CTN

BLUE GROWTH

IoT SECTOR MARINO

INFORME DE VIGILANCIA TECNOLÓGICA

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1. Introducción

Este informe, elaborado por el equipo del Centro Tecnológico Naval y del Mar, describe la situación actual e introduce las tendencias futuras de la estrategia del Crecimiento Azul en el ámbito de Internet de las Cosas (**Internet of Things** o **IoT**) en el sector marino. Su finalidad es ofrecer al tejido empresarial una mejora en el conocimiento del entorno, que permita detectar tendencias y desarrollar estrategias adecuadas basadas en niveles superiores de certidumbre a través de la captación y divulgación de información y conocimiento de importancia estratégica en los ámbitos social, tecnológico y económico, que incidan en la detección de nuevas oportunidades de desarrollo regional.

Tal y como se verá a lo largo de este informe, Internet de las Cosas es un área transversal con aplicación en una amplia variedad de ámbitos, y en concreto en el sector marítimo-marino sus aplicaciones son tantas que se ha decidido restringir el ámbito de estudio a los siguientes: **diseño, construcción y transporte naval,** por un lado, y **acuicultura** por otro. El motivo no es otro que la limitación de tiempo y espacio.

Para la realización de este informe se han aplicado técnicas de Vigilancia Tecnológica, una herramienta al servicio de las empresas y organizaciones que permite detectar oportunidades y amenazas aportándoles ventajas competitivas y fundamentos para la toma de decisiones estratégicas mediante la selección y análisis de información de diversos tipos (científica, tecnológica, comercial, de mercado, social…).

Se parte de una introducción metodológica sobre las técnicas y fases de la Vigilancia Tecnológica (VT) que se han aplicado para el desarrollo del informe. A continuación, se introduce el Crecimiento Azul como estrategia europea y el papel de la **IoT** en el sector marino en el marco de dicha estrategia, con el fin de dibujar un cuadro de referencia para la contextualización de los contenidos temáticos del informe. Seguidamente se realiza un análisis del estado de la técnica, que incluye los ámbitos arriba mencionados: diseño, construcción y transporte naval, y acuicultura. Este análisis se completa con una visión de las oportunidades de financiación europea de I+D, en el sector.

2. Metodología

La vigilancia tecnológica se entiende como una "forma organizada, selectiva y permanente de captar información del exterior sobre tecnología, analizarla y convertirla en conocimiento para tomar decisiones con menor riesgo y poder anticiparse a los cambios" (AENOR, 2011). Su finalidad última es generar ventajas competitivas para la empresa ya que le proporciona datos para:

Figura 1. Finalidad de la Vigilancia Tecnológica

Para el desarrollo de la Vigilancia Tecnológica el primer paso el plantear los aspectos básicos (Degoul, 1992):
¿Cuál es el objeto de la vigilancia? ¿Qué debemos vigilar? ¿Qué información buscar? ¿Dónde localizarla?

Cuando el objetivo de la VT está claramente delimitado, se procede a planificar la estrategia de búsqueda. Para el despliegue de esta fase conviene tener en cuenta que la información puede presentarse de dos formas: estructurada y no estructurada. La primera es propia de las bases de datos, conjuntos de datos homogéneos, ordenados de una forma determinada, que se presenta en forma legible por ordenador (Escorsa, 2001). Su unidad es el registro –o ficha de un artículo científico o una patente- que presenta la información ordenada en campos: autor, título, fecha de publicación, titular de la patente, inventores, etc. En cambio, la información no estructurada se presenta en textos sin un formato determinado (noticias de periódicos, sitios web, blogs, correos electrónicos) cuyo tratamiento requerirá de nuevas herramientas capaces de "leer" y analizar estos textos. Estas herramientas son útiles también para analizar la información de textos completos de artículos científicos o de patentes. Hoy se considera que el texto es la mayor fuente de información y conocimiento para las empresas. (Escorsa, Pere, Pilar Lázaro Martínez, Círculo de Innovación en Biotecnología, 2007).

Tras la selección de las palabras clave se automatiza la búsqueda en función de las diferentes tipologías de fuentes a utilizar, se lanza la misma y se filtran los resultados en términos de pertinencia, fiabilidad, relevancia, calidad y capacidad de contraste (AENOR, 2011).

Una vez comprobada la calidad de la información, los métodos de análisis han de garantizar su valor para la explotación de los mismos (F. Palop, 1995). El objetivo del análisis es transformar la información en bruto recogida en un producto con alto valor añadido. A partir de aquí, la aportación de los expertos es crítica para crear información avanzada, para generar conocimiento. Pasamos de una masa ingente de información en distintos formatos y lugares a una etapa en la que se captura la información más relevante, se organiza, indexa, almacena, filtra y, finalmente, con la opinión del experto que aporta en este punto del proceso un máximo valor añadido (CETISME, 2003).

A continuación, se incluye un esquema con las distintas fases de la metodología empleada durante la generación de este informe.

Figura 2. Fases de la Vigilancia Tecnológica.

3. Estrategia europea de Crecimiento Azul

Blue Growth es la estrategia de la Unión Europea para apoyar la economía azul a largo plazo. Se trata de una iniciativa enfocada a aprovechar el potencial inexplotado que ofrecen los océanos, mares y costas de Europa para el crecimiento económico y la creación de empleo. Partiendo de la premisa de que los mares y los océanos son motores de la economía europea y un polo de innovación y crecimiento, tiene en cuenta tres factores adicionales (Europea, COMUNICACIÓN DE LA COMISIÓN AL PARLAMENTO EUROPEO, AL CONSEJO, AL COMITÉ ECONÓMICO Y SOCIAL EUROPEO Y AL COMITÉ DE LAS REGIONES - Crecimiento azul Oportunidades para un crecimiento marino y marítimo sostenible, 2012):

- Los avances tecnológicos aplicados a operaciones en aguas profundas, inviables hasta hace pocos años.
- La explotación sostenible de los recursos del océano como alternativa a los recursos finitos en tierra y agua dulce.
- La idoneidad del transporte marítimo frente al terrestre en relación con el ahorro energético y la reducción de emisiones de gases de efecto invernadero.

Este conjunto de consideraciones hace que la contribución de la estrategia Blue Growth a la consecución de los objetivos de la Estrategia Europa 2020 se considere clave para un crecimiento inteligente, sostenible e integrador.

3.1 Componentes de la Estrategia

Medidas específicas de la Política Marítima Integrada:

1. *Conocimiento marino* para mejorar el acceso a la información sobre el mar;
2. *Ordenación del espacio* marítimo para garantizar una gestión eficaz y sostenible de las actividades en el mar:
3. *Vigilancia marítima integrada* para que las autoridades tengan una mejor apreciación de lo que pasa en el mar.

Estrategias de cuenca marítima que garanticen la combinación de medidas más adecuada con el fin de fomentar el crecimiento sostenible para tener en cuenta factores climáticos, oceanográficos, económicos, culturales y sociales de carácter local:

a. Mar Adriático y Mar Jónico
b. Océano Ártico
c. Océano Atlántico
d. Mar Báltico
e. Mar Negro
f. Mar Mediterráneo
g. Mar del Norte

Actividades específicas:

a. Acuicultura
b. Turismo costero
c. Biotecnología marina
d. Energía oceánica
e. Explotación minera de los fondos marinos

(Europea, Crecimiento Azul, s.f.)

3.2 IoT en el marco de Blue Growth

El concepto de *Internet of Things* (**IoT**) se ha ido gestando y evolucionando en los últimos años y existen muchas definiciones que pretenden abarcar todas sus capacidades y características.

El término fue empleado por primera vez en el Instituto de Tecnología de Massachusetts en el año 1999 y se adoptó para referirse a un sistema en red de objetos y procesos que interactúan de manera autónoma y se autogestionan, de los que se espera que conduzcan a una convergencia de cosas físicas con el mundo digital de internet. En el corazón del concepto se extiende la idea de que los objetos-cosas son capaces de procesar la información, comunicarse con cada uno y con su entorno, y tomar decisiones de manera autónoma. Por ejemplo, los Productos Inteligentes son objetos físicos, que pueden ser transportados, procesados o utilizados y contar con la capacidad de actuar de un modo inteligente. McFarlane et al. (McFarlane et al. 2003) definen el Producto Inteligente como "…la representación física y de la información basada en un objeto […] que posee una identificación única, capaz de comunicarse eficazmente con su medio ambiente, puede retener o almacenar datos de sí misma, utilizar un lenguaje para exponer sus características, producción, requisitos, etc., y es capaz de participar o tomar decisiones relevantes para su propio destino."

En el informe del *Institute of Electrical and Electronics Engineers* (IEEE) podemos encontrar una sencilla definición de **IoT**: "Red de elementos, cada uno integrado con sensores, que están conectados a Internet" (Minerva, Biru, & Rotondi, 2015). Esta descripción del "Internet de las cosas" no supone una definición oficial del concepto y en ella podemos comprobar que aborda solo el aspecto físico de **IoT**.

Además, en este informe se detalla que "**IoT** es un dominio de aplicación que integra diferentes campos tecnológicos y sociales". Estos campos se muestran dentro la siguiente Figura 3. Aspectos tecnológicos y sociales relacionados con IoT (Fuente: IEEE).

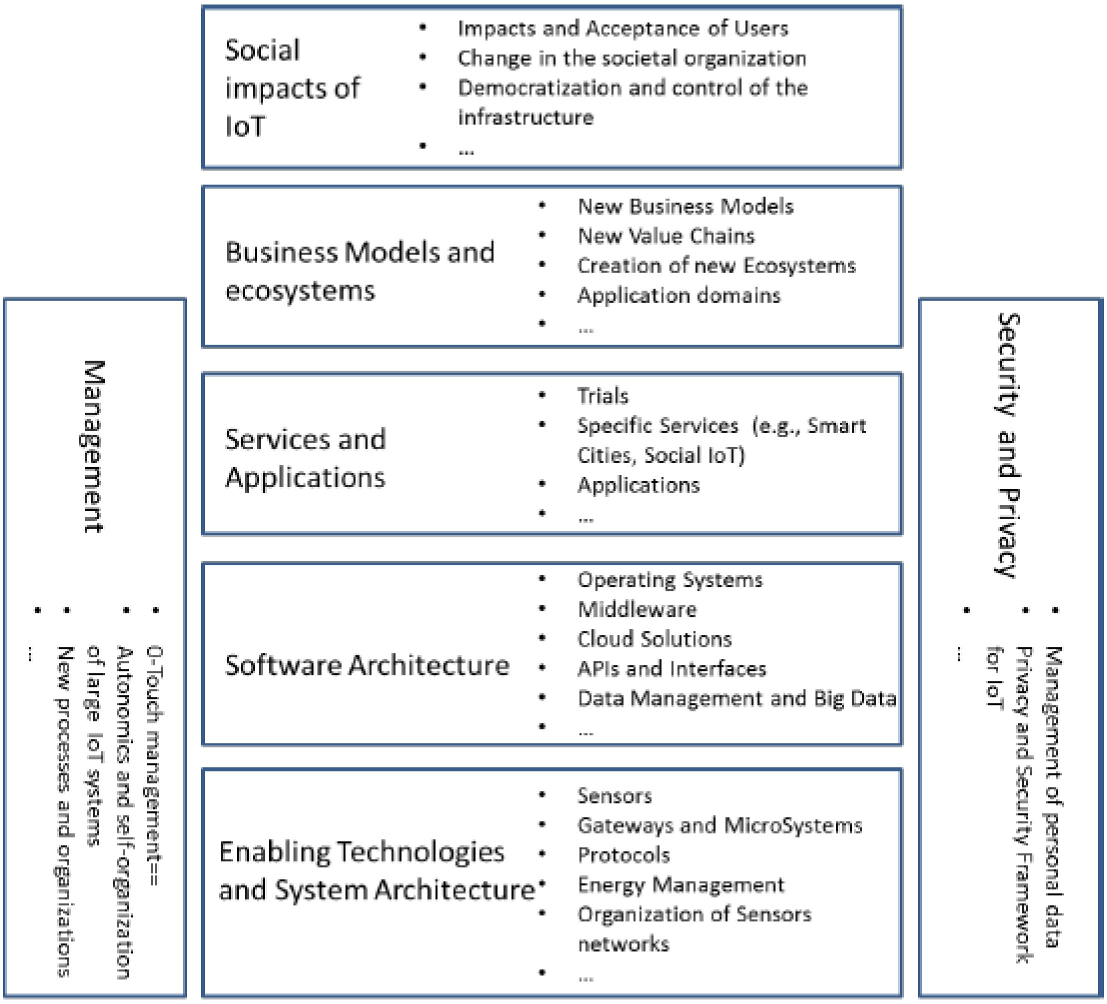

Figura 3. Aspectos tecnológicos y sociales relacionados con IoT (Fuente: IEEE (Minerva, Biru, & Rotondi, 2015)).

A pesar de la diversidad de investigaciones sobre **IoT**, su definición sigue siendo poco precisa debido a la amplitud de campos que abarca su aplicación.

Por ello, se está llevando a cabo el reto de realizar una definición sólida que aborde todas las aplicaciones de la **IoT** en distintos ámbitos, para poder así facilitar una mejor comprensión del tema, conducir a una mayor investigación y avanzar en la comprensión de este concepto emergente.

En el artículo *Utilising the Internet of Things for the Management of Through-life Engineering Services on Marine Auxiliaries* (Stietencron, Rostad, Henriksen, & Thoben, 2017) se menciona que «**IoT** puede verse como una evolución de la "vieja" Internet impulsada por los seres humanos hacia una Internet que está impulsada por objetos inanimados-cosas. Originada a raíz de la tecnología de identificación por radiofrecuencia (RFID), el **IoT** abarca todos los objetos que participan en el intercambio de datos con otros sistemas. No importa si este intercambio es multilateral o no, ni qué tipo de sistema se observa».

La aplicación de **IoT** supone un cambio trascendental en la sociedad, que influirá positivamente en la industria tecnológica, favoreciendo la inclusión de nuevas tecnologías que conviertan determinados elementos y dispositivos en objetos inteligentes e independientes.

En relación con la estrategia Blue Growth, el **IoT** se traduce en nuevas formas de diseño, de operación y mantenimiento durante todo el ciclo de vida de un producto (como pueden ser los barcos o las instalaciones de acuicultura), de forma que se conviertan en recursos sostenibles que conjuguen factores climáticos, oceanográficos y/o económicos.

4. Principales aplicaciones de IoT y otras tecnologías relacionadas con IoT al sector marino

Existe un gran rango de aplicaciones de las tecnologías Internet of Things dentro del ámbito del sector naval, abarcando todo el ciclo de vida del barco, desde su diseño y concepción hasta su operación final, pasando por todas las etapas de fabricación y producción.

La literatura realizada por compañías, grandes navieras, centros e investigadores enfocan las aplicaciones de una manera heterogénea, en función del ámbito de aplicación de la tecnología y el público objetivo o simplemente por la propia estructura del documento. Este hecho se acentúa debido a que el Internet de las Cosas no es una tecnología pensada para a trabajar sola, sino que se complementa con otras tecnologías y tendencias, muchas de ellas profundamente arraigadas en la Industria 4.0, como el Big Data.

