Protective Coatings Offshore: Introducing a Risk-Based Maintenance Management System—Part 2: Framework Establishment

S.B. Axelsen,[‡,] O.Ø. Knudsen,** and R. Johnsen****

ABSTRACT

This paper describes a risk-based maintenance management system for protective coatings and how it might influence offshore maintenance processes. Maintenance of protective coatings is one of the more resource-demanding and, hence, costly operations on offshore installations. On older platforms, typically about 5% of all man-hours are related to coating maintenance (including scaffolding). The cost is strongly influenced by initial coating system selection and maintenance strategy, together with the required lifetime. A new, risk-based maintenance management system is being developed, and Part 1 of this series discussed the risk analysis methodology. Parameters influencing the risk related to coating maintenance have been identified, and a framework for control and monitoring of these parameters has been established. This framework aims to optimize maintenance and inspection programs through risk evaluations, and may affect:

- *—inspection methodology and intervals,*
- *—priority-assignment during maintenance,*
- *—coating selection, and*
- *—follow-up of suppliers and contractors.*

KEY WORDS: corrosion control, maintenance, protective coatings, risk

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INTRODUCTION

This paper discusses challenges related to the introduction and implementation of a risk-based maintenance management system for protective coatings. Today, selection, application, and maintenance of protective coatings within StatoilHydro ([Stavanger, Norway] hereafter referred to as the Company) is performed according to NORSOK M-501 and additional Company specific requirements.[1-3] Adding risk-based evaluation criteria to the functional/visual maintenance strategy of today requires a risk analysis methodology. The risk analysis was discussed in Part 1 of this series.[4]

The overall objective of the maintenance management system is to ensure that corrosion protection is applied and maintained in a safe and economical manner throughout the installation's life span. Based on risk evaluations and additional functional requirements, a set of acceptance criteria for coating performance is established. This set forms the framework for any economical analysis. Both the risk management and the economical analysis should consider the entire lifetime of the offshore installations. This includes all life cycle phases from "concept and definition" to "disposal."[5] Traditionally, surface technology has not been widely considered in the early phases of a project, and for existing installations a new maintenance management system will only affect the "operation and maintenance" and "disposal" phases. This paper will discuss, however, the implementation of a risk-based system both in new build projects and on existing installations.

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The risk analysis methodology described in Part 1 forms the theoretical basis for a risk-based coating maintenance management system. However, to define coating maintenance evaluation criteria and a new framework for maintenance management, it is important to understand how the existing maintenance management system works and at which format historical data is available. Today's coating maintenance strategy/methodology within the Company has been described by Røssland.[6] Some of the main features are:

—Offshore platforms are systematically divided into work packages where all coated surfaces are identified. The area of each coated surface has been measured, and a pricing model based on fixed prices has been established. The maintenance contractor is compensated as a function of coating condition and of how much, in percent, of the total area of the work package that has been upgraded.

—Area corrosiveness is ranked on a scale from 1 to 3.

—Coating condition is ranked on a scale from 1 to 5, based on the degraded area/total area ratio.

—Functional requirements with respect to either corrosiveness (3 levels) or visual appearance (3 levels), which in principle defines an acceptance criteria for coating degradation, have been defined.

REQUIREMENTS—A RISK-BASED MAINTENANCE MANAGEMENT SYSTEM

How risk can be included as a governing parameter for managing the maintenance planning will depend upon the project phase. This section discusses how risk analysis and available historical data can be used to establish practical sets of evaluation criteria and requirements for coating selection and maintenance throughout the lifetime of the asset.

IEC 60300-3-14 divides the life cycle into six phases:[5]

—concept and definition
—design and development
—manufacturing
—installation
—operation and maintenance
—disposal

From Concept and Definition to Installation

A maintenance management system focuses, by definition, mainly on the operation and maintenance phase. Maintainability is determined, however, within the anterior phases. Thus, the importance of quality control and follow-up in the early phases of a project could not be overemphasized. Key words for these phases are as follows:

Maintainable Design — With respect to surface treatment, maintainability often is determined by accessibility. Particularly, on some of the older platforms, there are areas that are difficult to access for maintenance due to poor design. Awareness on accessibility has improved, however, since the first platforms were installed on the Norwegian sector. Maintainability is not limited to accessibility alone. Both a design that allows high initial coating quality, e.g., rounded edges, and correct material selection are aspects that need to be considered during design and manufacturing. Operational conditions causing high temperatures or a contaminated environment may prohibit coating maintenance without shutdown of the relevant process. Metallizing or use of corrosion-resistant materials may have to be considered for such areas.

