SUBJECTS	DEFINITIONS OF SUBJECTS
Maintenance within Physical Asset Management	
Life cycle extension	Maintenance is particularly concerned with the decision to extend the lifetime of assets. Indeed, the durability of assets and their renovation costs can be decisive factors in the choices made by assets managers.
Replacement investments	Replacement investment is generally an optimization problem often linked to life extension of items. Operational research techniques are used to find the best trade-off between costs and expected benefits of replacements.
Rebuilding & Reinvestment strategies	Rebuilding and reinvestment strategies depend in part on the maintenance effectiveness and maintenance costs. The assets reliability and maintainability assessed through the analysis of experience feedback are important elements for decision-making.
Integrated Logistic Support	"Management process to co-ordinate the provision of all materials and resources required to meet the needs for the operation and maintenance." [IEV 50(192)] ILS is a method introduced by the US Army (MIL-STD1388) to consider the activities and resources required to operate and maintain a product in service. It covers maintenance actions, manpower, training, spare parts provisioning, technical documentation, packaging and handling, storage and transportation, support equipment (tools, test and monitoring equipment, software) and disposal. Logistic Support Analysis (LSA) must be performed iteratively throughout the design process in order to ensure that the product can be operated and supported at an affordable cost. Indeed, the expenses due to logistic support are a major contributor to the life cycle cost (LCC) of a product and increasingly customers are making purchase decisions based on life cycle cost rather than initial purchase price alone.
Regulations and relations with auditing & safety organizations	A part of the maintenance tasks are required by regulations and close relationships must be established with the organizations/authorities in charge of safety of the installations to carry out and monitor the mandatory tasks. In addition, internal or external audits are often carried out to verify the implementation and results of maintenance, which is a strategic function for companies. Knowledge of regulations and relevant technical standards are paramount.
Facility management	To ensure, support and improve the effectiveness of the organization's core activities, actions as cleaning operations, routine maintenance on buildings (painting, plumbing, glazing, etc.) must be carried out.
Maintenance Management	
Lean Maintenance	The objective of Lean maintenance is to link different methods as TPM, RCM, Kaizen, etc. in order to improve productivity and quality and to reduce the amount of inputs and wastes. The use of CMMS (computerized maintenance management system) or EAM (Enterprise Asset Management) is strongly advised. Lean maintenance is rather principles than a formalized method.
Customer satisfaction surveys	An effective customer satisfaction survey program allows measuring customer perceptions of how well the requested performances are meet. In addition to the measurement of objective performances, perception of how customer's problem is understood is an important factor. Different techniques can be used to collect customer satisfaction (face to face, questionnaires, automatic notifications, etc.) and to analyze the results.
Decision making in maintenance	Decision in maintenance must often consider multiple criteria leading to complex choices. Decision making techniques can be used to aggregate criteria, to evaluate the costs and benefits of the alternatives and to synthesize the opinions of experts.

Design out maintenance	Design Out Maintenance consists of eliminating the need for maintenance during the design phase of an item. That can be done though over-sizing of items or any other solution which makes it possible to avoid critical degradation mechanisms or the consequences of these mechanisms. It can also results in determination of ways to detect hidden failures.
Maintenance execution	
e-maintenance	e-maintenance is a maintenance performed via computing, usually remotely, to monitor equipment and detect early degradation so that it is possible to refurbish the equipment at a convenient time.
Remote maintenance	Remote maintenance consists of maintenance actions "performed without direct physical personnel to the item". Robots can be used to perform this kind of maintenance.
Disassembly and reassembly processes	Disassembly and reassembly of items sometimes require special studies due to their accessibility and to the accessibility to their components. Computerized simulations of items' handling, storage and repair can be used to determine feasibility and to optimize maintenance times.
Reliability & maintainability improvements	when preventive maintenance does not provide good operational reliability or when maintainability is not sufficient to achieve a good level of availability, improvements of item are required in terms of reliability or maintainability. Analysis must be carried out to assess dependability characteristics and identify efficient and cost effective changes in the item design or manufacturing.
Health, safety and environment in maintenance	
Good practices in environmental preservation	In the field of environment preservation, good practices must be identified and shared in order to reduce pollution and damages to the environment. The pooling of good practices, both to prevent risks and to reduce their consequences must be undertaken systematically and as widely as possible.
Maintenance engineering techniques	
FRACAS (Failure Reporting Analysis Corrective Action System)	FRACAS methods are based upon the principles of problem solving techniques, they aim to improve the dependability of current and future designs by feedback of testing, modification and use experience. They include methods as PCDA (Plan-Do-Check-Act), DMAIC (Define Measure Analyse Improve Control), Ishikawa, KT (Kepner and Tregoe), KAISEN, 6 SIGMA, 8D (8 Disciplines), A3 (Toyota method), etc.
Fault diagnosis	Fault diagnosis covers the methods and techniques that make it possible to detect faults and to locate them. This includes testing for fault detection on standby items and techniques for localisation of faulty components when an item is in downstate due to failure.
Root Cause Analysis	Root cause analysis (RCA) is a "systematic process to identify the cause of a fault, failure or undesired event, so it can be removed by design, process or procedure changes" [IEV 50(192)]. Root Cause Analysis is a method to identify the preliminary causes of an event (especially failures). Different techniques can be performed to find causes, as why-because analysis, Ishikawa diagrams, fault trees, Bayesian networks, etc. It is based on past events in order to avoid recurrence of similar situations by changing conditions, actions or organization and to improve continuously the maintenance process.

