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Processes Management Guaranteeing Life-Cycle Quality of the Maintenance Service Agreement – A Study Regarding Outsourced Maintenance Services

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1. Introduction

1.1 The challenges when ensuring operational excellence in service business

There are many concerns when organizations strive to ensure quality and operational excellence in their operations and the challenge as organizations grow bigger more global is sustainable operations.

When we come to service organizations the challenge will have new dimensions. For a long time researchers have stated that service is intangible by nature and it is difficult to set consistent and accurate measures for quality assurance. External auditors often find difficulties when trying to assess the quality management system: whether the organization audited has a consistent and communicated quality plan; or that there is a traceable system in place to prove that key quality characteristics have been planned and further more they have also been followed and documented; or what the organizations own process is to ensure operational excellence.

The challenge above is due to certain characteristics that separate service from physical products. When new service development is concerned; the literature relates largely to traditional service products such as financial and hospitality services, not to a great extent to industrial services. Five key characteristics that distinguish service products from physical products have generally been identified as intangibility, perishability, non-ownership, inseparability of production and consumption, and variability (Kundu et al., 2007)

1. **Intangibility**: Services are predominantly performances of actions rather than objects that can be perceived using any of the physical senses.
2. **Perishability**: Services must be consumed as they are provided. In general, they cannot be saved, stored, returned or carried forward for later use or sale.
3. **Non-ownership**: Largely as a result of their intangibility and perishability, customers do not obtain ownership of services; rather, they experience the delivery of the service.
4. **Inseparability** of production and consumption: Service products are typically produced and consumed at the same time - consumption cannot be separated from the means of production.

5. **Variability**: Service product quality is subject to variability because services are delivered by people to people.

Two dimensions of variability have been identified (Zeithaml & Britner, 2003)

- the extent to which delivery standards vary from a norm, and
- the extent to which a service can be deliberately varied to meet the specific needs of individual customers.

Productizing (or productification) of services is the key word that has been used in service management. It is a key approach that has given organizations the opportunity to standardize offerings, service delivery and also many related development activities. It has also enabled increased accuracy in service cost determination, as well as enabled improvements in competence management and thus reduced dependency on some key service specialists which is a typical concern especially in the maintenance services field. Well defined and managed service productizing has given international service companies a remarkable differentiator – global, standardized implementation of service management model. One key thing in productizing also is that it has given the marketers the opportunity to create sales collateral to create image and brand for the service organization. We can say that thanks to productizing we can now see well defined and well marketed service products available for both business and consumer customers. And information technology has enabled that even bigger part of the services are delivered by the customers of the organizations themselves. The public sector is following fluently the private one; just think how clarification of the state taxes in some countries has evolved during the last few years, making tax announcement handling easy both for the customer, the tax payer and the supplier, the taxman.

But when we take steps beyond the service products we will face large variance. We find two big challenges concerning the service delivery.

1. How the organizations ensure operational excellence of the whole service set-up over the lifetime of the entire product portfolio they have the obligation to serve?
2. How the organization ensures constant high quality and meeting the customer requirements when its business is about delivering the services at the customers' premises during a long-term e.g. 5 to 10 years agreement?

Both of the research questions above have become vitally more important as the service models have been evolving from transactional contracts to KPI based service level agreements and further to long term performance based agreement where company is e.g. outsourcing its entire maintenance function to an external service provider.

1.2 The aim of the chapter

In this chapter the authors aim to provide an illustrative dialogue of the challenges that ensuring operational excellence includes and how a comprehensive processes management system can tackle the challenge over the life-cycle of the number of the agreements that the service provider has. The methodology is based on case presentation linked to background from literature and on the experience of the authors. The chapter gives input to further research as well as having a solid educational purpose.

1.3 Defining the business environment studied

The Authors have long experience in developing services and improving quality in a global industrial service business environment. Our recent work experience is with ABB, the leading, truly global and multinational power and automation Technology Company. Out of 135.000 people working at ABB more than 20.000 are working directly in service businesses, a fact that is not so well known in the market. Recently ABB has developed the ABB Group Service Strategy, aiming to triple the volume of the service business by the year 2015.

ABB classifies its services into three very different main categories:

1. Life-cycle services for ABB's own installed base
2. Consulting services for reliability, safety, and energy efficiency
3. ABB Full Service® for outsourced, performance-based maintenance of the entire production plant

As the business is a global one, productizing is essential in the ABB approach for standardizing and packaging service offerings. Service products are developed for the different phases of a product life cycle. The target is to offer customers service already before the introduction of the product up to the phase when product itself is obsolete but service is still required to lengthen the life cycle of the product or even to ensure the best result is achieved at the end of life and when a product is replaced/upgraded. The service development phase is very important when securing the successful launch and quality of ongoing activities. Thus the new service development is done in accordance with a specific service development process, the Stage-Gate Model. Service productizing itself does not guarantee the quality, thus the organization has developed a set of design, sell and deliver processes. The challenge is to agree and maintain a consistent approach across more than two dozen globally managed Business Units and in more than one hundred countries where local country service organizations are delivering the service.

ABB's maintenance outsourcing business differs strongly in nature from the product life cycle business. For the maintenance outsourcing business ABB has developed ABB Full Service® with the following definition:

"Globally supported long-term, performance-based agreements in which ABB commits to maintain and improve the production and equipment performance, energy efficiency and reliability for an entire facility with agreed cost base."

The definition above includes the following special characteristics when compared with life cycle service businesses or typical man-power related services:

1. The service is performance based, the performance clause is linked directly to the customers production process outcome and customers financial results than just with the service providers own performance.
2. The service agreement is long-term, typically a greater than five year evergreen agreement. Thus the quality must be defined for a long period into the future, the strategy, requirements and KPIs will probably change in the course of the time.
3. The value proposition includes production performance improvement, energy cost saving and total maintenance cost optimization or saving, thus opening a very interesting but also a complex benefits definition.

4. The provider will have a contractual commitment to some main customer KPIs. That commitment forces the provider to assume total management responsibility of the whole maintenance function, and the scope of the services is thus wide, typically covering maintenance management, development, engineering and execution. The typical pricing model is a fixed price covering labor, materials and sub-contracting.
5. In outsourcing service the customer's related personnel is typically transferred to the provider, who in turn takes the responsibility for the safety, competence development, motivation and supervision of the people to be transferred. The service includes an enormous change management activity and potential as well.
6. Also management of the maintenance materials and subcontracting are typically part of the agreement. The suppliers also need to be empowered, common targets created, and synergies plus economy of scale obtained. Suppliers will be used both for specialist services when suppliers are the technology owners and at the lower end when they are expected to provide competitive man-power.

2. Service models evolving towards performance partnerships

Nearly all industrial companies see production as a core competence, meaning that development of any production and product feature will directly connect the company into a position of competitive advantage. Production strategy is one of the core strategies of the company. To maintain the competitive position companies have started to ensure they are keeping focus in core competence by outsourcing non-core activities. In western countries support functions such as IT, payroll, cleaning, canteen, health care, security and facility management have been outsourced to external companies, rates usually being connected to the volume of labor consumed. These outsourcing projects are usually easy to do and argue – the function is outsourced to a provider who can give the most attractive, often man-hour based offering with low risk. These functions are not life important to the customers which is often demonstrated to the service provider as one inconvenient fact – very seldom does the facility management company get the chance to present and review the business case to a customer's CEO or COO.

In above cases the quality can be defined relatively easily. There exists a requirement for the service quality; service is usually seen in a transactional way where a key feature is to do the required amount of service correctly the first time. The customer controls the key service characteristic, (cost) by controlling the unit price and amount of the work done based on a clear contract and a bill of quantity based service contract. As we are in service, however the most relevant measure in transactional service is customer satisfaction, as the service outputs review will be basing on reporting certain jobs done.

Figure 1 illustrates how the transactional service is evolving to being KPI based and then further to performance based agreements. We can see that as the business model develops also the strategic nature of the agreement increases.

We would want to add a quality angle in the figure as well. In a transactional relationship the service product is a commodity and the quality measurement is tied solely with the supplier's delivery. When we reach the "Performance Partnership" stage the service product is based on strategy and risk sharing and the quality measurement is clearly linked with the customer's outcomes, outcomes that will be obtained together, under a partnership

Characteristic / OPEX topic	Business type		
	Product Supply	**Product Based Services**	**Performance Based Services**
Product Development	At Supplier	Mainly at Supplier	Close to customer Mainly with customer
Production	At Supplier	Visiting customer	Permanently at customer
Follow-up, KPI	On-time delivery	Response time	Customer output KPI
Reporting Analysis	Internal	Mainly internal	Mainly to customer
Review	At Supplier	Mainly at Supplier	Mainly at customer

Table 1. Comparison of different business types regarding quality planning

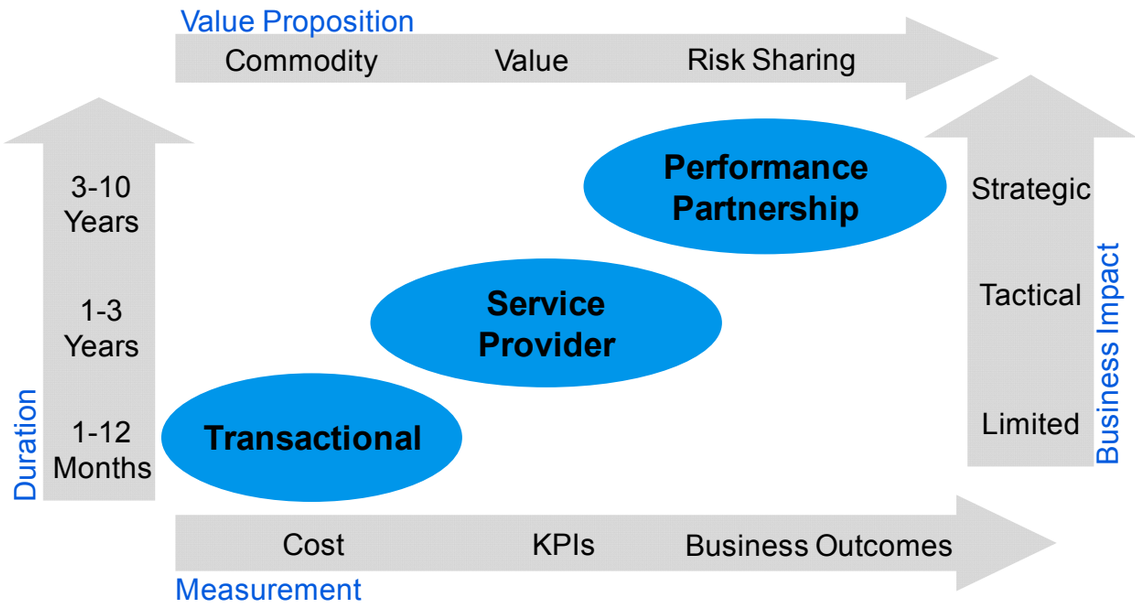

Fig. 1. Evolution of service models (ABB, 2006).

relationship. We have here many angles and very seldom companies have clearly been able to specify the quality responsibility being of either partner's sole responsibility. Quality measurement and operational excellence become both more important and difficult.