Correct Coating Selection/Specification and Application — Some of the reasons for the coating barrier to fail are incorrect coating selection or application, or simply that coating has not been applied. The latter may seem obvious, but there are projects where, due to a tight schedule, parts of the surface treatment scope are moved from the building and installation phases into the operation and maintenance phase. Experience within the Company shows that installations put into service, with a significant amount of the coating scope remaining, will suffer from back log on maintenance throughout their entire lifetime. The offshore organization is not dimensioned to meet the increased scope, and in the competition for beds offshore, painters are not given priority. The maintenance management system needs to cover the entire life cycle, and this kind of knowledge must be captured within the system. In other words, the system should ensure consistency between initial technical solutions, follow-up during the early project phases, expected lifetime, and number of beds available for coating maintenance personnel. A maintenance management system should not only answer when and where coating maintenance should be performed, but also how and why; i.e., the system shall not only include plans and schedules for the maintenance processes, but also store and structure historical data to allow monitoring, evaluation, and learning. In high-activity market situations, this is particularly important. To either lower cost or because of the lack of capacity with the established suppliers, new and less experienced (with respect to offshore deliverances) suppliers are introduced. These new suppliers may not be familiar with the strict requirements to corrosion protection offshore. Hence, proper quality assurance/control, QA/QC, is essential. On one of the Company's current development projects, coating is applied at about one hundred sites worldwide. Some of these sites/workshops have not delivered according to NORSOK specifications before and the project requires extensive follow-up.[1] Hopefully, the extra effort on QA/QC will not only ensure correct coating selection and proper application, but will also give