Role	Application of Ship IoT and open platform
Shipping	Shipowner and operator needs applications for energy saving, minimize downtime and safety transport and environmental conservation
Manufacturer	Remote maintenance, preventive maintenance and self-diagnostics
Shipyard	Data analysis services for shipowners, life-cycle support and feedback to new design
Service provider	Fleet management system, big data analysis services, condition monitoring services and IoT platform
Academy	Research on big data analysis, numerical simulation methods and trainings
Class society	Shore data center and class inspection

Figura 4: Áreas de aplicación del IoT en el sector naval. Diagrama. Fuente: Monohakobi Technology Institute. Utilizing Big Data and the IoT in Shipping, Taizo Yoshida, 2016

Role	Function	Example of big data application
Ship operator	Operation	• Energy-saving operation • Safe operation • Schedule management
	Fleet planning	• Fleet allocation • Service planning • Chartering
Shipowner	Technical management	• Safe operation • Hull & propeller cleaning • Condition monitoring and maintenance • Environmental regulation compliance • Energy-saving retrofit
	Newbuilding	• Design optimization

Figura 5: Áreas de aplicación del IoT y Big Data en el sector naval. Diagrama. Fuente: Monohakobi Technology Institute. Utilizing Big Data and the **IoT** in Shipping, Taizo Yoshida, 2016

Por motivos prácticos se ha optado por clasificar las aplicaciones del **IoT** en el sector marino en dos grupos: Diseño y construcción; y operación. Sin embargo, es necesario recalcar, que las tecnologías **IoT** buscan, como fin último, optimizar la operación del buque durante toda su vida y, por tanto, están pensadas para permanecer en el buque en todas las etapas de su vida útil, proporcionado información versátil, de aplicación tanto para armadores, operadores de buques y clientes, como para los propios astilleros e ingenieros responsables del diseño del buque, que seguirán monitorizando el buque durante su operación para utilizar los datos adquiridos en sus futuros diseños.

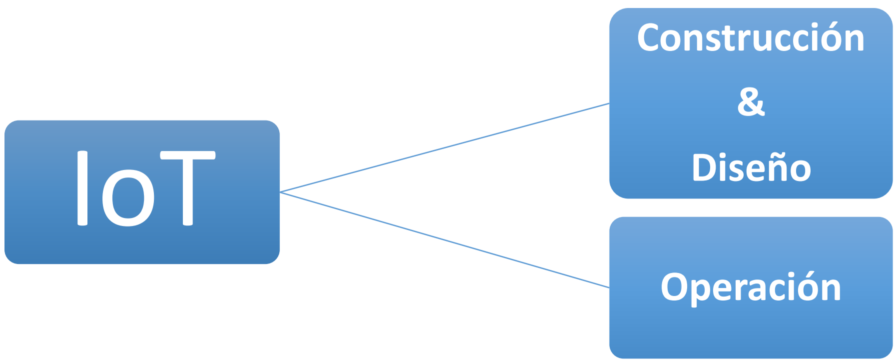

Figura 6. Principales aplicaciones de IoT en el sector naval.

Antes de enumerar y desarrollar en detalle las aplicaciones del **IoT** es necesario discutir una serie de conceptos nuevos estrechamente relacionados con esta tecnología: "*Internet of Ship*", "*Smart Ships*" o buques inteligentes y "*Unmaned vessels*" o barcos no tripulados.

Internet of Ships

"The Royal Institution of Naval Architects" define en su artículo "The internet of Ships: a new design for Smart Ships" el concepto Internet of Ships, o simplemente IoS, como un nuevo ecosistema que incorpora tendencias tecnológicas emergentes que se han adaptado al entorno específico de la construcción naval.

El informe "Internet of Ships: The future ahead", profundiza en este nuevo concepto, estableciendo que la aplicación del **IoT** en el sector naval no solo debe limitarse a la monitorización del buque durante su operación, sino que debe aplicarse en las fases de diseño y producción del buque. La monitorización continua que nos permiten las tecnologías **IoT**, integrada a software CAD de diseño naval como FORAN, reducirá costes y evitará errores y fallos permitiendo tomar decisiones en tiempo real desde cualquier punto conectado a la red, ya sea en el astillero o la oficina técnica.

Todas estas ventajas y oportunidades muestran al IoS, basado en sistemas **IoT**, como una herramienta clave para la mejora y la eficiencia del proceso de diseño y producción de un buque. Además, este concepto estará presente durante la vida útil del barco, permitiendo detectar si un elemento a bordo está a punto de fallar, predecir cuándo se ha de disponer del buque para su reparación o pintado, detectar si la corrosión ha alcanzado cierto límite, etc. La eficiencia energética también podrá ser monitorizada y evaluada, permitiendo retrofits del buque y mejoras en diseños futuros. Esta información es de gran utilidad para el armador, pero también para el propio astillero, ya que permite aumentar la calidad de sus servicios y reducir los tiempos muertos de los buques.

Por tanto, el objetivo último de los IoS es alcanzar una producción rentable, segura, eficiente y sostenible en el marco de la construcción naval.

Smart Ships

Se entiende como Smart Ship o barco inteligente, un buque que emplea aplicaciones **IoT** con el objetivo de alcanzar una operación óptima en términos de seguridad y eficiencia.

Partiendo de esta sencilla definición se llega a la conclusión de que no es posible el desarrollo de este tipo de embarcaciones sin el empleo de tecnologías **IoT**, las cuales se combinan con otras tecnologías tales como sensores, comunicaciones por satélite, big data y automatización, entre otros, para crear un sistema de control y monitorización del buque que haga posible la mencionada optimización.

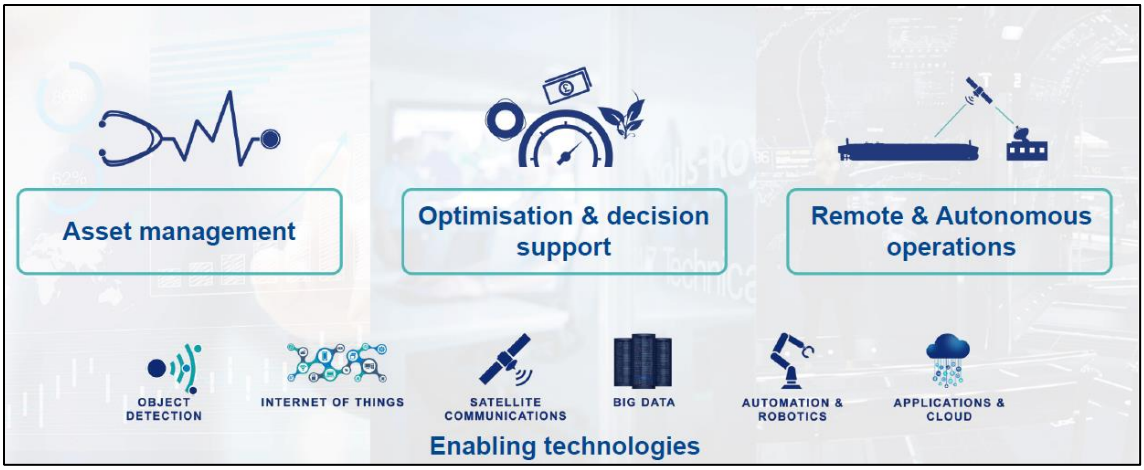

Figura 7: Ship Intelligence. Fuente: Rolls-Royce. Smart Ships of the Future, Oskar Levander & Esa Jokioinen, 2016.

Unmanned vessels

Un *unmanned vessel* o barco no tripulado, como su nombre indica, es un buque que tiene la capacidad de operar por control remoto y/o de manera autónoma sin necesidad de que exista una tripulación a bordo. Estos buques son el resultado de implementar las virtudes de la Industria 4.0, combinada con la tecnología **IoT** y mediante una conexión completa de todos los elementos del barco.

La evolución hacia este concepto de buque supondrá un cambio drástico en el entendimiento y comprensión del sector de la construcción naval y la navegación tal y como conocemos. Dicho escenario será propicio para una mayor implantación y desarrollo de las tecnologías **IoT** en el sector naval.

4.1 IoT en el diseño y la construcción naval

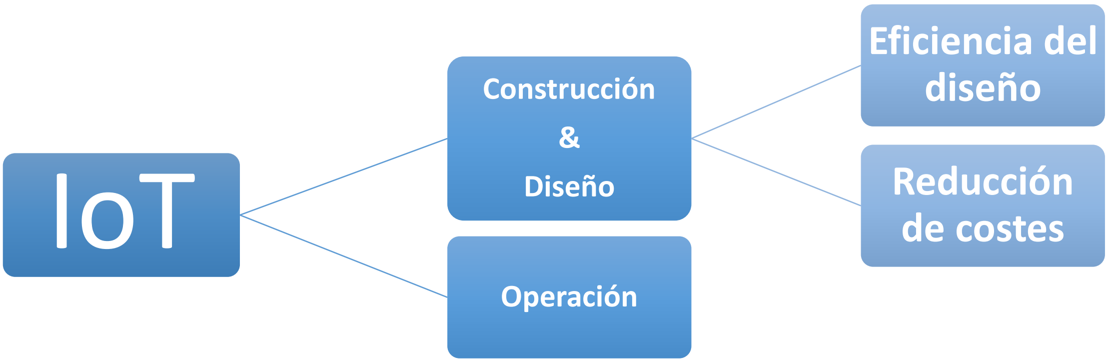

Figura 8. Principales aplicaciones de **IoT** en el sector naval. Construcción & Diseño

Internet of Things (**IoT**) está posicionándose como una de las tecnologías emergentes dentro del sector de la construcción naval. El proceso de construcción de un buque genera tal cantidad de información que, a priori, hace imposible disponer de todos estos datos en tiempo real. Sin embargo, el avance de las nuevas tecnologías y la implantación del **IoT** plantean una solución efectiva a este problema. La posibilidad de monitorizar internamente los procesos de producción supone reducir costes, identificar desviaciones, evitar errores y tomar decisiones en tiempo real.

Esta ventaja tiene especial relevancia en un sector descentralizado como el naval, donde a menudo la ingeniería y la producción se encuentran ubicadas en diferentes localizaciones y donde las decisiones críticas no pueden esperar. El **IoT** puede proporcionar medios para supervisar todas aquellas partes en las que la detección temprana de eventos permite tomar las decisiones correctas. La buena toma de decisiones, la reducción de errores y la capacidad de detectar si el producto presenta desviaciones con respecto al diseño CAD en las primeras etapas de la producción, supondrán una reducción de costes y una mayor eficiencia del proceso productivo.

Una vez finalizada la construcción y tras la puesta en servicio del buque, las tecnologías **IoS** posibilitan el monitorizar una serie de parámetros de interés durante el ciclo de vida del buque. Mediante una monitorización continua es posible optimizar el diseño de cara a futuros buques o incluso disponer de información suficiente para realizar un retrofit del buque monitorizado a fin de mejorar sus características. Uno de los parámetros más relevantes desde el punto de vista del diseño, es la eficiencia energética. Los datos obtenidos mediante los sensores instalados a bordo y la transmisión continua de datos puede proporcionar bases sólidas para la mejora de las formas del buque.

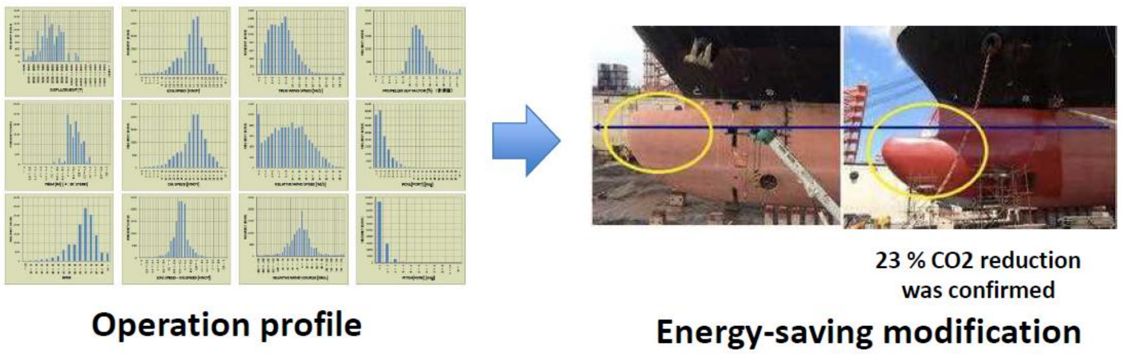

Figura 9: Modificación del bulbo a partir de datos recogidos durante la operación del buque. Fuente: Monohakobi Technology Institute. Utilizing Big Data and the IoT in Shipping, Taizo Yoshida, 2016

En conclusión, el **IoT** es por tanto una herramienta que ayudará a garantizar una producción segura, eficiente y sostenible para todo tipo de buques.

4.2 IoT durante la operación de buques

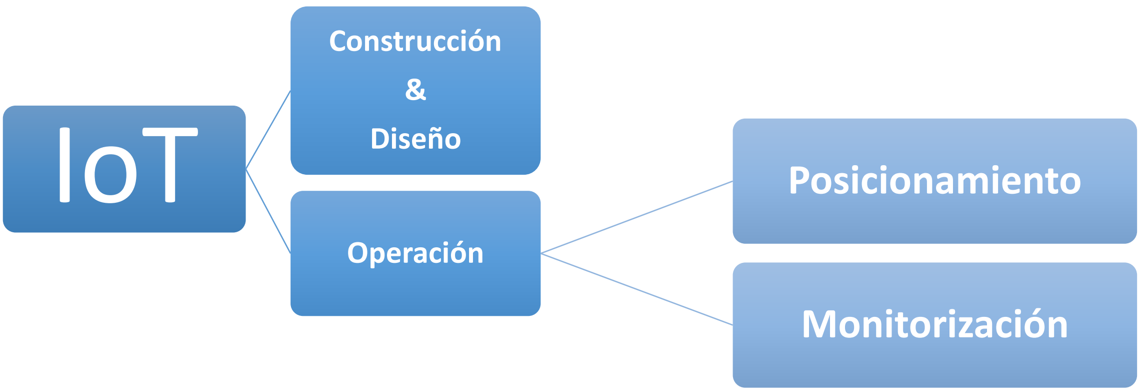

Figura 10. Principales aplicaciones de IoT en el sector naval. Operación

La implementación de soluciones **IoT** en los buques puede tener un impacto significativo en la optimización de rutas, reducción costes de mantenimiento y mejora de la seguridad, entre otros. Mediante estas tecnologías, los armadores tienen la capacidad de monitorizar el estado del buque en tiempo real lo que permite un gobierno más eficiente, ahorrando costes en tiempos y combustible. Los sensores y las tecnologías

IoT están facilitando, además, la introducción de nuevas aplicaciones en el mar, tales como la distribución de energía, control y tratamiento de las aguas y monitorización de equipos en tiempo real.

4.2.1. Posicionamiento

Optimización de rutas

La comunicación entre buques es siempre un factor fundamental a la hora de determinar las rutas más eficientes y evitar colisiones. Gracias a las tecnologías **IoT**, es posible rastrear en tiempo real la posición de un buque y transmitir esa información a otros buques conectados a la red.

Esta información se actualiza constantemente, ya que las tecnologías **IoT** permiten captar y enviar datos en tiempo real. Este feedback continuo permite recalcular constantemente la ruta de los barcos, a fin de elegir las más eficiente.

Esto supone que los capitanes o las oficinas en tierra pueden analizar y modificar las rutas de los buques para determinar la más eficiente, evitando accidentes y temporales de manera eficaz. Ya existen navieras que han implementado software que muestran mapas interactivos donde los capitanes muestran información sobre su ruta e intenciones mediante tecnologías **IoT**.

