ID) drawings and for a formal notification of startup of the change. Finally, all documentation is saved in a

specially-nominated “Management of Change” database, which can be searched by change name, date, completion status, department, and people responsible for sign-off.

Q: Did any unique strategies develop at your company for preparing this sort of documentation?

A: When these processes were first implemented, the catalyst business was already a global business, but almost all work (and all mobile laboratory work) was done out of only the Houston and Moerdijk, Netherlands offices. This made change management relatively easy. During the last 15 years, the business has grown considerably, with offices opening in China, India and Dubai and expansion in Singapore. Some of those locations are offices rather than chemical plants or R&D sites. This meant they might not have local infrastructure for the full PSM-type of Management of Change. But expansions in virtual presence allowed us to gather subject-matter experts and trained change-management personnel, usually via Skype or MS Teams applications. This means pictures and video can be shared, drawings can be reviewed, and (for example) an electrical engineer can be consulted in Netherlands for an implementation happening in Nanhai, China.

In case of the EO catalyst group, this allowed centralization of training and storage from the Houston office and helps ensure that the entire global team is functioning with a like-understanding of how to manage change. Further, it allows us to check in cross-regionally as the work is happening in order that we keep each area focuses on what compliance with the standards means. In that sense, the OSHA regulation on Process Safety Management is seeping into standards, practices, and cultures worldwide. I would judge this to be a good thing.

Jody Zolli Transcript

A: I, for a number of years, worked at companies with either one or two or a very small number of writers. And I'm now at a company with a lot of writers, and it's very wonderful to be surrounded by people, be able to share thoughts and share expertise and learn and it's just great. I think I've landed well.

Q: So they're making software for the mass spectrometers?

A: Their equipment, their instruments are in labs all around the world (the company started in the 60s). And what they do is they have software that allows people to analyze the data that comes. For example, when you do liquid chromatography you get data out of that, and what you're looking for over time is peaks of the material, and the results, and you need to analyze the area under the peak curve, which means you need to identify exactly the quantity of what you measured there. And that's how you can detect what's in something, so they can help analyze food for safety, make sure there's nothing unhealthy in it, and their equipment has been used to create the vaccines for COVID, which is pretty cool. But it's great to be a part of a company that is doing so well, both because it's something competitors doing and because of the pandemic, lab people don't want to go into the lab to use the equipment, right? They want to be able to monitor test equipment from home, or from down the hall in their office, and so what we're doing is we're starting to provide solutions that allow people to monitor their instruments remotely. It is really cool and I have zero expertise in this chemistry domain, so I have a lot to learn, but I have hope!

With technical writers, I was surprised just this week (I mean I've been there for 9 weeks, I haven't been there long) but I was surprised that for a company that is so well equipped and so well run, they're still short staffed with technical writers.

Q: How many people?

A: So there's an organization called Customer Experience and Knowledge Management. And I would guess there are 60 people in the organization, and probably half of them do customer experience... they have a user experience lab and they do customer interviews as they're planning and developing products. And I would guess the other 30 are writers, but when you have 30 writers in a company of 6500, that's not a lot of writers. So I think companies typically shortchange documentation because they don't value it. And the challenge is, like for example I spent the last few years at a company called EdgeGravity, well it was VidScale before it was acquired by Ericson. And I was the first writer there, when I got there the ratio was maybe 1 writer to maybe 25 developers, and then I was eventually able to hire a second writer, but at the end of my time there it was 2 writers to 100 developers. So the ratio of developers to writers actually doubled, and really all we could do for documentation was just get the minimum out. I mean it was complete, it was accurate, it was on time, but we couldn't do any of that wonderful

elegant stuff like giving people context, how to use things, when to use things, why to use things, which things to use together. And so I think it's a shame, because if you have just like 10% more time to think about what you're doing, you can think about smarter ways to do it, and you can think about things that customers will really benefit from.

I do remember I was at a company that made computer hardware and software that would digitally encode, store and deliver video for cable broadcast television, a company called See Change. And I actually had some spare time, like one of the 10 years I was there, and I created a troubleshooting guide for the supporter organization: I went through customer calls and troubleshooting support things, and I organized all that information and what I did was for every symptom, like every chapter was a symptom, here's what you're seeing and then I would list a procedure from most likely and easiest to solve problem to least likely and hardest to solve problem. But it just made such a difference to the support organization, but I would never have time to do that under normal conditions, which is frustrating. And I think a lot of the rewriting that happens for documentation isn't documentation improvement or process improvement – it happens due to acquisitions, like a company gets acquired and then you need to rebrand their documentation, which may include a change to the look and feel, terminology, of course the copyright page, and that doesn't really add value.. it's just like make work. And that's such a shame.

