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Thesis position

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Optimization of the maintenance process through the monitoring of the equipment's health condition during its life cycle

Keywords: intelligent maintenance, s-maintenance platform, knowledge oriented platform, maintenance domain ontology, prognostic and health management, traceability, equipment's life memory, web service for equipment monitoring, diagnostic.

The problematic to solve in this thesis is between two communities of study: the PHM (Prognostic and Health Management) which develops predictive maintenance strategies and the PLM (Product Life-cycle management) which studies the management of the life cycle of a product from its design to its recycling. One of the interests of this study is the recycling of components having reliable traceability of their health condition during their operating phase. The place of maintenance in the life cycle of a technical complex product and the sharing of the information about the product and the processes of its life cycle will be privileged to ensure also the sustainability of the product (equipment).

The objective of this study is from one hand to optimize the industrial process of maintenance and in the other hand to design and develop a solution allowing to elaborate and to capitalize the knowledge related to the health state of industrial equipment through its life cycle, in order

1. to ensure its traceability through the monitoring of the vents related to failures which can occur on the components of this equipment and to their occurrence context subject to extreme conditions or not.
2. to provide this knowledge to the maintainers of the equipment, with a comprehensive manner and at the moment that they request it, in order to improve the maintenance supports systems.
3. to elaborate for each useful component a memory containing date, information, synthetic criteria and knowledge allowing to define different maintenance services, such as the possible reuse of components, knowledge extraction from data ensuring a feedback experience on the health state of this component.
4. to lengthen the useful life time of the equipment by using the knowledge of its life cycle.

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Consequently, we are interested to one step of the life cycle: the maintenance step in order to ensure the monitoring of the complex equipment's behaviour, through a maintenance web platform, cooperative and distributed user and knowledge oriented.

We will rely on the works of the PROMI research team in this domain, where a first platform of s-maintenance has been realized in the framework of the SMAC project (S-maintenance and life cycle). This platform proposes web services associated to different maintenance support systems and has as main characteristic, contrary to e-maintenance platforms, to be knowledge oriented. Its architecture relies on the knowledge management module and consequently is based on the expert knowledge formalized by domain ontology.

From these works, we propose to design a s-maintenance platform adapted to the studied equipments and to propose several maintenance services such as the online monitoring of the health state of the system, the diagnostic and/or the prognostic, services on the life cycle especially the elaboration of dedicated memory, registering all the knowledge related to the equipment's life, memory which is available for consultation through ITCs of last generations, feedback experience service about the equipment, etc.

The work requested in this thesis will be oriented according two axes: the first concerns the elaboration of a s-maintenance platform by considering the works of the PROMI team in the domain, and the second the development of services in the platform from the platform ontology, the gathered data and the expert knowledge related to the complex equipment:

1. Axis s-maintenance platform and architecture: a state of the art on different existing maintenance platforms and their maintenance architectures is requested. From the maintenance needs in the project, choose the adapted modules to construct a dedicated s-maintenance platform and define the different services which will be developed in this one. Re-update the existing maintenance ontology which must be instantiated to the complex equipment and which allows to define the specific knowledge.
2. Axis collection and data-information-knowledge processing: register the data types, information, and knowledge which must be collected, processed, formalized and elaborated in the platform.

Formalize the maintenance expert knowledge associated to the equipment to be monitored, its functional and dysfunctional analysis, its actual analysis and its physical decomposition. A state of the art on these different existing models is requested in order to propose a modelling of these information and knowledge, in the objective of defining processing leading to propose:

- a service of online monitoring requiring a data collection module, where the data can be provided by different origins, associated to detection module of the operating modes,
- possibly, and if necessary, a prognostic service,
- a diagnostic service defining the component which is the cause of the failure,
- etc...