siveco China

On The Road

Case studies of maintenance improvement projects in China

On the road to Maintenance 4.0, ten years of Siveco China customers' stories…

The idea of this book, collecting updated versions of the best customer stories previously published in our "Maintenance in China" newsletter, came about as we celebrated the tenth anniversary of Siveco China in 2014. We have never been shy of sharing our experience and success stories, through articles, seminars and workshops, as we believe this is the best way to promote maintenance improvement in this country.

Making our case studies available to the public has helped us built considerable trust, in a market where most vendors or consultants still use ROI figures from foreign customers or other "market average" often ludicrously quoted in US dollars. While reference visits often rely on financial reward for the visited customer team, public case studies require corporate approval before publication: the facts, figures and quotes have been by higher levels of management before release – they are real.

As the concept of Industry 4.0 is becoming popular in this country, we are proud to say many of our clients have taken major steps towards Maintenance 4.0, using technology to obtain real measurable ROI, a know-how that Siveco China is now successfully exporting to other markets!

This book is about real industrial challenges and solutions, ROI and benefits, from about thirty Siveco China clients in various industries, in various provinces of China and even abroad, as we expanded our overseas business over the years working with Chinese EPC companies and China-based multinationals.

This book is also about real people and their good work over the years: we would like to thank all of them, our customers, our Siveco employees and partners. These stories are theirs!

We do not expect everyone to read it from cover to cover, but we are quite sure all readers will find something of interest, something to learn, some inspiration or perhaps a new idea. A recurring theme in these pages is that "maintenance excellence" can be reached in China, not with a copy-paste of foreign solutions, that almost inevitably fail, but through a homegrown approach designed for "maintenance with Chinese characteristics".

I invite our readers to see more stories and in-depth articles on our monthly blog newsletter.sivecochina.com, entirely bilingual Chinese-English.

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Ensuring maintenance readiness at Fushun Mining Group's ATP project

Fushun Mining Group ("FMG") is a large state-owned mining company located in Fushun, Liaoning Province, China. The corporation consists of about 30 companies focused on coal mining and oil shale processing, with a total of around 28,000 employees. FMG is one of the world's largest oil shale producers: it owns 3.5 billion tons of geological reserve for high grade oil shale, of which the exploitable reserve is 560 million tons. The company operates the largest oil shale plant in the world consisting totaling 220 sets of Fushun-type retorts, with annual shale oil yields of 330,000 tons. In this process, finer particles of oil shale are discarded, resulting in waste and environmental pollution.

To make full use of resources, FMG invested 800M RMB to build the first Alberta Taciuk Processor (ATP), designed by a Canadian subsidiary of ThyssenKrupp Technologies to treat small-size oil shale that can't be processed in Fushun retort with a capacity of 6000 tons per day.

From construction to maintenance, specific challenges

ATP construction started in early 2006 and was completed in 2010. Commissioning took several years to complete until late 2012, reflecting the great complexity of the facility. FMG's management team, recognizing the maintenance challenge presented by the new plant and its imported technology, decided to tackle the problem and contacted Siveco. China's largest maintenance consultancy, Siveco is known to have pioneered the concept of implementing maintenance systems during the construction of a plant, thus supporting start-up and enforcing good maintenance practices from day one.

Typical plant documentation and maintenance preparation challenges, met in construction projects all over the world, tend to be exacerbated in China, where operators lack the long track record of their Western counterparts. In addition, greenfield projects in China often present specific challenges, as for the ATP plant its uniqueness, size and complexity.

FMG also realized that simply cutting and pasting a Western management model would not work in China. Foreign engineering companies involved in Chinese projects, especially those lacking local experience, often fail to recognize the specific needs, strengths and weaknesses of Chinese maintenance team, and get bogged down in misunderstandings. Siveco, with its in-depth knowledge of "maintenance with Chinese characteristics" was a good match for this project.

Building the maintenance system

FMG hired Siveco to implement the new plant's maintenance management system in time for startup. The contract was signed in June 2012 covering the maintenance system itself, as well as start-up assistance to ensure smooth handover from commissioning to operation.

Specific goals for the project included:

- Building a complete plant database, to avoid omissions or mistakes in the transfer of technical documentation from construction to maintenance.
- Ensuring work safety, through strict operating procedures and tracking of employees' qualifications and licenses.
- Enabling feedback from event and failures (symptoms, failure, actions, etc.), in order to create usable historical records for improvement purposes.
- Implementing the preventive maintenance strategy from the first day of the operation and developing good habits of regular analysis.

To achieve these objectives, Siveco implemented a maintenance management system (CMMS), integrated with a documentmanagement system (DMS) and a mobile solution for

> This project provides critical support for the long-term operation of this technologically-complex plant by our local team.

plant inspections. The Siveco project team provided maintenance engineering services onsite, working alongside the ATP maintenance team for a five-month period, until the system was put into use in December 2012.

ATP implemented Siveco's mobile solution bluebee® "for the worker of tomorrow" to support daily maintenance work

The maintenance system, ready for startup

By the end of the project, FMG's objectives were achieved:

- The plant was fully documented in the CMMS and DMS, including equipment structures and related documentation, technical specifications, spare-parts lists, contracts, standard work instructions, etc. The entire database was built on standard coding rules, allowing quick retrieval of information.
- The system provides full support and traceability of work procedures: maintenance work orders, work permits, inspections. The bluebee® mobile solution, used for plant inspections, enables strict supervision of field work through scanning of barcodes and onsite data capture, without having to rely on paperwork.
- The work order system ensures incidents and work done are reported in a structured manner, to form comprehensive and usable historical records. The planned maintenance system allows automatic generation of preventive maintenance schedules and an assessment of their execution.
- Finally, Key Performance Indicators (KPIs) and analysis reports were defined in the system, to support the maintenance team's regular review meetings. Reports comply with the international standard *EN 15341 Maintenance Key Performance Indicators*.

According to Director Sun Yongshu:

> "Our maintenance system covers both the front-end (technicians working onsite) and the back-end (technical management team). Already considered a milestone in the industry, this project provides critical support for the long-term operation of this technologically-complex plant by our local team."

Leading PVC maker revolutionizes its inspection process, adds value to SAP

Hanwha Chemical (Ningbo)

Hanwha Chemical (Ningbo) was established in 2008 in the Ningbo Daxie Development Zone, a national-level economic and technical development zone in Zhejiang province, as a subsidiary of Fortune 500 Company Hanwha Group, a diversified Korean conglomerate. Hanwha Chemical was the first producer of polyvinyl chloride (PVC) in Korea in the 1960s, a pioneer that laid the groundwork for the nation to emerge as a leading chemical producer: the history of Hanwha Chemical epitomized the history of the petrochemical industry in Korea.

With a total investment of 363 million USD, the Ningbo plant is the largest foreign-invested project in the zone and one of Hanwha Group's largest investments outside of Korea, targeting the world's largest PVC market, China. Production started in December 2010. The plant boasts an annual production of 0.3 million tons of PVC, 0.5 million tons of EDC, and 0.3 million tons of VCM, with an annual sales revenue of approximately $ 2.3 billion.

The challenges of optimizing the inspection process

Hanwha Chemical's complex chemical production units operate around the clock and face tough safety, environmental and mechanical integrity regulations: ensuring reliability, availability and safety is at the core of the company's business. The Ningbo plant has established good operation and maintenance practices, based on the group's long experience and the know-how accumulated by its local engineers and technicians. Preventive maintenance, more particularly in the form of inspections to detect early signs of failure and monitor process parameters, plays the major role in the company's operation. Hanwha has also implemented SAP, the de-facto ERP standard in the petrochemical industry, including SAP Plant Maintenance module to support its maintenance process.

As often observed in the chemical industry, however, the management of inspections, both operation and maintenance checks, measurement rounds, tends to fall in the gaps of the IT system and is left to rely on technicians' individual know-how and sense of duty.

Equipment structures in SAP, the implementation of which is usually financial-driven, are often not detailed to the necessary level (individual components like valves, inspections and measurements points) and the associated instructions and documentations are usually managed in other databases or on paper. The "Work Order", designed to capture costs related to maintenance tasks, is not suited for simpler daily routine checks. Finally, the usage of SAP PM is, in most cases, limited to maintenance supervisors and "system secretaries" assigned to input data from paper reports. It does not reach the operation and inspection teams, less accustomed to using complex IT

> The management of inspections tends to fall in the gaps of the IT system and is left to rely on technicians' individual know-how and sense of duty.

systems in their daily work. Most chemical plants face the same challenge when it comes to managing inspections, assessing their executions and handling feedback in a useful manner:

- Difficult to control and track work execution (has the inspection really be done?)
- Less accurate reporting or measurements (often handwritten report on paper)
- Results and measurements are not usable for analysis (paper reports get archived in folders, analysis would require manual input into a system, sometimes done in Excel or in separate, specialized subsystems)

As a result, the inspection loop is hard to close: significant gaps exist between the definition of inspection routines, the planning process, the execution and reporting process and finally the analysis and optimization process. Support from traditional IT systems, designed for administration and cost control, is severely lacking.

The Hanwha Ningbo team quickly came to the realization that new innovative tools were needed to support the daily inspection process, so critical for the plant operations.

Solving the problem

Faced with these challenges, Hanwha's VCM (Vinyl Chloride Monomer) operation team launched a project to search for the ideal tool to support their inspection and measurement rounds: they envisioned field technicians using mobile devices to carry out their daily work.

The project team conducted an extensive review of hardware and software vendors, to find that most of them were IT developers or hardware makers without knowledge of their industrial requirements, proposing to custom-develop whatever Hanwha would specify, a solution described as "using PDAs to access a database". This approach carried all the risks associated with IT development projects and did not meet Hanwha's expectations: finding the right supplier had become another challenge. This is when Hanwha engineers came across an article in a technical magazine, featuring a case study of Sichuan Lutianhua, a large fertilizer plants using Siveco's mobile solution, known as bluebee®, to optimize inspections. A few months later, in September 2011, Hanwha signed a contract with Siveco, a company uniquely positioned in using high-tech to solve real-life maintenance problems, for the implementation of bluebee®.

The goals of the project were direct answers to the challenges faced by Hanwha:

- To ensure that jobs are actually performed, through mandatory scanning of asset tags
- To provide a diagnosis aid for technicians, based on reported symptoms and access to existing know-how
- To allow analysis of measurement trends, in order to predict failures
- To use operation and management reports to optimize inspection plans, ultimately enabling a Risk Based Inspection (RBI) strategy

The project was launched in middle of October 2011 and successfully went live at the end of the year.

The bluebee® project

Siveco provided a complete turnkey solution including maintenance engineering services, the bluebee® software, hardware (mobile devices, PC server and barcode printer) as well as equipment tags (stainless steel plates).

PDA devices from Korean supplier Bluebird were selected, optimized to run bluebee® and equipped with 2D imagers for asset identification.

Two Siveco project managers were appointed, one focused on overall project management and maintenance improvement, the other on the delivery of the system. The Siveco back-office team, located in Shanghai, dedicated three people full-time to support the project.

Thanks to bluebee®, inspection technicians receive their inspection tasks and related specific guidelines

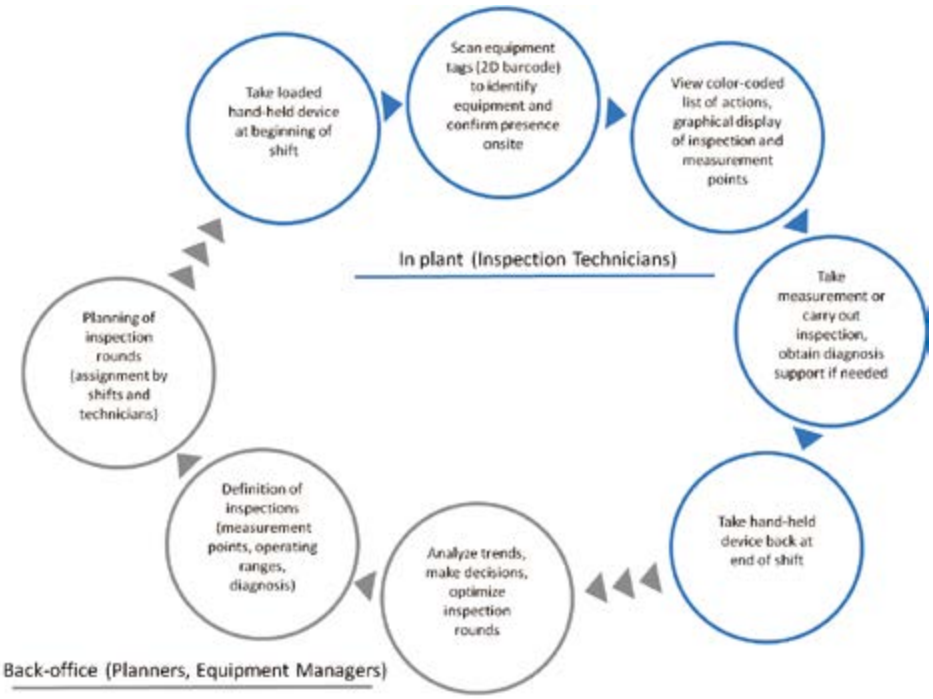
on their PDA and, after scanning the tag of the corresponding asset or inspection point, record results directly in the device. For example, operation staff can input operating parameters observed during their daily walking inspection routine on pumps (outlet pressure, temperature, oil level, unusual sounds, visual checks of seals etc.). bluebee® will provide immediate feedback on abnormal readings and further assistance can be obtained if needed. All data will be summarized and analyzed in the back-office management system, also producing regular reports for management (monitoring execution) and analysis (improvement of plans and strategy) purposes. The process is shown below:

During the implementation, Siveco organized an exchange visit between the Hanwha VCM team and Sichuan Lutianhua, an existing bluebee® client. Such visits, opened to all Siveco customers, are meant to promote experience sharing between different plants and have proven very successful.

What are the main differences between the Hanwha and Lutianhua projects?

- **Main focus**: Lutianhua uses bluebee® for maintenance inspections, while Hanwha uses bluebee® for daily operation inspections.
- **Inspection planning**: in Lutianhua, tasks carry various frequencies of execution and thus require using the back-office planning module to schedule and assign tasks automatically, while in inspections by the operation team have a 4-hour frequency, which do not require scheduling – the focus is purely on execution and reporting.
- **Telecommunication requirements**: Lutianhua is using the public 3G mobile network for bluebee® devices to connect to the back-office system in real-time, while Hanwha chose to synchronize data when PDA are put back into their cradle when the operator is back at the office – indeed, the plant's potentially explosive atmosphere prohibits the use of wireless communication (ATEX directives).

Reporting process: in Hanwha, whenever abnormal circumstances appear, the inspector can take a photo with the PDA camera to create a work request in the back-office system; the manager can then immediately view it and launch related activities through his daily work wizard screen. In Lutianhua, focus is not on triggering corrective actions. Instead, when something needs to be fixed, a Work Order is entered manually in their CMMS Maximo.



The results: three layers of benefits

First layer: enabling critical maintenance engineering activities

Hanwha experienced the first benefits of the bluebee® project during the implementation itself, as the inspection team was immediately fired up by the use of high-technology. As a direct consequence, awareness of best

> The project has not only received great feedback from users, but also praises from our top-level management in Korea.

practices increased. The project prompted a more in-depth definition of equipment structures and inspection points, at a level of detail which did not exist in SAP PM; bar-coded steel tags were physically attached on the equipment, ensuring exact match between the database and the reality. A continuous improvement process was initiated based on a systematic analysis of data collected in the field, something which was practically impossible to achieve using a traditional paper-based process.

Second layer: immediate improvement in accuracy and traceability

Once bluebee® was put into day-to-day service,it provided a range of immediate operational benefits both from the technical and management point of view. Inspectors saw the accuracy of their records improved, as bluebee® clearly indicates inspection points, requires scanning of barcode for confirmation, warns users in case of abnormal readings and provides basic diagnosis support. Any unfinished action is clearly visible in the mobile display, through simple color warnings. From the management point-of-view, bluebee®'s back-office system keeps track of job completion and back-logs. Management and analysis reports can be sent automatically by email or queried from any PC. Thanks to physical barcode scanning, the technicians' presence at the inspection point is assured, greatly enhancing compliance with regulations and safety standards, critical in the chemical industry.

Third layer: optimization and beyond

Longer term ROI in terms of reliability and availability will derive from regular analysis of data and the resulting optimization of the maintenance strategy. The project has achieved the necessary steps to implement a true Risk Based Inspections (RBI) strategy based on real data from the field, which is seldom seen in the industry.

According to JANG Sang Moo, Senior Manager of VCM production team:

> "bluebee® has already helped our team achieve excellent results. The project has not only received great feedback from users, but also praises from our top-level management in Korea. Based on our successful experience in VCM, the PVC division has decided to start its own bluebee® project in 2012."

A catalyst for maintenance improvement at leading chemical group

This project has won the 2010 Motorola Enterprise Mobility Solutions Industrial Applications Grand Prix.

Sichuan Lutianhua Company Limited

Sichuan Lutianhua Company Limited is engaged in the production and sale of fertilizers and chemical bulks. The Company primarily offers urea under the brand name of Gongnong and synthesis ammonia, with an annual production capacity of one million metric tons of synthesis ammonia and 1.6 million metric tons of urea at its Luzhou, Sichuan, production base.

Optimizing the inspection process – a key requirement in the chemical industry

Sichuan Lutianhua manages complex chemical production units, operating around the clock, with strong safety requirement and environmental regulations: the company is highly dependent on its maintenance organization to ensure availability, reliability and safety. In the chemical industry, maintenance can be considered the core business of the company and one of keys to its success.

Sichuan Lutianhua has over the years established a good maintenance practice, based on the know-how accumulated by its technicians, with a focus on preventive maintenance. Inspections and measurements play a major role in the company's preventive maintenance program, as a means to detect early signs of failures.

In 2009, Sichuan Lutianhua invested in a state-of-the-art "Enterprise Asset Management" (EAM) solution, which is currently still in improvement phase.

Sichuan Lutianhua's management team, always on the lookout for improvement opportunities and rich of this first experience using IT systems, decided to launch a project to support the inspection and measurement rounds. The utilization of mobile devices was imagined to be the ideal solution to support field technicians. The project team reviewed various hardware and software vendors before meeting with Siveco, the largest maintenance consultancy in China, a company uniquely positioned in using high-technologies to solve real-life maintenance problems.

The two companies quickly reached an understanding and the project was started in August 2010 with the following objectives:

- Standardization and planning of inspections (routine maintenance and measurements)
- Ensuring jobs are actually performed, through mandatory scanning of asset tags
- Diagnosis aid for technicians based on reported symptoms and access to know-how base
- Analysis of measurement trends, operation and management reports and optimization of plans over time

The project

Motorola handheld device were selected, equipped with 2D imagers for asset identification, to run the Siveco bluebee® Inspector solution. Siveco provided the complete turnkey solution including consulting services, software, hardware (mobile devices, server and barcode printer) as well as equipment labels (stainless steel plates).

Two Siveco project managers were appointed, one focused on overall project management and maintenance improvement, the other on the delivery of the system. The Siveco back-office team located in Shanghai, with three people dedicated full-time on the project, provided support for the entire project.

Immediate benefits

Such a project is characterized by immediate benefits experienced during implementation itself:

- Motivate the

> Immediate benefits experienced during implementation itself: motivate the maintenance team and increase awareness

maintenance team and increase awareness: high-tech acts as a catalyst for maintenance improvement.

- Initiate a continuous improvement process based on predictive maintenance: strong linkage is created between field inspections and back-office analysis.
- "Clean up" of the CMMS database: especially more detailed equipment structures, down to specific inspection or measurement points.

The second series of benefits happened from the very first days of utilization:

- Ensure inspections are done: records cannot be saved without scanning of equipment tag (two-dimensional barcode on stainless steel tags), ensuring technicians have actually been there. Highly visual color-codes indicate unfinished actions. Management staffs receive completion reports to track job done.
- Immediate increase in accuracy of records (temperature, vibration): instant warning for out-of-range data.
- Onsite inspection results without the need to return to office: technician gets immediate warning when measurements are outside of safe range or into danger range and get access to diagnosis information, with easy contact with the back-office team if needed.
- Enable analysis based on trends: performed by the back-office team (equipment managers), they allow for true predictive maintenance and long-term optimization of the maintenance strategy.

Long-term benefits from the project will derive from the implementation of predictive maintenance that bluebee® enables. Rapid improvements are expected in terms of downtime reduction and the indirect cost of maintenance.

bluebee® – not the same old mobile solution!

The traditional mobile solutions provided by CMMS/EAM vendors are usually smaller-screen versions of the main product, presented as an option to the main system but almost never implemented. Hardware resellers can also develop custom applications with no industrial valueadded. Siveco's bluebee® suite, on the other hand, consists in standard off-the-shelf applications designed by maintenance engineers for maintenance engineers. Based on very intuitive user-interface requiring little or no training, bluebee® allows for the direct creation of, and access to, know-how by technicians in the field.