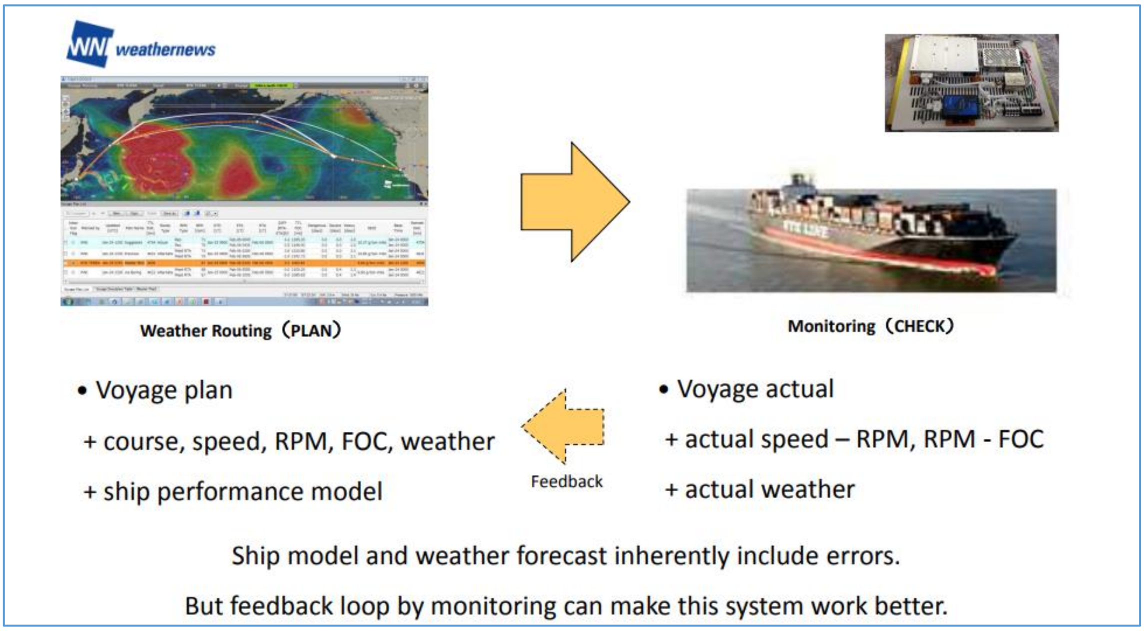

Figura 11: IoT en la optimización de rutas. Diagrama de proceso. Fuente: Monohakobi Technology Institute. Utilizing Big Data and the IoT in Shipping, Taizo Yoshida, 2016

Seguimiento de la carga

El rastreo en tiempo real es de gran utilidad para el dueño de la carga, quien puede conocer la posición de ésta en todo momento, pudiendo adelantarse a cambios e imprevistos en el itinerario del buque y, por tanto, actuar sobre los otros eslabones que componen la cadena de suministro de la carga (transporte en tierra, operaciones en puertos, etc.)

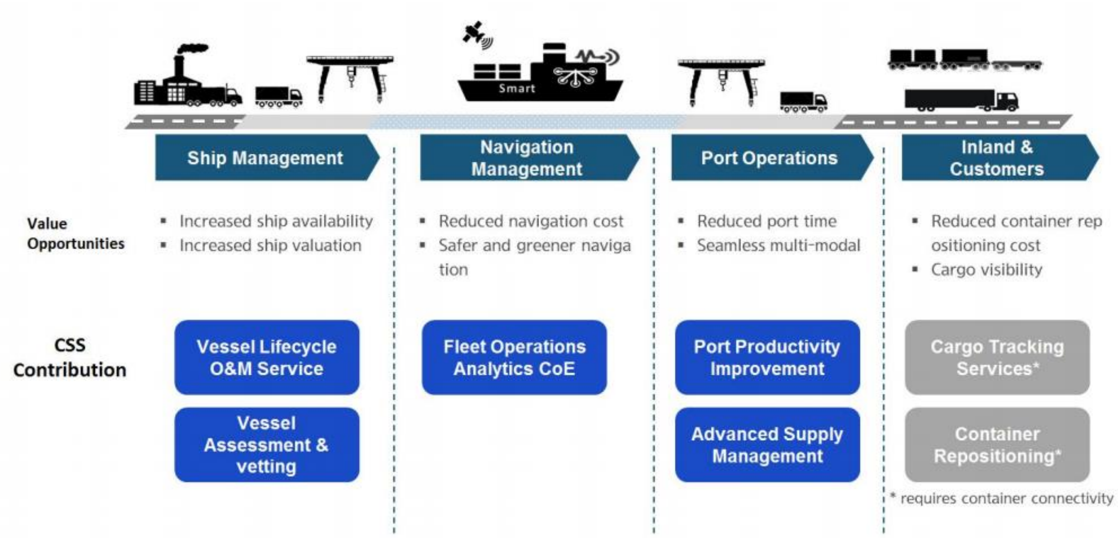

Figura 12. Cadena de valor. Connected Smart Ship. Fuente: Hyundai, Connected Smart Ship, YoungSoo Cheong, 2015.

Mientras que lo expuesto anteriormente beneficia en gran medida al propietario de la carga, la naviera es capaz de automatizar la gestión de contenedores vacíos y la recolocación de los mismos gracias a las tecnologías **IoT**.

Seguridad

La seguridad también se ve beneficiada por este sistema, ya que es posible establecer un seguimiento continuo del buque en tiempo real y conocer la situación exacta del buque en el momento en que se produce un accidente o se detecta una amenaza.

En lo relativo a colisiones y errores humanos, el rastreo continuo de la posición del buque y la conexión directa con otros buques y centros de control en tierra, permiten tomar las medidas necesarias antes de que estos eventos ocurran.

4.2.2. Monitorización

Seguimiento del estado de la carga

Los modernos contendores empleados para el transporte marítimo incorporan sensores capaces de medir una serie de parámetros dentro de los mismos, tales como temperatura, humedad o refrigeración. Ciertos contenedores han de permanecer a la misma temperatura durante toda la travesía a fin de garantizar un buen estado del producto hasta llegar a tierra firme.

Las tecnologías **IoT** permiten transmitir estos parámetros en tiempo real, haciendo posible determinar las condiciones en las que se encuentra la carga durante toda la travesía, lo que permite al operador del buque, a la compañía o al propietario de la carga, controlar y validar su estado. Este sistema sustituye a las inspecciones que se llevan a cabo en los contenedores habitualmente (especialmente los refrigerados), para garantizar el buen estado de la carga y del propio contenedor.

Optimización del mantenimiento

El mantenimiento de grandes buques supone, en la casi totalidad de casos, un elevado consumo de tiempo y dinero. La monitorización de los costosos equipos abordo puede ayudar a solucionar problemas antes de que ocurran.

Históricamente, el mantenimiento preventivo se ha orientado como una serie de tareas a realizar periódicamente -según un calendario o tras haberse producido un determinado número de acciones-. La periodicidad de las tareas de mantenimiento se determinaba mediante estudios estadísticos.

La implementación de sensores y las conexiones **IoT** suponen un avance en el mantenimiento de los equipos. Los sensores y las conexiones **IoT** permiten recoger datos del equipo y transmitirlos en tiempo real, con lo que se realiza una evaluación continua del equipo bajo sus condiciones operativas reales. Los datos obtenidos y transmitidos son analizados y dan como resultado un informe del estado del equipo basándose en los parámetros analizados. Al detectarse una desviación en los parámetros esperados, el sistema alertará a los operarios o al personal responsable de supervisar y/o operar el equipo. Además, estos sistemas son capaces de establecer predicciones acerca del rendimiento del equipo en el futuro. Teniendo todos estos datos a su disposición, las navieras, armadores o capitanes podrán tomar decisiones acertadas en los relativo al mantenimiento del equipo, se reducirá el número de acciones periódicas preventivas y se actuará sobre el equipo solo cuando la situación lo requiera, reduciendo los tiempos en puerto por mantenimiento. Todo ello permite una gestión más eficiente del buque y de sus partes críticas mediante una monitorización en tiempo real y diagnósticos predictivos.

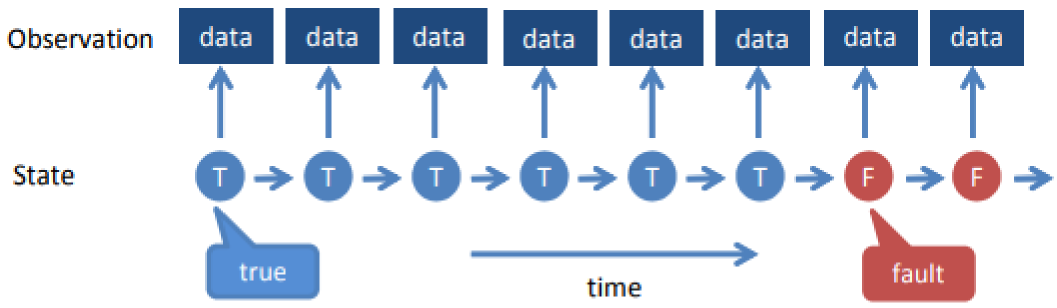

Figura 13: Monitorización del estado de un equipo abordo.

Eficiencia energética

Un buque eficiente desde el punto de vista energético es aquél que consume el mínimo de combustible o potencia durante su operación y en cuya construcción se han empleado la mínima energía y recursos.

Durante su operación, los operadores de barcos tienen el deber de operar sus buques de la manera más eficiente posible desde el punto de vista energético, lo que contribuye a reducir la contaminación del medio. Mediante las nuevas tecnologías es posible monitorizar parámetros tales como la velocidad del buque y las condiciones del medio (corrientes y viento) y analizarlas automáticamente con el fin de optimizar la ruta del buque desde el punto de vista energético. **IoT** y Big Data son imprescindibles para hacer realidad este hecho. Del mismo modo, estos datos se pueden emplear para modificar la configuración del buque durante la navegación -como el agua de lastre o la disposición de la carga-, de manera que el buque consuma el mínimo posible de energía. Toda esa información puede ser compartida con otros buques que la emplearán para, a su vez, hacer comparaciones y encontrar su disposición y rutas óptimas para la travesía.

Además, a esto hay que sumar las operaciones de mantenimiento del casco ya descritas en esta misma sección. El conjunto de estas medidas incide muy positivamente en la reducción del consumo de combustible.

4.3 IoT en acuicultura

Las principales ventajas de la aplicación de **IoT** a la acuicultura se localizan en torno a la rapidez de las comunicaciones, la mejora en los estándares de calidad, del suministro o de la cadena de frío. Pero quizás el mayor beneficio sea la monitorización remota. A medida que más dispositivos se vinculan a Internet, los gerentes y responsables de las instalaciones pueden ver constantemente varias tendencias y otros datos cruciales en tiempo real, vigilando los parámetros desde cualquier ubicación.

La sobrepesca, la demanda cada vez mayor de los consumidores, la contaminación/el cambio climático y una serie de otros factores amenazan el suministro mundial de productos del mar. Una solución que ha demostrado ser efectiva es la acuicultura, o la piscicultura, aunque no deja de tener controversia. Mientras los productos pesqueros cultivados de muchos países (principalmente occidentales) son seguros, los que provienen de países mal o nada regulados, hacen que los consumidores se cuestionen sobre seguridad de los os peces no silvestres que consumen. Las pruebas de laboratorio y las investigaciones han descubierto productos químicos cancerígenos, así como desechos humanos y de otros animales, en el agua. Además de eso, algunas granjas de peces se dedicaban a actividades consideradas ilegales en la mayoría de los países.

La tecnología **IoT** puede ofrecer muchos beneficios. Puede optimizar cualquier operación de acuicultura, además de garantizar que los productos cultivados y cosechados cumplan con los estándares aceptados.

¿Cómo está el agua hoy?

El pescado de granja y las plantas comestibles literalmente viven o mueren en función de las condiciones del agua. La temperatura del agua, el pH y la turbidez, junto con el oxígeno disuelto, la clorofila, el amoníaco y otros elementos, se pueden controlar en tiempo real para garantizar un entorno óptimo. Cualquier irregularidad, incluida la presencia de contaminantes que pueden causar cáncer, genera alertas que pueden aumentar si el sistema detecta que el bienestar de la población se ve amenazado. Los parámetros de alerta pueden basarse en el tipo de stock, el entorno de crecimiento deseado o el tamaño de cosecha ideal, eliminando así posibles amenazas antes de que puedan tener un impacto significativo y negativo. Por ejemplo, un cierto nivel de pH puede ser aceptable para los peces, pero también fomenta el crecimiento negativo de bacterias.

La monitorización también puede usarse para detectar objetos desconocidos o intrusos en el momento que entran en el agua, una característica especialmente valorada en piscifactorías al aire libre o aquellas donde el público puede acceder. Los sensores pueden ser ajustados para ignorar o descartar cosas como hojas caídas o pequeñas ramas -mientras sigan estando presentes- incluso envían notificaciones aún si el más pequeño visitante se ve en peligro (como un insecto invasor). Esta sensibilidad puede decir si el pescado se está alimentando de restos de comida caída que no forma parte de su dieta habitual (e incluso estricta), lo que afecta los esfuerzos generales de cultivo. Cada "invasor" se identifica y se siguen sus patrones para garantizar la seguridad de la población y si la operación necesita ajustes para contrarrestar una nueva amenaza (como una eclosión masiva de una especie de insecto determinada).

Una gran historia del pescado

Monitorizar el estado del stock puede ser igual de preciso con **IoT**. Además de los esfuerzos de detección ya mencionados, los sensores también pueden descubrir enfermedades y problemas similares en sus etapas iniciales antes de que se generalicen. El comportamiento de cada pez es monitorizado constantemente para cualquier anormalidad que pueda derivar en un problema, incluida la combinación continua de patrones de nado con estándares conocidos para la especie. Esto permite que los gerentes realicen modificaciones en la acuicultura con el fin de duplicar mejor los entornos del mundo real para una salud óptima del stock. El número de pece se contabiliza con precisión cada minuto, y se envían alertas si desciende por muerte o incluso por casos de pesca ilegal.

Con los conocimientos granulados de **IoT**, la comida se libera en el agua en el mejor momento para dar de comer en función del tipo de especies. Cualquier sobra se registra y posteriormente la cantidad se relaciona con el histórico de datos para descubrir las razones subyacentes. Por ejemplo, la cantidad asignada puede haber sido demasiado grande para empezar, o los peces pueden estar reaccionando negativamente a una condición ambiental no detectada. Si algunos peces crecen más rápido que otros y/o consumen más alimentos, los peces menores pueden ponerse en cuarentena y someterse a una dieta especial para aumentar sus tasas de crecimiento. Puede realizarse una detección temprana de los problemas de stock imprevistos, como los que se encuentran cuando un ecosistema existente se repone con peces nuevos, para prevenir cualquier daño o pérdida de vidas. Cualquier cantidad de experimentos, desde probar diferentes tipos de alimentos hasta alterar las mezclas de agua, se puede hacer sobre la marcha con resultados inmediatamente rastreables. Esto puede mejorar tanto la calidad de las acciones como las ganancias finales.

IoT optimiza todos los aspectos de la acuicultura, promueve la sostenibilidad y permite a los gobiernos/agencias locales monitorear mejor incluso las granjas de peces más remotas para garantizar que se críen animales sanos y comestibles. Todo lo cual hace que la acuicultura sea el sub-nicho ideal para los proveedores de servicios.

5. Tendencias en la aplicación de IoT en el ámbito de este informe

Tal y como se especifica en la Introducción, la aplicación del **IoT** se va a centrar en los ámbitos del diseño, construcción y transporte naval, y acuicultura. Para ello, en este apartado se recogen publicaciones, patentes, proyectos, noticias y eventos que reflejan las tendencias de **IoT** en los ámbitos de estudio de este informe.

5.1 Literatura científica

5.1.1. Diseño, construcción y transporte naval

Internet of Ships. The Future Ahead
Autores: Guangwu Liu, Rodrigo Perez, Jesús A. Muñoz, Francisco Regueira.
Fecha de publicación: 29 de octubre de 2016
Enlace: https://file.scirp.org/pdf/WJET_2016112917055129.pdf

Abstract: There are many advantages of using Computer Aided Design (CAD) Systems in a shipbuilding environment: ease of design, speed of construction, use and reuse of information, etc. It is expected that in future CAD tools will advance further and allow greater information management and virtual access through smart devices. The authors of this paper talk about a new concept in shipbuilding, the Internet-of-Ships (IoS) which would have a deep impact on the ship design and production, with a huge diversity of present and potential applications.

