

Quant plus

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Realizing the full potential of maintenance

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Sabrina Vilhena
CEO Quant

Welcome to the first issue of Quant plus, our official customer magazine. I would like to take this opportunity to tell you about Quant, our journey and where we want to be in the future.

For over 25 years, we have been realizing the full potential of maintenance for our customers. Previously ABB, we became Quant at the beginning of 2015. Our new company name I feel, reflects the quantifiable value we create for our customers that is, optimizing maintenance cost and improving plant performance. Additionally, our professionalism and industrial maintenance management expertise we have in our team of over 2000 employees. As we are located in close to 30 countries with our headquarters in Stockholm, Sweden, to me, this enables our customers all around the world to feel they have instant access to our professionals.

When our customers outsource their maintenance management and execution to us we ensure that they achieve both their short and long term goals. We

“We empower our people to achieve our customers’ goals in the most professional way.”

deploy empowered, maintenance-focused people to work as an integrated part of their production teams, using world-class processes and methodologies to improve safety and productivity all while optimizing cost.

For us and our customers, safety is our top priority. Many of our customers are convinced that, if safety practices are not in order, the rest doesn't matter. We factor this important measure with every site and make sure that our employees are the first to recognize this.

Proof that our safety measures are paying off, can be found in our latest safety numbers. Over the last two years, we decreased our Total Incident Rate by over 50 percent, whilst over that same period, our Lost Time Incident Rate dropped from 0.75 to 0.55.

Low incidents numbers isn't the only sign we are keeping people safe, it is also an indication that we are doing our jobs professionally, which is noticed by our customers. That said, our unique approach to optimizing maintenance management and execution, with a focus on safety, education, motivation and empowerment, takes our customers' performance to the next level, adding value in both the short and long term.

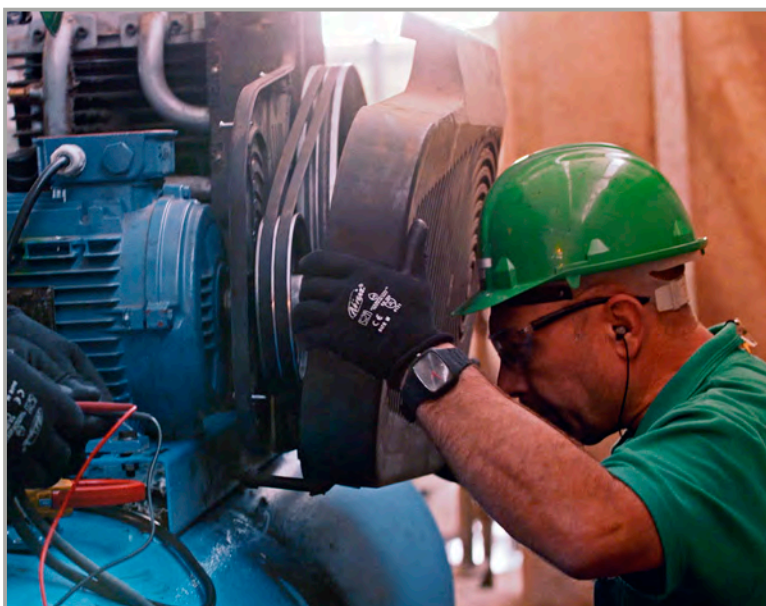
This is where I envisage the growth of Quant for the future. It is the people that make the difference and I am proud to say at Quant, we value the satisfaction that comes from acting with integrity and achieving our customers goals.

We have some interesting success stories in this first issue, the most recent being the renewal of a flexible contract with Nordkalk in Finland. Secondly in China, Stora Enso is integrating a Total Maintenance Outsourcing (TMO) contract as a vital part of their plant management arsenal. We also feature one of our biggest sites, Ludvika in Sweden and how at this site, it does more than just maintenance services.

If you keep reading our magazine issues, you will soon realize there is a lot going on at Quant. You will start to realize the full potential of maintenance and how we turn maintenance from a cost into a value creation process.

I hope you enjoy reading what we are doing for our customers and what we could do for you.

Enjoy this issue of Quant plus.



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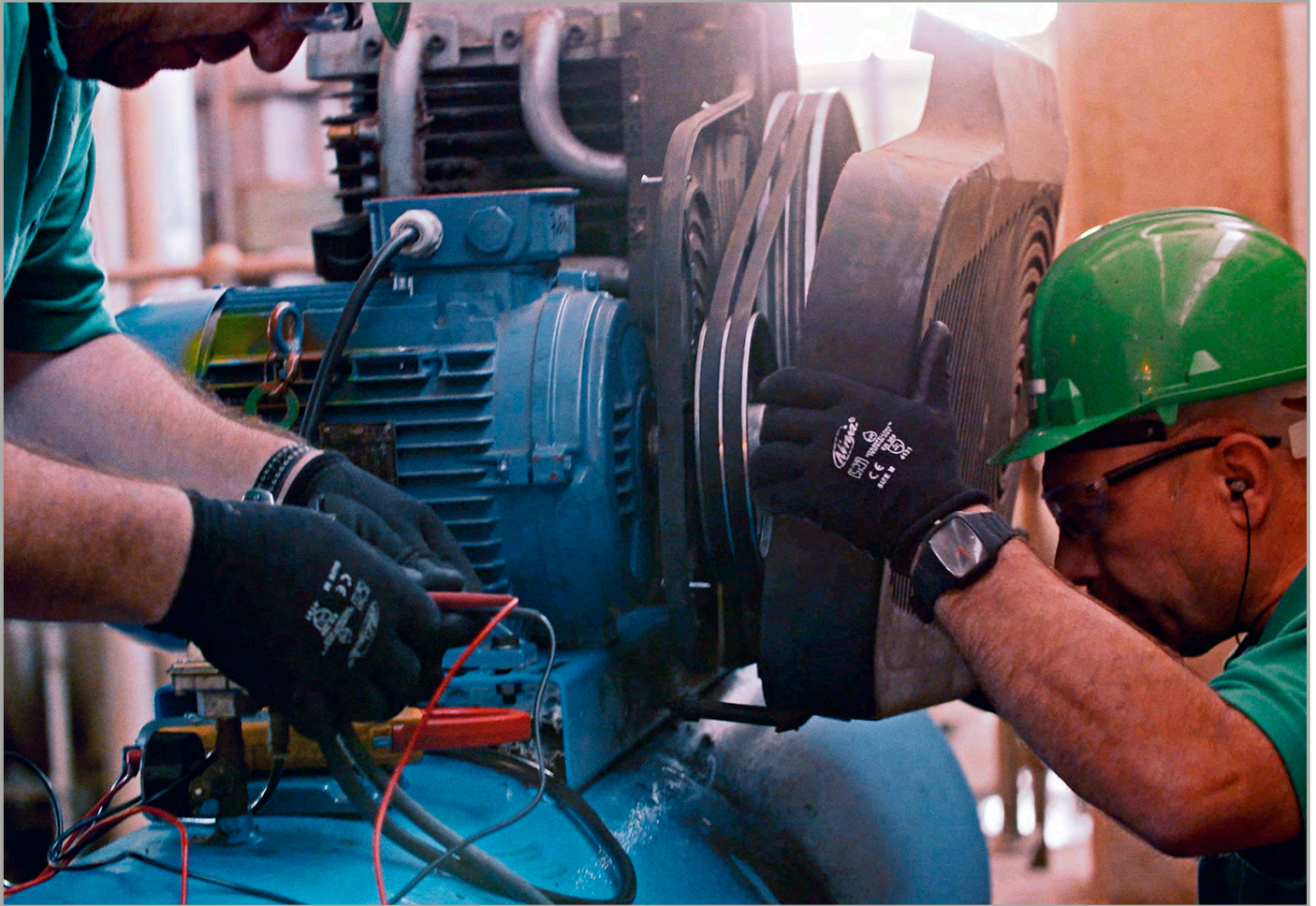
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How maintenance productivity measurement identified significant maintenance cost reduction opportunities