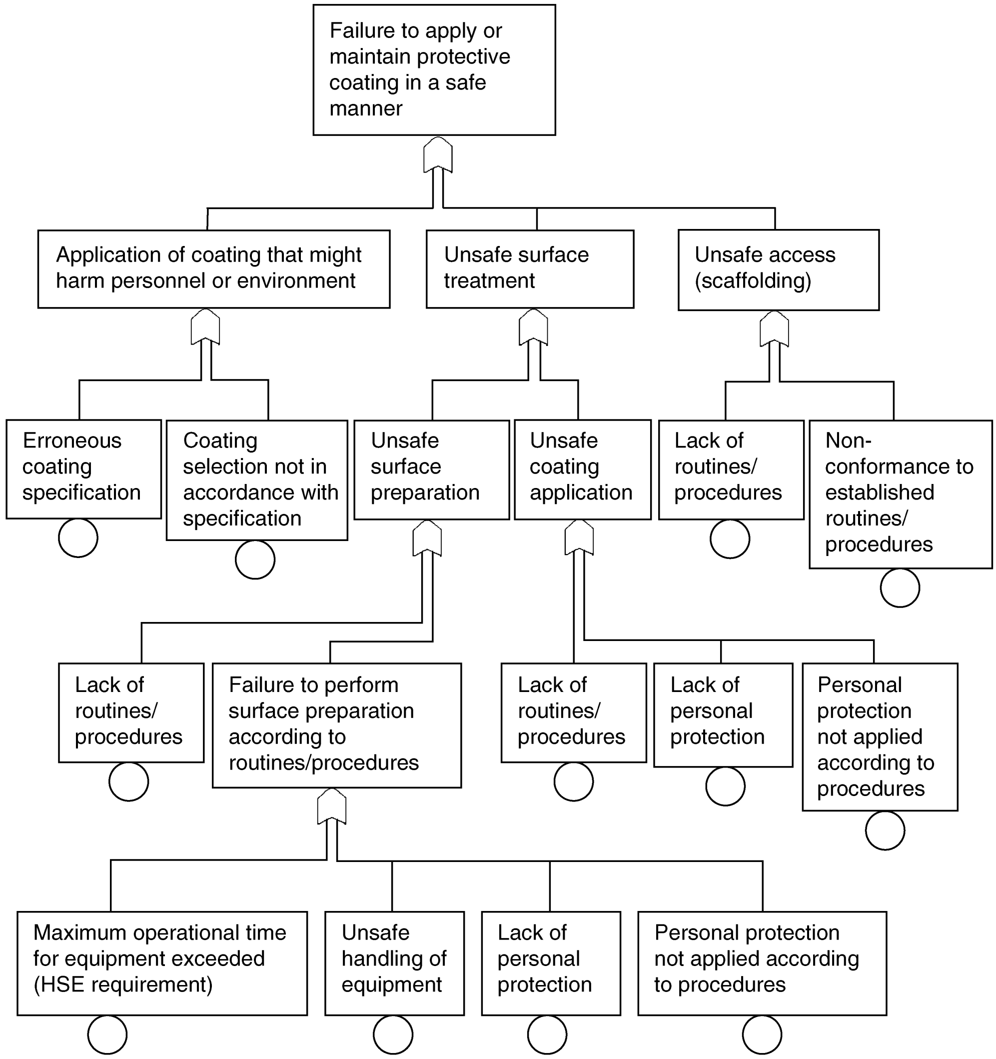

FIGURE 1. *Fault tree analysis for application or maintenance of protective coating.[7] represents an "OR-gate," i.e., the event above will occur if one of the sub-events occur. indicates a basic event, i.e., no further development is required.*

good results on health, safety, and environment (HSE) during the manufacturing/construction phase (Figure 1,[7] fault tree analysis for application). The effort during construction needs to be documented properly and registered in a structured manner, since this is a necessity to be able to monitor and evaluate the effect of risk-influencing parameters during the early phases of projects. According to experiences within the Company, establishing correct coating specifications is seldom a problem. The challenge is to ensure that the requirements are understood and met by the suppliers, and that the quality of the workmanship meets the expectations. Any efforts to improve on this part of the process are therefore essential and need to be documented and learned from within a structured manner.

If feasible, criticality evaluations with respect to potential for, and effect of, excessive external corrosion and area corrosiveness classifications should be considered already in the early phases of the project. Criticality and corrosiveness classifications of areas and equipment will form the premises for inspections and maintenance. Risk and corrosiveness evaluations, however, will often not take place until after the start-up of operation.

To summarize, requirements to the risk-based maintenance management system during early project phases (prior to "operation and maintenance") are:

—Ensure a maintainable design.
—Ensure selection of appropriate technical solutions, and consistency between selected solutions and planned future maintenance.
—Ensure proper quality and safe application of the initial coating system.
—Ensure documentation of (a) technical solutions, i.e., surface preparation and coating selection, and (b) organizational processes and efforts made to fulfil requirements listed in the bullet points above.
—If feasible, establish criticality and corrosiveness classifications of areas and equipment.

Operation and Maintenance

The essential requirements to a maintenance management system during operations and maintenance is to define where, when, how, and why coating maintenance should be performed. A systematic approach for unique identification of all coated areas (equipment, piping, structures, etc.) is required for the planning of coating maintenance. Such an identification system is established within the existing Company framework for coating maintenance. Introducing risk as a governing parameter will affect, however, why, when, and how maintenance is to be performed.

The scenarios discussed in the risk analysis are related to excessive corrosion or industrial injuries/damages during maintenance work. Increased coating maintenance reduces the likelihood for excessive corrosion, but increases the likelihood for industrial injuries/damages during maintenance activities. A maintenance management system needs to address this conflict of interest and define a set of evaluation parameters and acceptance criteria. Since the objective is to maintain the asset in a safe, but also economic manner, an overall acceptance risk level also needs to be defined. In other words, the maintenance management system should specify maintenance to be performed when both:

—the corrosion protection is below an acceptable level, and

—the risk reduction gained from maintenance exceeds the risk related to the maintenance processes.

In principle, if only the first criterion is fulfilled, other compensating measures should be considered, e.g., inspections or monitoring. The dilemma is that the processes are not easily quantifiable. Further, the coating degradation is related to an area, whether it is blistering, cracking, flaking, or rusting, while risk related to corrosion in most cases are related to depth of the corrosion attack. A maintenance planning tool should establish a link between coating degradation history (area and time) and worst-case scenario corrosion depth. The system should also be able to communicate findings of severe local corrosion discovered during inspection or by operational personnel.

The existing Company maintenance management system differs between areas where the functional requirement of the coating system is corrosion protection, evaluated according to ISO 4628,[8] and areas where the requirement is visual appearance (including cleanability). The latter is evaluated on a scale from 1 to 5 based on area and distribution of the coating damage. The new framework is suggested to rank the criticality or importance of a given coated area only on one scale. Given the criticality, corrosiveness, weathering, and coating system, the inspection scheme and acceptance criteria should be defined.