Q: So when you say acquisition..

A: Like for example, several times, I've been working for this company.. I was working for this little company called VidScale Inc. in Cambridge, I got there in like 2016, and in 2018 the big corporate Eriksson came in and bought VidScale. And they renamed us EdgeGravity, they changed all of our processes, we suddenly had to use like the computers they used and the software they used and the processes they used, and it was jarring, it was disruptive, and there are some companies that are really good at acquisitions, they're really good at supporting the company they acquire without crushing them, but Ericson, Oracle, these are companies that kind of acquire companies and digest them. Pretty much 5 years after they acquire a company, Oracle will finish firing off all the original employees, because they'll have fully digested the technology and the expertise, things like that, and decided on features of the company they want to keep and what they want to let go.

Q: Wow, that's brutal.

A: It's brutal and it's kind of a dog-eat-dog world. I was thinking back on companies I've worked at for the last 35 years and only 1 of them still exists, which is Akimy, where I worked from 2012 to 2016. It's the nature of the beast.

Q: Were most of the companies places where there was an established procedure for technical writers, where they knew what to do with them? Were they mostly big companies that have been working for a long time?

A: Yes, they were big companies that were by and large over 30-40 years old. And they valued technical writing, and that makes all of the difference. When you think of how long a company spends on documentation vs. research and development, marketing and manufacturing, it's actually a very tiny amount of money, but 5 or 10% of money either way can really make a difference in the quality of documentation, like where I work now every month they have like an analysis of how satisfied the customers are with the documentation, and they report that to us every month, so we know how we're doing. And one of the reasons that we're excited about cloud products, and eventually we'll have our documentation in the cloud, we're going to have a content hub out on the cloud, is that then we can start seeing who's using our docs, and how they're using them and whether they value them and whether they're getting the answers they need. And i'm really excited to do that, it's going to take a couple of years to get there, but I think it's going to be super valuable.

Q: Have you worked with manufacturing, like operation manuals?

A: I've done installation and configuration guides for both hardware and software for computers, but i haven't really done manufacturing equipment or milling or drilling machines or anything like that. I think it's interesting that a lot of those companies just make do with what they can. I think one of the challenges is some cultures, like when I worked with, and this is my experience, this is obviously not everybody, but working with writers who were supporting engineers in china, their documentation was more like a specification and it wasn't so task-based because that's what documentation looks like there. They're really not about usability, it's more about the product and the sales. But there are some companies that are just passionate about making sure the documentation is awesome, and I'm thinking Waters is one of them, and so I'm excited to be there, because one of the things I've really been missing for the past few companies where I was the only writer or one of two, and we were just barely able to keep up, is taking a little extra time to delight customers. Because if you have something in the docs that is of value to the customers, they'll come back to the docs. And I do know that customers don't curl up with a technical manual the way we'd like them to, but I also understand that if yyou are able to anticipate their needs and meet their needs the first time they look, they will develop trust in the documentation and return to the documentation, and maybe even if someone asked them how to do something with the software, they'll refer them to the documentation. At the very least, the support people can refer them to the documentation.

Q: Are you seeing any trends towards switching over from written instructions to videos?

A: Yeah. We'd like to do that at my company. Right now, we do a lot of e-learning, but I think having sort of bite-sized videos either embedded in e-learning or accessible from the product,

like I was talking to the training developer and what he said he'd really like to do with the cloud products is let's imagine that.. and cloud products are different from Waters' historical products, cause historically customers decide when to install customer updates, because it's a highly regulated industry there's a whole process to that and with as to be done very meticulously, and there's a lot of validation and verification, but with the cloud Waters will control when the software gets updated. Because it's running on virtual machines in the cloud, and we can refresh the software in the cloud without involving any of the equipment on the customer's side. And that will make customers very nervous. We of course have to assist them in getting over their concern about whether it will meet with the customer standards, and will my data be secure, and will my competitors be able to see my data. This is a whole new world for them, they haven't done this before.