Big Data and Industrial Internet of Things for the Maritime Industry in Northwestern Norway
Autores: Hao Wang, Ottar L. Osen, Guoyuan Lit, Wei Lit, Hong-Ning Dai, Wei Zeng.
Fecha de publicación: 2015
Enlace: https://ieeexplore.ieee.org/document/7372918/

Abstract: Big Data Analytics (BDA) and Internet of Things (IoT) are rising quickly. The recent emerging Industrial IoT (IIoT), a sub-paradigm of IoT, focuses more in safety-critical industrial applications. Studies showed that the adoption of BDA increase companies' output and productivity; IoT enables companies to have more information and control in physical resources, processes, and environments; BDA and IIoT complement each other and develop as a double "helix". In this position paper, we briefly review the opportunities and challenges in this era of big data and IoT for the Møre maritime cluster; then we propose a new framework integrating BDA and IIoT technologies for offshore support vessels (OSVs) based on a hybrid CPU/GPU/FPGA1 high performance computing platform. We believe that such a framework, when implemented, can help maritime companies increase their output and productivity, and hence enable the whole cluster to continue to be a leader in the global maritime industry.

IBM. Industrial Internet of things use cases
Autor: Tracy, Phillip.
Fecha de publicación: 9 de abril de 2017
Enlace: https://www.ibm.com/blogs/internet-of-things/the-i**IoT**-at-sea/?lnk=hmhm

Abstract: The Industrial Internet of Things has found its way to sea, with connected sensors and unified platforms designed to provide increased visibility for crews. Ships have been equipped for some time with sensors that collect data. Now, that data can be optimized and sent in real time to captains, their colleagues, other ships in the network or the shipping company's communication headquarters on land. These sensors monitor everything from a ship's speed to the temperature of its cargo, allowing for an optimized shipping ecosystem.
Despite the fact ships carried an estimated 9.6 billion tons of cargo in 2013 – around 80% of global trade by volume and over 70% of global trade by value – the maritime industry lags behind alternative transport industries in terms of its use of information and communications technology, according to Ericsson.
Instances where industrial IoT solutions can be implemented in maritime operations can have a significant impact on route optimization, maintenance costs and asset tracking. Here is a closer look at those use cases for implementing an IIoT solution out at sea.

Marsec Inc. Industrial Internet of Things in the Maritime Industry
Autor: Wojnarowicz, Krystyna.
Fecha de publicación: 11 de febrero de 2015
Enlace: https://blog.blackducksoftware.com/industrial-internet-of-things-in-the-maritime-industry/

Abstract: In the recent report issued by the World Economic Forum in January 2015, "Industrial Internet of Things: Unleashing the Potential of Connected Products and Services," we read about the emergence of hybrid industries as a result of the Internet of Things (IoT);

In time, the Industrial Internet will blur industry boundaries or give rise to new hybrid industries.

Intermodal transportation networks are one example of these new, hybrid industries, encompassing the maritime industry as an integral part of such a global network. These hybrid industries will require a new breed of engineers and specialists where domain-specific software engineering will play a crucial role.

Transportation has already been very active in the Internet of Things development, with transportation and logistics companies being some of the first to adopt IoT in their daily business. The transformative power of IoT has already made an impact on the traditionally conservative maritime industry. In fact, maritime has an advantage over many other industries when it comes to IoT implementation and adoption. For decades, ships have been carrying a multitude of sensors onboard, collecting data that, until recently, has not been utilized and analyzed to optimize the maritime operations. The Industrial IoT may be as disruptive for maritime as the steam engine or the introduction of cargo containers were in the past. Accelerated by open source software, wireless, and mobile technologies, the adoption of IoT by the maritime industry has already began.

Web-Based GIS Through a Big Data Open Source Computer Architecture for Real Time Monitoring Sensors of a Seaport
Autores: Fernandez, Pablo; Santana, Jose M.; Ortega, Sebastian; et al.
Páginas: 41-53
Fecha de publicación: 2017
DOI: 10.1007/978-3-319-45123-7_4
Enlace: https://books.google.es/books/Web-Based GIS Through a Big Data Open Source Computer Architecture for Real Time Monitoring Sensors of a Seaport

Abstract: Numerous activities and processes of a wide nature occur in a modern seaport. To name a few, goods, travelers transportation, fishing, rescue and protection agents and increasing demanding human habits around tourism. In the paradigm of "The Internet of Things" we present "Puerto de la Luz" SmartPort a solution for real time monitoring of sensor data in a seaport infrastructure. We describe the computer architecture and the enriched Internet application that allows the user to visualize and manage real-time information produced in the seaport environment. The Big Data management is based on the FIWARE platform. The entire system is implemented in the "Puerto de La Luz" seaport, in Las Palmas de Gran Canaria, Canary Islands, Spain. We remark the architecture for processing and visualizing the streaming data coming from two sensors physically deployed on the neighborhood of the seaport and underline new features to truly manage Big Data.

Developing a Maritime Internet of Things Service Big Data Analytics for Remote Vessel Monitoring, Operations
Autores: Balog, Bob; Hopkins, Robert; Croy, John.
Páginas: 41-43
Fecha de publicación: junio 2017
Fuente: Sea Technology, Vol. 5, Núm. 6
ISSN: 0093-3651
Enlace:https://apps.webofknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=3&SID=D1RkDYMCKQb3IjMk7Jq&page=1&doc=1

Abstract: The aim of the project is the realization of R & D, the results of which will be deployed product AVAL constitutes a breakthrough innovation in the market of maritime transport. AVAL is a technology autonomous marine vessel integrates with navigation devices, autopilots and control systems of modern ships. AVAL technology consists of three components: 1) Technology unmanned marine ship BSM. The biggest challenge will be BSM anti-collision algorithm and a system of communication between the BSM. BSM will use both unmanned ships (further in the future) as well as those operated by the crew of the level of autonomy AL3. 2) Technology unmanned aerial BSP (ang. UAV - Unnamed Aerial Vehicle), which hovers and lands on BSM and during the flight leads observing the area around the ship. The aim of the BSP, equipped with a camera and sensors to register and transfer to the BSM video data and hydro-meteorological. 3) The image processing SPO, which is a key element detection algorithm in the images recorded by the BSP objects that are not "visible" on devices navigation (AIS, Radar, ARPA), and which pose a threat to shipping (ie. Pleasure craft, mountains ice, whales). The aim of the study is to verify the research also implies a strictly defined technological uncertainty in the area of three technology components AVAL. Their positive verification in laboratory conditions, quasi-real and real is a prerequisite for the start of the implementation work on the product AVAL. The project was planned 10 stages of research, which will be implemented by a multidisciplinary team of experienced R & D remaining in the disposal of the consortium of scientific and industrial using closely matched to the tasks of the project research infrastructure.

Mobile middleware platform for secure vessel traffic system in IoT serviceenvironment
Autores: Park, Namje; Bang, Hyo-Chan.
Fecha de publicación: abril 2016
Páginas: 500-512
Fuente: Security and Communication Networks, Vol. 9, Núm. 6.
e-ISSN: 1939-0122

DOI: 10.1002/sec.1108
Enlace:http://caclase.co.uk/wp-content/uploads/2017/07/ST_DevelopingMaritime.pdf

Abstract: The Inter-VTS Data Exchange Format (IVEF) service is the draft standard designed for exchange of information on sea traffic between the vessel traffic systems and between the vessels. Standardization of this service is under way as a part of the next-generation navigation system, called e-Navigation. The International Association of Lighthouse Authorities suggests, on its recommendation V-145, the IVEF service model and the protocol for provisioning of this service. But the detailed configuration of this service must be designed by the users. IVEF service is aimed at establishing a common framework to ensure exchange of ship information between vessel traffic service (VTS) centers gained via automatic ship identification device, closed-circuit television, radar system and other devices. Robust exchange of marine traffic information between VTS centers through IVEF service will enable related authorities to identify location of domestic and international ships in the coastal waters real-time and predict expected sea route, thus ensure effective sea route control and pre-emptive response to potential disasters or accidents. This paper suggests, based on the basic service model and protocol provided in the recommendation V-145, the implementation of the Jeju-VTS middleware, which will facilitate exchange of information on sea traffic. This paper developed a system enabling IVEF service simulation under an Internet of Things environment made possible by improving IVEF software development kit, which is an open source. For this, a mobile phone loaded with Android platform and desk top PC has been used for emulation of a ship on voyage and VTS center. Copyright (c) 2014 John Wiley & Sons, Ltd.

Utilising the Internet of Things for the Management of Through-life Engineering Services on Marine Auxiliaries

Autores: von Stietencron, Moritz; Rostad, Carl Christian; Henriksen, Bjornar; et al.
Fecha de publicación: 2017
Páginas: 233-239
Fuente: Proceedings of the 5th International Conference in Through-Life Engineering Services, Vol. 59.
e-ISSN: 1939-0122
DOI: 10.1016/j.procir.2016.09.003
Enlace:https://apps.webofknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=8&SID=D1RkDYMCKQb3ljMk7Jq&page=1&doc=1

Abstract: The producers of marine auxiliaries face the challenge, that they need to adapt their schedule for maintenance, repair and overhaul (MRO) operations and other Through-life Engineering Services (TES) to the otherwise defined and often not well communicated schedules of the ships, which are carrying their products. The management of the MRO operations is currently a manual and time-consuming effort and makes the creation of Product Service Systems (PSS) a tedious effort. To help overcome this unnecessary hurdle, this paper presents a solution approach and its prototypical implementation utilising the Internet of Things (**IoT**) to aid the marine auxiliaries' producers in the process of managing the product usage phase and its services. As data basis for the decision support, the constantly produced information of the Automatic Identification System (AIS) is used and combined with Product Usage Information and enterprise data. (C) 2016 The Authors. Published by Elsevier B.V.

Visual analytics in ship performance and navigation information for sensor specific fault detection
Autores: Perera, Lokukaluge P.; Mo, Brage
Fecha de publicación: junio 2017
Fuente: 36th ASME International Conference on Ocean, Offshore and Arctic Engineering, Vol. 7B.
ISBN: 978-0-7918-5774-8
Nº Art.: UNSP V07BT06A032
Enlace:https://www.researchgate.net/publication/314230100_Visual_Analytics_in_Ship_Performance_and_Navigation_Information_for_Sensor_Specific_Fault_Detection

Abstract: This study proposes visual analytics, where hidden data patterns, clusters, correlations and other useful information are visually from the respective data set extracted, to identify such erroneous data regions. The domain knowledge (i.e. ship performance and navigation conditions) has also been used to interpret such erroneous data regions and identify the respective sensors that relate to the same situations. Finally, a ship performance and navigation data set of a selected vessel is analyzed to identify erroneous data regions for three selected sensor fault situations (i.e. wind, log speed and draft sensors) under the proposed visual analytics.

Smart Pipe System for a Shipyard 4.0
Autores: Fraga-Lamas, Paula; Noceda-Davila, Diego; Fernandez-Carames, Tiago M.; et al.
Fecha de publicación: diciembre 2016
Fuente: Sensors, Vol. 16, Núm. 12.
ISSN: 1424-8220

DOI: 10.3390/s16122186
Enlace:https://apps.webofknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=10&SID=D1RkDYMCKQb3ljMk7Jq&page=1&doc=1

Abstract: As a result of the progressive implantation of the Industry 4.0 paradigm, many industries are experimenting a revolution that shipyards cannot ignore. Therefore, the application of the principles of Industry 4.0 to shipyards are leading to the creation of Shipyards 4.0. Due to this, Navantia, one of the 10 largest shipbuilders in the world, is updating its whole inner workings to keep up with the near-future challenges that a Shipyard 4.0 will have to face. This article first conducts a thorough analysis of the shipyard environment. From this analysis, the essential hardware and software technical requirements are determined. In order to build a smart pipe system, different technologies are selected and evaluated, concluding that passive and active RFID (Radio Frequency Identification) are currently the most appropriate technologies to create it. Furthermore, some promising indoor positioning results obtained in a pipe workshop are presented, showing that multi-antenna algorithms and Kalman filtering can help to stabilize Received Signal Strength (RSS) and improve the overall accuracy of the system.

The IT convergence framework design in the internet of things environment
Autores: Yoo, Taijong; Chang, Hangbae.
Fecha de publicación: 2013
Fuente: Eurasip Journal on Wireless Communications and Networking. Art. 53.
ISSN: 1687-1499
DOI: 10.1186/1687-1499-2013-53
Enlace: https://jwcn-eurasipjournals.springeropen.com/track/pdf/10.1186/1687-1499-2013-53?site=jwcn-eurasipjournals.springeropen.com

Abstract: In the Internet of things that could intelligent functions such as communications, context awareness, remote control, and provide services to users by assigning advanced communication functions to things, a convergence process between the general manufacturing industry and the IT industry. In detail, the IT convergence is divided into one for the product itself and one for the product manufacturing process. This study designs a model to objectively measure the IT convergence level for the automobile and shipbuilding industries, which are classified as a typical manufacturing industry, and applies it to them so that it would like to acquire availability of the model as well as to provide the present condition of current IT convergence level.

Research on Intelligent Design of Luxury Yacht
Autores: Liu, Fuyong; Chen, Chaohe; Wu, Wei.
Fecha de publicación: 2017
Fuente: 13th Global Congress on Manufacturing and Management, Vol. 174
Páginas: 927-933
ISSN: 1877-7058
DOI.: 10.1016/j.proeng.2017.01.243
Enlace:https://www.sciencedirect.com/science/article/pii/S1877705817302436?via%3Dihub

Abstract: Unified model-driven and intelligent collaborative design has gradually become a new paradigm in luxury yacht design as the Internet of Things (**IoT**) and Big Data are gaining global momentum. This paper aims to initiate a research framework to systematically study feasibilities and challenges in developing and implementing this new paradigm. As the first step of this grand research endeavor, the paper investigates the state-of-the-art technological infrastructure to digitalization and automation in yacht production design and conducts theoretic analysis of data integration and synergistic design collaboration as the backbone to this data-intensive, intelligent and collaborative design approach. The paper then conjectures the possible development trend of luxury yacht production in the intelligent design and manufacturing environment and lays out a foundation to future research. (C) 2017 The Authors. Published by Elsevier Ltd.

Energy-Efficient Through-Life Smart Design, Manufacturing and Operation of Ships in an Industry 4.0 Environment
Autores: Joo Hock Ang, Cindy Goh, Alfredo Alan Flores Saldivar and Yun Li.
Fecha de publicación: 2017
Fuente: MDPI (Multidisciplinary Digital Publishing Institute)
Páginas: 13
Enlace: http://www.mdpi.com/1996-1073/10/5/610/htm

Abstract: Energy efficiency is an important factor in the marine industry to help reduce manufacturing and operational costs as well as the impact on the environment. In the face of global competition and cost-effectiveness, ship builders and operators today require a major overhaul in the entire ship design, manufacturing and operation process to achieve these goals. This paper highlights smart design, manufacturing and operation as the way forward in an industry 4.0 (i4) era from designing for better energy efficiency to more intelligent ships and smart operation through-life. The paper (i) draws parallels between ship design, manufacturing and operation processes, (ii) identifies key challenges

facing such a temporal (lifecycle) as opposed to spatial (mass) products, (iii) proposes a closed-loop ship lifecycle framework and (iv) outlines potential future directions in smart design, manufacturing and operation of ships in an industry 4.0 value chain so as to achieve more energy-efficient vessels. Through computational intelligence and cyber-physical integration, we envision that industry 4.0 can revolutionise ship design, manufacturing and operations in a smart product through-life process in the near future.

5.1.2. Acuicultura

IoT Enabled Real-Time Fishpond Management System
Autores: Idachaba, Francis E.; Olowoleni, Joseph O.; Ibhaze, Augustus E.; et al.
Páginas: 42-46
Fecha de publicación: 2017
ISBN: 978-988-14047-5-6
En: World Congress on Engineering and Computer Science, Wcecs 2017, Vol I.

Abstract: The infrastructure requirement for setting up catfish farms include, a source of clean water, an avenue for discharging the waste water and reliable water containment systems. The challenges faced by the operators of these fish ponds include the need for regular feeding of the fish, monitoring of the water quality and the changing of the water when the quality becomes unhealthy for the fish. This work presents an Internet of Things based approach for automating the management of the farms and enabling remote monitoring and management of the ponds. The system comprises of a pond controller which uses appropriate sensors to monitor the water quality of the pond. A CCTV records the activities around the pond and stores them in a cloud location. The Pond controller manages the automatic feeding system of the fish and the water control system for the pond. The system is also designed with capacity for remote operation through a specially designed mobile application which accesses the CCTV files and controls the operation of the pond controller. This system will enable the management of one or more fish ponds from one mobile device, it will reduce the costs associated with managing the fish farms and improve quality of their yield.

