Fleet Maintenance from the Operational Perspective

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1. Introduction

Fleet management in the 21st century is becoming increasingly more challenging with regulatory and technological evolution. The definition of a well managed fleet can be much different from the operational and maintenance perspectives. Fleet operators are often frustrated when maintenance goals appear to be at odds with the needs of operations.

Fleet operators of well managed fleets use key performance indicators (KPI’s) to identify problems and fine tune their fleet operations. The primary metric for fleet operators is availability. When equipment is not operational, revenue cannot be generated or expenses paid. There are many other methods of measuring fleet operational performance, but most of the views are beyond the scope of this training. Two additional KPI’s which will be examined are maintainability and reliability. All three of the measurements are used by fleet maintenance managers who are sensitive to operational issues.

Typically, maintenance management information is written for people who are maintenance professionals. Many fleet operators are not familiar with the maintenance management tools used to measure fleet performance. Maintenance staff have skills which allow them to maintain equipment quickly while controlling excessive cost.

Fleet operational management becomes even more challenging when an organization does not have an in-house maintenance facility. Third party repairs mandate the dedication of company staff for maintenance management. This is necessary because third party maintenance providers are profit driven and may have priorities which do not include lifecycle cost reduction.

Repairs services performed by third party vendors rarely constitute fleet management.

Employees assigned by the fleet operator to manage third party maintenance rarely have strong maintenance management skills and need guidance to be successful. They essentially become a maintenance manager without the benefit of technical skills, training or a dedicated staff.

1 A fleet operator for this document is defined as an owner or an operations manager.
There are many different opinions regarding “Best Practices” in maintenance management. Two apparently conflicting views may both have value. Awareness of the basics and a plan to improve are the first steps in reducing the lifecycle costs. Return on investment is often a pleasant surprise.

The information contained in this document is designed to help the fleet operator to better understand the fleet maintenance view. The goals an enhanced working environment, reduced lifecycle costs and increased equipment availability.
2. Capital Asset Management

Fleet maintenance managers in well run organizations have a wealth of equipment operating knowledge which can save the fleet operator time and expense when used to specify new assets. Most maintenance managers are too highly tasked to have significant participation in the equipment acquisition process, but their cost and reliability information can reduce lifecycle costs.

2.1. Equipment Selection process

In all but the smallest fleets, most fleet maintenance managers do not have sufficient route knowledge to select equipment to match the business needs of the company. However maintenance variance reports which show abnormally high cost trends can be analysed to drive component specifications which will reduce failures and operating costs. For example, fuel consumption comparisons of power train configurations and other cost per mile/hour of operation on similar routes give verifiable data which is not just a sales estimate. The information can only be retrieved through use of a CMMS which is properly implemented and supported. The fleet maintenance staff must be trained to create and interpret reports.

These statements seem obvious, but as we progress through this document, it will be demonstrated that fleet operators need to:

1. Dedicate resources to build the infrastructure needed to create verifiable data.
2. Analyse operating cost data from the maintenance perspective.
3. Engage maintenance staff when making asset specification decisions.
3. Maintenance Management Basics

This section is designed to demonstrate some basic principles of fleet maintenance management. The tools which are used to measure and analyse fleet operations differ from those which are used to assess maintenance operations.

3.1. The Goals of Fleet Maintenance Management

The basic goals of Fleet maintenance management in priority are to:

- Manage risk
- Minimize asset lifecycle costs
- Minimize operational costs
- Maximize equipment availability

Risk management used to be a subconscious result of good maintenance management, but with the passing of legislation such as Bill C-45, it has become a significant part of everyday decision processes.

Notice that the order of importance of the last three goals is the reverse of operational needs. This is because the maintenance community trains their people to control costs first. This focus often causes conflict with operational groups who focus on revenue generation and third party repair facilities that are profit driven. *Note that operating cost per unit*² *meter reading is not mentioned.*

Arbitrarily reducing fleet spend³ is a common mistake made by decision makers in an attempt to mitigate equipment lifecycle costs. This approach only defers, and ultimately, increases costs. It creates a system which is not sustainable. The correct methods of reducing equipment operating costs are to:

a. Reduce utilization.
b. Reduce asset count (Individual unit utilization must remain constant).
c. Reduce average asset lifecycle (Average asset age)
d. Optimize asset specification.

