
Benchmarking as a Maintenance Performance Measurement and Improvement Technique

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Benchmarking was a "hot" topic in the early 1990's. It was seen as the next "big thing" in business improvement. In contrast to the Quality Improvement movement, which offered small, frequent, incremental improvements in business performance, Benchmarking offered the key to large-scale, step improvements in performance. Unlike the labor intensive, high workforce involvement Quality Circle approach, benchmarking was supposed to provide these gains with relatively little effort, as it involved learning from the best organisations, and "copying" what they did. Everyone was "doing" benchmarking, or talking about doing it. Governments were even assisting private enterprises to do it. Like most over-hyped techniques, the bubble soon burst, and benchmarking was in serious danger of becoming viewed as yet another of those "flavour of the month" management consulting-driven fads that would quickly sink into oblivion.

With the passage of time, however, benchmarking has not disappeared into the realms of folklore. It is increasingly being viewed as one of a number of important business improvement tools that any organisation should have in its kit bag. If anything, it is going through something of a resurgence, as organisations attempt to become less inward- and more outward-focused. In this section of the paper, we set out to discuss benchmarking in an equipment maintenance context, and discuss a number of key questions, including:

- What is benchmarking?
- Why benchmark?
- Obtaining, analysing and understanding global best practice - The benchmarking process
- Determining what to benchmark
- The importance of consistent terminology
- Adopting and incorporating best practice

What is benchmarking?

There are a number of different definitions of benchmarking, which all have a similar flavour, but a slightly different emphasis. The definition that I prefer, and which is contained within the Maintenance Terminology article at www.plant-maintenance.com/terminology.shtml, is as follows:

The process of comparing performance with other organisations, identifying comparatively high performance organisations, and learning what it is they do that allows them to achieve that high level of performance.

*a-se-tiv'-i-ti, n, the efficient and effective configuration, operation and maintenance of physical assets

The key aspects of this definition are that:

- Performance is measured - this implies the existence of quantitative, identically defined performance measures
- High performance organisations must be identified - this requires some knowledge of those organisations

It is not sufficient to merely compare performance - to be truly effective, benchmarking involves gaining an understanding into why those organisations do well, and, as a result, what you need to do to achieve similar performance

The last point above is particularly important. Often, it is easy to get hung up on the quantitative comparison of performance to the exclusion of gaining a true understanding of why high performance organisations achieve the results they do, and then applying that knowledge to improve your own organisation.

Why benchmark?

So, why benchmark? In theory, benchmarking gives benefits in the following areas:

- Improved understanding of business processes
- New ideas leading to improved business performance
- The ability to "fast-track" improvement initiatives by utilising knowledge already held by "best-practice" organisations

In practice, in my view (and there may be many that disagree), the benefits in these areas are frequently oversold, although there is little doubt that, when performed successfully, significant benefits can be achieved through benchmarking. However, one benefit of benchmarking, and one which, in most organisations, is sufficient in itself to warrant undertaking some form of benchmarking, is to generate broader recognition of the need for any improvement at all.

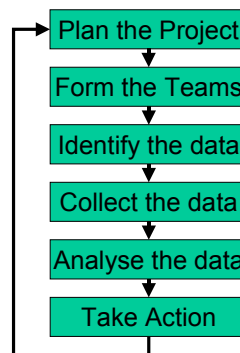
In many organisations, particularly at lower levels within the organisation, and especially so in those organisations where there has been a history of distrust between management and "the workers", there is a general perception that "things are OK as they are", and therefore "if it ain't broke, don't fix it". Comments that are heard among shop floor and first line supervisory staff are often along the lines of "Sure there are a few minor things that could be done better, but, for the most part, we do a pretty good job". Benchmarking often shatters that illusion. For example in John Campbell's book Uptime, he quotes the case of a European microchip manufacturer which had set itself what it thought to be a daunting goal - to double a production line's reliability from 24 to 48 hours. However, when it did some comparisons with similar production lines in Japan, it discovered that reliability on those lines averaged 200 hours. Instantly, the goal of 48 hours became obsolete - the production line could not possibly hope to be competitive, let alone a world leader, if it achieved such a low level of performance.

