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Information modelling for building maintenance using mobile clients

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Energy efficiency and more effective management of maintenance processes in buildings is a critical aspect to modern facility management (FM). With advances in ICT more informed decision making can be made available to maintenance engineers, in addition to more coordinated administration activities by facility managers. With the use of mobile technology, a more intuitive decision making process for maintenance can be achieved (Tolman et al., 2009).

Our research is part of the ITOBO project which aims at enabling the development of a holistic, methodological framework for life-cycle oriented information management and decision support in the construction, operation and maintenance, and energy-management sectors. The domain-specific goal is to develop an anticipating, smart building that operates on an energy efficient and user-friendly basis while reducing its maintenance costs (ITOBO, 2008).

To create a platform to support performance-based maintenance (PBM), a definition of performance criteria must be modelled. Once we define the performance criteria, the application of fault states can be applied to equipment and system performance procuring a more effective means of applying fault detection. This information can be presented to the facility manager or maintenance engineer pinpointing the cause of the fault and the other systems that will be affected.

The initial step is to use an existing standard to classify the individual components and systems in the ERI Building. CIBSE and ASHRAE standards were consulted in order to provide this classification and IFC standards were also incorporated (CIBSE 2005; RA99 1999; IFC).

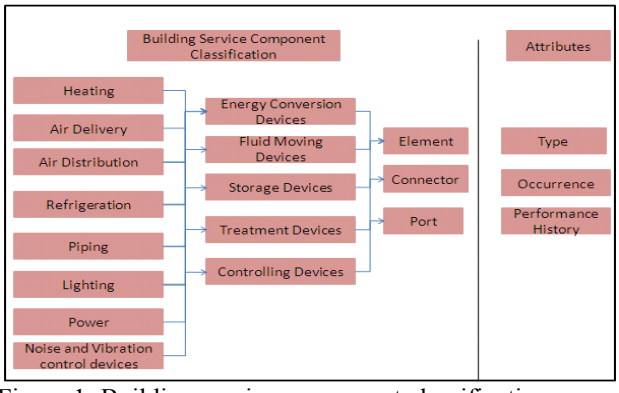

Figure 1: Building service component classification

Each component has a number of operating states which it can be in. The table summarises the states of components in the solar circuit.

Table 1: Solar Circuit – Operating states of components

Component	**Component Name**	**States**
Heat Exchanger	*HE 02*	ON/OFF
Diverting Valves	*VS1*	OPEN/SHUT/THROTTLE
	VS2	OPEN/SHUT/THROTTLE
Solar Circuit Pumps	*P06 A*	ON/OFF
	P06 B	ON/OFF

Coupled with these states, sensors/meters have been placed within the solar circuit to view performance levels. The details of this sensing/metering are listed in Table 2.

Table 2: Solar Circuit – Sensors for monitoring components

Component	**Sensor Purpose**	**Type**	**Units**	**Range**
Solar Panel	Fluid Outlet	Temperature	Celcius	-
Solar Panel	Fluid Inlet	Temperature	Celcius	-
Weather Station	Sunlight	Radiant solar ray	W/m2	-
Heat Exchanger (HE-02)	Outlet water	Temperature	Celcius	-
Diverting Valve (*VS1*)	Actuating Valve 1	-	%	0-100
Diverting Valve (*VS2*)	Actuating Valve 2	-	%	0-100

When a fault is being diagnosed, it is necessary to be able to decide what is causing the fault and also be able to pin-point exactly where the fault has occurred. To facilitate the process of highlighting the fault occurrence, tabular decision trees were used. Table 3 is an example of the tabular decision tree for fault finding for a heat exchanger.

Table 3: Heat Exchanger Fault States

Fault	**Fault**	**Possible Cause of Fault**
1	Reduced Capacity	Reduction of the heat transmission and/or a rising pressure drop
1.1	External Leakage	Running with a higher working pressure than specified on name plate
1.2	Inside Leakage	Liquid is mixed and is due to holes in one or more plates

The methodology used in analysing system or subsystem failures and states is based on performance-based maintenance. Individual plant or parts are evaluated for their performance against a standard, expectations or set rules. Different failure states are analysed and traced to determine their impact on the overall performance. The use of equipment performance data can be more effectively used to assist in FM processes.

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