The integrated system provides a technical knowledge base for the plant, to support the inspection work and to provide a decision support system for the maintenance team. By enforcing systematic recording of failures and work done, a historical database of inspection will be built up, thus enabling technical-financial analysis.

Key functionalities are:

- **Intuitive user-interface requiring very little or even no training.**
- **Access to the central knowledge-base** with three main points of entry: diagnosis (fault), equipment and inspection work orders.
- **Report of measured values (meters and measurements)** to the central database, with support to identify abnormal values and consult historical data.
- **Report of failures, with selection of faults and access to diagnosis support information.**
- **Access to inspection WO lists and possibility to report on the work orders.**
- **Synchronization with the back office system.**
- **Possibility to barcode (2D barcodes) equipments and inspection points**, for quicker and more accurate input and for verification purposes ("is this the right inspection point?", "has the technician actually been there?").

The mobile solution can be integrated with any back office system (SAP PM, Maximo, Datastream, Coswin etc.) through a robust synchronization platform that takes care of data exchanges as well as optimizing telecommunications and the management of devices (software updates, security…). The platform is highly scalable, from a few devices to hundreds of mobile workers (for example for large multisite company). Siveco China's mobile R&D team, located in Shanghai, can further customize the standard modules to cater to specific customers' requirements.

CMMS as a tool for continuous maintenance improvement for large iron pipe manufacturer in Anhui

Saint Gobain Pipelines' Maanshan manufacturing base

Established in 1997, Saint-Gobain Pipelines (China) owns plants located in Maanshan, Anhui Province and Xuzhou, Jiangsu Province, producing ductile iron pipes & fitting, for both the domestic and export markets. With total sales in excess of 3.5 billion RMB, Saint-Gobain Pipelines employs more than 4,800 employees in China.

With a total investment of over 100 million Euros and currently 1400 employees, Saint-Gobain Pipelines Maanshan site was established in 1997 when a JV was formed with state-owned Magang (Maashan Iron & Steel Company). Saint-Gobain later acquired the remaining shares of the company. The company produces ductile iron pipes and fittings from 100mm to 1000mm, with a total capacity of 400,000 tons.

In 2006, a blast furnace was built and started up successfully during the third quarter of 2007, allowing the company to produce its own iron marking a significant step forward for the Chinese units' productivity and cost reduction plan. At the end of 2008, the piping plant was modernized, in order to raise its productivity. Further productivity improvements based on the group's best practice were also launched in the foundry.

Each plant has its own maintenance department (total of over 200 staff) with, since 2008, a central site-level maintenance manager and support team. A dozen of subcontractors are also involved in the maintenance of the site.

The Siveco projects

Saint Gobain Pipelines boast a long experience with CMMS, with over 30 years' history using such systems in its European factories. In Maanshan, the implementation of a famous CMMS software from the United States had failed a few years before: the system was never put into actual operation and quickly forgotten.

Organizing maintenance at the new iron-making plant

Siveco implemented the Coswin Maintenance Management System during the first quarter of 2007 to support the startup of the new plant, which included a blast furnace, a sintering plant, a power plant using exhaust gases and various utilities.

The aim of the project was to build a strong foundation for future operations, by supporting the creation of an accurate technical database from the project stage. Preventive maintenance plans were defined based on suppliers' documentation and Saint-Gobain's experience.

Coswin was also interfaced with Saint-Gobain's ERP system Fourth Shift to allow for the management of parts linked to work-orders and equipments, in a totally transparent manner, so that maintenance users who see all relevant spare-parts from Coswin.

The CMMS was used from the first day of operation, ensuring ease-of-use for maintenance technicians on a daily basis through the utilization of diagrams. Based on systematic recording of failure information (what, when, impact on production), regular analysis meetings are held to optimize the

Screenshot of SGPL: Work Order Details

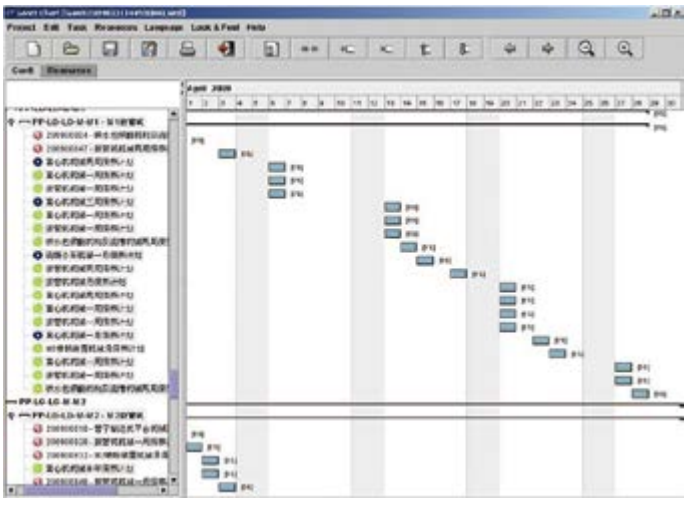
> Siveco's focus on maintenance improvement rather than software has ensured continuous success to help Saint-Gobain achieve its plant management goals.

maintenance strategy and to support specific decisions such as equipment replacement, design change, job frequency, change in operators TPM checklists etc.

Maintenance preparation for the modernization of the piping plant

Following the success of the first project, a new contract was signed in late December 2008 to support a challenging reliability improvement project and the new organization of maintenance, with a centralized site-level manager. Following the piping plant's ongoing modernization project, almost non-stop operation was required to meet production target in 2009, thus putting increased demand on preventive maintenance.

The Siveco project involved the rapid roll-out of Coswin CMMS before Chinese New Year, maintenance support services for the setup of optimized preventive maintenance plans in the piping plan, as well as longer-term coaching by Siveco's maintenance experts over a one-year period. This project was also an opportunity to work more on maintenance analysis - Coswin reports based on the European standards (*EN 15341*, *Maintenance*, *Maintenance Key Performance Indicators*) were installed for that purpose.



Screenshot of SGPL: Gantt Chart

Deployment of Coswin on foundry plant

Saint-Gobain Pipelines' maintenance team prepared all the data required to extend the system to the foundry plant, the only part of the site not yet using Coswin. The data was then migrated to the central database in just a few hours by Siveco engineers.

The foundry operates under very different constraints from the rest of the site, as it produces special fittings. It has also been selected as a pilot project for manufacturing best practices, an opportunity to further explore the analysis capability of the CMMS.

Based on the experience accumulated by the Saint-Gobain Pipeline team, this implementation required only a few days support from Siveco.

Benefits

Today the database contains over 5,000 equipments and over 644 preventive maintenance routines, for which the planning is managed in Coswin with an ongoing process to optimize maintenance tasks.

By no means a simple project, the implementation of the Coswin in Saint-Gobain Pipelines as a mean to organize and modernize the maintenance department, illustrates that year-after-year sustainable maintenance improvement can achieved in a large, complex organization in China.

Quote by Mr. Hua, Common Maintenance Manager:

> "Siveco's focus on maintenance improvement rather than software has ensured continuous success to help Saint-Gobain achieve its plant management goals. Coswin is now a tool for continuous improvement at Saint-Gobain Pipelines Maanshan."

Saint-Gobain Pipelines & Siveco, a long-term cooperation to improve maintenance

New maintenance challenges never experienced before

Saint-Gobain Pipelines China relationship with Siveco dates back to 2007, with the first CMMS project at the Maanshan iron making plant, which was later extended to other plants on the site.

In 2008, Saint-Gobain PAM launched a new project to build a large-diameter, highly automated piping plant in Xuzhou.

Saint-Gobain PAM Xuzhou pipes ready for shipping

The nature of the equipment in the new plant required high levels of maintenance, and the large numbers of drawings and technical documents added further complexity: how to manage this information and ensure its accessibility?

Preparing maintenance from the construction stage

The decision to work with Siveco and to use a CMMS was taken early in the project. The project team took concrete steps to prepare maintenance at the various stages of construction.

- Incorporating so far as possible the reliability and maintainability experience accumulated in similar plants in Europe in the design of the Xuzhou plant.
- Involving as much as possible the maintenance staff in equipment control and commissioning, the earlier maintenance engineers get to know their equipment, the better.
- Documenting the plant in the CMMS during construction. Data preparation included equipment data, spare parts lists and initial maintenance instructions, keeping the CMMS as visual and practical as possible, with access based on drawings.
- Conducting systematic root cause analysis on breakdowns which were documented in the CMMS.
- Organizing the maintenance team, as part of the reorganization, new positions were created such as planners (ensuring coordination between mechanical and electrical teams), CMMS administrator, and spares engineers.

Project team on site

According to Jean-Sebastien David, Xuzhou Site Director of Pipe Operations:

> "Companies building new facilities should never underestimate the effort required in maintenance preparation, in fact, I believe that as much time should be spent on preparing maintenance as on the project itself. So far I have been satisfied with the service provided by Siveco for our project."
>
> "Far from the usual theories of consulting firms and software vendors, Siveco delivers very practical solutions, using technology to improve maintenance based on a real-life experience of China. Siveco has accompanied our development for several years and we continue to expand the scope of our cooperation."

Saint Gobain Pipelines is currently using Coswin 8i, the latest version of the CMMS, as well as bluebee® mobile for inspections. Coswin 8i has been interfaced with the corporate ERP system SAP. Other divisions of Saint Gobain group are also working with Siveco, including Saint Gobain Proppants (ceramic proppants for the oil and gas industry) in Guanghan, Sichuan province, and Saint Gobain Hanglas Sekurit (automotive glass) in Shanghai.

Leading cable maker implements continuous improvement process with Coswin

Acome Xintai Electric Cables Co., Ltd.

Acome is a highly innovative Cooperative Production Company (employees hold the majority of the company's share capital) and a European leader in the cable, wire and synthetic tubing industry.

Founded in France in 1932, the company currently employs more than 1,400 people worldwide. Acome operates sites in Europe, South America and China, with 8 production units including two in China (in Xintai, Shandong province and Wuhan, Hubei province).

Acome's fully-owned subsidiary Acome Xintai Cables Co., Ltd was established in Xintai, Shandong, in year 2000. Operating a 10,000 sqm production facility, it is now one of the major suppliers of RF cables to mobile operators and telecommunication equipment manufacturers in the Asia-Pacific region. The semi-continuous manufacturing process requires a strong involvement of the maintenance team.

The maintenance project

In 2009, the company's management team decided to implement a CMMS to structure its maintenance department and to launch a continuous improvement process. Siveco with its user-friendly CMMS Coswin, was selected for its focus on maintenance improvement rather than pure IT.

The project started in December 2009, focused on training the maintenance team on key concepts (fault reporting, work orders, preventive maintenance, regular meetings and improvement process) using the CMMS as a support. The system's analysis capability would then be used to define longer-term measurable improvement targets, in terms of reliability and cost reduction. The Coswin CMMS was put into operation in April 2010.

Application to quality management

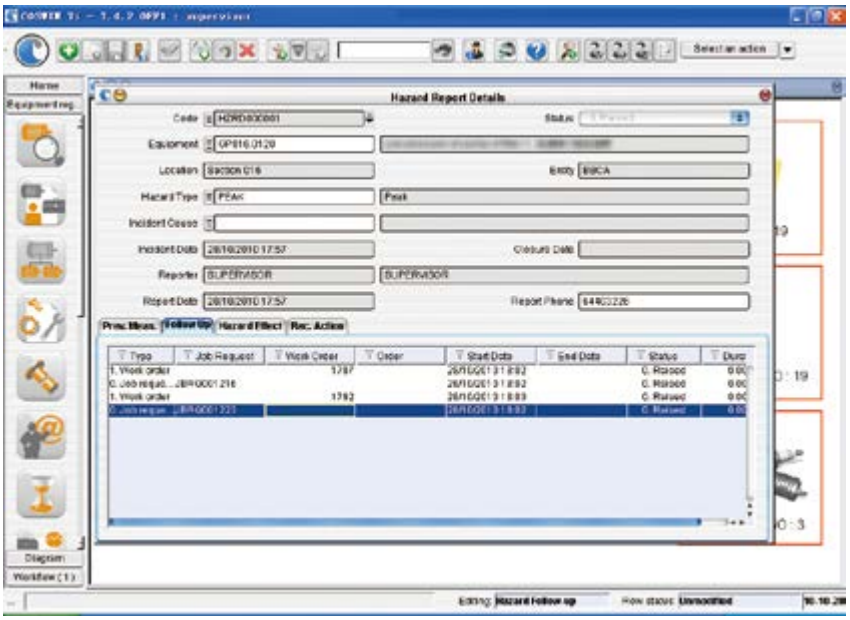
During the initial audit conducted by Siveco at the beginning of the project, important savings opportunities were identified in using Coswin to support Acome's technical team for the resolution of quality problems.

In order to carry a given signal properly, the cables have to respond specifically to certain frequencies: may the cable be too thick or too thin (a few micrometers) at some point, the frequency response will show a peak out of the specified range and the whole batch will have to be scrapped.

When such defect is detected, a Hazard Report is raised in Coswin, containing all related information such as the peak value in MHz. An inspection is then carried out on the production line, involving a number of tests: standard exchanges of bearings or gear-boxes, tightening of bolts, adjustment of speed control. For each such modification, a test is conducted, until the cause of the defect is identified. The challenging part of this procedure is that each modification can itself generate more defects – the entire process is very closely managed using Work Orders, one for each modification, all linked to the initial Hazard Report.

A given peak (identified by its MHz value) for a given

> The historical record is an extremely powerful tool to identify the cause of a defect, bringing a costly investigation from 2-3 days down to a few hours.



Example of Hazard Report at Acome Xintai

production line is linked to a unique cause, which makes the historical record an extremely powerful tool to identify the cause of a defect, bringing a costly investigation from 2-3 days down to a few hours. This approach has resulted in important downtime reductions at Acome Xintai, as well as significant direct savings in raw material, energy, etc. In addition the perceived value of the maintenance team in the overall plant performance has been significantly improved!

Continuous improvement

As part of its service contract, Siveco provided follow-up audits one month and three months after start-up, with a focus on coaching the maintenance team during analysis and improvement sessions. The June 2010 audit (two months after start-up) showed an increasing utilization of the system, with an estimated 85% of actual work reported in the CMMS and preparation for planned shutdowns in Coswin.

Based on findings from last maintenance audit, saving opportunities were identified in the form of an additional production capacity of nearly 3 million RMB (in turnover), the direct consequence of a 10% reduction of the breakdown rate on critical machines.

According to Paul Liu, General Manager of Acome Xintai Cables Co.:

> "We are pleased with the results obtained so far, more particularly with the stronger involvement of our technical team in the continuous improvement process, in line with our goal to constantly enhance the performance of equipment and maintenance."

In November 2010, Acome Xintai decided to extend the usage of Coswin to cover stock management: by maintaining the links between parts and their actual usage i.e. equipment and work orders, the system will allow Acome to forecast its material needs and ensure the availability of the critical parts. The purchasing department will also benefit from the more accurate technical specifications and data will be coordinated between Coswin and the SAP financial system.

How systematic analysis helped leading lactic acid producer to quickly improve its plant reliability

Anhui BBCA & Galactic Lactic Acid Company Limited (B&G)

Anhui BBCA & Galactic Lactic Acid Company Limited (B&G) was born in 2002 as a joint venture between the Anhui BBCA Biochemical Co. Ltd., one of the leading agricultural products processing enterprise in China, and the Belgian company Galactic S.A., the second largest producer of lactic acid in the world.

B&G is using highly efficient technology and is integrated to an existing corn-based glucose production site. This set up results in highly rationalized production costs thus warrants strong competitiveness to the company and ensures the highest quality standards for the products.

B&G products are marketed within the Chinese Domestic Market as well as abroad. Further expansions will enable the company to follow the market growth and to provide high quality lactic acid to Polylactic Acid (PLA) projects. PLA is a new promising biodegradable polymer derived from lactic acid.

The maintenance project

After a few years of operation in a highly corrosive environment, the plant started to experience the early effects of aging: with production running at full capacity, breakdowns could affect the fulfillment of customers' orders. Recommendation by another Siveco client in Anhui province (Saint- Gobain Pipelines in Maanshan) and the company's successful track record in maintenance improvement were the key factors leading to the selection of Siveco for this project.

The main project goals were to build up a technical knowledge base for the plant, to support the maintenance team's daily work and to provide a decision support system for the management team. The Coswin system was up-and-running in about three months and during the next three months the quality of data was progressively raised to the level necessary to conduct in-depth failure analysis.

The improvement process: example of failure analysis conducted 6 months later

Pumps are critical pieces of equipment in B&G's process: a failure could lead to a production stop resulting in significant financial losses. While technicians are familiar with pumps that break down several times per month and tend to focus their efforts on them, it is more difficult to identify less frequent breakdowns, the impact of which is however far from being insignificant in terms of time and money. As technical teams are busy dealing with daily emergencies, those infrequent problems tend to be overlooked: quick fixes are applied, without long-term solutions.

According to Martin van Gansberghe, former Deputy General Manager (Technical) at B&G and currently Technical Director of Galactic Group:

> "Thanks to the Top 10 report in Coswin, less than 6 months after implementation, we easily identified three types of pumps experiencing regular failures, which finally were more time-consuming than the most frequent, better known, problems."

While the report did draw their attention to this particular problem, B&G's technical team still had to understand why these

> How could we have got rid of all these small, yet costly, failures without a systematic failure analysis process?

breakdowns occurred. As Martin describes it:

> "Coswin simplifies our life: we sit around the table with Coswin, then go to the plant: the conclusion is right before our eyes!"

The condensate pump was badly designed: the head was too low; as the pump was at times running light, the resulting cavitations accelerated the wearing out of the mechanical seal. The root causes of the other breakdowns were then quickly identified: an analysis of failures data gathered in Coswin led the maintenance team to identify a bad mechanical seal choice for the evaporation pump. For the sulfuric acid pump, the main cause was bad operation of the pump: the timing of the related control valve was wrongly set up, causing the pump to run without load for a short moment.

Martin summarized the benefits of Coswin-driven failure analysis:

> "How could we have got rid of all these small, yet costly, failures without a systematic failure analysis process? In effect, the system literally pushes the results to the technical manager's mailbox, so that he can follow the progress and questions his teams on a regular basis."

> "Before Coswin, some of the problems were perhaps known (our technicians obviously knew the pumps had problems, we just did not take time to think about it). Some corrective maintenance work was so frequent that it was wrongly re-qualified as preventive maintenance: we had someone checking it everyday, ready to act when the problem occurred. Top management was not aware of problems until they got out of hand and affect the business. Root causes were not systematically identified, quick fixes were applied instead."

Aluminate cement leader implements world-class maintenance practice in its Chinese plants

Kerneos Aluminate Technologies

Kerneos, formerly known as Lafarge Aluminates, is the world leading manufacturer of calcium aluminate cements under the brand names of CIMENT FONDU®, SECAR®, PERAMIN® etc. These high-tech aluminate products are designed for refractory, building chemistry and technical concrete applications. A company with over a hundred years of history, Kerneos is part of Materis Group, one of the worldwide leaders in building construction specialty chemicals.

To satisfy increasing demand for aluminates products from the Chinese market, Kerneos started up its first Chinese plant in Tianjin's Economic Development Area (TEDA) in 2001. The modern plant was designed as a model for the group's future development in China, providing best practices and qualified resources for the company's future expansion in the country. Ten years later, Kerneos China operates five plants, a R&D center, and the company continues to invest in the local market.

Implementing the group's "Common Language" in China

Kerneos Aluminate Technologies has a long history working with Siveco to implement the Coswin Maintenance Management System (CMMS) throughout its worldwide manufacturing operation (France, UK, USA): the group's IT strategy has always privileged strong industrial "best-of-breed" solutions rather than one-size-fits-all corporate management software.

Building up on a century of industrial experience, Kerneos has developed a very mature maintenance practice, with a well-defined management framework known within the group as the "Common Language". The Common Language includes standards for plant structures, coding rules, work report processes, technical analysis reports, etc. that form the basis for Coswin implementation within the group.

In TEDA, while the initial approach to use paper processes and Excel spreadsheets had proven successful, the plant started to experience more downtime due to aging. As preventive maintenance became more critical, the plant's maintenance team needed more sophisticated tools to analyze failures and support improvement decisions. The decision was finally made in December 2007 to roll-out the Coswin Maintenance Management System, based on Kerneos' Common Language. The project started immediately.

The CMMS project

The CMMS project was completed in only two months, thanks to the strong experience of the TEDA team, support from Kerneos group and Siveco's specific experience of maintenance improvement in China, all of which proved highly valuable for the success of this project.

