

# STREAMLINING YOUR MAINTENANCE PROGRAM

Organized documentation can be the foundation of an efficient maintenance program that maximizes uptime and reliability, and can strengthen the organization.

By Don Bridges



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**A FEW YEARS AGO A MAJOR OPERATOR** signed a deal to operate wind farms at several locations over a multi-year period. The farms would then be turned over to a local authority once the initial service period ended. Near the end of the operator's service period, it was determined that all of the maintenance plans and procedures would need to be conveyed to the local authorities.

The only problem was, there was no maintenance plan in place and no procedures had been documented. All that existed were piles of repair tickets that listed the scheduled and unscheduled work that had been done over the past several years—that and the combined knowledge of the maintenance staff, which was filed in the 8" space between

their ears. With some outside help, the operator was able to analyze the repair tickets and build the required documentation needed to complete their contractual requirements.

A better approach would have been to develop and implement operational strategies from the beginning that mitigate (or eliminate) the effects of unplanned maintenance events. Achieving the correct balance of scheduled and unscheduled maintenance is an ongoing quest that evolves as equipment wears and economic conditions merit. Organizing technical information (typically procedures and schematics) in a way that is easy for the field technician to comprehend and utilize—regardless of the



**Fig. 1: Advance preparation streamlines maintenance programs.**

- unscheduled maintenance;
- Manage spares inventory while increasing your part availability, and;
- Implement technology that allows maintainers to work more efficiently.

## ORGANIZATION

The first step is to determine how your technical data will be organized so you can find the information you need efficiently. Unfortunately, there are no universally adopted standards as to how technical information is organized in the wind power industry. Instead of reinventing the wheel, the operator in our story structured their technical information similar to what is used by the commercial air transport industry (Kinnison, 2004). The information is laid out so that the top-level assembly (tower platform) is divided into major components (tower, nacelle, electrical systems, etc.), and these components are divided into subassemblies. For example, the gearbox cooler is a component of the nacelle. Subassemblies can be further divided into components (gearbox fan, gearbox motor, gearbox radiator, etc.). The process is repeated until the lowest repairable unit is reached. At that level, the specific information can be provided that is applicable to that unit. These may include description information, inspection tasks, repair tasks, and servicing tasks.

The organization of information is relevant for any tower platform, regardless of the manufacturer or design. This allows the maintenance staff to locate the correct information quickly regardless of the manufacturer, and enables the staff responsible for updating technical information to know exactly where the revised information belongs.

## KEEP IT SIMPLE

Once the information is organized, it needs to be written in a manner that makes it easy to use and maintain. Simplified Technical English (STE) is one approach that helps improve the readability and portability of your information.

The objective of Simplified Technical English (STE) is clear, unambiguous writing. Developed primarily for non-native English speakers, it is also known to improve the readability of maintenance text for native speakers. STE does not attempt to define English grammar or prescribe correct English.

specific machinery being maintained—is critical to the success of the operation.

In this article we will walk through the high-level basics of defining a maintenance program and see how the operator used this approach to meet their needs. We will discuss how to:

- Organize your procedural information in a universal manner;
- Incorporate simplified English in technical documentation;
- Understand organizational objectives and determine the correct balance between scheduled and

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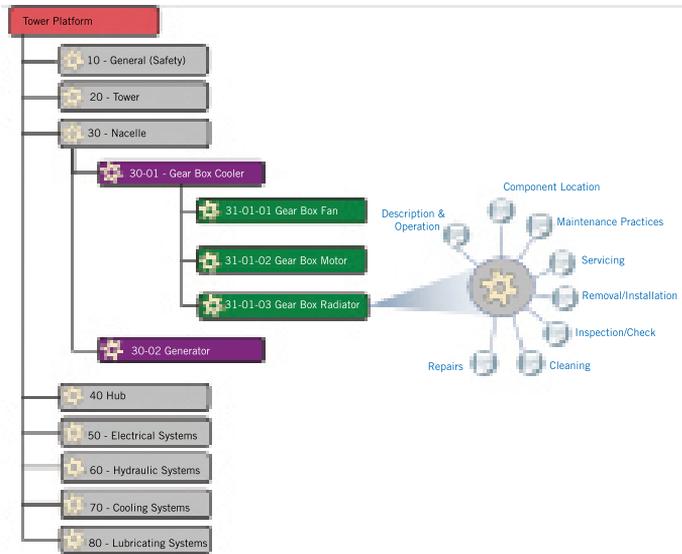


Fig. 2: An organizational structure for maintenance programs.