Jose Baptista, Development Manager for Reliability at Quant, identifies how facilities can improve their business operations through outsourcing.

Throughout my career, I saw, or rather felt, the various economic crises created by several factors from the 1970s oil crisis at the beginning of my career to the world economic crisis in 2008 when I first moved to the U.S. The crisis periods and an increasingly competitive market always results in one common remedy: an enormous pressure to reduce costs. Without the proper precautions or criteria, this cost cutting may jeopardize business continuity.

Labor productivity has a major impact on the cost of maintenance and few maintenance managers know the effectiveness of their crews. They should know and improve the conditions that affect labor productivity on their sites. The way they design and implement their maintenance management processes directly impacts the productivity of the maintenance workforce.

I will try to illustrate how the company, Quant, the global leader in industrial maintenance helped one

Assuming a workforce of 100 people with an average labor rate of \$40.00 per hour, these losses represent a substantial economic drain equal to \$4.6 million each year.

customer to identify and remove barriers to improve the maintenance workforce productivity.

I will start by defining maintenance productivity as the ratio of the output to the input of a production system. With a given input, if output of products or services is higher, then productivity/ efficiency is higher. Efficiency is doing things right or it is the measure of the relationship of outputs to inputs and is usually expressed as a percentage.

In summary, the total productivity of the maintenance workforce can be divided into three factors:

1. Utilization:

The elimination and reduction of nonproductive work such as time spent waiting, walking or being idle.

2. Performance:

Increasing speed of task execution through a higher quality of employees, improved tools and working methods and planning and scheduling.

3. Quality:

The elimination of unnecessary tasks using work flow and plans analysis, organization analysis, failure analysis, execution quality and equipment design-out.

Utilization X Performance X Quality = Total Productivity

Our study focuses on the utilization factor only. We wanted to identify the wasted time associated with maintenance tasks, for example, the time technicians lose having to move around unnecessarily in different areas of the plant or wasted time waiting for work permits, spare parts, tools, instructions and other documentation required for completing an assigned task.

To be able to measure productivity, we adopted the work sampling methodology, which is a measurement technique developed in the 1930s by L.H. Tippet to analyze, classify and quantify work using instantaneous observations of work in progress taken randomly over a period of time. It is based on the laws of probability and to determine the proportion of the total time dedicated to the various components of a task.

To conduct a work sampling study, a large number of observations or snapshots are taken randomly and during each observation and the condition of the worker is determined and recorded in a predefined category of activity pertinent to the particular work situation. Inferences are then drawn concerning the total work activity from the proportions of observations in each category.

Based on these measurements, we conducted this study in various petrochemical plants in Brazil. The study was carried out over a 30-day period, and observations were made at predetermined locations to cover the entire plant. Based on statistical calculations, the numbers of required observations were 8,800 with a margin of error of ± 1 percent. For the study, the maintenance activities were divided into three categories: productive, support and nonproductive:

Productive: Working and Planning

This category includes adjusting, welding, positioning, cleaning, inspecting, assembling, analyzing discussing execution, drawing sketches and a number of other activities.

Support: Watching, Walking and Waiting

Watching refers to supporting and serving as a stand-by, while waiting refers to time spent acquiring tools, materials, scaffolding, lifting equipment, work permits or instructions.

Nonproductive: Personal and Idle Time

Nonproductive time is classified and personal and idle time such as drinking water, coffee breaks, smoking and conversations not related to work. The study revealed the following percentages:

Working: 26 percent

Planning: 11 percent

Productive (Working + Planning): 37 percent

Waiting: 27 percent

Walking: 28 percent

Nonproductive (Personal): 1 percent

Nonproductive (Idle): 7 percent

Assuming a workforce of 100 people with an average labor rate of \$40.00 per hour, these losses represent a substantial economic drain equal to \$4.6 million each year.

Available daily hours per craftsman	7
Measure Value	37%
Lost time per day (minutes)	265
Number of workers	100
Days per month	22
Lost time per month (hours)	9702
US\$/Hour	\$40.00
Losses per month	\$388,080
Losses per year	\$4,656,960

The results of study were presented to plant management and interested parties and then working groups were created to analyze the causes of unproductive time and to propose plans for improvement. These groups studied and suggested actions for each of the priority items. For example, for the “walking time” issue, the working group identified the following causes: logistics and improper layout, incomplete maintenance planning, deficiencies in internal transport, workers stretching lunch breaks, unavailability of tools, difficult access to productive areas, unavailability of scaffolding, and lack of operators to issue work permits.

