Optimisation through digitisation: Red light for energy guzzlers... and more

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INTRODUCTION:

Integrating energy data with a Manufacturing Execution System (MES) is the ideal way for paper manufacturers to bring transparency to consumption right down to the production process level. SAP Gold Partner T.CON knows the industry for 25 years and integrates energy data to generate a detailed consumption profile for current and scheduled orders. This opens up a range of possibilities for improvements. Which ones are they and what are the success factor for an MES integration?

In the dynamic landscape of the paper industry, where innovation meets tradition, the quest for sustainable practices has become more crucial than ever. As managers at the forefront of energy-intensive paper production, the imperative to embrace effective energy management cannot be overstated. Beyond its environmental implications, the strategic implementation of robust energy management systems holds the key to optimizing operational costs, enhancing resource efficiency, and ensuring long-term competitiveness. But how to cope with the energy-intensiveness and achieve sustainable and cost-effective production method?

Figure 1: **Enriching the EMS with MES data.**

In this article, we delve into the pivotal role of energy data in the paper industry, introducing measures that help to not fall and instead create transparency in this and other production-related regards with state-of-the art software solutions.

A survey of 2000 companies conducted by the International Energy Agency recently found that 97 percent of manufacturing companies are planning to invest or have already invested in energy efficiency measures. Indeed, 89% are planning to increase their investments in energy efficiency over the next five years. To maximize payback on such investments, it is usually most efficient to focus on production. While energy management has been defined by the VDI 5600 standard as one of the core tasks of an MES since 2016, and on paper almost all products support energy management as per ISO 50001, this often means nothing more than a way for the user to manually enter energy meter readings into a form field. Meanwhile, a number of software vendors have established themselves on the market with dedicated energy management systems that operate independently from an MES.

Enriching the EMS with MES data

An energy management system (EMS) measures consumption continuously and offers analysis options. Most enterprises already have numerous meters and sensors in place, and are running various enterprise systems – for example, they might have a BDE, MDE, or MES and an ERP system – all of which can provide relevant data for energy management. MES software can also provide functions for logging, processing and visualizing data, thereby complementing the strengths of an EMS. Even if all the MES supports are manual entry of meter readings, these can still be useful for exploring how energy management data correlates to production data. Depending on the user, the number and type of loads logged may differ. Some companies might log the consumption of each individual production machine directly, while others only have a single meter for a whole group of machines. However, by integrating the MES and energy management system, it is possible in virtually any setup to determine historical energy consumption over a specified period, broken down to specific production orders or produced material.

Order-specific energy data

T.CON's MES CAT, used particularly in the paper and film production industries, makes use of data broken down by wafer or reel. This data is combined with energy cost information provided by the ERP system. That way, companies know exactly what is being consumed where; the links between different factors are made transparent (such as resource utilization, processes, production volumes and temperature). Additional parameters can then be incorporated into the analyses, so that energy consumption can be broken down at order level, rather than just treated as a cost factor. This information can in turn be used as the basis for a continuous improvement process (CIP).

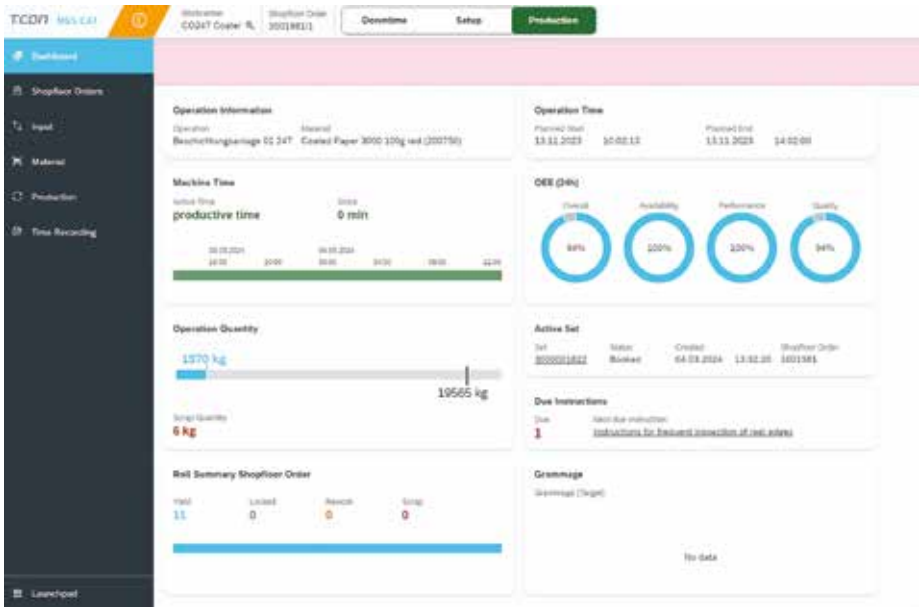

Figure 2: Screenshot MES CAT Dashboard.