When comparing characteristics of product based businesses, transactional based service businesses and performance based service businesses, the following characteristics can be found.

3. Customer's pains regarding maintenance and the strategic outsourcing decision

3.1 Asset performance management constraints

During the downturn many companies have significantly reduced maintenance costs, either by themselves or by reducing external services to a minimum and without proper

management and a systematic approach. This approach has introduced significant risks for the future by generating remarkable levels of maintenance debt. Too often important reliability programs have been stopped and even banned, CMMS usage is often reduced and, too often, there is a clear drop in investments for asset health, maintenance management and competence development. Many maintenance managers are now struggling to convince higher management of the need to increase the maintenance to more sustainable levels.

The key element in industrial maintenance service is still cost. However when industries are expecting the market to recover, the focus on costs becomes focus on the costs of each produced unit and into increased manufacturing flexibility. Certainly, availability and total output (e.g. measured in terms of Overall Equipment Effectiveness, OEE) will be of greater importance as we are beginning to see a new born market for the increased output requirement. The key factor in requirements is the commodity price development. It has been favorable for most raw materials within the last year. But the expectation has been shaken more and more often with every new crisis somewhere in the world. Locally it can be the problems of a single industrial company, and also globally it is affected by, for example, the sudden political unrest in a number of Middle East countries in 2011.

Operations and maintenance are the key contributors to the operational profit of a company. The main pressures are in reducing costs and increasing efficiency. This includes efficiency in the use of raw materials e.g. Energy.

This is of particular relevance since maintenance has at least as high an impact on energy consumption as on plant availability itself. A good maintenance operator does not only contribute strongly in shutdowns, ramp-ups, and ramp-downs but also is key to considering how much energy is wasted during any phase of instability in production. We see a clear trend that a traditional maintenance outsourcing company will soon become a maintenance and energy stability company.

But there are also other challenges. Operational constraints need to be managed while improving sustainability. Asset Management has to be kept in balance over the long term. The main responsibility of operations is the maximum utilization of the assets and the main responsibility of maintenance is asset availability while managing the critical issues and operational constraints of the plant, especially in the areas of EHS. This means excellent co-operation between operations and maintenance while both need to be specialists in their own areas.

Figure 2 illustrates the challenges production and maintenance have. Without a good business plan, clear agreement between the two players and a consistent well defined process organization cannot take the best out of the two contributors. There must be a process management system in place and good comprehensive KPI's, i.e. we need Operational Excellence.

As the challenge is cost and the need for increased technological, automation and software know-how at the same time when the real specialists and performers are ageing, companies use more and more external services to solve bottlenecks and to balance consumption peaks, it is a strong trend and seldom is there a way back. Six clear arguments for maintenance outsourcing are listed below.

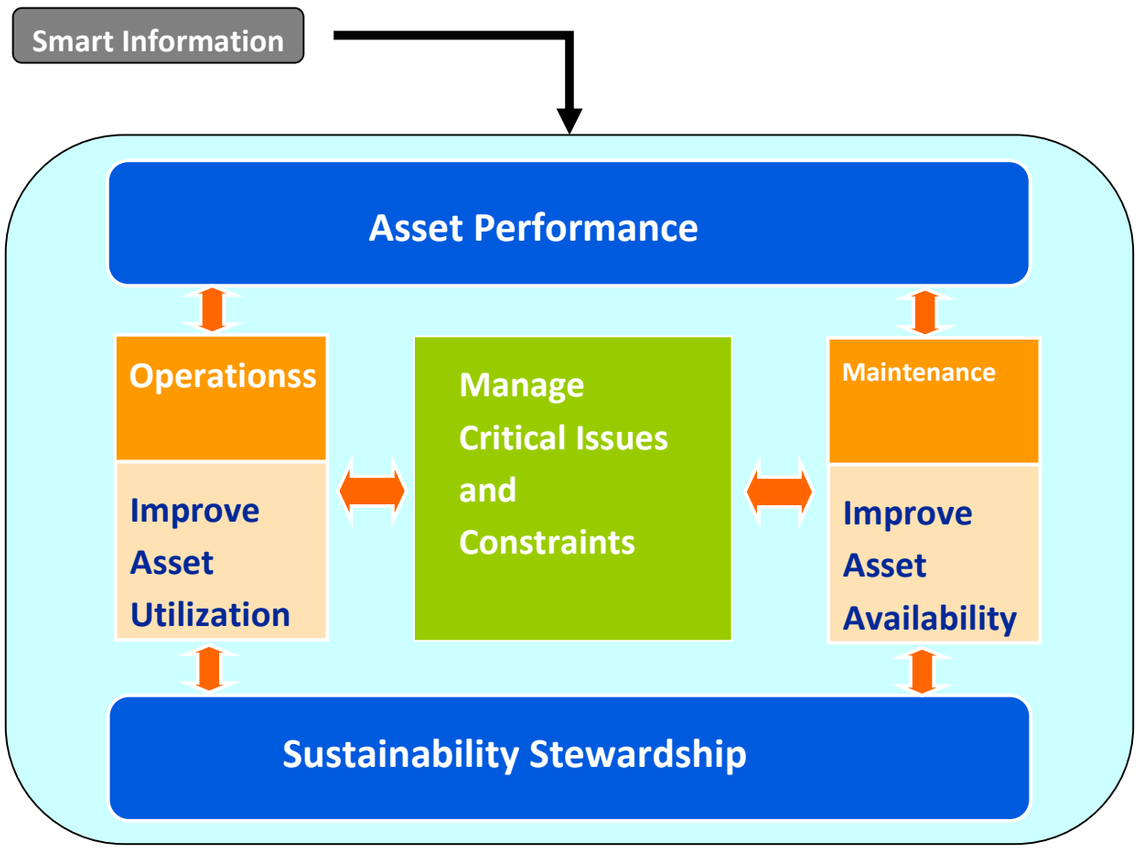

Fig. 2. Asset performance management for process industries (ARC Strategies, 2010)

1. Outsourcing companies are continuously developing their own core business, operational personnel and key management employees
2. Allows company to concentrate its attention, efforts, and investments on core business and reallocate key resources and focus to strategically important issues
3. Makes company lighter, more agile and able to react to the market with increased flexibility
4. Improves access to knowledge not available internally to help address key problems
5. Brings in world class resources, processes & best practices to;
   a. Reduce operating and ownership costs
   b. Make budgeting simpler and obtain predictable cash flow
   c. Speed up changes and improvements
   d. Reduce the dependency on individuals' skills
   e. Improve the utilization of resources
6. Outsourced scope is clearly defined and measured to introduce disciplined execution and better management of risks

However there are also large concerns related with the outsourcing business case, labor issues, confidentiality, high dependency, staff moral, the binding nature of service agreements etc. Loss of control is also a concern, and for some individuals the concern is also around the perceived loss of power. In many instances the solution is to use strong purchasing tactics and to outsource to several service providers. The effect of this tactic is to

keep the power status clear, however in everyday life there will be constraints when trying to enhance seamless co-operation, innovation and responsibility to solving the main production constraints (Figure 2).

Maintenance outsourcing to one single provider is a successful model when searching for better asset performance and short & long term nurture of the equipment. With good agreements the focus can be turned from constant control to collaboratively solving the production challenges and constraints and hence there is a solid opportunity for a win-win-win performance based approach and set of KPIs. But a lot is required when targeting to reach a performance based partnership (Figure 1). There needs to be a clear strategy and decision, the partners' cultures, business ethics and principles need to match at a company and also at a personal level, and a good business case must be on table before the customers' management, usually the board will make the decision.

The challenge for the service provider is to prove that a) total outsourcing is the solution and b) they are the right choice. Thus maintenance outsourcing companies need to show a good business case, solid references and evidence of solid approach, i.e. Operational Excellence in their own operations is a must. Both CAPEX and OPEX expenditure needs to be addressed in the business case, the decision maker must also look at both.

3.2 Service providers' challenge to respond

The adoption of strategic, performance based outsourcing has not been extremely fast. That is primarily due to the fact that at the end of the day proving the benefits of the agreement have not always been easy. In this area the following topics must be addressed:

1. The benefits and targets must be agreed and communicated. Even if there is a study and a business case as a basis of the agreement the parties may not have made the contract review as defined e.g. in ISO 9000. The parties responsible for the delivery of the agreement are not always aware of the targets and KPIs. That can be the case on at the customer's side, on the provider's side or also on both sides.
2. There must be a governance model and sponsors in place. As the key nature of performance based outsourcing is strategic, there needs to be top management support and understanding that the targets will be reached only by working together. That fundamental cannot be maintained in an everyday operational business environment without having champions that can review and solve any issues with objectivity and a view that is from external to the plant.
3. Partners need to understand that moving to performance based partnership is a process of change. The change is deeply touching the existing maintenance team at a personal and identity level but it is also a remarkable opportunity to shake up the customer's organization. Colleagues become business partners and operators become real customers. That change is a remarkable resource which must also be understood. The service provider must have delicacy, experience and skills to run a professional change program and the customer must commit to be part of that program, standing as partner not as a master.
4. The economical changes and multiple financial crises' one after another have changed the business case dramatically, huge flexibility has been required and the fundamentals of the clear, compelling business case have sometimes been crushed permanently. The

performance based business case may have changed purely into a series of cost cutting requirements. Whatever investment that would have needed to guarantee successful and renewing implementation has often been taken away.

5. The service provider must be extremely capable, must manage maintenance as a process and must be able to implement generic, industry and customer specific leading practices. That calls for a strong methodology, implementation skills generally and in the country or business in question, as well as a well prepared, experienced and motivated team. The site team must get coordinated support from service organizations, country organizations but importantly from the international specialists. We see too often cases where the service provider is not mature enough and has failed on the topics above, company has seen this as field service and the site team has been parachuted into the "jungle" without support, tools and processes.

We can conclude from above that successful performance based outsourcing requires a long-term view, a long and dedicated business development as well as execution process; agreement development skills and good sensitivity in identifying the motives of different levels of the organizations. Several workshops are needed to reach a good mental connection. The risks have to be identified and a mitigation plan must be developed. We must stress that to be successful, the mitigation plan is to be common, not just the providers' one.

4. Multiple customers and multiple industries – Why a process is needed

The disciplined approach to respond to challenges that we analyzed in chapter two requires the service provider to have a clear strategy and a strong business model. Those need to be deployed efficiently across customer types and regions. Good way to deploy is to have a process management in place. Customers do want to see that the service provider can implement maintenance solution that supports customer's ever more changing strategy, is transparent and after all turns previous reactive maintenance strategy into more preventive and predictive mode, they key words in modern maintenance. In other words industrial customers want to see a process approach instead of fire fighting.