A CMOS Seawater Salinity to Digital Converter for IoT Applications of Fish Farms
Autor: Chiang, Cheng-Ta.
Páginas: 2591-2597
Fecha de publicación: 2017

ISSN: 1549-8328
En: IEEE transactions on circuits and systems i-regular papers, Vol. 64, núm. 9.

Abstract: This paper proposes a complementary metal-oxide-semiconductor (CMOS) seawater-salinity-to-digital converter for Internet of Things (**IoT**) applications in fish farms. In contrast to previous studies, the proposed converter not only is suitable for processing seawater salinity but also has immunity to environmental low-frequency noise. Another innovation is that it can be easily delivered through transmission media before the **IoT**. The performance and functions of the proposed converter were successfully verified through measurements. The measured salinity range was 20-80 g/L, and the corresponding measured signal-to-noise-distortion ratio was 81.3-62.5 dB. The proposed converter is, therefore, suitable for **IoT** applications in salinity monitoring devices.

Application of Fault Tree Analysis and Fuzzy Neural Networks to Fault Diagnosis in the Internet of Things (IoT) for Aquaculture.

Autores: Chen, Yingyi; Zhen, Zhumi; Yu, Huihui; et al.
DOI:10.3390/s17010153
Fecha de publicación: 2017
ISSN: 1424-8220
En: Sensors, Vol. 17, Núm. 1.

Abstract: In the Internet of Things (**IoT**) equipment used for aquaculture is often deployed in outdoor ponds located in remote areas. Faults occur frequently in these tough environments and the staff generally lack professional knowledge and pay a low degree of attention in these areas. Once faults happen, expert personnel must carry out maintenance outdoors. Therefore, this study presents an intelligent method for fault diagnosis based on fault tree analysis and a fuzzy neural network. In the proposed method, first, the fault tree presents a logic structure of fault symptoms and faults. Second, rules extracted from the fault trees avoid duplicate and redundancy. Third, the fuzzy neural network is applied to train the relationship mapping between fault symptoms and faults. In the aquaculture **IoT**, one fault can cause various fault symptoms, and one symptom can be caused by a variety of faults. Four fault relationships are obtained. Results show that one symptom-to-one fault, two symptoms-to-two faults, and two symptoms-to-one fault relationships can be rapidly diagnosed with high precision, while one symptom-to-two faults patterns perform not so well but are still worth researching. This model implements diagnosis for most kinds of faults in the aquaculture **IoT**.**IoT**

Design and implementation of a distributed IoT system for the monitoring of water quality in aquaculture

Autores: Encinas, Cesar; Ruiz, Erica; Cortez, Joaquin; et al.
Fecha de publicación: 2017
ISBN: 978-1-5090-3599-1
En: 16th Annual Wireless Telecommunications Symposium (WTS) - Global Wireless Communications - Present and Future. 2017 Wireless Telecommunications Symposium (WTS).

Abstract: In this work we present the prototype and proof of concept of a distributed monitoring system of the most important variables in aquaculture water quality. This is of great importance because aquaculture is a lagging area of technology compared to other areas such as agriculture. So, it is important to solve the problems that are in this area with the support of technology. Among the problems is the slow response time in the care of water quality, the waste of resources and losses. The system proposed in this work monitors the water quality based on wireless sensor networks and on the Internet of Things (**IoT**). This information is important for the development of this area, since it allows sharing the different conditions in the breeding of aquatic organisms between different breeders and organizations. This information is useful to know the conditions in which there is a better development of a product, worse development, what conditions can mean a possible disaster in the environment and how to optimize resources for the care of the pond.

Ubiquitous Energy Efficient Aquaculture Management System

Autor: Rajesh, Sangeetha.
Páginas: 1124-1127
Fecha de publicación: 2016
ISBN: 978-1-5090-2028-7
En: 2016 International conference on advances in computing, communications and informatics (icacci).

Abstract: Pervasive computing enabled by wireless network technologies span a wide area of applications in modern living. Heterogeneous devices used in Internet of Things are highly constrained in terms of energy efficiency. Aquaculture is a technique of human intervention in the rearing process of aquatic animals. Several natural water parameters affect the productivity of aquaculture farming. This paper proposes an energy efficient ubiquitous architecture based on Internet of Things for an aquaculture environment. The proposed system collects the aqua_data in real-time using sensors. It applies the changes in the water environment at suitable times without human intervention. The algorithm for decision making in expert system is depicted. The paper converse about Thread wireless network protocol which provides longevity to the battery operated heterogeneous devices.

Intelligent Fishpond Monitoring System Based on STM32 and Zigbsee
Autores: Xie, Xi; Jian, Weizhong.
Páginas: 495-502
Fuente: Research Journal of Applied Sciences, Engineering and Technology 13 (6).
Fecha de publicación: 2016
ISSN: 2040-7459
DOI:10.19026/rjaset.13.3009
En: http://maxwellsci.com/msproof.php?doi=rjaset.13.3009

Abstract: The study is designed to monitor the temperature and dissolved oxygen content in the fishpond, especially to ensure that dissolved oxygen content in the fishpond is enough for aquaculture. This fishpond monitoring system is designed based on stm32 and Zigbee wireless transmission technology. This study uses Zigbee to build up a sensor network to monitor multi fishponds. Data acquisition unit consist of temperature sensor and dissolved oxygen sensor. The sensor data is transfered from the data acquisition unit to the stm32 master controller. These data can be used to generate a control strategy, which can control the oxygen-enriching machine to produce enough oxygen for aquaculture in the most optimized way. The data transformation between master controller and data acquisition is through Zigbee protocol radio communication, which is a reliable means to transfer data. Experiments results show that this fishpond monitoring system can achieve remoting monitoring and control dissolved oxygen content in an effective way. By controlling the dissolved oxygen in the fishpond, the system can increase the production of the aquaculture and decrease the breeding cost.

Automated Monitoring System for the Fish Farm Aquaculture Environment
Autores: Chen, Jui-Ho; Sung, Wen-Tsai; Lin, Guo-Yan.
Páginas: 1161-1166
Fecha de publicación: 2015
ISBN: 978-1-4799-8696-5
En: IEEE International Conference on Systems, Man, and Cybernetics (SMC).

Abstract: This panel will establish an automated monitoring system of wireless sensor networks for a fish farm Environment Simulation. This system allows a user with a mobile device to monitor the fish farm Environmental Data with Instant mastery and control over the various environmental data. Temperature, dissolved oxygen, PH value and water level sensing modules are incorporated in this monitoring system. MCU processing is used to capture the physical sensing signal. The ZigBee wireless sensor network brings the data to a central processing core. A WIFI interface

transfers the data to the user terminal device. The user can control the entire fish farm environment through the terminal device. Android software was used to design the terminal device user interface. A low power MSP430 series MCU is the core of each sensing terminal and the central terminal. The power supply can be battery-powered, standard electricity supply and/or solar battery powered. UPS makes the whole system more secure with low-cost, low energy consumption, easy operating features with a high degree of freedom for this wireless breeding environment monitoring system.

Dynamic Monitoring Based on Wireless Sensor Networks of IoT
Autor: Hu, ShaoHua.
Fecha de publicación: 2015
ISBN: 978-1-4799-1891-1
En: 2015 International Conference on Logistics, Informatics and Service Sciences (Liss).

Abstract: The Internet of Things is very important to monitor aquaculture environment. Pre-warning on aquaculture safety is an important measure to ensure quality safety of aquatic products. At present, most pre-warning methods on aquaculture safety are restrained by single factor, e.g., water quality, bacteria, viruses and another single factor. And meanwhile, those pre-warning methods are confronted with the difficulties such as real-time constraint, heterogeneity problem and so on. To deal with the above problems, services in the Internet of Things are to be introduced into the project. The project is also useful to related domains.

5.2 Patentes

5.2.1. Diseño, construcción y transporte naval

Patent description	Publication number
Ship internet of things based integrated service system and ship Internet of Things based convergence module	KR20170132497 (A)
pollution compliance system using IoT and its method	KR20170125675 (A)
Real-time push mobile satellite communications system and method for ship smart work	KR101623896 (B1)

Patent description	Publication number
System for recovering, positioning and searching marine instrument	CN107205224 (A)
Unmanned ship cloud control system based on 4G Internet technology	CN107172184 (A)
Automatic ship recognition system based on mobile network	CN107172144 (A)
Combined internet and handheld AIS (automatic identification system) marine anti-collision method and system	CN107103789 (A)
Ship oil consumption data analysis-based oil consumption management method and system	CN107070997 (A)
Unmanned ship information interaction system	CN107040583 (A)
Remote-control ship information returning device and control method thereof	CN106878429 (A)
Integrated data acquisition, processing and transmission system of ship	CN106856495 (A)
Real -time 3D remote monitoring system of ship posture	CN206235872 (U)
Ship real-time monitoring system	CN106713292 (A)
Ship information transmission system based on Beidou communication	CN106487441 (A)
Ship Safety Management System	KR20170007639 (A)
Acquisition and storage system for big data of maritime ships	CN106357750 (A)
Robot ship system for acquiring water area information	CN106357752 (A)
Ship lock health state remote monitoring system and monitoring method thereof	CN106289388 (A)
WIFI connection-based ship Internet of Things system	CN106101002 (A)
Maritime safety information broadcasting system based on Beidou navigation	CN106102014 (A)
METHOD OF COLLECTING DATA IN BALLAST WATER TREATMENT SYSTEM AND SYSTEM FOR ANALYZING SHIP BALLAST WATER TREATMENT BIG DATA USING MOBILE COMMUNICATION NETWORK	US2016280352 (A1)

Patent description	Publication number
System for recovering, positioning and searching marine instrument	CN107205224 (A)
PLATFORM AND METHOD FOR SAFETY NAVIGATION AND DISASTER RESPONSE OF IOT INTELLIGENT SHIP	KR20160060798 (A); KR101641787 (B1)
Internet of Things technology-based ship part sectional logistics monitoring system and method	CN104951912 (A)
Ship conduction system on basis of internet of things	CN104887207 (A)
Unmanned ship cloud control system based on 4G Internet technology	CN107172184 (A)
Construction ship operation area virtual guard mark system and method based on AIS/GPRS	CN107016879 (A)
Automatic depth finding and monitoring system with unmanned ship for sea	CN106990422 (A)
Cloud framework based integrated ship management system and communication and rescue methods thereof	CN106878430 (A)
SYSTEM AND METHOD FOR PROVIDING INTEGRATED UNLOADING AND LOADING PLANS USING CLOUD SERVICE	WO2017105069 (A1)
Cloud management method for ship shore power system, server, and system	CN106571950 (A)
LNG ship data acquisition device	CN106441489 (A)
Ship networking fuel gas supply system	CN106401745 (A)
Acquisition and storage system for big data of maritime ships	CN106357750 (A)
Safety monitoring system of Internet of vessels	CN106338952 (A)
Cloud monitoring device of ship engine	CN106331103 (A)
Cloud monitoring system of ship engine	CN106331102 (A)
Navigation method and system for sailing	CN105928521 (A)
Cloud management platform based on micro-service architecture	CN105662432 (A)
Improved navigation method and system for sailing	CN105698800 (A)
Bridge anti-collision warning system and realization method	CN104916166 (A)

Patent description	Publication number
NAVIGATION SYSTEM FOR VESSEL, INFORMATION DISPLAY METHOD OF VESSEL NAVIGATION, AND RECORDING MEDIUM THEREOF	KR20120108534 (A); KR101280066 (B1)
System for supervising fishing vessels arriving in and departing from port and positioning of fishing vessels dropping anchor in port and management method thereof	CN105868804 (A)
Internet of things (IOT)-based ship dynamic monitoring system	CN203300054 (U)
REAL-TIME PUSH MOBILE SATELLITE COMMUNICATIONS SYSTEM AND METHOD FOR SHIP SMART WORK	KR101623896 (B1)
PLATFORM AND METHOD FOR SAFETY NAVIGATION AND DISASTER RESPONSE OF IOT INTELLIGENT SHIP	KR20160060798 (A); KR101641787 (B1)
Ship berthing auxiliary system based on Internet of Things technology	CN106875753 (A)
Ship conduction system on basis of internet of things	CN104887207 (A)
Ocean environment monitoring and early warning system	CN102394917 (A)
Thing networking device of integrated sonar and space environment detection system who is suitable for thereof	CN206178139 (U)
Internet-of-things equipment integrating sonar and space environment detection system of Internet-of-things equipment	CN106199611 (A)
Water travel protection system for shipborne unmanned aerial vehicle based on Internet of Things	CN106005451 (A)
Xijiang river waterway shipping monitoring system based on Beidou satellite	CN105336218 (A)
Ship navigation positioning and communicating apparatus	CN203299388 (U)
Self drive's of accurate positioning ship anchor	CN206171724 (U)
Internet of Things technology based ship part sectional logistics monitoring system and method	CN104951912 (A)
Ship conduction system on basis of internet of things	CN104887207 (A)
Internet AIS (automatic identification system)-base ship anti-collision method and system	CN105788370 (A)

Patent description	Publication number
Ship local and/or remote track tracking method based on maritime satellite	CN105185161 (A)
Maritime search and rescue WSN	CN203015128 (U)
Ship track positioning system	CN102999044 (A)
Dynamically monitoring and managing system of offshore ship	CN202306258 (U)
Ship recognition and locating system	CN201936459 (U)
Marine navigation network shared radar	CN106610291 (A)
Marine internet system	CN105809371 (A)
Automatic system of collecting evidence of boats and ships illegal activities	CN205384759 (U)
Mobile-internet-based VTS safety information service system and method	CN105261239 (A); CN105261239 (B)
MARINE WEATHER DATA PROVIDING SYSTEM FOR OPTIMUM ENEGY AND SAFETY NAVAGATION OF VESSEL	KR20150102808 (A); KR101604016 (B1)
Ship remote video monitor system based on maritime satellite and base station	CN204408529 (U)

5.2.2. Acuicultura

Patent description	Publication number
Aquaculture intelligent integrated monitoring system based on IoT (Internet of Things)	CN107179732 (A)
Aquaculture heating pipeline monitoring device and system under mixed communication mode	CN106679731 (A)
Automatic oxygenation feeding IoT (Internet of Things) monitoring system for aquaculture	CN106647891 (A)
Aquaculture and livestock breeding multi-parameter measurement and control system and method based on IoT (Internet of Things) and GIS	CN106603629 (A)
IoT -based intelligent aquaculture management system	CN105976256 (A)
Automatic aquaculture unmanned aerial vehicle	CN106719230 (A)

Patent description	Publication number
Intelligent feeding device based on real-time cultivation water quality monitoring	CN106771031 (A)
Accurate water-transferring operation system for unmanned aerial vehicle aquaculture based on wireless sensor network and method thereof	CN106227236 (A)
Unmanned aerial vehicle aquaculture precise feeding work system and method based on wireless sensor network	CN106227075 (A)
Information service and equipment remote power feeding system are synthesized in aquatic products industry	CN205983187 (U)
CLOUD GENERAL-PURPOSE ENVIRONMENTAL INFORMATION MONITORING SYSTEM AND MIDDLEWARE THEREOF	JP2016058084 (A)
Shrimp environment intelligence control system that grows seedlings based on multisensor information fusion	CN204790651 (U)
Internet-of-things-based on-line litopenaeus vannamei aquaculture water quality monitoring system	CN203324260 (U)
Lightning protection aquaculture water quality monitoring device	CN106053747 (A)
Lifting type aquaculture sensing platform	CN106020242 (A)
Multi -functional aquaculture monitoring facilities	CN205547021 (U)
Aquaculture intelligence control system	CN103823415 (A)
Aquaculture system	CN203467421 (U)
Intelligence control system for aquaculture oxygenation device	CN203275991 (U)
Industrial aquaculture distribution and control system	CN203275989 (U)
Water quality online monitoring system for industrial aquaculture	CN203275396 (U)
Aquaculture oxygenation device wireless intelligent control system	CN202583842 (U)
Aquaculture intelligent feeding system	CN202565981 (U)
Aquaculture intelligent integrated monitoring system based on IoT (Internet of Things)	CN107179732 (A)