The change process is often described as consisting of three phases - Unfreezing, Changing and Refreezing. In order to "unfreeze" an organisation there needs to be a common recognition that it needs to change. Benchmarking certainly has a vital role to play in this area. Benchmarking can be used to provide the basis for an "Imperative for Improvement" within the organisation. This is often its major value.

Does this mean that all organisations that undertake benchmarking get some value from it? Some interesting research from the American Quality Foundation in 1992 surveyed 580 service and manufacturing firms that had undertaken benchmarking. They classified these firms into three classes - high performers, medium performers, and low performers, based on their Return on Assets. What they found was that firms that were already high performers showed particularly high and positive results from their benchmarking activities. Firms that were already medium performers showed "no compelling positive impact" from any of their benchmarking activities, while low performance firms actually demonstrated negative impact from having conducted benchmarking. The conclusion of the researchers was that low performing firms probably needed to focus more on getting their core business under control, rather than distracting themselves by trying to emulate the "best of the best".

Obtaining, analysing and understanding global best practice - the benchmarking process

In its simplest form, the benchmarking process can be outlined as in the following diagram:



The first step, **Planning the Project**, involves:

- Establishing the objectives of the benchmarking project
- Defining the boundaries of the benchmarking project – which business processes are included, which geographical areas etc.
- Deciding whether to benchmark “best in class” or “best in industry”. For example, if you were a mining company wishing to benchmark its spare parts warehousing and logistics processes, then you could decide to benchmark yourself only against other mining companies (“best in industry”) or you could choose to benchmark yourself against any other companies which have spare parts warehousing and logistics functions, such as the automotive industry (“best in class”). Benchmarking “best in class” potentially will provide greater benefits, in providing insights into good practices that may not yet have filtered into your industry, but is also potentially more expensive. It can also be more difficult to identify potential benchmarking partners, and some of the practices that are identified may not be entirely appropriate for your industry.
- Deciding whether to communicate directly with your benchmarking partners, or to benchmark through a third party. Particularly if you are seeking to

benchmark within your own industry, many of your competitors may be reluctant to invite you to examine their data (and you may be reluctant to give too much away to them also!). In this situation, benchmarking through an impartial third party may be an avenue to ensure that more reliable data is made available, and that there is more widespread involvement in the benchmarking project. This impartial third party could, potentially, be an industry or professional body (such as the Society of Maintenance and Reliability Professionals – see below), or alternatively could be a respected consulting organisation.

The second step, **Forming the Teams**, recognises that, to be effective, benchmarking must result in concrete improvement activities. It is important, therefore, that those people who will be responsible for, or potentially affected by, the resulting actions should be identified early in the process, and become involved in performing and/or overseeing the benchmarking activities. Performing formal stakeholder analysis to identify the stakeholder groups or individuals who should be involved in the project is extremely worthwhile at this stage.

The third step, **Identifying the Data**, involves confirming the business processes that you wish to benchmark, and identifying the qualitative and quantitative data that you wish to collect. This step also involves identifying potential data sources, and making decisions regarding where the data will be collected from. A data collection plan should be developed at this point which addresses the following points:

- How will you organise the data that you collect?
- How will you check that the data you collect is relevant, accurate and up-to-date?
- How will you arrange the responsibility for collection data?
- What data will be used from external sources and/or third party publications and databases, and what data will be collected directly from site visits?
- What tools will you use to collect the data and make sure that it is complete?
- How much data do you need?

There are many possible third party sources of benchmarking data – some of these are available via the internet, but almost all benchmarking data costs money.

Some of the benchmarking data is industry-specific, and maintenance benchmarks are only one part of the total benchmarking package. Examples of these include:

- Solomon Associates (www.solomononline.com), for those in the petroleum refining or petrochemicals industry
- Electric Utility Benchmarking Association (www.euba.com) the International Electricity Generation Benchmarking Association (www.iegba.com), or the Generation Knowledge Service (www.beyondbenchmarking.com) for those in the Power Generation, Transmission or Distribution businesses.
- The American Productivity and Quality Center (www.apqc.org), has taken over the International Benchmarking Clearing House, and offers a Knowledge Sharing Network and Best Practices database covering most industries, and

several processes, but there is not a maintenance-specific benchmarking study. Other benchmarking databases are specific to maintenance, and are generally cross-industry databases. There are two, that I am aware of, that are free of charge, but these are of limited value, due to concerns about the quality of the data contained in their databases. The two free maintenance benchmarking resources are:

- MaintenanceBenchmarking.com (www.maintenancebenchmarking.com), This site contains a small number of specific questionnaires/surveys, free of charge, on topics relating to maintenance, such as use of infrared thermography, CMMS benchmarking, Electric Motor Testing etc. These are of limited value, as there is no data cleansing, and they use someone's preconceived assessment of what represents "best practice" as the benchmark. While these preconceived notions may be accurate, they do not enhance the learning process.
- Plant Maintenance Resource Center (www.plant-maintenance.com/benchmarking.shtml) - a quick, free, survey tool, which collects, by industry, information regarding maintenance costs as a % of estimated equipment replacement value, and maintenance costs as a % of total site costs. Again, this has limited value, as there is no quality assurance on the data that is collected, and there are only two measures collected.

Other, pay for service, benchmarking services and databases that I am aware of are listed below:

- SIRF Roundtables (www.sirfrt.com.au) offers an excellent benchmarking service, consisting of a site visit to collect and validate data, and then comparison with their excellent database of over 100 maintenance organisations. This database has been collected over the last 6 or 7 years, with a significant proportion of the organisations being in the mining industry, but a wide range of other industries are included also, including petrochemical organisations, other continuous manufacturing process organisations, and discrete manufacturing organisations.
- The Society for Maintenance and Reliability Professionals (www.smrp.org) offers its Executive Company members a free annual maintenance benchmarking service. Other non-member organisations can also participate for a very moderate fee. The benchmarking study consists of a detailed questionnaire, in eleven sections, but there is no independent verification of the accuracy of the data submitted.
- The Australian Graduate School of Engineering Innovation, in association with the Maintenance Engineering Society of Australia (www.agsei.edu.au/benchmarking) also offers a benchmarking service, but this is relatively in its infancy.
- There are also many other consulting organisations that offer Maintenance Benchmarking services, including Assetivity, and others.

The bottom line is that you will pay more for a quality database – the free services simply won't meet the needs of anyone looking to perform serious benchmarking.

The fourth step in the benchmarking process, **Collecting the Data**, involves actually

collecting the data in the format that you have previously determined, using the tools that you have selected. If you are using third-party data sources, then you are likely to have more time available to browse the data that is available, and manipulate this into the format that you prefer for later analysis. However, if your data is being collected during site visits, then time is likely to be more limited, and you must, therefore, be highly organised to make sure that you collect all of the data that you have planned to collect. You will need to ensure that the data collection roles of every member of your site visit team are well defined and clearly understood. You should also establish, beforehand, which data collection methods your benchmarking partner is happy for you to employ – for example, at some sites, you may be permitted to take photographs and/or video, while at others, you may not even be permitted to take notes.

The fifth step in the benchmarking process, **Analysing the Data**, involves comparing and contrasting the data that has been collected, and sifting out the important observations from the merely interesting. There are a number of analytical tools that may assist here – at the most sophisticated end (and only possible with large quantities of reliable data) are quantitative statistical analysis tools such as multiple regression analysis, which permit you to identify those factors that appear to have the greatest impact on organisational performance. On the other hand, you may be able to identify significant improvement opportunities by using simple tools such as comparison charts.

When performing the analysis, what you are seeking to identify are the key business process **enablers**. The quantitative or qualitative data that you have collected will assist you to identify those organisations that are performing well, but you must focus on identifying those organisational factors that have enabled this high level of performance to be achieved. In essence, the performance measures tell you how far you may be able to improve, but the enablers tell you how to achieve that improvement.

The final step in the benchmarking process, **Take Action**, involves developing concrete improvement actions, assigning responsibilities for these actions, ensuring that adequate resources are made available for implementing these actions, determining the timing of actions, and then making it happen. This is easy to write in one sentence, but far more difficult to actually achieve! In essence, all improvements need to be effectively project managed, and the most effective organisations simply do not “take their eye off the ball” until the improvements are in place.

Determining what to benchmark

Benchmarking Metrics vs Processes

As mentioned previously, it is often easy to put undue emphasis on the quantitative portion of the benchmarking process - the benchmarking metrics. However, knowing the size of the gap you have to bridge in order to achieve "world class" performance is only of limited value if you have no idea how you are going to bridge it. It really is vitally important to understand the reasons why the good organisations are as good as they are. This involves getting in behind the numbers and looking at all of the things which they do which might be leading to their excellent performance, and learn from them.