Several actions were suggested and implemented to eliminate and reduce walking time including reviewing standard work order preparation, reducing internal bus intervals, reviewing meetings schedule, inventing a mobile tool cart so that workers would not have to go to the warehouse and allowing tools to be left at work during breaks and at the end of the day. After implementation, a new study was conducted with the following results:

Working: 50 percent

Planning: 10 percent

Productive (Working + Planning): 60 percent

Waiting: 17 percent

In Transit (Displacement): 19 percent

Nonproductive (Personal): 2 percent

Nonproductive (Idle): 2 percent

With the results above, the losses were reduced by approximately \$1.7 million per year.

Available daily hours per craftsman	7
Measure Value	60%
Lost time per day (minutes)	168
Number of workers	100
Days per month	22
Lost time per month (hours)	6160
US\$/Hour	\$40.00
Losses per month	\$246,400
Losses per year	\$2,956,800



If we consider that the maintenance labor productivity benchmark for petrochemical industry is 60 percent, we can say that this company achieved their target. The results demonstrate the importance of monitoring maintenance functions in order to improve efficiency and productivity in manufacturing plants.

Author: Jose Baptista – Development Manager, Reliability Quant

For more information, please visit:

www.quantservice.com or email

info@quantservice.com

Nordkalk partners with Quant to reduce overall maintenance cost



L-R: Kari Vyhtinen (Nordkalk), Pekka Ruutu (Quant), Jan Weber (Nordkalk) ja Anders Wiberg (Quant).

Quant has renewed a total maintenance outsourcing contract with a leading limestone product producer Nordkalk, to reduce the overall maintenance cost at their Lohja site in Finland. As Nordkalk worked with Quant in the past developing excellent safety measures, reducing material costs, and developing a good partnership, Nordkalk decided to renew the contract. This new contract which commenced on the 1st September will provide Quant the opportunity to enlarge the business to other Nordkalk sites by utilizing resources in a more flexible way.

Nordkalk needed to retain the strength of their resources in order to produce high quality products for their major industries which are, paper, steel and building materials. In order to achieve this, the reduction of overall maintenance cost needed to be achieved. Quant identified the key targets to achieve this, which included having a flexible contract.

Nordkalk's Production Director for North East Europe, Kari Vyhtinen outlined the advantages of having a flexible contract. "For us it is important to have a flexible contract, making it possible to use resources at other sites and in all duties necessary. This is a new contract model for us and we are excited to see how it will enhance our cooperation."

Quant's Regional Manager for Northern and Central Europe, Pekka Venalainen highlighted the

importance of a flexible contract. "We are very happy to continue our partnership with Nordkalk and develop our contract model together with Nordkalk. Market changes creates needs for more and more flexible way to work and we in Quant are ready to meet our customer expectations and work for sustainable maintenance development."

Quant's goal is to deliver Nordkalk an industrial activity in which we will work towards a positive and sustainable maintenance development.

About Nordkalk

Nordkalk is the leading producer of high quality limestone-based products in Northern Europe. The products are used mainly in the paper, steel and building materials industries as well as in environmental care and agriculture. Nordkalk's turnover totalled EUR 331.6 million in year 2014 and it employs about 1020 people. Nordkalk has operations at more than 30 locations in 9 countries. Nordkalk has mines and quarries in five countries.

For more information about please visit:

www.quantservice.com or email info@quantservice.com

Efficient maintenance management for the mining and minerals industry

“We have the human capital to develop the full potential of maintenance for our mining and mineral customers.”

Maximiliano Aqueveque,
Industry Segment VP Mining and Minerals.



Maximiliano Aqueveque, Industry Segment VP Mining and Minerals of Quant and General Manager of Quant in Chile, expects to grow more than double by 2020 the operation by working with a first level team to strength current mining and mineral contracts worldwide, upon an efficient maintenance management aimed at increasing productivity and at the same time taking assets to their best condition.

“Presence in various industries in the five continents allows us to be aware of their weaknesses, challenges and best practices in order to share this knowledge globally within our customers, thus remaining in the forefront of latest developments to accomplish an efficient maintenance with most strict safety standards. We fulfill an accurate maintenance in accordance with a strategic plan, to avoid over maintenance which turns into larger production hours without jeopardizing the plant condition,” Maximiliano explains.

He adds that the team is continuously evaluating opportunities to improve clients’ operation conditions beyond maintenance in order to implement plant performance improvement projects which turns into productivity increase and cost reduction, taking care of topics like energy efficiency or inventory reduction through criticality analysis. “Our model provides a guideline in what to do, but our people make the difference,” he says.

“The worldwide commodities price reduction has produced changes in the industry and the need to make their current operations more efficient. We

have the capabilities to help our customers with a better assets management. By implementing best maintenance practices it is possible to increase productivity, reduce total maintenance costs and contribute with energy efficiency. For greenfield projects, we can manage equipment guarantee and take actions since their purchase or even consultancy in decision making and later build a maintenance strategy to change maintenance concept from a cost center to a benefit center from Day One,” he ensures.

Partnering with customers for success

One good example of how Quant is working with a customer in this related industry is with a leading nickel chemical and nickel metal producer site in Finland.

Quant has been responsible for maintenance operations at the site since 1999, and the Total Maintenance Outsourcing agreement was recently renewed again for another 3-year term starting in 2015.

The renewal of this successful partnership is mainly related to the continued development of maintenance, where they had seen Quant to have the capability to continue this. The company has had, and will have, many process changes that Quant has adapted, and will adapt to, together with their joint strategy. This requires the maintenance functions to be very flexible and the communication in this partnership plays a key role. The company’s common target is to optimize OEE and secure the most efficient utilization of their assets. Quant has achieved

Unnecessary production breaks are avoided by executing a service program every four weeks. This includes continuous onsite condition monitoring.

this and will continue to optimize their resources and work closely with the customer to align future strategies and common goals.

The current maintenance plan also pays special attention to predictability and the improvement of maintenance disciplines. According to the customer, production breaks are avoided by executing a service program every four weeks. This includes continuous onsite condition monitoring.

Increased emphasis on OEE (Overall Equipment Effectiveness) has also improved technical availability, which has risen from 96.7% to 99.6% between 2003 and 2010.

For more information about Quant's mining and mineral services, please visit:
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Benefits

Maintenance has managed to improve effectiveness even when the production process has changed significantly

Lost production volume due to maintenance downtime has decreased by 86% between 2003 and 2010

Technical availability of production reached 99% in 2008 (96.7% in 2003) with availability levels at steady 99.4% – 99.6% (2008-2010)

Decrease of 86% in production losses

Quant wins large contract with Stora Enso in China



Stora Enso production build in Beihai, Guangxi, China.



