

THE USE OF RCM AND SOFTWARE AS A STRUCTURED PROCESS TO DEVELOP ASSET MAINTENANCE PLANS

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ABSTRACT

In most manufacturing plants, preventive maintenance (PM's) and predictive maintenance programs has developed over the years without a structured process followed or keeping track of changes to the asset maintenance plans. This might result in either unnecessary scheduled maintenance performed on assets, or the deletion of important maintenance schedules without applying the necessary management of change. Reliability-centred Maintenance (RCM) is a structured process not only to develop asset maintenance plans for new assets, but also to review the effectiveness of current asset maintenance plans. A RCM software database can further expedite the process as huge amounts of information can be stored, quickly sorted and changes can be reviewed against the original thought process.

1. INTRODUCTION

The objective of the Maintenance function is to support the production process with adequate levels of availability, reliability, operability and quality at acceptable levels of safety and cost. This is normally achieved by having planned maintenance schedules for the assets. Planned maintenance has to begin with a plan in mind. Developing preventive and predictive maintenance tasks or procedures for your plant or facility without a solid plan will result in inconsistent and unreliable procedures. [1]

Creating a maintenance plan is generally not difficult to do, but creating a comprehensive maintenance program that is **effective** poses some interesting challenges. Too many times asset maintenance plans exist in one or another form, which evolved over a period of time - in most cases the plan, is either over maintaining or under maintaining the assets. The question is how to develop new asset maintenance plans or amend current asset maintenance plans that ensure adequate levels of availability, reliability, operability and quality at acceptable levels of safety and cost.

When analysing the asset maintenance plans it is clear that in most cases the plans evolved over a period of time, without a structured process followed or keeping track of changes and reasoning for the changes. Most asset

maintenance plans started off with the maintenance recommendations of the original equipment manufacturer (OEM) of the asset. As time progress, these plans are adjusted based on the failures experienced on the assets, recommendations from root cause analysis (RCA), other initiatives such as lean manufacturing, total productive maintenance (TPM) or similar initiatives and strategies. One might reason that there is nothing wrong with this approach, of starting asset maintenance plans and evolving it over the life cycle of the asset, but there are also short comings with this approach. The purpose of this paper is to discuss the short comings and how it can be addressed.

2. RCM AS VEHICLE TO DEVELOP ASSET MAINTENANCE PLANS

Front-end loading (FEL) is a term generally used in the project management environment for the process of conceptual development of processing industry projects. This includes robust planning and design early in a project's lifecycle, at a time when the ability to influence changes in design is relatively high and the cost to make those changes is relatively low.

A similar approach to project management must be followed in the development of asset maintenance plans. Asset maintenance plans are normally hosted in, or managed from the computerised maintenance management system (CMMS), but there is no thought process on how the asset maintenance plan was developed – it is almost if there is a “cavity” in front of the asset maintenance plan. This phenomenon is evident in most of the asset management programs in the manufacturing industry. In some cases the specific asset maintenance plan does not even make sense and there is no evidence to support the reasoning for the specific plan. So, we need a form of “front end loading” for our asset maintenance plan as to ensure we always have the “intelligence” of our current asset maintenance plans available.

What process can be followed as “front end loading” for the asset maintenance plans? RCM is a structured process or tool that we can use to fill this gap. RCM is a systematic and scientific process to define what must be done to ensure that physical assets continue to do what their users want them to do (or what they were designed for) cost effectively. If used correctly, the RCM process is the front end loading of the asset maintenance plan.

2.1 THE RCM PROCESS

The RCM process asks the following seven basic questions for each asset:

- What is its function?
- What are the functional failures?
- What are the failure modes?
- What are the effects of those failures?
- What are the consequences?
- How can the failure be mitigated?

- What if a suitable task cannot be found? [2]

Asking these questions for all the assets can become a daunting task, sometimes to such an extent that most people are so overwhelmed that they never start the RCM process. The good news is that it can be done! The well know proverb of “how do you eat an elephant? - bit by bit” is also true for the implementation of a RCM program.