As most providers offering industrial maintenance are specialized not just one but various industries we have to discuss the nature of process model; is it general, do we need a specific process for each industry or shall the maintenance process model be customer specific? We analyze the topic here starting by understanding first what industrial maintenance is.

4.1 What is an industrial maintenance service?

Industrial maintenance usually refers to the repair and upkeep of the different types of equipment and machines used in an industrial setting. The basics of industrial maintenance know-how can be broken down into the following five categories:

- General knowledge,
- Mechanical knowledge,
- Electrical knowledge,
- Welding knowledge, and
- Preventative maintenance (Sasser).

According to this wide variety of areas of expertise, industrial maintenance technicians are usually multi-skilled individuals who are proficient in many tasks.

Industrial maintenance also involves a great degree of problem-solving skill. Identifying the problem along with the best and safest means of resolving the difficulty are typically integral parts of the industrial maintenance process. The general knowledge usually required in industrial maintenance is an understanding of tools, blueprint reading, and safety. The correct tools and the comprehension of how to use them can be crucial for fixing potential machinery problems. Blueprint reading enables the industrial maintenance technician to understand how a particular machine works. Safety is also a pivotal aspect of maintenance, as most industrial machines can be considered dangerous. Usually it is important for the technician to maintain his or her own safety, as well as that of other workers using the machinery.

The Industrial Services market may be defined by the level of added value provided by the services offering. The outsourcing task can be divided on the basis of value or coverage of the service into following four categories (AlixPartners):

1. Outsourcing with low added value (Cleaning / Catering / Trade Fair Service / Security Service)
2. Outsourcing with medium added value (Facility Management / Maintenance / Scaffolding / Installation)
3. Outsourcing with high added value and/or project business (Planning of Facilities / High Value Services (IT, …) / Maintenance of complex facilities)
4. Industrial / Chemical park service (Utilities / Technical Service / Waste Management / Safety & Administration / Security)

4.2 Business models for industrial service

The maintenance provider's most critical task is to select the business model that enables sustainable business and satisfies the industry customer's present and anticipated needs. The strategy of an industrial maintenance provider needs to balance two main aspects:

1. **Customers' maintenance strategy**. What will be customers' present and future decisions towards the needs of the external services; what do customers see as core competence; will the solutions be centralized/decentralized; which part of the maintenance management value chain will customers manage and provide themselves and which will they outsource; which kind of agreement models are preferable; what are customers' attitudes towards networking and partnership models; where will the pain points be; where are the competence and technology requirements; which are the internal factors that affect decision making; and, interestingly, how does time and new generations affect choices.
2. **Maintenance provider's own strategy**. Where in the customers' value chain do we want to operate; where is the basis of our own competence and competitiveness; how do we differentiate; are we operating centralized/decentralized, locally/globally; what are our resources to develop competencies, maintenance solutions and technologies; how much can we add value; what is our readiness and capability to take risks and go for benefit sharing models; do we offer performance based models, know-how,

resources; are we working in networks and for partnership; and do we see how time and selected industries to be served will affect our strategy.

As a result, the selected business model affects the market the industrial service provider is operating in. It is not just in which category but it is also which kind of service the provider offers. A maintenance provider with lower technology and industrial know-how usually focuses on offering workforce, managing capacity peaks, shorter term service or service level agreements, short response time, limited responsibility and risk taking. The maintenance provider that has industrial background and is a provider of some key equipment usually provides more technological services, spare parts, upgrades, training, etc. The maintenance provider who has experience in both maintenance management and has an industrial/equipment background can split the offering according to which customer strategy and needs as well as according to which markets are selected. For example, our company, ABB, has several categories in the service tree which can all be developed and differentiated in the industrial maintenance marketplace, see section 1.3.

Each business model has its own value proposition, commitment level, and agreement structure. Each business model's characteristics differ from the other models so that the business management structure and core processes to provide value to customers are also different to a certain extent.

4.3 What is general and what is industry specific?

However, 70–80% of maintenance can be claimed to be general, and the rest is industry- and customer-specific. We do not consider fire fighting and issue solving heroes as general maintenance but systematic maintenance core processes, including the management of partnership, designing for reliability and life-cycle, planning and scheduling, the management of the supplier network, re-engineering maintenance work-flows and integrating safety practices with work instructions and work orders, systematic root cause analysis, etc.

What can be seen as industry-specific are the specific safety procedures, equipment condition upgrades, process specific know-how, automation solutions, OEE measurement definitions, process optimization activities, and, naturally, industry-specific technologies.

Taking the Pulp and Paper Industry as an example, the following are considered as industry-specific issues within maintenance (Weissenfelt, 2011):

- Pulp and paper producing equipment knowledge. Knowledge of all the equipment needed from the wood yard to the end of the last conveyor before the forklift takes the paper roll or the pulp bale to the ship.
- Safety at work
- Troubleshooting
- Knowledge about chemicals used in the process and proper equipment materials to be used with special conditions
- Roll Service
- Quality Control System Service
- Drives Service and Optimization
- Profiling management
- Web Inspection System Service

- Quality requirements for the final product for customers
- Hydraulics
- Condition monitoring
- Lubrication

As the professional maintenance provider must focus on industry and understand industry requirements, a very specific advantage is the ability to learn from others. Maintenance related methodologies have been developing in different ways and been implemented at different levels in industries. As maintenance specialists we know a variety of good approaches but struggle with implementation. That is often because each industry has its own tradition and there are walls between the outside world and the plant; the "outside world" here means other industries. Learning from another industry is an extremely valuable source of continuous improvement when it comes to performance-based maintenance practices.

From the discussion above we can conclude the rationale that in an industrial maintenance outsourcing business environment the following process management characteristics are a good basis for a successful process management model:

1. The maintenance management processes, core functional processes to deliver the maintenance and the required support processes are generic by nature. Greater value is created if the service provider has a learning environment where the leading practices as well as past mistakes are identified, reviewed and utilized in continuous improvement of the process than tailoring this level processes to specific industry or customer.
2. The industry specific processes will become very valid when we are looking at maintenance at a task level. Job instructions, preventative maintenance plans, special tools and skills must be looked at with regard to industry competence level – as defined e.g. for the Pulp and Paper industry as addressed above. For example the root cause analysis methodology is standardized but the cause and solution is often industry specific.
3. Customer customization will be seen in a very specific, exceptional equipment level where the technical solution is really tailored for that customer only. Key customer specific nominator is the customer's production and maintenance strategy. That does not specify the maintenance process itself but feeds the essential criticality and focus into the process. Well understood strategy will lead to update of plant, line or equipment level (technical) maintenance strategy, criticality classification, scheduling of maintenance tasks and to addressing relevant KPI's and reporting guidelines. As such it does not change the process.

5. The service delivery process – From single activity to delivering multi-year agreements

Here we present ABB Full Service® approach to develop a processes management system. We will introduce the ABB model; determine the specific elements and the link between the approach and the results. We also give a general process description and a more detailed definition of each process.

After analysis conducted in ABB we have decided that the process management model is a good approach for managing operational excellence in a long-term outsourced maintenance

business. The model needs to cover the whole business to ensure consistency, discipline and learning. Thus a good process management model needs to cover:

1. **The whole life-cycle of the maintenance outsourcing agreement**. There shall be a process for service design and development, sales and business development, delivery of the multidimensional service tasks and finally the review and assessment cycle.
2. **The different types of processes.** We can use general definitions of different process types, e.g. EFQM (European Foundation for Quality Management) categorizes processes into management processes, support processes and core processes.
3. **Processes for the life-cycle of a customers' plant.** There is a slightly different need for existing plant (Brownfield), newly built pant (Green field) and also for demobilizing of the plant.
4. **The industry applications.** As mentioned above each industry needs adaptation of the process to cover specific technically detailed areas.

5.1 Tools to define a process

To define a good process is a piece of art itself. Key attributes of a process are that the process is crossing several organizational boundaries, it is directed to meet the external or internal customer requirement, it can and will be repeated again and again and it needs to be measured and monitored. A good process is robust; it is designed to be in use for long periods, even if continuously reviewed for improvements. We say that organizational structures come and go, processes will remain.

A very important feature of the process is that it needs to be understandable and logical. People should understand why we do this, what is the purpose of the process and what is going on in the chain of activities, how information is shared. Processes cannot just be huge, room-size flow-charts or to be hidden into fancy process management IT system. Process must be **visual**.

The cross-boundary nature of the process gives a challenge for leadership and management. Executives need to show the commitment to the process, participate in process definition and meaningful process KPI set-up, they need to empower teams to work across the process, define clear ownership with mandate, and they need to demonstrate the process and results- finally presenting the process rather than the organizational chart. Process KPIs should be the key KPIs and process champions making the process successful shall be recognized. Companies should also be proud of their processes, present to customers and make sure that customers and suppliers are part of the process also giving valuable input for the improvement.

There are plenty of excellent tools to define and manage a process, as process management is definitely one of the key approaches in any Quality Management program or Six Sigma approach. We address here some central approaches ABB has used in maintenance outsourcing services.

5.1.1 SIPOC

As learned from above, good process definition is the key. There is not such a thing as "the right process", we can only talk about process in terms of excellence – more or less excellent.

That is why there must be a cross-function and or cross-border team to define the process together, involvement means commitment. The purpose of the process is necessarily not at all clear when the definition works starts, each participant views the purpose, inputs and out puts from his/her own point of view. The SIPOC tool is particularly useful when it is not clear (Simon, 2011):

- Who supplies Inputs to the process?
- What specifications are placed on the Inputs?
- Who are the true Customers of the process?
- What are the Requirements of the customers?

The SIPOC comes from the key words of process principle definition: **S**uppliers, **I**nput, **P**urpose, **O**utcomes, and **C**ustomers. We have learned that any process has more than one customers, or stakeholders. So there will b a variety of other factors as well. SIPOC can be used for defining the purpose of one single process as well ad the whole business system. Figure 3 gives a visual template used in process definition.

