



# Managing Motor Reliability

## Using A Partnership Approach with Plant Vendors

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A typical large continuous processing manufacturing facility has between 1,000 and 20,000 critical motors installed in the plant. The facility will typically purchase or repair between 10 and 100 critical motors each month. The cost of repair or replacement motors, the labor, and the down time associated with each repair can represent a significant portion of a plant's maintenance budget. In order to control these costs, a motor management program is essential. Typically management of each of the plant's hundreds or thousands of motors will first be attempted with the existing computerized maintenance management system (CMMS). In the plant, it soon becomes obvious that the plant CMMS is not capable of managing reliability information on re-buildable assets that migrate. Next plants often try to accomplish motor tracking using a homemade database in Access or Excel. This approach is usually very difficult to keep current and fails to be usable by more than one person. The Tango equipment lifecycle management software produced by 24/7 Systems is designed specifically to accomplish the management of re-buildable assets. This paper discusses the use of Tango in a web-hosted motor management program.

From the plants perspective, motor management is performed to achieve two objectives:

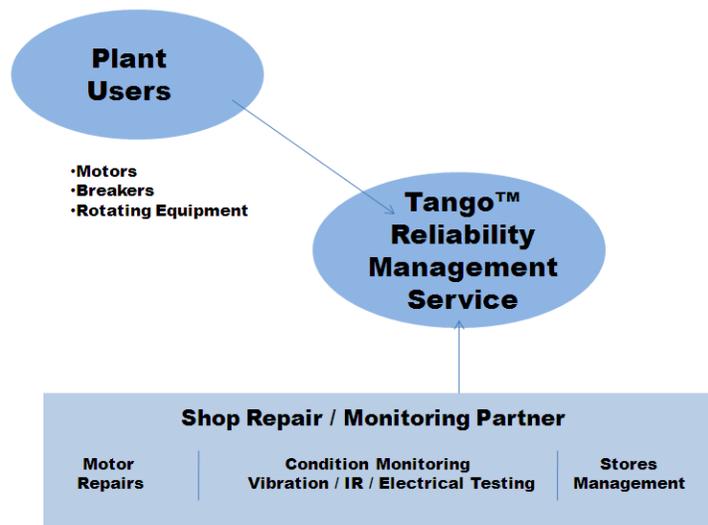
- I. Eliminate unexpected motor failures
- II. Extend the life of motors between overhauls

Integrating motor reliability and condition information is critical to the above objectives but the information comes from multiple subcontractor, vendors, and in-plant sources. So how can the plant with its limited manpower and resources realize the potential advantages of motor management? Some plants have found that they can utilize their motor repair vendors and new motor suppliers to do most of the work of motor management for them. The Tango equipment lifecycle management software provides the tools for integrating the diverse reliability information from multiple sources and allowing it to be viewed and analyzed in one system. When the Tango system is web-hosted, it allows the strength of plant/subcontractor partnership to be utilized. The

advantages to the plant of having their own overhaul shop(s) assist them with managing motors with a web-based application include:

- **Reduced data entry**  
The vendor is providing purchase and repair documentation in the normal course of business, so entering it into a web-hosted database relieves the plant of re-entering data or trying to track down hardcopies scattered among various file cabinets.
- **Consistency and Availability of Information**  
Often the various plant functional areas, units, or stations create their own tracking applications using Access or Excel. These independent sources rarely use the same nomenclature that allows other plant users to integrate the information, and the files may not be accessible by all interested parties. With a single web-hosted database a common nomenclature can be enforced, and information is available to any authorized manager or employee with Internet access.
- **Removes the plant CMMS limitations**  
Often the plants CMMS system does not have the capability or user interface needed for storing and retrieving asset life cycle or condition information.

