

Integrated Operations:

ABB's digital business transformation for the maritime industry

Whitepaper by
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Abstract

The previously conservative maritime industry is now tapping into the possibilities of connectivity and digitalization due to improved satellite coverage and cloud computing. Owners and operators are increasingly looking for suppliers that offer remote troubleshooting, performance monitoring, and condition-based maintenance. This allows operating the fleet at lower fuel and maintenance cost, while improving crew, passenger, and cargo safety and productivity. In order to facilitate the change, ABB is adding sensors and software to system deliveries on board the vessels; improving data transfer storage, and analysis of the data. Our service centers now start utilizing the information to support customers in emergency situations, in maintenance planning, and in helping to optimize ship operations. The future fleet will be better connected to the owner's shore side technical department, and to ABB's technical departments – by having access to the same information and monitoring systems. We call this way of operating Integrated Operations. Combining the new technologies with our traditional on-call and maintenance services will enable us to be part of our customers' daily operations and make better decisions together. Because vessels will become more complex, the ship owners will want to simplify how they manage their fleet. By working with ABB, our customers get a package that is integrated from office to propeller - provided by a partner with strong domain knowledge. This way of operating will enable us and our customers to take the first step towards autonomous shipping.

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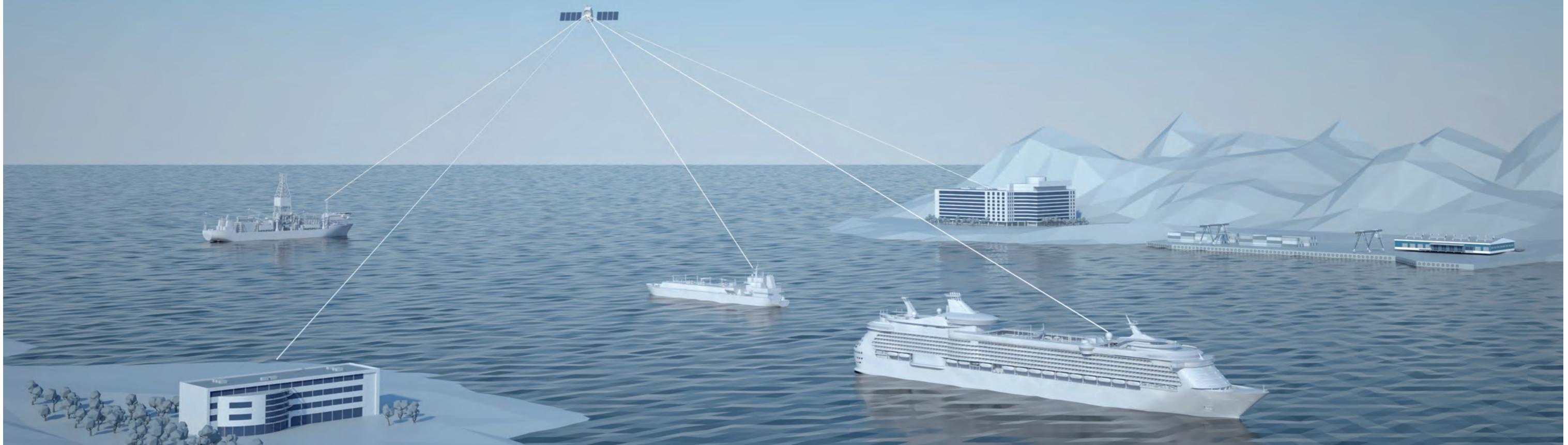
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A conservative industry is changing



Shipping has come under scrutiny by regulatory and environmental bodies for its environmental and safety record. Speculation in shipbuilding and slow economic growth have put the industry under significant economic pressure. The maritime industry needs to become more modern, efficient, and safe. In fact, we are witnessing how this industry is turning from being one of the most conservative industries to being open for new ways of operating.

