Improvement of Total Reliability and Maintenance Productivity

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PIMA 2006 International Leadership Conference

Disclaimer

- Currently work for IBM
  - Enterprise Asset Management Practice
- I have been asked to perform at IBM what I performed/led at SP Newsprint.
- This presentation is about what was done at the SP Newberg mill, not a sales pitch for IBM.
- I personally put a lot of effort into Newberg, and am proud of the accomplishments there.

SP Newsprint – Newberg, Oregon

- **Newberg Mill – details**
- **Maintenance Cultural Background**
- **A Future Maintenance "Business" Vision**
- **"Modernization" Strategy**
- **MMP Implementation**
- **Culture change**
- **Results – To-date**
- **Challenges Ahead**

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SP Newsprint - Newberg, Oregon

- Power & Utilities Department
  - Hog Fuel Boiler
  - (2) Natural Gas Turbine Generator/HRSG units
  - (2) Steam Turbine Generators
- Thermo-mechanical Pulp (TMP) Mill
  - 5 separate thermo-mechanical refiner lines
- Old Newsprint (ONP) De-Ink Pulp Mill
  - Drum pulper, 2nd generation flotation cells
- Paper Mill
  - (1) Voith & (1) Beloit

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Maintenance Cultural Background

- Average age of Maintenance Crew is 53.
- In 2002, Maintenance headcount @ 99
- In 2004, Maintenance headcount @ 74
  - Retirements, early retirement incentives & layoffs.
- Between 2002 & 2004, nothing systemically changed to compensate for 25 craftsperson reduction.
- Essentially a reactive environment with “area craftsperson” coverage.
  - Mostly answered to area Operations for daily work and breakdown needs.
  - Area craftsperson established ownership of the area, knew the areas, knew the operations personnel, knew the equipment.
  - No structure to daily work, planning done by craftsperson.

Maintenance Cultural Background (cont.)

- Newberg #5PM is 2005 reigning World's Most Efficient Newsprint Paper Machine
  - Held title 4 of the last 5 years
- Extremely strong craftsperson skills – in 2004 all but 2 of the maintenance crew completed 2½ year multi-craft training.
  - Electricians ⇨ Instrumentation (60%)
  - Millwrights ⇨ Pipefitters (60%)
  - Pipefitters ⇨ Millwrights (60%)
  - Instrumentation was required to attend Oregon Electrical Licensing apprenticeship school to receive industrial electrician license (still in progress).

Maintenance Cultural Background (cont.)

- Very little direction & leadership in Maintenance Management.
  - Essentially Operations gave maintenance direction through their needs – typically same day.
- Operations wanted “Maintenance to run maintenance”.
- Lack of mill-wide maintenance prioritization & scheduling processes
  - Operations who “squeaked” loudest won out.

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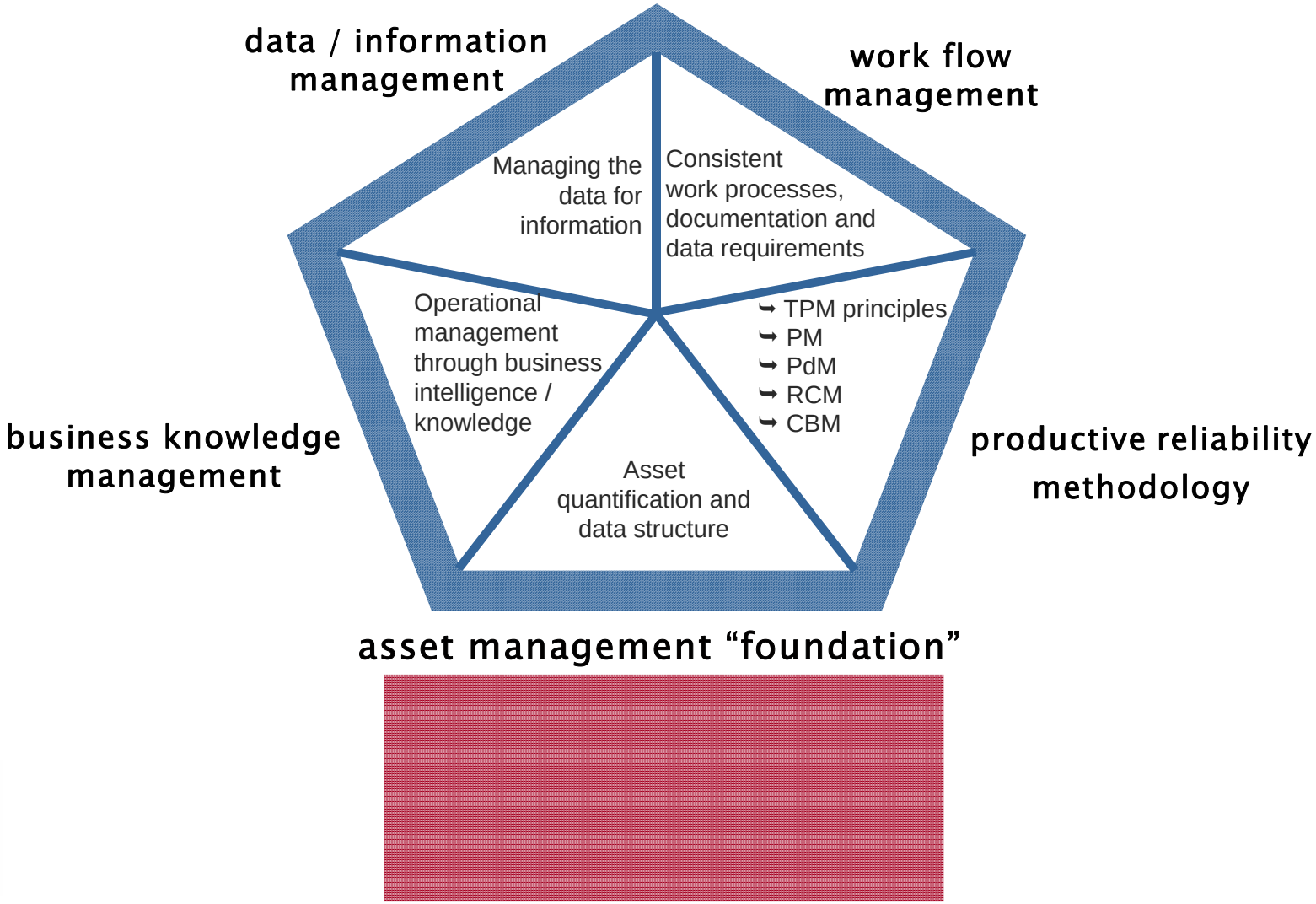
Problem

- Equipment in the mill are a core “owned-commodities”, but any lack of qualitative and / or quantitative maintenance makes total cost of ownership difficult to realize.
  - Outside of the return on investment through production with a given piece of equipment, the cost of business is making “depreciation only” of assets uneconomical and uncompetitive.
  - Given equipment needs the fortitude, capability and chance to prolong its useful life – the mill needed the chance, capability and fortitude to make intelligence-based business decisions about the equipment.
  - Equipment performance instability exponentially increases total cost of operation.
  - Reliability may be a priority, but the possible return on asset management is not maximized.

