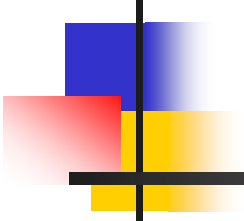


CMVA

October 31, 2008



**Savings generated using
Vibration Based Monitoring
Program**

Jack Field

I Otech Area Sales Manager



What is vibration?

- Vibration is motion of a machine or machine part back and forth from its position of rest.



Why avoid vibration?

- It is natural for machines to vibrate and make noise.
- When machinery vibration and noise increase, some mechanical fault may be identifying itself.
- Overall, it's not necessarily the vibration we want to avoid, but we want to avoid the dynamic forces that are the cause of vibration to enable:
 - " Safe machine operation
 - " Desirable operational life
 - " Acceptable production quality.



What causes vibration?

- Primary causes of vibration of rotating equipment include:
 - " Unbalance
 - " Misalignment
 - " Eccentricity Forces
 - " Bent Shafts
 - " Faulty Anti-friction Bearings
 - " Faulty Journal Bearings
 - " Mechanical Looseness
 - " Electrical Problems
 - " Belt Drive Problems
 - " Bad Gears
 - " Resonance
 - " Aerodynamic/Hydraulic Forces

MULTI-MODE VS. BALANCING READINGS

- Have you ever wondered why your vibration readings may be significantly different when taking the readings in Multi-mode (off-route) as compared to the same readings taken in Balancing mode?



KEEP THINGS SIMPLE

- Many vibration programs fail because they become too complicated. Too much data can sometimes become more confusing than too little data. Many potential machinery problems can be eliminated with the analysis if one keeps in mind several simple concepts



Machines Will Fail Eventually

- It's a fact of life – mechanical equipment is going to break down. It is simply a matter of time. You can only hope that the breakdown doesn't occur at the peak of your production schedule, or be caused by an out-of-inventory part. But if you know the health of your rotating mechanical assets, you are able to plan for repairs rather than react to unexpected failures. And sharing that information between maintenance and operations means repairs are anticipated and production schedules are adjusted accordingly. The plant recognizes increased availability and performance from production assets, rather than expensive downtime and costly repairs.



Keep Things Simple

- IRD Mechanalysis
- Founded 1952, now part of Rockwell developed Vibration Based Predictive Maintenance Program on 3 philosophies (I added 4th)



Keep Things Simple

- Detection
 - Find if a problem exists
- Analysis
 - What is problem
- Correction
 - Correct problem, balance, align, etc
- Confirm problem corrected

PREDICTIVE MAINTENANCE



- Always document "Lost Opportunities" in your predictive maintenance program. "Lost Opportunities" occur when equipment goes down due to an unpredicted failure.



DATA COLLECTION

- Sometimes the simplest things are overlooked. When taking vibration data, remember to always prepare the surface of your machinery before mounting the accelerometer.