Figure 1: Tango web-based Equipment Life Cycle Management architecture



**Tango™ Communication and Information Management of Shops Results**

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# I. Eliminating Unexpected Failures

The plants first requirement for motor management is the elimination of in-service motor failures. Predictive Maintenance (PdM) technologies provide information about the current status of motor health, and motor vendors have become key suppliers of PdM services. These technologies include:

Vibration Analysis  
 Infrared Thermography  
 Motor Circuit Evaluation

Current Signature  
 Bearing/Winding Temperature  
 Ultrasonic Inspection

From the trending and analysis of these tests, a set of standards can be established which when exceeded cause the motor to be removed for repair and prevent failure in service. The difficulty in tracking a motor's condition occurs because multiple condition technologies must be applied and there are no effective standards in place to facilitate integration of reporting between different vendor's software. Also, the traditional deliverable from PdM service suppliers has been hardcopy or e-mailed reports to a few individuals at the plant; other employees or managers who could benefit from the 'warning' information often never receive it.

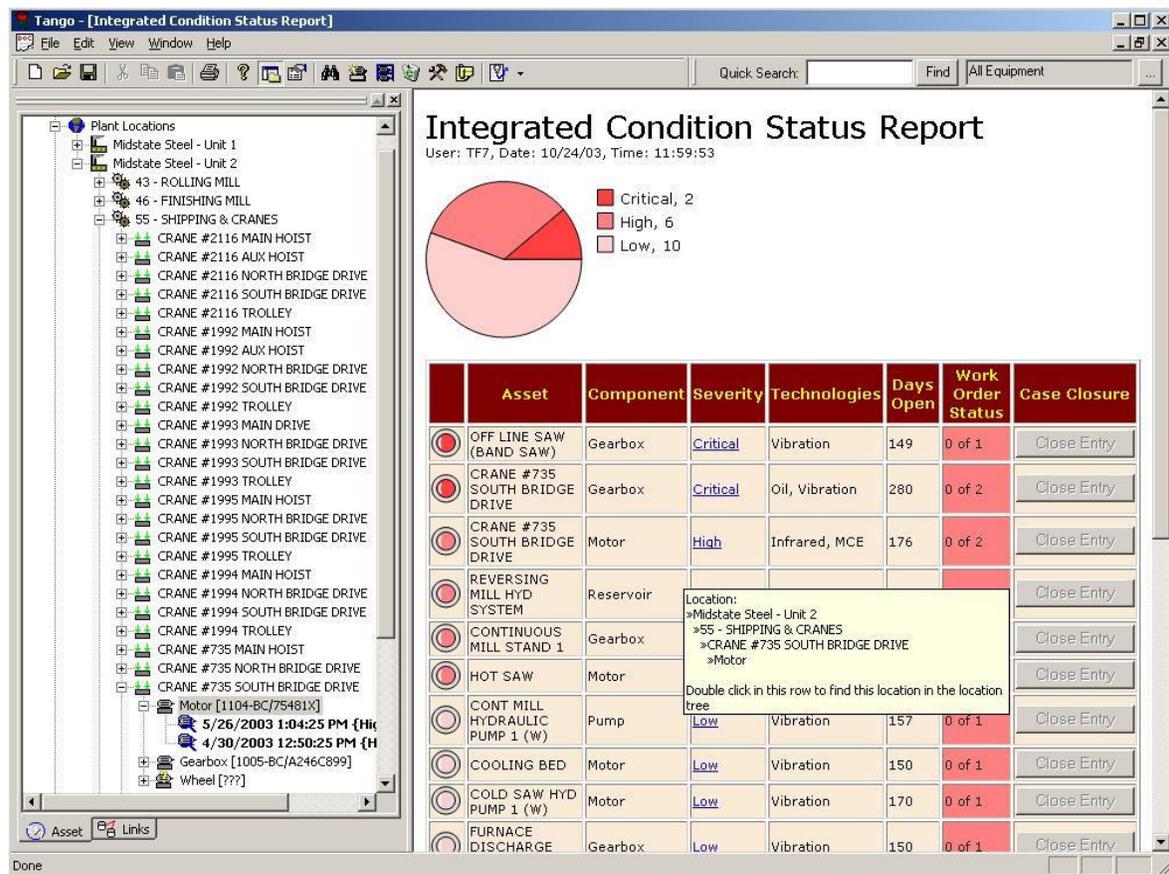


Figure 2: Web-based integrated condition report detailing condition and severity that can be accessed by all authorized plant users.

