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Integrated E-maintenance and Intelligent Maintenance Systems

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20.1 Introduction

Development and acquisition of technological capabilities has become one of the major strategic requirements to excel commercially today in various business sectors. Front-end innovative technologies in conjunction with mass globalization and outsourcing of industrial operations has created a fruitful environment for technology-based growth and excellence. Different industries are in search for various technological solutions in their continuous efforts to improve performance in different parts of their businesses. Advanced solutions are often found implemented within range of application areas varying from corporate information management to logistics planning and coordination activities. In this setting, both industrial assets and business processes have been subjected to a technology-driven change process.

As the industry began to pay more and more emphasis on quality, precision, task sensitivity, and product life cycle considerations, the automation solutions for production, manufacturing, and process plants are gradually taking central stage. This brought a major impact on the massive use of robot technology, electronics, advanced programming and mathematical modeling, that were earmarked for sophisticated technical solutions within the operational environments. Most of the complex and capital-intensive industrial plants and facilities, in particular, displayed the tendency to become fully or semi-automated, targeting various business benefits. Some of the core technologies were seen put into very practical and productive use during this period in production, manufacturing, and process environments. Use of such technologies for operational purposes still continues and apparently grows towards more advanced level of applications for relatively complex usage.

The growth of information and communication technologies (ICTs) has certainly brought a new dimension to the industrial plant or the facility environment today. This is not only in terms of abilities for creating repositories of gigabytes of data in comprehensive Enterprise Resource Planning (ERP) systems,
but also with respect to effective and efficient management of daily plant operations and maintenance activities. ICT is in fact a principal landmark in this setting today, and a major contributor to the current level of sophistication in the use of advanced technical solutions to resolve plant or facility related problems. With the parallel advancement in instrumentation technologies, analytical software and mathematical modeling, the industry has been presented with substantial potential to implement innovative solutions to improve operations and maintenance (O&M) practice. This has brought much optimism to different businesses, which still rely much on the conventional O&M practices, pushing those industrial sectors to exploit numerous opportunities to reduce commercial risks associated with plant operations.

Technical condition and safety integrity of plants or assets in operation are defining factors for risk mitigation and value creation. Formally, the technical condition can explicitly or implicitly be expressed by means of different terms including reliability, availability on demand, downtime (or uptime), history of failure, actual capacity utilization, failure frequency, and scale of losses. Obviously, the behavior of systems and equipment under a given operational setting, their functional characteristics, and the technical faults and failures, actively contribute in defining technical conditions of operating plants or assets. It implies that the ability of the operator to identify systems or equipment malfunctions prior to any unwanted event or an incident is very important part of risk mitigation and value creation efforts. In principle, such ability relies much on the technical data obtained from technical systems and equipment, and the decision support setting of the operator. Proper instrumentation of critical systems and equipment plays a vital role in the acquisition of necessary technical data, while the support of analytical software with embedded mathematical models is crucial for the decision making process. This explanation in fact presents the very basics of the O&M intervention process that aims at retaining or restoring systems or equipment in a particular condition so that the plant or the asset complies with specific level of performance (see Figure 20.1). The technical instruments in use and the analytical software and tools provide necessary engineering basis to monitor the condition of systems and equipment of any given asset. Results from this condition monitoring process are the inputs to the decision platforms and processes of the plant or the asset operator in making diagnostic or prognostic decisions. If a fault or a failure is imminent, then necessary work orders are issued for the O&M crew.

This O&M intervention process illustrates the very basic concept behind condition-based maintenance (CBM) practice. The wide spreading concepts of e-maintenance and intelligent maintenance systems can exploit the availability of a CBM platform and take the form of advanced applications employing modern ICT, robust technical infrastructures, and sophisticated electronic gadgets and data acquisition technologies.