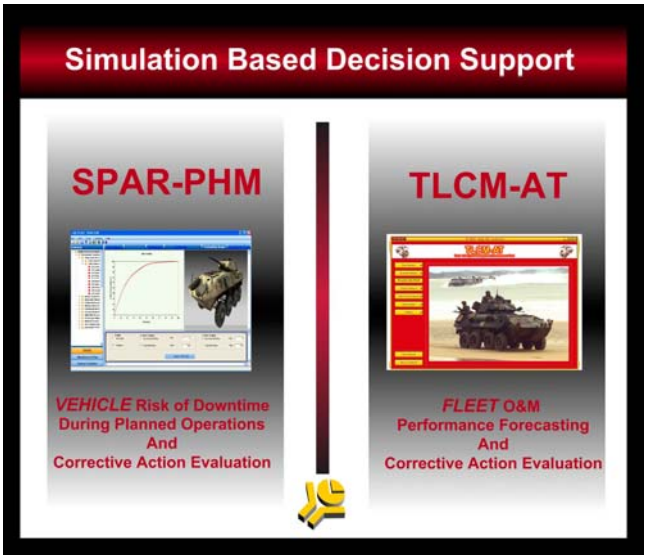
CLOCKWORK SOLUTIONS

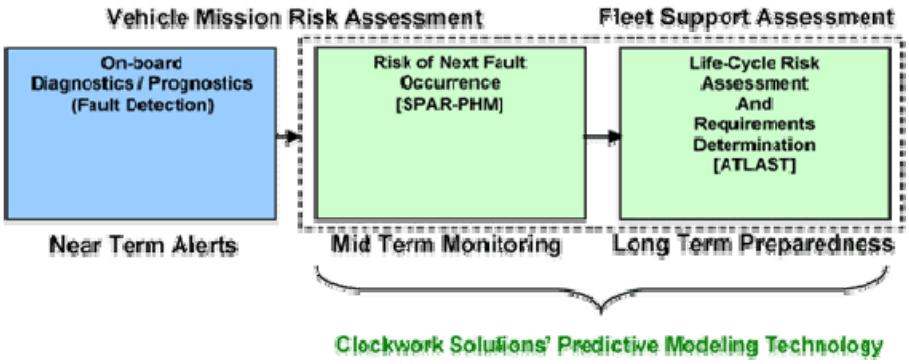
PRODUCT DESCRIPTION

SPAR-Proportional Hazard Model (SPAR-PHM™)



Condition Based Maintenance is an automatic process established to generate an alert when an equipment fault has occurred (or is soon going to occur) within a system. **SPAR-PHM™** further enhances CBM-enabled processes by providing enhanced capabilities to pre-plan for required logistics support by providing risk based notifications of *pending* faults, against any level of risk identified as unacceptable. Finally, advanced simulation-based life cycle performance prediction tools, such as **ATLAST™** and **TLCM-AT** provide a comprehensive, mathematically sound means of forecasting requirements in order to better control and manage life cycle uncertainty across a diverse and global fleet.

Clockwork Solutions' technology bridges the gap between near term alerts found in various Health and Usage Monitoring Systems (HUMS) technologies and longer term aggregate fleet planning tools and methodologies. It enables a means to deal with situations where logistics lead times dramatically exceed the lead time window supported by traditional short term alert systems. Quantifying the relationships between equipment conditions, described by quantitative health indices, and the application of logistic support elements in the form of parts and labor requires a high-fidelity model.



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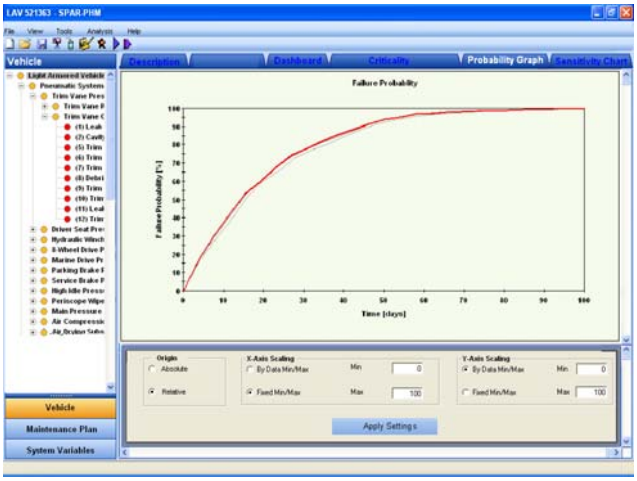
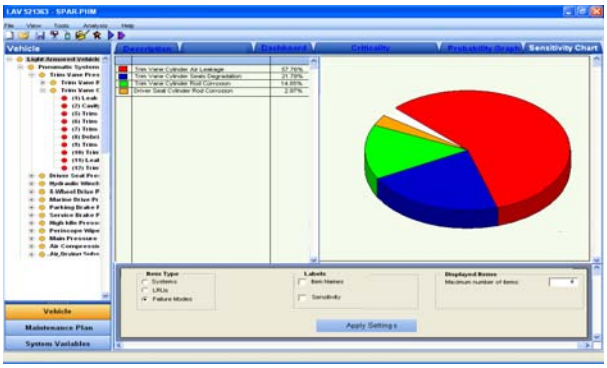
Since machinery events and human actions-based processes often exhibit variability and uncertainty, a time based modeling method must be employed that can closely emulate these random behaviors. Clockwork Solutions utilizes an effective methodology based on the Monte Carlo simulation method applied to a reliability block diagram representation of the systems, expanded with supporting process rules (planning, scheduling, materials ordering, work execution, etc.). This permits simulating expected equipment behavior without ignoring its probabilistic nature alongside with logistic support infrastructure, to predict economic and performance metrics of the systems over time. With the availability of on-line, real-time data systems providing machinery performance and condition assessment related information, the simulation model can provide dynamically changing predictions, allowing for more intelligent decision management throughout the system life cycle.

Clockwork Solutions applies the *Proportional Hazard Methodology (PHM)* as a probabilistic survival analysis tool to support the periodic adjustment/refinement of equipment failure rates. This technique provides a basis for identifying factors (covariates) influencing aging and degradation of equipment. Inclusion of these types of covariates within a PHM analysis actually produces a family of lifespan distributions that portrays the probability of survival across time of a sub-population within the overall population.



SPAR-PHM applies PHM principles by incorporating a PHM-based model for each failure mode within the system. Each PHM model will have one or more covariates that are used to project the variation in probability to failure over previous values determined from previous covariate readings. As covariates change with time so will the probability associated with the 'prediction' of an equipment failure mode occurrence. Ultimately, SPAR-PHM will continuously evaluate covariate readings with the associated equipment/failure mode PHM models, and predict future system failure probability as a function of current equipment state and planned operations or scenarios of use.

SPAR-PHM provides additional insight into criticality of equipment components and sensitivity of components to overall system performance.



Clockwork Solutions' technologies incorporate higher fidelity decision support capabilities into a growing and demanding sense and respond, autonomic logistics and overarching condition based maintenance market space.

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