## **II. Extending Motor Life**

When a failed motor is sent to the motor repair shop, the first step is disassembly and inspection. At this point, the shop knows the basic design and failure information about a motor. Once a repair has been approved and performed by the shop, the shop also knows the cost of repair and warranty period.

### **1. Design Information**

Design information on motors needed by the plant goes beyond just the nameplate data. Information such as a bearing currently installed, number of bars and slots, insulation class, and full load current is extremely helpful for plant condition analysis and testing, purchasing, and routine maintenance.

### **2. Root Cause of Failure**

Typically the plant will see the motor's failure as why it stopped functioning, which is either "winding failure" or "bearing failure". This level of information is not helpful in assisting the plant in understanding how to make the motor live longer. The shop can usually determine the root cause of failure such as:

- Over greasing
- Dirty cooling passages
- Overload
- Power quality
- Inadequate lubrication
- Lighting strike
- Internal moisture
- Excessive starts
- Wrong lubricant

Once the plant knows root causes of failures, action can be taken to eliminate the root cause and obtain longer motor life.

### **3. Date Received and Shipped**

These dates will allow the calculation of Mean Time to Repair and Mean Time Between Repairs.

### **4. Cost of Repair**

Upon disassembly and inspection, the plant may decide to overhaul the motor or to scrap it and purchase a new motor. In either case, the cost of the failure needs to be stored with the failure information.

### **5. Warranty**

Motor warranty is a special consideration of motor management. Overhauled motors often have 1 or 2 year warranties and new motors 1 to 5 year warranties. Many plants do not pursue warranty claims because the system required to easily warn them of a potential warranty claim does not exist. Often the savings obtained from warranty tracking will more than pay for the complete motor management package.

Typically a motor repair shop returns paper or e-mail documentation to the plant detailing repairs, post repair testing, new design information, and cost. Quite often this report is hard to retrieve within a few weeks of receipt by the plant. Whether the hard copy was placed in an office file cabinet, or e-mail was archived in a computer folder along with hundreds like it, it becomes very difficult to retrieve and use for meaningful analysis.

From the motor repair shop perspective, the biggest challenge for most shop's operations is capturing good root cause of failure information. Joe Longo, President of Longo Electrical Mechanical in Wharton, NJ, leads a large progressive apparatus repair facility and believes that root cause of failure information is not being analyzed well across the repair industry. "Just telling a customer they had a winding failure is not sufficient", according to Longo. Instead, they need to know if the winding failure was caused by mechanical, environmental, or electrical sources. "Finally we have a tool that prompts us to capture root information consistently. Before Tango lots of people talked about reliability but no one knew how to produce the information for our customers."

Solution: Tango™ Web-based Motor Management Web Service

Using the Tango™ web based motor management approach; the repair shop enters the motor ID, design information, failure analysis, repair, and cost information into a web form. In addition the repair details and photos can be attached. This information is then automatically entered into the web database and creates a life cycle repair history for the specific machine. In addition to the history for each machine, the database can produce information on Mean Time Between Repairs, root causes of failure, and cost of repair. This information could be further sorted or analyzed by size, vendor, repair vendor, voltage, type of motor, cost by year, etc...