Specific goals of the CMMS project in TEDA and the corresponding achievements included:

Setting up the plant's technical database, with a clear structure and up-to-date technical information.

A clear plant structure was defined in Coswin in accordance to the company's standards. In addition to purely location-based and technical structures, the relationship between equipment ("serve" and "served by") was also modeled in the system, which is critical in the process industry for reliability and safety purposes.

Implementing a work order system to ensure systematic recording of failures

A friendly user interface based on diagrams, similar to that of a DCS, was configured in order to simplify the engineers' work. Operators in the control room can report failures directly in Coswin, while the maintenance team will arrange schedules and report work orders.

The system's DCS-like user interface

“Coswin was interfaced with the group's central Work Permit system, which requires a strict approval process through the use of signatures on a special pad.”

Setting up the plant's preventive maintenance system

Preventive maintenance activities are managed in Coswin, from the initial job guideline to the actual planning and execution. The system's analysis tools are designed to support technical management decisions, in order to continuous improve the preventive maintenance plan.

Managing spare parts stock

Spare parts are not managed in the company's ERP system, as is often the case. Instead, Coswin links parts to the equipment they belong to and to work orders (preparation and consumption), ensuring full stock management.

Ensure safety in the maintenance process

Safety is the first priority for Kerneos and more globally for Materis Group: Coswin was interfaced with the group's central Work Permit system, which requires a strict approval process through the use of signatures on a special pad.

The entire system was built in compliance with Kerneos' Common Language, ensuring a sustainable implementation of the group's world-class maintenance practice and allowing benchmarking with other plants.

Further Coswin deployment

According to Liu Ke, IT Manager of Kerneos China:

"The system brought enormous benefits, by supporting the daily work of our maintenance team: from diagnosis and technical analysis, to preventive maintenance and spare parts management. The project ensures our ability to extend the Common Language to all our Chinese plants."

Kerneos is currently extending the usage of Coswin to its other Chinese plants to structure their maintenance organization based on Kerneos' Common Language and to promote a modern, reliability-focused, preventive maintenance approach. All plants access the central Coswin database already installed in TEDA, thus benefiting from the existing infrastructure and allowing easy benchmarking between plants.

CMMS optimization delivers concrete results for leading chemical producer

The Arkema Changshu industrial platform

Arkema is a leading chemical producer with over 5.6 billion Euros revenue, for 15,000 employees in over 40 countries. With internationally recognized brands, Arkema holds leadership positions in its principal markets.

Arkema (Changshu) Fluorochemical Co., Ltd., established in June 1996, was the first foreign-invested company dedicated to the chemistry of hydrofluoric acid and CFC substitutes in China. The plant, started up in May 2000, has a production capacity of 20,000 MT Anhydrous Hydrofluoric Acid (AHF) and 35,000 MT FORANE®22 (with applications to air conditioning and the polymer industry). Over the years additional investments were made, namely a 3,000 MT organic peroxides plant (Arkema Changshu Chemicals Co. Ltd.) and a 6,000 MT vinyl compound plant (Changshu Resichina Engineering Polymers Co. Ltd.), as well as several joint-ventures.

Further developments are now under construction, which will eventually make the Changshu industrial platform Arkema's third largest in the world.

The CMMS project

In 2001, Arkema Changshu purchased a computerized maintenance management system from a leading U.S. software supplier. The implementation of this software, however, did not make much progress until 2005 and the appointment of a new technical manager, who considered the CMMS a necessity for the successful operation of a plant of this scale. The project was shifted back into gear and finally went "live" at the end of 2007.

During this 6-year period, the implementation was plagued by all the issues typically found in IT projects in China: inadequate contract terms (man.days rather than result-driven), lack of industrial expertise by the IT vendor, high turnover of supplier's staff and so on. Arkema's needs naturally evolved over time, as operations developed, a phenomenon compounded by weak project management.

By the beginning of 2008, system usage was described as covering "basic daily work and some analysis from preventive maintenance history". Some functionality was not yet in use and some re-work had to be done for which the software vendor still had man.days available. As the last project milestone was soon to be signed off, Arkema hired Siveco to conduct an independent assessment of the CMMS implementation and usage. The goal of this audit was to identify possible improvement and allow Arkema to best utilize the remaining days from the IT supplier.

The Siveco audit

The audit was conducted in June 2008 by two Siveco project managers (one focusing on maintenance management, the other on the CMMS itself). Lasting four days, the audit consisted in reviewing the technical database and work order history, an indepth analysis of the equipment structure and interviews with users at different levels, from technicians to top managers, in all departments involved (maintenance, stock, purchasing). A report containing detailed recommendations was then prepared and presented to the Arkema team.

The report noted fist of all the excellent level of maintenance organization at Arkema Changshu and concluded on a satisfying level of utilization of the CMMS a few months after "go live", thanks to the know-how and efforts of the Arkema team. The necessity was clear, however, to move on to

> Siveco's involvement has been very beneficial to us,delivering concrete achievements above and beyond ofwhat our IT vendor could ever provide.

A standardized audit methodology

an improvement phase, i.e. not simply using the system for itself, but rather as a tool to manage, build-up knowledge, perform analysis and support decisions.

In line with Arkema's management priorities, a number of areas were identified where quick ROI could be obtained through simple enhancements of the system, more particularly with regards to simplifying the way preventive maintenance was structured in the CMMS and the management of strategic spare parts.

After the audit

Based on the actions proposed by Siveco, the Arkema team went back to their IT supplier to correct the most pressing issues. At the same time, Siveco was asked to help implement some of the recommendations, where maintenance know-how was required and to support the deployment of the CMMS to two new plants under construction at the time. Siveco also performed a similar audit in another unit of the group, Arkema Hydrogen Peroxide (Shanghai).

The way the preventive maintenance process was handled in the CMMS and its subsequent improvement is perhaps the best example of Siveco's no-nonsense approach. The existing preventive maintenance programs, although usable, were complex, with too many redundancies: Siveco had, during the audit, identified an opportunity to achieve the same result with a simpler, more flexible and leaner system. The same Siveco team came back to Changshu, this time with the assistance of a third consultant focused on the utilization of this particular CMMS, and conducted workshops with key users until the desired result was obtained. The joint team achieved outstanding results: the number of preventive maintenance work orders to be managed in the CMMS dropped by 75% (for the same actual tasks in the plant). The entire planning and scheduling process was thus immediately simplified, freeing time for improvement activities: analyses, optimization of job frequency, etc.

According to Bernd Kloepzig, Technical General Manager of Arkema Changshu:

> "Siveco's involvement has been very beneficial to us, delivering concrete achievements above and beyond of what our IT vendor could ever provide. The Siveco people proved to be true maintenance experts we could talk to: we understand each other. I would not hesitate to recommend Siveco for similar audits and improvement projects in the chemical industry. I am looking forward to a continuing partnership with them in future projects."

Siveco China has become a trusted Arkema supplier and has since delivered other maintenance consulting projects for Arkema plants in China and Malaysia.

Maintenance support for new Sino-US manufacturing plant

Daramic from the US is the world's leading manufacturer of high performance polyethylene battery separators, supplying more than 50% of the world's demand. To consolidate its leading position in China, Daramic signed in 2010 a joint-venture agreement with the largest local Lead Acid Battery producer. The JV Daramic Xiangfan Battery Separator Co., Ltd. is located in Xiangyang, Hubei province.

To better serve the local market, the JV has built a new facility with two production lines, representing 35M sqm of capacity, in a two-step process. Most equipment was imported second-hand from Europe.

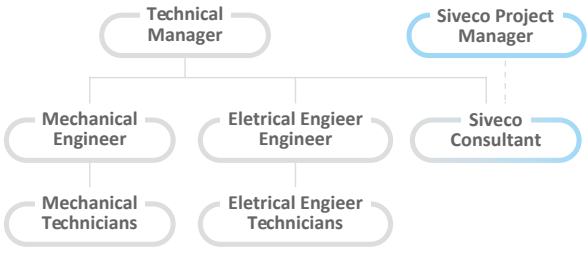
Siveco's one-year mission

Daramic selected Siveco to provide maintenance engineering services for the new plant. A long term contract was established to dedicate a Siveco consultant for a one-year full-time mission, to support the implementation of good maintenance practices, including:

- Definition of the maintenance strategy
- Organization of the maintenance department
- Building up of the spare-parts stock
- Development of troubleshooting and preventive maintenance guidelines
- Implementation of maintenance methodologies
- Setting up accurate technical documentation
- Start-up assistance for new production lines

The appointed Siveco consultant, working with support from the Siveco back-office team, was immediately deployed on site in Xiangyang, at the beginning of June 2012.

Embedded in the local organnization chart, the Siveco consultant is part of the customer's organization



Building an efficient maintenance organization

One of the roles of the Siveco consultant was to take a step back from the day-to-day events and to advise the local technical manager on how to organize an efficient maintenance department. As the factory was new, all the procedures had to be written, management tools and others KPIs needed had to be set up, local teams had to be trained and coached.

Localizing spare parts procurement, a risk-based approach

Having the right spare parts at the right time is the first requirement to ensure reliable operation of the production line. In Daramic's case, with used equipment coming from Europe, spare parts proved to be a major challenge. How to replace parts no longer produced? How to handle the very long and irregular lead-time for imported parts? How to maximize the use of China-made parts to replace costly European parts?

The Siveco consultant was in charge of leading a review of safety stocks and implementing related actions:

- A criticality analysis was performed for each PID (Process and Instrumentation Diagram), to establish the list of critical parts in a systematic manner.
- A weekly KPI was defined to follow up progress.
- The final Critical Spare Parts list contained more than 250 references of critical spare parts.
- For each critical spare, a risk assessment was done as to the possibility to localize its procurement, weighing in critically, cost, lead time, quality, and after-sales service.

The Siveco consultant, thanks to his long maintenance experience both in China and

> The Siveco maintenance consultant wears working clothes like all the other maintenance workers.

Europe, was uniquely positioned to assess the pros and cons of European versus local suppliers, based on the systematic risk analysis.

Continuous improvement

As soon as production started, the Siveco consultant set the continuous improvement process in motion. Inspired by TPM methods, every week a meeting is held to analyze every single event and to define corrective and preventive actions. The Production and Technical departments, but also HSE when needed, work hand-in-hand during the analysis sessions, to achieve results that will benefit everyone in the plant.

A consultant in working overall

According to Zhanjun Zhao, the General Manager of Daramic Xiangfan Battery Separator Co., Ltd.:

> "The Siveco maintenance consultant wears working clothes like all the other maintenance workers. When his technical assistance is needed, he is personally involved in repairs, troubleshooting and machine modifications. When the Siveco consultant is not at his desk, you will sure find him somewhere in the plant!"

Infrastructures

SCIP Sino French Water I SCIP SITA Waste Services I Renwu SITA Waste Services I Degrémont I Ranhill Powertron II Power Plant Bukit Asam's Banjarsari Power Plant I Tanggu Sino French Water I Chongqing Sino French Water

Continuous improvement at leading industrial water treatment JV

Shanghai Chemical Industry Park Sino French Water Development Company Limited

The Sino French Water Development Company Limited ("Sino French Water") is a successful partnership between Suez Environment of France and NWS Holdings Limited of Hongkong. Sino French Water has been active in the Chinese water industry since 1992. Its core businesses can be classified into five areas: water production, water distribution, municipal sewage treatment, industrial water treatment services as well as investment holding company. Sino French Water currently operates 22 joint ventures in 16 Chinese municipalities, serving a population exceeding 14 million inhabitants and employs over 5,000 employees in China.

With an area of 29.4 km^2, Shanghai Chemical Industry Park (SCIP) is one of the most heavily invested in industrial projects in China's 10th Five-Year Plan. In 2002, Sino French Water partnered with SCIP Development Company Limited and SCIP Investment Company Limited to form Shanghai Chemical Industry Park Sino French Water Development Company Limited. With a concession period of 50-year, this joint venture (JV) is exclusively dedicated to providing water and wastewater treatment services to the industrial park.

Water Supply Capacity:

- Industrial water: 200,000 m^3/day
- Domestic water: 7,000 m^3/day
- Demineralized water: 150 m^3/hour

Wastewater Treatment Capacity: 50,000 m^3/day, CODcr load 30 tons/day

Wastewater Treatment Plant: Each inlet is equipped with online toxicity meters, for real time monitoring of the biological toxicity of the wastewater. Furthermore, the plant has a 15,000 m^3 emergency storage capacity for off-spec wastewater. This is used in the event of an accident during production. The storage facility also eliminates pollution load fluctuation from the treatment process. The plant's treated wastewater meets national emission standards and its discharge point is connected to Shanghai's Environmental Protection Bureau's online monitoring system.

Demineralized Water Plant: The plant has a production capacity of 150 m^3/hour. It can reuse treated wastewater as raw water for the production of demineralized water. This results in decreased WWTP discharge volume and better circular economy.

Laboratory: In 2006, the laboratory started to use a Laboratory Information Management System (LIMS). In 2007, it ranked as a "Reference Laboratory" in Suez Environment's Inter-laboratory Tests. In 2009, it achieved CNAS accreditation and achieved the *ISO 17025* certificate. The laboratory is capable of analyzing around 100 parameters and conducting more than 400 analyses a day.

SCIP Water Research Center (SWRc): It is China's first R&D organization dedicated to the research of industrial water and wastewater treatment. In 2008, SWRc acquired one patent. Another creation patent is under consideration in 2009. To promote circular economy, SWRc is working on two projects: one focused on using wetland to treat wastewater; the other on ways to reuse water.

Health and Safety Management: The JV achieved the Lloyd's Register Quality Assurance (LQRA) approved *ISO 9001* certificate in 2006, as well as the *ISO 14001* and *OHSAS 18001* certificates, accredited by the same body, in 2008.

The project

In 2006, SCIP Sino French Water initiated a selection process for a CMMS, to replace earlier purchased software that was never put into actual use. Coswin, with its flexible graphical user interface, compared very favorably with complex IT tools used elsewhere in the group. Moreover Siveco already had a successful reference in Shanghai Chemical Industry Park.

SCIP Sino French Water had from the outset a very clear plan: the implementation of the CMMS would allow the team to grow and improve at their own pace. The company's management team clearly stated that the project was about

> Siveco has continuously helped us improve our maintenance management.

learning from their own experience in order to improve, rather than about IT, in line with Siveco's approach. Consequently, the project was executed in several phases.

Building the foundation

The initial focus of the project with Siveco was on building the company's equipment structure from data already available and to support the work management process. Highly user-friendly diagrams were designed to allow operators to report failures and work requests directly in the system. By involving operation teams in the process and ensuring all corrective work orders were prepared and reported in Coswin, the Sino French Water maintenance team was able to raise its service quality.

Example of Coswin screen used by operators at SCIP Sino French Water

Supporting technical decisions

After one year of utilization, Sino French Water realized the need to optimize the existing equipments structures and failure codes, in order to better support the decision process and future maintenance improvements. The initial data structure was revamped with the help of Siveco engineers, thus ensuring it could better support future development (plant extension, changes in equipment, improvement in maintenance practice). The management of preventive maintenance was introduced (definition of job guidelines and inspection rounds). New management indicators and reports were designed to support regular meetings and management reporting.

According to Jean-Pierre Arcangeli, General Manager of SCIP Sino French Water Development:

> "Coswin has proven to be an excellent tool for our company and Siveco has continuously helped us improve our maintenance management. Four years down the line, good maintenance management habits have been acquired and, as our activity in Shanghai Chemical Industry Park grows, we continue to work with Siveco on the expansion of Coswin."

After using Coswin successfully for many years, Sino French Water and Siveco have signed of a corporate agreement covering all the company's operation in China (more than 30 joint ventures). The CMMS solution has subsequently been deployed to many of the group's joint ventures (full water service, water production, industrial waste water services, sewage water treatment and sludge treatment). Meanwhile, in Q3 2013, SCIP Sino French selected the bluebee® inspection solution, running on Android mobile phones, to add on to the current Coswin CMMS. This project went live in early 2014.

“Maintenance is the key to our business” at leading-edge hazardous waste incinerator

Background

Shanghai Chemical Industry Park (SCIP) lies at the north coast of Hangzhou Bay with the total planning area of 29.4 km^2. SCIP is one of the industrial projects with the highest investment in China during the 10th Five-year Plan period. It is the first industrial zone specialized in the development of petrochemical and fine chemistry businesses, and is also one of the four industrial production bases in Shanghai.

Established in 2003, SCIP SITA Waste Services Company Ltd. (SCIP SITA Waste Services) was jointly built by SCIP DC, SITA WASTE SERVICES (the waste management branch of French group SUEZ ENVIRONNEMENT) and NWS Holdings Limited (HK) with a total investment of 575 million RMB.

SCIP SITA Waste Services operates the largest and most sophisticated chemical waste incinerator in mainland China, with an annual treatment capacity of 60,000 tons per year. The incinerator, in operation since June 2006, is a critical element in the supply chain of giant chemical producers located in the park, which rely on the SCIP SITA to burn hazardous by-products according to European standards.

Project objectives

Based on SCIP SITA and Siveco’s experience of greenfield utility projects, the main goals of the projects were to:

- Build a strong foundation for future operations by accurately documenting the plant before start-up, allowing smooth knowledge transfer from engineering to maintenance.
- Ensure the systematic use of work orders (what, when, who, impact on operation and safety) for follow-up actions and analysis.
- Help the operation team focus on preventive maintenance.

Project implementation

The plant was fully documented in the Coswin CMMS before start-up. The 4 months project allowed SCIP SITA to build its management system and train the maintenance team based on industry’s best practices and European standards.

Starting from the commissioning stage, 100% of the work was managed with work orders, ensuring full traceability of all actions. When problems did occur, corrective action requests were immediately documented for follow-up.

Once this basic discipline, necessary for SCIP SITA to ensure strict regulatory compliance, was in place, the team moved its focus to improving the maintenance strategy, namely by promoting a preventive maintenance approach.

> Maintenance is under full control, regardless of the inevitable personnel changes.

The entire process is, since 2006, managed in Coswin, all the way from work management, planning, inventory management and procurement.

Comments by SCIP SITA General Manager Philippe Allouche

"From day one, we recognized maintenance as a key success factor for our project. The Coswin Computerized Maintenance Management System (CMMS) was implemented before startup."

"The system allowed us to manage safety right from the commissioning stage, by enforcing a strict work process. The CMMS is used to educate and organize our team and to support management decisions."

"Reliability is the key to our business, serving chemical plants in the area, whose own operation could be affected by a prolonged downtime of our facility. Four years down the line, we have succeeded in creating a true culture of maintenance in our Chinese operation: maintenance is under full control, regardless of the inevitable personnel changes."

Today

In October 2009, SCIP SITA Waste Services and Siveco China were jointly nominated by the Global Supply Chain Council, Asia's largest supply chain organization for the Green Supply Chain Award for the CMMS project. Each year, the awards recognize the importance of supply chain, procurement and logistics excellence, by identifying and rewarding outstanding performance among leading manufacturers, retailers, service providers and key individuals working in Asia.

Hazardous waste incineration plant optimizes plant inspections with bluebee® mobile solution

The case study was nominated for the 2015 Suez Innovation Trophies.

SCIP SITA Waste Services, a subsidiary of SITA Waste Services, operates a Hazardous Waste Incineration Plant ("HWIP") in Shanghai Chemical Industrial Park ("SCIP") since 2006. It has a successful record of treating a wide range of hazardous waste, in full compliance with applicable Chinese regulation. The current facility consists of two incinerators with a total capacity of 60,000 tons per year. The plant is becoming one of the largest HWIP in the world with the extension of a third line.

Ensuring and optimizing the high availability of equipment is critical for the continuing success of the plant and its coming extension. The main way to ensure it is through an excellent preventive maintenance by checking and measuring frequently the critical equipment and also doing appropriate replacement on some parts, based on scientific and on-site knowledge.

Since start-up, the Maintenance department uses a Computerized Maintenance Management System (CMMS) to record and create all maintenance work, including preventive maintenance and overhauls. Inspections however were set by each engineer using a paper-based process which didn't allow analysis or consistent tracking of findings and measurements. Inspection quality was impossible to measure or review.

The bluebee® project

The bluebee® project aim was to improve the quality of maintenance by standardizing the inspection content (such as routine and daily inspection) and increasing the reliability of data coming from the field. The use of bluebee® was to eliminate the traditional paper work orders from the CMMS system and help establishing a real inspection database for diagnosis and performance analysis.

The pilot project started in March 2013 and went through several optimization phases. Due to the plant hazardous working environment, explosion-proof ATEX Zone 2 mobiles were selected, supplied by Bartec, a Siveco Value Added Partner.

bluebee® PDA, with a QR code tag

The inspection process

The plant operation condition is constantly monitored online by the plant supervision and control system. Another level of monitoring is performed through onsite inspections by the operation and maintenance team. Many rely on the five human senses: vision, hearing, touch, smell… only taste is limited to the company canteen and is not used to detect problems. Other inspections rely on using specific tools or instruments, including more complex vibration measurement, X-ray test or material analysis. This sometimes inconsistent and hard to optimize paper process was replaced by bluebee® mobile, integrated with the existing CMMS.