A Future Vision: Knowledge-Based Asset Management



What Is K-BAM

- **K-BAM is a systemic approach to asset management, integrating the five core elements of a closed-loop system:**
  1. Asset Foundation
  2. Productive Reliability Management
  3. Work Flow Management
  4. Data / Information Management
  5. Business Knowledge Management
- **All elements of the traditional Maintenance & Reliability best practices can be found in K-BAM, but this systemic approach enables and keeps focus on the elements where *Return on Asset Management* is truly found - *Data / Information Management* and *Business Knowledge Management*.**

Knowledge-Based Asset Management Business Objective

- Delivery of knowledge-based asset management principles on assets to manage cost, reliability, and capital investment requirements

"Technology is not the biggest challenge anymore. The challenge is to use the information in an intelligent way."

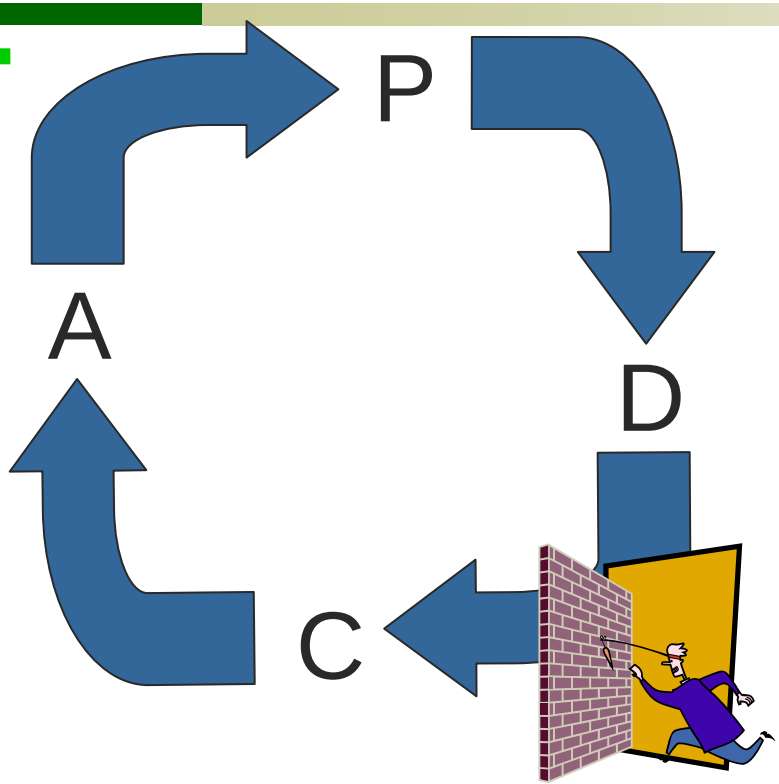
Koen Vermeulen

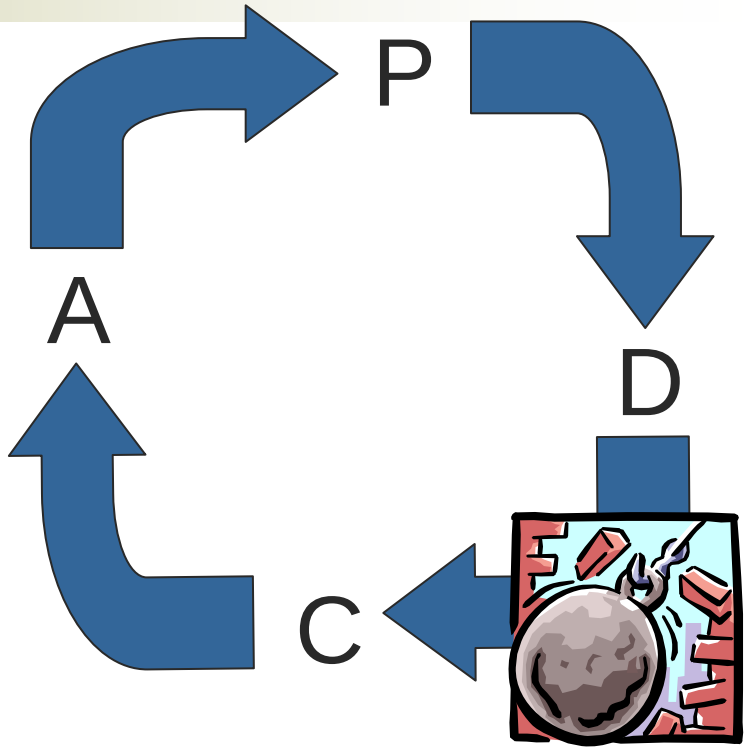
Director, IT Business Analysis

Belgacom

Knowledge-based asset management…

…brings the value of p-d-c-a to life

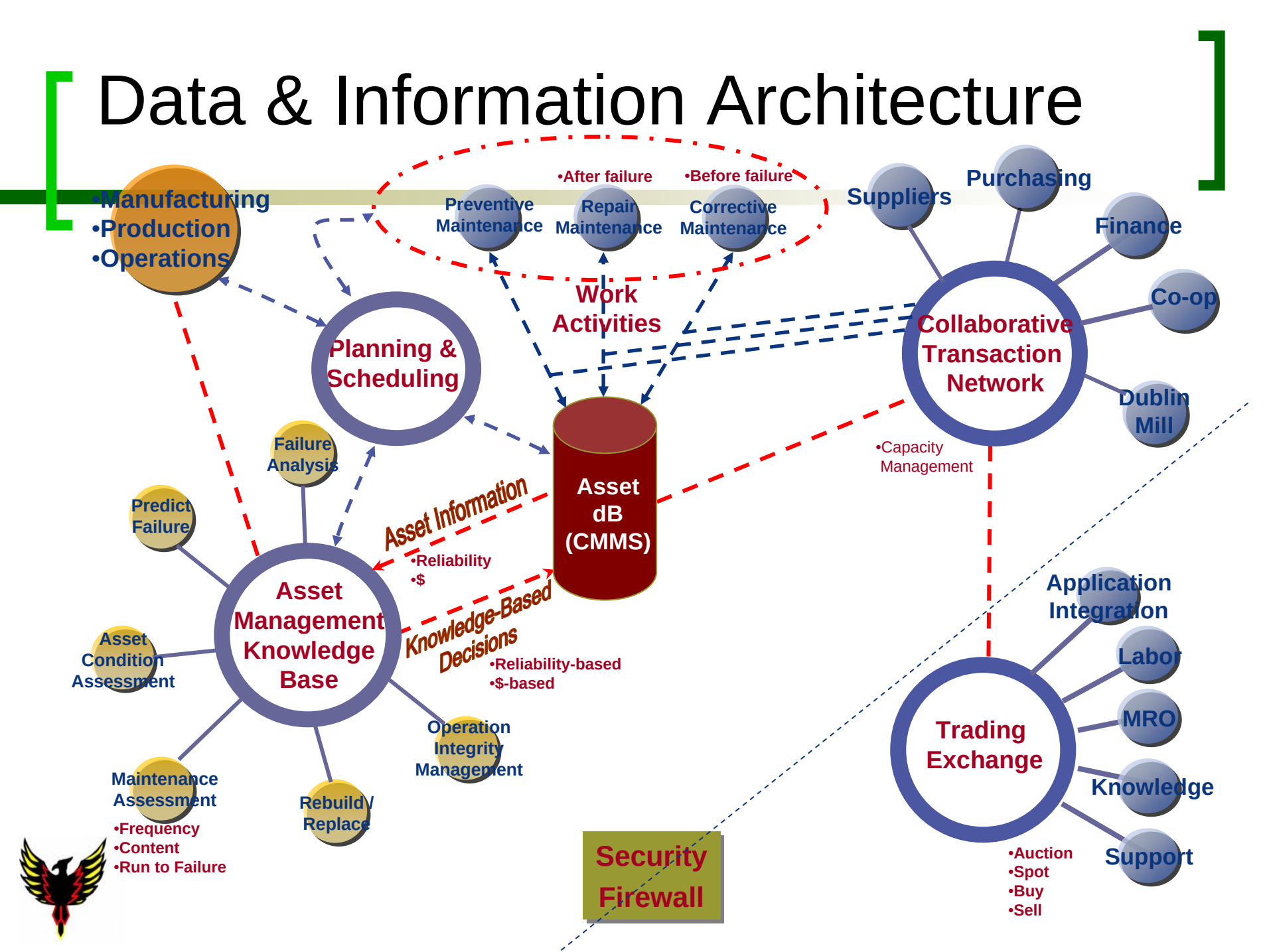




Many asset management programs have barriers to using their asset data – data integrity & data collection efficiency – directly proportional to asset foundation efforts

Knowledge-based asset management breaks down those barriers by enabling and thus expecting the transfer of asset data to business knowledge

Data & Information Architecture



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Modernization Strategy

- Maintenance "improvement"???
  - NO!!!
  - With a mature workforce & most efficient paper machine???
- Modernization: the act of modernizing; being modernized
- Modernize: involving recent techniques, methods, or ideas - up-to-date
- Establishment of the Maintenance Modernization Project (MMP)
  - a.k.a. the "Phoenix Project"

2005 SP NEWSPRINT CO. NEWBERG MAINTENANCE EFFECTIVENESS IMPROVEMENT

Prepared By:	Tom Woginrich	Site:	Newberg	Department:	Maintenance
Revision:	Rev. *3.2* / May 2005			Date:	*5/11/2005*

Situation: The SP Newsprint Newberg, Oregon Pulp & Paper Mill is a seasoned plant with the World's Most Efficient Newsprint Paper Machine (#5 PM*), and* recent investments in power *generation make* it a mill with literally dynamic potential. The primary outside dependencies for mill operations are natural gas (gas turbine generators), wood chips (TMP) and ONP (De-Ink). The Newberg *Mill is positioned* to offer SP Newsprint Co. revenue from several different facets of its operation (electrical power sales, sludge by-product sales and newsprint paper). In turn, these unique *features require* flexibility and dynamic asset management principles from the Maintenance Department. *However, due to the lack of effective