Improved satellite connectivity at sea allows the introduction of modern software and cloud computing. Life at sea as we know it, is going to change profoundly. And so will the life at the office. Digitalization will affect everything, 'from office to propeller'. Planning, operational tasks, and decision-making will be carried out by involving more people and information, and by creating virtual teams whose members are located on board, on shore at the owners' offices, and at the suppliers'. Improved connectivity, teamwork, and availability of information means a big change for an industry that used to operate in a very fragmented and isolated manner. Most ships are still run as rather self-sufficient units, and the shore side departments' focus is commercial and technical planning. Whenever there is a technical issue, it is the crew's job to try solving it first themselves, and if they can't, they contact their shore side technical department or the equipment manufacturer. The fact that vessels are moving and need to keep their schedule makes it difficult for anyone to organize

the right support, in the right place, at the right time. Also the crew keeps changing, which means that the person who knew the system on board best, might not always be there.

Coordination problems, lack of efficiency, and technical risks are costing the maritime industry and its suppliers billions every year and they are a risk for the safety of passengers, crew, cargo, marine wildlife, fisheries. In addition, the maritime industry is being increasingly pressured to reduce its carbon footprint and contribution to global warming.

One of the biggest operational improvements lies in the integration of the operations taking place on board the vessel and on the shore side, from anywhere, and with anyone who is critical to the value chain, such as original equipment manufacturers (OEM) like ABB.

Any company that aims to supply to that maritime industry will have to master the following four megatrends:

Digitalization and connectivity: satellite connectivity and software will improve further and allow fast and reliable connectivity between the vessel and the shore side. Increasing amount of operational and diagnostics data will be available to support

decision making on shore and offshore. The suppliers of critical systems such as the propulsion, power, automation, cargo handling, drilling, air conditioning, and other systems will have to provide data from their systems.

Automation and electrification of systems: everything that can be automated will be automated. Also on board, the engine room and the bridge will merge and become a single command and operational center, and they will be closely integrated with the shore side operational centers of the vessel owner. This will further increase opportunities for digitalization and connectivity as data will not be distributed to isolated systems. By effective use of simulation models and advanced control algorithms systems can be made more efficient and more reliable.

Emissions reduction and electrification: reducing the carbon footprint of the maritime industry will become a priority for governments and regulators in order to force that industry to make its contribution to the reduction of greenhouse gases. This will put pressure on ship owners, ship builders, and their customers such as major logistics and oil companies and we will see a more active adoption of innovative technologies such as the use of batteries for energy storage and propulsion. Maintenance intensive mechanic systems such as the combustion engine and thrusters will be increasingly replaced by electrical and battery storage systems and electric propulsion. The vast majority of

today's technical operations will be planned maintenance work that is performed every five to ten years, and technical problems during operation will be solved through remote diagnostic services. Reaching aviation standard safety, productivity, will be the target. Smaller vessels such as double ended car ferries will become completely powered by electricity, as other short sea vessels.

Automation of work: just as the digitalization, electrification and automation of on board vessel systems will make the work for operators on board easier, the introduction of new software and cloud applications will improve the efficiency of administrative personnel. The integration of the vessels' resource planning system with the shore side, and with the suppliers' means that people need to spend less time on coordination activities and can focus better on the content of their work. New professions will emerge that blend operational experience with IT skills. Enabling technology may also lead to entirely new business models for the operator and the OEMs.

The era we are dealing with here is the 4th Industrial Revolution. Work will be revolutionized and the production and use of energy will be revolutionized. Even if these changes still seem far away for many of us, some shipbuilding tenders include exactly these kinds of features we are laying out here in this white paper.

Operators and their suppliers will integrate and automate their processes

Due to the megatrends smart and digital features are differentiators right now but eventually they will be part of the new standard offerings of maritime suppliers. The race towards the cloud has started and by 2020 we will probably see a couple of established Maritime Industry cloud platforms already dedicated to hosting marine specific data and applications. The question is whether these platforms will have originated from OEMs, software companies, large multinationals, international industry initiatives, or a combination of these.

All OEMs will eventually meet competition from the software and analytics industry, which is entering the maritime industry now. This means we will see digital services become part of daily business, and daily operations. Operations Execution Systems (OES), analytics software and information technology security platforms are going to play an important role in future maritime operations.

This puts pressure to OEMs to develop a state of the art Operations Execution System. This operations execution system is created by combining equipment, control, automation, cloud, business intelligence toolkits, and services. For ABB the key differentiator will be how well our scope of supply integrates to our customers' business and processes.