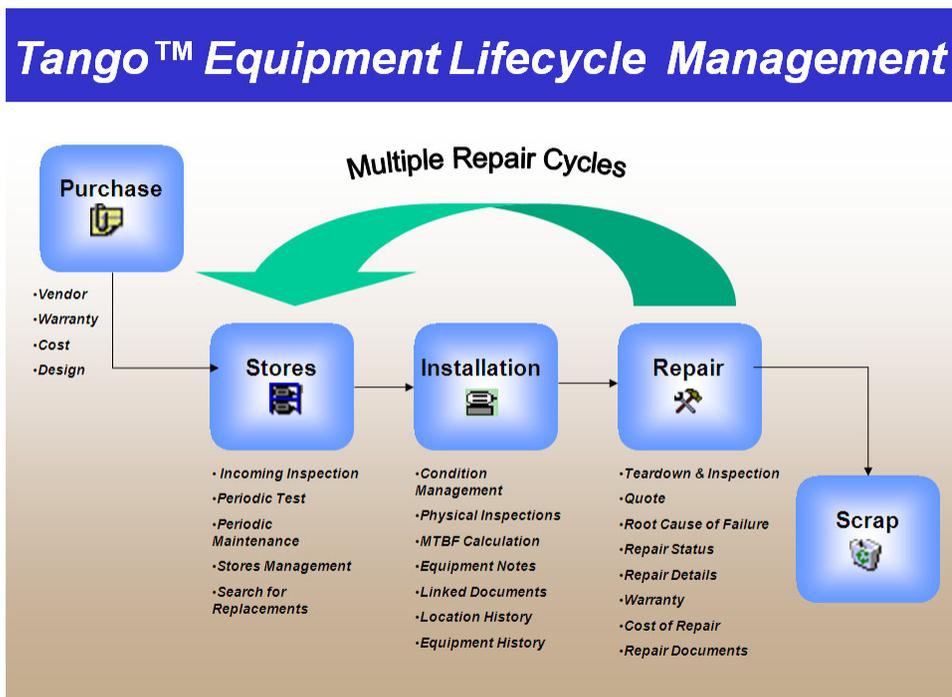


Figure 3: Summary of motor life cycle steps handled by Tango Equipment Life Cycle Management software.

### Tango™ Repair Tracking

Tango™ Repair Tracker provides the ability for repair shops to enter motor design, failure, repair and repair status information.

Figure 4 shows the Repair Tracker start page. This view shows all of the motors in the shop for repair and the status of repair for each motor.

Figure 4: Tango™ Repair Tracker start page

	Company Name	Plant	Equipment Type	Plant Tag	Start Date	Plant PO Number	Shop Tracking Number	Status
<a href="#">View</a>	Mohawk	Antioch Plant 2	Roll - Friction	<a href="#">140030369</a>	Apr-13-2006		677555	Quote Approved
<a href="#">View</a>	Mohawk	Antioch Plant 2	Motor - AC Induction	<a href="#">1400BTRM517</a>	Apr-26-2006		677703	Tear down and Inspection
<a href="#">View</a>	Mohawk	Antioch Plant 1	Roll - Grooved	<a href="#">1400BGRA138</a>	May-01-2006		677724	PO Received
<a href="#">View</a>	Mohawk	Antioch Plant 1	Motor - DC Series	<a href="#">1400FEM006</a>	May-02-2006		677747	Quoted, Waiting on Approval
<a href="#">View</a>	Mohawk	Antioch Plant 1	Motor - AC Synchronous	<a href="#">1400BCGM110</a>	May-04-2006		677803	Quote Approved
<a href="#">View</a>	Mohawk	Antioch Plant 2	Roll - Grooved	<a href="#">1400BGRA002</a>	May-08-2006		677834	Quote Approved
<a href="#">View</a>	Mohawk	Antioch Plant 1	Motor - AC Induction	<a href="#">1400BAM158</a>	May-11-2006		677866	PO Received
<a href="#">View</a>	Mohawk	Antioch Plant 1	Roll - Grooved	<a href="#">1400BGR127</a>	May-11-2006		677867	Quote Approved
<a href="#">View</a>	Mohawk	Antioch Plant 2	Godet	<a href="#">1400BCGM115</a>	May-13-2006		678669	Quote Approved
<a href="#">View</a>	Mohawk	McFarland	Gear Motor - AC Induction	<a href="#">148211831</a>	May-16-2006		677918	Tear down and Inspection
<a href="#">View</a>	Mohawk	McFarland	Gear Motor - AC Induction	<a href="#">148211900</a>	May-16-2006		677917	Tear down and Inspection

Figure 5: Tango™ Repair Tracker Design Information

The screenshot shows a web browser window displaying the Tango Repair Tracker interface. The page title is "Equipment Definition" and it lists the following information:

- Plant Tag: E-20547
- Equipment Type: Motor - AC Induction
- Equipment Class: Motors

Below this information is a table with two columns: "Property" and "New Value".