But when we think of deploying software in the cloud, one of the things he was suggesting was, well let's say we just refresh the software in the cloud, they're launching it for the first time, wouldn't it be great if we gave them a little video tutorial that is a walk through of the new features and the changes. We aren't going to force them to download a pdf with release notes. We're going to support them where they are, give them something that's quick and memorable, and doesn't distract them from the task at hand... they just want to get to work, that's what any customer wants to do. The other commitment that we're making in my organization is our prime deliverable for this first generation of cloud software documentation, is we are working with software developers on all the text in the user interface. Whether it's error messages, dialogue messages, labels on fields and tabs and options and buttons. We really like to make that so much better that they hardly have to look at the documentation.

Our goal would be to have that kind of "just in time" what I like to call Goldilocks information, which is just what you need ust when you need it, like it's just right. Goldilocks information embedded in the customer experience, so they don't have to look for it. I mean yes, there will be help and resources, but at the same time, wouldn't it be great if you didn't have to leave your work to figure out the answer to all your questions. And that's what we're hoping to do, and as we move towards the content hub it will house support information, FAQs, kind of online help, might even have use cases and tutorials and examples. We just have all these visions, now we just have to get IT to buy into getting us the software.

Q: How does that communication work, as you're going from department to department? Are there challenges with getting the different sides to have the same vision?

A: Yes, and the biggest challenge... so the challenge that we're facing right now, is that the whole organization I'm part of didn't think we'd have a problem with, is we identified third party software that we wanted to use that would be like a solution to all of our questions and concerns, like how do we deliver documentation from our content management system, and how do we refresh it regularly, and how do we track what the users are looking at and make sure that it

works properly. So they said here's the software we want, it's called ZoomIn or something, here's how much it costs, when can we buy it. And the Waters IT first said that they needed to look at it, they started to look at it and they said well, we'd rather not buy somebody else's system, we'd rather build our own. And the truth is that the IT Department has a lot of work they do supporting the entire worldwide corporation of 600,000 people. And so as it is, we're already 6 months behind in adopting this content hub that we want to make available, and it started out with people at my level making proposals and pitching them, and now it's gone to the level of my great-grandboss who's now fighting with the IT department to get a solution in place by next summer, when we ship our next project.

So it's frustrating, and I've worked many places where you can't get the tool you need, or you can't get the support you need, or you can't get the equipment you need, or mostly you can't get the manpower you need. You can't get enough writers to really do a great job, and it's rare for a company to have enough writers with enough extra time to really innovate, to really do something. That makes it to the next level of maturity or innovation. And in there I'm sure there are some companies that do devote their time and energy and their customers are very pleased with their documentation. I wouldn't say Waters customers are displeased, but I would say it's been a long time since we've had the time to do something remarkable.

Q: Is there a system you use to keep track of revisions, and how is that organized? If different people are doing different revisions..

A: So what we do for documentation is that we have a revision system made by a company named SDL, it's called SDL Tridion docs, and what it does is that it manages, you create a project and in that project you create a deliverable, so we go in, we use an XML editor to create individual help topics and then you organize them into a table of contents, you organize them into a body of work, and you can publish that to many different output formats. But like while one person is working on something, another person can't, so that there's no conflicts.

I don't know if you're familiar with software engineering, but when software engineers are working on something like git or github, they can work on something at the same time because afterwards they merge them and identify or resolve conflicts, but that's because it's text-based. The challenge with the files we're working with is that they're binary, and there's no real good way to compare the changes, so it's basically one person at a time, and basically they have a structure where you have the product name and under that, if you're looking at a project structure, you'd have a product version and then under that you'd have the different kinds of deliverables – there might be an installation guide, a user guide, release notes, stuff like that. So basically whenever you revise them, you publish off the final versions of those for that release and then you move those files into a new release. So you kind of freeze the files as they are released for legal and historical purposes, and then you start working on them again in a separate release.

But we are finding that there are several products that may share the same collection of screens, like for example there might be a user profile, change your password to this or that, and that interface might be common across multiple cloud products, and they may be at different revisions at different times, so within the CMS we can share a topic and reuse it in multiple places if we need to. Framemaker also allows reuse of content, where you can basically conditionalize the text and say ok if it's in this book, have it say this, and if it's in that book have it say that, which is pretty cool. Actually when I was at EdgeGravity I had an 800 page documentation set, but there were only 400 unique pages because I did so much sharing and conditionalization, and that way if I changed it in one place it would be updated everywhere, which is ideal because that's one of the challenges of maintaining documentation, if you have the same information in multiple places it can get out of sync.