We believe that only a vertical integration of the entire product and activity chain, from the machine, sensors, historian on board, the cloud platform, applications, and dispatch of service engineers, design, and R&D is going to provide ship owners and their fleet with a next-level standard in safety, productivity, and low carbon footprint. Or as one of our major customers put it, "our ambition is to operate by aviation industry safety and productivity standards by 2020".

Large amounts of data should be collected by using professional IT architectures and technologies, but a meaningful analysis and interpretation of the collected data is only possible through the application of domain knowledge.

While ABB has always had this domain knowledge, such as hydrodynamics, advanced power management, propulsion, and control systems, it is only now through the technologies of the

Internet of Things that we are able to share this knowledge with our customers in an efficient manner. In simple terms, much of the technology we are developing now aims at integrating ABB with its customer, for the purpose of sharing knowledge and making better decisions on both sides of the table. This means that also ABB, as a supplier of automation, power, and propulsion systems and services is going through an industrial revolution. Today a hundred highly skilled service engineers are able to support 500 vessels with phone and on-call technical support, but in the future, the same amount of engineers and technical experts will be able to support a significantly higher number of vessels at sea, if a remote connection exists. The amount of on-call visits would be reduced dramatically as well which means safety and reliability goes up. Already today, we reduced the on board visits by service engineers to those ships with remote condition monitoring on propulsion drives by 70%, and with improving predictive monitoring we are able to inform the crew before damages may occur.

The automation and centralization of work will be one of the most significant drivers for our business, in order to attract more business from customers who are transforming their own operations in similar ways. The slower growth of the world economy means maritime operators will focus less on expansion and more on improving their efficiency of operations. Because of sensors, software, satellite connectivity, and cloud technology, our customers are able to centralize operational teams by using software and introducing automated or semi-automated processes. On shore, the fleet management will become more efficient as well because visibility of vessel operations will be improved, and software will handle tasks from order fulfilment processes to detecting inefficiencies in scheduling and fuel consumption.

This is a fundamental change to our business, our competence, and structure. In 2025, our products and services will have a significantly lower failure rate due to preventive monitoring, many of our customers will be seamlessly integrated with us by using joint software and communication, and order processing tools. This will allow us and our customers to reduce response times and make operations simpler.

The most progressive ship owners and operators have already implemented advanced operational models and tools, and they look for partners who are on similar technology level, in order to integrate with them, and run the business at next level safety, and productivity. The automation of work will affect every company, and every department inside the company.



Where we are today in terms of connectivity

Back in 2015, we had more than 500 vessels with some form of monitoring system on board. For example, we can monitor the Azipod® propulsors' oil and bearing temperature, moisture and particles in oil, vibrations of bearings, RPM, and other Azipod® propulsor parameters. In the electrical system, we can monitor for example motor winding temperatures, the water pressure of the cooling system of propulsion drives, monitor critical alarms, actual values like RPM, power, torque, and events such as unbalances, the status of the satellite link, and the status of RDS system on board. We monitor fuel consumption, propeller power, hull condition, chillers, hotel load, machinery, boilers, fresh water production, voyage speed, RPMs, weather, and forecast the motion.

When we have this critical equipment and operational information available, we can help our customers avoid maneuvers that are harmful to critical equipment; we can alert them before a drive is going to fail, when to clean the hull or service a bearing; or how to reduce the average speed of the vessel. This all results in fuel savings, less downtime, reduced use of on-call service engineers, increased operational performance and lower dry docking cost.

Based on our experience, owners can reduce the need for receiving engineers on board by up to 30% to 70% based on the type of equipment.

We will integrate these software-based solutions with our automation, power, and propulsion system delivery, and ensure that these information systems can be jointly used by the crew on board, and personnel on the shore side. Already today, the captain of a container vessel can receive guidance from onshore, which route around the heavy weather will be the most fuel efficient. A chief engineer on board a drill ship can grant remote access to a technical expert sitting onshore, in order to get a thruster up and running again.



Five steps to autonomous operations

We take the first steps towards autonomous shipping by combining new digital services with our existing technical services.

We call this phase Integrated Operations' because it speaks to a new way of operating. We are not here to replace the crew but to support them. We also believe that new technologies will help to improve efficiency to the a similar level where best-in-class industries (such as Aviation industry) operate.