Property	New Value
Plant Tag*	E-20547
Catalog ID Number*	1911035
Frame Size*	256TY
Model Number*	n/a
Motor Mfg*	Reliance
Power*	15 HP
Serial Number*	1MAF93105-G-001
Speed*	1620 RPM
Voltage - Stator*	230 V
Air Gap	0 in
Assembly	
Bars - Rotor (cnt)	0
Bearing ID Number - DE	
Bearing ID Number - NDE	
Comments	cold mill with gearbox and coupling
Conduit Box	None

For equipment being repaired, the view option allows the shop to enter the failure reasons, photographs, documents and warranty information. The customer may view this information in a read-only view.

Figure 6: Tango™ Repair Tracker Failure Details

Plant Requisition Number: 1187963  
 Start Date: Jan-16-2007  
 Due to Finish Date: Feb-28-2007  
 Sent By: AnnP

LOW MEGS ON THE ARMATURE

Any comments about the state of the equipment when it came in

Finding Desc	Status	Comment	Problem Level
<input checked="" type="checkbox"/> E - Dirty	Fixed		Contributing Factor
<input checked="" type="checkbox"/> E - Insulation failure	Fixed		Root Cause
<input checked="" type="checkbox"/> E - Moisture	Found, Not Fixed		Contributing Factor

Supporting Linked Documents  
[Test Report](#)

Photograph Photograph

## Equipment History Report

Report Date: 9/23/2003

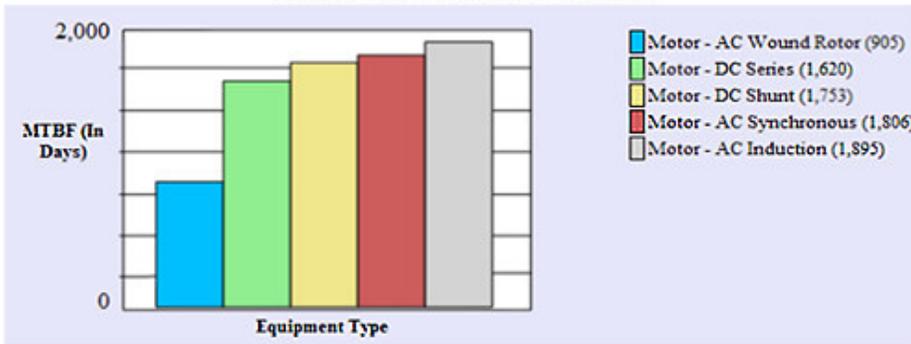
Plant Tag	Serial Number	Frame Size	Model Number	Motor Mfg	Power	Speed	Voltage - Stator
1450	5282414002	509UPD	????	Louis Allis	350 HP	1200 RPM	460 V

Start	End	Days	Type	Remarks
2/1/1983	2/8/1983	7	Repair	
5/12/1986				RECONDITION * BRGS * NEW OIL SEALS * LEAD
11/1/1988				
1/5/1990				
5/19/1993				
5/24/1995				