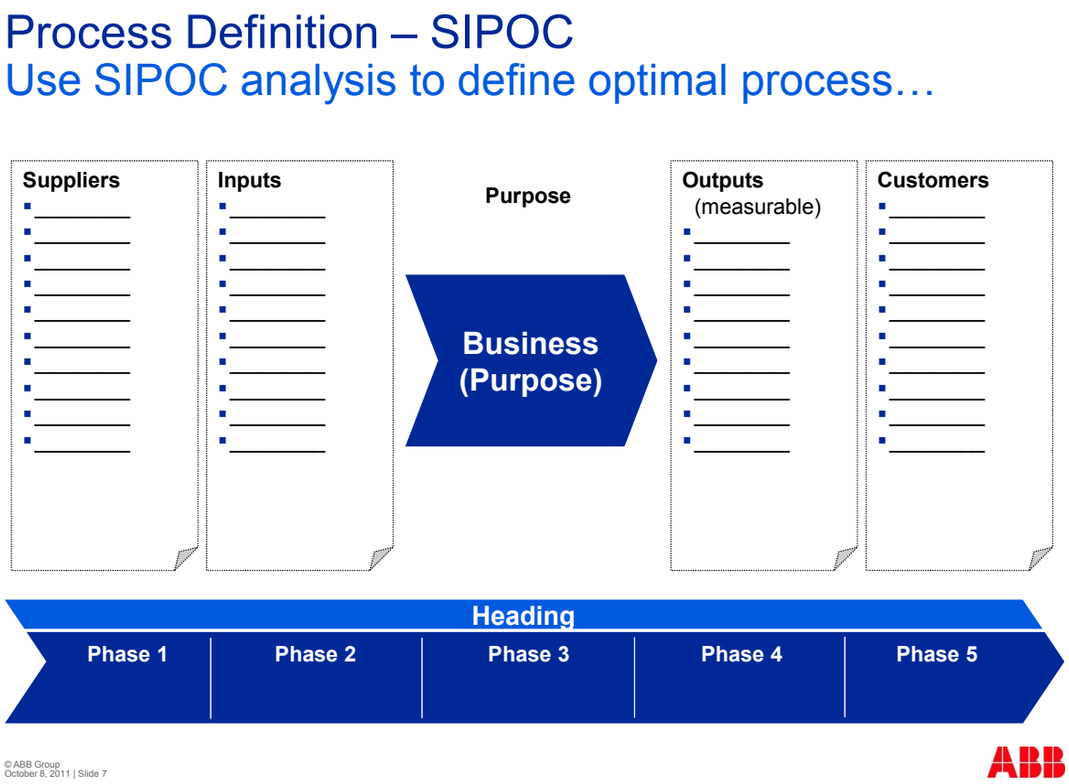

Fig. 3. SIPOC template used as business and process purpose definition

5.1.2 RACI

Another key issue on top of purpose is the ownership of the process. As process nature is most often cross organizational clear roles and information principles are needed. If these are not in place the process gets stuck, becomes meaningless or causes more problems than brings benefits. When talking about responsibility we find that that different kind of

roles are needed to make a process successful. The approach widely adapted is RACI-matrix.

The RACI model is a straightforward tool used for identifying roles and responsibilities and avoiding confusion over those roles and responsibilities during a project. The acronym RACI stands for (Haughey, 2011):

- **Responsible:** The person who does the work to achieve the task. They have responsibility for getting the work done or decision made. As a rule this is one person; examples might be a business analyst, application developer or technical architect.
- **Accountable:** The person who is accountable for the correct and thorough completion of the task. This must be one person and is often the project executive or project sponsor. This is the role that responsible is accountable to and approves their work.
- **Consulted:** The people who provide information for the project and with whom there is two-way communication. This is usually several people, often subject matter experts.
- **Informed:** The people who are kept informed about progress and with whom there is one-way communication. These are people that are affected by the outcome of the tasks so need to be kept up-to-date.

Without clearly defined roles and responsibilities it is easy for projects to run into trouble. When people know exactly what is expected of them, it is easier for them to complete their work on time, within budget and to the right level of quality.

A RACI matrix supports the model and is used to discuss, agree and communicate roles and responsibilities.

5.1.3 Process visualization

There are several ways to visualize how the process flows on. Selection of the visualization depends on the purpose and on the amount of information that is intended to show. Typically organizations want to show task, responsibilities and time in the process description. Then the model is **flow-chart**. Flow-chart is the most popular process definition format as it brings in time well. Strength is that each unit or department can easily see and understand in which tasks own and other's responsibilities are. There are also many IS solutions for process mapping that support flow-chart appearance, so the visualization can be linked with some real data.

A flowchart is a diagrammatic representation that illustrates the sequence of operations to be performed to get the solution of a problem. Flowcharts are generally drawn in the early stages of formulating computer solutions. Flowcharts facilitate communication between programmers and business people. These flowcharts play a vital role in the programming of a problem and are quite helpful in understanding the logic of complicated and lengthy problems. Once the flowchart is drawn, it becomes easy to write the program in any high level language. Often we see how flowcharts are helpful in explaining the program to others. Hence, it is correct to say that a flowchart is a must for the better documentation of a complex program (WebZip News, 2011).

The negative side of flow-chart is that it easily gets very extensive and complicated, and the purpose may remain unclear. The font in the print is either too small to see or the print

becomes so big that printing is troublesome and expensive. On computer screen flow-chart is seldom visible at one glance.

Process arrow is very practical when organization wants to address the purpose and overall understanding. The important phases and activities can easily be listed and agreed, and the print and screenshot can be visual and even attractive. Process arrow can be broken down into sub-arrows when a good structure from high level to detail can be built, organization is forced to build structured model which e.g. is typical way of thinking in maintenance people who are used to build equipment hierarchies and criticality and root cause analysis.

Downside in process arrow is that phases and tasks are by assumption sequential by time and that is not the case in all cases. Also detailed responsibilities cannot be shown easily in the arrows. Well managed process arrow needs either flow-chart or instruction to be more specific.

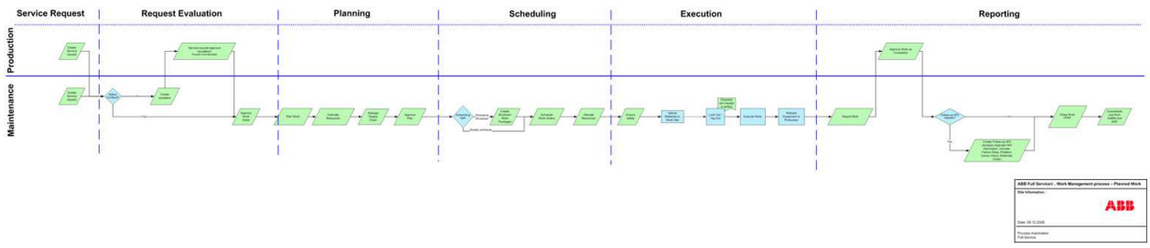

Fig. 4. Example of a simplified flow-chart, Maintenance work-order flow

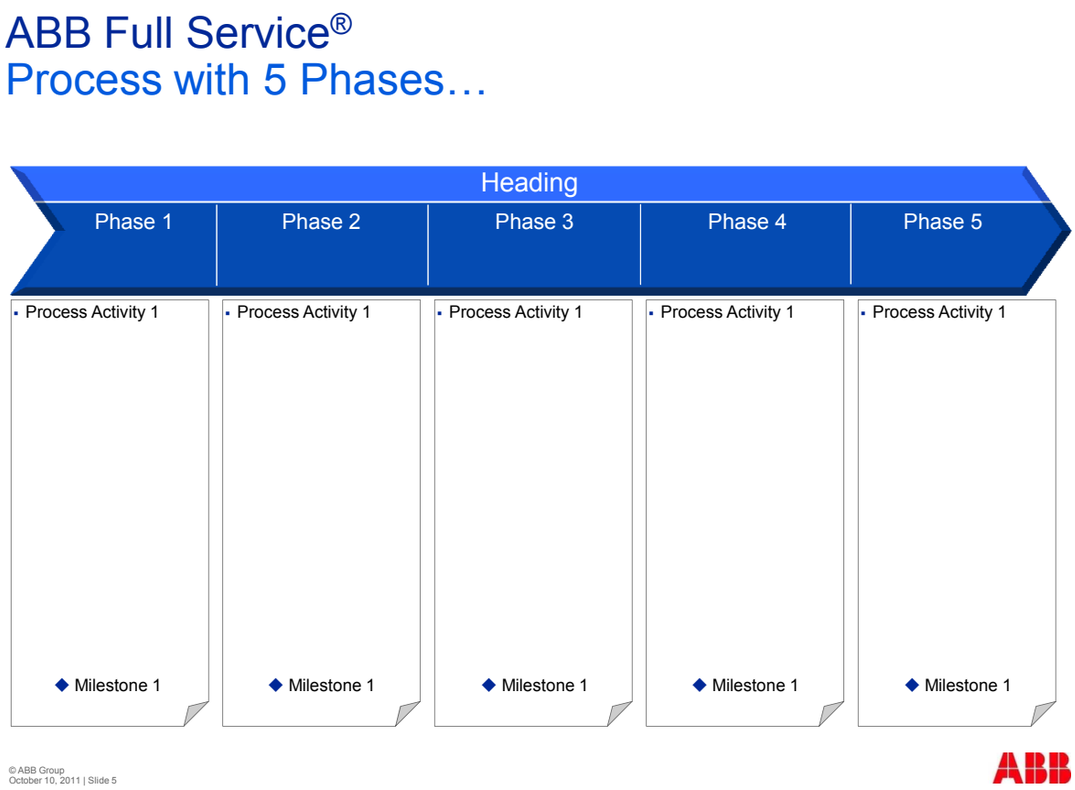

Fig. 5. Process arrow, ABB process arrow template, 5 phases

Closed loop is typical way of process visualization when there is the need to show loops. Annual planning and reporting cycles are typical closed circle visualizations, in these is easy to show moving to next quarter or next phase. However circle can include limited amount of information and making good visualization is bigger job and needs specialist support for tools to be used.

In ABB Full Service® Concept they key process definition approaches are to create first an overall process model, the big picture where all the management, support and core processes needed to bring the results are visualized, including the results area. Then the main process description level is process arrow, as it is highly visual, all the different processes can be shown with standardized format, and needed tools can be "hung" on the process. For many design and sales related processes the arrow model is sufficient and much more detail is not needed. When we speak about very operational processes like doing preventative maintenance task or managing a shutdown the applied model is flow-chart. In many instances the flow-chart supports the process arrow, and is also furnished with IT solution such as CMMS system work flow.

5.2 Case: The ABB Full Service® process model

The ABB Full Service® business excellence model is the comprehensive management model of the outsourced maintenance business, presented in figure 6. The model is designed to cover the overall life cycle of the maintenance outsourcing business.