Q: And I guess since you're working the cloud, you don't really have the issue of distributing it printed all over again.

A: What's interesting about that is we're just starting to move away from that. Historically, Waters did print out documentation and then eventually I think now, currently, with our equipment, our physical machines that are shipped, we ship a CD of documentation with it, that has pdfs on it. All of the user interfaces, even the ones not in the cloud, do have an online help system, but I think everybody at Waters is looking forward to moving into the cloud because some of the interfaces were designed 20 years ago and you can see it, they look so dated. They work just fine, our equipment is among the best in the industry, it's just that nobody had the time to keep us fresh, to keep our look fresh and innovative. And customers, now there are competitors, when you have a company that's 50 years old, competitors start to crop up and they can move quickly, they can move very quickly because they don't have 60 years of code base that they're dragging forward every time they release a product. So we have to be a bit lighter on our feet and keep up with our competitors and keep our edge. That's one of the challenges we're facing right now.

Q: I'm guessing you have a style guide. Do you also have any company or federal standards that you follow?

A: Actually there's a lot of regulatory standards that this type of equipment has to comply with, because it's used by the FDA for food safety and things like that. So when the equipment is installed, it needs to be verified in a very specific way. Every time you change something in the equipment you need to note it in a notebook or otherwise log it, and any time, like one of the features that's coming with the cloud products is something called an audit log, so anytime anyone changes anything in any of the cloud apps, it will create an audit log entry that will be completely uneditable. You cannot modify the audit log, it's basically anything anyone ever did. And that's mandatory. That's for companies that are working on pharmacological things, or food things, or other things where government regulation is mandatory, you need to have all these

checks and balances around how things work and what you do. You basically run standard tests and then you compare tests to the standard tests, and it's just very well regulated.

So I actually printed out the Waters style guide, so they have (and I love this, like my heart is singing as I'm reading this) is that they have an editorial style guide for technical content, they have a procedure for managing an issuing content, like how to publish it. They have structured authoring guidelines, cause they use a structured authoring tool, they have a reuse strategy for when and how to reuse content, they have a terminology list, they have a spelling quick reference guide for words you can commonly misspelled, and producing SXKM documentation for how to go through production, they actually have to do tracking of all their part numbers and deliverables through a company called SAP. We actually have a very big SAP database, where we actually, when our subject matter experts review the content they have to approve it and we track that approval in SAP, then we publish it, it gets tracked on the SAP and then published on the Waters page. There's also a complete user guide on how to use our CMS.

And they actually walked me through a whole training course when I started at the company because I had never used this type of CMS before. So I felt very supported. And the first few weeks I was there of course I didn't have anything I had to produce, so I was mostly being a sponge and learning, but one of the things that I wound up doing was I created, they have confluences their wiki tool in an engineering organization, and I created a page called the Hitchhiker's guide of CX can, and what it has is all the links to all the resources of things I discovered and that people shared with me in my first few weeks there. And my goal is that the next person that joins the organization can look at the hitchhikers' guide and maybe get a few clues as to where things are and maybe people who have even been here a while can refresh them on where to find particular things. And as with many different companies they're using something called a community system to track pages, but now they're moving to confluence, and they also have some things in sharepoint, so stuff is scattered around, so I thought that making a table with all the things they need in one place would be really helpful.

Q: It's so different from other companies that I've spoken to so far, where it's really just the engineers doing everything and kind of winging it.

A: It is, and you can tell!

Q: How often are you speaking to people on the floor?

A: So what's really cool is that the past 10 years or so I've been working with the engineering team, following something called Agile methodology. So we're doing Agile, and one of the challenges of Agile for technical writers is you really need to embed yourself on the development team. You need to be at all the standups, you need to be at their refinement sessions, at their demos, at their retrospectives, at their planning sessions... it's very time-consuming. However, it can really legitimize you as a member of the team, because one of

my passions, you know I know that in my experience often writers need more from developers than developers need from writers, so when they see us coming they see us as a time sync, as a drain on their energy and their resources. So my goal has been to reduce that unequal dependence that we have between writers and developers. And I've actually done a presentation at a conference about how writers and developers can support each other in an Agile environment, and I'm happy to send that to you if you'd like to see it.