maintenance management systems, a dynamic, proactive maintenance approach OR demonstrated focus towards maintenance/asset management principles have been missing*. In fact, the prevalent nature of Maintenance work at Newberg is centralized around reactive, breakdown and unscheduled failure repairs. As a direct result of this environment, maintenance ***and*** spare parts are affected detrimentally. Inconsistent communication with the Storeroom and lack of understanding of Maintenance activities and direction has made for a large gap between the two and has *created* an adversarial relationship. *Due to a* very recent reduction in maintenance headcount, the department morale is less than positive, but still the craftsmen want to deliver quality work. The *lack of systemic maintenance direction and leadership in recent time* has led to Operations Departments taking more of a lead in maintenance activities in their areas. As a result, break-in work has been the norm, and at the discretion of the Operating Department. Indicators of the current situation include:

- More than 97% of current maintenance work is non-documented, non-PM.
- Highly experienced maintenance crew; however, carnal knowledge is also high.
- Maintenance has not been recognized for the positive contributions to all Operations Departments.
- Operations have not been accountable to impact on Maintenance schedules.
- The Maintenance OSHA Recordable Safety rate is @ 16%.
- Maintenance does not effectively influence maintenance shutdown plans.
- Operations is resistant to a cultural shift towards planned/scheduled maintenance.
- The Storeroom does not have all spare parts quantified, numbered or inventoried*, and shipping/ receiving processes are minimal and mostly not documented*
- Lack of consistent key maintenance business processes (equipment management, work flow management, inventory management, etc.)
- *Maintenance Management software lacks capability for real time tie of work orders to parts, purchase orders or work schedules; limitations also with equipment & preventive maint.*
- Planning & scheduling maintenance work is extremely limited.
- A critical spare parts strategy has not been developed to substantiate and streamline inventory requirements.
- Tensions exist between Maintenance and Operations; a true teamwork concept is not currently embraced
- Operations use Maintenance as a "knee-jerk" trouble-shooting support mechanism.
- System or equipment failure mode analysis processes do not exist or are not consistently utilized to improve reliability*; instead "who" to blame is existing culture for all involved*
- Business measures have not been established or implemented with knowledge-based intent.
- Demands placed on Maintenance during weekend coverages exceeds manning (beginning Friday morning) – lack of proper prioritization.