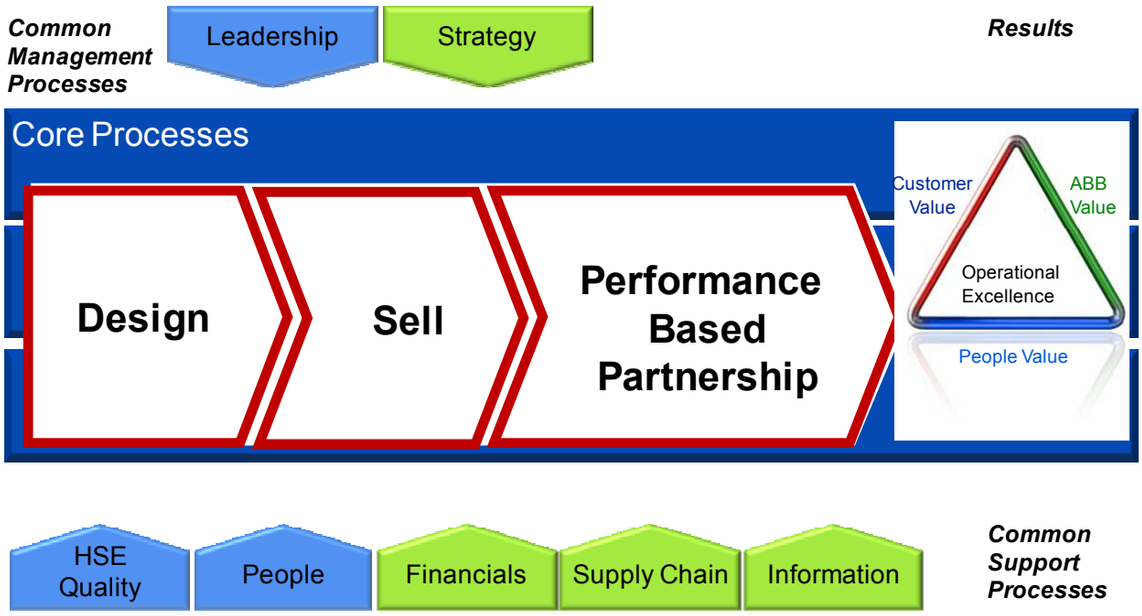

Fig. 6. ABB Full Service® Business Excellence model

The main process types are common management processes, core processes and common support processes. The core processes main focus is to deliver the results for the maintenance outsourcing agreement. Common management processes give the framework for the important management processes Leadership and Strategy. The common support processes are vital to support core processes in the creation of value. This model is based on

the experience of managing a 1 BUSD global maintenance outsourcing business and in the structure we have adapted the global business excellence models, i.e. EFQM Excellence Model (EFQM, 2011).

When considering the definition of the processes the level and phase of the operation must be considered. In the business management model we need to identify how the service product and business model is designed, how the business development or sales is conducted and how the service itself is delivered. In the chain of core processes we have identified processes designing and delivering client value as core processes. Others then are considered as management or support processes. We have to remember also that these definitions can be considered as an agreement within the organization. The definition of what is core is dependent on the strategy and interpretation of customer needs, and the result is an agreement and most often a consensus.

In the ABB Full Service® model the first core process is "Design". That process covers the sub processes that help to identify the market evolution, select the service product strategy with related business models, the development process of those models and finally the exposure, all related marketing activities. That process is globally led and coordinated, to ensure that we have a unified service product and offering in each target market. The Design process can be seen as global process even if the delicacy or specialization comes from the regional and local distribution of the responsibilities.

The second core process is "Sell". In the performance partner model maintenance outsourcing business a more descriptive name could be "Business Development". Each pursuit goes through a long sequence before the business case and value proposition is possible to be developed, identified and presented to the customer. The Sell process can be globally or locally executed but we see that the sales management is best to be global to ensure correct customer selection and focus, professionalism in pursuit development, value proposition creation and agreement development. Most often the maintenance outsourcing pursuits are also big and developing the value proposition requires special skills and know-how, i.e. teaming cross borders and industries. The sales is performed by a capture team and the phases from "Screening" all the way to executing the "Performance Based Partnership" is visualized in Figure 7.

The third core processes model is "Performance based Partnership". Here the globally developed maintenance alliance agreement will be executed under a long term agreement. Differently from the former processes which have been clearly globally managed this set of processes needs to be managed at site level. Site level capability to manage the core processes in value adding way always requires utilization of external support and tools. A consistent process model is necessary to enable efficient external support for site operations; it is also the key to operational excellence as the performance partnership model calls for implementing world-class approaches.

The core execution processes in ABB Full Service® concept are based on the strategic targets of the value proposition.

Partnership Fulfillment is the customer relationship focused process that is vital to ensure that the agreement targets will be turned into strategy based operational targets, customers are listened too at any moment as well as value is created and benefits validated.

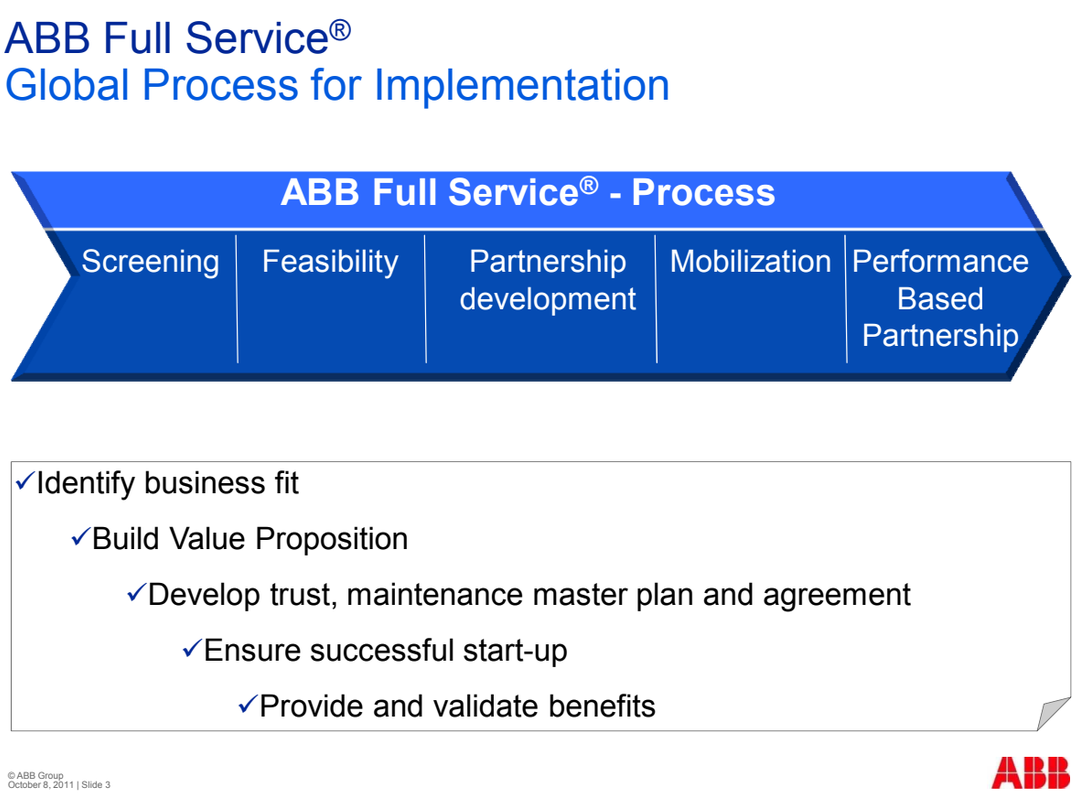

Fig. 7. ABB Full Service® business development process from screening to execution

Reliability Maintenance is the backbone process of the model, ensuring that customer's asset value is maintained properly, reliability is improved based on critical issues from the customer's production strategy, and the life-cycle of assets is managed with systematic approach.

Maintenance Operations is a process to ensure that the work-flow for different maintenance technical strategies is optimized, the customer's short and long term requirements are fulfilled at shop floor level; and that systematic planning leads to reducing total maintenance hours used at the same time than reliability is improved. A very essential component is the smart and disciplined utilization of the CMMS.

Energy Efficiency Improvement is the process where professional maintenance can deliver a large amount of value. It is about everyday awareness and focus to manage maintenance, shut-downs, ramp-ups and ramp-downs in a smart, energy efficient way. It is also monitoring energy waste, planning, implementing and financing investments that are proposed based on monitoring and identifying waste.

Plant Performance Improvement is the process that has the most impact on the performance based maintenance agreement. Here the service provider has the strong motive to capture plant performance and other relevant KPI's, drive with passion the root cause analysis and continuous improvement activities, provide technological and soft solutions to improve the production and maintenance processes and to bring in global resources to support the customer to gain a competitive edge in terms of plant performance and operations.

As the site can and must focus on agreement fulfillment it needs a guideline and support from a combination of management and support processes. **Leadership** is to be seen mostly at a site level process where the leader demonstrates target orientation, partnership. **Strategy** sets up the strategy process, ensures that maintenance outsourcing agreement brings benefits to all stakeholders, customer, ABB and employees. **The support processes** take care of the essential support activities around HSE, people management, financial management, supply chain and welding business supporting IS systems of the partners together.

Results is the area that proves that the outsourcing agreement has been the right choice. In ABB Full Service® this essential part of the business model is visualized by a balanced score card model. The model is visually stronger and more attractive by using a triangle to addresses the key essential values, client, ABB and people.

The process models described above are the standard "Boilerplate" model, however variations need to be considered depending on the scope of the agreement, whether the customer's business type is an existing plant (Brownfield) or where we would work with a cradle to grave approach (Greenfield) Also considered but of less importance is the variations between customer industries where a more specific or detailed process is required.

6. Example of a specific process – Reliability maintenance

In this chapter we dive deeper into the detail of the most essential service process in maintenance; Reliability Maintenance, which is ABB's approach for implementing world-class reliability engineering. Introduced in this section will be how ABB's reliability maintenance process contributes to operational excellence.

What then is reliability? The US military standard defines it as follows: "Reliability is the probability that an item will perform its intended function for a specific interval under stated conditions"(DOD, 1981). Reliability is a broad term that focuses on the ability of a product to perform its intended function. Mathematically speaking, assuming that an item is performing its intended function at time equals zero, reliability can be defined as the probability that an item will continue to perform its intended function without failure for a specified period of time under stated conditions. Please note that the product defined here could be an electric, electronic, mechanical hardware product, a software product, a manufacturing process or even a service.

When looking back to not so long ago, we find that the designers of new production equipment were also the builders, operators and maintainers of their equipment. They had a close relationship in all aspects with their hardware and they, for a fact did "know" their equipment; what worked, how well, and for how long, what broke, how to fix it, and how to take reasonable (but not too expensive) preventive actions to avoid future failures (Smith 2003). In this environment there also developed exceptionally good senses based condition monitoring routines and experience was the major source to define preventive maintenance programs.

As later there emerged a requirement for higher production capacity and increased efficiency, technology developed to be more and more sophisticated and more complicated,

leading companies to specialize solely in manufacturing production equipment or operating those equipment to manufacture end products for their clients. This was a necessary development to enable economical growth throughout the world, but it came also with down sides, one was the increasing challenge to design effective preventive maintenance plans since experience over total life cycle of equipment was scattered between several companies making feedback from operators and maintainers to the designers difficult.