Q: That would be really great, thank you!

A: I have found that when I am a full participant in the Agile process, I gain respect that I wouldn't have gotten otherwise, when I'm part of the conversations they're having about the product under design, I have a deeper understanding of the product and how it operates and why they made particular design decisions, and I don't think that would be available in any other way. In the past when we used something called the waterfall process, everything would be designed, then everything would be built, then everything would be tested, then everything would be documented. The developers would literally throw something over the wall to the tech writers and then they would move on to something new. And then when you contacted them for review edits or something, they couldn't remember, like that was weeks ago or months ago! They couldn't remember what they did and they couldn't answer your questions. So it was very frustrating. But I find that being embedded, I mean it does take a certain kind of attitude to do that, like I often try to get to the meetings and these days they're all Zoom meetings, early, because people are chatting and you can get to know them, and then the meeting starts and they're off to business. But people get to know you and you get to know them, and you build this relationship with them that is really so different from the us and them that happened 5 or 10 years ago, and probably still happens at some companies.

Our skills as technical communicators are halfway to other roles. Like you're halfway to a usability engineer, and you're halfway to a graphic artist if you do your own art, and you're halfway to contributing to product design documentation. So I did a presentation just kind of thinking about, here are all these various roles, and this is the way we can contribute back to development... you know my goal is to be the swiss army knife of tech writers, I want to do everything. But just again, reducing that unequal dependence and also making ourselves flexible. I've known many tech writers who have grown into other roles, they're doing QA or product management or various other things, and just to understand that a lot of people think technical writing is a dead end, but you actually have many skills that are widely applicable within the industry as it stands but also outside of the industry.

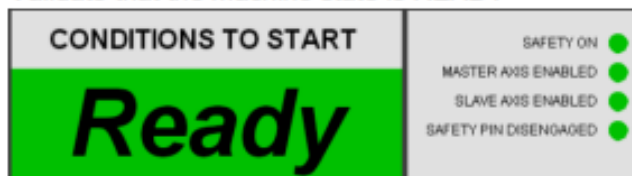
Appendix IV. Complete Original Document

User Manual

SECTION 7
SANITATION

Sanitation sequence

1. Close all doors and pull all emergency stop pushbuttons.
2. Press the "RESET" button for half a second to reset (REARM) the safety and clear all faults.
3. The "RESET" button should turn blue.
4. Go to the Alarms page to validate that there is no more alarms.
5. Validate that the machine state is READY



6. From the Equipment Selection Section, press on the "MASTER (RIGHT)" motor.



7. Move the Guillotine to its locking position
8. **Lock the Guillotine (See "Section 2 – Safety")**
9. From the Sanitation Selection Section, Press the "SANITATION" button. The SANITATION page will open.



10. The ultrasonic cooling will turn ON
11. Unlock the Doors
12. Open the guillotine Guards (Infeed/Outfeed/Bottom frame on operator side).
13. Install plastic bags over the HMI.
14. From the SANITATION page, it is possible to activate the Roller Conveyor even if doors are opened

User Manual

15. Blow air on the machine to remove particles (Guillotine and roller)
16. Rinse the Conveyor Roller and bottom of the equipment with hot water at 140°F with low pressure.
17. Apply a soft cleaner starting from top to bottom of the machine (Except to the blades). Leave it in place for 20 minutes.



Do not use chlorine base cleaner on the blades

18. Scrub with white bristle brush at the places subject to accumulation.
19. Rinse the machine with hot water at 140°F.
20. Use a soft cloth with hot water and soap to clean the blades.