---

² Mile, kilometer or hour for example.
³ Reducing capital and maintenance dollar spend, frequency of service, reducing quality of materials etc.
e. Improve maintenance processes.

Most fleet operators wish to grow their sales. If a company has over-reached their optimum sales mass due to logistical or other reasons, then a. and b. are practical options.

It becomes clear that the last three options, c., d. and e. are the only methods whereby a fleet operator can reduce costs without having a negative impact on availability, unless the ratio of spare vehicles is too high. Obviously, to action the beneficial methods, an organization must make an initial investment in order to realize the benefits of improved fleet maintenance management. As well, all participants from the shop floor to senior management must embrace the culture of change. Lastly, the prescribed changes must be resourced properly to ensure success.

The focus of this course will be to discuss the improvement in the fleet maintenance processes. Lifecycles and asset specifications will be considered when they affect maintenance optimization.

3.2. Repair Strategies

Fleets usually have three basic choices for maintenance and repairs:

- Perform repairs on site
- Outsource repairs to a third party
- A combination of both

Fleet operators should study the factors which affect shop efficiencies even when their repairs are fully outsourced. One of the best practices of modern fleet management is to create service level agreements with vendors. An element of the service level agreement with a service provider should be transparent information exchange regarding the performance of the vendor’s employees. Other factors which affect vendor performance such as customer specific parts should also be included. See the basic sample of a service level agreement in appendix XX.
3.3. The Cost of Availability

Equipment operating costs are composed of maintenance and repair expenses as well as the costs of maintaining availability. What is the cost of availability? When we look at the formula for availability and understand the concept we can calculate the cost.

Availability is explained in section 3.1.2. Increased asset availability is usually proportional to maintenance cost. Figure 2.1 is a typical graphical relationship of availability vs. cost over time, when a vehicle is placed out of service due to breakdown.

![Breakdown Maintenance Cost and Availability vs Time](image)

**Figure 3.1**
Fleet Maintenance from the Operational Perspective

From the graph we see that increasing availability also increases cost. The metrics are general, but the relationships equivalent. The cost of repair is not linear in relation to time. Each fleet operator must determine their optimum cost of availability. Some operators have limited opportunity to control their cost of availability due to low spare ratios and high advertised service standards.

Some other factors affecting maintenance and repair costs in general are:
- Shop efficiencies (labour)
- Materials costs
- Preventive maintenance program set-up
- Operator behaviour
- Warranty recovery
- Spare ratios

3.4. Maintenance Types
There are two basic maintenance types, corrective and preventive.

3.4.1. Corrective Maintenance (CM)
Corrective maintenance is also called reactive maintenance. This is the “run to fail” scenario. Some operators feel that it is an acceptable method of maximizing component lifecycles, but it is usually an indication of poor planning and results in reduced equipment availability, increased operating costs and added corporate risk. It is the most common type of maintenance in North America and should be avoided.

3.4.2. Preventive Maintenance (PM)
There are many types of preventive maintenance. Scheduled maintenance is commonly mislabelled as “Preventive Maintenance”. Many fleet operators believe that scheduled maintenance is the best method of maintenance cost control. In fact, scheduled maintenance is only a starting point for management of fleet maintenance and there are many more methods of reducing cost and maximizing equipment availability. This course will examine
three types of preventive maintenance which are relevant to commercial transport - Scheduled Maintenance, Predictive Maintenance and Reliability Centered Maintenance.

3.4.2.1. Scheduled Maintenance
Scheduled maintenance is simply defined as the servicing of equipment on a planned basis. The frequency of service is commonly based on chronological time, distance travelled, hours of operation or a combination of the three. Regular oil changes and tire rotations are good examples of preventive maintenance tasks whose value is understood by accepted by fleet operators.