This type of writing standard is also known as a controlled language because it restricts grammar, style, and vocabulary to a subset of the English language. The main characteristics of the STE standard are: simplified grammar and style rules; a limited set of approved vocabulary with one word having only one meaning; a thesaurus of frequently used terms, technical nouns, verbs, and suggested alternatives, and; guidelines for adding new technical words to the approved vocabulary.

STE attempts to limit the range of English, and many of its rules are recommendations found in technical writing textbooks. For example, STE requires writers to use the active voice, use articles wherever possible, use simple verb tenses, use language consistently, avoid lengthy compound words, and use relatively short sentences. Companies in several industries—manufacturing, mining, oil exploration and software development, for example—have produced their own controlled-language writing standards (Works, 2005). Here is an example, with the “original” text: Place the water heater in a clean, dry location as near as practical to the area of greatest heated water demand. Long un-insulated hot water lines can waste energy and water. Clearance for accessibility to permit inspection and

servicing such as removing heating elements or checking controls must be provided.

And the same content in STE: Put the water heater in a clean, dry location near the area where you use the most hot water. If the hot water lines are long and are not insulated, you will use too much energy and water. For inspection and servicing, make sure that you have access to the heating elements and controls.

Besides readability, STE offers a business advantage when creating documentation that will be translated into a number of languages. As the text volume is typically reduced by at least 20 percent and the remaining text becomes more repetitive, the use of STE normally results in 30-40 percent less translation cost. In addition, STE will reduce the number of unique terms and improve translation quality and consistency. The graph shows typical results of rewriting standard English into STE (Wijma, 2012).

Text in STE is easier to understand and may not even require translation. Where translation is needed, STE helps to drastically reduce translation cost and time-to-market, as it effectively eliminates redundant words and improves consistency. With the ever-increasing number of languages that companies need to deal with, these savings add up quickly. Con-

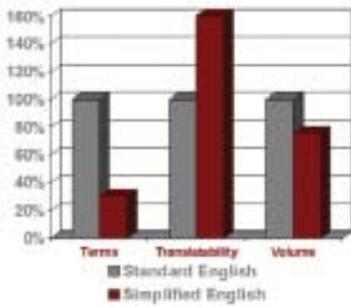


Fig. 3: The advantages of using Simplified Technical English (STE) are readily apparent.

tent is easier to validate, technical writers will be more productive, and fewer iterations and less rework will be required.

### STRIKING A BALANCE

There are some industries where unscheduled maintenance is associated with catastrophes. Air travel is one. There is no road shoulder at 30,000 feet. Nuclear power is another. Thankfully we are not in the brokerage operations market, where the cost of downtime is reported to be \$107,500 per minute (Marquis, 2006). For the wind power industry, unscheduled maintenance is a bad event, but it's also something that can be managed.

Scheduled maintenance, while allowing the operator to avert part failure, almost always results in premature part replacement. Unscheduled maintenance results in parts being replaced only once full part life has been utilized. Unplanned failures are a problem not because of the repair costs, but because of the downstream effect of loss of energy production. This makes it difficult to arrive at a cost estimate that is both accurate and believable.

Applying industrial engineering concepts allows the operator to evaluate items such as costs and likelihood of downtime, and the cost of purchasing parts with higher reliability or having spare sub-assemblies available (which have a cost on the shelf). In some cases an operator will have a database of thousands of repairs that can be analyzed to prevent future failures before they occur through planned maintenance and condition based maintenance programs. These programs are designed to preserve and restore equipment reliability by replacing worn components before they fail. Preventive maintenance activities include partial or complete overhauls at specified periods, oil changes, lubrication and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure.

### SPARE PARTS

The inventory of maintenance items includes all the replacement parts for machines, for tools, and for company-supplied finite-lived employee equipment such as safety glasses. This category excludes items used in manufacturing, such as washers or bolts, and this category includes consumable items for cleaning or safety, such as solvents. Maintenance storeroom management has three major goals:

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- To have the item that is needed;
- To supply that item when needed, and;
- To control the overall cost of keeping items in stock.