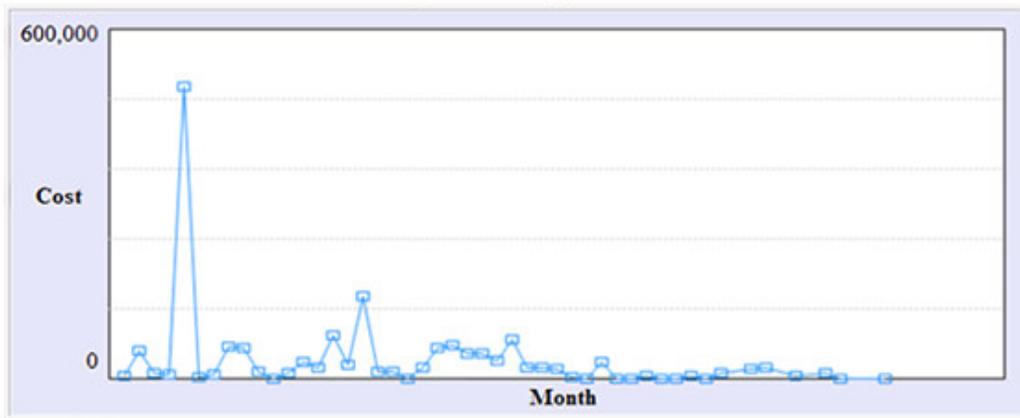
<i>Work Order</i>	
<i>Vendor</i>	SANDERS ELECTRIC
<i>Cost</i>	5,699.00
<i>Order Number</i>	500895
<i>Shipping Number</i>	
<i>Vendor Order Number</i>	
<i>Repair Type</i>	Repair
<i>Warrenty Date</i>	
<i>Attachments</i>	<a href="#">Shop balance report</a> <a href="#">Shop card</a>

Work/Repair Findings				
Fault Type	Fault Group	Status	Level	Comment
Drive end bearing failure	Mechanical	Fixed	Resulting Effect	
Lubricant contains water	Mechanical	Fixed	Root Cause	
Vibration/Bearings by NDT	Mechanical	Fixed	Secondary Cause	
Worn shaft	Mechanical	Fixed	Secondary Cause	
Moisture/wet	Other	Found, Not Fixed	Contributing Factor	

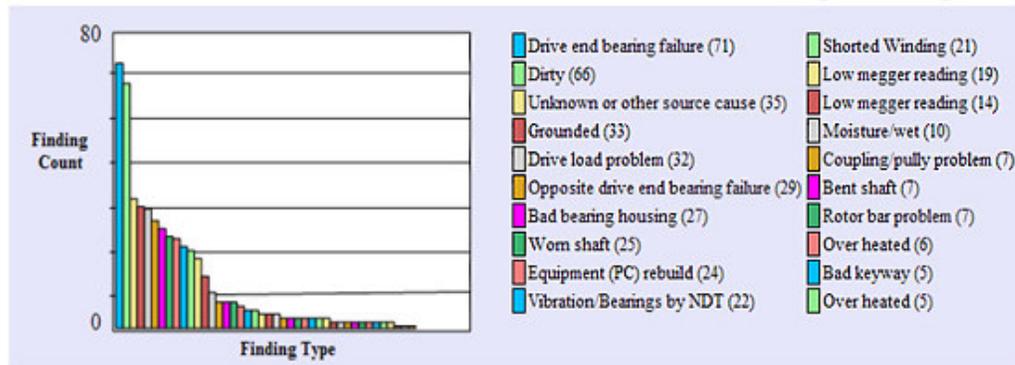
### Mean Time Between Failures



### Repair Cost By Month



### Repair Findings



## Conclusion

Effective motor management requires lifecycle tracking to capture the design, condition status, repair, and failure root cause information that comes from a wide variety of sources. A web-based motor management system allows a motor repair vendor to become a working partner to capture this information for a plant, without having to get involved with the plant's IT firewall issues. It also facilitates broad communication of critical reliability issues to interested plant users without additional manpower burden to the plant. The motor vendor becomes an essential partner for the plant's motor management effort. Tango Equipment Life Cycle Management produced by 24/7 Systems is the enabling technology that allows motor repair vendors to provide a web-based motor management service for large industrial accounts.

For information about Tango Motor Life Cycle Management Web-service from 24/7 Systems, Inc, e-mail [sales@tf7.com](mailto:sales@tf7.com), or call 865-681-0282.