Some would call "Integrated Operations" Digital Solutions (and they of course are) but we believe that 'Digital', just as 'IoT', or other buzzwords will in a few years disappear, just as no one talks about eBusiness (the buzzword of 2000) anymore because it is considered simply as a part of doing business. Therefore we chose a name that describes the business and solutions and that can be maintained for years to come, when the marketing hype has gone. Integrated Operations is enabled by digitalization, or what ABB calls the Internet of Things, Services, and People (IoTSP). The IoTSP is defined as "intelligent industrial devices,

connected via networks that expand opportunities for remote services and that allow people to make better decisions thanks to their ability to collect, analyze, and act on data, by working closer together and sharing applications, tools, and processes." Integrated Operations is defined as "a way of operating that allows ships, onshore operations, and ABB to operate on the same information and communication technology (ICT) backbone in order to deliver troubleshooting, technical support, condition monitoring, performance monitoring, and analytics, and condition-based maintenance in a seamless, and fast manner that improves operational costs and safety on board the vessel but also onshore."

The picture on the next page explains how sensors and software onboard the ship send equipment and performance data via satellite link which allows ship owners, in collaboration with ABB's experts, to perform remote troubleshooting and make informed

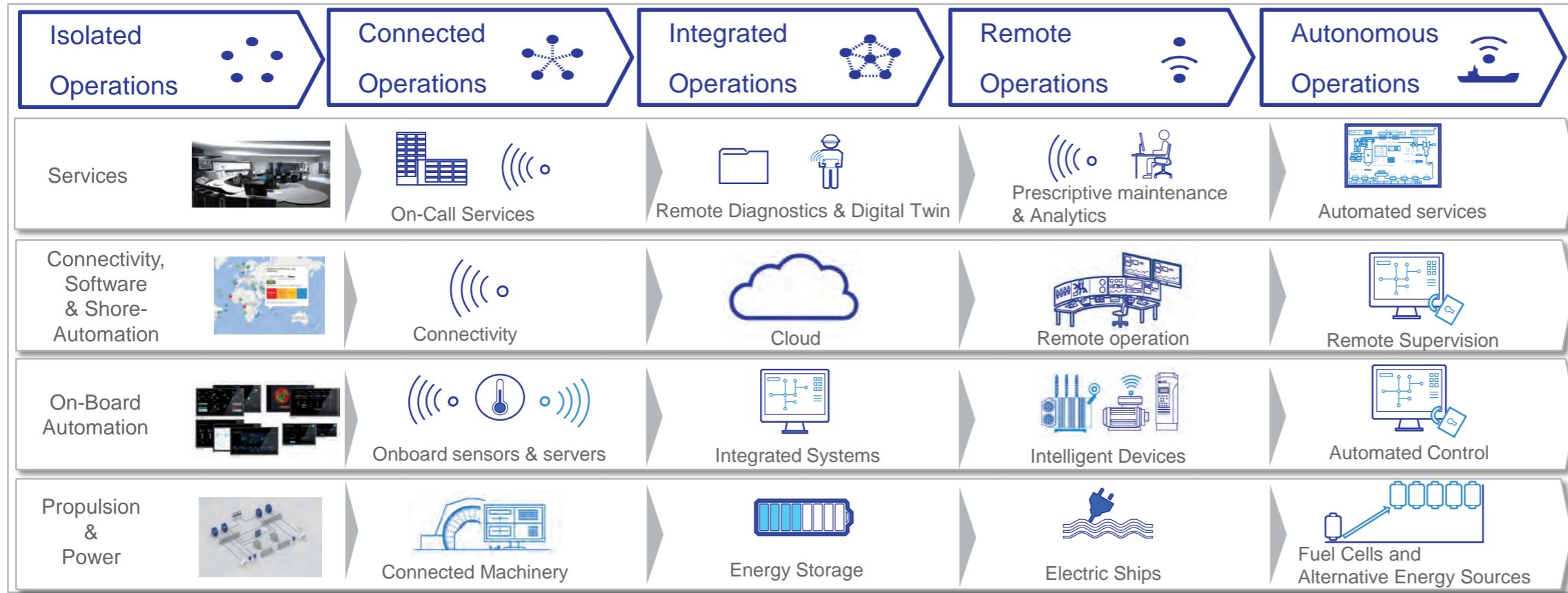


Figure: ABB's 5 steps towards autonomous operations

judgements about the ship's performance and maintenance plan.