For most offshore platforms, risk-based inspection plans for piping and stationary equipment, which addresses the potential outcome of a leakage due to internal corrosion, have been established. These criticality evaluations could easily be adapted in the risk-based external corrosion protection maintenance management. Similar assessments will have to be performed with respect to structural strength. The criticality evaluations provide a ranking of which areas should be given priority with respect to both inspections and maintenance, and hence answer where, why, and when coating maintenance should be performed. Economical analysis, however, will also affect the decision-making processes. Economical considerations are discussed in detail in Part 3 of this series.

How to perform the maintenance, in addition to existing specifications and standards,[1-3] will have to be based on experiences. The maintenance management system should store historical data and refer to relevant standards/specifications to assist the selection of technical solutions.

As for the initial coating application, it is important to ensure that the maintenance requirements are understood by the suppliers. The new framework should aid communication and documentation of the requirements. Further, the maintenance management system should be able to communicate, e.g., through visualization, planned maintenance operations to relevant personnel.

To summarize, a maintenance planning tool needs to:

—address critical work processes during maintenance;

—store historical data in a structured manner to assist selection of the correct technical solutions;

—refer to all relevant standards and governing documents;

—aid reporting and communication, e.g., through visualization;

—ensure selection of effective and adequate inspection methodology and reporting.

Disposal

During the disposal phase, applied products must be known in case there are special requirements for the protection of personnel or the environment, or any limitations with respect to hot work. This knowledge needs to be captured within the maintenance management system. It should also be possible to report lessons learned during disposal, which could be useful in earlier project phases.

A NEW FRAMEWORK FOR MAINTENANCE MANAGEMENT

This section describes how the new framework suggests meeting the requirements identified in the sections above.

TABLE 1

Proposed Organizational Risk Indicators (Indicative Only)

<table>
<tr><th rowspan="2">Organizational Factor</th><th colspan="2">Organizational Risk Indicator</th></tr>
<tr><th>Early Phases</th><th>Operation and Maintenance Phase</th></tr>
<tr><td>Training/competence</td><td colspan="2">Proportion of painters who have certificate of apprenticeship</td></tr>
<tr><td></td><td colspan="2">Average number of years of experience for the painters</td></tr>
<tr><td></td><td>Number of man-hours for coating specialists during design/engineering</td><td>Average number of years' experience in total for relevant personnel (Company and contractor)</td></tr>
<tr><td></td><td>Average number of years' experience in total for relevant personnel (Company, engineering contractor, suppliers)</td><td>Number of previous contracts with Company</td></tr>
<tr><td></td><td>Number of previous jobs/deliveries to Company (yards, workshops, suppliers of equipment)</td><td>Number of years into current maintenance contract</td></tr>
<tr><td></td><td>Number of previous jobs/deliveries according to NORSOK M-501 (yards, workshops, suppliers of equipment)</td><td></td></tr>
<tr><td>Procedures, guidelines, instructions</td><td colspan="2">Number of JSAs[A] carried out</td></tr>
<tr><td></td><td colspan="2">Proportion of relevant personnel having received JSA training</td></tr>
<tr><td></td><td>Proportion of equipment where coating/paint specification were included in invitation for tender</td><td></td></tr>
<tr><td></td><td>Project/installation specific paint specification (yes/no)</td><td></td></tr>
<tr><td>Planning, coordination, organization, control</td><td colspan="2">Proportion of critical jobs being checked</td></tr>
<tr><td></td><td colspan="2">Incentive for the contractor to apply or develop new and better technology (yes/no)</td></tr>
<tr><td></td><td colspan="2">Number of applications for deviations</td></tr>
<tr><td></td><td colspan="2">Number of QA/QC audits</td></tr>
<tr><td></td><td colspan="2">Number of man-hours for trained inspectors (FROSIO or NACE certificate[B])</td></tr>
<tr><td></td><td>Company representative with expertise within coatings present at site during construction (yes/no)</td><td>Established reporting routines for observations of critical coating failures or damages to thermal insulation (yes/no)</td></tr>
<tr><td></td><td></td><td>Established routines for coordination of activities between the different disciplines, e.g., scaffolding (yes/no)</td></tr>
<tr><td></td><td></td><td>Coordinated programs and reporting systems for the different disciplines (yes/no)</td></tr>
</table>

[A] JSA–Job safety analysis.
[B] FROSIO is a professional council based in Norway. Like NACE, they are a certification body for coating inspectors.