Stora Enso signs a six year contract with Quant for total maintenance outsourcing services.



Quant maintenance team in China.

Stora Enso (Guangxi), the leading provider of renewable solutions in packaging, biomaterials, wood and paper has signed a six year contract with Quant, which commenced in April this year. This is the first warehouse management solution within China, where Quant will own part of inventory after two years. Secondly it is the first maintenance workshop where Quant will own and operate the machinery.

Stora Enso decided to implement a Total Maintenance Outsourcing (TMO) service agreement, which involves managing all maintenance on site, including warehouse and warranty management. The project consists of two main phases; Phase one, board machine with mechanical pulping line and supporting utilities — Phase two, chemical pulp line with expanded utilities. The ongoing maintenance team size is estimated at 80 people for phase one.

As the site is a Greenfield site it poses the task of getting the construction completed safely and on time, whilst meeting other targets for 2016. With the goal of lowering costs and improving efficiencies and downtimes, Stora Enso saw the importance of integrating a TMO approach as a vital part of their plant management arsenal.

Creating a path for future success

Quant were able to define clear objectives, such as providing Stora Enso with sustainable, world-class industrial operations, while demonstrating the value of taking maintenance to the next level. With benefits already seen from other companies partnering with Quant within China, enabled Stora Enso to easily identify the advantages that a TMO approach creates.

Why outsource?

The main advantages a TMO approach creates is budget flexibility. It lets companies like Stora Enso pay for only the services they need and when they need them. It also reduces the need to hire and train specialized staff, brings in engineering expertise from the outside, and reduces capital expense, yielding better control of operating costs. Another feature is that the outsourcing arrangement can change as a company's maintenance needs change.

Just because plants, such as Stora Enso are getting help from the outside doesn't mean that managers are removed from the process. The free exchange of information and resources helps them pursue common goals: cutting costs, increasing efficiency, and extending product life.

With more and more plants using outsourcing vendors to help with maintenance needs, efficiency increases and diminished downtime are being realized in a variety of industries. Operators and managers are getting a fresh view on the workings of their equipment and systems as better data and better access to that data becomes more available. This lets them analyze, prioritize, and schedule maintenance needs before their systems actually fail.

Stora Enso has identified this opportunity as an important competitive advantage within their targeted industry.

For more information about Quant's TMO services, please visit:

www.quantservice.com or email info@quantservice.com

Pulp and paper industry is a forerunner for maintenance outsourcing



According to a survey made by Bain & Co, the pulp and paper (P&P) industry has been a forerunner in maintenance outsourcing. Pertti Weissenfelt, Pulp and Paper Industry Segment Manager for Quant gives an insight into why this industry has outsourced more maintenance than any other industry.

1. Has the P&P industry been under harder cost pressure than other industries?

They are today, especially printing paper production where the demand is declining all the time because of the digitalization that has had huge defect on printing paper consumption. Paper producers are looking for all possible ways to cut costs and ensure their own competitiveness in the market where prices have been declining for years.

Board and pulp producers are in a lot better market situation and basically they can sell what they are able to produce. For them, the most important thing than pure cost cutting is the reliability of the

machinery to ensure the highest possible production efficiency – without forgetting the maintenance costs.

So one main driver for maintenance outsourcing in the P&P Industry has certainly been due to cost cutting. This is especially in Europe and US, while in some other regions the main driver has been the need to keep and improve maintenance capabilities and expertise.

2. Are P&P industry maintenance organizations more traditional when needing a culture change?

This is the main reason in many cases for maintenance outsourcing in every industry. Outsourced maintenance is driven as a business, which makes it vital for everyone to always consider the most efficient way of their own work. Furthermore, continuously develop it to be able to guarantee the most cost efficient solution to the customer and stay competitive in the market.

3. Does outsourcing maintenance give more flexibility than having it in-house?

This has always been important in the P&P industry. This is because the need for maintenance resources varies a lot for a longer period of time. For example, a pulp mill shut (normally between every 12-18 months) requires a lot more resources compared to the production phase. Secondly, due to a weak market (like now), when paper machines need to be occasionally stopped temporarily for days or even weeks due to lack of orders, the machines don't need any maintenance. Both these situations are easier for the customers to outsource this maintenance cost, which guarantees better flexibility for resource allocations.

4. Do P&P mills contain more complex technology than other industries?

Today the P&P mills are highly automated and that has caused quite a big reduction of people working at mills. For example, the European P&P Industry had 420 000 employees in 1992. However in 2014, the amount was 180 000. Production at the same time has increased from 65Mt to 90Mt.

This result creates a higher automation rate, making machinery and maintaining them more complex, which requires an in-depth knowledge and skill base from the maintenance team. P&P mills don't have many employees anymore. All of them have their own expertise, therefore they support the increasing development of maintenance outsourcing to companies who have a wide enough customer base to keep all needed resources. Pulp and paper production processes are already by themselves, complex enough to be managed. By outsourcing maintenance, the production organization can concentrate 100% on their own core, pulp and paper production.

5. Do P&P Industry customers get more benefit out of outsourcing than other industries?

It is maybe easier in the P&P industry to define the full potential that exists in maintenance than in some other industry. This is because paper machines are quite similar for each different paper and board grades. Regardless of the original equipment manufacturer (OEM) who has made the machine, the machines have been like that for decades. This similarity makes them easier to compare.

Usually P&P companies are comparing their own machines to identify the ones that perform and the ones that don't. Quite often, company targets are set based on their top sites. That still doesn't demonstrate to the company if they are among the best compared to their competitors. Quant has been benchmarking the P&P industry for over 10 years and has a wide global database of paper and board machines' efficiencies and maintenance costs, divided by production grades and geographical regions. Benchmarking with the best in the P&P



Pertti Weissenfelt, Pulp and Paper Industry Segment Manager for Quant.

industry is a strong tool when defining the full potential of maintenance.

Having such a similar machinery makes it more important to have the capability to find, share and implement best practices. There is basically no new equipment failures in the P&P industry. If you get a machine failure or problem that you haven't seen before, it most certainly has happened somewhere else earlier and there is maybe a solution for it already.

Quant being a global industrial maintenance company with experience in the P&P industry over 25 years has wide network in the industry as well as other industries. This guarantees the access to best practices and specialists.