Scheduled maintenance is the least effective preventive maintenance for controlling costs and maintaining equipment availability. It is the most used type of preventive maintenance in North America because it is easily understood and implemented. It is a significant contributor to the poor industrial productivity ratings of North American industry. Its roots go back to World War Two when some method had to be found to keep military equipment available during operations and when in storage.

In spite of the inefficiencies built in to scheduled maintenance, implementation will greatly improve equipment availability and cost reduction will be a minimum of 12% to 18% when compared corrective maintenance. Return on investment will depend on the current state of affairs, but in one case, a KelRoy customer realized an ROE in 11 days.

3.4.2.2. Predictive Maintenance
Predictive maintenance can be defined as service or repair based on the condition of the components. Predictive maintenance is often referred to as “Condition Monitoring Maintenance”, but it is usually made possible by condition monitoring. It is the next logical improvement over scheduled maintenance. A component can be defined as any item which has a lifespan. Some examples of predictive replacement items are fluids, components which cannot be lubricated, batteries etc. For example, oil intervals could be extended or reduced based on oil sampling. The change in frequency would be designed to maximize oil lifecycle or reduce major component wear.

Predictive repair or replacement triggers depend on measurement of existing items in frequencies which are significantly less than the established
lifespan of the item. The measurements can be sensor, sample analyses, historical trend or any other method which is effective.

3.4.2.3. Reliability Centered Maintenance
Reliability Centered Maintenance has a least two distinct definitions in industry.

1. In industries where equipment failure must be reduced to the lowest possible level I.E. Medicine or aviation, targets are established for failure percentages and budgets built to support the goals.

2. In budget constrained industries it is a planned strategy which utilizes predictive maintenance, trend analysis and equipment prioritization combined operational key performance indicators to develop a complete maintenance program. It is a method which combines many details to achieve high level goals. Ratios between corrective, scheduled and predictive methodologies are actively managed.

The benefits of RCM differ dramatically from business to business and implementations are rarely similar. The concept was originally conceived in the aviation industry because of the importance of unanticipated failures. RCM is similar to the Total Productive Maintenance method embraced by the manufacturing sector. It is making inroads in the more progressive commercial transport and off road equipment fleets.

Part of RCM is a continuous improvement philosophy which does require ongoing investment in process improvement. Studies have shown that ROE rarely exceeds three months and that benefits precede investments thereafter.

RCM is a worthwhile venture and can give a company a competitive business edge with reduced operating costs and greater equipment availability.

4 RCM
Studies of equipment maintenance costs versus the type of maintenance implementations show dramatic reductions in maintenance costs. One such study by John Piotrowski in 2001 gave the results shown in figure 3.1

![Cost vs Maintenance Types](image)

**Figure 3.2**

**3.4.2.4. Other Types of Preventive Maintenance**

This section has demonstrated a few of the common maintenance programs which are commonly used to manage assets. Many more programs exist which can provide significant reductions in maintenance cost and still increase asset availability. The purpose of this section was to demonstrate that preventive maintenance is not just scheduled maintenance. The programs discussed are in common use in well run fleet maintenance facilities.
3.5. **Maintenance Management Tools**

Skilled fleet managers have a number of performance measurement tools at their disposal to help them manage their fleets and drive continuous improvement.

- Corrective to preventive repair ratios will monitor the effectiveness of the preventive maintenance program.
- Worker KPI’s will help to identify training, departmental support and skill set problems.
- Failure codes\(^5\) will identify weaknesses in the fleet specification.

The goal of this course is to help the operational professional understand the maintenance view. Conversely, a maintenance professional who understands the importance of operational issues, will also appreciate the KPI’s associated with asset operational performance. Basic operational and maintenance KPI’s will be discussed in the following section.

\(^5\) Failure codes are also known as fault codes.
4. Key Performance Indicators (KPIs)

For the purposes of this course the differences in some of the operational and maintenance oriented key performance indicators will be explained.

Without a method to measure equipment performance we cannot compare performance improvements or set goals. Some fleet operators and maintenance managers may use self designed KPI’s with mixed results.

