The Avantis Solution to Asset Performance and Reliability
Reliability Centered Maintenance Enablements of Avantis

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ABSTRACT
In an ideal sense, the path to asset performance and reliability begins with establishing sound fundamentals in terms of business practices, organization effectiveness and well-deployed informational tools to support them. From this foundation, proactive steps can be taken to drive performance and reliability to new heights. Engaging in collaborative tactics unleashes the full creativity of the organization, thus broadening and extending the possibilities and leading to continuous improvement.

In reality, the extent to which organizations pursue the path to asset performance and reliability excellence depends on their perception of the cost versus the benefits they believe are possible and practical within the context of their business environment.

As solution providers, Invensys is positioning products and services that are fully scalable to meet the varied demands of a broad range of organizations as they endeavor to improve asset performance and reliability while at the pace, and to the degree, they deem appropriate.

THE PATH TO ASSET PERFORMANCE AND RELIABILITY
The path to asset performance and reliability excellence can be viewed as a journey through multiple platforms of maturity and growth.

The diagram here (Fig. 1) describes this as having four distinct levels:

- The Fundamental Level establishes the foundation on which the successive levels can be built.
- The Proactive Level defines the elements necessary to take control.
- The Collaborative Level focuses on and unleashes the creativity of the organization to open new doors.
- Continuous Improvement – The ultimate level nourished by leadership and support.
Each platform can contribute significant performance and reliability benefits although the commitment in terms of time and resources increases accordingly. The extent to which organizations pursue the path to asset performance and reliability excellence depends on their perception of the cost versus the benefits they believe are possible and practical within the context of their business environment.

**FUNDAMENTAL - ESTABLISHING THE FOUNDATION**

The business practices and procedures that the organization chooses to use, together with the organizational changes in terms of culture, roles and responsibilities, training, etc. supported by a well-deployed Enterprise Asset Management (EAM) system, defines the foundation that is fundamental to improving asset performance and reliability. Without first establishing a firm foundation, proactive and collaborative measures will not achieve their potential.

**Organization leadership and skills management**

The journey begins with management developing a vision and a set of supporting principles to guide the thinking of the organization towards asset performance and reliability excellence and demonstrating unfaltering commitment to its pursuit. Management commitment means that, beyond providing system support budget and resources, management must demonstrate high visibility and commitment to change within the maintenance department. Leadership also means addressing reward and recognition issues to enable a changing culture.
Alignment of business processes with best practice

"Best practices" benchmarks come from documented strategies and tactics, employed by companies held in high regard. These companies are not "best-in-class" in every area (such a company does not exist). But due to the nature of competition and their drive for excellence, the identified practices have been implemented, are used and respected to help place their advocates as the most admired, the most profitable, and the keenest competitors in business.

The world-class Avantis® EAM solution is based on the philosophy of accepted “Best Practices” for maintenance and materials management professionals. Further, Avantis offers sufficient flexibility to allow independent business process enhancement by users to continue “Best Practice” process improvement.

Avantis implementation

Invensys has developed a rapid deployment methodology for Avantis called InRIM™ (Industrial Rapid Implementation Methodology). The InRIM methodology was developed in response to the common needs of a broad cross-section of organizations that were asking for:

- Rapid implementation
- Low risk
- Low cost to implement
- Minimum demand on internal resources

The InRIM structured, multi-component methodology assures a low-risk initial implementation of the Avantis solution without compromising the ongoing evolution and continued growth of the applications in use.

The InRIM methodology includes predefined business processes founded in Best Practice, a preformatted core database configured to support those processes, implementation tools and templates, structured workshops and a data conversion tool. End-user training is also provided using standard training and reference materials.
InRIM\textsuperscript{plus} builds on the Avantis implementation to provide the client organization with additional business process and organizational features that make the realization of business benefits a reality. While the core of the InRIM approach including the preformatted database remains consistent, the activities are broadened based on client-specific applications of Best Practice principles.