From Concept and Definition to Installation

Compared to the functional/visual maintenance strategy of today, introduction of risk as a governing parameter brings more focus on organizational aspects. To build on the existing model and data, a two-split framework including technical evaluations and organizational evaluations is suggested. Technical issues and evaluations in the early project phases may be handled through QA/QC processes and proper specifications, since they are within today's system. The new framework, however, should ensure that the chosen technical solutions are reported and available, e.g., through coating specification, technical data sheets, and inspections reports, within the maintenance database. Any deviations from the specifications should also be reported. The idea is to collect all documentation in one system to ensure easier access to data relevant to maintenance processes and to be able to sort historical data on a format that can assist and ensure correct coating selection in future projects. Further, t is suggested to evaluate and rank all contractors'/suppliers' technical processes on a scale from 1 to 5:

1 – well below Company average, should normally not be accepted
2 – below Company average
3 – Company average
4 – above Company average
5 – well above Company average

The evaluation should comprise design, surface preparation, coating application, and HSE aspects.

Organizational parameters are also suggested to be evaluated according to the scale above. A modified Organizational Risk Influence Model approach is suggested,[9] where the contractor's/supplier's organization is evaluated with respect to:

—training and competence;
—procedures, instructions, and guidelines;
—planning, organization, coordination, and control.

These three parameters may be assessed through a list of indicators, as shown in Table 1.

The technical and organizational evaluations should be performed simultaneously, and are expected to correlate. For instance, it would not be logi-

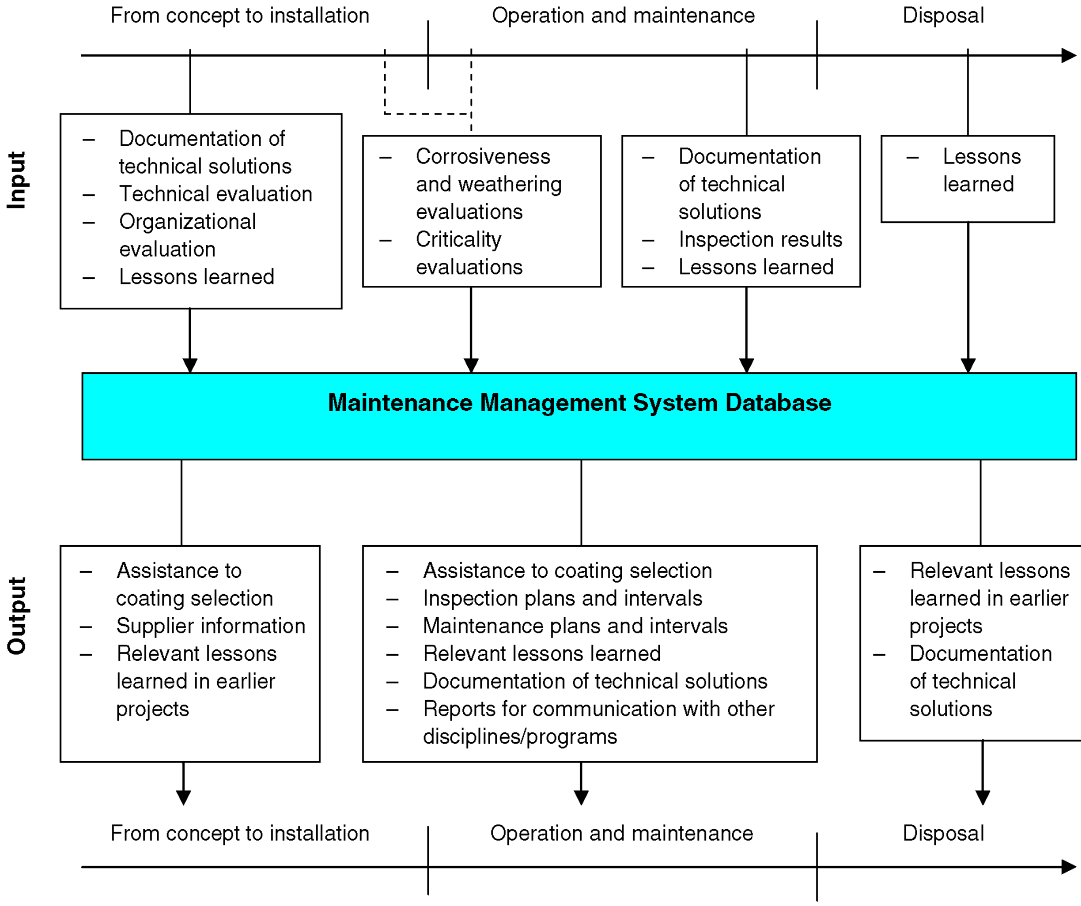

FIGURE 2. *Schematic outline of the new maintenance management system with required input and possible output as a function of project phase.*

cal if the technical processes were ranked well above Company average if there has been limited or no control to ensure that this is the case.