OBJECTIVE

- ***Increase overall mill-wide Reliability***
- ***Maintain & increase Uptime mill-wide***
- **Maintenance Safety rate in 1st quartile.**
- **Newberg Maintenance recognized for quality work in Maintenance Technology Magazine.**

TARGET / GOALS

- ⇒ *$1.0 million annualized increase in profitability through reduction of unplanned downtime*
- ⇒ *25% reduction in stocked spare parts (inventory)*

NO.	STRATEGY	PERFORMANCE MEASURES
1.0	Shift the Newberg mill culture from reactive & breakdown maintenance to planned, scheduled & prioritized maintenance	• Period-end reviews include updates • Bi-weekly reviews in Steering Team • Maintenance "change" named/identified
1.1	Evaluate Maintenance performance & value	• *Maintenance metrics (measures)* established • Metric data calculations *and source data id'd* • *Current Best Practices (CBP) assessment*
1.2	Establish an infrastructure for Maintenance work flow, planning\scheduling and resource management	• Planning/Scheduling training initiated • A common work flow process established • Maint. Coord. in place for all Ops. Depts.
1.3	Establish methods for equipment life-cycle management	• Equip. #'ing *field verified & dB updated* • Equip. RCFA process established • *Engineering for maintainability/reliability*
1.4	Develop and implement storeroom/inventory practices for equipment spare parts management	• Storeroom best practices gap assessment • All non-stock items entered into CMMS • "Valid" storeroom locations identified
1.5	Implement Computerized Maintenance Management System (CMMS) based on Strategies 1.0 through 1.4.	• CMMS purchased for Newberg • CMMS Team established (Crew & Staff) • Work Order & Inventory implemented
1.6	Develop and implement *an Essential Care / Condition Monitoring program (Preventive Maint.)*	• *All equipment evaluated for PM needs* • *Measuring compliance to PM schedules* • *Define & document autonomous maint. roles*

Core Modernization Strategies

1. Shift the Newberg mill culture from reactive & breakdown maintenance to planned, scheduled & prioritized maintenance.
2. Evaluate maintenance performance & value.
3. Establish an infrastructure for Maintenance work flow, planning & scheduling, and resource management.
4. Establish methods for equipment life-cycle management
5. Develop and implement storeroom/inventory practices for equipment spare parts management.
6. Develop and implement an Essential Care/Condition Monitoring & Preventive Maintenance program.
7. Implement Computerized Maintenance Management System (CMMS) based on all core strategies (MAXIMO).

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Successful Executive Sponsorship

- Executive VP of Operations stood firmly as project Executive Sponsor.
- CEO fully supported (financially & verbally) and appreciated magnitude of change at hand.
- Established expectations of project "players".
- "More Meddler Management" Change Syndrome
  - As a result of the executive sponsorship, this project **AVOIDS** the Middle Management struggle many Maintenance Managers face (or any change agent for that matter).

Maintenance Modernization Project (MMP) Benefits

- Improve Productivity through a reduction in Unplanned Downtime.
- Reduce Newberg Cost of Goods Manufactured.
- Profitability Improvement for Newberg.
- Annual Value in excess of $1.1MM/year
  - IRR = 44%
  - Payback = 2.74 years
  - NPV = $720,000

MMP Annual Reliability Benefits

- #5PM Uptime = $80k
- #6PM Uptime = $280k
- #10 Hog Fuel Boiler uptime increase = $90k
- DI tpd increase = $40k
- Subtotal Reliability = $490k

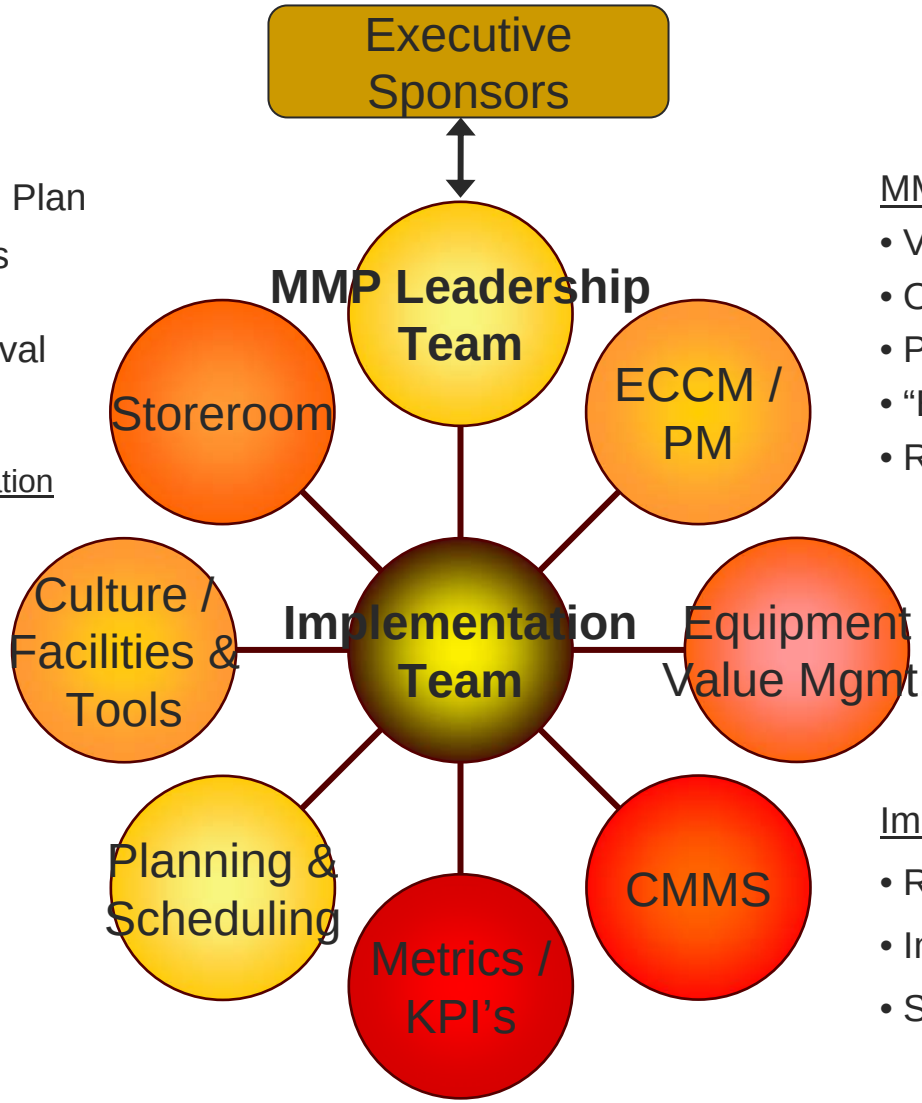
MMP Annual $ Reduction Benefits

- Reduce Maintenance Overtime = $200k
- Maintenance Attrition by 2 = $200k
- Reduce onsite contractor hours = $130k
- Reduce outside contractor hours = $100k
- Subtotal Cost Reduction = $630k or 6 FTE