Pay attention to the sharp edges of the blades

21. Blow air on the machine to remove the excess of water on the surface.
22. Apply a sanitizer on roller and blades with a spray bottle and let it dry to free air.
23. Remove the plastic bags on the HMI.
24. Remove the blade lock pin beside the guillotine
25. Close the guillotine Guards (Infeed/Outfeed/Bottom frame on operator side).
26. Close the sanitation page (Air will stay on until you turn off)

Appendix V. Complete Adapted Document

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PEPSICO QUALITY and FOOD SAFETY

TITLE: ULTRASONIC CUTTER HEAD DRY CLEANING AND SANITATION PROCEDURES	
REFERENCE NUMBER:	REVISION DATE:
PREPARED BY:	ISSUE DATE:
APPROVED BY:	Page 1 of 9



- A. Scope**
- This procedure applies to Frito-Lay's Randolph manufacturing plant.
- B. Purpose**
- To dry clean and sanitize the ultrasonic cutter head to prevent the development and spread of microbiological growth.
- C. Responsibilities**
- All plant employees are responsible for their own training and compliance with procedures outlined in this policy.
 - All employees are responsible for reviewing documents as they use them and submitting document change requests to the document control coordinator for update, as necessary.
- D. Timing**
- FREQUENCY:** This task is to be completed every week as a minimum.
 - DURATION:** This task will require 1.5 hours to complete.
- E. Safety Requirements**
- Wear the following personal protective equipment (PPE) when handling chemicals:
 - Hearing protection
 - Eye protection
 - Footwear
 - Chemical-resistant outerwear
 - Ensure guards, shields, and barriers are in place before operating equipment.
 - When work requires safety guard bypass, follow appropriate local Lock-Out/Tag-Out (LOTO) procedures.
 - Follow all site-specific Good Manufacturing Practices (GMPs).
 - Follow all site-specific safety and environmental program policies.
- F. Equipment, Supplies & Chemicals**
- | | |
|---|---|
| <ul style="list-style-type: none"> Flashlight/headlamp Cut-resistant gloves Plastic coverings Air gun | <ul style="list-style-type: none"> Wypall towels Ladder Plastic scraper ATP swab & detection system |
|---|---|







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G. Chemical & Sanitizing Chemical Requirement

- Approved DrySan Duo 2-in-1 cleaning and sanitizing chemical solution.
NOTE: Only DrySan Duo may be used due to the water-sensitive nature of the equipment.

H. Instructions

- Special Notes: Please reference the OEM manual for additional specific guidance around cleaning and maintenance.

Safety Watch-Outs	Critical Details
 Safety 1: Warning	Wear appropriate PPE when working with chemical compounds (i.e.: cut-resistant gloves and safety glasses). Refer to the chemical manufacturer Safety Data Sheet (SDS) and Technical Data Sheet (TDS).
 Safety 2: Warning	Ensure the blade is fully locked and powered off before cleaning. Follow proper LOTO and interlock procedures.
 Safety 3: Warning	Exercise caution when cleaning near the sharp edges of the blades.
 Safety 4: Caution	Do not allow the equipment to come in contact with water. Never use water to clean the ultrasonic cutter.
 Safety 5: Caution	Never use anything other than Wypall towels and a plastic scraper to scrub during cleaning, as this could permanently scratch the equipment and lead to rusting.
 Safety 6: Caution	Do not use any chemical other than the approved chemical solution.

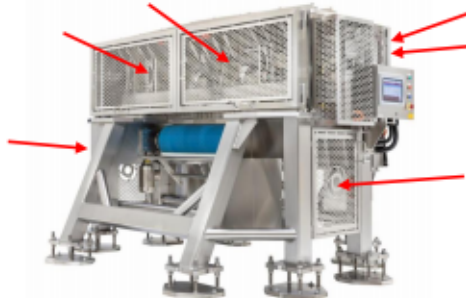
1.0 Prepare & Bulk Dry Clean

- 1.1 Gather all tools and supplies.**
- 1.1.1 Make sure Wypall towels are clean.
 - 1.1.2 Retrieve chemical.

1.2 Stop ultrasonic cutter operation:

CAUTION: Ensure that the guillotine is fully powered off before cleaning.

- 1.2.1 Close infeed doors, outfeed doors, and bottom frame doors on either side to activate guard lock. All door locations are indicated with arrows in the image below:



- 1.2.2 Pull emergency stop pushbuttons: one by the monitor and another on the opposite side of the machine.