A formalized organizational evaluation is expected to increase focus on HSE during manufacturing and initial coating application, and hence lower the risk for accidents. Reward suppliers who deliver both good HSE results and good scores on the organizational evaluation could be considered included in the contractual scheme.

Operation and Maintenance

As pointed out earlier, a system has been established that identifies coated areas and equipment on a level suitable for risk evaluation and risk-based maintenance. Ideally, the risk evaluation should be performed in the earlier project phases, but the evaluation will be performed, in most cases, in the operation phase. For static process equipment, the existing risk-based inspection (RBI) framework will provide useful input with respect to criticality evaluations. Output from the new coating maintenance management system will also be useful to the RBI, and interfaces and interactions should be established. Evaluations similar to those for static process equipment will have to be performed also for dynamic equipment and structures if considered relevant. The evaluation should cover risk for leakage, loss of structural strength, and if fire protection is to be included, fire hazards. As indicated in Figure 2, the risk evaluations are considered to be input to the coating maintenance framework, and will not be discussed further in this work.

With respect to coating maintenance, the criticality (as evaluated by relevant personnel) is suggested ranked on a scale from 1 to 3:

1 – low (e.g., low-pressure water systems)
2 – medium
3 – high (e.g., high-pressure hydrocarbon systems)

Both corrosiveness and weathering are also suggested ranked on a scale from 1 to 3. Corrosiveness is defined according to the ISO 12944 classification,[10] (Table 2), while weathering is classified in this way:

1 – indoor conditions
2 – outside, partly shielded from UV, wind, and water exposure
3 – outside, fully exposed

Together with an identification code for the applied coating system, the data are registered in the

TABLE 2

Corrosiveness Classification for the Risk-Based Maintenance Management System, Based on the ISO 12944 Classification

Corrosiveness Category According to ISO12944-2	Corrosion Rate (μm/y)	Suggested Classification
C1	≤1.3	1
C2	>1.3 to 25	
C3	>25 to 50	
C4	>50 to 80	
C5-I	>80 to 200	2
C5-M	>80 to 200	
	>200	3

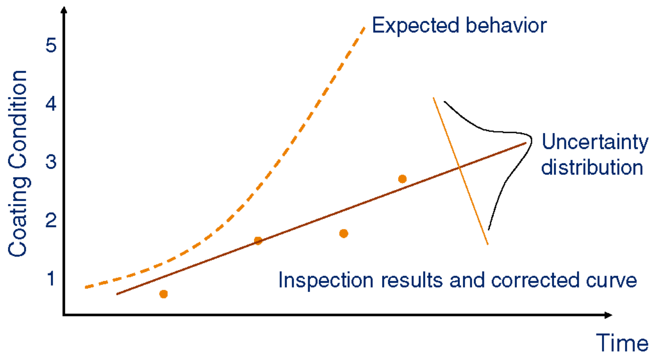

FIGURE 3. *Coating degradation vs. time. The broken line indicates the expected coating performance, which the maintenance planning is based upon. If the coating performs better or worse than expected, the system should establish a corrected curve, and maintenance plans should be revised. When revising the maintenance plans, a safety factor should be included to compensate for uncertainty.*

maintenance management system database for each item identified in the work packages. This allows sorting of relevant data on coating performance, and will help ensure correct coating selection (both for maintenance and initial coating application). Anticipated coating degradation vs. time curves, based on historical data, are valuable inputs to the planning of both maintenance and inspections (Figure 3).

The evaluation of both the technical processes and the organizational aspects suggested for the early phases of projects should also be performed in the operation and maintenance phase if possible. The format for such evaluations will have to be adjusted to the organization for the installation in question, because there are variations in the degree of follow-up by the Company. For technical evaluation of the coating maintenance processes, self-evaluation by contractor or third-party inspections may be considered. For organizational evaluation, see suggested indicators in Table 1.

In principle, the classifications above could be used to define inspection intervals. Company experience does indicate, however, that the inspection typically is not a time-consuming process, and that the inspectors, when they are offshore, may inspect all coated areas. Still, the classifications should be available to the inspectors as an indication of which areas are of particular interest/importance.