4.1. Operational Key Performance Indicators

- Reliability
- Availability
- Maintainability
- Spare ratios
- Operating cost per mile/hour

In order to understand the calculation of the following KPI’s the reader needs to know the difference between preventive and corrective maintenance. Preventive maintenance repairs are those repairs which are planned in advance and generally performed on work orders triggered by a maintenance management program. There are many types of preventive maintenance routines.

Corrective repairs are repairs which are not planned and which are initiated by the failure of a component prior to its scheduled replacement frequency or for which there is no scheduled replacement frequency. If a failed component is found on a preventive maintenance repair, which is not to be replaced in the normal course of repair, that portion of the repair should be designated as a corrective repair.

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6 Computerized or manual
7 Frequency based, predictive, reliability centered,
8 Sometimes called “Reactive”
The ability to separate preventive and corrective maintenance repairs when calculating the following KPI’s allows a better understanding of the root cause of poor performance metrics.

4.1.1. Reliability
This is not to be confused with the financial reliability KPI’s used to determine the cost effectiveness of a maintenance program.

Reliability is defined as the average time between failures the formula looks like:

\[
\text{Scheduled Operating Time [minutes] - Time Out of Service [minutes]} \over \text{Number of Failures} = \text{minutes Reliability}
\]

In order to be able to use this indicator, the maintenance manager must know the scheduled operating time of the equipment (planned) and be able to report on the number of failures. A common mistake is to combine preventive maintenance repairs with corrective repairs where parts had been ordered in on a previous repair order.

4.1.2. Availability
Availability is defined as the average percent of scheduled operating time the equipment was available for use (i.e. not out of service from equipment failure).

\[
\text{Scheduled Operating Time [minutes]} - \text{Time Out of Service [minutes]} \over \text{Scheduled Operating Time [minutes]} \times 100 = \% \text{ Availability}
\]

4.1.3. Maintainability
Maintainability reports can be used to identify
Maintainability is the average time to repair equipment after a failure.

---

\(^9\)Also defined as MTBF (mean time between failures)
The asset operational key performance indicators can be used to identify:

- Equipment suitability to task (optimization).
- Asset lifecycles which are too long.
- Preventive maintenance service frequency problems.
- Supply chain problems.
- Manufacturer quality issues.
- Repair training requirements.
- Operator training and abuse concerns.

### 4.1.4. Spare Ratios

Spare ratios are probably the least understood fleet metric. Spare ratios are used to ensure that sufficient equipment is available to perform work to the service level standards and to rationalize the fleet asset population. Until the inception of maintenance free assets, equipment availability will never be 100%. This mandates the need for spare equipment.

#### 4.1.4.1. Spare Ratio Calculations

Traditionally, fleet and operational managers would calculate the number of spare assets needed by applying an arbitrary factor to the existing fleet asset numbers. Fleet performance based on the additional assets model would be reviewed periodically and adjusted as necessary.

This approach is a reactive style of management which is inefficient and should be discouraged.

Current best practices support a different approach. Modern methods link the ratio of spare vehicles to the operating need. The system requires the coordination of the dispatch and the fleet staff:

Dispatch staff
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- Determines the hourly operational or route need per truck/trailer based on history, forecasts, driver availability or any other factor which drives equipment need.

Fleet Staff
- Calculates availability based on history. If no history is available, uses preventive maintenance service needs plus corrective repair needs to estimate availability.
- Compares the operational need to the fleet capability and calculates spare ratio.

The calculation looks like:

\[
\text{Work need (hours/routes) - Asset count x availability (hours/routes) - Asset count x availability (hours/routes)} \times 100 = \text{spare ratio (%)}
\]

This is a simplified calculation with many possible variations and additional detail; the concept is based on planned need and should use a forward view to compensate for changing requirements.

4.1.4.2. Operating Cost per Mile/Hour
Operating cost per unit meter reading is calculated in arrears. When a system is set up to measure the other KPI’s, the calculation becomes effortless. Fleet operators should take caution when comparing these KPI’s to other fleets because of the many variables used in the industry. As well, fleet maintenance managers do not have direct control over the methods used to calculate the numbers.

