WHITESTEIN Technologies

Solution Profile *LS/AMC – Living Systems® Autonomic Machine Control*

An Autonomic Control Software for Machine Optimization

Solution features

- Autonomic module control optimizes operation and capacity utilization of each module
- Self-controlling orders allow for dynamic optimization even with batch sizes of 1
- Comprehensive simulation mode
- Seamless integration into existing environments and ERP-software
- Virtually unlimited scaling possibilities
- *CANopen* standard interface

Solution benefits

- More flexibility in module setup and combination
- Reconfigurations possible while system is running
- Higher reaction speed to customer and order requirements
- Improved logging and maintenance
- Competitive advantage through innovative offering

Flexibility and Adaptivity as Key Success Factors

Efforts to increase the flexibility of production lines are a pivotal trend in manufacturing. Whole assembly lines as well as individual machines are increasingly subdivided into modules in order to adapt precisely and just in time to constantly changing specifications (quasi make-to-order). An instance of this trend can be also found in micro production.

However, the centralized, 'hardwired' design of traditional control software imposes limits on successfully dealing with unpredictability. It is thus necessary to choose a novel approach to the development of control software, such that it is capable of managing modular machines dynamically and with minimal manual intervention. This allows a production line to continuously adapt to changing boundary conditions and order specifications.

Such a control system stands out due to its superior flexibility and adaptivity and drives the automatization and optimization of modern production lines further – while at the same time embracing the rising complexity and dynamics of their environment.

An innovative offering in this area is a key differentiator for all vendors and users of modular production lines.

Requirements for a Future-Proof Control System

This new generation of control software has to fulfill a number of special, advanced requirements. Their unique value is to minimize the complexity of development, operation and maintenance of machines, without reducing the degrees of freedom for future application scenarios – even such that are not (yet) foreseeable at the time of a facility's design and installation. Specifically, this means:

Automatic equipment adaptation

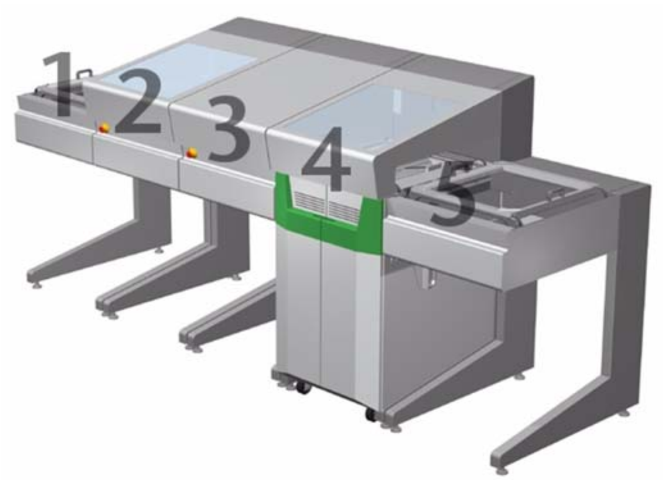
The control software of a modern production line should automatically adapt to the ideal equipment configuration for each order. This all but eliminates the need for manual reconfiguration. It also ensures that future enhancements of the system remain possible with only minor outlay.

Dynamic performance optimization

The capability to dynamically optimize capacities with changing configurations and target values is a top-most priority. It ensures maximum throughput and minimizes idle capacities and rejects.

Robust failure resistance

To minimize maintenance efforts, a modern control system should detect any malfunctions immediately. Failures should be adequately assessed and resolved or bypassed.



The autonomic control system solution with LS/AMC *optimizes the operation and capacity utilization of this facility's five modules dynamically for each order and in all combinations.*

Keyword: Autonomic IT-Solutions

The ever-accelerating complexity and dynamics of IT-systems makes their administration and optimization with only human resources no longer feasible or at times even impossible. Hence, it is reasonable and necessary to equip IT-systems with capabilities that allow them to increasingly administrate, monitor and maintain themselves.

These *self-management* properties of so-called *autonomic solutions are:*

- ***Self-configuration:*** The system automatically changes its operating parameters to adapt to mutable external conditions, some of which may even be unpredictable at the time of a system's development.
- ***Self-optimization:*** The system continuously assesses its own performance, explores possible courses of actions that would result in performance improvements, and adopts the ones that are most promising.
- ***Self-healing:*** The system has abilities to recover from certain unfavorable conditions that may result in malfunctions. It autonomously attempts to determine compensation actions and performs them.
- ***Self-protection:*** The system detects threats against its functioning and takes preventive and corrective measures to ensure correct operation.

Whitestein Technologies is first to apply these advanced concepts of autonomic IT to the control of modular production lines.

Due to its autonomic self-control abilities, *LS/AMC* is ideally positioned to successfully embrace the highly complex and dynamic environment in manufacturing.

This leads to significant benefits and cost-savings in operations in the near and long term.

Flexible integration capability

At the macro level it is required that an innovative control software for modular production lines offers standard interfaces to integrate it into a total production control system.