Integrated Operations increases our customers' uptime, ability to plan, and the cost to operate. In addition, this way of working provides internal benefits to ABB, such as reducing quality related cases in production, execution and service delivery. It also helps to compete for new talent, and increases workforce productivity, due to reduced coordination that is required to communicate and organize internally, and towards our customers. Availability of accurate and analyzed information allows data-based decision making that allows more focused actions and better results.

Through the Integrated Operations concept, critical equipment and control systems on board a vessel can be monitored, and are used at ABB on shore service center and the customer's on shore fleet operational center, for optimizing the vessel and fleet operations.

While earlier, the systems we sold to our customers consisted of automation, power and propulsion equipment, our new system delivery includes more sensors and monitoring hardware and software on board – to monitor the critical systems, and give the crew in the engine control room, and the bridge, more visibility of their operations. That is what we call the integration ‘from bridge to propeller’. Some of the data provided by these systems is analyzed already on board the vessel, by automated algorithms, which allows immediate and fast reaction from the crew to act on anomalies, performance issues and emergency situations. But in addition, we can send some of that data to the shore and make it accessible to the customer wherever they need it, whether that is in an operational center or just on a laptop or a smart phone. This data transfer takes place either through a cloud server or

within their own IT network. This gives the customer's technical department (which is located on the shore side), better visibility of each vessel and the total fleet, and enables it to react in a more efficient way in emergency situations and to plan better for maintenance and operations. In addition, we are using this information ourselves, in our own service centers, from where we can remotely access key equipment in order to troubleshoot, or to analyze losses and support our customer in maintenance planning and making improvements to systems during operation.

Basically, we can run a virtual copy of the system on a server and make it ‘age’ according to the vessel that is operating at sea. This concept, also often described as ‘Digital Twin’ will soon be a commercial reality and it will be a key to provide condition-based maintenance.

This scope of an integrated offering and technology package is called ‘from office to propeller’.

What we are going to sell can be described as a horizontally and vertically integrated system – not only by integrating products and software on board the vessel horizontally (such as having transformers, motors, and drives talk with each other directly without higher level supervisory system) – but also by integrating the troubleshooting and maintenance services we deliver to the vessel, the lifecycle and fleet services we deliver to the customer's technical departments on shore, and the monitoring of the systems on board. Essentially, we are selling a new way of operating, because our new offering allows the different stakeholders on board and on shore to close existing communication gaps and

switch from a fragmented way of operating to a more integrated one. No information should get lost anymore, and our response times should become the best in the industry. The result is a new system and services integration that allows to introduce remote operation for selected functions on selected vessel types, or for selected operational and navigational situations. Our offering will be vessel type specific, and we will use many of the services and technologies across these different vessel types. By tapping in to the data and operations characteristics, more efficient technology solutions can be created and designed to better match the specific needs.

Some of our customers are establishing Fleet Operational Centers already, which means that they are centralizing certain management tasks, and giving more support to their fleet from ashore. For example, the largest container operators have operational centers where they monitor and support their cargo vessels. This makes it also easier for us at ABB to centralize our support to that particular customer, by establishing Integrated Operations Centers, which can support a number of customer accounts. We will establish our technical hubs and integrate all Service Centers with each other. With this set up, we will create a stronger and more positive bond between us and our customers because it makes it easier to serve our users and create insights.

With this offering, we aim to continue differentiating ourselves from our competition, mainly due to two reasons. First, the sensors and optimization software we offer, is integrated with our systems and products. This means our customers get solutions that are much better integrated with their critical systems, allowing them to optimize fuel consumption, prevent failures, lengthen the operational window, or reduce maintenance. It makes our

products and systems smarter, and we do not have to compete on software alone.

By implementing a way of maintenance planning and execution, of 20% or more on dry docking costs on ABB equipment can be saved if monitoring, pre-survey, and project execution are managed in close cooperation between ABB and the ship owner.

Second, we are the only one of the system suppliers that can offer an integrated automation, power, and propulsion system with our own products produced in ABB factories, as well as global service coverage.

By monitoring the most critical systems on board and making key information visible on the bridge, in the engine control room, and at the customer's onshore operations center, we allow our customer to manage the fleet in a better and safer way.