6. In your opinion, did the Pulp and Paper industry just happen to be the first industry where outsourcing started?

In some cases this may be true. Many of Quant's (ABB at that time) first outsourcing agreements were done in the P&P industry and we became very good references that encouraged others in the same industry to outsource as well.

For more information about Quant's pulp and paper services, please visit:

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Industrial maintenance today and future trends

New technologies and ideas, and how they could influence the future industrial maintenance trends.

This article describes the evolution of industrial maintenance over the past sixty years and the key areas that have influenced it. It also explains how to achieve a situation that could be considered the “perfect world” for any maintenance professional. The article also surveys the new technologies and ideas, and how they could influence the future industrial maintenance trends. Finally the strategic initiatives that Quant implements that continue to provide world-class services for the future.

It has been said that over the past 40 years, the industrial maintenance has changed, perhaps more than any other management discipline.

The overall technical and methodical scope of maintenance has changed over time. Today maintenance is not restricted to simply repair the equipment when it breaks, it also has influence on the sustainable development of society as it influences the environment, safety of personnel and facilities, energy efficiency and financial aspects.

Companies that previously considered maintenance simply as a source of spending, increasingly have become aware that maintenance is, without any doubt, a critical factor to remain competitive.

Looking at the evolution of industrial maintenance, we cannot fail to mention the analysis done by John Moubray in his well-known book named Reliability-centered Maintenance, best describes the changes that have occurred in industry during the last sixty years. The book describes the gradual evolution of maintenance practices throughout those sixty years.

In his analysis of the maintenance evolution, Moubray divides maintenance into three distinct generations:

The first generation covers the period up to the Second World War

During that time, industry in general, used simple and robust mechanical equipment. Management was not particularly concerned with downtime or maintenance. Once the equipment became fairly reliable and relatively easy to repair, there was no need of any special maintenance methodology; keeping the equipment clean and well lubricated was enough. Consequently, there was no need either for systematic maintenance or special skills from maintenance professionals.

The Second World War marked beginning of the second generation in maintenance

The war dramatically changed the scenario described above because it increased the pressure for goods of all types. This caused a shortage of manpower in the industry and increased mechanization. The 1950s were marked by the emergence of increasingly complex equipment, to reduce the need for human intervention in the production process.

As manual labor decreased, the need for more reliable equipment operation became necessary, in other words, the equipment downtime became a real

concern to the plant operation managers. This new concern led to the idea that the equipment failures could and should be prevented, which led, in turn, to the concept of preventive maintenance.

In the 1960s, the prevailing concept of preventive maintenance consisted of planned shutdown of equipment to perform maintenance tasks at planned intervals. This practice resulted in the drastic increase in the maintenance cost compared to other operating costs and, in this context, maintenance planning and control systems emerged as a way to have maintenance under control. Those systems were incorporated into maintenance practices and they are, still today, indispensable to any maintenance management system.

It should be noted that the capital investment for the modernized equipment increased significantly. The cost of capital necessitated the need to find ways to improve, maximize, the life of the equipment and thereby reducing the need for additional investment in capital replacement.

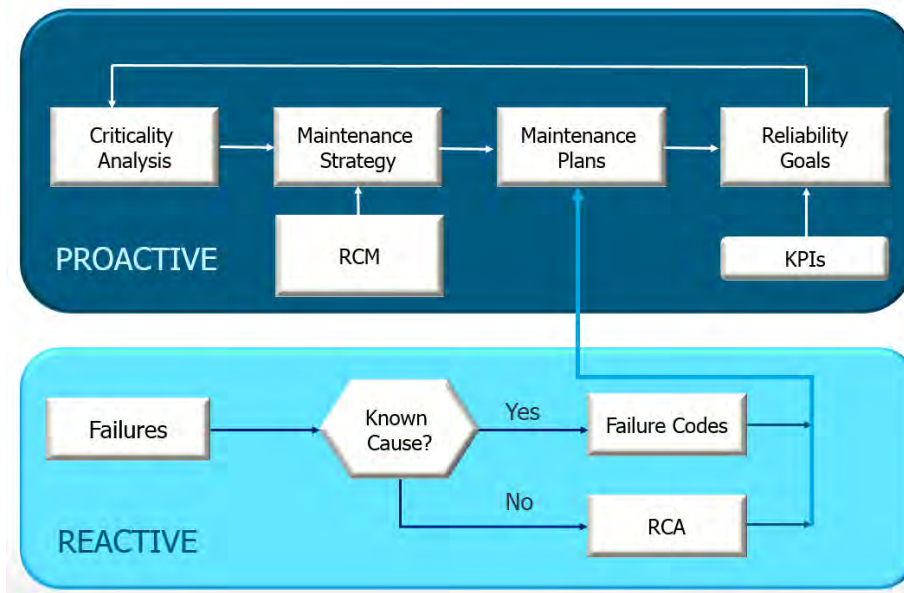
The third generation of maintenance, still according Moubray, started in mid-1970s

During this period, there were growing expectations from maintenance; unplanned downtime was less and less tolerable, since it affected the productive capacity, increased operating costs and, ultimately affected customer service.

Industry increasingly adopted the “just-in-time” system in order to reduce raw material inventories and work-in-process inventory. Any unscheduled equipment downtime could negatively impact the accomplishment of production plans.

In recent times, increasing automation in equipment and systems, brought emphasis on reliability, consequently, failures are not tolerated, especially in sectors such as hospital equipment, data processing, telecommunications, etc.

Equipment failure may also negatively influence the quality of the products, climate control in buildings, the punctuality of public transport services, power generation and control among many other important services. Today, it is fundamentally important to consider the impact of safety and environmental failures when addressing maintenance planning. In many parts of the world operations can be shut



The situation considered to be the “perfect world” for any maintenance organization occurs when the maintenance team is working most of the time in the proactive mode.

down due to safety and environmental concerns. The integrity of physical assets has evolved from one factor that only influenced the manufacturing cost to a matter of organizational survival.

Techniques to cope with changing trends

To cope with the increased equipment reliability expectations, such as reducing and eliminating failures and the consequent reduction in maintenance costs, new techniques have emerged. For example: Reliability-centered Maintenance (RCM), Root Cause Analysis (RCA), FMEA, etc.

Additionally, in recent years, technological developments, especially advances in information and communications technology, enabled several innovations in maintenance. These include: predictive techniques, remote diagnostic systems and expert maintenance systems.