For example, you may find that the best Maintenance organisations have a lower ratio

of Maintenance planners to craftsmen than your organisation has. Does this mean that you should reduce the number of planners in your organisation? Not necessarily. Digging in behind the numbers, you may find that world class Maintenance organisations have computerized information systems that permit the more speedy development of Maintenance plans; they may also have built up, over time, a comprehensive library of job plans, based on previous work that they have done, which means that whenever one of those jobs arises again, then they simply need to pull the job plan out of the library, make a few adjustments, and then issue it (whereas you may need to develop each job plan from a blank sheet of paper); you may also find that the world class organisation has progressively eliminated causes of failure, thereby leading to a lower requirement to plan corrective work, because there is less corrective work arising requiring planning; and so on.

So there are some dangers in simply measuring quantitative benchmarks of performance – the best way to benchmark is to use these quantitative benchmarks as a starting point for further investigation into the underlying reasons for the differences, which will inevitably lead you into consideration of such things as maintenance management processes, maintenance work practices, organisation structure, skill levels, organisational culture, the use of information and other technologies, and so on.

Which Metrics to Benchmark?

Having decided to benchmark some metrics, the next key question to be answered is “Which metrics should we benchmark?”

As discussed earlier in this paper, Kaplan and Norton have introduced the concept of the Balanced Scorecard for performance measurement, and while this concept is more commonly used to establish the appropriate performance measures within an organisation, I believe that it is equally applicable in identifying benchmarking metrics.

To recap, the Balanced Scorecard suggests identifying performance measures based on four key perspectives:

- The Owner/Shareholder’s view of your business
- The Customer’s view of your business
- Internal Processes
- The Learning Organisation

In my view, the first three of these are likely to be highly relevant for benchmarking. The performance measures that are relevant in the final view – the “Learning Organisation” are more likely to be company-specific, and therefore less relevant for benchmarking.

Kaplan and Norton also suggested that there should be relatively few performance measures that are reported in each of these dimensions (but, as discussed earlier, these performance measures could differ as you move down through the organisation – the performance measures that are of interest and relevance to a craftsman or production operator are likely to be different to those that are of interest to the Maintenance Manager or Production Manager, for example).

Let's re-examine the balanced scorecard from the point of view of the Maintenance process, but the principles could be applied to any particular business process that you may be benchmarking.

The Shareholders View – Shareholders are most likely going to be interested in financial and risk performance. The measures that should be developed here are likely, therefore, to include measures of costs, and risks, such as safety, environmental, asset integrity risks.

The Customers View – While I am hesitant to refer to Production as Maintenance's "customer", in this case, let's consider the Maintenance process from a Production perspective. What are they looking for? In this case, the measures are likely to be physical output measures from the maintenance process. These could include measures such as Equipment Availability, Equipment Reliability, Equipment Productivity/Efficiency, Product Quality etc. They may also be interested in other performance measures such as breakdown response times, maintenance workmanship quality etc.

The Internal Process View – In this case, we are interested in measuring the performance of key internal maintenance processes which lead to high levels of performance in the Shareholders and Customers eyes. For example, we may wish to measure the proportion of work that is performed which has been effectively planned and scheduled in advance, or we may wish to measure our labour productivity, the nature of "on-the-job" delays that have occurred, or the number of unpredicted failures.

In each of these areas, there are many performance measures that could be used. Some of these could be more applicable than others. How should we select the most useful performance measures from the rest?

I would suggest a process of selecting benchmark measures that uses the following process:

Brainstorm potential performance measures – identify as many measures as you can that could measure performance in the three balanced scorecard views discussed above. You may wish to supplement this with other measures that are commonly used in industry – refer to other benchmarking studies that you may be aware of, or other publications. Terry Wireman's book "Developing Performance Indicators for Managing Maintenance" (Industrial Press, ISBN 083113080) contains a comprehensive list of over 80 Maintenance performance indicators that may also be useful to consider.

As was discussed earlier, select the most appropriate measures by assessing their:

- Relevance
- Reliability
- Understanding
- Availability of Data
- Timeliness
- Controllability

The importance of consistent terminology

When benchmarking quantitative measures, it is extremely important to ensure that the definitions of the measures used are consistent across all the organisations being compared. For example, take a fairly common performance measure that is used across many maintenance organisations – equipment availability.