Presently when end users take over their operations they have limited knowledge about the reliability of the equipment, in parallel, the manufacturers try to design the most reliable products and systems but have limited information about the actual operating conditions. It is clear that the combined experience of both these parties will lead to the improvement in overall availability and reliability of the production equipment. Another factor greatly affecting equipment reliability is how limited resources, both financial and physical are utilized to maintain or improve reliability. Today too often we can see that preventive and predictive maintenance plans are inadequately designed or if those are well designed the execution of tasks are neglected. On the other hand there is constantly increasing demand for improved equipment reliability, demand coming from our society to conserve natural recourses and energy, protect our environment and to improve safety.

One of the ABB Full Service® core processes is Reliability Maintenance, which is presented in figure 8 under. In that picture it is also shown how the reliability maintenance process is embedded into the whole operational excellence model. In the next section ABB's reliability process will be discussed in more detail.

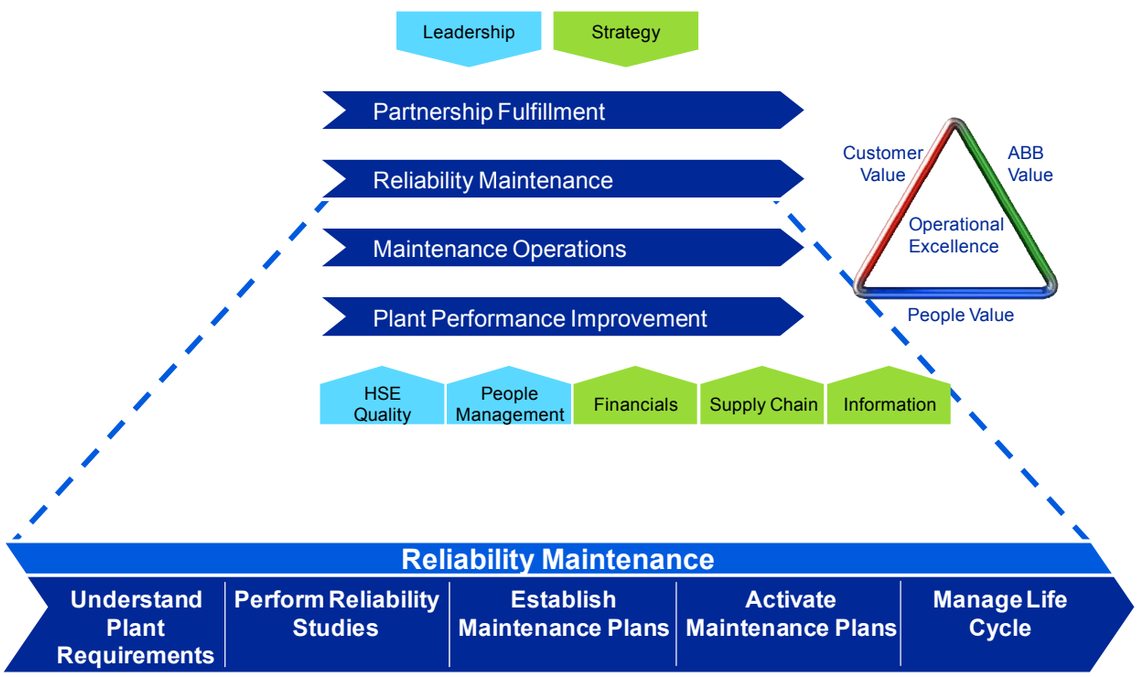

Fig. 8. ABB Full Service® Reliability Maintenance process

The Reliability Maintenance process aims to maximize the life of equipment and minimize consequence of failures. It sets a consistent standard for processes and tools for all activities

across the plant to assist the organization with the maintenance plan reviews and the asset life cycle management. In the next sections each phase of the process is discussed in more detail.

6.1 Understanding plant requirements

In this first phase of the Reliability Maintenance Process implementation, the main idea is to obtain a snap shot of the production facility and equipment with respect to reliability issues. There are several methods to assess the current state of reliability at the production plant. ABB has developed its own tool for this assessment, the Reliability Audit. Engineers at site assess four important aspects within reliability engineering, those are:

- Reliability Planning
- Maintenance plans
- Root Cause Analysis (RCA)
- Precision Maintenance

In each area there are predefined multiple choice questions. This enables ABB to compare, notify gaps and set targets for the reliability implementation (Vicente, 2011). Figure 9 displays an example of the reliability audit tool.

Reliability Audit

Customer: Oil&Gas site
Respondent: Fernando Vicente
Date:

Results - BMDB | Reli
Asked examples list

	Language: ENG	0 Not Done	1 Good Practice partially implemented	2 Good practice across site, or best practice partially implemented	3 Best practice across Site
1	**Reliability Planning (1)**				
1	Is a Reliability Champion identified?	○ No-one identified	◉ Position identified as default	○ Single person identified but not advertised well	○ Single person identified, everyone aware
2	Is there a documented Reliability Management plan, describing what needs to be done to implement or improve reliability on site? **Including: Maintenance plans, Preservation plans, lubrication, precision maintenance, increase of MTBF, decrease in MTTR etc**	○ No plan	○ Some tasks identified, not detailed	◉ Brief detailed plan, including most listed items	○ Detailed project plan including all listed items
3	Does the plan have dates and responsibilities?	○ No	◉ Only some, or vague	○ only on high level	○ Dates and responsibilities for all actions
4	Do the planned tasks have implementation plans? *A plan detailing how that task is going to be executed* **Including: Who, when, how, all people involved, equipment needed, priorities clarified, meeting plan, reporting plan etc**	○ No	◉ Only the major ones	○ Most have plans	○ All have plans

Fig. 9. Example of Reliability Audit tool

6.2 Perform reliability studies

Once key reliability challenges have been identified, a complete equipment classification analysis will be completed to give an equipment maintenance prioritization. The purpose of

equipment classification is to give each piece of equipment or in some cases subcomponent a single classification, A, B or C, considering all factors related to the impact of failure to the manufacturing process. The classification project highlights which equipment needs to be addressed first to ensure reliability; this type of analysis is performed together by engineering, maintenance and operational (production) personnel. An example of classification factors and equipment criticality are described in Figure 10 below. Before starting a new equipment classification project the description of classification levels will be thoroughly checked and agreed in advance between maintenance and production personnel. For example a paper mill will defined Frequency Factor totally differently to the electronics manufacturing plant. in

EVALUATION FACTOR	LEVEL 1	LEVEL 2	LEVEL 3
Safety Risks for people	Equipment failure affects seriously people	Equipment failure causes risks to people	No consequence
Environment Risks for the environmen	Equipment failure affects seriously environment	Equipment failure causes risks to the environment	No consequence
Quality Effect of failure on product quality	Failure affects quality, generating out-of-specification products or affecting seriously the revenue	Equipment failure makes product quality variable and affects revenue	No effect on the product or revenue
Working Shift Working shift of the equipment	Equipment is required 24 hours per day	Equipment is used more than half of a day	Occasional use
Production Effect of equipment failure on production	Equipment failure causes total interruption of production	Failure causes interruption of an important system or unit, or reduces production	There is spare equipment or it is cheaper to repair the equipment after failure
Frequency Number of failures in determined period	Many shutdowns due to failures (more than once per 6 months)	Occasional shutdowns (once per 6 months)	Not frequent (less than once a year)
Cost Amount of money involved in the failure	Repairing time and costs are very high	Repairing time and costs are high	Repairing time and costs are not significant

Fig. 10. Criticality classification table

A logical selection tree is prepared to assist personnel in coming to a conclusion of the classification of each equipment; an example of the logic selection tree is presented in Figure 11. All details of how class (A, B, C) has been assigned to equipment are documented. If modifications or investments are subsequently made to these equipment, it is easy to check from a well documented criticality analysis if the classification needs to be changed. The ABB logic tree is also translated into algorithms so that when equipment data is downloaded from the Computerized Maintenance Management System (CMMS) there are ready made dropdown lists and formulas creating ease of use, documented traceability and efficient time utilization in the criticality analysis meetings.

Another important task inside this phase is to understand the operational context and failure behaviour based on equipment history and experience that can sometimes be very different to those failure modes considered by the OEM during the design phase.

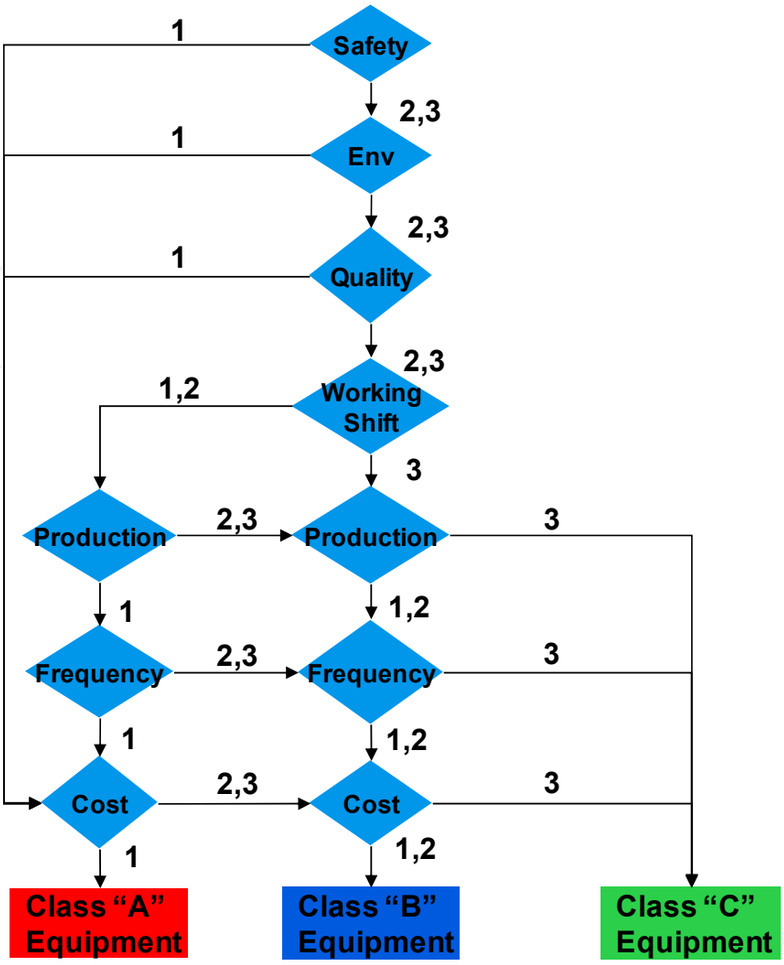

Fig. 11. Decision logic diagram

As an end result of this phase there will be a criticality analysis completed and a classification assigned to each piece of equipment.

6.3 Establish maintenance plans

After equipment classification, failure and operational context are studied, reliability analysis developed and then preventative maintenance plans (PM's) will be uploaded or updated in the CMMS. For A-class (the most critical) equipment, common RCM principles like FMEA can be used to identify functional failures and then logical thinking used to define how each functional failure can be avoided. There is often temptation to utilize only existing experience to define preventive maintenance plans in this phase, without any documentation as to why those PM's were chosen. Again thorough documentation would support more effective future development.