Perhaps one of the biggest challenges that maintenance professionals face today is, in addition to learning all the new techniques and methodologies, is to decide which one best meets their organization’s needs. They need to clearly understand the cost / benefit of each one of the many offered alternatives.

A frequently asked the question to this topic is, “How does one move from reactive maintenance, fixing what is broken, to proactive maintenance, preventing the failure in the first place or at least minimizing the consequences?”

This question summarizes the maintenance evolution from the “Fix it when it broke” to what can be considered the “perfect world” of any maintenance professional. To better understand, the flow diagram

above gives a good visual explanation. Starting from the bottom, the part named “reactive”, the first step is to understand why the equipment is failing. If we know the causes of failures, then we need to group them to identify what are the most important.

At this point, it is worth noting that we need to assign codes to the failures. This is necessary in order to provide simply direction the staff in identifying the failure and then to group them for further analysis by the reliability engineering group.

If we are unable to identify the cause or causes of failure, then we should use the Root Cause Analysis (RCA) to assist in their identification. The output of “reactive mode” will have data for maintenance and reliability engineering, data representing the causes of equipment failure.

However, this alone is not enough; we must now examine the actions that are at the top of the flow diagram, the “proactive mode”. At this point the maintenance and reliability engineering starts by defining the plant equipment tree or equipment hierarchy, which is the backbone of the reliability maintenance process. It lists and organizes all production equipment in a logical hierarchical structure, where each piece of equipment is identified by its position in the production process, and given a name and code.

The next step is to analyze the criticality of the equipment using Quant standard procedure, which results in the breakdown of equipment at three levels (A, B, or C). The basic criteria for the definition of this criticality involve aspects of safety, environment, production, quality and cost. Once the criticality is defined, then the strategy of maintenance will

Perhaps one of the biggest challenges that maintenance professionals face today is, in addition to learning all the new techniques and methodologies, is to decide which one best meets their organization's needs.

be defined from the RCM (Reliability-centered Maintenance) analysis.

The maintenance plans are then implemented in CMMS (Computerized Maintenance Management System) and executed accordingly.

The plant performance is monitored using different indicators (OEE, technical availability, MTBF of critical equipment, maintenance costs, etc.) to verify how the maintenance activities are influencing them. Over the time, for every failure which impacts the plant performance, we must ask why the existing plans were not able to avoid it or minimize its consequences. The answer to this question will serve as feedback to the system, promoting the review of the existing maintenance plans.

When established, the process of continuous improvement will have a stabilization effect and then a significant reduction in failures.

What is a perfect world for maintenance?

The situation considered to be the "perfect world" for any maintenance organization occurs when the maintenance team is working most of the time in the proactive mode, without fire-fighting, without emergency calls in the middle of the night, without operations managers complaining about equipment downtime, without maintenance budget overrun and without stressed maintenance people.

Even today, we see that not all industrial segments have their maintenance programs at the same stage of development. For example, reliability, availability and asset life cycle planning had initial focus in the nuclear industry and this was quickly followed by the aerospace industry, but not so many other

industries have this same focus.

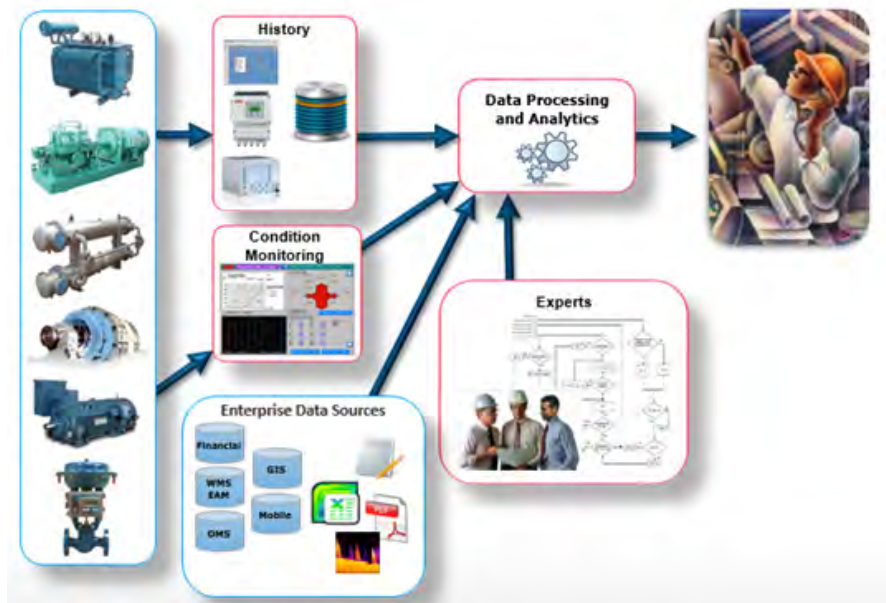
The concern for the safety and risk analysis have been developed in the chemical and petrochemical industry and, in certain way, spread to most industries.

In some other industrial segments, where the equipment failure is "acceptable", as long as the repair and return to operation time is short, often the up time is more important than reliability. In other words, the focus is more on reducing the equipment downtime than its probability of failure.

Where will maintenance be in the future?

Looking at future trends of maintenance, based on the resources listed in the bibliographic reference and in our experience; we see the emergence of new models such as the customization of maintenance services, which are directed specifically to customer needs. Good examples are the integrated services for rotating equipment; the supply of bearings, vibration analysis and lubrication service through performance-based contracts. This type of service releases the plant staff to focus on their core business without worrying about the management of services, acquisition of lubricants and bearings.

Additionally, maintenance contributes to sustainability. The concept of extending the life of physical assets and maximizing reliability at minimum cost, which are the day-to-day maintenance goals, provides an authentic competitive advantage to the business. This is done by avoiding unnecessary replacement of equipment and parts, as well as supporting efficient operation of industrial plants with minimal energy consumption. Another maintenance trend for the future is the



Development in decision making.

development of support for decision-making systems. Today many industrial maintenance decisions involving risks for equipment, costs and people are still made based on inaccurate or even missing data.

Experiencing a sticky situation

Some years ago, the company experienced a difficult situation at a petrochemical site, where we provided maintenance services that illustrate the deficiency in decision making on the shop floor. At this site, the vibration data collected from a boiler fan electrical motor indicated that one of the bearings should be replaced immediately, a fact that was promptly reported to the customer's engineer responsible for the utilities area. We also requested the customer to plan for the boiler's immediate stoppage to replace the motor bearing.