Patent description	Publication number
Aquaculture water quality monitoring and early warning system based on Internet of Things	CN107065984 (A)
Monitoring data sharing and leasing method of intelligent aquatic product system	CN106960393 (A)
Aquaculture water quality monitoring device based on Internet of things	CN106896844 (A)
Abalone culturing device integrating disinfection and washing, dead body collection, oxygenation and water quality early warning	CN106879519 (A)
Aquaculture water quality monitoring device based on thing networking	CN206270786 (U)
Color-changing vest for aquaculture field early warning and implementation method of color-changing vest	CN106723464 (A)
Aquaculture farming system based on Internet of Things	CN106774560 (A)
Internet of things net cage remote monitoring system	CN106791589 (A)
Internet-based cage aquaculture system	CN106719213 (A)
Smart aerator based on narrowband Internet of Things and dissolved oxygen stereoscopic monitoring method	CN106647835 (A)
Internet based beach aquaculture pool automatic management system	CN106614237 (A)
Aquaculture pond inspection sign-in and water quality detection device and system and realization method	CN106657404 (A)
Internet + intelligence disinfection aquaculture pond	CN205756561 (U)
Intelligent aquaculture system and method based on LABVIEW remote monitoring and control technology	CN106371485 (A)
Aquaculture quality of water automatic monitoring system	CN205861115 (U)
Internet + electrolysis aquaculture pond	CN205794495 (U)
Pond aquaculture management device based on internet of things	CN205620801 (U)
Novel aquaculture scheme based on Internet of Things technology	CN105660505 (A)
Aquaculture monitored control system based on thing networking	CN205507466 (U)

5.3 Proyectos de I+D

5.3.1. Diseño, construcción y transporte naval

SSAP - Smart Ship Application Platform - Maritime Industry Revolution Through Big Data & **IoT** Technology.
Country: Japan.
Period of time: 01/06/2014 al 31/03/2017
Current state: partly ongoing.
Objective: The concept of Smart Ship is to utilize **IoT** application services to achieve optimum ship operation in terms of safety and energy efficiency. The target of Smart Ship Application Platform (SSAP) project is to support these **IoT** application services to access ship equipment data easily and enhance more application services development (more info).

SCOUT - Smart Monitoring COntrol and User interactive ecosystem for improving energy efficiency andeconomic maintenance of Medium-WeighT Ships.
Project ID: 781154
Country: Spain.
Period of time: 01/08/2017 al 31/01/2018
Current state: closed.
Objective: SCOUT provides a Smart Monitoring & COntrol and User interactive ecosystem for improving energy efficiency and economic maintenance of Medium-WeighT Ships, taking advantage of the above opportunity presented by the necessity and recent regulations of monitoring and reducing emissions, as well as the economic need of saving costs in terms of fuel combustion and maintenance of medium-weight ships market.

NOVIMAR - NOVel Iwt and MARitime transport concepts.
Project ID: 723009
Country: Netherlands.
Period of time: 01/06/2017 al 31/05/2021
Current state: ongoing.
Objective: NOVIMAR aims to adjust inland/short-sea shipping such that it can make optimal use of the waterborne system of waterways, vessels and ports/terminals. To achieve this NOVIMAR introduces the waterborne version of 'platooning', the Vessel Train.

H2H - EGNSS Hull-to-Hull.
Project ID: 775998
Country: Norway.
Period of time: 01/11/2017 al 31/10/2020
Current state: ongoing.
Objective: The overall objective of the proposal is to address the need of the maritime community to safely navigate in close proximity of other vessels and objects, being stationary or moving. This will assist mariners in making correct navigation decisions. And further, this will be a fundamental requirement for autonomous vessels.

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i-vSAVE - Intelligent Vessels using space technology for Safety on board.
Project ID: 782426
Country: Spain.
Period of time: 01/06/2017 al 30/09/2017
Current state: closed.
Objective: i-vSAVE is a disruptive maritime communication system with integrated satellite communication and positioning, GSM /3G connectivity, on-board LoRa sensor network and a terrestrial server for data processing and management, that promotes overall communications, safety and crew/passenger comfort on merchant, passenger and recreational vessels. Maritime companies, crew and passenger (target users) have a need for real-time information exchange, safety and 24/7 connectivity.

RANGER - RAdars for loNG distance maritime surveillancE and SaR opeRations
Project ID: 700478
Country: United Kingdom.
Period of time: 01/05/2016 al 31/10/2019
Current state: ongoing.
Objective: RANGER aims at re-enforcing EU by combining innovative Radar technologies with novel technological solutions for early warning, in view of delivering a surveillance platform offering detection, recognition, identification and tracking of suspicious vessels, capabilities exceeding current radar systems.

5.3.2. Acuicultura

SMARTFISH - Smart fisheries technologies for an efficient, compliant and environmentally friendly fishing sector.
Project ID: 773521
Country: Norway.
Period of time: 01/01/2018 al 31/12/2021
Current state: ongoing.
Objective: The objective of SMARTFISH is to develop, test and promote a suite of high-tech systems for the EU fishing sector, to optimize resource efficiency, to improve automatic data collection for fish stock assessment, to provide evidence of compliance with fishery regulations and to reduce ecological impact.

MarTERA - Maritime and Marine Technologies for a New ERA.
Project ID: 728053
Country: Germany.
Period of time: 01/12/2016 al 30/11/2021
Current state: ongoing.
Objective: The overall goal of the proposed Cofund is to strengthen the European Research Area (ERA) in maritime and marine technologies and Blue Growth.

STREAM - Sonar Technology for Remote Environmental Monitoring.
Project ID: 781195
Country: United Kingdom.
Period of time: 08/01/2017 al 31/01/2018
Current state: closed.
Objective: STREAM will significantly reduce the catastrophic impacts of undetected oil and gas leaks on marine ecosystems, fisheries and aquaculture by helping producers effectively detect leaks and meet stricter industry legislation.

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eoFRESH - Earth Observation freshwater monitoring services
Project ID: 718835
Country: United Kingdom.
Period of time: 01/03/2016 al 31/08/2016
Current state: closed.
Objective: The eoFRESH service responds to the increasing demand with an independent multi-satellite based monitoring solution, as only traditional in-situ methodologies are capable neither to retrieve historic information, nor to provide actual harmonized information for a huge number of inland waters.

FiDaCaMS - Fisheries Data Capture and Management System.
Project ID: 735732
Country: Malta.
Period of time: 01/08/2016 al 31/01/2017
Current state: closed.
Objective: The aim of the FiDaCaMS project is to build a new innovative system that enables fishermen to collect accurate and reliable fisheries and related environmental data in an automated and highly efficient form.

5.4 Noticias

5.4.1. Diseño, construcción y transporte naval

E-Logs in South East Trawl Fishery
Fecha: 01 de febrero de 2018
Fuente: Wolrd Fishing & Aquaculture
Enlace:http://www.worldfishing.net/news101/industry-news/mandatory-e-logs-in-south-east-trawl-fishery

Abstract: South East Trawl (SET) vessels will have to record their activity using electronic logbooks (e-logs) from 1 May. E-logs will allow SET fishers to report their fishing operations, including daily catch, discarded fish and protected species interaction data, in real time.

Port Of Rotterdam, IBM To Build A Connected, Smart Port Of The Future
echa: 31 de enero de 2018
Fuente: MarineLink
Enlace: https://www.marinelink.com/news/rotterdam-connected433495

Abstract: The Port of Rotterdam Authority and IBM has announced their collaboration on a multi-year digitization initiative to transform the port's operational environment using Internet of Things (**IoT**) technologies in the cloud to benefit the port and those who use it.

Marlink introduces prepaid cards for Inmarsat Fleet Xpress voice calls
Fecha: 31 de enero de 2018
Fuente: Fathom news
Enlace: http://www.fathom-news.com/press-release-marlink-introduces-prepaid-cards-inmarsat-fleet-xpress-voice-calls/

Abstract: Marlink has become the first Inmarsat Fleet Xpress Value Added Reseller (VAR) to provide customers with a prepaid voice card calling facility, giving seafarers a low-cost and easy to manage way to call family and friends ashore. The prepaid facility is available through Marlink's established Universal Card, Universal Card Go and Prepaid Talk products, making it easy for ship owners to start offering the service and providing familiarity for the crew members using it.

Autonomous Vessels: Modern Ferries Evolve
Fecha: 23 de enero de 2018
Fuente: MarineLink
Enlace: https://www.marinelink.com/news/autonomous-vessels433224

Abstract: The word 'autonomous' is probably the maritime industry's most frequently used term in the past year. The word, however, has a far different meaning than the similarly sounding "automated" – which means that certain processes are handled by machines, rather than by humans. Throughout 2017, industry thought leaders have been mulling over the new digital paradigms that are emerging including the 'Internet of Things' and/or the linkage of processes and machines – the 'Fourth Industrial Revolution' – where devices talk to each other, and other emerging disrupters.

Nautic Alert Unveils New Solution To Control Water Discharge In Vessels
Fecha: 09 de enero de 2018
Fuente: Ship Technology
Enlace: http://www.ship-technology.com/news/nautic-alert-unveils-new-solution-control-water-discharge-vessels/

Abstract: Market Spectrum's Nautic Alert has launched a new system that allows operators to plan, manage and control the discharge of untreated bilge water on-board commercial vessels as a part of an internet of things (**IoT**) marine solution.

From 1 January 2018 Large Ships Must Monitor And Report CO2 Emissions
Fecha: 09 de enero de 2018
Fuente: Hellenic shipping news worldwide
Enlace:http://www.hellenicshippingnews.com/from-1-january-2018-large-ships-must-monitor-and-report-co2-emissions/

Abstract: As of 1 January 2018, subject to a few exclusions, ships over 5000 gross tonnage ("Relevant Ships") became subject to monitoring and reporting requirements on carbon dioxide emissions (CO2), fuel consumption and cargo carried within all ports under the jurisdiction of a

Member State and for any voyages to or from a port under the jurisdiction of a Member State.

Maritime's Digital Transformation & Simulation-Based Training
Fecha: 28 de diciembre de 2017
Fuente: MarineLink
Enlace:https://www.marinelink.com/news/simulationbased-maritimes432480

Abstract: Nearly 200 delegates from across the world gathered in Den Haag, The Netherlands in September 2017 to hear about the latest developments in maritime training based on state-of-the-art simulation technology. The three-day Kongsberg UC2017 International Maritime Simulation User Conference brought attendees up to date on developments in digitalization, maritime training, navigation technology, maritime operations simulation and the use of virtual reality in training. The Kognifai digital platform is a set of tools built on modern Cloud technology providing access to KONGSBERG and third-party simulation solutions (**Figura 14**).

Figura 14 . The Kognifai digital platform is a set of tools built on modern Cloud technology providing access to KONGSBERG and third-party simulation solutions. (Image: Kongsberg)

Driver-Less Ships: Autonomy In The Maritime Sector
Fecha: 27 de diciembre de 2017
Fuente: MarineLink
Enlace: https://www.marinelink.com/news/driverless-autonomy432393

Abstract: a show of prototypes, a pod of unmanned sailboats from around the world competes to cross "The Atlantic" test tank in Horten, Norway. Cross the real ocean, and the Sail Bots race similarly challenges scholarly robotic-vessel designers to North America for a bit of station-keeping, collision-avoidance and "cargo moves". For all, the future seems bright — the first commercial runs of unmanned vessels are underway or scheduled worldwide. These earliest movers have the support of governments, Google and grateful clients.

SM Line Selects Intellian V100 VSAT Antennas
Fecha: 15 de diciembre de 2017
Fuente: MarineLink
Enlace: https://www.marinelink.com/news/intellian-antennas432166

Abstract: Maritime satellite antenna systems provider Intellian announced that its V100 maritime VSAT antenna has been chosen by SM Lines to power its ships' data and communications and enable its **IoT** (Internet of Things) freight monitoring system.

Dnv Gl: Standardization Can Aid Shipping's Digital Transformation
Fecha: 17 de noviembre de 2017
Fuente: MarineLink
Enlace:https://www.marinelink.com/news/standardization-shippings431380

Abstract: Classification society DNV GL has released a new position paper setting out the importance of standardization in enabling the growth of digital applications in the maritime industry. Drawing from the experiences gained from digital pilot projects focused on ship sensor data, the paper examines how standardization can enable the effective collection, storage, exchange, analysis and use of data, while contributing to improved data quality and sensor reliability.

Portacontenedores Autónomo De Cero Emisiones
Fecha: 10 de octubre de 2017
Fuente: Revista del sector marítimo – Ingeniería Naval
Enlace:https://sectormaritimo.es/portacontenedores-autonomo-de-cero-emisiones

Abstract: Yara Birkeland va a ser el primer portacontenedores del mundo totalmente eléctrico y autónomo, con cero emisiones. Este diseño es el resultado de la colaboración entre la compañía agrícola Yara, Kongsberg, DNV GL, Marin Teknikk, Sintef Ocean y las autoridades marítimas noruegas. Para garantizar la seguridad, se han planificado tres centros con perfil operacional diferente para manejar los aspectos operativos. Estos centros gestionarán situaciones de emergencia y excepcionales, monitorización, supervisión operacional, apoyo en toma de decisiones, inspección de buques autónomos y otros aspectos relativos a la seguridad.

EUMETSAT To Launch Upgraded Monitoring The Oceans From Space Course
Fecha: 08 de octubre de 2017
Fuente: Ship Technology
Enlace:http://www.ship-technology.com/news/newseumetsat-to-launch-upgraded-monitoring-the-oceans-from-space-course-5943971/

Abstract: The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is set to re-launch a modified version of its open online course known as 'Monitoring the Oceans from Space' next week.

Los Barcos Serán Los Siguientes Vehículos Autónomos
Fecha: 15 de septiembre de 2017
Fuente: MCPRO MuyComputer
Enlace:https://www.muycomputerpro.com/2017/09/15/barcos-vehiculos-autonomos

Abstract: A pesar de todo el ruido que hacen, los vehículos autónomos no estarán circulando libremente por las carreteras del planeta hasta dentro de unos cuantos años. Puede que a los coches les adelanten hasta los camiones sin conductor. Pero los que sí puede que lleguen antes son otro tipo de vehículos autónomos: los barcos sin piloto. Los ferrys que están construyendo para que naveguen por los canales de Ámsterdam sin piloto. Pero la automatización en los barcos no se limita únicamente a pequeños botes de pasajeros; de hecho, está más centrada en el transporte de mercancías. Así, se esperan barcos que se piloten por control remoto y puedan llevar contenedores de un lado a otro de los océanos Atlántico y Pacífico. Y las tareas de investigación, desarrollo y prueba están tan avanzadas que los primeros podrían estar en funcionamiento dentro de tres años.

The Edge of Tomorrow: designing tomorrow's ships today
Fecha: 8 de agosto de 2017
Autor: Sean M. Holt
Fuente: The Maritime Executive
Enlace:https://www.maritime-executive.com/magazine/the-edge-of-tomorrow#gs.DEnEiX8

Abstract: Some say the future is created by designing it. Rolls- Royce says it is "Bringing the Future to You" through advances in digital technology and the development of remote capabilities. In this article we journey around the globe to showcase a sampling of advances in smart ship

technology and design, so let's begin with a vision of future shipping from a Rolls-Royce white paper on "Ship Intelligence".

Figura 15. Portada del artículo. *Fuente:* Maritime Executive.