MMP Scope

- CMMS Hardware & Software
- CMMS Implementation
- Maintenance Process Consultant - IDCON
- Additional SP Staffing
- Training
- Total = $1,250k
- Internal Staffing Demand = $1,150k
- Total Project Cost = $2,400k / 12 FTE

Maintenance Modernization Project Implementation Structure



Executive Sponsors

- Supports Project Action Plan
- Monthly project progress reviews
- External resource approval

Implementation Team Representation

- (Culture, HR)
- (Storeroom, hourly)
- (Maintenance, hourly)
- (Operations Mgmt.)
- (CMMS System Administrator)
- (IT)
- (IDCON)
- (Project Manager)

MMP Leadership Team

- Vision
- Objectives
- Principles
- "Barrier-busters"
- Resource commitment

Implementation Team

- Recommend major decisions
- Implementation Plan
- Status update to Plan

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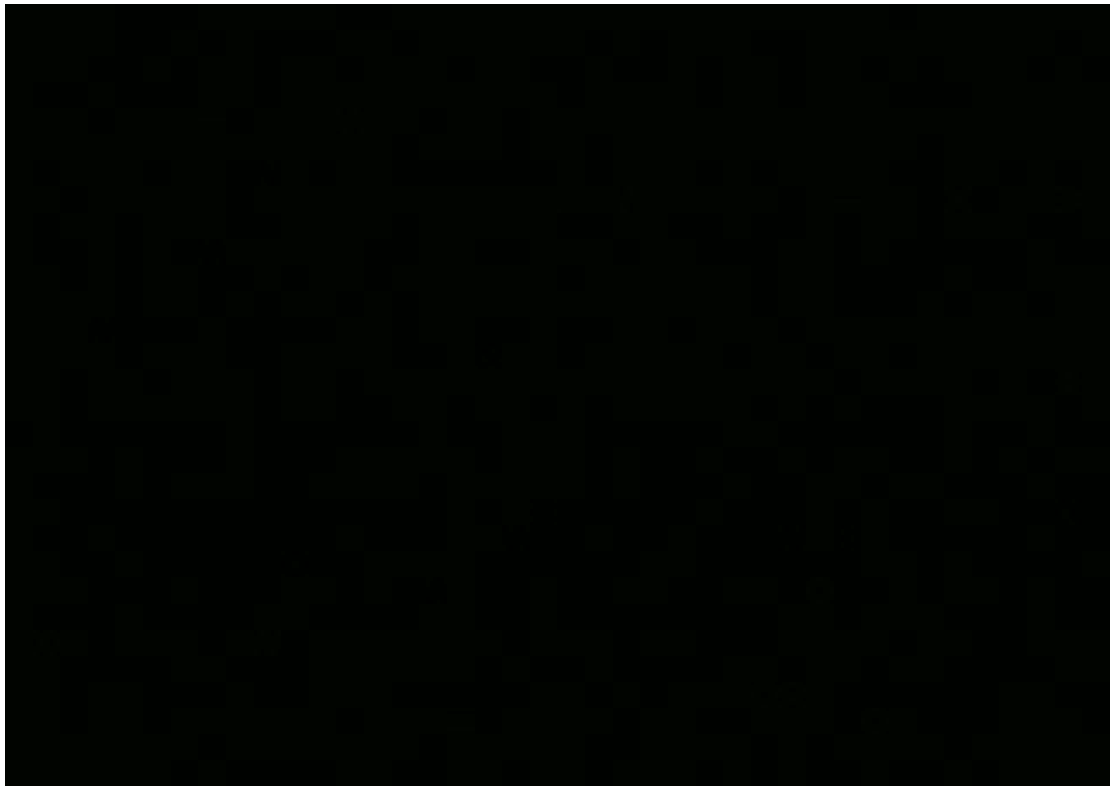
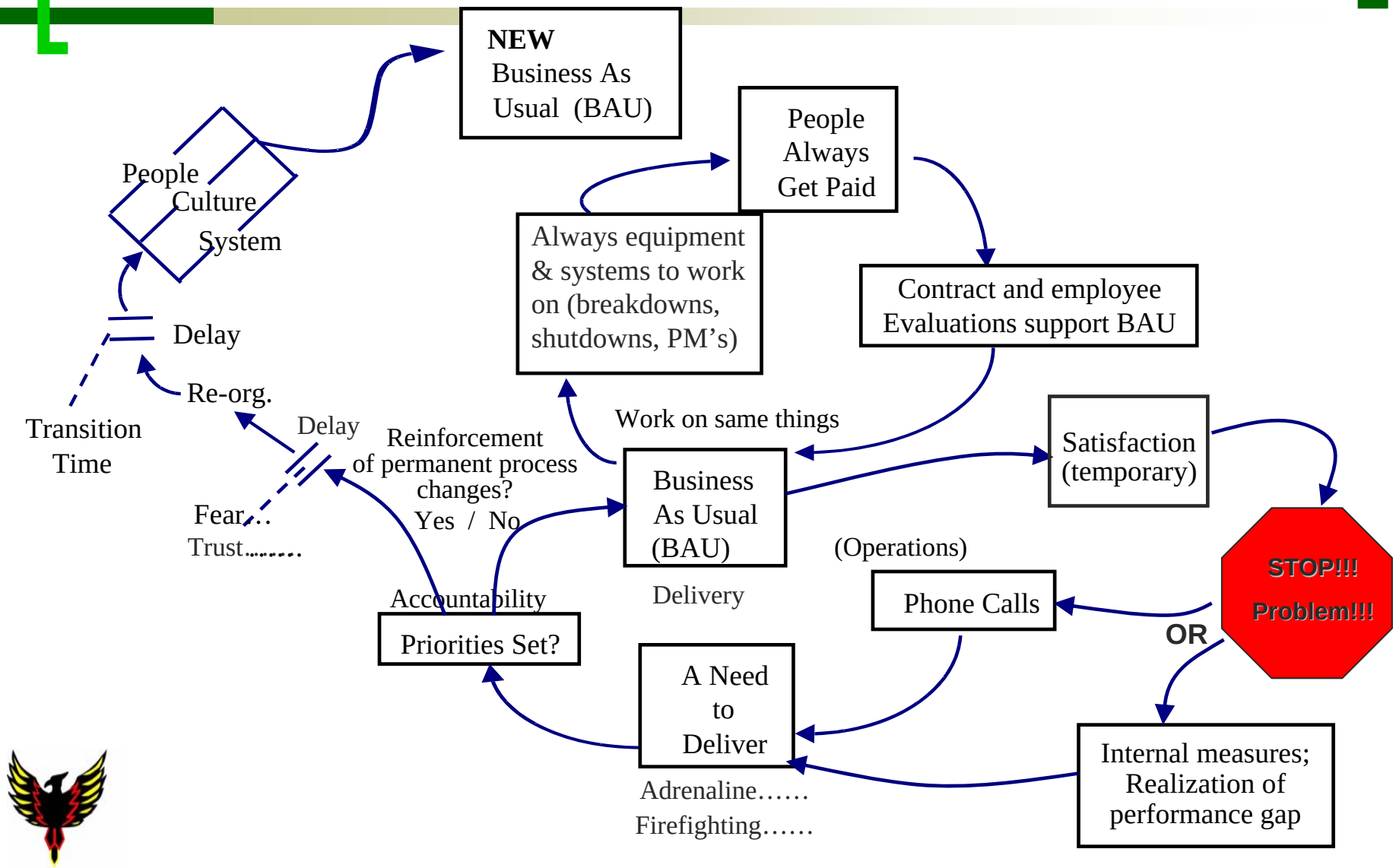
Culture Change is Not a Sprint … However …