Since we are part of this communication by having access to the vessel from our own onshore service operations centers, we are a safer and more reliable choice for our customers to call when they have a critical situation. Having an access to the product level information is beneficial when accurate decisions need to be made and recommendations given how to rectify faults or improve performance.

How this will benefit our customers



There will be significant changes how work is carried out and organized, by the automation of work. Therefore we need to understand who the users will be, and how they will use our products and services. All kinds of users, whether the service engineer, the plant manager, the vessel's captain, the business controller, the designer, or the supplier's operations manager, have access to information that helps them making different types of decisions.

This also means that customers are looking for new ways of operating, and for solutions that deliver practical benefits to different personnel, on shore and on board. Therefore, a useful portfolio of smart services, which is linked to the customers' installed base, daily operations, to technical planning departments, to troubleshooting, spare part inventories, and the customers' improvement initiatives, is clearly needed. Integrated Operations enables access to the best possible knowledge as the centralized service operations is not that dependent on individual service engineer's ability to solve problems on site. Therefore few experts can support larger fleet, which does not mean that our service delivery will feel more anonymous to our customers. We will still make extensive use of local resources but they will be better integrated in communication and coordination.

Applications which display KPIs to top management should only be a by-product of information systems that are used in daily operations. This translates into customer benefits at two different locations: the vessel, and the shore. In addition, the benefits depend on the customer's type of business, as well as the vessel type. For example, a cruise vessel has a different

operational profile, demand for power, and is subject to different class requirements than a drill ship. But both customers may want to centralize their onshore operations, transfer more management tasks from the vessel to the shore, and have better access to vessel systems. On a large ship like a cruise ship, removing routine tasks from the vessel, may allow the crew on board to use more time on critical operations and ensuring the safety.

The solutions we already have today, provide the vessel with energy savings by monitoring and managing power and propulsion, forecasting ship motion and taking into account the operational actions such as changing the route, speed, or when to retract the stabilizing fins.

With our motion power production, power consumption, motion forecasting and voyage advisory software we have saved customers up to 5% in fuel cost.

Another effect is the increased up-time for offshore related work such as pipe laying and drilling. The more efficient collaboration also results in cost benefits for the customers' on shore technical operations due to less coordination work, reduced supply chain costs for planned maintenance, and less work for technical planning and management. Customers have already centralized many other functions, such as logistics and supply chain management. The Technical Operations function is for some companies the last function that still operates in a fragmented way.

Customer benefits

- Full transparency of critical systems down to detailed level
- Visibility of critical processes and alarms
- Detection of failures and analyze together with the OEM
- Ability to reduce voyage speed of ships and the whole fleet
- Higher availability of systems and vessels by accepting known, low risks
- Incident management combining onshore, OEM, and vessel crew
- Plan, manage and increase maintenance during operations
- Save man years in technical planning department, by better OEM cooperation
- Comply with Classification, in extended and reduced maintenance
- Help plan fuel efficiency during voyage and operation
- Develop new solutions that solve challenges based on data
- History of performance, condition, and intervention performed on the systems
- Attract and retain a new generation of professionals
- Benefit from your staff's and OEM's expertise through cooperating better
- Manage documentation globally, easy to update and locate files
- Manage software installed base, and upgrades, globally and reliably
- Leaner global footprint due to better access to resources from OEM and internally

How this will affect the service business of ABB



By implementing technologies of the Internet of Things, Services, and People (IoTSP), we will be replacing manual work with software and change the economics and performance of our business. By adding software and analytical expertise to our competence, the same amount of people will be able to support a fleet many times greater than today.

White collar productivity will be increased through a greater use of software and connectivity. Sales and sales support will be partly automated, including order handling and processing. Much of analytics will be automated, as well as alarm monitoring. We will be able to operate our business in real-time, which allows to react faster to demand, avoid resource misallocations, and reduce the real cost of poor quality, significantly.

Service agreements in the future will be executed through the integration of our maintenance, supply chain, and order handling processes with those of our customers' which will allow automating many of the tasks and processes, leading to reduction in sales, order handling, and reporting tasks. This will reduce cost for both sides.