Automated data capture

If energy data is to be exploited in real time, the MES must support automated data capture from energy-consuming devices, for example via an OPC router or by means of bidirectional data exchange with other IT systems. An all-in-one system for energy data capture proves its strengths when it comes to logging data from energy-consuming devices of different ages and fitted with different technology. All the various data can be transferred to the MES and thus included in the analyses and optimisations. The next stage involves linking in additional systems and databases. Most energy data management systems are very well suited for displaying historical information about consumption across the enterprise. An important question is: How can the energy data now be used to help ongoing production?

Integrating IRES data

This is where Intelligent Resource Efficiency Solution data, or IRES comes in, with Intense AG's system integrating energy data to the MES. IRES is a system for logging and managing energy data and processing it together with relevant parameters in close to real time. To do this, data from different systems is combined. Data from orders and machine data from the MES is integrated with virtual profiles for machines and energy-intensive processes, all stored in the IRES evaluation platform. These profiles are developed specifically for each enterprise. So, for example, IRES can interact with T.CON's software to define reference orders based on energy-efficient orders for producing a particular type of paper or film. When production is underway for new orders, the current energy consumption is compared with the reference orders stored in IRES. It is then possible to calculate what the consumption profile will look like, based on historical consumption data and the planned production volume.

Live load monitoring

The data model can also be enriched with further information, such as the weight of raw materials used or the weight of the manufactured products. Using this information, the company can generate normalised energy performance data, for instance 'kW/h electricity consumption per kg of finished product' or 'cubic meters of steam per meter of finished product'. This energy performance data is essential for ISO 50001-compliant reporting. However, it is often challenging to generate without built-in system support.

Monitoring and alarms

At the same time, the enterprises benefit from a monitoring and alarm system: measurements from current energy usage and visualizations displayed on the shop floor can be used for comparisons against targets and progress monitoring of the company's energy-saving projects. The system doesn't have to stop at displaying information about time- and machine-specific energy consumption; it can also provide order-specific and material-specific information. When the system is enriched with this kind of detail, virtual profiles and reference orders are used for comparing current energy consumption with normalized historical usage data. Visualization could be for example by means of a red/amber/green display. It's also possible use the same principles to visualize consumption of other resources, such as water or gas, on dashboards in the production environment. The dashboards can be displayed on various devices – mobile devices, workstations, big screens, etc., including in the vicinity of the relevant machines and systems.

Green light

The IEA has calculated that investments in this kind of system pay off rapidly: The energy efficiency measures implemented since the turn of the century saved some US $680 billion in the year 2022 alone – about 15 percent of all energy costs in that year. Globally, industry improved its energy efficiency in 2022 by two percent over the preceding year. However, that is not enough to ensure green manufacturing in the long term. To achieve the goal of net zero emissions by 2050, the IEA has determined that efficiency improvements of around four percent per year are needed. Tools like the red/amber/green visualization can help industry reach this goal while still remaining profitable.

MES: Benefits beyond energy management

We learned that Manufacturing Executions Systems can contribute to keeping an eye on energy data. But there is much more to it. A huge benefit for paper producers is that an MES makes it possible to manage, monitor and control production in real time. As a production control system or manufacturing management system, it serves as a link between the planning and production levels and thus establishes the connection to the ERP system as well as to the machines and plants. This creates transparency. Each production step can be related to a value-added step - it becomes clear where production is profitable and where money is being wasted.

You gain new insights into the cost structure and can calculate material costs more accurately. Another positive side effect using a sophisticated MES: By integrating CO2 data from material master data and recognized databases, you strengthen transparency along your supply chain. Going green with more precise cost communication & presentation of your ecological footprint bring along a big benefit. Especially in consideration of decarbonization targets for the future in the EU and elsewhere, this is an unavoidable must. However, the introduction of MES is a project that involves time, resources and costs. It is therefore particularly important that the introduction is carried out efficiently and successfully:

Success factor 1: Finding the intersection of provider, MES and requirements

First of all, companies should answer for themselves what exactly the system should do and why an introduction makes sense. After all, an MES can do so much more than just report back production data. At Greiner Packaging, a specialist in plastic packaging, for example, the core task of the MES is to uniformly record machine and reporting data for analyses. The system gathers up to 10,000 sensor data per minute from the connected machines. Hence, production managers are informed around the clock as to whether there are any malfunctions, how quality can be improved, or what the status of energy consumption is.