Change In-Action or Change Inaction?



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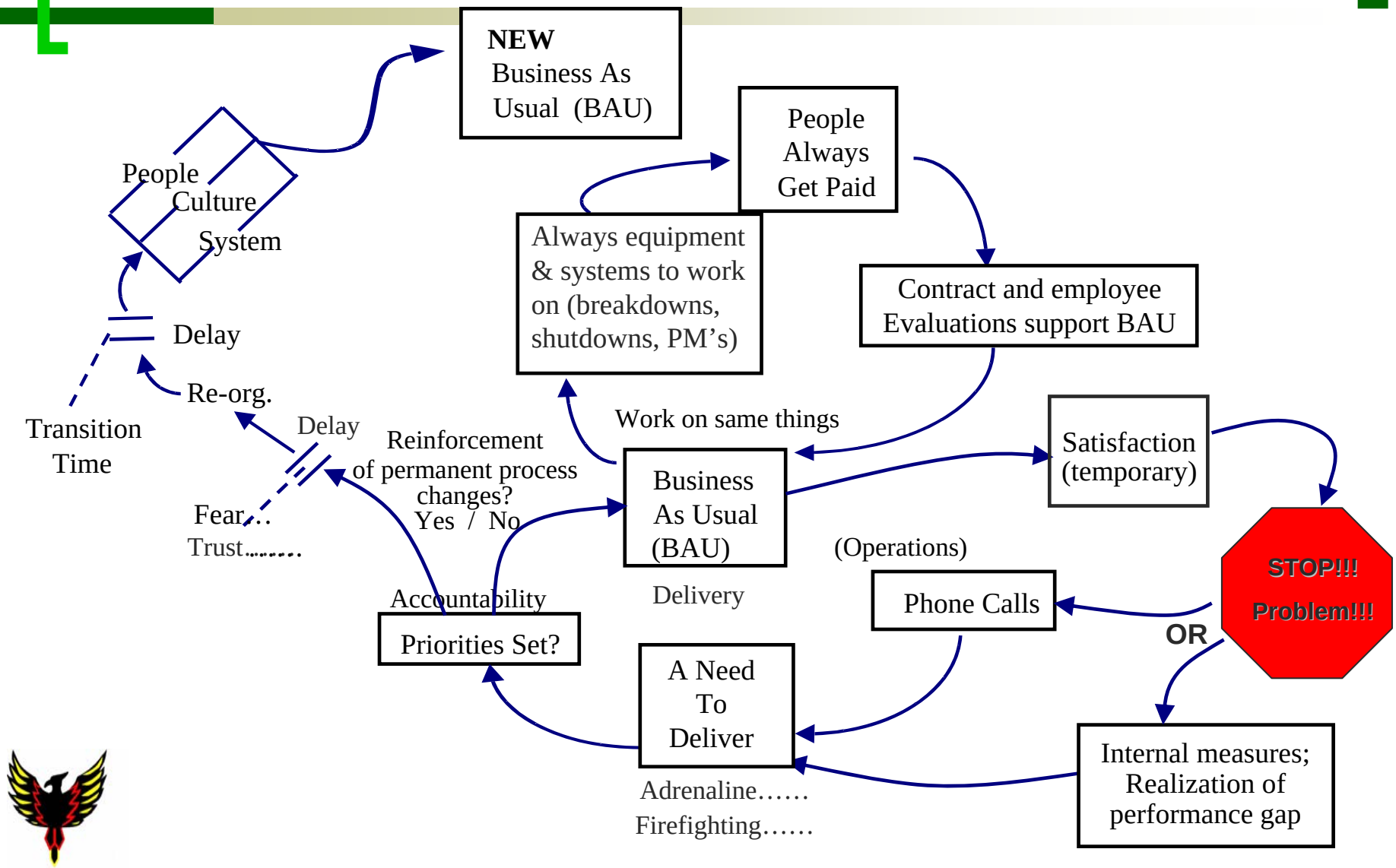

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Maintenance Work Flow Priority