A total of 102 inspection were defined initially. The frequency of inspections vary, from daily or weekly routine, to less frequent schedules, according to the criticality of the equipment and the probability of degradation or failure.

Each equipment is labelled with a unique QR code, with its name and code: as part of the project, a total 1,116 QR codes have been installed in the plant (159 for mechanical, 145 for electrical and 812 for instruments).

Inspection workload is automatically balanced by the system, optimizing the daily schedules of all technicians. Each morning, each technician downloads his work orders of the day and prepares for his inspection route accordingly. There is no need to bring any paper on site. After scanning the equipment QR code with his mobile, the user inputs related data. The action of scanning a QR code makes the process more reliable in many aspects: no loss of information as with paper notes, true information collected at the source, easy to check the regularity and content of work, etc. When the technician comes back to his

> The project makes inspection and preventive **maintenance more efficient, reliable and easier.**

office, he only needs to launch the synchronization process (using the office Wifi or USB cable to computer) and can focus on something else. Everyone has direct access to the data, there is no need any more for data input, sending emails, etc. The automatic input make analysis easier, thanks to the back-office reporting system (part of the CMMS).

The results obtained

According to Baptiste Garro, Planning Engineer:

"The project makes inspection and preventive maintenance more efficient, reliable and easier. Data from the field (reports, measurements) is now available in the same central database, allowing in-depth analysis and better support on decisions. The technicians benefit from higher motivation in their work, thanks to this technology.

Although there are direct efficiency improvements (less time spend reporting on paper, compiling data or looking for missing data), the main benefit will be indirect: less problems, improved thinking on risks and losses, and scientifically taken decisions.

Finally, it directly helps the detection of minor and major malfunctions that can lead to a breakdown. Each day when a breakdown is avoided is a day without safety or environmental issues. It also will save huge direct and indirect costs from avoided breakdown."

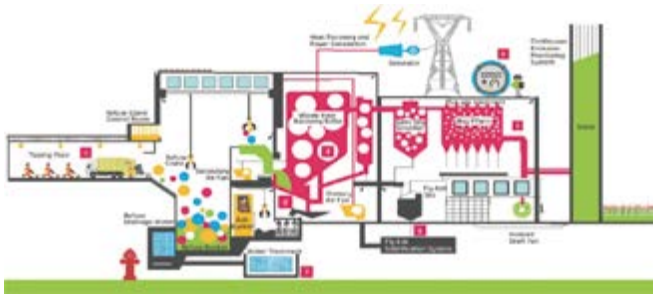
the bluebee® Team, from left to right: Thomas Tao, Baptiste Garro, Sun Junwei and Xu Yong

Taiwanese waste-to-energyplant optimizes its entire operation with Coswin

SITA Waste Services Limited, Taiwan Branch, Renwu Plant

SITA Waste Services Limited is a subsidiary of SUEZ ENVIRONNEMENT, a world leader exclusively dedicated to water and waste management services.

SITA was awarded a contract in Taiwan by Kaohsiung government for the operation and maintenance of Renwu Incineration Plant under a 20 years contract. Commencing from December, 1st 2000, the facility is managed by high calibre crew trained by SITA for the purpose of maximizing energy efficiency, and meeting the most stringent environmental protection standards in the world.



Main equipment at SITA Renwu Waste Incinerator

The facility is designed to incinerate 1,350 tonnes each day of blended non-hazardous combustible solid waste with a weighted-average heating value of 2,300 kcal/kg. The energy generated is converted to a total of 33 MW of electricity.

The CMMS project

In December 2012, SITA Waste Services selected Siveco China to implement a Computerized Maintenance Management System for the Renwu waste incinerator. The choice of Siveco was based on the company' successful experience at another SITA facility located in mainland China.

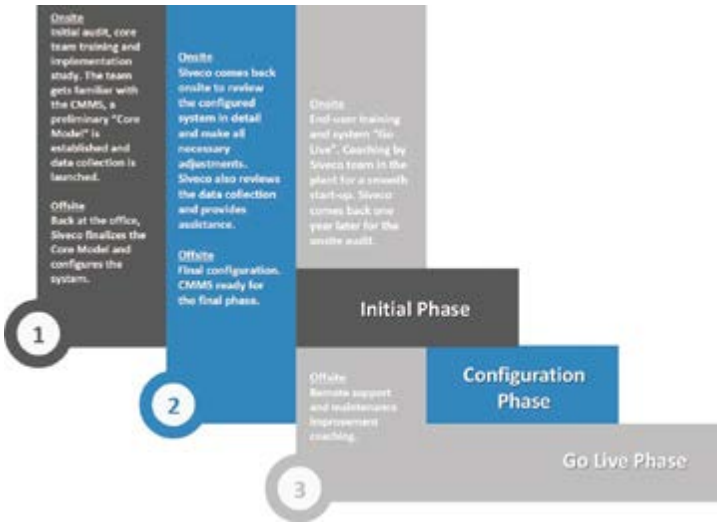
The project covered the implementation of the Coswin CMMS, with a step-by-step approach aimed at promoting maintenance improvement at the plant, through a progressive structuring of the maintenance activity towards systematic analysis and preventive maintenance.

The project was entirely managed by the Siveco China team, traveling onsite to Kaohsiung, with support from the Siveco back-office in Shanghai, following the company's well-established "export" implementation model for CMMS.

The Siveco implementation methodology builds on over 20 years of implementing maintenance solutions in utility plants all over the world, either for existing plants or as part of new construction projects, and specific experience accumulated in recent years by the China team. Siveco has developed a cost-effective and proven model whereby Siveco engineers set up the main system in China before delivering it onsite.

Siveco engineers will come to site at the initial, middle and final stages of the project, ensuring a smooth CMMS implementation. This approach, used for the SITA Renwu project, is summarized below:

The CMMS project started in January 2013. The new management system was in place eight months later, in September 2013, after which the project entered its Enhanced Maintenance Support phase, during which Siveco monitors system usage on a monthly basis and comes back onsite once a year.

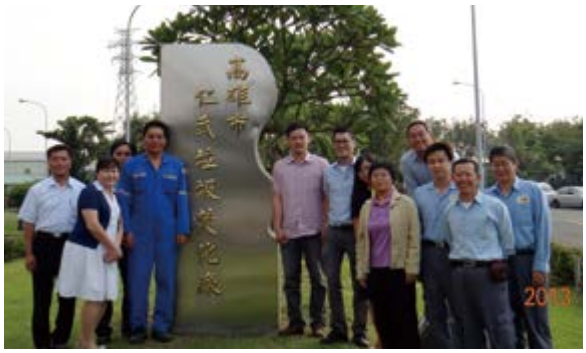


A user-friendly system to support a

> The solution implemented has helped us in the analysis of maintenance data and in the orientation of the maintenance strategy.

comprehensive management model

All departments of SITA Renwu have taken part in the project and are now using the system, which covers a comprehensive functional scope: equipment management, work management (corrective maintenance, preventive maintenance and overhaul management), spare parts stock management,



purchasing management, reports and analysis. The entire management team was involved under the plant manager, with additional support from China-level management. Several exchange meetings were also organized with other SITA plants using Coswin. As a result, the entire management of the Renwu plant was streamlined and the system will continue to support improvement for years to come.

Another key aspect of the CMMS is the use of Coswin Diagrams to easily navigate the system and graphical management and analysis reports. The reports offer support for management meetings at departmental and plant levels.

As part of the Enhanced Maintenance Support (EMS) contract, Siveco will also analyse the results obtained, the utilization of the system and resulting operational improvement, in order to suggest improvements. The last EMS visit took place in September 2014, during which improvement actions for the coming year were clearly identified by the joint SITA-Siveco team.

"Siveco team had demonstrated their expertise in CMMS development and implementation that bring Renwu CMMS project a success. We had raised quite a few special requests during the development phase that may not be common to other industries. Siveco team managed to find solutions to adjust the CMMS to best fit our needs. I am expecting Siveco to be our long term partner that brings our maintenance management to a higher level." said Mr. Franco Wong, General Manager of SITA Waste Services Limited Taiwan Branch.

"The selection of Siveco as CMMS supplier and as the solution implementer for Renwu WTE plant is part of our long term maintenance strategy in the region. Siveco is able to deliver a friendly and efficient tool and is guiding the local team during implementation. After implementation, Siveco is supporting the local team by a succession of Audits to improve the usage of the system. Siveco is a professional Company offering maintenance solution for the industry. They differentiate themselves with their local team who can speak the maintenance language. The solution implemented has helped us in the analysis of maintenance data and in the orientation of the maintenance strategy." Francois Jenny, Business Unit Director.

A long term relationship

Based on the results obtained in the SITA Renwu and other projects with Siveco, SITA has strengthened its partnership with Siveco: the CMMS Coswin and its mobile solution for plant technician, known as bluebee®, will be deployed to all future SITA sites in Asia. Siveco also assists SITA to develop its in-house maintenance management training program.

Degrémont - Operator know-how, builder expertise, leveraging IT tools

Degrémont, the world water treatment specialist

A subsidiary of the SUEZ ENVIRONNEMENT group, Degrémont has been the world water treatment specialist for more than 70 years. Operating in more than 70 countries with over 5,000 employees, Degrémont generated revenues of €1,110 million in 2013.

The Operation & Maintenance (O&M) Support Division represents one third of Degrémont's employee, namely 1,800 people, specialists in large high-tech facilities, present in 20 countries. 19 million people are serviced by a drinking water production plant operated by Degrémont and 21 million people-equivalent are serviced by a wastewater treatment plant operated by the company.

The main challenges faced by water treatment facility operators are: guaranteeing continued water production or water treatment, controlling operating costs and preserving assets. On a daily basis, these challenges translate into rigorous planning and a multitude of interventions to manage the facility.

In order to better serve its industrial clients in China with maintenance services, Degrémont has decided to team up with Siveco China, the country's largest maintenance consultancy. Siveco brings over 10 years of experience in the Chinese market, with a customer base of over 800 sites in China, a team of maintenance specialists and the award-winning bluebee® solution for multisite maintenance management.

Maintenance improvement services for industrial water plants

The service proposition prepared by Degrémont provides a broad range of solutions to allow operators to choose adapted and cost-efficient solutions. Siveco's maintenance specialists work as part of the Degrémont team, while Siveco also provides the central maintenance management platform bluebee® cloud that Degrémont uses to manage O&M contracts. The joint approach usually consists of three main phases:

1. Initial maintenance assessment

A joint Degrémont and Siveco team goes on site for an assessment of current facilities condition and maintenance status: inventory of key equipment and its condition, review of existing maintenance plans, records and documentation, interview with key personnel. This third-party assessment, based on European maintenance standards, provides clients with practical recommendations in the form of prioritized action list. Collected data and findings are uploaded into central bluebee® database, accessible by all parties.

2. Review and update of maintenance plans

Degrémont and Siveco recommends immediate corrective and improvement actions, based on onsite condition, as well as a professionally-reviewed inspection and preventive maintenance plans, based on equipment suppliers recommendations, industrial best practices and maintenance history at site. Plans include spare parts and consumable requirements. All actions are available in the easy-to-use bluebee® cloud database (export to Excel and pdf available) and immediately usable to obtain quotes from service suppliers. QR-coded tags for equipment and inspection points can also be printed directly from the system.

3. Implementation and follows-up

With a focus on ensuring that planned actions are actually being implemented, Degrémont and Siveco train the maintenance team (in-house or contractor) in new maintenance plan and usage bluebee® mobile (Android app), a foolproof mobile recording system based on scanning QR codes on equipment and inspection points. Monthly remote reviews are performed based on system reports, as well as additional onsite coaching every 3 months, and a yearly performance assessment. The combination of coaching and recording system ensures that

> Thanks to our advanced IT tools, we leverage both expertise and ensure monitoring of the activity, to guarantee the quality and reliability of your installation.

recommendations are actually implemented.

bluebee®, the supporting tool

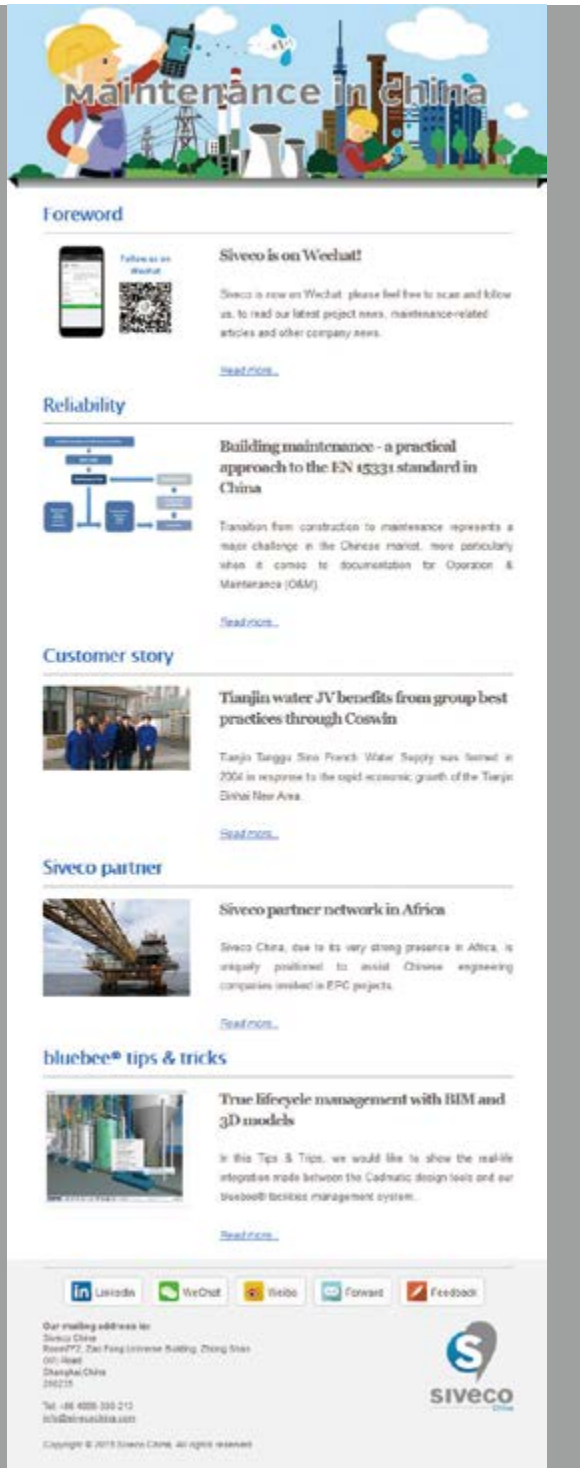
The bluebee® suite supports the entire process: Degrémont and Siveco engineers are equipped with the bluebee® surveyor app for the initial audit. All data is then uploaded into bluebee® cloud, accessible with secure login by all authorized parties. Maintenance supervisor (customer's in-house team or appointed contractor) use the bluebee® technician app for daily recordings.

The award-winning bluebee® system is designed to be easy-of-use, facilitating daily work. It automatically produces maintenance reports based on European standards.

Benefits: Leveraging process and maintenance expertise with IT tools

According to Herve Lienhardt, Asia Services & Equipment Solutions Director at Degrémont:

> "Our partnership with Siveco ensures for our customer one single interface for a dual expertise: process & maintenance. Thanks to our advanced IT tools, we leverage both expertise and ensure monitoring of the activity, to guarantee the quality and reliability of your installation."



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A collaborative approach to asset lifecycle management in gas turbine power plant project

The Ranhill Powertron II (RPII) 190MW Power Plant

Ranhill Berhad is one of Malaysia's leading engineering and construction company, with asset management and ownership in the environment, infrastructure, power, petroleum and chemical sectors. With more than five decades in the industry, Ranhill has a strong presence in Malaysia and growing overseas operations in China, India, Libya, Saudi Arabia, Sudan and Thailand.

In mid-2009, Ranhill started the construction of a new 190 MW combined-cycle gas turbine power plant (CCGT) in the state of Sabah in East Malaysia, known as Rugading Power Plant in addition to the existing 190 MW Teluk Salut CCGT power plant which is located next to it. The Rugading power plant was built by the Chinese EPC. China National Electric Engineering Company (CNEEC) at a total project cost of 1.74 billion RMB and commissioned in less than 22 months. It comprises two gas turbines of Frame 6FA (Model PG6111+e) units each with a nominal capacity of 65 MW. The first gas turbine unit achieved COD in March 2010 and the second unit COD was on July 2010. The overall Combined Cycle Plant Facility was on Commercial Operations in April 2011, making Ranhill the largest Independent Power Producer in the State of Sabah.

The CMMS implementation: a collaborative project led by Siveco

In 2009, CNEEC selected the partnership of ABB Bailey Beijing Engineering Company and Siveco China to supply DCS and CMMS for the power plant. Based on a long experience of greenfield infrastructure projects all over the world, the Siveco China team had developed a specific expertise to assist EPC companies and their equipment suppliers during the construction phase, ensuring smooth transfer of technical documentation to operation, supporting plant commissioning and start-up with an accurate technical database and enforcing good maintenance practice from day one.

Siveco launched the data collection phase in Beijing on December 2009, working alongside CNEEC, the Northwest Electric Power Design Institute (NWEPDI), equipment suppliers like GE for the turbines and ABB (DCS) to define the data structure, coding rules, based on international standards: *IEC61346*, *IEC PAS 62400* and *ISO/TS 16952-10 RDS-PP* (the "new KKS"). Data collection priorities were then defined.

In the beginning of 2010, Siveco China engineers set up and configured the CMMS "Coswin" at Siveco Shanghai office. Available data were uploaded into the CMMS by batch using the Clic-Clac tool, ensuring consistency and quality control. The system was shipped to customer site in Sabah, Malaysia towards the end of the year, for final data migration and system acceptance tests, after which Siveco is providing babysitting support onsite to ensure Coswin is effectively put into operation.

Training took place in several stages. An implementation study was conducted with the RPII team at the early stage of the project. Core Team training was performed on the preconfigured system at Siveco Shanghai mid-2010. A few months before "Go Live", Siveco organized end-users training on site in Sabah, after which the power plant's operation and maintenance team has started to use the CMMS to manage its daily maintenance job and spare parts inventory.

> Siveco's role in the project proved to be critical, considering the very different working practices between Chinese construction **firms and overseas power plant operators like us.**

Functional scope of the CMMS

The CMMS covers a complete life-cycle asset management scope, as follows:

- Graphical diagram navigation
- Asset management
- Corrective maintenance
- Safety and work permits
- Preventive maintenance
- Stock management
- Repairable spares handling
- Procurement

Results

According to Mr. Muhamad Kamal Ibrahim, Operations Manager at RPII O&M:

> "Siveco's role in the project proved to be critical, considering the very different working practices between Chinese construction firms and overseas power plant operators like us: Siveco's experience of both ensured that that our expectations were met despite the obvious challenges."

He added:

> "The approach consisting in preparing the CMMS from the early construction stage helped us ensure operation readiness in time, a major business goal for Ranhill being our commitment to reduce construction time and providing the much needed energy for Sabah."

Ranhill is now considering extending the usage of Coswin to its other units.

Ranhill Powertron II is the first major cooperative project of Siveco and Chinese engineering and construction companies in Asia. Siveco is actively promoting the same concept to Chinese EPC companies building infrastructures all over the world. The concept could also be successfully applied to Chinese power project, as operators' expectations evolve and get closer to those of international players.

Maintenance preparation support for Indonesia's Banjarsari power plant with CNEEC

Bukit Asam's Banjarsari power plant

PT Bukit Asam (PTBA) is an Indonesian state-owned coal mining company, partly listed on the Indonesian stock exchange. The second largest coal producer in Indonesia, with mineable reserves of approximately 7.3 billion tons (17% of the total coal reserves in Indonesia), PTBA strives to become a competitive energy company. This vision has been manifested by the establishment of PT Bukit Pembangkit Innovatif (BPI), a sister company of PTBA, to operate the Banjarsari mine-mouth coal-fired steam power plant.

The 2x135MW power plant, a total investment of 240M USD, is located in South Sumatra province. China National Electric Equipment Corporation (CNEEC) was selected as the EPC contractor for this project. Construction started in April 2012 and the plant was handed over to client at the end of 2015, after which the warranty period started.

The challenge: meeting the owner's expectations for plant documentation

Chinese engineering and construction companies traditionally emphasize cost control during construction, with progressive adjustments and modifications of the design as the project moves ahead. While the resulting speed and construction cost advantages have proven critical to support the development needs of many countries such as Indonesia, it often comes at the expense of maintenance preparation: Chinese EPCs face difficulties to provide complete as-built drawings or preventive maintenance instructions.