Modern user interface

Not least, such an advanced solution also needs to provide a modern user interface. It offers simple controls for the machine operator, extended functionalities for specialists and technicians, and comprehensive remote maintenance capabilities via the Internet.

A Unique Solution with *LS/AMC*

With *Living Systems® Autonomic Machine Control (LS/AMC)*, *Whitestein Technologies* offers an autonomic control software solution that taps the full potential of modular production lines.

This is made possible through the first-time application of a novel software engineering concept in the area of machine control. Instead of a monolithic product, *LS/AMC* offers a comprehensive modular solution that consists of autonomous, self-managing software components. These so-called *software agents* have unique abilities and characteristics that are not attainable with a 'hardwired' architecture of the control software (*see left column*).

LS/AMC offers the full functionality of a comprehensive solution and is individually customized to the requirements of the specific deployment scenario.

The special features of a solution with *LS/AMC* are:

Autonomic module control

Every machine module is represented by a specifically adapted software agent that optimizes the module's functioning and capacity utilization.

Superior coordination

Through permanent bilateral negotiation and coordination between neighboring modules (i.e., of their software agents) the system constantly reaches a state of superior coordination. This eliminates the need for a central control instance.

Self-managing orders

As for every module (resource), software agents also are responsible for the control of each production unit (order). They self-manage the order's progress through the machine(s) autonomously and ensure that all requirements relating to (cost-)efficiency, speed and quality are optimally satisfied.

Distributed communication

The decentralized approach based on bilateral communication allows for virtually unlimited scaling possibilities, while at the same time increasing the robustness to malfunctions and various external influences.

Future-proof interface

At the controller level, *LS/AMC* works with *CANopen* as the established industry standard, which ensures openness when enhancing a setup in the future.

Benefits of a Control System with *LS/AMC*

Flexibility

The modular and distributed architecture of *LS/AMC's* agent system allows for easy addition of new modules, without causing fundamental changes in the existing system architecture.

The introduction of new kinds of machine modules only requires the development of a new module agent, which can be integrated into the current (and running) system with minimal effort.

Adaptivity

Modules that are failing or in need of maintenance can be exchanged while the system is running. Thanks to *LS/AMC's* distributed system architecture and adaptivity, such changes at run-time are possible without requiring a restart of the software.

The introduction of new optimization algorithms is also very straightforward. In order to implement additional optimizations, it is sufficient to adapt the directly involved agents. The existing system architecture remains fundamentally untouched.

Furthermore, due to its distributed logic, an agent system can react with more speed and robustness to changing requirements than conventional systems with a central, static control.

Maintainability

Compared to traditional procedural or purely object-oriented approaches, the agent-oriented design of *LS/AMC* offers the advantage of intuitively mapping the real-world production line and order structure 1-to-1. This makes the system better to understand and use, increases its durability, and improves its maintainability.

An agent system also supports the easy and targeted customization of logging routines at the process level. This ensures the availability of more helpful and efficient methods of error monitoring and analysis.

Simulation

Complex simulation scenarios are easy to develop with *LS/AMC*, since a realistic mirror of a production line is more straightforward to simulate than an abstract model. Many different machine states and process flows can be recreated quickly and realistically. This significantly reduces the cost of quality control and improves personnel training and product demonstrations.

Goal-orientation

Software agents are capable of explicitly representing partially conflicting goals. Order agents, for example, may pursue the minimization of throughput time. Module agents, on the other hand, may have the goal of optimizing the modules' resource consumption. With *LS/AMC* they do not block each other, rather they coordinate towards an optimal performance.

Dynamic optimization

A production program is coupled to each work piece and moves together with it through the facility's modules. The modules adapt to the particular program – and even anticipate such adjustments when appropriate. Thus, the program is linked to the individual order or batch and not tied to a central, fixed setting for the entire facility.

Technical footprint

- PC or embedded industry-PC
- Supported operating systems: Linux, embedded Linux
- Supported databases: relational and embedded databases (e.g., Derby)
- Programming language: Java
- Controller interface: CANopen

Contact Information

Whitestein Technologies AG
Patrick Brunschwig
Vice President Logistics & Control Systems
Tödistrasse 23
CH-8002 Zürich
Switzerland
Phone +41 44-256-5000
Fax +41 44-256-5001
E-mail pbr@whitestein.com

For more information, please also visit our Web site at
→ http://www.whitestein.com.

About *Whitestein Technologies*

Whitestein Technologies is a leading innovator in the area of software agent technologies and autonomic computing & communications. *Whitestein Technologies'* product offering includes advanced solutions for the telecom, logistics, financial services, and manufacturing domains, as well as a comprehensive middleware for the development and operation of autonomous systems. *Whitestein Technologies'* customers and partners include leading global enterprises in the above markets, as well as technology companies, system integrators, universities, and other research institutions.

Whitestein Technologies was founded in 1999 and is privately held. The firm is headquartered in Zug (Switzerland) with offices in Zürich (Switzerland), Donaueschingen (Germany), and Bratislava (Slovakia).

wt.mkt.lsamc.profile.en | v1.4 | 2009-10-22 | MFE