	Priority One (1)	Priority Two (2)	Priority Three (3)	Priority Four (4)
Class	***Emergency*** Work Order	***Urgent*** Planned Work Order	***Regular*** Planned & Scheduled Work Order	***Project / Improvements*** Planned & Scheduled Work Order
Criteria	Significant equipment damage requiring immediate repair/attention, mill outage, machine/process interruption, immediate life/safety or environmental issues	Machine / Process "slow-down", Time critical request (within days), urgent equipment repair impacting production within 7 days, direct customer feedback issues, safety or environmental requests	Preventive Maintenance (PM), equipment repair within 30 days, predictive maintenance (PdM), Lubrication notifications, repair of redundancy, safety or environmental planning, PM findings follow-up work	Requires Engineering, is a modification of existing equipment/system, is an upgrade to existing equipment/system, low impact asset preservation work, facilities/buildings work, follow-up work for temporary repairs
Response Maintenance acknowledges work request & begins "work order" approval process and planning.	15 minutes Maintenance called/notified by Production. Call is acknowledged by Shift Craftsman or Maintenance Supervisor	Same day Maintenance called/notified by Production. Call is acknowledged by Shift Craftsman or Maintenance Supervisor	7 days Maintenance receives work request. Acknowledgement is completed by Maintenance Supervisor or Planner. Work planning/scheduling begins	14 Days Maintenance receives work request. Acknowledgement is completed by the Maintenance Supervisor or Planner. Work planning/scheduling begins.
Communicate Maintenance notifies requestor or designated others	1 hour	Next day	Weekly Update	Monthly Update
Completion Maintenance closes WO.	Process Operation Restored	7 Days	30 Days	120 Days

Equipment Criticality Ranking Matrix

	No Impact	Slight	Moderate	Heavy	Severe
Severity	Failure is of such a minor nature that system performance is not compromised. No safety hazards as a result of failure Business Loss – No impact Maintenance Cost - <$1,000 1 – 5	Failure may result in a slight system interruption. Equipment backup is available and will automatically come on line with only a slight system upset. No safety hazards as a result of failure - Loss of redundancy may require notification to customers. Business Loss - <$5,000 Maintenance Cost - $1,000 to $10,000 5 - 10	Failure may compromise safety to personnel, code requirement, or environmental contamination. Backup systems or mitigation available, but must be manually initiated. - 1 to 8 hrs max downtime or out of spec - Entire mill down up to 2 hours Business Loss - $5,000 to $50,000 Maintenance Cost - $10,000 to $20,000 10 -15	Failure will compromise safety to personnel, code requirement, or environmental contamination. Mitigation may be possible, but is not documented or knowledge resides with a single individual - 8 to 24 hours of Paper Machine downtime/out of spec grade - Immediate safety risk can be mitigated - Entire mill down 2 to 8 hours Business Loss - $50,000 to $100,000 Maintenance Cost - $20,000 to $50,000 15 – 19	Failure will result in Death or Injury, Severe Code violation, Severe impact to Production or Severe Environmental contamination. There is no known backup or mitigation. - 24 hours or more of Paper Machine downtime/out of spec grade - Newspaper reportable - Entire mill down beyond 8 hours Business Loss - >$100,000 Maintenance Cost - >$50,000 20 – 25
	Remote	Low	Moderate	High	Very High
Occurrence	Remote possibility of equipment failures. Failures in similar applications have been non-existent. - No known failures in running life of equipment over approximately 5 years 1	Low failure rate. Equipment failures rare and infrequent - Failure every 2 to 5 years 2-3	Moderate rate of equipment failure - Failure every 1- 2 years 4 – 6	High rate of equipment failure. Equipment has known failure and are somewhat expected - Failure every year or less - Seasonal factors may cause yearly failures 7-9	Very high rate of failure. Failure is a near absolute certainty. - Constant attention required to keep on-line - Failures have occurred in “Batches” 10 – 12
	Very High	High	Moderate	Low	No Detection
Detection	Very High probability that a defect leading a failure will be detected - Predictive Data Collected - QMS Level II - Notification of impacts 1 - 2	High probability that a defect leading a failure will be detected. - QMS Level I - All PM’s Defined and performed 3 – 4	Moderate probability that a defect leading a failure will be detected. - Critical PM’s defined and performed - Local Monitoring - Rounds Required 5 - 7	Low probability that a defect leading a failure will be detected. - No Monitoring - Visible inspect required - Rounds by Security 8 - 9	Sudden failure. No detection or warning. - Equipment inaccessible - No Rounds - No monitoring 10 – 11

Key Performance Indicators

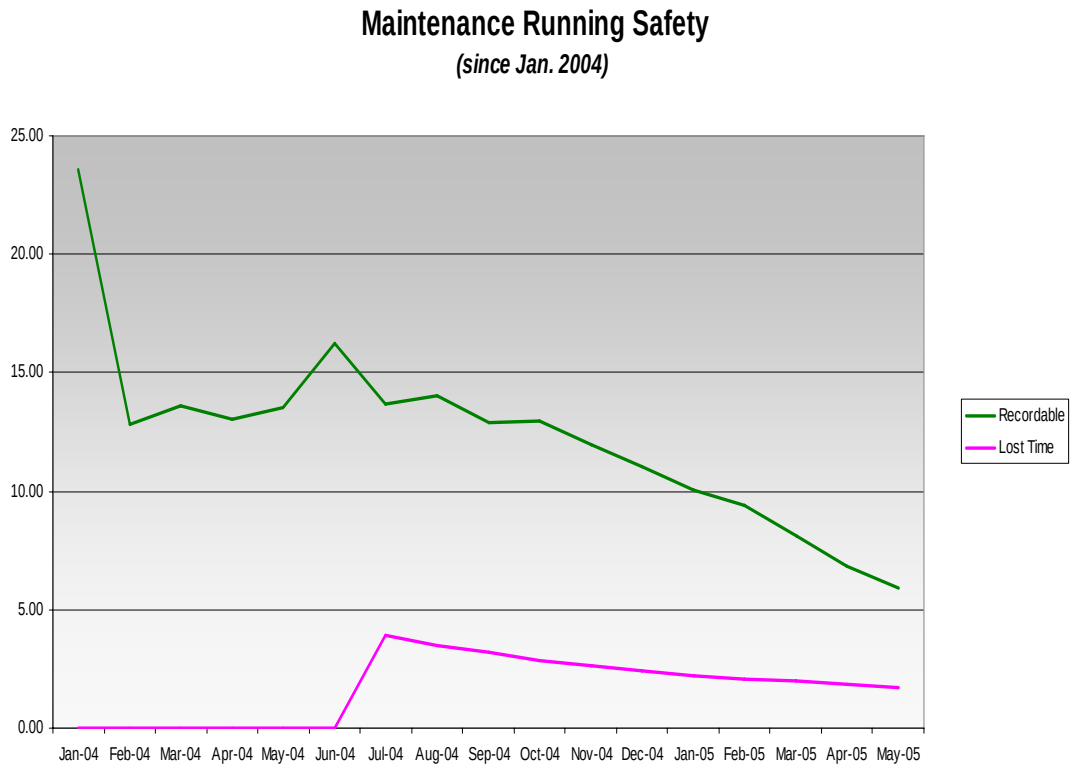
- Double baseline CBP score (as measured by IDCON)
- 98%+ of all Critical Parts in Inventory or Inventory-controlled consignment
- Critical Spares Storeroom availability @ 98%+
- Storeroom Overall Inventory Record Accuracy of 95%+
- Planned and Scheduled Work of 80%+ of Total Work
- Weekly Schedule Completion Compliance of 85%+ (within service level agreements)
- Preventative Maintenance Completion Compliance of 90%+
- Craftsman Time Scheduled vs Total Hours Worked of 90%+
- Craftsman work order feedback of 80%+ for all work orders completed
- Operator Inspection Schedule Compliance of 85%+
- Break-in Work less than 10%
- Root-Cause Problem Analysis (RCPA) solution follow-up of 85%+
- Maximo Work Order Usage equal to 100% (no non-Maximo work orders)