Once the central improvements and goals have been defined, companies should work out which requirements and which processes are involved. A detailed set of specifications and the additional support of an implementation partner can provide orientation. The partner's industry and process expertise enables him to see the big picture in the context of a project and know the sweet spots. "For companies that are still at the beginning, we recommend a workshop with the selected provider as a first step. This ensures clarity and helps to build the necessary trust," knows Michael Karl, Product Lead MES CAT from the consulting firm T.CON. If you want to be absolutely sure that your favourite MES meets your requirements, a fit-gap analysis is carried out and followed by a preliminary study with proof of concept. Prototypes are created and feasibility is ensured.

Success factor 2: Establish a homogeneous landscape between ERP, MES and warehouse

If the MES is functionally capable of supporting all relevant production processes, the technological basis should be examined. The crucial questions: Can the MES be integrated into the existing ERP system? Is the development environment easy to maintain and further develop? And to what extent is the MES itself functionally expandable? The goal is a seamlessly integrated MES that provides fully automated, uniform and seamless data acquisition for all locations. For example, the delfort group, a manufacturer of functional specialty papers, uses its MES, which is fully based on SAP technology, to evaluate around 1,400 international accounting records and business data in the SAP Business Warehouse every day. In turn, released production orders from SAP planning applications, as well as cutting plans and knife settings from specialist applications, which are also based on SAP technology, are immediately available in the MES and thus in production. "The integration of SAP data without the detour via interfaces usually opens up a lot of potential for companies to produce more cost-effectively and efficiently," says Karl. "Machine operators, production managers and management receive precise information on energy consumption, personnel expenses, downtimes, changeover times, quality characteristics, repair and maintenance costs. They can then derive concrete measures from this."

Success factor 3: Designate data analysis as a core function of the MES

In further expansion stages, machines and consumption data enable data-driven shop floor management. Koehler Paper, a manufacturer of high-quality specialty papers, for example, uses such functions for predictive quality assurance. By combining MES, an SAP HANA database, and analytics applications, Koehler is improving paper quality, reducing scrap, predicting paper breaks, and avoiding costly rework. Michael Karl: "At T.CON, we advise companies to think about analytics right from the start in order to benefit from the many advantages. Up-to-date, meaningful key figures in high quality provide an overview and a clear view of production. As soon as disruptions or personnel bottlenecks occur, you are informed and can react promptly and optimize."

Functionally expanding an MES can also mean, for example, evaluating manufacturing analyses with the help of AI technology. With corresponding applications, companies are expanding production-related IT landscapes into a networked ecosystem that enables data-driven decisions and optimization. Cloud-based applications are used to different data sources such as ERP and MES data with sensor and machine data.

Success factor 4: Focus on everyday users

For the project to really get rolling, motivated users are a prerequisite. Experience shows that the earlier and more openly everyone involved is informed about the project, the more successful the introduction will be. It also makes sense to involve the works council and top management directly. In this way, employees' concerns and fears can be eliminated from the outset, and changes are more readily accepted. It is also advisable to use small, practical examples to show the overall potential of the solution and how it can improve the day-to-day work of those who use it on a daily basis.

This is often successful where immediate advantages and a return on investment can be achieved or where the need for a solution is greatest. A pilot installation on a few machines allows employees to test the system and suggest reasonable adjustments prior to and suggest reasonable adjustments before the roll-out. To ensure that the project runs smoothly, it is internally important to put together a cross-departmental project team. The team ensures that tasks in the project plan are completed step by step, deadlines are met, and all stakeholders are kept and that all stakeholders are informed about the progress of the project in regular meetings. The project team also selects key users who will test the system intensively and continue to be available as contacts for colleagues later, after the system has gone live. "Key users take on a central role. That's why it's important for the company's management to cover their backs and give them the time they need to work intensively on the project," explains Michael Karl.

Success factor 5: Choose MES with modular structure

Connecting the MES to the IT in the ongoing daily business is a major challenge. To ensure that milestones are reached as planned, an agile, iterative process model oriented to the company's needs is suitable. Individual functions such as quality management and workforce planning are then added step by step as required. The prerequisite for this is a modular and flexibly expandable system in which new modules can be activated in the MES itself or on-premises and cloud applications can quickly and easily supplement the core MES functions. "The modular principle, as we have come to implement with our MES SUITE, is a real game changer from T.CON's point of view for modernizing an old, monolithic architecture," says Michael Karl. "Companies can future proof their production in the sense of Industry 4.0. At the same time, employees use an uniform, intuitive interface and can slowly familiarize themselves with the new system." The final result is a contemporary MES that on the one hand monitors and controls production, and on the other acts as a data hub for the ongoing adaptation of production to new framework conditions. In both cases, it ensures fast added value and future-proof flexibility.