The goal is to transform our business into a modern enterprise that can withstand the changes the next Industrial Revolution is going to bring us. Especially the automation of work and processes that our customers are going to implement (and which we therefore must implement as well) will require investments in software, tools, and new competences. But digitalization and enabling technology will also provide us with significant growth opportunities, which means software-related services will grow, and enable the growth of traditional services.

Thus, Integrated Operations is not only a growth initiative but also an operational excellence program, because we improve many of the basics in our service delivery processes, technology platform, engineering, installation, commissioning, and in Service. When we implemented our ticket management system that runs our internal and customer technical support, we realized this information is valuable internally for quality control and for our customers to analyze exactly which equipment on which vessels requires attention.

This means our possibilities to provide our knowledge to customers has greatly improved. Software-related investments in our operational excellence will pay back by internal cost savings and revenue from customers. This will improve customer satisfaction, employee motivation, and sales, due to a smoother and more professional and more collaborative work environment where experts can focus better on their tasks.

Also required will be a closer integration with our suppliers, who are mainly ABB factories and their service departments. This supplier integration will provide significant cost savings and improvement of response times towards our customers. Another benefit of the improved lever of integration with the customer is the possibility to expand the scope of services by integrating different sources of data, while at the same time reducing system complexity by streamlining hardware and software architecture with larger systems. This brings down the cost for services such as hull condition monitoring and monitoring of critical rotating equipment.

The goal is to transform our business into a modern enterprise that can withstand the changes the next Industrial Revolution is going to bring us.

Benefits for ABB

- Productivity in technical support, field service, and commissioning
- Reducing costs due to quality issues in manufacturing, installation, and operations
- Reduce warranty cost
- Reduced commissioning cost
- Reduced sales cost per customer and opportunity
- Manage documentation globally, easy to update and locate files
- Improved response time and reduced coordination of responses
- Research and development closer to customer needs
- Attract and retain a new generation of professionals
- Benefit from our staff's and customer's expertise
- Leaner global footprint due to better access to our own resources

The modular offering

Our service offering is modular and customers can start with whatever service addresses the issues they have at that given moment. Because we are doing the services ‘with’ our customers, we need to be able to integrate with the tools and providers they are using as well.





Remote Diagnostics

- RDS remote diagnostic service onboard infrastructure for remote troubleshooting
- Preventive and continuous monitoring, combining online with manual monitoring if necessary
- Available for the entire ABB marine drive train, Azipod® propulsion, the Automation System, and Power Systems
- Integrated with ABB automation and advisory systems to provide Integrated Solutions and Services
- Monitoring of ABB system delivery (non-ABB equipment can be included in exceptional cases)



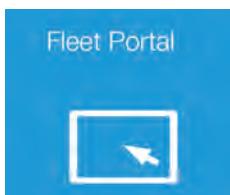
Operations Monitoring

- Monitors energy production and consumption
- Improved forecasting of behavior of vessel in weather and motion
- Decision-making support while operating in different weather conditions
- Map energy flows, understand where you can optimize
- Measures fuel and energy consumption
- Measure energy and power savings of products such as drives and motors, sending data to cloud
- Displays consumption and losses
- Recommends actions



Fleet Intelligence

- Documentation of cases, easy case tracking
- Utilization of case data for identifying issues with specific equipment on specific vessels
- Utilization of data for maintenance planning on individual vessels and across the fleet
- Utilization of data for identifying improvements in crew's and suppliers' maintenance practices



Fleet Portal

- Easy access to all customer relevant information ABB Marine has
- Single sign on to a dashboard that provides a quick summary of key activities per vessel and fleet
- Allows interaction with ABB for all services that are included in the customer's agreement
- Portal features are switched on or turned off, based on agreement content with customer



Advanced Analytics

- Analysis of data coming from different sources, combining that data with off-line expertise
- Reporting of key facts, according to customer's needs and requirements by stakeholders
- Going through large volumes of data and identifying the essential, small amounts of data that are important
- Using data analysis to make statistical calculations and predictions on failures and fatigue
- Using data analysis for optimizing new buildings and making structural changes to existing vessel



Condition-based Maintenance

- Prediction of equipment failure and risks
- Advice when to perform maintenance actions
- Advice whether maintenance and repair can be delayed to a later point, based on the real risk
- Certified by the Class
- Focus on ABB systems



How we accelerate our digital transformation

The implementation of the Integrated Operations strategy requires the integration of many existing development initiatives, aligning internal units in different countries with each other, and with the digitalization strategy.