Newberg 3 to 5 Year Vision

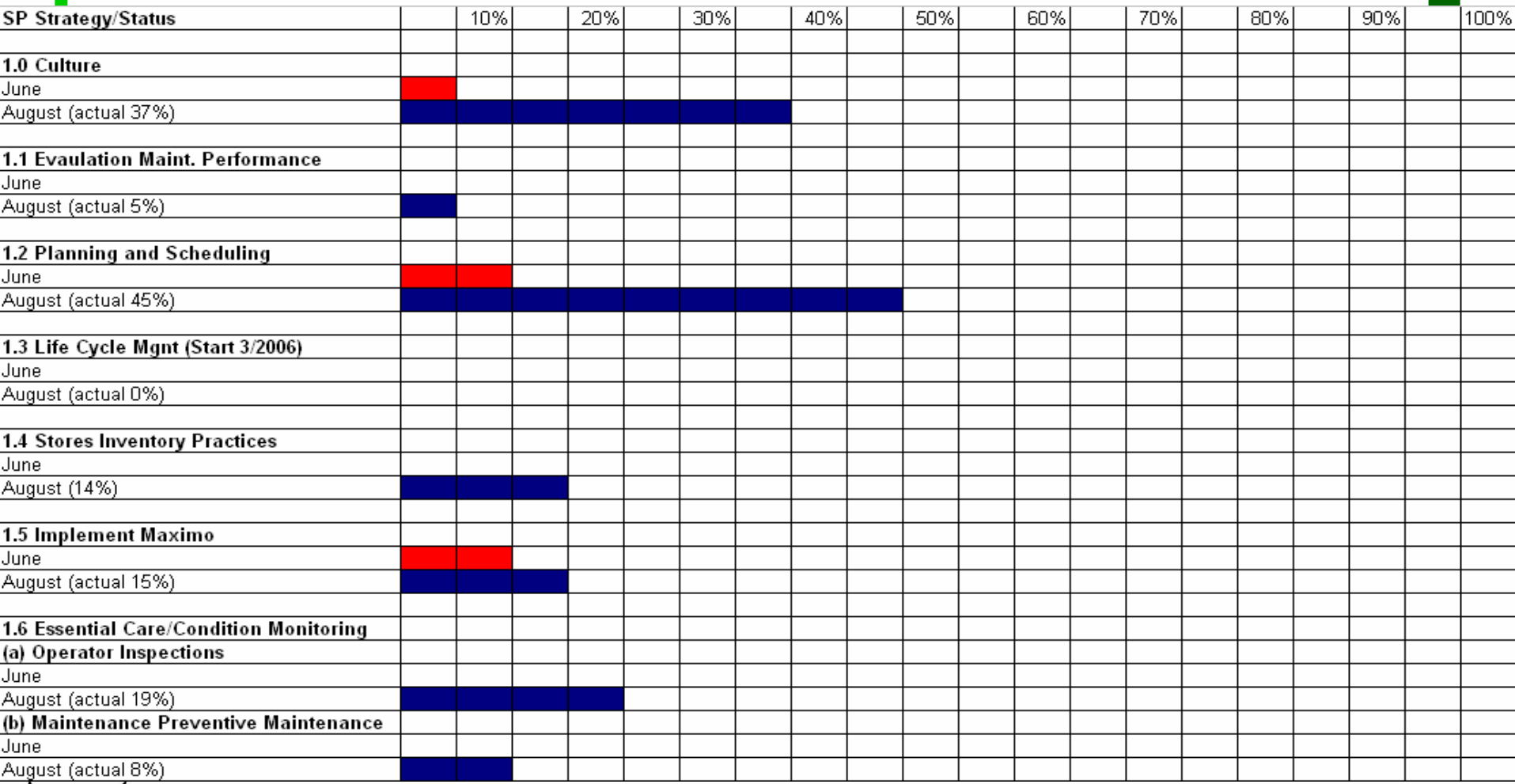
A responsive, flexible, and most importantly, a proactive Operations and Maintenance Partnership dedicated to proven world-class maintenance performance in the areas of safety, equipment reliability, planning, manpower productivity, and cost-effectiveness. Leadership will inspire and empower employees with the confidence, courage, and camaraderie to successfully achieve a profitable and financially secure future for our mill. Independent audits will show our achievement of this vision by a Current Best Practices (CBP) score of 80+.

Safety Results

- Set new Maintenance Department longevity Safety records – Recordable Injuries & Lost Time Accidents
  - Lost Time Accidents > 500 days and still going



Project Completion Progress



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Challenges Ahead

- You can take the fire fighter away, but it is difficult to take out the "fire fightin'" spirit.
- Current energy crises
  - Do not panic…do not overreact
  - Continue planning & scheduling work – do not give in to impulse to throw resources at work unless other alternatives have been ruled out.
    - Break-in work will continue to be measured & monitored.
- Continue to E-X-E-C-U-T-E!!
  - Push through the innate "delays" of change.

Things Aren’t Always How They Seem

THANK YOU!
QUESTIONS??