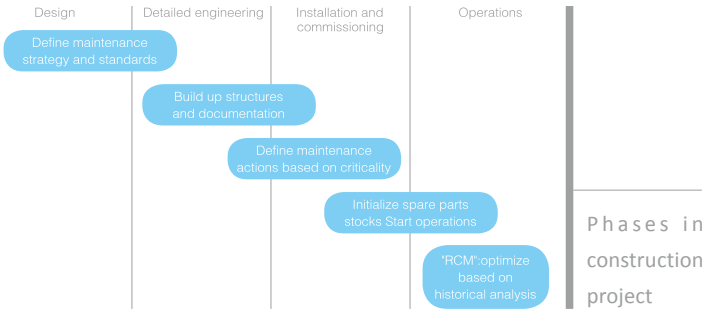
On the other hand, plant owners or operators in overseas markets have certain expectations in terms of the documentation to be handed over to the maintenance team, often as part of the Computerized Maintenance Management System (CMMS) delivery. For the Banjarsari power plant, PTBA required the plant technical database to be loaded in a Computerized Maintenance Management System (CMMS), to be delivered turn-key by the EPC.

CNEEC selected Siveco China, the country's largest maintenance consultancy, for this project. Based on a long experience of greenfield infrastructure projects all over the world, Siveco has developed a specific expertise working alongside EPC companies and their equipment suppliers during the construction phase, ensuring smooth transfer of technical documentation to the plant owner, supporting plant commissioning and strat-up with an accurate technical database and enforcing good maintenance practice from day one. Siveco was awarded the contract in March 2013.

The project: preparing maintenance during the construction stage

The main objective of the project was to build up the plant database in a CMMS for hand-over to operations before startup, in order for all the plant to be accurately documented in the system and for maintenance teams to use the system to support their daily work from day one.

The figure below summarizes the Siveco approach for maintenance preparation during a construction project based on the utilization of the CMMS:



The Banjarsari project was split into three main phases:

1. Data preparation
2. CMMS configuration and factory-testing
3. Onsite delivery

> The Core Model describes the overall maintenance strategy, the CMMS data structures, all the plant's maintenance management business processes.

The first two phases were mostly performed in China, working closely with CNEEC and subcontractors. Phase 3 was performed at the plant in Indonesia starting in the last quarter of 2015.

Siveco appointed a project manager for the entire project, a senior maintenance consultant with experience in similar power plant projects. Siveco China's main resource center in Shanghai provides personnel for phases 1 and 2. All Siveco engineers are bilingual Chinese-English and have experience working in an international environment.

Phase 1 - Building a detailed, accurate and easily accessible technical documentation

The plant's technical documentation consists of plant structures, equipment data, specifications, contracts, spare-parts, preventive maintenance instructions and inspection routines, technical documents etc. It can be entirely delivered in the CMMS and its associated Document Management System.

While this is ideally launched before contracts with the major equipment suppliers are signed, in order to ensure that the data collection requirements are incorporated into those suppliers contract with a clear delivery schedule, it is often not possible, as was the case for the Banjarsari project… Instead, Siveco held a kick-off meeting in April 2013 with CNEEC and key subcontractors to review the project schedule, explain the plant owner's requirements and define the data collection process, activities and milestones, as well as applicable standards (*IEC61346*, *IEC PAS 62400* and *ISO/TS 16952-10 RDS-PP* also known as the "new KKS").

Siveco engineers created the overall plant structure and are supervising the entire data collection project, checking the quality of data provided on a monthly basis, ensuring consistency and compliance with standards, proposing alternative solutions when data is not readily available. The data collection phase will continues until the end of the construction, at which point the final data will be delivered in the CMMS database. It runs parallel with phase 2 (CMMS configuration).

Phase 2 - Preparing the CMMS before onsite delivery

In July 2013, a week-long "Implementation Study" workshop was conducted by Siveco experts with Banjarsari power plant's top managers in Shanghai (at this stage of the project, it is normal that the maintenance team is not yet in place). The main purpose of the Implementation Study is to ensure that the CMMS supports the plant's maintenance strategy and deliver the expected functionality and benefits.

Implementation Study with Banjarsari Power Plant leaders and Siveco team

Drawing on Siveco's long experience with similar projects all over the world, the Implementation Study resulted in a "Core Model" document (sometimes known as "CMMS blueprint"), defining the way the CMMS will be used in the plant. The Core Model describes the overall maintenance strategy, the CMMS data structures, all the plant's maintenance management business processes (including spare parts management). The document also defines Key Performance Indicators (KPIs) and management reports, based on the *EN 15341 Maintenance Key Performance Indicators* standard.

The Banjarsari CMMS Core Model was finalized and approved in September 2013, after which the CMMS configuration activities started at Siveco office.

> Coswin 8i has become the main operation and maintenance management system for the plant.

On August 27, 2013, the power plant's number 1 boiler underwent successful water pressure test.

Based on the Core Model, the CMMS was configured at Siveco Shanghai office. Already prepared plant data were uploaded for Factory Acceptance Testing (FAT) in Q1 2014. Data collection continued until final delivery onsite.

Phase 3 – Onsite delivery

Onsite delivery started during Q4 2015. The Siveco project team conducted end-users training and babysitting activities in Indonesia for several weeks. At the end of 2015, BPI purchased a total of 10 Coswin 8i concurrent user licenses for the Banjarsari power plant. Coswin 8i has become the main operation and maintenance management system for the plant, covering the following main processes:

- Plant data management: keeping up-to-date of equipment structure and equipment-related information
- Preventive maintenance planning: standard work instructions and the entire planning process
- Work management: scheduling, execution and reporting all maintenance activities
- Stock management: maintain item register, stock receipt, stock issue, stock transfer, stock adjustment, stock count and repairable management process
- Purchasing management: purchase request, quotation, purchase order
- Management and analysis reports and KPIs

Additional coaching services are provided during 2016, as part of the warranty period.

Tianjin water JV benefits from group best practices through Coswin

Tianjin Tanggu Sino French Water Supply

Tianjin Tanggu Sino French Water Supply ("TGSF") was formed in 2004 in response to the rapid economic growth of the Tianjin Binhai New Area.

A joint-venture between Tianjin Water Works Group and Sino French Water Investment Company, TGSF provides full water services (water production, sales, construction, distribution network management and related customer services) to one of the largest harbors and the second largest development zone in China. This company has a daily production capacity of 320,000 cubic meters, serving a population of 600,000.

The project: Deploying best maintenance practices through the CMMS

Based on the good results obtained by several other joint-ventures of Sino French Water with municipal water groups elsewhere in China, TGSF selected Siveco to deploy a computerized maintenance management system (CMMS) in order to improve its maintenance practice.

The kick-off meeting was held in October 2014. Two Siveco consultants involved in the project, with support from Siveco's back-office team, working with Zhao Hongwei, manager in charge of TGSF's Water Supply department.

A "Group Core Model" had already been established with Sino French Water, inorporating water industry maintenance management best practices, within a management framework in line with the *ISO 55000 Asset management* - Overview, principles and terminology and Sino French group reporting standards.

The first phase of the project consisted in training TGSF team in the Group Core Model and, after a thorough study of the local joint-venture's maintenance needs, adapting it into a local Core Model and planning its deployment through the Coswin 7i CMMS. In particular, TGSF outsources all its maintenance execution to contractors, both for corrective and preventive maintenance, working under the supervision of TGSF staff.

In TGSF, the coverage of the CMMS includes the management of all the company's equipment, work management, preventive maintenance, resources management, spare parts and tools management.

The system went live in March 2015.

Benefits obtained

The first benefit obtained from this project has been a smooth implementation of the group Core Model guidelines, using each step of the CMMS project and Coswin itself as a practical training tool. A full *ISO 55000* compliant management system is now in place at TGSF.

TGSF has established standard preventive maintenance activities, based on the know-how of its team, combined with the experience accumulated in Coswin at the other Sino French Water joint-ventures. The CMMS is setup to automatically generate the preventive work plan on a regular basis for its contractors.

Failures are systematically reported in Coswin in a structured manner: end-users can quickly find the related equipment in the system, using the plant layout, the equipment structure or through a search. A failure report can then be created, with Symptom, Defect, Cause and Action ("SDCA").

By using the system, TGSF is now able to continuous improve its maintenance strategy, to meet its management goals of reducing maintenance cost and enhance production efficiency.

According to Zhao Hongwei, Water Supply Department Manager at TGSF:

> "The Siveco project has helped us to further enhance our maintenance practice, to learn from the other joint-ventures, but also to contribute our own knowhow and experience to other sister companies in the group. This benchmarking process will allow us to continuously improve ourselves."

Maintenance 4.0 in practice: optimizing water supply assets with field inspections on mobiles

This project was nominated for the 2015 SFW Innovation Trophies.

Chongqing Sino French Water Supply Company Limited

Chongqing Sino French Water Supply Company is a joint-venture of Chongqing Water Group and Sino French Water, supplying drinking water to 1.2 million people. Chongqing is China's youngest municipality under the jurisdiction of the central government and the gateway to Western China. This JV was the first concession project following the opening up of China's distribution networks to foreign involvement and also Sino French Water's first large full services venture in China. In operation since November 2002, the JV remains the sole drinking water supplier and network manager for Jiangbei, Yubei and the new developed zone in the Northern part of Chongqing. This area is developing quickly and, over the past years, the demand for water has grown at an average rate of 14% per annum. In 2009, the JV also secured a new drinking water distribution contract for Yuelai District, with a daily capacity of 600,000 m³, representing a total investment of 1.5 billion RMB.

The project

To meet its maintenance improvement objectives, Chongqing Sino French Water has implemented the Coswin computerized maintenance management system since the beginning of 2013, covering the operation of 4 subsidiary plants. By getting rid of its old-time Excel-based management model, the project helped Chongqing Sino French Water build up a complete technical database and to streamline its previous preventive maintenance plans and fault reporting system, while optimizing decision-making through reports and KPIs generated by the system.

After one-year operating with the system and the results obtained, new requirements were raised by the management team: based on the CMMS, how to fill in the gap between onsite inspection and back-office engineering? How to replace the current paperwork by state-of-art technology? How to implement the best maintenance practices in the field? How to analysis the performance of inspection? How to motivate the junior technicians?

Inspired by the concept of "Maintenance 4.0", Chongqing Sino French Water was determined to use advanced mobility tool to improve the inspection work.

The goals

Based on initial studies, the project aimed at achieving the following objectives:

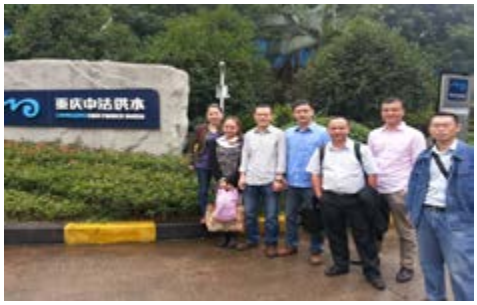
- Link the existing Work Orders (WO), preventive maintenance plan and fault codes (SDCA Symptom, Defect, Cause, Action) from the CMMS to onsite users and data, in order to bridge the gap
- Streamline the inspection SOP based on *ISO 55000 Asset management* and set up a comprehensive inspection technical database to prevent mistakes in the field
- Use technology to guide end-users to follow the best practices while improving work safety
- Analysis inspection results to provide technical-financial decision support
- Motivate the staff by fancy technologies, becoming the benchmark among all the Sino French JVs

The solution

Chongqing Sino French Water decided to work with Siveco to implement bluebee® solution to meet its inspection needs. bluebee® is an off-the-shelf, well-proven Maintenance 4.0 software package, unlike most self-developed applications found in the market. The coverage of the project included the 4 subsidiary plants and 30 pumping stations in the water supply network. The project required 46 mobiles phones (20 for plant maintenance, 24 for inspection and the rest for pump stations) and 1,200 QR-coded tags corresponding to 1,200 inspection areas. The total number of people using bluebee® is 88. The project started in January 2015.

> The bluebee® project improves our inspection process, while ensuring the safety of our operations.

To reach World Class Maintenance, the new inspection process was defined based on *ISO 55000 Asset management*, involving inspection strategy and policy, organization, equipment coding, job coding, job description, job type, job frequency, actions, action types, scan QR codes etc. Measurements were standardized as well in terms of temperature, vibration, pressure and normal values were defined. This was documented in the "Core Model".



The joint project team

Beyond traditional inspection tools, the bluebee® app allows users to create Work Orders and Job Requests once a problem is detected onsite. The technical know-how database is made available to field users for diagnosis and decision support. Through 4G network, the mobile phones can automatically synchronize data with the Coswin back-office system.

The Core Model established above has been adopted and configured by Siveco into the app. Considering the complex working environment and existing working habits, the user interface also ran several tests to ensure the smooth hand-over. The project officially went live in August 2015.

The benefits

In short term, Chongqing Sino French has defined certain reports and KPIs to measure the results and progress compared to the previous management model:

- Measurements over safe value
- Meters trends
- Abnormal failures analysis
- Comprehensive inspection analysis
- Unfinished job analysis

The bluebee® project improves the field inspection through SOP and systematic analysis. One stone, two birds: it also optimizes the usage of the existing CMMS system, ensuring greater ROI. The project also contributes to higher safety, always the top priority for Sino French Water.

According to Wang Zhibing, Chongqing Sino French Water's Production Leader:

> "We got rid of pen and paper and it is fun to be equipped with bluebee® while working. "

Luo Feng, the company's Operation Manager, added:

> "The bluebee® project improves our inspection process, while ensuring the safety of our operations."

The introduction of "Maintenance 4.0" and more generally "Industry 4.0", corresponds to the "New Normal" phase of China's development. It requires the combination between new Internet technologies and industrial know-how. As a pioneer, Chongqing Sino French Water took the first steps to adopt this concept into day-to-day practice. The project not only motivated workers but also demonstrated the value of their work and their capacity for innovation.

Based on the complete inspection Core Model established in Chonqging, bluebee® is planned to be duplicated to the other Sino French Water JVs in 2016.

Discrete Manufacturing

Nokia I Wuhan Boiler Company I Dayang Shipyard I Essilor Shanghai I Fives Cryo I SOGEFI I Brose Wuhan I BYJC-Fabricom Danfoss

Obtaining ROI from maintenance optimization at mobile phone giant in Beijing

This case study, written before the acquisition of Nokia by Microsoft, represents a great example of optimizing maintenance costs in tough economic times.

Siveco's first encounter with Nokia was during the company's heydays, when the LEED Gold certified Nokia Beijing campus was the center of attention in the Facilities Management community.

Unfortunately, times got tougher… As sales volume went down, Nokia became concerned with cost control and maintenance was rightly identified as a priority.

As the overall Chinese economy shows signs of slowdown, the experience of Siveco at Nokia Beijing demonstrates that maintenance represents a great opportunity for savings through optimization.

Nokia Beijing

Nokia is a global leader in mobile communications whose products have become an integral part of the lives of people around the world. Nokia's technological and design innovations have made its brand one of the most recognized in the world. Nokia operates a modern production facility located in Beijing Economic & Technological Development Area (BDA), part of the well-known Nokia China Campus built in 2008.

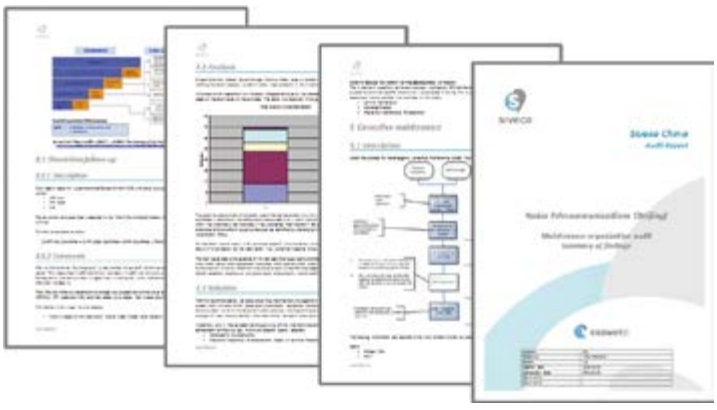
Nokia's Customer Fulfillment Operations (CFO) is responsible for final assembly and testing. A large organization with several thousand employees, hundreds of which work in maintenance, CFO employs most of the plant's personnel. While turnover is moderate (up to 10% for technicians) thanks to Nokia's favorable policies, the company faces the typical challenges of the Chinese maintenance market, including a lack of multidisciplinary skills, making workload balancing difficult.

Production is characterized by the relatively short commercial life of products (1 year), frequent product changes, a highly variable production volume (fluctuating demand) and a very lean production process, based on just-in-time principles. In such an environment, "No production means no maintenance; no maintenance means no production".

The initial project – taking it upside down

In 2010, Nokia Beijing launched a supplier selection to install a computerized inventory system for the management repairable equipments, tools, spares and consumables. Various IT vendors were considered, among them software development companies, CMMS/EAM suppliers and ERP vendors. Towards the end of 2010, Siveco was consulted and proposed to turn the project upside down: what was the actual pain?

Nokia decided to hire Siveco to conduct a maintenance assessment to identify the real ROI opportunities and to make relevant commendations for the implementation of supporting systems. Based on the conclusion of the 2-week onsite assessment by Siveco experts, the joint Siveco and Nokia team defined a multiphase project aimed at achieving the best possible ROI.



Nokia Audit Report

> Downtime rate reduction by 15% (target was 7%)
> MTBF increase by 12.7% (target was 5%)

The implementation – maintenance expertise, IT tools

The first phase of the project was to focus on building a standard maintenance platform around an equipment database using Siveco's "Coswin" CMMS. The utilization of the system covered second-line maintenance, including standard exchanges, workshop repairs, spare parts and purchases. Work processes were redefined, with KPIs and reports aimed at assisting the Nokia team to meet their improvement objectives.

For this part of the project, Siveco was onsite for 3-month period, followed by regular onsite coaching sessions. The Siveco team consisted in a project manager (maintenance manager with multidisciplinary background), providing consulting and strong guidance for the project, with a focus on ROI; a maintenance engineer (automation background), for the day-to-day coaching, acting as a user; a CMMS engineer, for system configuration as needed and training. The Nokia project team comprised the department manager as project manager, with a strong business focus, result-oriented; and project team members: key engineers from various departments. Other departments were involved, helping them to gain an understanding of the project (finance, purchase, top management).

At the 1-month follow-up review, ROI was considered obtained from phase 1. The team obtained agreement from top management to continue the project, with better data to estimate ROI from future phases. Multiple small phases, or implementation packages, were defined in order to reduce risk, in relation to Nokia's highly variable business environment. A target ROI was estimated, and committed to by the joint team, for each implementation package, with the idea to prove ROI before moving on to the next package.

Results obtained

As Nokia's maintenance cost was well within benchmarks, the main focus was not put on cost reduction but rather on the impact of maintenance activities on production volumes.

According to Nokia's own estimates, the following results were obtained from the first phases of the project:

- Downtime rate reduction by 15% (target was 7%)
- MTBF increase by 12.7% (target was 5%)
- Inventory accuracy increased from 67% to 96% (stock value remained stable)

As a company like Nokia is naturally very secretive with their financial information, we cannot reveal the cost of downtime that would allow us to calculate savings (however our readers could make their own estimates). **A very rough calculation only taking into accounts the time saved by production operators and approximate operators salary adds up to 500k RMB per year – this is really the tip of the iceberg.**

According to Li Zhihong, Maintenance Manager,

> "Siveco's performance-driven approach was very well-matched with our own company culture and Siveco gained our trust by hard work and results. Thanks to the CMMS we now have access to reliable data, giving us a much clearer view of the performance of CFO maintenance teams. While management is satisfied with results, the project has also gained positive attention from other plants in Nokia's supply chain. Last but not least, the end-users, our engineers and technicians, are happy with the project and benefit from improvement in their daily work and opportunities to enhance their maintenance skills."

All the phases in Nokia project

Organizing a modern maintenance department at one of the world's largest boiler factory

A version of article was published in Alstom internal newsletter.

Project Background

In 2007, Alstom acquired a majority stake in Wuhan Boiler Company (WBC), initiating a project to relocate production from its historical location started in 1957 in downtown Wuhan to a newly-built facility in the East Lake Development Zone. The 140,000 square meter plant, dubbed "the world's largest boiler factory", regroups previously separated workshops under one roof, together with laboratory, R&D and office facilities. More technologically-advanced machines have been acquired and the product range has been extended to 1,000 MW ultra supercritical boilers, as well as large CFB boilers. Production started in November 2009.

In 2015, US energy giant GE acquired Alstom's energy business, the biggest industrial investment GE has ever made.

