Knowledge Sharing of Asset Condition Data and Performances

E.Gulski (1), E.R.S.Groot (1), J.J.Smit (2), B. Quak (2)
(1) KSANDR, (2) Delft University of Technology
The Netherlands
e.gulski@ksandr.org

ABSTRACT

Power utilities asset managers face a strong drive to maximize the value created through their assets. Important information in such decisions needs knowledge about asset performance. Techniques and diagnostics for performance indication are therefore applied intensively. Consequently knowledge rules for decision support are indispensable. Based upon a research this knowledge exchange aiming at asset performance knowledge sharing is now under consideration. The research was directed at the estimation of the level of interest for such a sharing and was executed via a survey that was distributed amongst more then 330 T&D utilities in approximately 130 countries and states, representing about 1/3rd of the larger transmission and distribution utilities world-wide. This paper describes some of the results of this survey. Besides some supporting information about the analysis of the survey answers, representing the actual needs of the power utilities asset managers and the possible further steps are given.

Introduction

Forced by the pressure to minimise their operation costs asset managers are increasingly applying risk and reliability strategies. In whichever form presented, both strategies are based upon balancing the locally accepted risk or reliability against the (expected) asset or circuit performance and directed at the support to the asset manager to perform in the best (value directed) way. Figure 1 shows an example of the “balancing” act of an asset manager in these decision-making processes. With regard to expectances and performances all relevant data should, if they exceed a certain limit, come together in a decision support “impact assessment” system for the asset manager.

In this system the correct relations between the different data will advice the asset manager about a decision. Based upon the cockpit information the asset manager controls the information coming in, judges the advice given by the expert system and decides upon and manages the action to be taken based upon the risk he is advised to take [1-4].

Future asset performance is best analysed via a condition assessment based upon failure mode effect based condition measurements. It is evident that the quality of the analysis/assessment increases if more condition data of the asset concerned is available.

The supporting information system

It is evident that decisions supporting either risk or reliability management are based upon the accepted level of risk/reliability and the (expected) performance of the circuits/equipment’s involved. Where the first (risk/reliability) part of this analysis is strongly influenced by the local situation the second (performance) can best be executed by analysing both the dedicated historical as the type based performance data of the assets concerned. It is generally accepted that the type directed information give maximum support because of the “new” nature of the information involved. As a result, the asset managers around the world are confronted with the technical and economical ageing processes (figure 2) of their assets, on the one hand and performance measurement requirements on the other hand.

Due to the fact, that from the technical point of view own assets populations of the same type are mostly not large enough to generate sufficient decision support the utility asset managers are interested in

- Having an expert system to store performance data of your high and medium voltage assets.
- Using this expert system to create operational knowledge of the assets based upon history and type data.
• Using the expert system for the knowledge about the same assets obtained in other networks.

• Disposing about the knowledge for a fraction of the life cycle costs of your assets.

Besides information of asset performance elsewhere would even improve the analysis results. The newly designed software system facilitates the storing and analysing both historical as type oriented condition data and is directed at the generation of new knowledge about the asset performances by embedding of different statistical analysis tools.

Knowledge Sharing Approach

The described analysis above has triggered the authors to start an investigation if there would be a general support for a platform of asset operators that were interested sharing information about asset performances and condition measurements. Logically an approach that is directed at creating new knowledge would be maximally effective if applied broadly. This would give a maximum of data population, which improves the statistical analysis made by the system, and thus the quality and number of knowledge rules. Accordingly the idea of starting up a knowledge platform was born. This knowledge exchange would have the mentioned information system at disposal if all condition measurements would be based upon the same failure mode effect and criticality analysis (FMECA). As a result a generic set of knowledge rules to support risk and reliability directed decisions would evaluate. To check the “market” support for this idea a short survey was organised.

Survey Content and Organization

The survey basically covered questions about the identity and the function type of the respondent followed by questions related to the size and the economical value of the asset network concerned. Besides questions were put forward that would give us an impression about:

• Profile of the responder; e.g. asset manager, service provider, system operator.
• General opinion to support the idea of sharing knowledge about assets through co-operation in a knowledge platform.
• Type of asset knowledge to be shared; e.g. maintenance strategies, inspection / testing results, life cycle, performance (failure rate versus operation period), condition (FMECA based status information), asset quality benchmarking, failure risk of identical assets, legislation.
• Willingness to exchange the information with other utilities.
• The preference for the type and identity of a platform organisation.
• The willingness for paying a fee for the membership including the availability of the concerned software system.

To guarantee the worldwide coverage and the potential progressiveness and to simplify the answering and analysis process the following issues are taken into account:

• The asset operators addressed were based upon personal relations and colleagues from Cigre and Cired organisations.
• Due to the limitation in possible answers and the application of pull down lists a very quick and almost intuitively answer was provided.
• The survey was offered via a web-site www.knowledgeplatform.nl.
• All respondents received feed back with the survey answers in both graphical as figure format.

Survey Results

Of the 330 utilities/asset operators approached 75 reacted in some form with an answer. 55 of them actually filled in the survey, which means a theoretical coverage of about 10% of the world population (table 1) with quite a good geographical cover (figure 3). The 20 utilities that answered without filling in the survey
informed us that they were basically interested but, at this moment, had to many other priorities.
In the following the most interesting results of the survey are presented by the statistical responses.