**PROACTIVE – TAKING CONTROL**
With the fundamental elements in place, the organization is empowered to truly influence asset performance and reliability. The proactive level includes:

- **Condition monitoring** which involves tapping directly into control data sources to capture statistics to manage preventive maintenance and to enable instant reaction to failures when they occur, or preferably, before they occur.

- **Preventive maintenance** which covers the range of periodic tasks (from inspections and adjustments to component replacement) that are performed on assets on an elapsed time, or preferably, a usage basis in order to keep assets functioning.

- **Predictive maintenance** which goes a step further by using non-destructive testing methods to uncover hidden or pending failures in their primary mode.

Measurements, or KPIs (Key performance indicators), are used to convey strategic direction, to allow the organization to select and evaluate tactics needed to pursue the direction and to monitor operational performance related to those tactics.

- **Benchmarks** provide a specific comparison of relevant KPIs against known standards of performance or the performance of complementary processes or companies that are considered as good examples of achievement.

Fundamental to taking control is the collection of accurate maintenance and materials management activity data and the transformation of that data into information through relevant compilation and presentation. With insight, direction and involvement, this information provides the knowledge to guide tactical planning and decision-making processes.
Our view of asset management and reliability extends to all critical assets and processes within the environment that contribute to the performance of the plant and ultimately to the performance of the business. Within this context, Invensys offers the Asset Intelligence Suite™, encompassing:

- Avantis Enterprise Asset Management
- Field Device Manager
- Condition Monitoring
- Decision Support System

These components each provide strong independent value, but when combined, they allow our customers to move to a fully predictive and pro-active management environment that allows them to focus on asset and plant performance and the overall return on assets of the plant.

COLLABORATIVE – UNLEASHING CREATIVITY
Two key elements are defined at the collaborative level:

- TPM (Total Productive Maintenance)
- RCM (Reliability-centered Maintenance)

Total Productive Maintenance
TPM has been defined as changing the corporate culture to form a partnership with engineering, maintenance and production focused on improving equipment effectiveness, and product quality and reducing waste, while continually refining teamwork among labor, management and individual workgroups.¹

TPM begins with a sound maintenance program that includes effective preventive maintenance programs, planned and scheduled maintenance, training programs, EAM system, and moves beyond into a more quality-focused employee empowerment approach.

As with the proactive level, the collection of accurate maintenance and materials management activity data and the transformation of that data into information through relevant compilation and presentation is critical for an effective TPM program. With insight, direction and involvement, this information provides the knowledge to guide the TPM teams in their tactical planning and decision making processes.

The Avantis solution acts as the central collection point for all asset information (cost, performance and history) and provides unparalleled access to this data allowing you to maximize the return on your critical assets.

Reliability-centered Maintenance
RCM is defined as “A process used to determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating context.”

The classic RCM methodology as presented by Nolan & Heap recognizes three pillars:

1. Failure modes and effects analysis (FMEA) is a structured analysis based on experience and “what if.”
   - Functions: What are the functions and associated performance standards of the asset in its present operating context?
   - Failures: In what ways does it fail to perform its functions?
   - Failure modes: What causes each functional failure?
   - Effects: What happens when each failure occurs?
   - Consequences: In what way does each failure matter?

2. Decision algorithm determines the maintenance action plan and its execution in terms of:
   - Proactive tasks: What can be done to predict or prevent each failure?
   - Default tasks: What should be done if a suitable proactive task cannot be found?

3. Age exploration
   - The continuous analysis, revision and upgrade process

There are numerous variations and derivatives of the classic RCM process in use today; most of which are aimed at facilitating the failure modes and affects analysis and developing the appropriate plan of action. These methodologies are often supported by tools such as:
   - RCM Analysis Software
   - RCM Forms Generators
   - RCM Spreadsheets

Reliability is the responsibility of “all” employees, not just maintenance. Unreliability or failure, thus downtime, is the consequence of poor processes, not events. There is a process behind each of the six points listed above, for example. This means that there must be considerable effort devoted to eliminating defects that cause failure. This, in large part, is RCM.