There are numerous pieces of commercial software available for reliability analysis. It has to be noted that software itself does not create preventive maintenance plans, although in skilled hands they are powerful tools to assist in analysis, decision support and documenting arguments for preventive maintenance plans. Not having dedicated software

is no reason to avoid running the reliability maintenance process; all phases of the process can be completed successfully without reliability software.

In figure XX there is one simple template presented to support documented failure prevention planning. This template is utilizing commonly available RCM methodology. After identifying functional failures the significance of each functional failure will be defined in the upper left part, questions 1 to 4 in Figure 12 under. For each question a yes or no answer is given and some documentation as to why each answer was given. When the significance of the failure is defined there will be questions (from A to F) to assist on formulating the functional failure preventive actions. The principle should be that actions to define equipment condition while it is left running are preferred to obtain an early indication of possible maintenance needs without disrupting the manufacturing process.

As a result of this phase there will be actions to prevent functional failures defined for the most critical equipment.

6.4 Activate maintenance plans

When the required preventive actions are defined, those actions must be planned and scheduled which means that each task will have resources assigned, possible materials to be identified and then the execution interval is to be defined.

In operational excellence it is important to recognize that it is not enough to define correct failure prevention actions, but those actions must be uploaded into the CMMS and most importantly for the execution of those important actions is the proper training and instruction for technicians. Getting feedback from the technicians to improve the preventive maintenance plans further is closing the loop of continuous reliability improvement on site.

Results of this phase of the process are detailed maintenance plans which are executed on time by trained and well instructed personnel.

6.5 Manage life cycle

After preventive maintenance routines have shown their value by reducing failure rates, there is then organisational capacity freed up for longer term planning of equipment strategies. Long term life cycle plans will be prepared for the critical or expensive equipment to determine when major repairs or replacement investments are most favourable to be undertaken. For this phase ABB reliability engineers also selectively connect equipment OEM's. From the OEM's there is often information of their equipment life cycle available, under (figure 13) is example from ABB's drives life cycle classification, which supports decision making on modernization of equipment if equipment are in obsolete or limited phase.

When considering capital investments life cycle costing (LCC) is one way of analysing equipment purchase choices. If the analysis is completed correctly, all factors are addressed, and the quality of information is good, the item that costs the least amount to own (buy and use) over its working life would be selected. When compared to other suitable items this piece of equipment would perform its lifetime service with the least total cost to the organization.

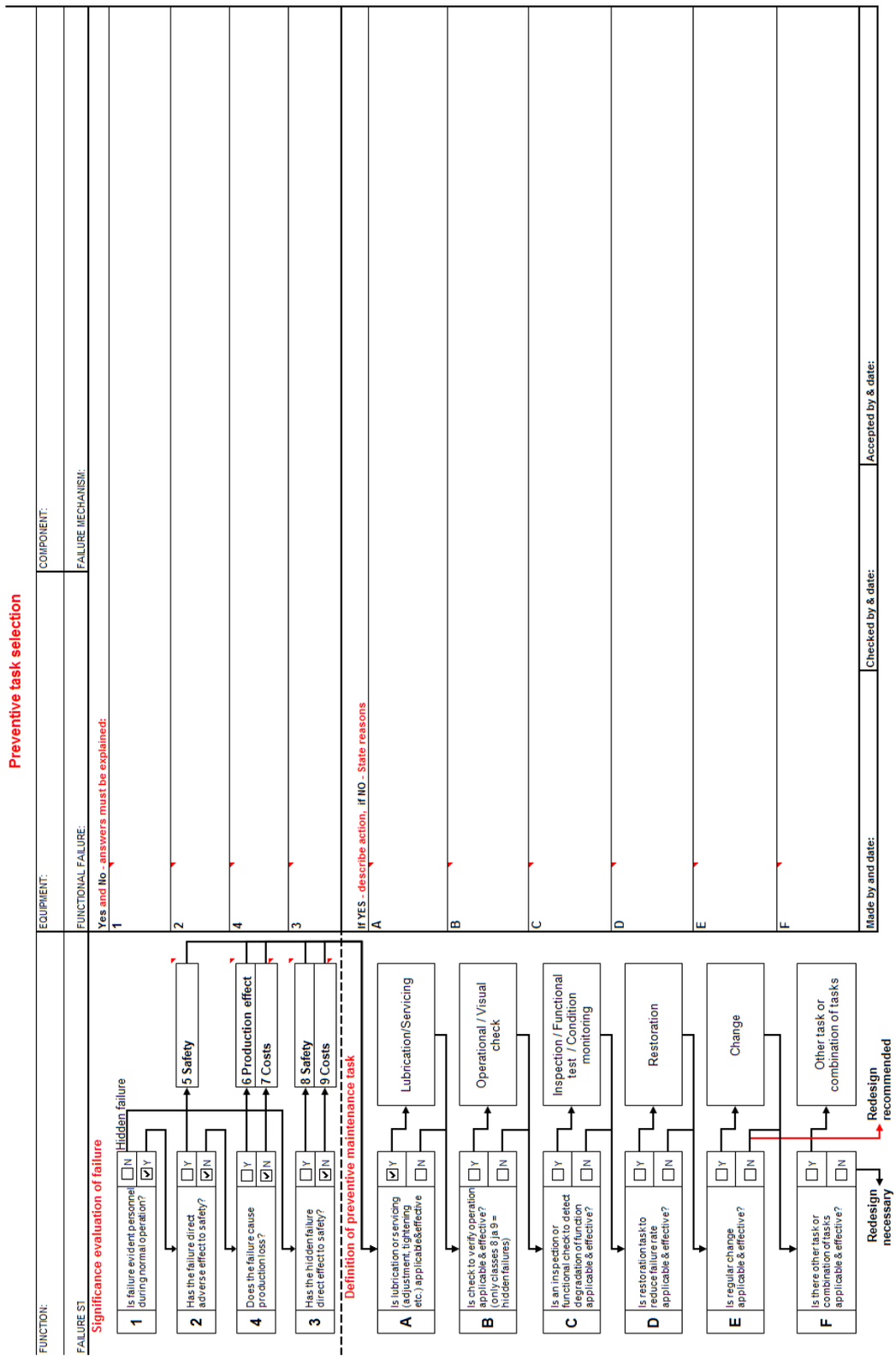

Fig. 12. Preventive action planning support tool (adapted from Moubrey, 1997)

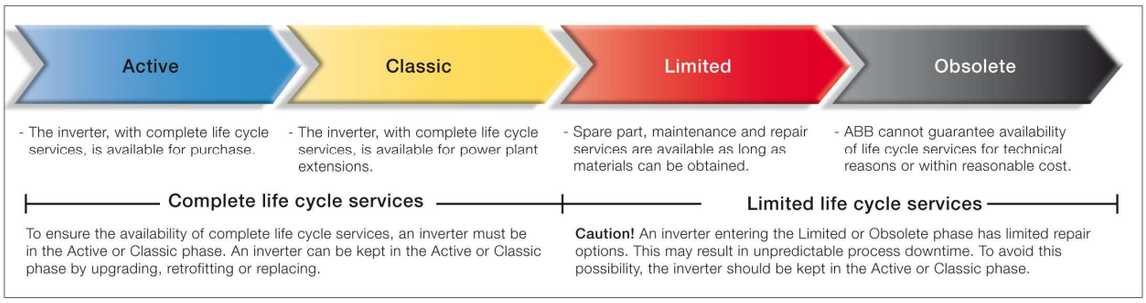

Fig. 13. Example of solar drives life cycle classification (ABB, 2011)

When buying equipment there are three things to know - purchase cost, running cost and maintenance cost. The combination of these over the equipment's life is its LCC. A low LCC means the least amount of money necessary was spent on it, while a high LCC means extra money was spent and that money was then not available for other things. From a purely financial viewpoint it is sensible to go for equipment with the lowest LCC possible. But it is not only the cost of equipment that needs to be considered when purchasing it.

As a simple example of the process we will choose a lawn mower. The options are a reel mower or a rotary mower. First is started by developing a simple table like the one below listing the frequency and costs of the activities expected to occur throughout its working life. The costs and frequency are the standard ones from the manufacturers and the parts and service people. Then we take the recommendations of the manufacturers and service specialist so that the comparisons are based on facts and opinion of knowledgeable persons.

	Reel Mower	10 Year Cost	Rotary Mower	10 Year Cost
Purchase Price	1 off	$900	1 off	$700
Fuel for 10 Years	120lt.	$120	120lt.	$120
Service Every	5 year	$240	3 year	$240
Replace Blades Every	3 year	$600	1 Year	$500
Total Cost for 10 Years		$1860		$1560

Table 2. LCC calculation sheet

Above calculation shows that rotary mower has the best LCC being the cheapest to own. Does that mean people will not buy a reel mower? Off course not. People buy reel mowers because they leave a better quality of cut on the lawn and are self-propelled. It is not always the cost that determines the selection, at times the functionality of the equipment is also important. Putting a value on functionality is difficult when compared to putting a value on a piece of machinery. Functionality is measured in job time savings, accidents not incurred, overtime not worked, people not having to be employed, etc. LCC falls short in that aspect of justifying equipment.

Outcomes of this process phase are investment and major repair plans for the equipment owner. These long term plans are extremely important to give the owner the chance to plan future expendature and also to evaluate risks related with delaying investments.

6.6 Summary

The Reliability Maintenance Process is a good example of how operational excellence is implemented in practice; there is well defined standard process to be followed and all actions are carefully documented. As a result of successful work significantly reduced failure rates, reduced maintenance cost and improved reliability of machinery can be achieved. Also maintenance work is more motivating for the employees due to fact that only meaningful maintenance actions are kept and executed.

7. Supporting the process management – Key information systems considerations

There are huge volumes of various information to be managed related to the maintenance of production equipment e.g. equipment technical data, warranty information, all planned work details, various reports and test results, monthly KPI information, personnel information and drawings. Commonly this data is scattered around the organization into different systems or archives, some data is in electronic format and some only exists on paper. On top of data management there is the challenge to make relevant data available for all personnel requiring access to it. An extra challenge comes when a service provider works for a different company than that of the machinery owner. These two companies will most probably have different IT/IS policies which can create obstacles for effective data sharing and access. And adding to this challenge, existing systems are not often capable of providing information easily and with user friendly interfaces.

When finding solutions for the above mentioned challenges there is often a lot of design work done before setting up any IS solution. The IS team who will be responsible for configuring the new system (CMMS or other knowledge sharing system) will be first updated with maintenance and production strategies so that they fully understand what the priorities are. Then that team will gather the reporting needs from maintenance, e.g. what KPI's are needed to be available from the system and what other standard reports are needed. When understanding needs it is easier to create standard workflows for maintenance (see figure 4 In section 5.1.3 as example of the workflow). Then all of this information is translated into configurations in the CMMS and other information systems. ABB has traditionally selected IBM Maximo to be utilized as a global standard solution for maintenance management. Into that global system standard workflows have been created for maintenance activities. This standardization brings benefits in faster start-ups of new installations and also when personnel move between sites it is easier to adapt into new working environment when there are familiar functions in the system, this also reduces training requirements.