REPORTING

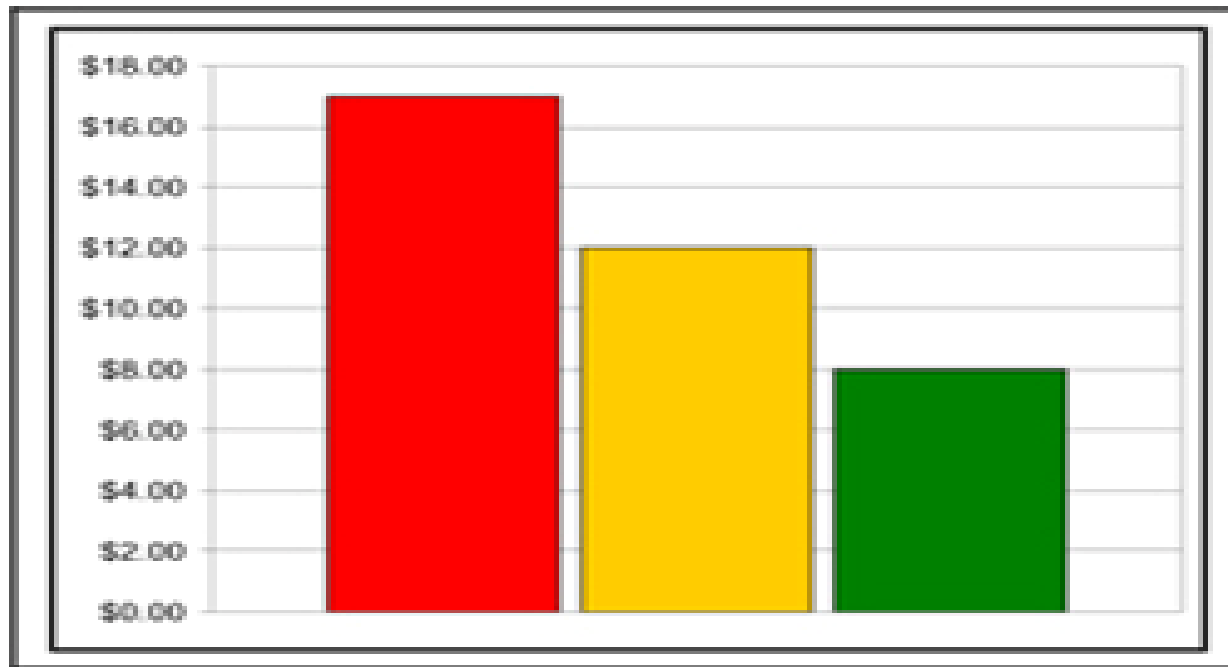
- To help justify your vibration analysis program, try providing your machinery's health in a report.
- Often, you think management only wants to see the bad equipment, but one of the major benefits is showing a problem in its infancy, before the failure.



Easy to Justify Cost (?)

- **It's easy to justify the cost!**
- Reactive Maintenance costs
\$17/horsepower/year
- Preventive Maintenance costs
\$12/horsepower/year
- Predictive Maintenance costs
\$8/horsepower/year

Easy to Justify Cost (?)





Approaching Management

- Maintenance Managers have to Present Business Case to Upper Management
- A financial analysis or ROI study is imperative
- Identify all costs associated with all maintenance functions



Approaching Management

- PdM Manager must be able to demonstrate an increase in uptime/availability due to vibration program



Approaching Management

- **Approaching Management**
 - **This cannot be emphasized enough**
- **Talk in terms on dollars**



Financial impact

- It is vital for those responsible for the vibration monitoring and analysis program to establish a financial process that adequately shows senior management the impact the vibration program is having on the company's profits.

Financial Impact

- A good monitoring system has the potential to save an organization considerable money as well as optimize equipment operation



Financial Impact

- A company in the chemical industry reduced its maintenance expenditures from \$9 million to \$7 million and has maintained expenditures at \$7 million for the past two years by instituting a vibration and inspection program. (Design Maintenance Systems Inc.)



Financial Impact

- Imperative to determine dollar value of machine downtime
- These records can be obtained from Manufacturing. Just ask

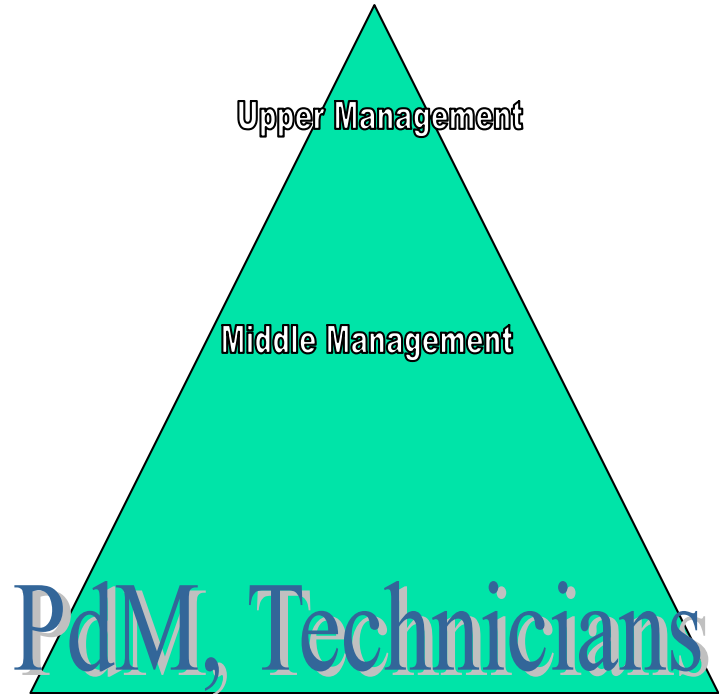


Financial Impact

- All costs incurred if the potential mechanical failure was not detected by the PPM program should be recorded and kept in a file.
- This is your justification