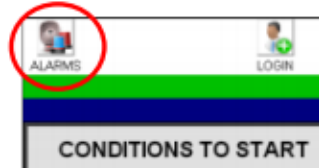
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1.3 **Set up ultrasonic cutter for cleaning:**

1.3.1 On the screen, press the **RESET** button for half a second to reset the safety and clear all faults.

1.3.2 The **RESET** button should turn blue.

1.3.3 Go to the **ALARMS** page by pressing the button on the upper left side of the screen, circled in red below:

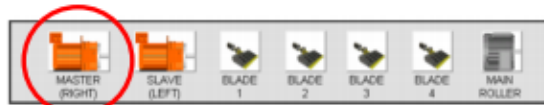


1.3.4 Validate that the page appears green and that no alarms are listed. If this is not the case, contact maintenance.

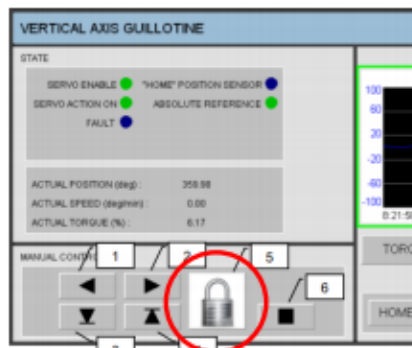
1.3.5 Validate that the machine state is **Ready**, and looks like the following image:



1.3.6 From the **Equipment Selection** section, select the **MASTER (RIGHT)** motor, circled in red below:

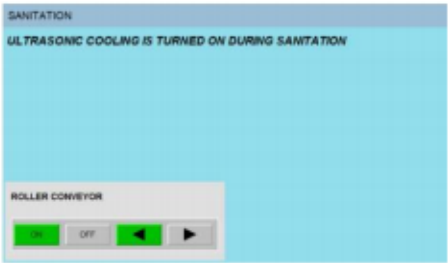


1.3.7 Lock the guillotine by pressing the lock icon on the screen, circled in red below:



1.4 **Initiate sanitation sequence:**

1.4.1 In the **Sanitation Selection** section, press the **SANITATION** button. The **SANITATION** page will open:



1.4.2 The ultrasonic cooling will turn ON.

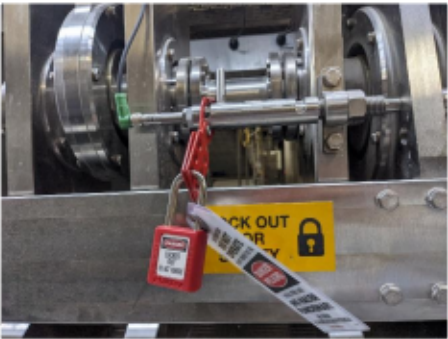
2.0 Secure and Disassemble

2.1 Prepare equipment:

- 2.1.1 Open infeed doors, outfeed doors, and bottom frame doors on either side.
- 2.1.2 Open both adjacent conveyor belts as indicated in the following picture. Ensure all conveyor belts are locked and labeled.



2.1.3 Lock the blades by pulling down the lock bar on the outfeed side of the equipment and moving the lock pin from left to right. Secure with a LOTO padlock. The pin should be in the position pictured:



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2.2 Remove loose particles:

2.2.1 Using an air gun, blow air over the machine to remove particles from the top to the bottom of the cutter, including the guillotine and roller.



2.2.2 Using a Wypall towel, wipe down outside surfaces to loosen debris.



2.2.3 Blow air over all surfaces with the air gun.

3.0 Dry Clean

3.1 Spray DrySan Duo onto surfaces and rub off using Wypall towels, moving from the top to the bottom of the equipment.

NOTE: Do NOT set the DrySan Duo bottle down on the machinery, as it could transfer impurities to the equipment.



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3.2 Do multiple wipes of each area, 2-3 times or until clean.

CAUTION: Never use anything other than Wypall towels and a plastic scraper to scrub during cleaning, as this could permanently scratch the equipment and lead to rusting.



3.2.1 **For hard-to-reach surfaces:** Use a ladder braced between the cutter and the conveyor belt.



3.2.2 **For inside surfaces:** Spray and soak for about 2 minutes, then wipe down with Wypall towels. If there is clumping, remove clumps using a plastic scraper. Pull towels between wheels/shafts to dislodge particles.

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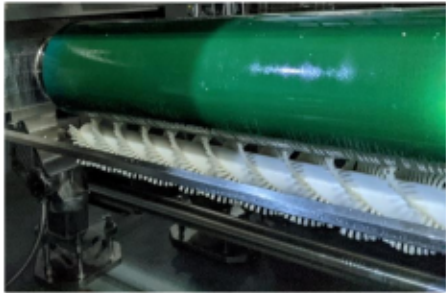


3.2.3 **For blades:** Clean from the top of the blade, as pictured.

