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Boosting productivity and flexibility through digitalization

Challenges facing the chemical industry

The chemical industry is one of the key drivers of any economy, as the majority of its products are the starting point for countless different value adding chains. However, for years now the demand for chemical products has been increasingly shifting from Europe towards the Asian markets, and in particular to China. The German Chemical Industry Association reports increasing import pressure on basic chemicals from regions rich in raw materials and intermediates, while competitive pressure is mounting in existing export markets. At the same time, the industrial nations are dependent on technological advancement to compensate for increasing shortages of skilled labor as well as rising raw material and energy prices. Against this backdrop, the importance of new technologies, digitalization and efficient, sustainable management is growing all the time.

According to the German Chemical Industry Association, over half of all medium-sized chemical enterprises will carry out extensive digitalization of their processes and business procedures over the coming years. This will allow the wide-ranging technical possibilities opened up by automation, information technology and power engineering to raise production process transparency to a whole new level. Even just the collection, utilization and analysis of process data occurring everywhere is sufficient to significantly boost production efficiency and performance within the framework of largely unchanged production and business models.

The greatest efficiency gains for companies operating in the field of basic chemicals will be achieved by improved plant engineering, rapid commissioning following on from changes and the prevention of unscheduled downtime. In terms of production, productivity gains can best be achieved by ensuring reliable, secure automation and low-cost energy supplies. To bring down the total cost of ownership and also increase plant availability over the entire lifecycle, increasing use is being made of remote monitoring services, preventive maintenance measures and digital applications to leverage added potential for optimization.

In the consumer-oriented fields of fine and specialty chemicals, efficiency gains can be achieved in the design of new products and the flexible operation of plants and machines, in other words by facilitating a rapid response to changing market conditions (short time to market) across the entire supply chain from supplier to end user. In the face of ever more scarce and increasingly costly raw materials, chemical companies are attempting to improve their resource efficiency by using solutions such as energy management systems, energy-efficient drives or energy monitoring/tracking. Totally Integrated Power (TIP) from Siemens enables the optimum use of resources and consistent power distribution from the medium voltage range right through to the socket on the wall.

Another movement towards greater sustainability in the chemical industry is the use of renewable energies in production. For example, one of the world's biggest manufacturers of biobutanol, Cathay Industrial Biotech Ltd. based in Shanghai, China, produces bio-based polyamide and synthetic fibers. Its new plant was equipped by extensive automation, electrification and digitalization solutions from Siemens.

Foundation of the digital transformation

Hardly any other technology has brought about more sustainable change in the world of production over the past thirty years than automation, which has provided the basis for open interfaces, low-cost standard solutions and greater transparency across production processes. One major leap forward in terms of innovation was the networking of devices and reliable, end-to-end communication using bus systems – from the humble sensor through to the ERP system. In the meantime, a similarly momentous step forward is being achieved with digitalization and the “Digital Enterprise” approach from Siemens. Manufacturers are now benefitting from extreme flexibility enabled by the smart link-up of components within the framework

of modular production using Module Type Packages (MTP) or the NOA (Namur Open Architecture) concept, and the facility to directly access data in the cloud.

Digitalization requires comprehensive networking and communication between all plant components and IT systems, alongside stringent monitoring of plant and cyber security. The acceptance and implementation of digitalization in the chemical industry hinges on adherence to these strict security conditions. It's vital for users to have absolute confidence in the security, credibility and high quality of all transmitted measurement values, for instance, and for secure authorized user access to data to be guaranteed at all times. It was to provide this assurance of system integrity coupled with plant and network security that Siemens developed its multi-layer Defense in Depth concept. The protection of people, machines and the environment take top priority in the chemical industry, and extensive integrated safety functions such as alarm management, redundancy concepts, safety-related modules and integrated safety systems provide the assurance of trouble-free operation in all of these vital areas. At Siemens, process reliability also extends to products and services such as risk analyses or explosion-proof motors.