2.2 A 12 - STEP APPROACH TO RCM

The following 12 steps, as illustrated in figure 1, is a process to implement RCM in order to deliver asset maintenance plans for managing it in the CMMS.



Figure 1 – A 12 step approach to RCM

Determining the criticality of the assets plays an important role in the process. This ensures a focussed approach in the development of the asset maintenance plans, in other words to “eat the elephant bit by bit”. The first step in setting up a criticality analysis model is to define those characteristics that will be used to analyse each maintainable asset. These characteristics could cover a wide range of business attributes, such as:

- Mission and customer impact
- Safety and environmental impact
- Ability to isolate single-point-failures
- Preventive Maintenance (PM) history
- Corrective Maintenance (CM) history
- Mean-Time-Between-Failures (MTBF) or “Reliability”
- Spares lead time
- Asset replacement value
- Planned utilization rate

The RCM process might take a couple of years to apply to all the assets of a medium to large company. The asset prioritisation helps to start the process on the assets with the highest criticality first, as to gain the maximum benefits or value add from the RCM process as quickly as possible. This is similar to the Pareto principle (80-20 rule), that 80% gain or improvement will be derived from the 20% most critical assets.

The RCM selects the appropriate strategy for each asset based on the criticality. Strategies that are considered include:

- Predictive Maintenance
- Preventive Maintenance (discard/restoration)
- Failure finding
- Run to Failure
- Engineer out Maintenance (EOM)

A note of caution – where a strategy of Run to Failure is selected, it must be a conscious decision, in other words, it must be documented and approved as a strategy for the specific asset. This should be also captured in the CMMS as to evaluate in future, when failures do occur, whether it is still the correct strategy.

2.3 WHAT RCM ACHIEVES

By the practical implementation of RCM the following benefits can be achieved:

- It can be the most efficient maintenance strategy for your manufacturing facility as RCM evaluates each asset and then decides what the best strategies for the specific assets are.
- Fully documented asset maintenance plans build on rational foundations. This will assist the operations teams not to start from scratch if asset maintenance plans has to be changed because of continuous improvement.
- Doing away with unnecessary work.
- Reduce probability of sudden failures.
- Focus attention on critical assets and the criticality of component failures.
- Incorporates pro-active root cause analysis (RCA) techniques, which can be used in future for evaluating failures. During this analysis phase. once of engineering solutions (EOM) can be identified and implemented to improve the reliability of the assets.
- Better understanding of the operation and maintenance of the assets by the production and maintenance teams.

With a recent implementation of a RCM program in the food and beverage industry to review current asset maintenance plans, the following benefits were listed by the engineering/plant managers:

- Understanding what is the critical assets.
- A better understanding of the assets to production and maintenance.
- Areas of the assets were identified which were not previously covered in PM’s. Previous PM’s were based on supplier manuals whereas RCM’s is based on years of experience and physical inspection.
- Standardisation on lubricants throughout the company.

- Detail task lists could be developed as some of the current tasks were too generic.
- Opportunity to correct the wrong PM task intervals.
- Understanding that the vast majority of failures are not necessarily linked to the age of the asset.
- Focus more on predictive maintenance than preventive maintenance.
- Entrenching a culture of properly executed PM's with good paper trails.
- Identification of training requirements once asset maintenance plans have been established.
- Alignment of maintenance structures in order to execute asset maintenance plans.

There are several benefits in implementing RCM to develop asset maintenance plans as listed above. However one should realise that it cannot be properly implemented without visionary leadership, resources and time. Some of the stumbling blocks seen in industry when implementing the RCM processes are:

- The RCM process can be very time consuming and interest may be lost before realising the value add or benefits.
- The right people (normally your best) should attend the RCM sessions. This might constrain resources for smaller companies.
- For large companies or for a large number of assets the management of the RCM data, especially when a software database is not used, can become a nightmare and might even require more time and resources.
- For large companies the process can take anything from 2 – 5 years, depending on the availability of time and resources.
- The saving potential of RCM is not always readily seen by management.