As an example, suppose that an oil pump is typically replaced twice a year, but only when it “fails,” rather than on a pre-emptive maintenance schedule. That tower’s production will stop until the pump is replaced. If it is out of stock, there will be a significant delay in returning the tower to production. If a replacement pump is listed in the inventory, but misplaced, there is still a delay. Now suppose the response to this scenario is that a dozen pumps are purchased, with some stored near the machine and more in the storeroom. That expense represents a six-year supply. If we assume some of those pumps will be misplaced in the ensuing years, part of this investment still represents a loss of production time at best, and inventory cost if the missing pumps are never found.

One key recommendation is to consider a computerized inventory management system for the maintenance supplies. This should integrate the purchasing, storage, and stock-release functions so the system tracks pending orders, expense authorizations, where items are stored, and to whom the items are released. For scheduled maintenance, the demand for repair parts will be known in advance. Ensure that the storeroom workers are given sufficient notice of the maintenance schedule so they may pick the items and prepare maintenance “shopping carts” for each tower. This streamlines the workload for the storeroom staff, and it leads to fewer errors (Olofsson, 2011).

## IMPLEMENTING TECHNOLOGY

Perhaps the hardest part of a maintenance program is knowing when to invest in your maintenance staff through training and when to invest in tools through technology. Most organizations realize that training is required when implementing new concepts. What few organizations do well is monitor mistakes in order to better understand when training would have improved the efficiency of the maintenance staff. If similar mistakes are being repeated across the staff, training classes can reinforce best practices or clarify information.

This is an area where technology can help training. Some electronic technical manuals have a functionality that allows end users to add their comments about technical information, typically a task or procedure. In many cases the task can be improved by leveraging the knowledge of the people doing the task in a field environment, and this functionality allows that feedback. But in some cases the added suggestion is not what the person who originally developed the task had in mind. For instance, an employee suggested using a broomstick to rotate a very delicate compressor assembly to assist in the inspection. In reality, the broomstick could introduce nicks and dents to the compressor blades. There were two results of this well-meaning feedback: a warning was added to not use foreign objects (like a broomstick) to rotate the compressor; and a training session was conducted to alert the maintenance

staff as to why this was not an approved maintenance method.

As a side note, the employee who made the suggestion was actually rewarded with a gift certificate for making the suggestion. Not because it was a good idea; it wasn’t. But because he was using the system to leverage his experience.

One way to get the most from your training budget is to record videos of processes that warrant it. This is likely to be the case when it is difficult to do the process correctly, or it is a common to many processes. Just as some electronic technical manuals have a “knowledge manager” that allows for field feedback, there is also the capability to embed training videos and 3D model browsers into technical documentation. Try getting a piece of paper to play a video.

While most maintenance staff will attempt to memorize procedures because of repetition or convenience, it’s difficult to memorize all the part numbers associated with scheduled maintenance tasks, and impossible for unscheduled maintenance tasks. This is what makes the Illustrated Parts Catalog (IPC) a critical piece of technical information. But even with an updated IPC, identification and ordering of spare parts can be a trouble spot. Maintenance is often delayed when the wrong parts are ordered because part numbers are identified or entered incorrectly. Use of an electronic parts catalog provides a point-and-click functionality where part numbers are automatically inserted into a shopping cart. Implementers of this technology report that creating a parts list via an electronic shopping cart is 35 percent faster than manual entry into a form, and ordering errors are reduced by more than 20 percent.

## SUMMARY

While some organizations look at their documentation as a “necessary evil” at best, in reality it can be the foundation of an efficient maintenance program that maximizes uptime and reliability and can strengthen the organization. By implementing a consistent organization and structure to your technical information, managers provide your staff a head start in finding the information they need consistently, regardless of the equipment being maintained. Implementing STE allows even the most inexperienced maintainer to more easily comprehend complex task. Building a maintenance plan that factors scheduled and unscheduled maintenance with organizational needs can save money by avoiding unnecessary maintenance. Determining which spare parts to stock—and where they should be stored—will help make parts inventory lean and efficient. Likewise, knowing when and how to leverage technology will keep a workforce on the cutting edge without being gashed by not having the information foundation in place.

And what about the operator with the eleventh-hour requirement for maintenance plans and procedures? They were delivered on time, with the information well organized and unambiguous. ✨