Digitalization secures competitive standing

For over a century, Siemens has been an experienced and innovative technology partner to the petro, basic, specialty and fine chemical industry. Today, its portfolio covers a wide spectrum of products, solutions and services along the entire value chain and across the whole of a plant's lifecycle. Alongside automation systems, process instrumentation and analytics, drives and industrial controls as well as energy management systems, Siemens has developed a wide range of digitalization solutions capable of seamless integration into existing processes. This spectrum encompasses everything from digital consulting and process engineering, 2D/3D engineering, simulation and virtual commissioning to asset performance management within the framework of maintenance, documentation and process optimization, alongside the associated digital services and cloud-based applications.

The Siemens "Digital Enterprise" approach for the chemical industry addresses three main spheres of action, start smart with intelligent integrated engineering and outperform your plant with reliable integrated operations to leverage optimization potential through to secure your assets and investments in the long-term using associated services and maintenance measures. Digitalization solutions from Siemens help companies working in the chemical sector to maintain a sharper

competitive edge over the entire lifecycle of their plant, paying particular attention to the improvement of productivity and flexibility. The central core of the Digital Enterprise is the digital twin, which is created during the engineering phase as the virtual counterpart of the physical plant through the interaction of data gathered from the different subsystems. The digital twin can be used to simulate the plant and even commission it virtually in advance. As a result of the uniform database and by exchanging information with the process control system, the plant data and the associated documentation stays right up to date through every stage, from planning through to maintenance.

As a MAV (Main Automation Vendor) and MEV (Main Electrical Vendor), Siemens is able to offer its services not only in the capacity of technology supplier but most importantly also as a development and solution partner. This results in fewer interfaces as well as faster set-up and modernization processes. For instance, the MAV approach was used successfully in two BASF projects, one in Nanjing, China the other in Camaçari, Brazil, resulting in the efficient deployment of engineering resources and a rapid time to market. The two plants used for manufacturing superabsorbers and polymers were automated and commissioned practically simultaneously using the “Engineering & Cloning” approach.

Smart start with intelligent integrated engineering

Integrating all the different disciplines such as mechanics, electrics and automation at the earliest possible stage is pivotal to speeding up commissioning and preventing flawed concepts. If an asset’s digital data is generated as early as the concept phase using the 2D engineering software Comos, this data can continue to be utilized over the entire lifecycle of the plant, enabling companies to make up to 40 percent savings in terms of time and costs. As digital data can be generated straight away in the design and development process, this is a relatively simple process for new plants. However, when looking to existing facilities, data is often only available on paper and is frequently out of date. Siemens has a solution for updating and digitalizing data from legacy equipment in the form of the Bentley reality modeling software OpenPlant 3D. To model existing plants, laser scanners create a point cloud of the components, and the software uses this as the basis for creating digital planning documentation. The Simit simulation software allows the entire automation to be analyzed virtually in real-time on the basis of the Simatic PCS 7 process control system, and different plant optimization possibilities to be

tested. This facility for virtual commissioning speeds up physical commissioning on site and reduces the time to market.

The Operator Training System (OTS) is to a plant operator in the chemical industry what a flight simulator is to a pilot. Regular practice allows operators to improve their operating skills, saving time spent on actual start-up and changeover between product types. At BASF in Ludwigshafen in Germany, as an example, plant behavior was mapped and tested using a simplified process model prior to migration of the process control system. Virtual commissioning then took place using the Simit simulation software, allowing errors to be detected at an early stage and the engineering quality to be improved. This enabled the number of actual trial runs to be reduced as well as the development and commissioning times for the application. At the same time, the simulation framework was put in place for early, system-specific operator training.

Trouble-free operation with integrated operations and logistics to outperform your plant

Siemens offers an integrated product and system spectrum for the electrification, automation and digitalization of chemical plants in the form of Totally Integrated Automation (TIA) and Totally Integrated Power (TIP). Forming a solid basis for this and enabling improved process flexibility and production efficiency is the Simatic PCS 7 process control system. The sophisticated integrated control functions provided by tools as Advanced Process Control enable improvements such as optimized energy consumption and enhanced plant capacity utilization.