In its old premises, Wuhan Boiler Company operated with the typical organization structure of state-owned enterprises: a central equipment department was in charge of documentation, planning, engineering, while each workshop ran its own repair team. A new organization was needed for the new plant, to support a switch to a more performance-driven, preventive maintenance approach. To achieve the build-up of this new organization in a sustainable manner, WBC hired maintenance consulting firm Siveco China to implement a Computerized Maintenance Management System, as a tool to train the team on modern maintenance principles, enforce best working practices on a daily basis and continuously optimize maintenance through analysis.

Project implementation

The project was started in the end of 2010, and it has officially gone live on July 1st, 2011. A joint WBC & Siveco team was setup to conduct the half-year project, headed by the plant's maintenance manager, considering the key role the CMMS would play in organizing his team.

At WBC, the CMMS was designed to be very graphical, allowing user navigation through diagrams, so as to ensure that people would actually use it with minimum training. Production staff, for example, can easily report failures and follow them up directly in the system.

The system covers a complete life-cycle asset management scope, as follows:

- Equipment management: a technical database for all equipment, organized in a hierachical structure based on international standards, complete with all technical attributes and corresponding spare parts lists.
- Unplanned maintenance: support for the entire corrective maintenance work management process, with an emphasis on ensuring all failures are reported and compliance with good work practices including Health, Safety & Environment.
- Planned & preventive maintenance: covering planned corrective maintenance and regular preventive maintenance, with a focus on creating maintenance plan, following up their execution, regular analysis and improvement.
- Stock management: managing spare parts and maintenance consumables, keeping track of stock levels, consumption, receipts and issues in direct correlation to maintenance activities.
- Analysis reports and Key Performance Indicators: including equipment reliability, defects analysis, maintenance activity and spare parts-related reports and KPIs, which are generated automatically by the CMMS.

All the related processes, reports and KPIs were defined by the joint WBC & Siveco project team at the early stage in the project, as part of a "Core Model" forming WBC's maintenance practice. In addition to defining this Core Model and implementing the CMMS "Coswin", Siveco offered suggestions on the new maintenance organization, helping define the roles of the various maintenance and warehouse staff based on similar experience in other large Chinese plants.

> Great improvement has been achieved over the years: average plant availability, a very stable 99.25%. Downtime is kept well below 1%.

WBC acted on those recommendations and set up an efficient maintenance team, with clear roles for each member.

Joint WBC Siveco project team working on site

For the first time, WBC built suitable facilities for the store keepers and performed an inventory count for all the spare parts in the warehouse.

Around 20 supervisors in production and labs are currently using the system to report failures and service requests. On the maintenance side, 49 staff including 2 planners, 4 supervisors and the department manager are using Coswin to perform their daily tasks.

Results obtained

The project helped WBC built its new maintenance organization around clear work processes defined in the CMMS, which also acts as a daily guide to the maintenance activity. Immediate outcomes of the projects include:

- A comprehensive plant technical database, up-to-date, easy to access, easy to maintain.
- A standardized process between production and maintenance, avoiding the usual conflicts.
- A preventive maintenance plan, already put into practice and subject to regular reviews.
- Improved ability for supervisors to define the work to be carried out, thanks to the historical database and work templates.

None of the above were previously available in WBC.

Long term benefits have been achieved from the systematic recording of all failures, breakdowns and activities including spares consumption and resources utilization, allowing in-depth technical-financial analysis of the plant's maintenance to support future improvement decisions (choice of suppliers, frequency of maintenance actions, machine modifications, etc.).

As part of the Siveco Enhanced Maintenance Support, Siveco provides audits and improvement coaching on a regular basis to WBC. Further to the acquisition by GE in 2015, WBC and Siveco continued their cooperation towards World Class Maintenance. The project is playing a key role in the company's Lean Manufacturing (or TPM) program. Great improvement has been achieved over the years from an average plant availability of 95% in 2010, to a very stable 99.25% in 2015. Downtime is kept well below 1%.

The photo was taken during the annual assessment by Siveco in 2015

Further improvement opportunities have been identified during the latest assessment conducted by Siveco at the end of 2015, for which actions will be coordinated with WBC "Step 3" Lean Manufacturing initiative.

Embracing maintenance KPIs leads to improved performance in the challenging shipbuilding industry

Yangzhou Dayang Shipbuilding Co., Ltd.

Yangzhou Dayang Shipbuilding Co., Ltd. ("Dayang Shipyard"), is the largest shipyard in Sinopacific Shipbuilding Group and a National First Class I Level steel shipyard. Established in 2003, Dayang Shipyard's major products include bulk carriers, container vessels, offshore supply vessels and LPG carriers. The company's annual production capacity reaches 2 million deadweight tons and delivery of more than fifty vessels. Its annual revenues exceed 10 billion RMB. Considered one of the most efficient shipyards in China, Dayang Shipyard employs over 20,000 staff in Yangzhou, Jiangsu province.

Challenging times for shipbuilders

Beginning in the late 1990s, China's shipbuilding industry experienced a 10-year boom. However, the 2008 financial crisis hit many shipyards quite hard, and some are still in the process of recovering from that crisis. Dayang Shipyard, like other shipyards across China, faced great challenges following the 2008 financial crisis: fewer orders in queue and ever-increasing costs. Determined to succeed despite the challenges caused by the crisis, the company's leadership established a strategic goal to reduce cost and enhance performance. As part of this strategic goal, every department within the company was challenged to identify all possible ways to reduce costs and upgrade performance.

Dayang Shipyard's 180-employee Equipment and Power Department embraced this challenge, determined to improve equipment reliability and reduce maintenance costs, especially with respect to spare parts.

Facilities and equipment

Dayang Shipyard's facility features two inverted U-shape production lines. The process and key equipment are shown below:

Key challenges

The company identified four key challenges to performance improvement and cost reduction, all of which related to lack of reliable data:

Unreliable equipment data: Maintenance data was often incomplete or inaccurate. For example, there was no reliable way to track the reliability of equipment, much less the cause of any breakdown in such parts. Additionally, tracking spare parts usage – what was used when, where, and why – was virtually

"The kick-off meeting was held in January 2011, and a new management system was in place just three months later, in March 2011."

impossible with the existing information.

Unreliable employee efficiency data: Employee efficiency data was equally problematic. For example, there was no reliable way to determine how long employees spent on troubleshooting or on preventive maintenance, which in turn made it very difficult to manage labor costs.

Inflexible data compilation: The limited data that did exist was maintained in traditional, inflexible format – either paper or excel formats. Maintaining data in this format prevented the company from efficiently using the information to improve their processes.

Lack of decision-making reports: In light of both the unreliability and inflexibility of existing data, there was no effective way to generate key reports needed for strategic decision-making. In short, without reliable and flexible data, the department was unable to determine effectively what needed improvement and how to implement any such improvements.

Those key challenges were never previously identified and addressed when business was at its peak. Recognizing the need for professional expertise to reach their goals, Dayang Shipyard's Equipment and Power Department turned to Siveco China to assist them in this endeavor.

The Siveco approach

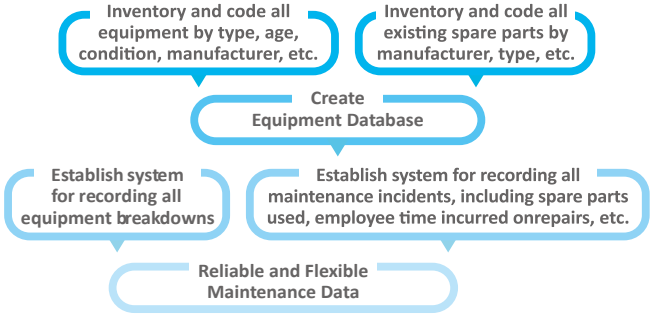
Siveco China, the largest maintenance consulting firm in China, was considered the logical choice for this project: With substantial experience of "maintenance with Chinese characteristics", Siveco has developed a unique approach to address the needs of companies like Dayang Shipyard by leveraging technological tools to implement rapid and sustainable performance improvement and cost reduction initiatives.

Two Siveco consultants worked with Mr. Sheng Yin, Director of the Equipment and Power Department, and his team on this project. The kick-off meeting was held in January 2011, and a new management system was in place just three months later, in March 2011.

Step 1: Generate reliable and flexible data

Given that the four key challenges in meeting the strategic goal of decreased cost and enhanced performance revolved around problems with data, the project team recognized immediately that the first priority was to ensure all necessary data was collected, and that the data was managed in a flexible and sustainable platform.

Generating historical data on the many pieces of equipment, including equipment acquired from the company's previous owner, was challenging and sometimes impossible. However, the team worked to compile as much reliable historical data as possible, and established a clear process for compiling data on a going forward basis.



To support this data collection process, Siveco worked with Dayang Shipyard to implement a Computerized Maintenance Management System (CMMS), with a focus on compiling equipment and technical data and systematically recording all breakdown incidents and maintenance events. While some companies might consider CMMS installation to be an "IT project," the Dayang Shipyard project team recognized that the system needed to be "owned" by the Equipment and Power Department rather than IT. The CMMS implementation was managed by Siveco's maintenance experts, as a tool to address the industrial improvement needs of the shipyard.

Step 2: Leverage data to generate KPIs that enhance decision-making

Developing a system to ensure collection of reliable and flexible data was the first and most important step in establishing an effective maintenance management system – but it is just the first step. The second step was to establish a system enabling

> Dayang Shipyard has experienced a dramatic increase in effectively managing all aspects of maintenance.

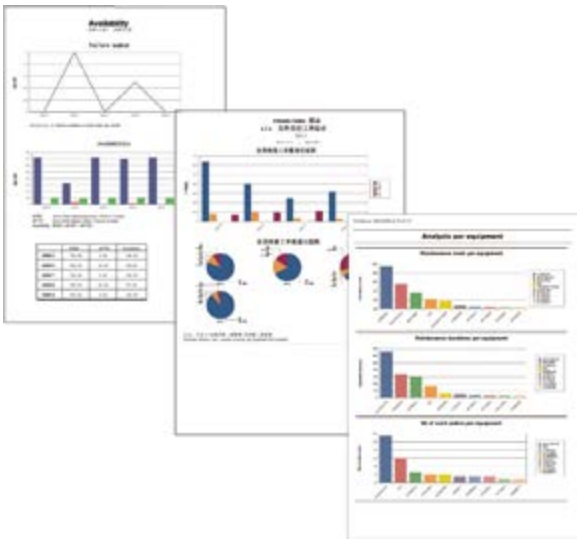
effective decision-making based on the data.

After installation of the CMMS, Siveco consultants worked with Dayang Shipyard's team to determine what types of KPI (Key Performance Indicator) reports would best help the company identify areas needing improvement and, thereafter, ensure effective maintenance management on a sustained basis.

Siveco made use of the existing reports library (over 100 easy-to-use graphical reports) based on the *EN 15341* standard on *"Maintenance, Maintenance Key Performance Indicators"*. This approach cuts down the time spent on discussing performance measures, by providing a recognized reference. Reports development time in the CMMS is also shortened, as users can pick and chose from existing KPIs. Finally, this approach allows managers to explore new, previously unknown, ways to analyze their maintenance activity, simply by browsing the available KPIs.

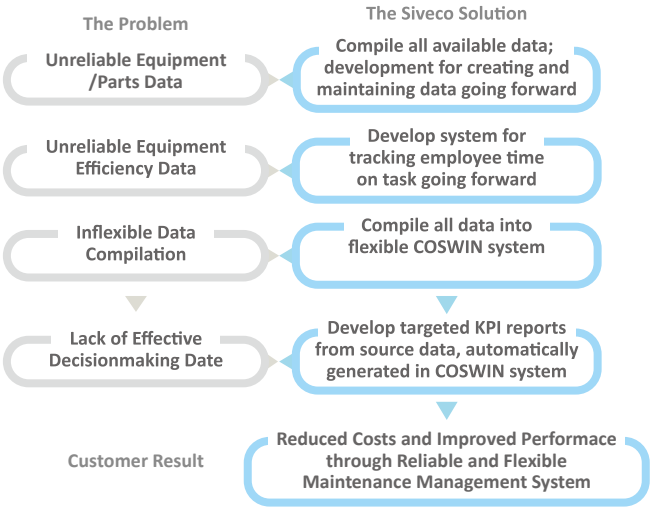
Results obtained

Dayang Shipyard faced four key challenges in meeting its strategic goal to reduce costs while improving performance. Since the Siveco solution has been implemented in 2011, Dayang Shipyard has experienced a dramatic increase in effectively managing all aspects of maintenance in its Equipment and Power Department, and has begun to see tangible cost reduction benefits



The Road Ahead

As Mr. Sheng Yin, Director of Equipment and Power Department has put it:



> "Thanks to the Siveco approach, our shipyard now possesses a powerful reporting and analysis tool, which has helped us overcome the main challenges we were facing. Flexible analysis of faults data, working hours and spare parts consumption, across various categories of equipment and disciplines, make the best use of feedback from our technicians. We are planning to extend our cooperation with Siveco as the economy further improves: our next step is to optimize preventive maintenance and inspection plans."

Siveco is proud to partner with Dayang Shipyard as it strives to achieve its strategic goals fully, and as it continues to develop leadership role in the shipbuilding industry.

World leader in optical products benefits from integrating maintenance in their supply chain

The second largest factory of the world leader in ophthalmic optics

Shanghai Essilor Optical Company (SEOCL), a subsidiary of the world leader in ophthalmic optical products, manufactures organic lenses in its Shanghai, Songjiang factory since 1997. Lenses are produced using a traditional casting process and a more modern molding process. The Songjiang plant is the group's second largest, with over 1,100 employees (around 30 of whom are dedicated to maintenance and utilities).

The initial assessment

SEOCL started working with Siveco in 2007, when an initial maintenance assessment was performed. The production appeared well organized, with 6-sigma and 5S improvement processes in place. Overall maintenance cost was not too high, but unexpected breakdowns did happen with potentially damaging impact on operations. The management of spare parts was not optimized, in spite of the implementation of a corporate ERP system (Oracle E-Business Suite).

Little or no financial-technical analysis was available to support the maintenance strategy, which meant that decisions (maintenance plans, modifications, investment) were often "educated guesses" or simply could not be made. The most immediate concern for SEOCL was clearly the lack of proper maintenance record and performance indicators, including those related to spare parts consumption. The management team was well aware of the situation and decided to launch a project with Siveco.

The maintenance improvement project

Siveco's computerized maintenance management system (CMMS) Coswin was implemented to support improvement activities. A team of Siveco engineers involved throughout the project to advise SEOCL, to setup the system and to support end-users. The duration of the initial project was 4 months, after which the first technical-financial reports could be analyzed by the joint team.

A key component of this project was the integration between the CMMS and SEOCL's Oracle E-Business Suite, aimed at optimizing the management of spare parts. SEOCL had implemented Essilor's corporate ERP covering the finance, production, stock and purchasing processes. As is often the case, the ERP was designed with production in mind, not technical services. It however contained valuable information on suppliers, purchases and stock items, and formed the corporate support system for the company's supply chain, of which maintenance was becoming an essential link.

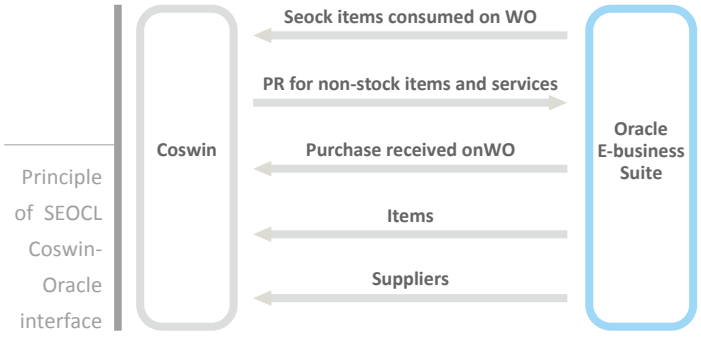
Advanced interfacing made easy: getting more value from your ERP

While IT suppliers are known to make simple things complicated, Siveco followed a practical non-nonsense approach to meet the company's management requirements.

This resulted in a design whereby the administrative process related to stock and purchasing remained in Oracle, in compliance with Essilor's corporate guidelines and existing users' habits. A layer of technical management was added in Coswin, linking parts to assets (build up of spare parts lists for each machine) and then to maintenance instructions (what parts are required to complete the job).

The issuing of parts in Oracle was to be made against a Work Order from Coswin, thus creating consumption records usable for technical analysis. As a result, it became possible to forecast parts needs based on preventive maintenance plans and historical consumption data, i.e. to more accurately budget spare parts costs and to optimize purchase plans. The link between technical requirements (from Coswin) and the actual purchasing (in Oracle) further simplified the communication between departments, ensuring the right part if purchased at the right time. The only change in existing business processes was that the stock keeper was now required to issue parts against a Work Order number, which is done in Oracle.

> Monthly cost (except labour, which is stable): from 802k in 2011 (19% attributed to Preventive Maintenance) to 580k in 2012 (with 43% PM)



Technically the two-way interface was implemented using Coswin standard interfacing modules, which were configured accordingly. SEOCL's IT department modified the Material Issue form in Oracle and learnt to maintain the interface program. No software development was required.

A few years down the line…

According to Sebastien Sabourault, SEOCL's Managing Director, who initiated the project in 2007:

> "We have, since the initial implementation of Coswin, been hiring Siveco for further coaching of our technical team, which helped us achieve more and more benefits from the utilization of the CMMS. As part of this effort, we have also been able to benchmark with other large multinational companies, sharing experience of maintenance improvement.."

SEOCL's Manufacturing Manager Mr. Zuo Lei Ming added:

> "Siveco's engineers have been working along my team, accompanying our growth and new challenges. As a result of this successful long-term partnership between us, we have most recently signed up for Siveco's enhanced maintenance contract, which includes a yearly assessment, regular follow-up visits and an improvement guarantee. I am looking forward to this continuing relationship."

The CMMS has become the tool for continuous improvement at SEOCL. The SEOCL maintenance team has achieved continuous improvement since the project started and, contrary to common belief, has demonstrated that benefits can actually increase over time. This is what Essilor has achieved in 2011 and 2012:

- MTBF +30% in two years
- Downtime first year -13%, second year -38%

Due to confidentiality reasons, we cannot elaborate on the indirect savings (losses avoided) linked to these reliability improvements, which would involve multiplying downtime reduction by downtime cost/losses… Readers could for example take their own production figures and do a calculation to obtain financial values.

- **Monthly cost (except labour, which is stable): from 802k in 2011 (19% attributed to Preventive Maintenance) to 580k in 2012 (with 43% PM)**

This proves that PM ultimately costs less than corrective maintenance, although an initial effort is required. For 2012, this amounts to **2.6 millions RMB saved compared to the previous year**…

In this case, indirect savings (losses avoidance) represents the bigger ROI. However, direct savings are always easier to measure! This is one of the many paradoxes of the maintenance business: don't be fooled by this and do not focus on direct costs!

The successful experience of SEOCL has led other Essilor factories all over the world to hire Siveco for similar projects, for example Essilor Da Amazonia in Brazil and Essilor Laos.

Practical maintenance improvement supports production ramp-up at leading heat exchangers manufacturer

Fives Cryo (Suzhou)

Fives Cryo manufactures brazed aluminum plate-fin heat exchangers used in industrial gas processes for air separation units, hydrocarbons separation, ethylene production, natural gas liquefaction by cryogenic process and low-temperature refrigeration. The Suzhou plant started operations in September 2009, following its historical customer Air Liquide.

The initial focus of Fives Cryo Suzhou was on starting production and ensuring the first deliveries. Once fully up-and-running, the company started signing new customers and ramping up production volume, thus putting more pressure on maintenance. As many manufacturers in the East China region, the company is faced with high staff turnover, which proves a major challenge in its development. From an equipment perspective, two critical machines (degreasing unit and furnace) constitute bottlenecks, with major impact on production in case of breakdown (no available backup on-site). The maintenance department consists of 6 people in charge of repairs and preventive maintenance including lubrication, inspections, etc., while more specialized work is usually outsourced.

The maintenance improvement project

The main pains experienced by Fives Cryo were constant operation in "firefighting" mode due to lack of planning. At the same time, the data needed to make decisions such as technical improvement, machine modifications, maintenance budget, recruitment needs and so on was lacking.

Fives Cryo (Suzhou) started working with Siveco on March 2012, with a maintenance project designed to build up a structured and sustainable maintenance organization. The ultimate goal of the project was to improve the availability of the machines, as the production output rose, and to extend their lifetime.

A computerized maintenance management system (CMMS) was implemented to structure the maintenance team around clear work processes, reporting requirements and regular meetings (daily work, weekly planning, monthly analysis etc.). By providing measured indicators of performance, it allows the team to start working on improvement maintenance. This principle is shown in the figure below:

The Siveco Approach

This system-based approach, pioneered by Siveco China in the mid-2000s, has proven particularly successful in China where maintenance engineers lack methodological background – the implementation of a "real" system helps them grasp the various concepts associated with maintenance (a systematic approach, preventive maintenance, analysis and decision making). Typical customers experience Return On Investment (ROI) within the first year.