The initiative spans across technology, systems delivery, project and engineering departments, new sales, operational support and service. In addition, global processes and tools need to be implemented for services such as Global Remote Diagnostic Support, and Global Technical Support.

Many initiatives which were earlier managed separately, such as Remote Monitoring and Management, Global Technical Support, Diagnostic Services, the Marine Online Portal, Software Development, Systems Engineering, and many of the Operational Excellence initiatives, are now combined with each other.

We continue the integration of Automation to the power and propulsion package, the integration of all sub systems with each other, as well as integrating monitoring, analytics, and troubleshooting services on ABB's side, with our customer's fleet of vessels and their onshore operational centers.

Integrated Operations was kicked off as a Digitalization Strategy in the end of 2014, after half a year of planning activities and pulling all necessary tasks and departments together. Now, in 2016 the transformational program will be taken over by the business organizations, and the new departments that were established in the past years.

Combining the monitoring capabilities of its centres in Norway, Finland, and the Netherlands, we can connect to more than 600 vessels and there are further centres scheduled to open in Asia and the US in 2016.

Digitalization, and digital services and processes will simply be a part of our daily core business.

For the past years, we have been conscious of the fact that our Digital business transformation is essentially different from typical product inventions, or simply launching a cloud service. We are bringing digitalization to the core of our business, products, and processes. This means our innovation process is fundamentally different compared to traditional transitions or new product launches.

Final words and vision forward

The Internet of Things, Services, and People is an emerging industry megatrend that will change the way the maritime industry and many other industries operate.

The Internet of Things, Services, and People is an emerging industry megatrend that will change the way the maritime industry and many other industries operate. But the key is to know which new solutions and services to combine with the existing core of our business, in order to provide the customer with enhanced productivity of their assets, and investments – whether that is a productivity improvement in the production process, in safety, quality, or in cash.

By end of 2016, we will have turned four Marine Service Centers and Competence Centers into Integrated Operations Centers. In these locations, we will have an Integrated Operations room, able to support customers and our own workforce worldwide, 24-7, based on new software tools and cloud services. Already today, the majority of systems supplied by ABB have a basic scope of Integrated Operations features, which allows ship owners and operators to utilize some of our digital services right from the beginning of operations. Retrofit solutions are available as well. The newest generation in system architecture design will allow customizing project deliveries more efficiently while giving ship owners additional product features at less complexity.

By 2020, we aim to be connected to 3000 vessels. We estimate that 20 percent of our customers have a modern operations center and our target is to be part of these centers. The share of software developers and software-related jobs among our workforce will increase significantly. By 2020, Integrated Operations features will be part of every new vessel, and we expect that most newbuilding specifications will require these types of features to be part of the suppliers' scope.

By 2030 we aim to have supplied vessels with technology that allows to remotely and autonomously operate selected functions on board the vessel. We will support ship owners and operators in monitoring all critical sub systems, in real-time. In the future, a substantial amount of our business

volume and competence will be software-based, also driven by customers that operate on modern, IT-based processes. Our core services will also increase in revenue and software content, which means that modernizations and planned maintenance will be based on the insight we gain through the new technologies.

Working closely with our customers and using the same tools means there will be more interdependencies between our work processes and value chains. The work we perform in engineering, service, and supply chain will become more performance-driven and customer focused because Integrated Operations improves our ability to provide our knowledge and services to the users.

The more all parties in the value chain are connected, the higher Operational Excellence will move to the agenda. Improvement initiatives will be joint efforts between the owner, operator, and supplier, for example in supply chain and spare part management, handling emergency procedures, and asset lifecycle management.

Integrated Operations is also a good example of ABB's Internet of Things, Services, and People (IoTSP). We have taken action to accelerate the digitalization, by improving our competencies in new areas and integrating them with the existing organization. Our new Integrated Operations Centers are proof of that. We consider this the beginning of the next Industrial Revolution and a wave of shipbuilding activity that will see more connected, integrated, electrical, and autonomous vessels and maritime operations.

We believe the next step-change in productivity and safety in shipping comes from integrating ships better with shore side operations. Integrated Operations is the concept that will drive this change in the coming years.