Well organized operations will split the cost per unit meter readings and only use trend reporting to drive continuous improvement.

4.2. Maintenance Program Key Performance Indicators
Maintenance management programs can be manual or computerized. Either system will work if set up and managed properly. The advantage of computerized systems is the reduced resource hours need to maintain the system and the timely retrieval of information. Skilled maintenance managers use many tools to manage the fleet
Fleet Maintenance from the Operational Perspective

performance whether repairs are done by vendors or company employees. This course will cover the most basic indicators so that operators do not become overwhelmed with technical details.

An important key performance indicator for the health of any fleet management program is the ratio of the planned (preventive) to failure (corrective) repairs.

Corrective Maintenance is work which is not planned
Refer to Section 3.4.1.

Preventive maintenance is work which is planned.
Refer to section 3.4.2.

The units of measure can be in measured in repair events, repair hours, or cost of repairs. Cost of repairs is usually preferred since inclusion of contract repairs is easier. The indicator is expressed as a percentage and looks like:

Preventive repairs
----------------------------------------- X 100 = % Preventive to corrective ratio
Preventive repairs + corrective repairs

Many fleets struggle to keep the percentage above 50%. A well managed fleet will be above 70%. Note that this percentage can be affected by factors outside the repair management such as fleet age, optimization and operator styles.

PM to CM repair ratios can be measured whether maintenance is done on site or at external vendors. Tracking of this information will be discussed in section 4 – Information Management.

4.2.1. Shop Staff Key Performance Indicators
If repairs are done on site, the fleet operator has the opportunity to mange company staff to greater efficiencies. The ability to control the destiny of the repair offsets the challenges of shop management for some operators.

10 In this case, optimization is the suitability of equipment to task.
If repairs are outsourced, the person managing fleet expenses should still understand the basics of shop floor efficiencies. This knowledge will help in vendor selection or in determining the value of specific repairs.

There are two basic worker key performance indicators:

- Productivity
- Efficiency

As well, there is a blended measurement which will be discussed.

Productivity and efficiency are often confused even within the maintenance community.

4.2.2. Productivity

Productivity is defined as the percentage of time spent in productive work. The formula looks like:

\[
\text{Actual productive working [hours – tenths of hours]} \times \frac{100}{\text{Scheduled work time [hours – tenths of hours]}} = \% \text{ Productivity}
\]

Productivity cannot be more than 100% under normal circumstances. Workers only have partial control over their productivity. If a worker has good efficiency and poor productivity, scheduling or logistics are often the cause.

4.2.3. Efficiency

Efficiency is defined as the time it takes a worker to perform a task compared to a standard repair time for the task. The formula looks like:

\[
\text{Standard time for task [hours – tenths of hours]} \times \frac{100}{\text{Time taken by worker to perform task}} = \% \text{ Efficiency}
\]

Skilled workers can have efficiencies greater than 100%. Poor shop logistics, insufficient training and experience can all have negative impact on worker
efficiency. Poor material supply line process and tool management are the most common shop logistical issues.

4.2.4. Standard Repair Times

Standard repair times are a tool which was developed by the automobile manufacturers to control the cost of warranty repairs to their products. Interestingly, consumer groups have challenged the cases for and against their use.

In some repair environments, standard times are difficult to ascertain. Diverse fleets, skewed preventive to corrective repair ratios, custom equipment outfitting and any other diversions from standard are challenges for establishing standard repair times. Standard labour times, coupled with advertised labour times and service level agreements are a valid method of controlling the cost of repairs. Some CMMS programs have standard labour guides embedded; few have commercial transport or heavy duty times in their programs. There are, however, low cost stand alone labour time guides which are available.

One inexpensive computer program such is Real Time Labor Guide which provide most of the common repair times for commercial transport vehicles. These programs are a useful tool for under $300 (as of March 1, 2011) which can be used by fleet operators to negotiate repair times which appear to be unreasonable.