Scheduling and first results

The project was executed in a 3-month implementation period, followed by audits after 1 and 2 months, after which the plant entered an "Enhanced Support Period" during which Siveco experts remotely monitor performance thanks to the CMMS, provide necessary guidance and come back for a yearly onsite audit. The project involved the top management, as well as the Production,

At the beginning of the support period, Fives Cryo had already achieved significant benefits. The immediate project

> More than 800 pieces of equipment were documented in the CMMS, based on the principles of the ISO 14224 and ISO/IEC 81346 standards.

goals were met, namely:

Establishment of the plant's asset database

More than 800 pieces of equipment, technical specifications, related spare parts, documents and contracts, were documented in the CMMS, based on the principles of the *ISO 14224* and *ISO/IEC 81346* standards. The impact is visible outside of the system as equipment codes defined are now used on paper documentation as well. Spare parts codes have been unified between SAP and the CMMS, allowing efficient collaboration between maintenance, procurement and accounting departments. Standardized job guidelines were created for preventive maintenance tasks.

An example of the structuring impact of the CMMS on the maintenance organization:

Equipment codes defined during implementation are now used on the documentation folders

Training of the maintenance team on key concepts

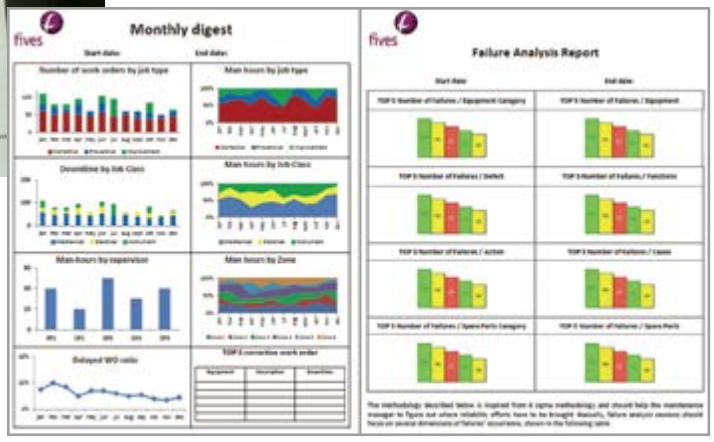
The team was trained both through classroom training and hands-on through the project and using the CMMS. Training covered plant documentation, fault reporting, work orders, preventive maintenance, regular meetings and improvement process. The staff ability to manage preventive maintenance in a structured way, though plans and work orders, was assessed.

Ensuring that all failures are reported and coaching the team on creating a preventive maintenance plan and follow it up in the system

At the time of the second audit, 70% of the work orders in the system had comprehensive feedback – an excellent result by any realistic standard – and quality was shown to be improving. As a result, the team is now able to perform root cause analysis and to make technical-financial decisions based on the maintenance history in the system. In addition an average of 80 hours/month of preventive maintenance activity were reported, consistent with reality – to be compared to the situation before the project when preventive maintenance was not formally defined and virtually inexistent.

Using reports generated from the system to support regular meetings and improvement process

By the time of the second audit, the first improvement analysis session was performed using the system, by Fives Cryo's maintenance team, with the assistance of Siveco experts. Regular team meetings were now in place, conducted by Fives Cryo's own team.



Sample management reports obtained at Fives Cryo

The road ahead

As the project has entered its final phase, with an ongoing "enhanced maintenance period" – during which Siveco experts provide remote audit and support, while coming to site at least

> The share of Preventive Maintenance (in percentage of time spent) increased from less than 10% initially to around 60%.

once a year – the Fives Cryo team has grown confident about using the CMMS to manage its maintenance.

According to Jean-Yves Lacroix, Engineering Director at Fives Cryo:

> "The work already done with the Siveco team has really put our maintenance team on the right track towards preventive maintenance and the monthly report helps drive this new attitude. From a management perspective, we clearly see how the system will be used in the longer term (a year or so) to assess the need to outsource some of our maintenance, with hard technical and financial data in hand, or to recruit internally if necessary. The accurate historical database will also help us negotiate contracts with spare-parts suppliers."

Benefits summary after 2 months

- 80 hours/month of preventive maintenance were reported – to be compared to the situation before the project when preventive maintenance was not formally defined and virtually inexistent.

- The team is now able to perform root cause analysis and to make technical-financial decisions based on the maintenance history in the system.
- Standardized job guidelines were created for preventive maintenance tasks.
- Spare parts codes have been unified between SAP and the CMMS, allowing efficient collaboration between maintenance, procurement and accounting departments.

Benefits summary after 6 months

- Average of 174 work orders are recorded every month, based on which technical data analysis is conducted in a structured manner once a month.
- The share of Preventive Maintenance (in percentage of time spent) increased from less than 10% initially to around 60%.

The results after 6 months demonstrate how the strong foundation established during the project is leading to actual improvement results (increased share of Preventive Maintenance). For confidentiality reasons, no financial figures are provided in this customer story, astute readers can however compute their own savings estimate…

The simplest calculations are often the best. As a rule-of-thumb, well accepted in the industry, planned work (preventive) is at least 50% more efficient than unplanned work (corrective), i.e. approximately 50% less costly. Assuming a hypothetical annual maintenance cost of 1 million, a calculation shows the increase in preventive maintenance results in 300k savings.

A lifecycle approach to maintenance at world leading automotive supplier in Shanghai

Shanghai SOGEFI Auto Parts Co., Ltd

Sogefi, an Italian Group, is a worldwide leader in the automotive parts industry, specializing in flexible suspensions components and filtration systems. SOGEFI is a partner to the world's most important car manufacturers. The Company has a global presence: 46 plants, in 16 countries, across 5 continents.

Shanghai Sogefi Auto Parts Co., Ltd was established in Shanghai Pudong District in 2007 with a total investment of 150 million RMB. The plants manufacture filtration systems and suspension components for automakers.

An early partnership, starting from the construction stage

Collaboration between Sogefi and Siveco dates back to 2008, when Siveco was appointed to coordinate technical data and related documentation for the new stabilizer bars production line.

A Siveco maintenance expert was embedded in the construction project management team, in an owner's engineer role. His primary responsibility was to ensure tight coordination and good communication between general contractor (also in charge of the utilities), production line engineering team and machine suppliers. Siveco's specific focus was on the correct sizing and setup of the utilities, as well as maintenance preparation.

As part of this engineering project, technical data, drawings and other documentation were collected from the various construction contractors (civil works and utilities) and equipment suppliers, so as to establish the necessary documentation for the future maintenance team.

Organizing maintenance on paper, limited but encouraging results

In 2009, after production ramp-up, the Siveco teams came back on site to support Sogefi in the setup of a modern maintenance organization. The company's management favored a very progressive approach, starting first with a paper- and Excel-based system that could later be upgraded into a full CMMS solution.

The improvement project started with a maintenance audit, during which the current maintenance performance and activities were assessed based on international benchmarks. The outcome of the audit was a clear prioritized actions plan, which, after approval by Sogefi's management, paved the way for the successful execution of improvement initiatives.

Siveco specialists coached the plant technical teams on maintenance engineering principles identified as important during the audit. Monthly "Best Practices" workshops were held, each of them targeting a specific topic (equipment structures, root cause analysis, KPIs, etc.).

Each workshop featured an introductory training session, the provision of paper-based or Excel-based format or tools, a case study and onsite practice as part of the plant's daily operation.

The following standards were used: *EN 13460 - Maintenance - Documentation for maintenance*, *IEC 81346 - Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations* and *ISO 14224 - Collection and exchange of reliability and maintenance data for equipment*.

The project lasted from April to August 2009 and was concluded by a thorough evaluation and additional recommendations.

Evaluation report abstract, showing clear scorecards and management actions

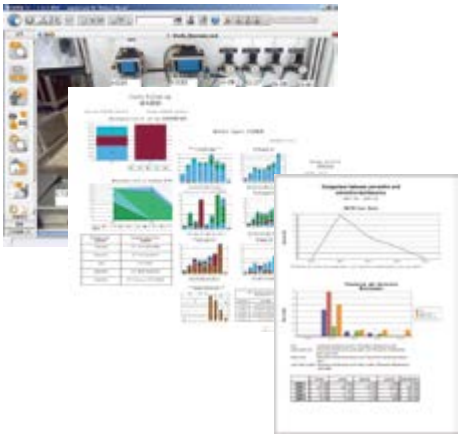
> The Siveco project has clearly helped us gain control of maintenance performance.

The main recommendation of this report was for Sogefi to use a CMMS to further enforce the new practices into the plant's daily routine,in a self-sustainable manner, with a focus on preventive maintenance. Indeed, based on Siveco's experience, most of the improvements already achieved were bound to vanish as people change and bad habits come back.

Long-term improvement, thanks to the CMMS

In 2011, Sogefi and Siveco agreed on an original way to implement the CMMS, using additional resources from Shanghai University's Sino-French School of Technology. As part of Siveco's academic outreach program, engineering students were trained on the CMMS, Coswin and ready to involve in industrial projects. A three-party project team was setup, with Siveco responsible for project delivery (including providing industry expertise and managing the students' team) and the students involved in resource-intensive activities such as system configuration and data collection.

Coswin was implemented covering equipment management and fault reporting as first steps. As a result of the initial projects, the existing equipment structure only required an update before being uploaded into the database, while the work processes in the CMMS were the same the Sogefi maintenance team was already used to. In November 2011, Sogefi started to use the CMMS to manage all the plant assets (1,000 pieces of equipment). The Siveco team provided onsite "babysitting" support to ensure a smooth startup.



The first operational audit conducted by Siveco, one month after CMMS start-up, showed over 150 fault reports (and follow-up work orders) in the database, reflecting a good utilization of the system, commensurate with activities in the plant.

Benefits obtained

According to Emilien Delecluse, Equipment & Maintenance Manager:

> "As our production capacity grows and new product lines are being added, maintenance has become more critical. The Siveco project has clearly helped us gain control of maintenance performance: reports from the CMMS are quickly put into practical use to analyze problems and to make improvement decisions."

Wu Yongqing, Technical Maintenance Manager, adds:

> "Technicians are confident with Coswin, thanks to the user-friendly screens and support from Siveco's maintenance experts. This ensures we get accurate technical feedback and failures are now systemically analyzed, leading to improvement in our preventive maintenance plan. We all learn a lot from this project."

Leading automotive supplier demonstrates ROI in less than a year with Siveco' SaaS solution

Brose Wuhan

Brose is a partner to the international automobile industry and delivers mechatronic systems and electric drives to more than 40 automakers as well as suppliers. More than 16,000 employees work for Brose at 46 locations in 21 countries on all major automotive markets worldwide. With a turnover of 2.6 billion euros in the 2009 business year, Brose is the fifth-largest family-owned company among the top 100 automotive suppliers worldwide.

In Wuhan, located in Hubei Province in central China, Brose opened a manufacturing plant for window regulators and seat systems in 2008. Among its customers are Shanghai General Motors, Donfeng Peugeot Citroen Automobile, Geely and Chery. The range of products made in Wuhan is currently being extended and the operation is set to grow significantly in the next few years as long-term contracts have already been secured, with a plan to build a new facility.

The project

Brose hired Siveco in July 2009 for a project aimed at establishing strong maintenance fundamentals at its Wuhan plant. With production volume and complexity on the increase, and new product lines being introduced, maintenance was becoming a priority for Brose in order to guarantee the reliability of its manufacturing process.

The joint Brose and Siveco team started to use Siveco's maintenance system Coswin on a Software-as-a-Service (SaaS*) basis as a support tool to organize the plant's technical know-how and to systematically analyze failures. The project was incorporated into Brose's TPM practice, with a strong Visual Management aspect.

Based on similar projects in the automotive industry, ROI was expected within one year.

* In the Software-as-a-Service (SaaS) model, software is rented, as part of a service contract, rather than purchased. The application can still be installed locally, but it is ideally suited for cloud computing on the Internet, i.e. hosted at Siveco's datacenter. Involving no capital expenditure, the SaaS model also presents obvious advantages in terms of IT administration. Apart from Brose, other examples of this approach among Siveco China customers include CCPG and BYJC-Fabricom.

Joint breakdown analysis session with Siveco at Brose Wuhan

The results

Marc Bourgeois, General Manager of Brose Wuhan, was interviewed by Shanghai Business Review for an article on Lean Manufacturing. This is what he had to say about the maintenance improvement project:

> "As our future growth plan is very aggressive, one of the fundamentals that Siveco has helped us with is establishing is a structured maintenance system from an early stage, before our operation gets on such a large scale that implementing systems become more difficult. The project included not only a maintenance software, but also Siveco's experience and expert advice. Here are some specific examples of improvements brought by the project."

Structure and discipline:

> "The system brings the necessary structure and organization to our maintenance department. It not only helps with the planning and execution of the various tasks, but more importantly ensures a systematic and disciplined approach to maintenance."

> **Based on calculations by our finance department, the** ROI target of one year has been realized.

Ease of use and flexibility:

"The system itself is very user friendly; its layout is extremely practical and our Brose team shows a very good understanding of it. It is also compatible with other systems that our company uses, such as SAP. With the Software-as-a-Service approach, IT issues are kept out of the way."

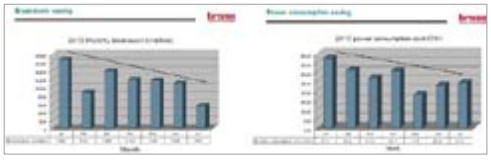
KPIs (Key Performance Indicators):

"Structured data make analysis and management reporting very easy, with both standard KPIs and customized reports. Based on the weekly and monthly reports, important improvements have already been achieved in key areas."

Return on Investment:

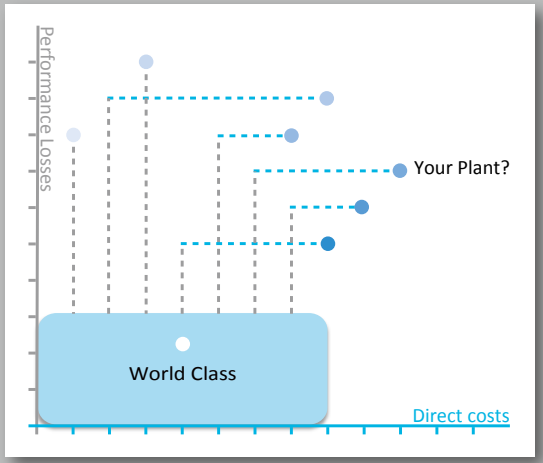
"Based on calculations by our finance department, which I believe to be on the conservative side, we can say with confidence that the ROI target of one year has been realized. As the project is still at an early stage and our activities are ever increasing, future savings will be even more important."

The figures below show a sharp decrease in downtime and energy consumption at Brose Wuhan, two essential components of the savings realized under the project.



Where do you stand? What can you gain? How do you achieve your goals?

Siveco's maintenance assessments follow a proven methodology to benchmark your organization against international standards and a database of 1500+ companies in China. Deliverables include a detailed analysis report with prioritized actions and ROI estimates, presented to your top management.



Talk to us at 4006-300-213 or info@sivecochina.com.

Maintainability and reliability improvement in the automotive industry with BYJC-Fabricom

Background

BYJC-Fabricom is a leading supplier of turnkey automated assembly lines, primarily targeting the automotive industry. A joint-venture between Beijing Number 1 Machine Tool Plant (BYJC) and Fabricom (a specialized subsidiary of engineering giant GDF SUEZ) the company boasts an excellent track record in China with customers such as BMW, Chery Automobile, Danfoss, Delphi, Dongfeng Peugeot Citroen, FAW, Hangzhou National Panasonic, Qingdao Haier, Siemens, Valeo, Visteon, ZF, etc.

In 2008, Fabricom was contracted by German automotive supplier ZF Group to supply a new state-of-the-art production line for the manufacturing of steering columns. The same line was to be delivered to three ZF global locations (Hungary, China and the US). Initially meant to follow the first installation in Hungary, thus benefiting from the experience, the Chinese project was in fact conducted almost simultaneously, not a small challenge considering the complexity of the line and the level of multicultural cooperation required.

Faced with tight deadlines, based on the production commitments of ZF Shanghai Steering (ZFSS), BYJC-Fabricom selected Siveco China to assist in the commissioning stage of the project in order to meet the contractual reliability requirements.

A state-of-the-art production line

The Assembly Line is composed of 14 standalone stations, each station capable of producing within a cycle time of 22 seconds.

The main stations are:

OP10/20/30: Axial rack and upper body manufacturing
OP40: Main body and crash tube assembly
OP50: Strap assembly
OP60/70/80: Transmission assembly

Fabricom assembly line -The most advanced and sophisticated of its category

OP90: Radial rack fitting
OP100: Roof bracket assembly
OP120: Lever sub assembly
OP130: Lever sub assembly insertion
OP150: Test
OP160: Packing

The project

Siveco engineers were deployed onsite in less than two weeks and worked alongside BYJC-Fabricom and ZFSS Shanghai teams from mi-July to the end of September 2008. The Siveco team was operational after a short on-the-job training period: already familiar with Siemens Simatic technology and Kuka robots, they assisted in the commissioning and troubleshooting of the machines. Siveco was more specifically in charge of reliability improvement, maintenance preparation and the training of ZFSS operators and maintenance staff.

The following results were obtained:

- A significant reduction in commissioning time through the provision of additional resources immediately operational on the project.
- Over 300 technical failures, ranging from critical to benign, were resolved. Root cause analysis was performed on approximately 50% of them, leading to a sustainable reduction of the failure rate.
- At the end of the project, the availability of the production

> Under extreme pressure to start production, the involvement of Siveco ensured that we met our target in terms of line availability and maintainability.

line reached the customer's requirement i.e. a 90% availability rate and takt time below 23 seconds.

- The line was entirely documented in the Coswin Maintenance System for hand-over to customer. All failures were recorded into the web-based system, ensuring complete traceability of the commissioning and early operation phase.
- Successful training of ZFSS operators and maintenance technicians.

Coswin as a support for engineers during commissioning

According to Thierry Dormois, General Manager of BYJC-Fabricom:

> "Siveco was able to quickly mobilize multi-disciplinary engineers, who successfully integrated within our multi-cultural team in a very short period of time. Under extreme pressure to start production, the involvement of Siveco ensured that we met our target in terms of line availability and maintainability."

He added that:

> "Siveco China's management remained involved throughout the project, sparing no effort to provide ZFSS and ourselves with value-added advice beyond their job scope."

Globalizing the maintenance of lab equipment using CMMS

Danfoss and its worldwide network of laboratories

Danfoss A/S is a global leader within energy-efficient solutions that help save energy and combat climate change. The company's key competencies are the cooling of food, air conditioning, the control of electric motors, and the heating of buildings - as well as solutions for renewable energy such as solar power and heat pumps. Danfoss has an annual sales turnover of approx. 31.5 billion DKK (2010). Worldwide 24,000 employees work at Danfoss in 21 countries.

The Commercial Compressors division develops and manufactures reciprocating and scroll compressors for commercial refrigeration and air conditioning applications. The division has globalized its development and operates a network of R&D centres in France, the USA and China (in Tianjin's Wuqing district). The interconnected world-class laboratories are key actors in the company's product development process, as they provide prototyping, testing and engineering services. They employ a total of 60 technicians, for over 360 testing machines, which can sometimes be shipped from one R&D location to another. All in all, the Laboratory Engineering Department manages over 150 million Euros worth of equipment worldwide.

Improving the reliability of lab equipment, a key challenge

The laboratories play an essential role in product development, itself at the core of Danfoss business: the company aims at reducing product development time and cost by increasing the availability of testing equipment. The can be achieved by continuously improving the laboratories machines' adequacy (through engineering), reliability (through maintenance) and precision (through metrology).

In 2007, as the Chinese lab was looking for metrology and maintenance software, Danfoss took this opportunity to launch a global project to unify the software platform used by the laboratories worldwide.

The main objective of the project was to support Danfoss strategic goal: better availability of lab equipment will reduce product qualification time. Secondary goals included:

- Setting up global KPIs for maintenance and engineering
- Implement a common tool to share methodologies, knowledge, spare parts and equipment between the labs on a worldwide basis
- Improve technical support for the Chinese lab
- Manage new testing equipment construction projects in a quicker way
- Integrate the US labs in a second phase of the project
- Obtaining ROI in one year

A comprehensive selection process was conducted, resulting in the selection of Siveco's web-based Coswin maintenance

> The Siveco China team was a major driver in the project, proving that global improvement initiatives can be managed from China.

management system and the setup of a joint project team.

A global project managed from China

The project was managed from Tianjin, China. From April to November 2008, key users were trained, technical data (both lab equipment and metrology equipment for the Wuqing plant) was migrated and the CMMS put into operation.