The boiler stoppage required shutting down all functions at that petrochemical site and the engineer who received the information questioned the accuracy of the diagnosis. He wanted to be absolutely convinced of the need of the required intervention before escalating this message to plant managers and to the site general manager.

We informed that the diagnosis was accurate and explained the possible consequences of the catastrophic electrical motor bearing failure should the electrical motor continue running.

We issued a formal report with our recommendations that the motor bearings should be replaced immediately.

The customer rejected the recommendation and asked that we simply monitor the motor while

operations continued. Some 15 hours later, the bearing failed causing the destruction of the motor and a total plant shut down.

What could have been a planned maintenance repair of some hours, a misinformed decision caused complete chaos for many hours with the additional cost caused by the unplanned all plants shutdown. To avoid this type of situation, research is being developed in order to provide automated assistance in decision-making processes by using data fusion methodology, commonly defined as a combination of multiple sources to obtain improved information; in this context, improved information means less expensive, higher quality, or more relevant information.

The data fusion methodology is used to combine multiple data and other real world information into a consistent and accurate representation of the issue at hand.

A support system for decision making should merge various types of information such as data obtained in the condition monitoring, the monitored variables history, financial data, data from maintenance work reports and expert's recommendation. The combination of these data produces an appropriate support for decision.

Developments in technological tools, even those developed for other purposes, end up benefiting industrial maintenance. In industrial maintenance, it is important to mention the use of wireless sensors, miniaturization, micro-electro-mechanical systems (MEMS), and disruptive technologies such as nanotechnology, algorithms, self-healing components and the Pervasive Sensing concept.

Developments in technological tools, even those developed for other purposes, end up benefiting industrial maintenance.

Wireless sensors are used mainly for monitoring and diagnosis with the advantage of enabling continuous monitoring and at low cost when compared to portable instruments.

Miniaturization also plays a key role among the technological advances, to give just one example, the first large scale digital computer, the ENIAC developed in the mid-1940s, weighed 30 tons and occupied a built area of 270 m². Currently, a tablet, small and light, has infinitely more resources, and not just computational, than its ancestor.

Among the mentioned disruptive technologies, we should highlight the self-healing components; those components “identify” that they are damaged and start the self-healing process. Finally, it is worth mentioning the ubiquitous sensing (pervasive sensing). For example, a vehicle built in 1990 had approximately 10 sensors on board; a similar model produced in 2005 had approximately 50 sensors with built-in diagnostic software. The systems and sensors are already present everywhere, for example, the mobile phones have high quality cameras, GPS, and can record live audio and video as well as music using internet connection.

Putting maintenance into black and white context

In the context future trends in industrial maintenance, how are we preparing to continue providing world-class services in the future? Three major topics could be identified about what the company is doing to continue providing world-class services.

1. Quant has a group of professionals exclusively dedicated to Research and Development activities, continuously developing and improving Quant

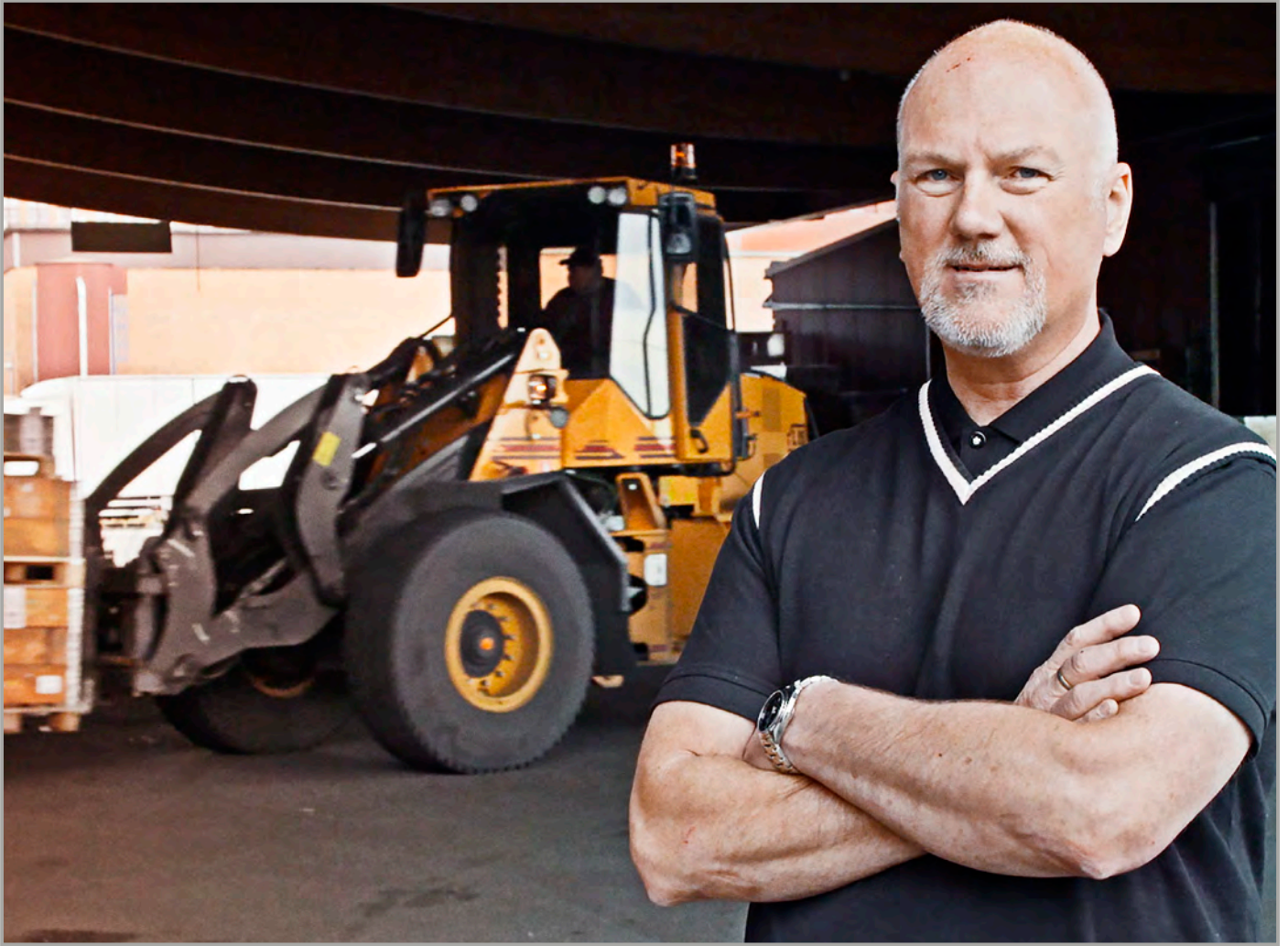
world-class maintenance concept, always aligned with market demands (modularization and flexibility) and technological innovations.