What is the definition for equipment availability that is used in your organisation? There are a number of areas where there may be differences in the way that this is calculated in different organisations. For example:

- If your normal production schedule calls for your equipment to operate between 6am and 6pm, 7 days per week, and you choose to perform a service of that equipment “after hours” – for example, between 6pm and 6am, is this downtime included, or excluded from your calculation of availability?
- What about if a maintenance task is started at noon one day, and is not completed until noon the following day – is the downtime for this equipment (and therefore its impact on equipment availability) 12 hours, or 24 hours?
- What if, for operational reasons (say, for example, a product change), production did not require the equipment for two hours between noon and 2pm, and you took the opportunity to perform some maintenance on the equipment during that time – would the equipment downtime be included in your calculation of availability, or not?
- What if you are operating a fleet of mobile equipment, such as a truck fleet. Is the time required to transport the truck from its normal operating area to the workshop, for routine maintenance included, or excluded from the availability calculation? What about the time that the truck is waiting outside the workshop for a suitable service bay to become available?

You can see that, depending on what we include, or exclude from our availability calculations, the recorded figure for availability may vary significantly from organisation to organisation. It is vital, therefore, to ensure that, for each metric that you are using for benchmarking, that you have a common definition that is to be used across all organisations, and that this definition is defined in sufficient detail, to enable valid comparisons to be made.

And this is just one possible benchmarking metric, that, you may think, has a fairly universal definition. There are many other benchmarking metrics that are used that have even less common definitions across organisations, and across industries. For example:

- Reliability (Mean Time Between Failures – what is defined as a Failure?),
- % Planned Work (by jobs, by labour hours? What is the definition of a “planned” job?)
- Schedule Compliance (based on what timeframe – does a job that is done within a schedule period, but not on the specific day that it was scheduled, comply?)

On many, if not most, occasions, the benchmarking definition of a metric will vary from the definition that you use within your organisation. In order to be able to

perform meaningful comparisons, your data will need to be “cleaned” and adjusted to take into account the benchmarking definition. This can sometimes be a lengthy and labour intensive, but entirely necessary, exercise.

Adopting and incorporating best practice

The key aspect of benchmarking to remember is that it is a change process – you can measure and compare yourself with as many organisations as you like, but if, after having done so, you have not implemented any improvements, then ultimately the process has been a waste of time, albeit most likely an interesting one!

While benchmarking, if performed properly, can provide useful insights regarding **what** your organisation should do to make step change improvements in performance, it does not tell you **how** to make those changes. Implementing significant change within organisations is a topic, indeed probably a conference, in its own right, and there is insufficient time or space within this paper to discuss it in detail. However some of the fundamental principles of successful change that I have learnt, through experience include:

- To be successful, there must be a powerful mandate for change within the organisation – the case for change should be clear and compelling, and not changing should not be an option. This is easiest to achieve when the organisation is in significant financial difficulties, but benchmarking can also assist here in providing an indication of the gap between current and best practice. Combining this with appropriate analysis of your competitive marketplace can provide incentive for change.
- Implementing significant change requires commitment from higher levels in the organisation – just how high depends on the nature of the change, but for the largest scale changes, commitment may be required from the CEO and/or the board
- Successful change initiatives proactively manage all stakeholder interests. Stakeholders can have both positive and negative influences on change – these must be identified and proactively managed throughout the change process.
- Successful change requires adequate resourcing – many good ideas have floundered due to a lack of time and/or money being dedicated to their implementation
- What gets measured gets managed – make sure that your change projects are able to visibly demonstrate progress – use visual charts and performance reports extensively to focus attention on what needs to be done.
- Look for “quick wins” – nothing breeds success like success. Getting some runs on the board early in the project helps to generate support for further improvements.
- Overcome the resistance from “conventional wisdom”. How many excuses can you come up with for why changes cannot be made? Your challenge is to replace those excuses with reasons why the status quo is not a realistic option.

Conclusion

So in summarising, there are a few key points to take note of if you wish to effectively perform benchmarking. These are:

- Plan your benchmarking effort carefully
- Perform benchmarking in teams
- Select your benchmarking data sources with care
- Benchmark metrics **and** processes
- Ensure that you effectively implement changes