Today, inspections are performed by bringing a list of the items within the defined work package and relevant drawings, and then the inspectors manually register the coating conditions. Afterward, the results are input into the database/archive. Within the new maintenance management system, hand-held computers are suggested to be used. Further, the data from the maintenance database could also be visualized by color codes in 2-D or 3-D models where such models are available. The principle, including the previously discussed interaction with external programs, is illustrated in Figure 4. Such a system is believed to improve and lower the risk related to inspection through:

—Lowering the likelihood for erroneous registrations because the process will be performed only once. The database will be updated automatically when docking the hand-held computer.

—Having the 3-D model available in the field. The process and pipe systems on offshore installa-

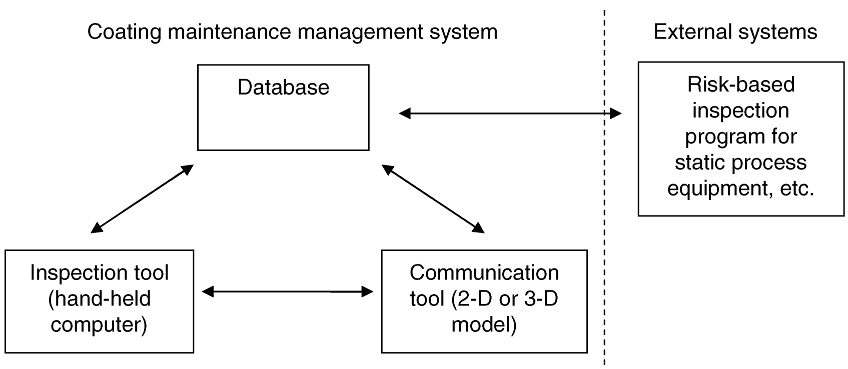

FIGURE 4. *Illustration of the three elements that form the ICT tools in the new maintenance management system, and the interactions with external systems.*

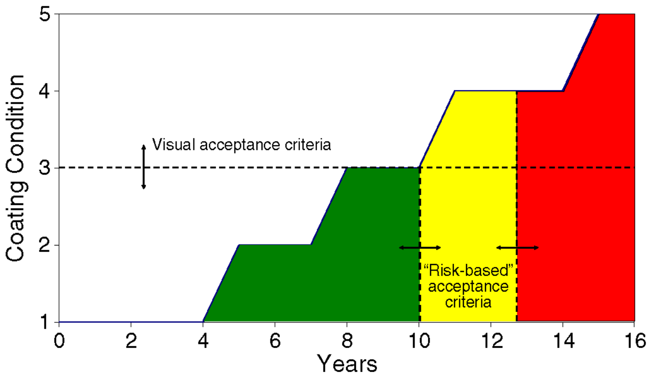

FIGURE 5. *Description of risk-based and visual acceptance criteria for coating performance.*

TABLE 3

Coating Condition Definition[3]

Coating Condition	Percentage of Total Area Requiring Surface Preparation	Percentage of Total Area that has: 1) Defective Topcoat, 2) Lack of Full Coating System, or 3) Film Thickness Below 60% of Specification
1	0 to 3	0 to 5
2	3 to 8	5 to 20
3	8 to 20	20 to 40
4	20 to 40	40
5	>40	

TABLE 4

Risk-Based Coating Maintenance Criterion

Criticality	1	2	3
Corrosiveness	C_{Hist} Yellow/red	C_{Hist} Yellow/red	C_{Hist} Yellow/red
1			
2		Decreasing values →	
3			

tion may be complex, and sometimes it is difficult to be sure that all coated surfaces of a given item have been inspected. Visualization of the item in a 3-D model will be helpful.

—Having less paperwork in the field. Registration on paper can be a challenge in the often windy and wet offshore conditions. Further, it is not always convenient to carry the necessary paperwork when inspecting less-accessible areas.

The use of 2-D or 3-D models and color codes for visualization is believed to be of great use not only to coating inspection, but also for communication of planned maintenance processes to other disciplines. Identified benefits are:

—The likelihood for industrial injuries/damages is a function of, among other parameters, man-hours. The number of man-hours for scaffolding or other access techniques can be reduced if coordinated with other disciplines. The need for scaffolding is easily communicated by visualization.

—Inspection results and observations relevant to other disciplines are easily communicated.

—Findings of local severe corrosion can be highlighted and visualized.