Food Chain





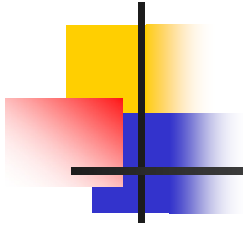
Food Chain

- PdM, Technicians
 - Think in terms of things
 - Bearing failed – Upper manager may think in line of kids skateboard (\$ 10.00)
- Middle Management
 - Worried about day to day
- Upper Management
 - Think in \$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$



Keep Trophies

- Take pictures of failures.
- Next time, when you prevent failure, include picture with report.
- Old Chinese axiom
 - Pictures speak louder than words



Keep Trophies





Program Running

- Most programs start with Data Collector.
- Detection
- Analysis
- Correction
- Confirmation

Program Running

- After a few years, problems begin
- Have to justify program all over again
- It is a constant battle



Program Running

- As the program grows and becomes more efficient and polished, the mechanical failure downtime decreases. Although this is one of the main objectives of a predictive maintenance program, the actual road to this objective and the actual dollar savings become somewhat gray and may even be lost.



Program Running

- PPM justification and payback measurement techniques should receive the same priority as computer and software selections do when a PPM program is being developed.
- Cannot be taken for Granted
 - Real financial impact is not clear



Program Running

- The dollar savings information produced by keeping accurate records in this area will not only support the much needed PPM department but will also provide a basis from which new instrument and equipment purchases can be justified.



Long Term

- A digital signal analyzer (DSA) is a much-needed tool for the PPM department but is costly and difficult to justify without concrete evidence and paybacks.



Long Term

- The ability to record 10 min of vibration data and play it back through a DSA with the capability to manipulate many parameters is invaluable to the technician.
- Can only purchase this type with proper justification



Sample Justification Worksheet

- **Direct Machinery Costs**
 - **Labor**
 - Regular Labor for Unscheduled Repairs
_____ Hr. x _____ \$/Hr. = \$ _____
 - Overtime Labor for Unscheduled Repairs
_____ Hr. x _____ \$/Hr. = \$ _____
 - Regular Labor for Avoidable Repairs
_____ Hr. x _____ \$/Hr. = \$ _____
 - Overtime Labor for Avoidable Repairs
_____ Hr. x _____ \$/Hr. = \$ _____
 - Total Labor Costs (1) \$ _____
 - **Parts and Materials**
 - Good Parts Replaced \$ _____
 - Premium Cost Parts \$ _____
 - Replacement Machinery \$ _____
 - Total Parts and Materials (2) \$ _____
 - Total Direct Costs Labor/Parts and Materials (1 + 2) \$ _____



Sample Justification Worksheet

- **Indirect Costs**

- Lost Production
_____ Hr. x _____ \$/Hr. = \$ _____
- Outside Repair Services \$ _____
- Excessive Parts Inventory \$ _____
- Cost to Maintain Standby Equipment \$ _____
- Excessive Insurance Costs \$ _____
- Out of Specification/ Scrap Material \$ _____

- Total Indirect Costs \$ _____

**Total Potential Cost Reduction Direct +
Indirect Costs \$ _____**



Sample Justification Worksheet

- **PM Program Costs**
 - PM Program Survey \$ _____
 - Initial Setup and Baseline \$ _____
 - Scheduled Data Collection
____ Visits/Yr. x _____ \$/Visit = \$ _____
- Total PM Program Costs for One Year \$ _____
- **Summary**
 - Total Direct and Indirect Costs (From Above) \$ _____
 - Machinery Maintenance @ 35% of Total Potential Reduction (Line 1 x 0.35) \$ _____
 - Savings generated by 50% Reduction of Machinery Maintenance (Line 2 x 0.50) \$ _____
 - STI PM Program Costs (From Above) \$ _____
 - Annual Savings (Line 3 - Line 4) \$ _____
 - **PAYBACK**
(Line 4 / Line 3) Years _____



Summary

- Vibration Based PdM programs do work and have been effective for over 50 years
- Hard part is not running the program, but keeping the program justified