2 “Reliability-centered Maintenance” by F. Stanley Nolan and Howard F. Heap, 1978
RCM/RCO enabled Avantis software will facilitate and support organizations that have chosen to engage in an RCM process. While the Avantis solution is not positioned as RCM analysis software, it:

- Fulfills the essential core functions required to support reliability strategies
- Maintains openness to the exchange of information with virtually any commonly used analysis tools
- Conforms to standards and best practices

Specifically, the Avantis solution facilitates the collection of information needed to perform in-depth failure analysis. Typically, this type of failure analysis will be applied to critical entities only; that is, equipment or components whose failure results in a loss of production, impacts safety, or has a negative effect on the environment.

The Avantis solution includes the ability to capture the tradesperson's interpretation of the cause and required actions needed to resolve the problem as well as the actual statistical information available at the time of failure. Downtime is also a critical component for failure analysis. Both production downtime and maintenance delays may be recorded with the failure, as both can contribute to the total time that a critical entity is unavailable for use.

Our future vision includes the provision of web services to enable integration to FMEA software tools and to enable integration to continuously refine empirical modeling for case-based intelligence tools and advanced dynamic monitoring tools.

Fig. 3 – Graphical view

Phase 2 delivery will be dependent on market opportunity and partnership potential to provide the capability.
The Avantis Entity object allows the customer to identify that an entity is RCM enabled. For these types of entities, additional attributes are provided to enable entry of failure information to be enforced. The function of an entity can also be described, and costs related to downtime may be entered to facilitate cost analysis related to failure, to be performed.

In order to facilitate a failure analysis process, it is important to capture the statistical readings in effect when a failure occurs. Hence, related statistical information may also be captured at the time the work order is created, when work is triggered via Condition Monitoring, or recorded after the fact in Avantis, when work is completed or closed.

In order to ensure that the failure information collected is accurate, it is possible to direct it through a review process and, subsequently, allow it to be accepted as entered, or modified. Avantis supports an approval process for failure information to ensure data integrity for analysis purposes.

Reliability Centered Operations (RCO) expands the idea of RCM as purely a maintenance tactic, to include all areas of an organization. Operational inputs, as they pertain to determining maintenance strategies, are used when looking at equipment reliability, which extend from a tactic to a state of mind or culture within an organization. Reliability should be a measure for both maintenance and operations.

To run world-class uptime (85 to 95% as a rough measure), equipment must be reliable which encompasses more than the maintenance team. Reliability is the responsibility of “all” employees, not just maintenance personnel. The maintenance strategy needs to keep one eye on reliability and the other on maintainability. The operational strategy should be designed so that operational parameters are driven and determined by the need to maintain inherent reliability.

To push machinery operationally past that point will cause reliability degradation. As a result, machinery operates in a state of inefficiency. This is only acceptable if it is deliberately determined to operate in this mode to achieve a specific goal, and then usually only for a specific time frame. When examining the life cycle of a particular machine, keeping RCO in mind, the following should be considered:

1. Plant must be designed for reliability and uptime
2. Equipment/spares must be purchased with the purpose of reliability, not just cost
3. Equipment/spares must be stored to retain its reliability
4. Equipment must be operated reliably using process limits
5. Equipment must be correctly installed to lead to a long life
6. Correctly installing equipment leads to a long life
All plant personnel are responsible for following processes; doing all the small things prevents the “big one.” It is important to measure the organization holistically to ensure accountability. Process integration within all areas of a plant and committed team work with clear, strong leadership facilitate reliability and uptime using RCO. RCO facilitates reliability as Asset Performance Management facilitates utilization and availability. Reliability, along with Maintainability, are the two main facets of availability employing RCO which helps facilitate APM.

CONTINUOUS IMPROVEMENT – THE GOAL
Continuous improvement creates an ongoing environment of reanalysis and renewal. It involves shifting paradigms and opening possibilities that evolve over time as business needs dictate.

PRODUCTS AND SERVICES TO MATCH YOUR GROWTH
Ideally, organizations would evolve through the progressive platforms of asset performance and reliability excellence. In reality, the extent to which an organization progresses depends on their perception of the cost versus the benefits they believe are possible and practical within the context of their business environment.

Fig. 4 – Products and services to match your growth