Figure 5 illustrates a methodology for introducing risk-based criteria for when to perform maintenance. Coating condition is determined based on the established coating condition definitions (Table 3). Based on a time–coating condition curve, there may be established both a visual acceptance level and an acceptance criterion based on coating performance history. The latter is based on likelihood for severe corrosion, i.e., a risk-based criterion, and divided in a yellow regime where coating maintenance should be considered and a red regime where coating maintenance must be performed. The visual acceptance level is based on either purely visual appearance or also on cleanability or economical evaluations. The example shown in Figure 4 indicates that the protective coating should be restored when the coating condition has reached level 3 (which in this example is after 8 years in service). The actual acceptance level may vary between areas and installations. The risk-based coating condition acceptance level is suggested determined through the use of a coating history factor, C_{Hist}:

$$C_{Hist} = \sum_{i=0}^{i=n} \text{Condition\_year\_i} \qquad (1)$$

Risk becomes a governing parameter through the acceptance criteria for C_{Hist}. The yellow and red limits will be defined within the maintenance framework as functions of criticality and corrosiveness. High criticality and corrosiveness give low C_{Hist} acceptance levels, which means that the coating must be kept in good condition (low condition number) most of the time. The methodology, illustrated in Table 4, is based on the assumption that there is a correlation between coating condition or degradation history, and the likelihood for detrimental external corrosion. The example in Figure 4 indicates that the coating should be considered restored after 10 years and that it must be restored after about 12.5 years in service. The actual Company limits will be based on expert judgement. The system should also allow manual override of the default values, e.g., in case inspections show that the corrosion is not critical and/or that the remaining required lifetime is short.

The C_{Hist} methodology allows use of the established coating condition definitions (Table 3), and the reporting format is already known to the industry. The methodology, however, may suggest more selective coating maintenance than today's system. Particularly when maintaining areas requiring scaffolding or use of other access techniques, maintenance of larger areas should still be considered for economical reasons. Capacity/resource considerations may also overrule the recommendations from the C_{Hist} methodology. Due to the size of the scope, maintenance may have to be started before the coating status becomes critical. Large variations in the year-to-year manning are usually no option. Economical and strategic considerations will be discussed further in Part 3 of this series.

Maintenance activities should be planned within the maintenance management database, and all prevailing standards and guidelines for the maintenance work should automatically be addressed by the system.

An example to summarize the methodology: Inspection of a pipe system coated with coating system X shows that the coating condition, evaluated in accordance with Table 3, has reached condition 3. Earlier, the coating condition for this system has been reported as condition 1 for 5 years and condition 2 for 3 years. The coating history factor, C_{Hist}, for the system is then (1 5) + (2 3) + (3 1) = 14. This paper does not present the actual yellow and red limits discussed above (Table 4). However, let us assume that given the criticality and corrosiveness for this pipe system, C_{Hist} = 14 is within the "yellow regime"—maintenance should be considered. As an input to the evaluation, the database will then be able to provide:

- —expected further coating breakdown for coating system X at the given weathering and corrosiveness levels, based on empirical data within the Company;
- —any findings of severe local corrosion attacks;
- —visualization of the coating condition for nearby components/structure, and scaffolding requirements.

Together with considerations related to the visual appearance, available capacity/resources, and economical aspects, this information forms the basis for the decision-making process.

Disposal

During disposal, the database will provide reports showing which products, with full history and documentation, have been used in given areas. Furthermore, reports from earlier projects will be available, Figure 2.

CONCLUSIONS

❖ A new risk-based maintenance management system for offshore protective coatings has been described. Through use of models and analysis tools recognizable to the offshore organization, risk-influencing parameters have been identified, and a framework for control and monitoring of these parameters has been established. Some of the main features of the new maintenance management system are:

- —All documentation and data relevant to coating application and maintenance throughout the entire lifetime of the asset is coordinated in one database.
- —Formalized evaluation and monitoring of parameters important to coating performance. This data allows sorting of relevant historical data, and will be of use for both initial coating selection and selection of maintenance coating.
- —Through formalized evaluations of organizational aspects, parameters like training, procedures, competence, and control routines will become focused areas.
- —In addition to the existing functional or visual acceptance criteria for coating performance, risk-based criteria have been defined.
- —Use of new Information and Communication Technology (ICT) tools will improve inspections and form a foundation for better communication and coordination with other disciplines.
- —All features of the new framework will supplement the existing maintenance system. Hence, a gradual implementation of the new system will be feasible, and historical data can easily be adapted to the new format.

❖ The new system is believed to improve the quality of coating processes, including controlling and lowering the risks related to these processes.

❖ Part 1 of this series described the risk analysis methodology.[4] While this second part of the series has been devoted to the new technical framework, Part 3 will discuss economical and strategic considerations.

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