RSS stabilization techniques for a real-time passive UHF RFID pipe monitoring system for smart shipyards
Fecha: 12 de junio de 2017
Autor: Ministry of Defence and The Rt Hon Sir Michael Fallon MP
Fuente: The Maritime Executive
Enlace: http://ieeexplore.ieee.org/document/7945603/

Abstract: A regular ship contains between 15,000 and 40,000 pipes. With such a huge number and varied typology and functionality, it is important to maintain the traceability and status of the pipes, what speeds up their maintenance procedures, accelerates locating them, and allows for obtaining easily their characteristics when building and installing them.

A PBR/Galileo combo to detect and localise all ships in European seas
Fecha: 03 de marzo de 2017
Fuente: CORDIS
Enlace: https://cordis.europa.eu/news/rcn/126849_en.html

Abstract: A European project is coming close to the validation of a prototype of 'Passive bistatic radar' (PBR) technology based on Galileo transmissions. Once finalised, the new system could help relevant authorities to assure better maritime surveillance, detecting and localising, even of non-indexed ships.

Danish Maritime Authority To Support Gatehouse's New Ship-Borne Internet Of Things Project
Fecha: 11 de diciembre de 2016
Fuente: Ship Technology

Enlace:http://www.ship-technology.com/news/newsdanish-maritime-authority-to-support-gatehouses-new-ship-borne-internet-of-things-project-5694093/

Abstract: Danish Maritime Authority (DMA) is set to contribute to a pilot project, initiated by GateHouse, on the development and testing of a system that collects real-time data from various components on-board ships by next year.

Shipbuilder looks to Internet of Things for Future Business
Fecha: 06 de julio de 2016
Fuente: MAREX
Enlace:https://www.maritime-executive.com/article/shipbuilder-looks-to-internet-of-things-for-future-business#gs.bHRiDfY

Abstract: South Korean shipbuilding giant Hyundai Heavy Industries has signed a Memorandum of Understanding to develop Internet of Things applications for ships with SK Shipping, Intel, Microsoft, the Ulsan Center for UCCEI and the DCCEI. The Internet of Things refers to the wireless network of physical things, consisting of installed sensors, electronics, software and network connectivity enabling these 'things' to collect and exchange data.

5.4.2. Acuicultura

Sintef develops drones and robotics technologies for unmanned surveillance and operation of salmon farms
Fecha: 10 de octubre de 2017
Fuente: Robotics & Automation News
Enlace:https://roboticsandautomationnews.com/2017/10/10/sintef-develops-drones-and-robotics-technologies-for-unmanned-surveillance-and-operation-of-salmon-farms/14414/

Abstract: A Norwegian technology research company called Sintef has been developing drones and other robotics technologies to help salmon and aquaculture farmers manage their operations.

New robotic fish for environmental monitoring
Fecha: 10 de mayo de 2017
Fuente: Universidad Politécnica de Madrid
Autor: C. Rossi
Enlace:https://www.sciencedaily.com/releases/2017/05/170510091553.htm

Abstract: Researchers are developing a bio-inspired robot equipped with special chemical sensors able to detect the pH of water.

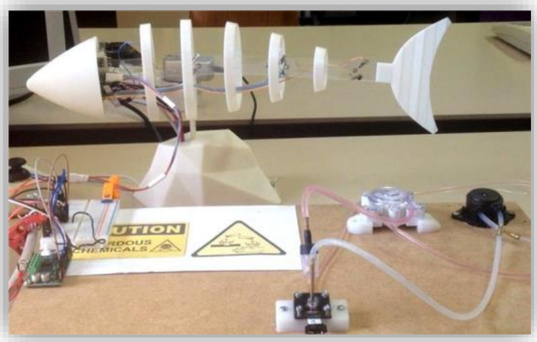

Figura 16. Fotografía del prototipo del nuevo pez robótico.

How technology is making farming and recycling sexy in Asia
Fecha: 19 de junio de 2017
Fuente: Eco-Business. Ecosperity 2017: Tomorrow Starts Today
Autora: Hannah Koh
Enlace:http://www.eco-business.com/news/how-technology-is-making-farming-and-recycling-sexy-in-asia/

Abstract: Bringing technology into industries like farming and waste collection in Asia is opening up opportunities for sustainable development. Here are three companies that are changing the world's oldest and most necessary professions.

Figura 17. El alimentador de peces *eFishery*, impulsado mediante **IoT**, se encuentra instalado en una granja acuícola en Indonesia. Fuente: eFishery.

Satellite Data Strategy To Help India
Fecha: 15 de enero de 2018
Fuente: Wolrd Fishing & Aquaculture
Enlace:http://www.worldfishing.net/news101/industry-news/satellite-data-strategy-to-help-india

Abstract: Scientists will meet this month to discuss how best to utilise satellite data to identify areas of fish abundance. The event will be held in Kochi, India.

InnovaSea Systems acquires Canadian aquaculture technology firm
Fecha: 02 de diciembre de 2017
Fuente: Fish Information & Services
Enlace:http://www.fis.com/fis/worldnews/worldnews.asp?monthyear=&day=2&id=95024&l=e&special=&ndb=1%20target=

Abstract: InnovaSea Systems has announced the acquisition of Canada based Amirix Systems, a global leader in electronic system design and manufacture for submarine acoustic telemetry. Amirix is the parent company of Bedford Nova Scotia based Vemco and Realtime Aquaculture and Seattle Washington based HTI-Vemco

Making Science Count for Sustainable Aquaculture
Fecha: 20 de noviembre de 2017
Fuente: CORDIS
Enlace: https://cordis.europa.eu/news/rcn/141895_en.html

Abstract: The first AQUAEXCEL2020 industry brokerage event "From Research Innovation To Industry Application" brought together researchers and aquaculture industry representatives during the Aquaculture Europe 2017 conference in Dubrovnik, Croatia, on 19 October 2017. This forum for engagement and exchange was hosted by the European Aquaculture Technology and Innovation Platform and AquaTT, both partners in AQUAEXCEL2020, an EU-funded project focusing on excellence in European fish research.

Startups In Asia: Indonesia's Efishery Aims For More Efficient Aquaculture
Fecha: 26 de octubre de 2017
Fuente: Nikkei - Assian Review
Enlace: https://asia.nikkei.com/magazine/20171026/Business/Startups-in-Asia-Indonesia-s-eFishery-aims-for-more-efficient-aquaculture

Abstract: Startup's high-tech approach to feeding fish reduces waste and hassle.

Smart fish feeder eFishery enters Bangladesh and Thailand, secured 300+ users in Indonesia
Fecha: 27 de marzo de 2017
Fuente: E27 – Connecting you to Asia's Startup Ecosystem
Enlace: https://e27.co/smart-fish-feeder-efishery-enters-bangladesh-and-thailand-20170327/

Abstract: Andung-based eFishery partners with local university and global non-profit organisations to introduce its platform in the two countries. Over-feeding is an issue that directly affects productivity in fresh water fish farming in rural Indonesia, and eFishery aims to solve the problem by providing an internet-based tech to monitor and control feeding. eFishery is also currently developing a technology that is able to detect the "level" of satiety in fishes, based on their behaviour and the ripples they have caused.

Success for COMMON SENSE - Marine Sensor Demonstration a Significant Achievement
Fecha: 09 de febrero de 2017
Fuente: CORDIS
Enlace: https://cordis.europa.eu/news/rcn/138375_en.html

Abstract: The EC-funded COMMON SENSE project held its final event in Barcelona on the 27 January 2017, attended by project partners and stakeholders involved in European marine monitoring. The full-day meeting provided in-depth context on the challenges and importance of improving methods and available technology to monitor and protect our marine waters. Presentations on the specific results generated by COMMON SENSE preceded a live demonstration of the marine monitoring sensors generated by the project.

5.5 Eventos

5.5.1. Diseño, construcción y transporte naval

Eventos sobre tecnologías en la ingeniería naval:

MARITIME SENSING TECHNOLOGIES - This workshop is organized back to back with the COLUMBUS Conference 'Making Marine and Maritime Research Count'
Lugar: EuroGOOS – Bruselas (Bélgica)
Fecha: 23/01/2018

SINAVAL - International Exhibition on Shipbuilding, Ports, Fishing and Ocean Energies.
Lugar: Bilbao (Spain) - Bilbao Exhibition Centre.
Fecha: 27.03 - 31.03 2018

SEATEC - Seatec is the International Exhibition of Technologies and Subcontracting for Boat and Shipbuilders.
Lugar: Carrara (Italy) – Carrara Fiere.
Fecha: 05/04/2018 al 07/04/2018

MAST (MARITIME SYSTEMS & TECHNOLOGY) EUROPE - Global Conference and trade-show for maritime security & defense leaders.
Lugar: Bristol (UK - United Kingdom).
Fecha: 15/05/2018 al 18/05/2018

NAVALIA - International Shipbuilding and Maritime Industry Exhibition.
Lugar: Vigo (Spain) - Instituto Ferial de Vigo.
Fecha: 22/05/2018 al 24/05/2018

UDT EUROPE - Undersea Defense Technology Exhibition & Conference.
Lugar: Glasgow (UK - United Kingdom) - Scottish Exhibition and Conference Center.
Fecha: 26/06/2018 al 28/06/2018

MARINE MAINTENANCE WORLD EXPO - International exhibition of marine maintenance technologies, services and systems together with the latest ship and off-shore rig maintenance concepts and techniques.
Lugar: RAI International Exhibition and Congress Centre. Amsterdam (Netherlands) -
Fecha: 27/06/2018 al 29/06/2018

SMM HAMBURG - Ship Building, Machinery and Marine Technology International Trade Fair.
Lugar: Hamburg Messe und Congress – Hamburg (Germany).
Fecha: 04/09/2018 al 07/09/2018

EURONAVAL - International Naval Defence & Maritime Exhibition & Conference. EURONAVAL is the international trade show applying high technology to naval defence and maritime security and safety.
Lugar: Parc des expositions du Bourget – Paris (France).
Fecha: 22/10/2018 al 26/10/2018

EUROPORT - Shipbuilding & Marine Equipment Show.
Lugar: Roterdam – Netherlands.
Fecha: 05/11/2018 al 08/11/2019

METS TRADE - Marine Equipment Trade Show.
Lugar: RAI International Exhibition and Congress Centre. Amsterdam (Netherlands).
Fecha: 13/11/2018 al 15/11/2018

OMC - Offshore Mediterranean Conference & Exhibition.
Lugar: Ravenna – Italy.
Fecha: 27/03/2019 al 29/03/2019

NOR-SHIPPING - Maritime Industry International Show.
Lugar: Lillestrøm – Norway.
Fecha: 04/06/2019 al 06/06/2019

BALTEXPO - International Shipbuilding and Shipping Exhibition.
Lugar: Gdansk – Poland.
Fecha: 09/2019 (?)

TRANSNAV - International Navigational Conference on Maritime Navigation and Safety of Sea Transportation.
Lugar: Gdynia – Poland.
Fecha: 06/2019 (?)

LISW - LONDON INTERNATIONAL SHIPPING WEEK - London International Shipping Week. LISW is offering over 160 industry functions and unique networking opportunities for leaders across all sectors of the international shipping industry – regulators, charterers, ship owners, ship managers...
Lugar: London.
Fecha: 09/ 2019 (?)

LONDON BOAT SHOW - International Boat Show. London Boat Show has the latest state-of-the-art powerboats & dream yachts on display and also dinghies, surfboards, electronics & equipment + hundreds of boats of all shapes & sizes during one exceptional 9 day event.
Lugar: London.
Fecha: Jan. 2019 (¿)

5.5.2. Acuicultura

Eventos sobre acuicultura:

EU AQUACULTURE FARMED IN EU REGIONS - "The Future of European Aquaculture" Regions have a key role to play in creating the right conditions for the development of EU aquaculture, through efficient licencing procedures, spatial planning, promotion of local products and other initiatives.
Lugar: European Committee of the Regions, Brussels (Bélgica).
Fecha: 02/02/2018

FISHACKATHON EVENT - *Fishackathon* is a worldwide hackathon event organised by UCA in Spain. The aim of the hackathon is to make Earth's waters, aquaculture, and fisheries more sustainable & equitable.
Lugar: Online event.
Fecha: 10/02/2018 al 11/02/2018

AQUAFARM 2018 - International exhibition and conference for aquaculture, algaculture, vertical farming and fishing industry.
Lugar: Pordenone (Italy).
Fecha: 15/02/2018 al 16/02/2018

AQUA-FISCH 2018 - International Trade Fair for Aquaculture, Professional and Sport Fishing, Aquaristic
Lugar: Friedrichshafen (Germany).
Fecha: 23/05/2018 al 24/05/2018

AQUACULTURE UK EXHIBITION - The event covers every aspect of aquaculture and provides the best commercial and technical advice for fish farmers, farm managers and aquaculture business professionals.
Lugar: Aviemore – United Kingdom.
Fecha: 09/03/2018 al 11/03/2018

2018 INTERNATIONAL SANDY BEACHES SYMPOSIUM - Sandy beach scientists, students and managers at all levels are invited to participate and share their research, making this symposium a platform to interact, establish links and identify synergies across disciplines.
Lugar: Institute for Marine Biology B**Io**Technology and Aquaculture, Hellenic Centre for Marine Research (Greece).
Fecha: 25/05/2018 al 29/05/2018

INTERNATIONAL INSTITUTE OF FISHERIES ECONOMICS & TRADE 2018 CONFERENCE – IIFET is the only global professional organization devoted to improving understanding of all aspects of fisheries and aquaculture economics and seafood trade. Members include academics, fisheries managers and policy makers, seafood industry members, international organizations and national government representatives.
Lugar: Seattle, Washington (USA).
Fecha: 16/07/2018 al 20/07/2018

AQUA 2018 – World Aquaculture Society Meetings.
Lugar: Montpellier (France).
Fecha: 25/08/2018 al 29/08/2018

AQUA SUR – International Aquaculture exhibition, the largest of southern hemisphere
Lugar: Puerto Montt (Chile).
Fecha: 17/10/2018 al 20/10/2018

AQUA-FISCH – *International Trade Fair for Aquaculture, Professional and Sport Fishing, Aquarist.*
Lugar: Friedrichshafen (Alemania).
Fecha: 09/03/2018 al 11/03/2018

AQUAFARM – Pordenone (Italy) *International Exhibition and Conference for Aquaculture, algaculture, Vertical Farming and Fishing Industry.*
Lugar: Pordenone Fiere (Italia).
Fecha: 15/02/2018 al 16/02/2018

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN FISH FORUM – The first General Fisheries Commission for the Mediterranean (GFCM) Fish Forum, one of the first of its kind, will encompass many areas, including oceanographic, social and economic science, as well as fisheries research.
Lugar: FAO headquarters, Roma (Italia).
Fecha: 10/12/2018 al 14/12/2018

ICFA 2019 – 21st international conference on fisheries and aquaculture aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Fisheries and Aquaculture. It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the field of Fisheries and Aquaculture.
Lugar: Roma (Italia).
Fecha: 17/01/2019 al 18/01/2019

AQUAFARM 2018 – Pordenone (Italy) International Exhibition and Conference for Aquaculture, algaculture, Vertical Farming and Fishing Industry is focus on Agriculture Machinery Equipment, Snack Machines, Fish Supplies. The cycle of the trade fair is once a year, organize by Upmarket Srl at Pordenone Fiere.
Lugar: Pordenone (Italia).
Fecha: feb. 2019

AQUA-NOR – International meeting place for the aquaculture industry and the wold's largest aquaculture technology exhibition.
Lugar: Tronheim (Norway).
Fecha: 20/08/2019 al 23/08/2019

Aquaculture Europe 2019 –
Lugar: Tronheim (Norway).
Fecha: 08/10/2019 al 10/10/2019

XVII Congreso Nacional de Acuicultura – El objetivo es revisar y discutir los principales retos de la acuicultura española en investigación, desarrollo e innovación, al objeto de favorecer la transferencia tecnológica y de conocimiento, así como potenciar el desarrollo sostenible de la actividad acuícola en nuestro país.
Lugar: Pendiente de confirmación – Murcia (España).
Fecha: 2019.