Figure 4.1 is a screen shot from a standard repair time program. The average time to look up a repair time is less than a minute.
4.2.4.1. Proficiency

There is a blended key performance indicator which is commonly used when standard repair times are not practical. There is a work around used to measure the performance of shop employees. It is commonly labelled “proficiency” and is the ratio of the worked\textsuperscript{11} hours to the “billable”\textsuperscript{12} hours. It is a tool which can be used in most maintenance operations because the information is readily available. The formula looks like:

\[
\text{Billable time [hours]} \div \text{Paid time [hours]} \times 100 = \% \text{ proficiency}
\]

In union environments there is reluctance to measure workers with key performance indicators. The argument that safety is compromised when focus changes to production volume has some validity. The argument is valid if a repair facility which has systemic process issues compares itself to an industry standard.

\textsuperscript{11} Payroll hours paid.
\textsuperscript{12} For government fleets, this is the repair hours charged against the work orders.
Nonetheless, it can be used as a baseline to measure departmental performance if the data input is credible.
5. Information Management

As recently as ten years ago maintenance trainers recommended that fleet maintenance programs could be run without the help of computers. This is not the case today. The effortless access to information, reduced staff workload and reduction of human error cannot be ignored. Computerized maintenance management systems (CMMS) used to be the domain of large organizations with sizable information technology (IT) budgets. Today, the cost of CMMS systems have become affordable for even the smallest companies. Ongoing CMMS costs can cost only pennies per day after set up. Set up costs can have return on investment cycles measured in days.

The reluctance to implement computerized maintenance management is usually caused by the fear of change. Any organization which chooses to avoid computerized maintenance management is facing a serious business shortcoming in the market. Ownership and staff must embrace the known advantages of the computerization before set-up is attempted.

Fleet operators who outsource all of their maintenance should still use a CMMS to track their fleet maintenance costs. Very few dispatch applications will provide the access to information needed to manage third party vendors. The payback in investment is typically less than six months and does not increase human resource loads if well implemented.

5.1. Computerized Maintenance Management Systems (CMMS)

A computerized maintenance management system is a powerful tool. It helps to reduce employee workload and is capable of managing functions such as warranty, dispatching, predictive maintenance and many more valuable maintenance and operational functions which provide significant cost savings, risk management and service improvements. Much of the information provided by computer reporting would be impossibly expensive to retrieve with a manual system. Calculations for

\[^{13}\] John E. Dolce.
return on investment for a CMMS should use operational improvements\textsuperscript{14} as well as maintenance spend reduction.

5.1.1. CMMS Program Selection
The selection process of a CMMS has ended the promising career of many a company employee. This is a task which is most often successful when outside help is engaged. Software vendors often have recommendations which are biased in favour of their product and their recommendations need to be carefully screened to ensure that they fulfill the needs of the company. The person(s) responsible for choosing the software must be well versed in:

- The business needs of the company.
- The needs of the maintenance department.
- The capabilities of the staff that will be using the software.

Maintenance departments often seem to work in isolation. This behaviour often frustrates the operations group because of the different goals mentioned in section two. Basic requirements of any CMMS would be:

- Communication with the existing corporate financial packages. This is not necessarily integration, but at least a process whereby double entry of repair cost information is reduced.
- Functionality which allows measurement of the KPI's for both Operations and Maintenance.

A desirable, but not essential requirement is the ability to automatically communicate with dispatching software.

5.1.2. CMMS Information Needs
Computerized maintenance management systems need accurate data to be useful tools. Initial set up requires what is known as “Tombstone Information” and as the system is used, operational data is added.

5.1.2.1. Tombstone Information
All assets must have certain information types stored in the database before maintenance staff can manage the fleet. As well the each piece of equipment needs unique identifiers to allow costs to be tracked separately.

\textsuperscript{14} Improvements in Reliability, Availability and Maintainability.
This information is entered when the CMMS is setup for all existing assets and updated at time of purchase for equipment new to the organization.