The importance of digitalization for batching processes in the field of specialty and fine chemicals is also growing all the time, for instance when it comes to online quality control and online process optimization. The Manufacturing Operations Management (MOM) system Simatic IT allows plant operators to improve efficiency and transparency in the fields of planning, order management, workflow and quality management. A consistent, paperless flow of information between production using Simatic PCS 7 Batch and the MOM online process control enables fast feedback and rapid quality checking against specification (Quality by Design / Process Analytical Technology). As a result, chemical companies can achieve greater productivity, fewer production losses and a shorter time to market, as evidenced by the new Dulux plant in Merrifield, Australia, the biggest paint factory in the whole of Oceania. Through digitalization, Dulux was able to eliminate around 75,000 manual

interventions per year, and so improve the accuracy of its electronic formulation processes. Alongside paperless manufacturing, it has also achieved comprehensive traceability and maximized its quality controls.

Integrated plant and maintenance management also helps ensure trouble-free operation. Using the Siemens products Simatic PCS 7, the Process Automation Maintenance Station (PAMS), Comos MRO for maintenance, repair and overhaul, and the Operations Intelligence Software XHQ, maintenance work can be carried out efficiently, cutting maintenance costs by up to 50 percent and improving plant availability. The digital twin provides support to plant operators for all maintenance-relevant tasks, starting with planning through execution to documentation. By providing a consistent database, Simatic PCS 7 and Comos MRO ensure stable processes by synchronizing maintenance requirements with servicing orders, showing the service technician all the information relevant to the maintenance job. As an add-on, the Simatic PCS 7 Mobile Operations Concept enables convenient on-site operation, the distributed monitoring of plant sectors and assets, and also maintenance support. The app on the Siemens Sipix industrial tablet can be combined with state-of-the-art devices such as smart glasses for remote servicing.

Masses of plant data is already lying unused today in the archives of chemical companies, a large proportion of which could be of immense importance. The ability to access this process information is vital. Company-wide operational and business data can be aggregated, related and presented in a compact overview using XHQ in real time. The provided dashboards are designed to help decision-making, create transparency and ultimately improve productivity.

When it comes to the introduction of new business models, particular importance is attached to the field of logistics. Tank farm, terminal management, automatic identification systems, and both mobile and stationary RFID systems ensure the reliable capture and control of material flows, and play a vital role in transferring the relevant information to higher-level material management, MES or ERP systems. For outbound logistics operations, Siemens offers AX4 from AXIT, a cloud-based IT solution for networking forwarders, carriers, shippers and consignees and for the optimum management of transport operations. Using the Software Dock and Yard Management, service yard functions, shipments, assignments and processes are coordinated with a view to reducing processing times.

Secure your assets and investments through integrated maintenance and performance optimization

Added operations, maintenance and servicing optimization potential can be detected using both cloud-based and other software applications. Within the framework of asset management, plants, machines, networks or plant components, as well as complete drive trains, pumps, valves or heat exchangers can be monitored either using software, smart apps or optionally with the aid of managed services. Apps such as Drive Train Analytics, Valve Monitoring or Pump Monitoring collect raw data, and analyze operating statuses, critical situations and maintenance requirements. Smart algorithms are then used to process the data into valuable information which is able to predict wear or failures. The data can be transmitted to a central location, either locally, remotely or in the cloud.

In a similar way to regular health checkups by a doctor, the industrial apps DCS Health Monitoring, Control Performance Analytics, Process Event Analytics and Equipment Predictive Analytics analyze large volumes of data as the basis for deriving optimization potential. This data can be used to check control loops and system components in the control system, and to analyze alarm reports and interactions between sensors. The gathered information is used to detect useful patterns. The resulting degree of transparency creates the foundation for improved process efficiency and lightens the workload of operating and maintenance personnel by taking smart data decisions. These web applications, cloud computing and the open cloud-based IoT operating system MindSphere from Siemens have a valuable role to play when it comes to analyzing large volumes of data.

Also supporting the digital transformation is a whole range of different services, such as use of an engineering environment, virtualization to modernize control systems, or modular structured lifecycle servicing agreements. As a result of its close-meshed product and service business, Siemens provides condition monitoring support straight from the factory.

There can be little doubt that by taking advantage of the new technologies enabled by digitalization, chemical enterprises can achieve efficiency gains and so secure an improved position in the toughly competitive global marketplace.

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