**Table 1: Geographic origin of the responders.**

<table>
<thead>
<tr>
<th>Region</th>
<th>Responders %</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Europe</td>
<td>16%</td>
</tr>
<tr>
<td>South Europe</td>
<td>12.5%</td>
</tr>
<tr>
<td>North Europe</td>
<td>16%</td>
</tr>
<tr>
<td>Middle Europe</td>
<td>10.5%</td>
</tr>
<tr>
<td>North America</td>
<td>12.5%</td>
</tr>
<tr>
<td>South America</td>
<td>6.5%</td>
</tr>
<tr>
<td>Fare East</td>
<td>10.5%</td>
</tr>
<tr>
<td>Near East</td>
<td>5%</td>
</tr>
<tr>
<td>Oceania</td>
<td>10.5%</td>
</tr>
</tbody>
</table>

Referring to the function within their own organisation the following distribution has been obtained:

- 82% asset manager
- 27% service provider
- 18% system operator
- 16% other functions

More then 92% of the responders support the general idea of sharing knowledge about the assets through co-operation in a knowledge platform.

The opinion about the non-profit character of such knowledge platform was supported by more than 45% whereas only 9% of responders agreed with the profit character of the platform.

About 61% of the responders could not indicate their preference for a legal format of the organisation: e.g. foundation (13%), association (22%) or liability company (4%).

From the technical point of view there was no preference for the data storage and analysis structure, e.g. local server, central server.

With regard to level of independency 25% of the respondents requested a completely independent character of the organisation supporting the knowledge platform.

To cover the operation and administration cost of platform 22% of the respondents were willing to pay an annual contribution of a proposed % of the re-investment value of the assets concerned in the platform.

The response to the question: *In which order of importance the interest to share the knowledge regarding the assets and / or services and / or operations concerned?* is shown in table 2.

**Table 2: Importance of asset knowledge.**

<table>
<thead>
<tr>
<th>Asset Knowledge Issue</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition (FMECA based status information)</td>
<td>70%</td>
</tr>
<tr>
<td>Performance (failure rates versus operation period)</td>
<td>79%</td>
</tr>
<tr>
<td>Maintenance strategy applied</td>
<td>72%</td>
</tr>
<tr>
<td>Life cycle</td>
<td>55%</td>
</tr>
<tr>
<td>Testing / Inspection results</td>
<td>60%</td>
</tr>
<tr>
<td>Information benchmarking regarding asset quality</td>
<td>42%</td>
</tr>
<tr>
<td>Failure risks of identical assets</td>
<td>72%</td>
</tr>
<tr>
<td>Legislation experiences</td>
<td>13%</td>
</tr>
</tbody>
</table>

**Figure 4: Order of importance of the given reasons to apply Condition Based Maintenance.**

**Figure 5: Strategies as preferred in utility organisations.**

With regard to the question about: What is the order of importance of the given reasons to apply Condition Based Maintenance? In figure 4 the statistical response of questioners is shown:

Moreover from the point of view of: Which of these three
strategies are preferred in your organization? The figure 5 shows that RBM and RCM are at present the most used strategies.

**Results Evaluation**

The chi-square and Cramers V² method as well as several correlation’s checked the reliability, validity and reproducibility of the survey answers. Besides the amount of answers (>30%) was sufficient to reflect a representative spot check. The business analysis was based upon the following two hypotheses:

1. There is a world wide support of the idea to exchange asset performance knowledge
2. There is a world-wide readiness to pay a yearly allowance of a proposed % of the relevant asset re-investment value.

Finally the analysis was completed by segmentation of the market into different regions and some recommendations for further actions.

The analysis concluded that the survey results show sufficient reliability and that the most important data exchange need will regard condition, maintenance and failure data.

The respondents emphasize a non-profit, independent platform organisation but do, in general, not accept an annual allowance of the level proposed. A fee to cover the platform costs is however accepted. Almost all respondents are interested to receive future information about the project and basically support the idea of knowledge exchange.

There are some large differences in the opinion of the different world regions, which seems strongly related to the liberalisation philosophy and cultural aspects (e.g. US supports the idea of a profit organisation).

The survey analysis recommends a separation of the market and to base further actions on a SWOT analysis that pays attention to the level of liberalization, culture and influence of already existing benchmarks. It also recommends starting the platform organisation as foundation, being the best and less bureaucratic non-profit format. Main focus should be to demonstrate the support that the designed information system could give and to find a allowance model which is acceptable for the majority of the asset managers.

Finally the report suggests approaching the world community step by step, starting with the regions that seems to support the idea best, and to look for joint venture models to reach the world “arena”.

**Conclusions and further actions**

Although the actual number of respondents seems to be limited it still reflects the opinion of about 10% of the world population representing an asset content of over 500.000 representing a re-investment value of more than 100 billion USD. As a result the following conclusions can be made:

- Without any doubt the asset managers recognise the potential of knowledge sharing on their decision-making processes.
- To support this process independently from commercial drive organisations a non-profit based knowledge exchange has to be organised.
- The collection and analysis of data related to asset condition and performances are of great interest to asset managers.
- The maintenance strategies as well as the experiences on failure risks of identical assets belong to important knowledge issues.

The in 2003 initiated institution organisation Knowledge Sharing and Research (KSANDR) www.ksandr.org now initiate the start up a knowledge platform as advised. Due to the nature of the platform and the added value preferred partners would come from the utility/asset manager groups. It is the intention to describe the foundation goal as

1. to promote and scientifically anchor the experience knowledge about the behaviour of assets as applied in transmission and distribution infrastructures for electricity, gas and water.
2. to stimulate the interest in the involved specialities and educations.

The latter goal comes towards the concern of the engineering society regarding the decreasing interest for education in the scientific area.

As a next step a more sophisticated second survey is now distributed to all the respondents of the first. The main focus of this survey is

- to estimate the most important, asset type directed, condition measurements,
- the most important reasons for the application of condition based maintenance and the preferred maintenance strategy

Based on the answers the knowledge exchange will be capable of directing itself better to the needs of its members.

**References**