CAUTION: Exercise caution when cleaning near the sharp edges of the blades. Wear cut-resistant gloves at all times.



3.2.4 **For the conveyor belt:** If the conveyor roller is off, press **ON** on the Sanitation screen pictured below. Spray and wipe the belt as it moves. Make sure DrySan Duo drips onto the brush beneath the belt as it cannot be directly cleaned.



4.0 Detail Clean & Inspect

- 4.1 Wipe down all surfaces with dry Wypall towels.
- 4.2 Using the air gun, blow on all surfaces to dislodge any remaining dirt.
- 4.3 Inspect for any remaining impurities.
- 4.4 Wipe down the conveyor roller one last time, then turn the roller off by selecting **OFF** on the screen.

5.0 ATP As Required

- 5.1 ATP swab test any required test locations. Follow proper ATP swab handling and sampling procedures.
 - On first ATP swab, fail locations on first failure.
 - ATP swab failures beyond first failure require the equipment to be chemically re-cleaned until a passing ATP swab result is achieved.
 - All ATP test sites **MUST** pass with green results prior to start-up of the line.

6.0 Apply Sanitizer & Inspect

- 6.1 Ask for verification from a team lead or manager to ensure the equipment is clean.
- 6.2 Apply approved 2-in-1 solution to equipment as a sanitizer.
DO NOT RINSE OR WIPE OFF – ALLOW TO DRY.

7.0 Reassemble & Return to Operational State

- 7.1 Close infeed doors, outfeed doors, and bottom frame doors on either side.
- 7.2 Press **LOCK** on the screen.
- 7.3 Cover the cutterhead section with a tarp or plastic bags to prepare for outfeed and infeed conveyor wet cleaning. **For wet cleaning procedure, refer to wet cleaning SSOP.**
- 7.4 Remove equipment, tools, chemicals, and trash from the floor.
- 7.5 Ask for sign-off from a team lead and manager.

8.0 Verification and Documentation

- 8.1 Individual cleaning the equipment is to complete the post-sanitation task sign-off documentation. Include chemical usage and concentration where applicable and return to designated location.
- 8.2 Person verifying the cleaning is to sign off on all documents.

TITLE: ULTRASONIC CUTTER HEAD CLEANING AND SANITATION PROCEDURES	
REFERENCE NUMBER:	Page 9 of 9

- I. Forms & Records**
 - Master Sanitation Schedule (MSS)
 - Post-Sanitation Task Sign-Off Form

- J. Attachments**
 - None

- K. References**
 - Chemical Safety Data Sheet (SDS) and Technical Data Sheets (TDS)
 - GMP Policy
 - LOTO Program and Procedures
 - eDocs – Online Document System
 - ATP Swabbing Technique Procedures
 - Plant Quality Control Program

- L. Related Documents**
 - Approved Chemical List
 - Verification Procedures
 - Validation Procedures

M. Revision History

Revision #	Date	Changes	Name

N. Approvals

Name (print)	Title	Signature	Date

Characterizing the Performance of a Frito-Lay Ultrasonic Cutter

A Major Qualifying Project Report

Submitted to the faculty of **Worcester Polytechnic Institute**

in partial fulfillment of the requirements for the Degree of Bachelor of Science

Submitted by:

Nasim Mansuri, Professional Writing & Chemical Engineering

Date:

03 May 2021

Approved by:

Stephen J. Kmiotek, Chemical Engineering

This report represents the work of WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review. For more information about the projects program at WPI, please see <http://www.wpi.edu/academics/ugradstudies/project-learning.html>

Abstract

This study compares the performance of a newly-installed Matisse ultrasonic cutter against its predecessor, a Romeo Engineering, Inc. waterjet cutter, both operating on a Frito-Lay Pita Thins manufacturing line in Randolph, Massachusetts. This analysis aimed to determine if the ultrasonic cutter's performance justified its investment. By analyzing product moisture content, food and water waste, cut precision, expenses incurred, mechanical reliability and return on investment, it was determined that the ultrasonic cutter not only decreased recurring costs and increased yield, but improved overall product quality as well.

This MQP contains information deemed confidential to the business interest of the industrial sponsor. Please contact Stephen Kmiotek at sjkmiotek@wpi.edu for additional information.