Joint Danfoss and Siveco team

The CMMS covers all maintenance, processes with a strong focus on preventive maintenance. Key functionality includes:

- Equipment, parts and technical documentation
- Stock management in all locations
- Preventive maintenance: first level, regular and condition-based maintenance
- Instruments calibration
- Corrective maintenance
- Reporting, analysis and decision support

The CMMS: a global tool for a global way of working

According to Gerard Fermon, Global Maintenance Manager at Danfoss Commercial Compressor:

> "For the first time, the central technical database provided the various laboratories with a common language, a know-how sharing tool and a global way of working. The US labs were later integrated into the system. The Siveco China team was a major driver in the project, from the very beginning, proving that global improvement initiatives can be managed from China."

Facility Management

Green Property I Changcheng Property Group I Carrefour China French Embassy

FM subsidiary of Chinese real estate giant strengthens its core business with bluebee®

Shanghai Green Property Management

Shanghai Green Property Managementis the property management subsidiary of Fortune 500 developer Greenland Group and a leading player in the burgeoning Chinese property market. Established in 2002, the company provides property management and consulting services in various types of properties including high-rise buildings, HOPSCA, residential projects, office buildings, shopping malls, school campuses, and hotels.

The evolving Chinese property market

After decades of tremendous growth, China's real estate market is becoming increasingly regulated, while facing the challenges of extending the life expectancy and decreasing the energy consumption of buildings. Sustainable development was set as a priority of the People Republic of China's twelfth five-year plan, approved on March 2011.

Green Property Management, as the main operating facility management company of Greenland Group, also has to overcome human resources challenges specific to the Chinese economy: skills shortages, rising labor cost, high turnover, etc., in order to deliver the high-value services demanded by the market.

In these conditions, how to design and implement its modern "best practice", across a large workforce, on multiple sites all over the country?

The chosen approach

Green Property Management's top managers have embraced the challenges and, in 2012, embarked on a project to modernize its management model. The company turned to Siveco, the country's largest maintenance consultancy. Established in Shanghai in 2004, Siveco has developed facility management software already used on a large scale in China.

As part of the decision process, Green Property's team visited two major Siveco clients: property management company Changcheng Property Group in Shenzhen (380 sites under management) and water infrastructure operator Sino French Water (27 joint-venture companies, most of them multisite). The visits confirmed Siveco's ability to deliver large technology-driven projects to improve facilities management in China and helped Green Property Management to clarify its vision.

Through this initial study phase, Green Property came to the same conclusion as Siveco, as to how to best enforce a new management practice, from top management down to individual workers, gardeners, cleaner and maintenance technician, using mobile technology.

Greenland Center Zifeng Tower: The highest in Nanjing, the second tallest in mainland China, the seventh tallest in the world.

The Green Property team was quick to understand that the many property management software available in the Chinese market did not offer support for its core business (the services its employees provide on a daily basis), focusing instead on administrative processes of lesser value. While working with Siveco for its core business, Green Property selected local software suppliers for its accounting, billing, payroll management and other supporting processes.

> During the pilot phase, more than 3.5 million work actions have been reported into the central bluebee® cloud system.

A contract was signed at the end of 2012, to deploy Siveco's bluebee® solution "for the worker of tomorrow" in a phase implementation approach supporting Green Property's management objective.

Project phases

During the initial phase of the project, Siveco consultants worked alongside Green Property management team to define a "Core Model" of best FM practices, covering both soft and hard services. The Core Model draws on Green Property's existing practices, Siveco's local and international experience, as well as relevant standards such as *ISO 9001*, *ISO 14001* and *OHSAS 180001*. The Core Model covers guidelines for building up facilities and assets data, the definition of work processes and key performance indicators.

The bluebee® system was then installed and configured based on the Core Model. bluebee® is a suite of very intuitive mobile applications, designed for facilities workers, with a central management platform known as bluebee® cloud. More than software, bluebee® is meant as a structuring tool for the organization daily work, in the following areas:

- Engineering and maintenance
- Landscaping
- Cleaning
- Quality control
- Overall service management

bluebee® is designed to enforce best practices down to worker level, thanks to mandatory scanning of asset tags and taking pictures by workers or supervisors using Android mobile phones.

After a test period, the system was then deployed on three pilot sites: office building Greenland Hechuang Mansion and residential property Ladoll Plaza in Shanghai, and 450m Greenland Center - Zifeng Tower in Nanjing, the 7th highest building in the world and 2nd in mainland China. On July 18, 2013, a ceremony was held with top managers of Green Property Management to mark the official "Go Live" of bluebee® on the three sites.

Based on the experience of the pilot sites, the use of

bluebee® is now being extended to other properties. The second batch of properties include Shanghai Metro Lines 1 and 3 (60 stations serviced by Green Property Management, with over 500 onsite staff). Ultimately the system will cover over a hundred sites, with an expected 3,000 mobile users within the next two years.

Benefits obtained

According to Zhang Yimin, the General Manager of Green Property Management:

> "Our ultimate goals for implementing the bluebee® FM solution were to upgrade our management model and to free our workforce. This informatization project proved essential to achieve these goals, as tool to:
>
> - Strengthen our core competitive advantages to meet market demands
> - Upgrade and standardize, systemize and streamline our current processes
> - Based on the system, train and improve the efficiency of our people
> - Based on analysis of data from the field, to improve our management
> - Reallocate our resources to focus on the most profitable business"

At this stage in the deployment of bluebee®, Green Property Management has already experienced the benefits, such as:

- Reduction in staffing level: thanks to the immediate efficiency improvement brought by the use of bluebee®

mobiles, a number of supervisors and site managers can be immediately redeployed to high value-added tasks, such as new customer services. New organization charts were put in place, requiringmuch fewer site managers than without bluebee®.

- Better management of subcontractors: subcontracting is a common practice in FM, which for the main property management company brings constant headache with quality control and work performance. Green Property subcontractors are also equipped with bluebee® mobiles, thus ensuring they remain totally aligned with the company's best practice.
- Continuous improvement: during the pilot phase, more than 3.5 million work actions have been reported into the central bluebee® cloud system. Data is timely and accurate, emanating directly from workers in the field. This wealth of structured information allows Green Property to analyze and benchmark its performance from one site, one team to another. On this basis, a new rewards and fine system has already been put in place.

As more and more of Green Property Management sites come under bluebee®, benefits are expected to increase deriving from consistent quality of service, efficiency improvement on a large scale, as well as further benchmarking and better decision support. In the longer term, the impact of better working practices on buildings lifecycle and energy consumption will benefit the community as a whole.

Unified FM system key to continuing service level improvement for leading property group

Changcheng Property Group (CCPG)

Changcheng Property Group Co., Ltd. (CCPG), the first joint-stock property management company in China, ranks among the top 3 local Facility Management service suppliers. With operation in 23 provinces, CCPG serves over 26 millions customers all over the country, covering high-rise buildings, villas, serviced apartments, office buildings, shopping malls, municipal public buildings, universities, hospitals, large communities etc.

A visionary company in many respects, Changcheng Property Group took the lead in the Chinese property management market by being the first to achieve *ISO9001*, *ISO14001* and *OHSAS18001* certifications. The company gained further credibility by managing the Olympic Village during the 2008's Olympic Games in Beijing, winning praises as "the best Olympic Village for 40 years" by IOC's President Mr. Jacques Rogge.

Experiencing fast growth at around 20% per year, CCPG is continuously striving to enhance service levels in order to reinforce its position in a very competitive market. CCPG intends to achieve this goal by systematically promoting good corporate governance and further standardizing its business practices.

The project – building the standard platform

CCPG selected Siveco to design and deliver a unified, centralized Property Management System (PMS) that would serve as the platform to implement standards and continuously improve performance across the company's large, geographical distributed, organization. Such a platform was considered critical to support growth, i.e. the setup of new branches and contracts according to best practice. The PMS was to cover both soft and hard FM services, namely technical services, cleaning, landscaping and security. The project was launched in August 2009.

In the initial phase of project, the Siveco team was dispatched to Shenzhen to review CCPG's already very sophisticated best practice (documented in comprehensive manuals and forms) and incorporating it into a web portal based on PMS's database, thus forming the "Core Model" for future rollout to all sites.

Overall PMS workflow in CCPG

The Core Model covers all aspects of property operations, with the following processes defined across all disciplines (technical, cleaning, landscaping, security):

Main processes:

- Unplanned work
- Preventive work
- Energy consumption records
- Daily shift records
- Etc.

Supervisory processes:

- Professional inspection
- Quality inspection
- Internal audit
- Decision support
- Etc.

Support processes:

- Suppliers management
- Stock management
- Employees management
- Etc.

> From a professional point of view, the PMS established by Siveco is invaluable.

Deployment processes (for new sites):

- Data collection (templates and processes)
- Training plan
- Coaching and follow-up
- Etc.

The Core Model also defines PMS' highly-graphical user interfaces, based on maps and processes:

The Core Model was then implemented in Shenzhen region for a first large-scale testing with users in 20 different sites. Implementation consists in collecting all relevant facilities and technical data for the site managed, then training and coaching the staff in the daily utilization of the system. Regular follow-up audits are provided to continuously enhance the utilization of the PMS. This phase of the project was completed by the beginning of 2010.

Six months later

After successful completion of the pilot, the Siveco China team has helped CCPG roll-out the PMS to all the sites in Shenzhen region: the number of users connecting to the PMS portal is already over 150. The CCPG project team has been trained to further deploy the PMS to its other regions, a process which is now in full swing.

At the same time, the implementation of the bluebee® mobile solution is under preparation at one of the Shenzhen sites, in order for CCPG to assess the benefits of this approach for Facility Management (inspections, meters reading). Another site will then be selected to integrate the central PMS with a site-level Building Management System.

Chen Yaozhong, President of Changcheng Property Group, said:

> "First of all, it is our pleasure to cooperate with Siveco, the largest maintenance consultancy in China, during the past six months. The whole program was very well-organized and structured. It was very flexible, yet strictly followed in terms of the length of the project. In addition, the Siveco China team was very professional, with responsibility in mind. More importantly, Siveco's way of working matches CCPG's, with clear management guidelines reflecting a results-driven approach."
>
> "From a professional point of view, the PMS established by Siveco is invaluable: the whole system, not only better integrates our C-level property management theory in terms of Standardization, Professionalization, and Empowerment, but it also helps our facility managers optimize operations and reduce costs on site."
>
> "We strongly believe that the PMS will help CCPG solve some of the problems within our old internal operational system, by allowing us to better manage data across the organization, in a practical way, making all key performance indicators and knowhow available via the Web."
>
> "Information technology has become the dominant field in today's science and technology development, also leading to further development and transformation within the property management service industry. CCPG hopes that synergetic IT systems will further enhance the satisfaction of our customers and improve the welfare of the community".

CCPG has calculated the direct savings achieved with the project:

- 30 millions RMB/year in labour cost (labour represents 70% of their operation cost).
- Indirect savings are harder to compute: increased quality of service, support for business growth and to provide new services (e.g. energy services)…

Risk Prevention, Key to sustainable retail success at Carrefour China

About Carrefour China

Over the past 40 years, the Carrefour group has grown to become one of the world's leading distribution groups. The world's second-largest retailer and the largest in Europe, the group currently operates four main grocery store formats: hypermarkets, supermarkets, cash & carry and convenience stores. Over 9,500 stores worldwide, either company-operated or franchises. A pioneering entrant in China (1995), Carrefour sees strong potential for further growth in the future. At the end of 2012, Carrefour operates 243 hypermarkets all over China and is continuously opening new stores.

Risk Prevention at Carrefour China

Safety issues have remained at the top of the agenda in China for several years now, and have attracted attention from the central government while receiving wide coverage from the media. In this challenging environment, Carrefour China places utmost important on safety and regulatory compliance.

The company's Risk Prevention Department has for its fundamental mission to ensure the protection of people, assets, goods and value across all Carrefour stores in the country. The department's wide range of responsibilities includes fire protection, food safety, fraud control, ethics compliance, loss prevention, as well as security.

In order to carry out its mission, the Risk Prevention Department has setup a Central Operation Security (COS) Center, to conduct information gathering and analysis, operation support and crisis management. The country is split into five territories, each with its own regional Risk Prevention team. Furthermore, each store has a dedicated team. The Risk Prevention Department is the largest in the company by number of staff.

The RPMS (Risk Prevention Management System) project

In June 2011, Carrefour selected Siveco China to implement a nationwide Risk Prevention Management System (RPMS). The RPMS is based on Siveco's bluebee® suite of software solution, designed in compliance with the *ISO 31000 Risk Management* standard.

Carrefour national Risk Prevention personnel access the RPMS from a large multi-touch panel in COS, while users anywhere else in China can connect through a secured internet browser. Security alarms from the 220 stores are automatically treated by the RPMS, together with all incidents and non-compliance reports, as well as audit reports from field personnel.

RPMS in Carrefour China COS Center, the largest touch-screen in China

bluebee® mobile application provides access to the central system for field personnel using rugged Personal Digital Assistants (PDAs) for daily safety and security inspection routines or Android tablets for managers.

> The RPMS has also proven to be a very powerful tool to raise safety awareness, thanks to its high visibility at COS and on mobile devices.

Store audit using bluebee® on Android tablet

The embedded Geographical Information System (GIS)

The bluebee® cloud open architecture allows for a seamless integration with a Geographical Information System (GIS). For RPMS, the GIS part of the project included:

- Map display as part of the bluebee® cloud portal, including large-screen at COS
- Geo-localization of all Carrefour sites, related events and records
- Display of alarms and geo-statistical indicators (risk level, fire cases, theft etc.)

Nationwide deployment: 243 stores team trained in 6 months

The project was conducted as a nation-wide deployment, with initial implementation study and pilot phase on 3 stores, followed by quick deployment to all existing stores. A Core Team was formed in Carrefour to conduct in-house training: during the 6-month deployment period, all the Risk Prevention teams were trained and the usage of RPMS was rolled out to all 243 stores. New stores are immediately integrated in the RPMS before opening. The RPMS is currently being expanded to further support Carrefour China's ambitious development plans.

According to Arthur Zhang, Preventive Business Intelligence and Technical & Safety Director:

> "With the RPMS, centrally established regulations and guidelines can be enforced on a large-scale, at every level: auditors, supervisors, service providers and workers. The mobile solution also acts as a training tool and allows immediate feedback from the field to regional and national control centers and crisis rooms."
>
> "The RPMS has also proven to be a very powerful tool to raise safety awareness, thanks to its high visibility at COS and on mobile devices."

In November 2013, the RPMS project won the 2013 CHaINA "Best Supply Chain Consulting Partner" Award by the Global Supply Chain Council, Asia's leading professional organization in supply chain.

According to the Global Supply Chain Council's announcement:

> "The RPMS is a well-recognized success in the industry and has been a showcase of good practices for Carrefour China. This project touches on many hot topics related to supply chain management in China and has deployed a very innovation solution to achieve food and public safety, innovation and more."

Loic Frouart, Carrefour China's Risk Prevention Director, spoke at the award ceremony:

> "For several years now, safety issues keep making headlines in China and all we hear is horror stories… We hope that, with this award, we can start talking about solutions and success stories."

Maintenance preparation, a key success factor for prestigious real estate project: the new French Embassy in Beijing

The new French Embassy, a flagship project in the heart of Beijing

Since 1964, the year diplomatic relations were established with the People's Republic of China, the French Embassy has occupied a small villa in Beijing's Sanlitun embassies district. With the opening and subsequent economic growth of China in the late 1980s, France's diplomatic and consular staff expanded to almost 300, spread across 7 rented locations all over the city: regrouping all the departments in one site became a necessity. At the same time, the French Ministry of Foreign Affairs had initiated a rationalization and modernization of its property portfolio worldwide: the construction of a new large building would allow the Embassy to escape the every-increasing rental costs in downtown Beijing, while the project could be funded by property sales in other countries. The new embassy project was launched.

Bird's-eye view of the new French Embassy on March 28, 2011

The 19,950 sqm U-shaped building was designed by architect Alain Safarti, an innovative combination of Chinese fengshui and French Haute Couture. The construction contract was awarded to Beijing Construction and Engineering Group (BCEG) at the end of 2008. The new embassy provides office space for 300 people, public and reception facilities, the ambassador's residence and gardens. Particularly attention has been put on ensuring energy efficient operations, with specific design features and an advanced energy monitoring system. The embassy was inaugurated by the French President in March 2011 and came into full operation later at the beginning of 2012.

The maintenance preparation project

In late 2009, the construction of the new embassy was well under way when the French Foreign Ministry's Property Department realized that its expectations in terms of technical documentation and preparing future operations would prove challenging to attain in China. Who could review the drawings with an eye on maintainability? How to obtain proper as-built drawings from contractors? How to ensure the reliability of critical building systems?

In January 2010, Siveco was selected to provide maintenance engineering services and facilities management consulting for the Ministry. The Siveco team worked alongside the construction team for a project in three phases:

The three phases of the project

Phase 1 – Preparation of maintenance plans

- Creation of preventive maintenance plans
- Design review for reliability and maintainability
- Support for building up technical documentation (as-built drawings, equipment numbering and tagging, operation and maintenance manuals etc.)
- Preparation of maintenance budgets and the corresponding manpower requirements

Phase 2 – Selection of Facilities Management (FM) suppliers

- Definition of service packages (soft and hard service, overall coordination)
- Preparation of technical specifications and tendering requirements, with a primary focus on hard services (maintenance)
- Preparation of FM contracts, including performance targets, incentives and penalties
- Organization and follow-up of tendering process
- Support for contracting and negotiation phase

Phase 3 – Commissioning and support for initial operations

- Delivery of a Computerized Facility Management System (owned by the embassy) and training of contractors
- Support for the start-up of FM contracts
- Monitoring of suppliers' performance for the first year
- Maintenance audit before the end of the warranty period

> I strongly recommend Siveco for maintenance assistance in similar construction projects, as their service offering corresponds to a real need of the Chinese market.

During the entire project, the project team had access to Siveco back-office resources and the Siveco network of experts on specific technologies, facilities or equipment (e.g. HVAC specialists) or methodologies and standards (most notably European standard *EN 13269 – Maintenance – Guideline* on preparation of maintenance contracts.)

Siveco's Facility Management System was used in all phases, providing a strong methodological framework for all involved. The system contained the initial technical database (maintenance procedures for typical building systems), helped structure the data collection process and was later delivered to site. This enabled smooth knowledge transfer to the selected FM suppliers, with long-term contract performance (based on the *EN 13269 standard*) assessed automatically in the system from the FM team's job records.

Benefits of the project

The involvement of Siveco helped the Embassy to overcome some of the challenges associated to construction projects in China and yet too often ignored by foreign investors:

- The shortcomings of Chinese engineering and construction firms in technical documentation (for example real as-built drawings) and maintenance preparation.
- Similar difficulties for local equipment suppliers to provide useful maintenance manuals.
- Widespread habit to improvise onsite solutions for problems met during construction and equipment installation, leading to undocumented design changes.
- Problems experienced during commissioning are often not well documented and solved by quick-fixes, rather than though proper root-cause analysis and modifications, leading to long-term recurring issues for the building.
- A run-to-failure approach to maintenance; preventive maintenance is seldom seen in practice or poorly executed.
- General lack of methodology, including fundamental aspects of maintenance such as diagnosis and troubleshooting.
- Weak or out-dated local technical standards.
- Lack of maturity of the local FM service market (and equipment vendors after-sales service), with a focus on providing low-cost labor rather than performance.

Operational benefits experienced by the Embassy included:

- Identification and resolution of maintainability issues from the construction stage, avoiding future impact on building operations.
- A pre-selection of high-quality FM offers, thanks to clear contractual requirements based on an in-depth technical analysis. Final selection of a supplier that was technically the best but also the most price-competitive among all bidders.
- The FM team was quickly operational on site, thanks to smooth handover process and full building documentation in the FM system.

According to David Seroul, head of the Regional Property Department at the French Embassy in Beijing:

> "Siveco has provided much-needed maintenance expertise: thanks to their hands-on experience of China, Siveco has helped us make the right decisions in this challenging project. All the objectives of their mission were achieved. I strongly recommend Siveco for maintenance assistance in similar construction projects, as their service offering corresponds to a real need of the Chinese market."

Thanking our 850+ customer sites

Welcome to Maintenance 4.0

The world has known three industrial revolutions and the fourth one is well on its way. Dubbed Industry 4.0, it promotes increased computerization and integration of industrial systems. Maintenance lies at the core of this fourth industrial revolution. Siveco China, founded in 2004, is the country's largest maintenance consultancy and a pioneer in the development of Maintenance 4.0 technologies, with a focus on mobile solutions "for the worker of tomorrow". Rather than replicating a western model, as previous Industrial IT initiatives have done, Siveco is designing new solutions to address the needs of maintenance "with Chinese characteristics".

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