The RCM process can realise benefits very quickly when the assets are prioritised as indicated by applying the 12 step approach as discussed in paragraph 2.2. Furthermore asset maintenance plans completed should be implemented as quickly as possible to start gaining the benefits. One should be careful not to wait for all plans to be completed first before it is loaded into the CMMS or implemented. By not implementing the plans no benefits will be gained.

If RCM is applied correctly it yields returns that far outweigh the cost and time it will take to implement the process [3]

3. THE ROLE OF THE CMMS IN THE MANAGEMENT OF ASSET MAINTENANCE PLANS.

A CMMS plays an important role in the effective management of the asset maintenance plans after applying the RCM process. Unfortunately, too many times, it is

found that it is only used as a scheduling and cost collecting tool.

Once the asset maintenance plan for an asset is completed, the plan must be uploaded into the CMMS. It is critical to populate master data and with enough detail in the CMMS. As far as possible the master data should be aligned (normally called the functional location) with the asset breakdown structure as developed in the 12 step approach to RCM.

The data from the RCM and decision worksheets can be used as an input to set up the master data in the CMMS. For example the failure modes identified can be used as catalogue profiles for the work orders (job cards) to be completed when the asset maintenance plans are executed.

History must be diligently completed and fed back into the CMMS on completion of work. The information in the CMMS should be regularly analysed as to review the effectiveness of the asset maintenance plans. This is also the point where the continuous improvement cycle (Plan-Do-Review-Act) should kick in. Where the asset maintenance plan is ineffective or inappropriate, the failure modes and the selected strategy of the RCM process should be reviewed and amend if needed. Such changes should also be documented in the RCM decisions worksheets as to keep an audit trail of changes.

The question one should ask is whether I use my CMMS to the fullest or just a part of the functionality?

4. THE USE OF RCM TO REVIEW CURRENT ASSET MAINTENANCE PLANS

The RCM process can also be used to review current maintenance plans.. If asset maintenance plans do exist, it is normally stored in the CMMS. This will mean that there is already an asset register, normally in the form of an asset tree (sometimes called the functional location and equipment numbers).

The 12 step approach to RCM can be applied with minor changes by starting to list the assets from the CMMS and start with the process of performing the asset criticality ranking.

The aim is to achieve the maximum benefit by starting with the most critical assets first. The existing history in the CMMS can be used in the failure mode and effect analysis (FMEA) to ensure that all past failures and failure modes are captured during the process, such as mean time between failures (MTBF's), mean time between repairs (MTBR's), time to perform inspections or repairs, failure mode analysis per asset, costs, etc. In the process new failure modes and mitigating/preventing measures are also identified based on asset performance, history and personal experience. This process of review also give the opportunity to investigate or evaluate new

condition based technologies available as an alternative to run to failure or costly preventive maintenance strategies.

Before finalising the asset maintenance plans it is advised to review the current plans in the CMMS. It will be foolish to ignore or discard of all the plans in the CMMS as it might contain lessons learned over the years that might not be revealed by the RCM process. Always challenge the addition of plans to the outcome of the RCM process as to ensure that assets are not over maintained by just adding current asset maintenance plans from the CMMS.

The CMMS should then be updated with the revised asset maintenance plans and implemented as quickly as possible to ensure the maximum benefits of the revised plans are gained.

5. THE USE OF SOFTWARE TO MANAGE DATA IN THE RCM PROCESS

There are different opinions on the use of software during the RCM process. Below is John Moubray’s view on the use of software for this purpose.

The information contained in the RCM and decision worksheets lends it readily to be stored in as software database. In fact if a large number of assets are to be analysed, it is almost essential to use a software database for this purpose. The software can be used to sort the tasks by interval, skill sets and a variety of reports can be generated form the analysis phase. Finally storing the analysis in a software database makes it infinitely easier to revise and refine the analysis as more is learned and the operating context changes. The RCM software should never be used to drive the RCM process. [3] RCM is all about exploring the real needs of the asset under review. In short RCM is “thoughtware and not software.” [4]

So yes, there is a place for software in the RCM process as long as it is used for the right reasons. In a recent RCM program implementation the daunting task of managing independent Microsoft Excel worksheets for different sites were realised, even more so when it has to be prepared for upload in the CMMS.