The output for each type of information is contained in table 5.1.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Source</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Asset Number</td>
<td>CMMS/System</td>
<td>Individual Asset Costs</td>
</tr>
<tr>
<td>Asset</td>
<td>Attributes</td>
<td>Search Functions</td>
</tr>
<tr>
<td>Asset Specifications</td>
<td>Survey/Documentation</td>
<td>Parts Identification</td>
</tr>
<tr>
<td>Asset Component #’s</td>
<td>Survey/Documentation</td>
<td>Cost Trends - Warranty</td>
</tr>
<tr>
<td>Warranty Coverage</td>
<td>Manufacturer/Documentation</td>
<td>Warranty Cost Recovery</td>
</tr>
<tr>
<td>Fault Codes</td>
<td>CMMS System Setup -VMRS</td>
<td>Cost Trends</td>
</tr>
<tr>
<td>Preventive Maintenance</td>
<td>CMMS System Setup</td>
<td>Cost Control</td>
</tr>
<tr>
<td>Other Coding</td>
<td>CMMS System Setup</td>
<td>Cost Trends</td>
</tr>
<tr>
<td>Asset Schedules</td>
<td>Operations</td>
<td>KPI’s</td>
</tr>
</tbody>
</table>

**Table 5.1**

### 5.1.2.1. Fault Codes

Fault codes are also known as failure codes and are rarely given the sufficient attention to make them useful. In repair orders they are often separated into three types and commonly called the three C’s – complaint, cause and correction. They help Fleet Managers develop the most successful repair strategies for repetitive problems. Repetitive problems often indicate vehicle specification and preventive maintenance program deficiencies.

**Complaint codes** are the symptoms of the problem. Typically they would be inoperative, missing, leaking etc. The customer knows the symptoms of the problem when the equipment is booked for repair and the service advisor records the symptom at the time the repair request is created.
Cause codes are the reason the problem occurred. Typically they would be worn, broken, needed adjustment etc. Cause codes can only be entered after diagnosis. Cause codes are determined by the repair staff.

Correction codes are the method of repair. Typical correction codes are replaced, adjusted, rebuilt etc. Correction codes can only be determined after a successful repair is completed.

Failure code regimes should be sufficiently diverse to accurately define the problems and corrections. Some descriptions are interchangeable between the three C’s. A poorly defined system is demonstrated when the users consistently choose “Other” as a description. The use of “Other” as a code hinders effective reporting.

5.1.2.2. Operating Data
Operational data must be communicated to the CMMS as the equipment is used in order to support cost trending, KPI support information and preventive maintenance triggers.

The key performance indicators only have value if the verifiable data is collected with a consistent method and organized properly. Manual or computerized maintenance management systems rely on quality inputs for useable results. The following accurate data records must be collected to support the key performance indicators discussed herein:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Source</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Repair Orders</td>
<td>CMMS – Repair Shop</td>
<td>Individual Asset Costs</td>
</tr>
<tr>
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Table 5.2
The list shows just the fundamental information required to support basic maintenance management and reporting.

5.1.2.3. Labour and Materials Coding
Proper labour and materials codes are essential elements for root cause analysis of equipment component failure. The codes provide the consistency necessary to accurately separate the causes of failure.

The Vehicle Maintenance Reporting Standards\textsuperscript{15} are becoming the standard format in the commercial trucking industry. The system was designed in the 1970’s by the Technology and Maintenance Council which of the American Trucking Association and consists of thousands of codes which describe equipment parts and repair activities. Repair codes give consistency

\textsuperscript{15} VMRS
6. Maintenance Planning

Why plan maintenance?

We fix it when it breaks!

Hopefully, the information in the preceding chapters and the illustration in figure 3.2 have helped the reader realize the folly of these two statements. However, maintenance planning is more than setting up a CMMS and servicing equipment when the scheduled repair orders are generated. This section will outline some basic elements which fleet maintenance need to be successful.

6.1. Organizational Support

Fleet management employees rely on fleet operators to:

1. Build a team environment with operations.
2. Provide unbiased facilitation when conflicting operational and maintenance goals reach an impasse.
3. Dedicate qualified staff to manage the fleet maintenance.
4. Provide training for fleet maintenance staff
5. Set goals for fleet maintenance.
6. Empower fleet management staff.

6.2. Resource considerations

The human resources dedicated to fleet management vary with the size of the fleet and style of operation.