2. Technological advances would not be effective without good management and empowered people. QUANT has a comprehensive Talent and Competence Management Program in order to provide the best maintenance professionals in all regions where it operates.

3. Quant also has R&D initiatives to partner with customers to develop specific solutions according to their needs.

For more information on how Quant can help you, please visit:

www.quantservice.com or email info@quantservice.com



Kurt Nordahl, Transport and Logistics Manager at Quant in Ludvika, Sweden.

Quant does more than just maintenance services

“Quant offers supplementary residual processing to customers who purchase our Total Maintenance Outsourcing (TMO) service. We manage and sort hazardous chemicals and metals such as, steel, iron, copper and brass.” - Kurt Nordahl, Transport and Logistics Manager at Quant in Ludvika, Sweden.

Quant offers supplementary services with a focus on streamlining. Services such as, transport and logistics and residual waste are provided to assist industrial enterprises by streamlining their

processes and minimizing environmental impact. Kurt Nordahl, Transport and Logistics Manager at Quant in Ludvika, Sweden discusses how Quant can address and improve processes within this industry.



1. How can Quant help customers achieve maximum potential when it comes to transport and logistics?

Our objective is to streamline processes, optimize logistics, reduce transport, and improve sorting equipment and cutting costs. At the same time, keeping good relations in focus where the customer's goal is to see solutions take shape is also important.

2. Specifically speaking, how do you help streamline their day-to-day business activities?

We're happy to handle all inbound and outbound goods as well as all internal transport. Alternatively we can look after customer schedules and check that shipments actually arrive according to plan.

3. What processes do you employ to achieve these goals?

Using our track and trace-system and tablet computers, we're able to keep track of all the packages in a warehouse. Our trucks, side-loaders and tippers and services such as, loading, unloading and pick-up, guarantee speedy inbound deliveries from the moment the customer receives the goods.

4. How do you ensure customer's inventory is managed professionally?

We take care of all the goods inside the 250,000 sqm industrial site at Quant in Ludvika, Sweden. In other words, we're used to working with customers who demand high standards of productivity and measurability.

5. What other supplementary services does Quant offer?

Quant also offers supplementary residual processing to customers who purchase our Total Maintenance Outsourcing (TMO) service. We manage and sort hazardous chemicals and metals such as, steel, iron, copper and brass.

6. How does this contribute to lowering environmental impact most industrial companies have issues in achieving?

Every conceivable waste fraction is removed, recycled or re-used. In this way the customer minimizes dumping and environmental impact. Customers make money from what was previously considered waste.

7. How is this achieved?

Combustible materials can be used, for example, in energy recovery in in-house district heating incinerators while money from scrap metal recycling will make a welcome addition to your investments. The better the sorting, the more money our customers make.

8. Are there any recent projects that you are particularly proud of?

The project "Pallpools" is a project which recently took effect and is associated with good cost savings for the customer. Another development is our track and trace system. We use bar codes for tracking the flow of all current incoming and outgoing goods as well as transportation within our customer's area. This project goes smooth forward and is associated with huge cost savings and development in other parts of Sweden.

9. Where does Quant currently supply these services too? Are there plans to expand operations in the near future?

There are plans to expand but at the moment it is in the planning stage.

10. How do you see the transport and logistics and residual recycling processing industry progressing over the next decade and why is it important to outsource these services?

Transportation will not decrease in the future, it will increase. When it comes to recycling, the environment will indeed be specialized as the environmental issue is a global issue.

11. How do you see current and existing customer's benefitting implementing Quant's supplementary services?

Our 40 years of involvement in industrial operations and employees with many years' experience provide an enormous fund of expertise to draw on. In my experience, it's the personal relationships and broad contact network we've built up that allow us to exceed customer expectations. This is also confirmed by our regular customer surveys.

For more information on how Quant can help you, please visit:

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Around the world in events with Quant

Chile, Brazil and Finland – taking Quant to the next level.



Mapla-Mantemin Congress in Santiago, Chile.



Kunnossapito Forum, Tampere, Finland.

EXPOMAN, which occurred during the 30th Brazilian Congress of Maintenance and Asset Management in Campinas, Brazil.

Turning maintenance from a cost into a value creation process



Maintenance is a people business. From embedding superior safety practices and building a true maintenance culture, to optimizing maintenance cost and improving plant performance, our people make the difference.

Maintenance is more than just a cost to production. It provides the foundation for a business's performance and profitability, affecting everything from safety to plant productivity and energy efficiency. From designing a new plant, to getting it running and keeping it running optimally, having the right approach to maintenance makes a real difference in both the short and long-term.

When working with new customers we often find: the total cost of maintenance is not under full control; spare parts and subcontracting costs constantly exceed budgeted levels; the impact of maintenance on the equipment life cycle cannot be quantified; maintenance is conducted in isolation of productivity improvements; and the cost of unplanned shut downs is greater than the total planned maintenance budget.

In a world where increasing regulation, competition and costs put pressure on our customers' businesses, we constantly ask: Where can maintenance have the greatest impact; how can it contribute to a more prosperous future for our customers, in both the short and long-term?

Unlike many other outsourcing companies, we don't focus on shedding jobs to reduce costs. Rather, we implement effective planning and working methods, training our people to use our best practice processes and tools, while empowering them to create value and reduce waste. We ensure they understand how they can contribute to realizing the full potential of maintenance for our customers, linking their performance targets directly to those agreed with the customer.

Scan the QR code below to watch our 3.14 minute video and see how Quant can turn maintenance from a cost into a value creation process.





Maintenance is a **people** business

Quant is a global leader in industrial maintenance. For over 25 years, we have been realizing the full potential of maintenance for our customers.

From embedding superior safety practices and building a true maintenance culture, to optimizing maintenance cost and improving plant performance, our people make the difference.

We are passionate about maintenance and proud of ensuring we achieve our customers' goals in the most professional way.

www.quantservice.com

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