Software can also provide advanced support for the application of RCM. It can support the role of the RCM facilitator in order to maximise productivity by providing special ease-of-use and speed-of-use features, such as asset classification, asset failure modes, trade skills, etc. The purpose of this feature is not an exercise of only ticking boxes, but rather to standardise terminology that is used in the RCM process, which can in future be used for the proper set up of master data in the CMMS.

Software includes many features specifically designed to make it quick and easy to extract information from one analysis and incorporate it into another analysis. This kind of incorporation of the analysis of one asset to another should be done with the necessary caution as to ensure

that RCM does not become a copy and paste exercise. RCM is all about preserving the function of the asset, so be careful not to group the same asset types together with different functions as you will surely miss the objective of RCM.

The software database can be used to keep track of changes to your plans through revision control. It will be a futile exercise to build a database as the implementation continues, but then not keep it relevant through proper management of change if plans are amended or revised.

Different reports can easily be generated from a software database and the following is some reports:

- Asset breakdown structure
- Asset criticality ranking
- Maintenance plans per asset
- Maintenance plan hours per trade discipline
- Mix of work order types to determine your maintenance mix

Figure 2 is an example of an asset maintenance plan from a RCM software database

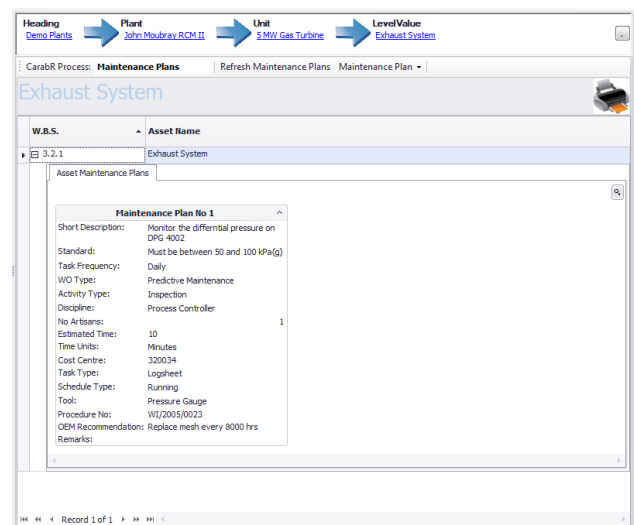


Figure 2 – Asset Maintenance plans in a RCM software database

Reports can be exported to current MS Office packages for reporting purposes.

Several of these reports might exist within the CMMS of the company, but special/unique reports might be very costly to generate within the CMMS.

For companies with multiple sites the software can also ensure a standard approach in the implementation of RCM. Too many times legacy systems are developed on different software platforms which ultimately die out, once the “father” of the systems moves on.

While a RCM software database can be a great tool, the fact still remains RCM require people to perform the analyses and implement the task. If you're counting on the software to make it work, then do not attempt to implement the RCM process.

6. CONCLUSION

In order to effectively manage physical assets, sound asset maintenance plans are essential. Most industries do not have a good record of how asset maintenance plans was developed or evolved over the years. It is however a world best practice to have a well-documented process in place – the question is many times, what must this process look like? RCM is a systematic and structured process to develop or review current asset maintenance plans that can fulfil this role. By prioritising the criticality of the assets, the process can focus on the critical assets first, yielding the maximum benefit for the effort as it should be realised that RCM require, time, expert resources and leadership. The good news is that when RCM is applied correctly it far outweighs the effort to implement the process.

When implementing the RCM process, large amounts of information or data needs to be handled and this can make the process very difficult and slow. When applied for the right reasons, a RCM software data base is a useful tool to assist with the facilitation of the RCM process. It can expedite the RCM process, generate management reports and keep record of changes made to the asset maintenance plans, but do not forget that the process MUST be driven by people!

Do not forget the quote of John Moubray – “RCM is about thoughtware and not software”

7. REFERENCES

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