One case study had the shipper/receiver managing third party repairs of more than 80 power and 100 trailing units. They reorganized to dedicate a full time person to fleet maintenance management with a ½ full time equivalent administration support. The savings in maintenance costs exceeded the increased expense structure by a ratio of 7 to 1. Return on investment for outsourced program set up,
CMMS implementation and initial staff training was less than three weeks. Improvements in shipping and receiving performance could not be calculated.

The point here is that the cost of maintaining a fleet without dedicated management is many times the cost of dedicating and training staff for the task.

6.2.1. Staff Training
Fleet maintenance staff requires ongoing training for third party or in house management. Their skill sets should be surveyed and an appropriate plan drawn up. In addition to fleet specific training, proficiencies should include:

- Basic financial training and budgeting
- Specific CMMS and reporting
- Procurement to pay
- Conflict resolution
- Risk management
- Compliance

6.2.2. Goal Setting
Goal setting for fleet managers can be financial, KPI based, organizational - almost anything which will maintain interest and promote continuous improvement. The key is ensure that the goals are attainable when above average performance is displayed.

Some of the best goals are team based which promotes cooperation with the operations group.

6.3. Strategic Planning
Last, in this section, do not forget to include the maintenance management staff in your strategic planning sessions. They are valuable contributors when planning the expense side of a business model. Their engagement will engender long term loyalty.
7. Business Management

7.1. Preferred Vendors
The tendency for fleet operators to choose materials and services based on lowest cost is slowly disappearing. The downturn in the economy has demonstrated the value of quality carriers to the expediters and in turn, the knowledgeable carriers, with a few exceptions, have reduced their tendency to cut their cartage rates below that which is sustainable.

7.2. Service Level Agreements
Many fleet operators, however, have not embraced the advantages offered by the establishment of service level agreements with selected maintenance vendors. The modern vendor - client relationship is viewed as a partnership where business is based on trust but governed by contracts. Carriers who define a contractual relationship with vendors without establishing service levels place their equipment availability at risk.

The selection of agreements with international lease-maintenance companies is often based on consistency and the availability advantages offered with replacement equipment. These benefits come at significant cost. Long haul carriers have the greatest challenge when selecting approved vendors, but the use of the advanced features of truck services locators combined with a CMMS eases the management of this group.

Fleet operators who allow time for their maintenance staff to identify and partner with preferred vendors locally or at major through points always reduce their repair costs and downtime.

7.3. Purchasing Processes

Maintenance planning will help to ensure that cost savings are sustainable. For example, how does a fleet operator ensure that a third party repair facility perform only those repairs which are authorized? A typical process is shown below in figure 5.1.
This sample process may seem obvious to anyone with purchasing training, but many fleets today operate without a defined process. The result is poor cost control and vendor relations as well as staff turnover from frustration.
8. Risk Management

8.1. Compliance and Regulations

Maintenance managers are sometimes accused of inflexibility when they will not release equipment for use which they feel is unsafe. Fortunately, most fleet operators wish to operate within existing regulatory guidelines. This section will have little value to companies who choose to operate outside the law due to financial considerations or philosophical reasons.

The National Safety Code (NSC) provides guidelines for the motor carriers in Canada. The maintenance component of the NSC is the Commercial Vehicle Safety and Enforcement branch which administers the Motor Vehicle act and Regulations. Bill C-45 holds management accountable not only for their actions, but for their inactions. Managers must ensure that they take proactive action to ensure the safety of workers.

In British Columbia the maintenance component of the NSC is administered by the Commercial Vehicle Safety and Enforcement division of the Ministry of Transportation. There are three documents which guide the program:

1. The Commercial Vehicle Inspection manual
2. The Motor Vehicle Act
3. The Motor Vehicle Act and Regulation

These are dynamic documents and are constantly changing with revisions, compliance circulars and bulletins.

Third party service providers may not provide perpetual compliance during regular service visits. This maintenance deficiency is often driven by the profit nature of their business where most non-inspection repair visits do not result in investigation beyond the scope of a specific repair.
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