The basic principle in ABB has been that the CMMS is the heart of knowledge, all maintenance related information should end up in that system. Unfortunately not 100% of information is economically viable to keep in that system, e.g. consider the cost of digitizing 100.000 paper format drawings only to have them in CMMS for an uncertain future need. But still, when ever new projects is executed and above mentioned principle kept in mind it steers the companies into requiring new documentation from supplier in such a format that it can be electronically linked to equipment in the CMMS. The same principle applies to reports created by maintenance or their subcontractors, e.g. thermography, oil analysis and

vibration measurement reports should be also linked to the relevant equipment. Collecting comprehensive information can greatly help future planning, failure prevention and troubleshooting.

There is also information needed to be shared which is not necessarily so relevant to be kept in CMMS. Let's say for example the monthly performance reports generated for the customer need to available easily and to a large audience in two different companies. The newly developed SharePoint solutions bring a good platform for sharing various kind of information not shared through the CMMS.

IS solutions are one of the most challenging areas to be well managed when creating a partnership with two companies, these systems need to be in place to ensure a high quality service, open communication and development based on facts. Modern IS solutions offer all the needed functionality, although the cost to fully implement those is usually high, so to guarantee value on money spent advance planning is essential and must be completed with care.

8. Closing the loop – Measures and assessment of the service delivery

8.1 Measuring service delivery

Performance of the service delivery is measured with a predefined set of Key Performance Indicators (KPI). A Key Performance Indicator is an common word for identifying the most important measures of the performance. KPI's are usually supported with a set of Performance Indicators (PI's). KPIs are commonly used by an organization to assess its success or the success of a specific activity in which it is engaged. A Key Performance Indicator is a measurement used to quantify advancement towards strategic objectives set as elements of a strategy. These indicators will differ depending upon the nature of the business and its strategic objectives. KPIs differ per business areas where companies are functioning, although there are some common KPI's that can be used in any business the KPIs that maintenance a service company might use are: safety indicators (e.g. Lost Time Incidents, near misses) customer satisfaction, revenue, profitability, maintenance cost/produced unit, spare parts consumption cost, spare parts stock value, employee satisfaction, personnel utilization rate, portion of preventive and predictive maintenance out of total maintenance hours.

Service providers should invest a considerable amount of time and resources in understanding what is really the most significant performance information that describes success and indicates if the service unit is on track in executing its strategy. It is also significant to notice what KPI's are most suited to different level of the organization – not all KPI's that are critically important to maintenance team are so important for the finance team for example.

Then after KPI's have been agreed, those should be kept in force long enough to be able to show the development of the KPI result. It is vitally important to follow long term trends together with short term ones. For its service delivery ABB has developed a follow-up tool that fulfills the reporting needs of service delivery. An example of the output of one KPI is presented in Figure 14. Naturally all KPI's should be available in the same format. It is important to record why results have been reached, since KPI's must be later on analyzed.

Fig. 14. Example of Key Performance Indicator follow-up (ABB, 2006)

If benchmarks are available for the measured KPI's (either internally from the corporation or even external) those should be used to gain wider understanding of how much more room for improvement there is before becoming best in class. Most importantly there must be targets set for each KPI, otherwise less effective to measure.

Due to the need for understanding of what is significant the choice of KPI's is often associated with the use of various techniques to assess the current state of the service delivery, and its key activities. These assessments can be internal development meetings or external assessments of the service unit's performance. These assessments often lead into the identification of improvement potential and as a result, realization of the performance indicators normally initiates improvement projects. In the next sub-section the method ABB uses to assess its service delivery performance is described.

8.2 Assessment of service delivery

Full Service Assessment closes the loop for ABB Full Service® operational excellence. Assessment is the tool to verify how efficient the service unit is in the implementation of the Full Service model and how well it is fulfilling the value proposition previously supplied to the customer. The assessment model is an adaptation of a common quality and business excellence model for the maintenance outsourcing business.

Utilizing global and regional teams ABB performs assessments for every large contract bi-annually or more often if needed. The assessment is a major approach to educate, support and share leading practices as well as to strengthen the partnership with the customer.

After an assessment, the service unit and upper management will have a clear picture where the service unit stands compared to other ABB Full Service® units. Scoring identifies where the site is good and where major areas for improvement exist. By way of simple recognition the higher performing service units are rewarded with bronze, silver or gold certificates.

The goal of the assessment process is to ensure that the service unit has a sustainable business providing Client Value, ABB Value and People Value. The main objectives are:

1. To ensure contract renewal and to guarantee results according to the business objectives
2. To ensure the ABB Full Service® concept is implemented as proposed

Other objectives are:

1. To identify and share Leading Practices
2. To support implementation of standard ABB Full Service® processes and tools
3. To provide analyses of assessed sites in terms of scoring, Client, ABB and People Value
4. To support gathering and harmonizing the main KPIs for benchmark purposes

8.2.1 Assessment methodology

The **results criteria** of the assessment cover Client Value, ABB Value and People Value. The assessor needs to get an understanding of the KPIs utilized and other measures under these areas. The important topics are to have good coverage on KPIs, positive trends to reach the targets and comparisons or benchmarks.

The enablers are the important approaches with which the service unit reaches its results. ABB Full Service® can be defined as a set of core management and support processes with relevant phases, activities and tools which are made available commonly for all service units. In the enablers' criteria consist of an assessment of approaches, their implementation level and the way approaches are reviewed.

The Full Service® Site assessment is not a desktop study. That is why the program includes visits to the main production facilities as well as to the maintenance workshops. During those visits assessors will have the opportunity to get a good general view of the processes and can in turn relate interviews with the real situation. Before finalizing the site visit, it is a standard way to have a formal wrap-up meeting with the site management. Assessors provide feedback immediately with key findings prior to the supply of a written assessment report.

8.2.2 Assessment reporting and learning

Delivering the high level report from the assessment is the main learning part, both for the site itself and for the service community. The Assessors will typically divide the responsibility for different criteria assessed. However in reporting the goal is to finding consensus, not compromise. Assessors will agree on the main messages as well as on the detailed report and scoring:

1. **The Site Assessment Report** is the document where the main observations and recommendations are detailed by each assessment criteria. The document is drafted so that it can be shared with ABB site personnel and customer personnel. The Maintenance Management Master Plan (MMMP) is the document where the improvement actions developed from the findings are captured and tracked.
2. **Scoring** is the consensus by assessors on which level of maintenance is in place at the site. Scoring is affected by results and enablers but also by financial results. The scoring is then categorized to form the basis for the formal Site Certification. Based on

assessment scoring and the financial results from the site, the ABB Full Service® Product Manager agrees on the Certification level with the main assessor. The Certification is to prove at which level the site is in terms of Full Service implementation thus giving tangible target setting for the continuous improvement.

Part of the learning process is to share the findings with other service units. Reports are stored in a common database where other service units have controlled access. Another important topic is Leading Practices. Assessors identify any leading practices and share them in the company's intranet based database.

Global assessors make analyses between results and enablers as well as between the individual scores, Customer Satisfaction/loyalty, People Satisfaction and EBIT. With the analyses complete ABB will understand better the relationship between the different aspects of the business.

The most important thing is to close the loop of continuous improvement. The assessor makes it clear that the reports, findings and recommendations are understood by the site. The ABB Site Manager's task is to review the recommendations with site personnel and with the customer as applicable and to integrate them into the service unit's strategy (MMMP).

Business excellence in the assessment process is not just writing the report but also supporting and helping the site to move forward. On a regular basis after the assessment the assessor and company management should review the action planning and accomplishments of the recommendations. The assessor should give guidance to the site on how to continue improvement based on and beyond the recommendations.

9. Summary and future challenge

In this chapter the authors have explained the business rationale behind modern performance based maintenance outsourcing, and also presented a validated approach for managing operational excellence. More detail has been given about one core process, called here Reliability Maintenance. The intent is to identify the nature of outsourced maintenance service, delivered at a customer's premises and repeated hundreds of times at global environment.

It is about changing service intangibility into tangible.

The challenge of successful and repeatable maintenance outsourcing activities accross multiple regions nd countries is to change

The success in running this business is heavily about managing the customer relationship extremely closely during the whole life-cycle, identifying a compelling business case and having the capability to design and implement a business model and set of processes that continuously address the strategy and requirements of the customer – with which the organization runs a long term, performance based agreement. Successful deployment is highly important; professionals having high level technical skills as well as strong leadership and change management are the vital success factors to implement the processes in consistent way.

The future challenge for the outsourced maintenance business model is to further add technology and automation into the solution to strengthen the maintenance role in asset

performance management and data analysis. The market needs also more consistent, capable partners to utilize the benefits of long term performance based agreements and to jointly innovate new solutions to increase the competitiveness of the partners.

However the model will be seen successful only when good results have been proven. To demonstrate this by example ABB Full Service® pursuits have delivered the following typical results over the course of the last 10 years:

1. Plant Overall Equipment Effectiveness increased 17 percent points in 4 years.
2. Total maintenance cost decreased 20% while production was increased by 20% over three years.
3. Exceeded 14 production records out of 15 measures over three years.
4. Unplanned breakdowns due to maintenance reduced by 90% in four years.
5. Achieved 105% of rated capacity in Greenfield plant just in three months.
6. Achieved 1000 days with no lost time due to injury from the beginning of the agreement.
7. In 5 months ABB have made significant changes to our plant. The same would have taken us 5 years.
8. ABB Full Service site was selected the organization of the year 2006 by New Zealand's government.

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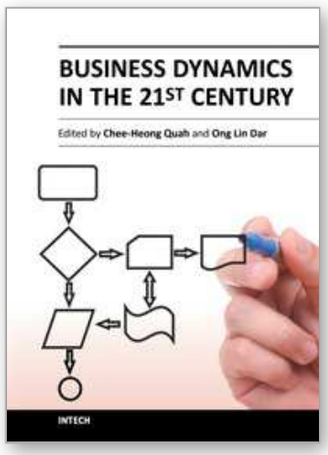

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In this 21st century of opportunity and turbulence, business firms need to equip themselves with new competencies that were never thought of before. For this reason, this book is timely as it introduces new insights into new problems in the aspects of performance and quality improvement, networking and logistics in the interconnected world, as well as developments in monetary and financial environment surrounding private enterprises today. Readers shall find that reading this book is an enlightening and pleasant experience, as the discussions are delivered in a clear, straightforward, and "no-frills" manner - suitable to academics and practitioners. If desired, the book can serve as an additional piece of reference for teaching and research in business and economics.

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