Equipment health analysis	Prognosis and Health Management (PHM) is a discipline which uses news technologies (especially digital electronics) to assess health of items (degradation levels) and to predict in real-time their reliability and remaining useful life. It is used in different industrial sectors such as aerospace, military systems, automobiles, etc., to improve maintenance and logistic support. That allows to carry out maintenance based on current and predicted health of the items and to be more efficient in detecting faults or degradations and in decreasing downtimes and costs.
Ageing and degradation mechanism modelling	Prediction of failures requires representing the failure mechanisms of items which can be done using : - "Black box" approaches based on the statistics of time to failure (distribution of useful lifetimes), - "Gray box" approaches that represent the evolution of degradation over time from measurements but without describing the physical mechanism, - "White box" approaches based on simulation of a physical model of the failure mechanism.
Human error analysis	Methods may be used to assess the probability of a human error during the completion of a maintenance task and to reduce this probability. They consider human factors having a significant effect on performance and may use cognitive models of human behavior to understand how and why humans make mistakes in order to propose prevention actions.
Robotics and remote handling	Special constraints (safety, accessibility, precision, etc.) lead to use robot or remote handling to carry out maintenance tasks. Many industrial sectors as space, aeronautics, energy, medical, etc., use these techniques.
Augmented reality techniques	Augmented Reality allows superimposing information about an item or a document. This enables maintenance personnel to have up-to-date technical documentation, safety information, lists of operations to be performed, diagnostic tools, etc., while they carry out maintenance tasks on an item.
Maintenance tasks modelling and simulation	CAD (Computer Aided Design) models can be used to test maintenance tasks in order to optimize disassembly, repairs, assembly, handling, etc., to decrease time to restoration and costs and to increase safety. These simulation tools are also useful to help trainees learning maintenance procedures through interactive exercises.
Maintenance of real estates	Wharehouses, workshops, offices are infrastructures that require constant maintenance to ensure that the installations function properly and to prevent unforeseen expenses. In particular, emergency items and infrastructures must be maintained according to given regulations.
Maintenance support	
Fundamentals of projects and control management	Project management plays a crucial role in achieving objectives. Different methods are used to determine tasks, milestones and schedule. They allow identify the critical path and know how to react quickly and be agile in case of unexpected events. They are used to create teams, to communicate, to prioritize everyone's tasks and to monitor the progress of the project.
Negotiation techniques and industrial relations	The maintenance manager must set up a network of industrial relations and know the negotiation techniques. These techniques consist of knowing how to set specific goals, how to listen the other parties, ask the right questions, propose innovative solutions, make concessions to find a compromise and finalize agreements. The manager must develop the necessary qualities to be a good negotiator.
Best practices identification	Identification and measurement of KPI and comparison to points of reference, for example, through benchmarking or modeling and simulation, provide directions for improvement. Then the last and essential step of the improvement process is to propose and to implement actions. Identification of best practices with questionnaires, interviews, etc., especially from the best organizations identified through benchmarking, and adjustment of these practices to the company can be used to carry out appropriate improvement actions

Tools for expert evaluation	Expert judgments are very often useful when decisions have to be taken without available quantitative data. Various methods and tools exist for assessing and combining expert opinions. They allow elicitation of quantities and uncertainties, frequencies, probabilities, etc. and can provide consensus expected to be better than individual judgments.
Maintenance documents	Maintenance documentation contains different types of documents (equipment technical data, maintenance plans, maintenance procedures, spare parts catalogs, etc.) which must be managed in order to be available when required with relevant and updated information.
Maintenance standards	Many maintenance standards are produced by various technical committees of standardization bodies at the national (national standardization bodies), European (CEN/TC319) and international levels (IEC/TC56, ISO/TC108, 135, 251, ...). These standards are documents, usually of voluntary application, that represent a consensus of experts on a given subject. It is important to monitor them, to participate in their development and to keep an up-to-date list in relation to the topics covered.
Maintenance knowledge & best practices	Maintenance improvement is based on Maintenance knowledge & best practices. That requires learning, training, benchmarking and implementation of better ways of ensuring high maintenance performance. Benchmarking makes it possible to identify best practices which must be analyzed and adapted to other context. Maintenance knowledge must be capitalized and carefully transferred within the company which requires an ad hoc organization.
Education & training in maintenance, E-learning in maintenance	This subject contains all the pedagogical resources that allow the initial education and the continuous training in maintenance methods, techniques and practices as well as all the support knowledges which are required at the different levels of responsibility.
Communication, training and coaching : basic principles and techniques	The explanation of maintenance objectives and strategies, the supervision and coordination of activities and the presentation of maintenance results require good knowledge of oral and written communication techniques. The ability to establish effective relationships with people involved in maintenance activities, company employees as well as external service providers, is essential to manage all the tasks to be performed with maximum efficiency. Communication, training and coaching techniques must be mastered by everyone involved in maintenance management.
Competences, qualification and Certification of maintenance personnel	Work profiles require different levels of competence and some require qualification or certification from maintenance personnel. It is necessary to establish the relationships between the positions and the requirements in terms of competence, qualification and certification.
Instrumentation & Wireless techniques	Instrumentation techniques are progressing and they make it possible monitoring and diagnosing better and better the equipment and predicting their future behaviors. These means lead to evolution and effectiveness increase of condition based maintenance techniques, and more particularly of predictive maintenance tasks.
Visualization for maintenance diagnosis	The maintenance diagnosis requires the use of signals or images visualization techniques to compare them with references. These techniques make it possible to reveal deviations and to deduce the level of severity of the degradations or failures observed.
Traceability	Traceability is an important characteristic for maintenance since it allows the causal chain between events to be established and thus to understand the phenomena, the situations and their root causes. The traceability of components is also sometimes necessary to better manage risks and ensure a high level of reliability.