European Maritime Day EMD – 2019 - The European Maritime Day (EMD) is the annual meeting point for Europe's maritime community to network, discuss, and forge joint action, in support of an integrated approach to maritime affairs. It is an inspiring, interactive and dynamic event with a strong focus on key European Commission priorities.
Lugar: Lisboa (Portugal).
Fecha: 2019.

5.5.3. Internet of Things (IoT)

Eventos sobre IoT:

SENSORNETS 2018 - 7th International Conference on Sensor Networks
Lugar: Portugal.
Fecha: 22/01/2018 al 24/01/2018

MILAN IOT THINGS – European event dedicated to the world of internet of things (**IOT**) & machine to machine (M2M) communication
Lugar: Milan (Italy)
Fecha: 10/04/2018 al 11/04/2018

IOT ASIA – The region's largest exhibition & conference exploring how the **IoT** will transform businesses, government and societies.
Lugar: Singapore.
Fecha: 21/03/2018 al 22/03/2018

IOT/M2M EXPO (IOT/M2M OSAKA) – International exhibition for **IoT** (Internet of Things) /M2M (Machine to Machine) related products & services.
Lugar: Osaka (Japan).
Fecha: 21/02/2018 al 23/02/2018

VEHITS 2018 – 4th International Conference on Vehicle Technology and Intelligent Transport Systems.
Lugar: Portugal.
Fecha: 16/03/2018 al 18/03/2018

SIDO – Trade show, conferences and business meetings dedicated to the Internet of Things (**IoT**) in France.
Lugar: Lyon (France).
Fecha: 04/04/2018 al 05/04/2018

6. Oportunidades de financiación

Las oportunidades de financiación bajo en paraguas del Horizonte 2020 se presentan in programas de trabajo (work programmes) plurianuales, los cuales cubren la extensa mayoría de la ayuda disponible. La Comisión europea regularmente prepara los sucesivos programas de trabajo dentro del marco de trabajo inicalmente establecido por la regulación Horizon 2020 [Europea 2012] y a través de un proceso de desarrollo estratégico que integra los objetivos prioritarios de la política de la unión.

La preparación de los programas de trabajo (Work programmes) implica la recopilación de ideas e intereses procedentes de múltiples actores. En este sentido, se han establecido 19 grupos de consulta (Advisory Groups) asociados al H2020 que representan al sector industrial, y la investigación hasta la sociedad civil.

El programa de trabajo activo en la actualidad es el Work Programme 2018-2020 que contiene una introducción, 17 secciones temáticas y los anexos generales que describen reglas genéricas tales como las condiciones de admisibilidad y los criterios de eligibilidad y selección, entre otras.

Cada section temática es autocontenida, y describe los objetivos en general, las respectivas “calls for proposals” y los tópicos dentro de cada call. Un call es la denominicación empleada por la Comissión europea para referirse al proceso abierto al público para recibir propuestas de financiación. El tema de cada call está definido detalladamente en cada parte del programa de trabajo. Las solicitudes que superar exitosamente el proceso de selección dentro de cada call reciben financiación del programa de trabajo.

La novedad del último work programme son las cuatro áreas de enfoque (Focus Areas) que se refuerzan mutuamente para trascende los límites del programa y alineanse con las principales prioridades políticas:

- 'Building a low-carbon, climate resilient future' (LC): https://ec.europa.eu/programmes/horizon2020/en/sites/horizon2020/files/LC_booklet.pdf
- *'Connecting economic and environmental gains – the Circular Economy' (CE)*: https://ec.europa.eu/programmes/horizon2020/en/sites/horizon2020/files/CE_booklet.pdf
- 'Digitising and transforming European industry and services' (DT):

https://ec.europa.eu/programmes/horizon2020/en/sites/horizon2020/files/DT_booklet.pdf
- 'Boosting the effectiveness of the Security Union' (SU): https://ec.europa.eu/programmes/horizon2020/en/sites/horizon2020/files/SU_booklet.pdf

En conjunto, estas Focus Areas reciben una dotación superior a siete billones de Euros en el Work Programme 2018-2020.

En concreto, las dos últimas áreas (DT y SU) ponen en relevancia la importancia de desarrollar las tecnologías asociadas con el Internet of Things como medio para alcanzar un completo desarrollo digital de la sociedad y economía europeas, para el beneficio de todos.

Por otra parte, cada sección temática se organizó de modo que las consultas con los agentes se centraran en los siguientes tópicos principales:

- Excellent Science
- Leadership in Enabling and Industrial Technologies
  - Information and Communication Technologies (ICT)
- Innovation in SMEs
- Access to Risk Finance
- Retos sociales (Societal Challenges)
- Spreading Excellence and Widening Participation

Debido a la extensión cubierta por cada tópico, éstos se subdividen en varios subtópicos de los cuales debe destacarse los siguientes dos:

- ICT, en particular, dentro de la parte de Internet de siguiente generación (Next Generation Internet) el reto ICT-27-2018-2020 Internet of Things (European Commission, 2018) (European Commission, 2018) que agrupa todas las propuestas y actividades destinadas a fortalecer la capacidad tecnológica de Europa para desarrollar la siguiente generación de dispositivos **IoT**.

- Reto Social 2 (SC2) denominado (Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy) responde a retos clave que nuestro planeta deberá encarar en los próximos años: adapting to and mitigating climate change; ensuring food security; safeguarding the natural resource base, promoting alternatives to fossil-based economies and sustainably using marine resources while protecting the oceans. Agriculture and food systems, forestry, the marine and the bio-based sectors are at the very heart of the challenges to be addressed.

En particular, contiene todas las calls relativas a la estratégia Blue Growth (European Commission, 2018) (European Commission, 2017).

7. Bibliografía

(s.f.).

AENOR. (2011). Gestión de la I+D+i: Sistema de vigilancia tecnológica e inteligencia competitiva. *UNE 166000 EX, UNE 166001 EX, UNE 166002 EX*. Madrid: AENOR.

Apromar. (2016). *La acuicultura en España*. Observatorio Español de Acuicultura (Oesa).

CETISME, P. (2003). *Inteligencia Económica y Tecnológica. Guía para principiantes y profesionales.* Comunidades Europeas.

Degoul, P. (1992). *Le pouvoir de l'information avancée face au règne de la complexité*. Annales de Mines.

Escorsa, P. R. (2001). *De la vigilancia tecnológica a la inteligencia competitiva*. Pearson Educación.

Escorsa, Pere, Pilar Lázaro Martínez, Círculo de Innovación en Biotecnología. (2007). Intec: la inteligencia competitiva, factor clave para la toma de decisiones estratégicas en las organizaciones. *Colección mi+d*. Fundación Madri+d para el Conocimiento.

Europea, C. (2012). *COMUNICACIÓN DE LA COMISIÓN AL PARLAMENTO EUROPEO, AL CONSEJO, AL COMITÉ ECONÓMICO Y SOCIAL EUROPEO Y AL COMITÉ DE LAS REGIONES - Crecimiento azul Oportunidades para un crecimiento marino y marítimo sostenible.* Obtenido de http://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A52012DC0494&from=EN&lang3=choose&lang2=choose&lang1=ES

Europea, C. (s.f.). *Acuicultura*. Obtenido de https://ec.europa.eu/fisheries/cfp/aquaculture_es

Europea, C. (s.f.). *Crecimiento Azul*. Obtenido de https://ec.europa.eu/maritimeaffairs/policy/blue_growth_es

European Commission. (01 de 08 de 2017). *DIGITISATION RESEARCH AND INNOVATION - Transforming European industry and services*. (Publications Office of the European Union,, Ed.) doi:10.2777/890905

European Commission. (27 de 10 de 2017). *Horizon 2020. Work Programme 2018-2020. Part 9. Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy.* (European Commission, Ed.) Obtenido de http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-food_en.pdf

European Commission. (01 de 08 de 2017). *SECURITY RESEARCH AND INNOVATION - Boosting e ectiveness of the Security Union*. (Publications Office of the European Union,, Ed.) doi:10.2777/657723

European Commission. (2018). *A guide to ICT-related activities in WP2018-2020*. doi:10.2759/127700

European Commission. (2018). *Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy - Work Programme 2018-2020 preparation*. Recuperado el 05 de 02 de 2018, de https://ec.europa.eu/programmes/horizon2020/en/food-security-sustainable-agriculture-and-forestry-marine-maritime-and-inland-water-research-and-0

European Commission. (31 de 01 de 2018). *Horizon 2020. Work Programme 2018-2020. Part 5.i. Information and Communication Technologies.* (E. Commission, Ed.) Obtenido de http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-leit-ict_en.pdf

F. Palop, J. V. (Febrero de 1995). Vigilancia Tecnológica e Inteligencia Competitiva. *Estudios Cotec, nº 15*. Cotec.

FAO. (12 de Mayo de 2017). *FAO 2005-2017. National Aquaculture Sector Overview. Visión general del sector acuícola nacional - España.* (FAO, Ed.) Obtenido de http://www.fao.org/fishery/countrysector/naso_spain/es

Hribernik, K., Thoben, K., & West, T. (2013). Towards Product Avatars Representing Middle-of-Life Information for Improving Design , Development and Manufacturing Processes:. En N. PROLAMAT (Ed.), *Proceedings of the International Conference Digital Product and Process Development Systems*, (págs. 85-96). Dresden.

Minerva, R., Biru, A., & Rotondi, D. (2015). *Towards a definition of the Internet of Things (IoT) - Revision 1*. The Institute of Electrical and Electronics Engineers (IEEE). Torino: Telecom Italia S.P.A.

Stietencron, M. v., Rostad, C., Henriksen, B., & Thoben, K.-D. (2017). Utilising the Internet of Things for the Management of Through-life Engineering Services on Marine Auxiliaries. (Elsevier, Ed.) *Procedia CIRP*(59), 233-239. doi:10.1016/j.procir.2016.09.003

Wuest, T., Hribernik, K., & Thorben, K.-D. (2012). Digital Representations of Intelligent Products: Product Avatar 2.0. (B. -B. GmbH, Ed.) *Smart Product Engineering*, 675-684. Obtenido de https://link.springer.com/chapter/10.1007/978-3-642-30817-8_66

8. Anexo I. Patentes

Diseño, construcción y transporte naval

Title			
	Publication number	Applicant(s)	International classification
SHIP INTERNET OF THINGS BASED INTEGRATED SERVICE SYSTEM AND SHIP INTERNET OF THINGS BASED CONVERGENCE MODULE			
	KR20170125675 (A)	DAEWOO SHIPBUILDING & MARINE [KR]	H04L29/08
POLLUTION COMPLIANCE SYSTEM USING IoT AND ITS METHOD			
	KR20170125675 (A)	DAEWOO SHIPBUILDING & MARINE [KR]	G06Q50/26; G06Q50/10; H04B7/185; H04L12/12
REAL-TIME PUSH MOBILE SATELLITE COMMUNICATIONS SYSTEM AND METHOD FOR SHIP SMART WORK			
	KR101623896 (B1)	SUNCOMM CO LTD [KR]	H04L29/08; H04B7/185; H04L29/06; H04W4/00; H04W4/14
System for recovering, positioning and searching marine instrument			
	CN107205224 (A)	SOUTH UNIV OF SCIENCE AND TECHNOLOGY OF CHINA	H04W4/02; G01S19/42; H04L29/08
Unmanned ship cloud control system based on 4G Internet technology			
	CN107172184 (A)	YANCHENG INSTITUTE OF TECH	H04L29/08; H04L29/06
Automatic ship recognition system based on mobile network			
	CN107172144 (A)	SHANDONG HEINO PORT CO LTD	H04L29/08; G06Q30/06
Combined internet and handheld AIS (automatic identification system) marine anti-collision method and system			
	CN107103789 (A)	FUJIAN NORTH STAR GALAXY COMMUNICATION CO LTD	G08G3/02; H04L29/08; H04W4/06; H04W52/02
Ship oil consumption data analysis-based oil consumption management method and system			
	CN107070997 (A)	BEIJING CENTURY GRANDTECH CORP LTD	H04L29/08; G06F17/50
Unmanned ship information interaction system			
	CN107040583 (A)	NO 707 RES INSTITUTE OF CHINA SHIPBUILDING INDUSTRY CORPORATION	H04L29/08; G01D21/02; H04L12/865
Remote-control ship information returning device and control method thereof			
	CN106878429 (A)	UNIV SHANGHAI MARITIME	H04L29/08
Integrated data acquisition, processing and transmission system of ship			
	CN106856495 (A)	CHONGQING LANYANG SHIP REPAIR AND PRODUCING CO LTD	H04L29/08
Real -time 3D remote monitoring system of ship posture			
	CN206235872 (U)	THE THIRD ENG CO LTD OF CCCC FOURTH	G05B19/05; H04L29/08

Title			
	Publication number	Applicant(s)	International classification
		HARBOR ENGINERING CO LTD; SHANGHAI MARIN AUTOCONTTROL CO LTD	
Ship real-time monitoring system			
	CN106713292 (A)	UNIV SHANDONG JIAOTONG	H04L29/06; H04L29/08; H04N7/18
Ship information transmission system based on Beidou communication			
	CN106487441 (A)	NINGBO SHENGYU MARINE ELECTRONIC TECH CO LTD	H04B7/185; H04L12/58; H04L29/08
Ship Safety Management System			
	KR20170007639 (A)	HANWHA L&C CORP [KR]	G08B21/02; B63J99/00; G01S19/01; H04L29/08; H04W4/02
Acquisition and storage system for big data of maritime ships			
	CN106357750 (A)	MENG LING	H04L29/08
Robot ship system for acquiring water area information			
	CN106357752 (A)	MENG LING	H04L29/08; G08C17/02
Ship lock health state remote monitoring system and monitoring method thereof			
	CN106289388 (A)	UNIV DALIAN MARITIME	G01D21/02; H04L29/08
WIFI connection based ship Internet of Things system			
	CN106101002 (A)	TIANJIN DEV ZONE RUIFENG TECH CO LTD	H04L12/771; H04L29/08
Maritime safety information broadcasting system based on Beidou navigation			
	CN106102014 (A)	CHINA TRANSP TELECOMMUNICATIONS & INFORMATION (TIANJIN) SCIENCE & TECH CO LTD	H04W4/04; B63B45/00; G01S19/42; H04L29/08
METHOD OF COLLECTING DATA IN BALLAST WATER TREATMENT SYSTEM AND SYSTEM FOR ANALYZING SHIP BALLAST WATER TREATMENT BIG DATA USING MOBILE COMMUNICATION NETWORK			
	US2016280352 (A1)	HANLA IMS CO LTD [KR]	B63J4/00; G05B15/02; H04L29/08
PLATFORM AND METHOD FOR SAFETY NAVIGATION AND DISASTER RESPONSE OF **IOT** INTELLIGENT SHIP			
	KR20160060798 (A); KR101641787 (B1)	IUCF HYU [KR]	G06Q50/26; G06Q50/30
Internet of Things technology based ship part sectional logistics monitoring system and method			
	CN104951912 (A)	UNIV WUHAN TECH	G06Q10/08; G06Q50/28
Ship conduction system on basis of internet of things			
	CN104887207 (A)	UNIV WUHAN TECH	A61B5/021; A61B5/01; A61B5/0402; H04L29/08
UNMANNED SHIP CLOUD CONTROL SYSTEM BASED ON 4G INTERNET TECHNOLOGY			
	CN107172184 (A)	YANCHENG NSTITUTE OF TECH	H04L29/06; H04L29/08

Title			
	Publication number	Applicant(s)	International classification
Construction ship operation area virtual guard mark system and method based on AIS/GPRS			
	CN107016879 (A)	UNIV WUHAN TECH	G08G3/02
Automatic depth finding and monitoring system with unmanned ship for sea			
	CN106990422 (A)	SHANGHAI HUACE NAVIGATION TECH CO LTD	G01S19/42; G01B7/26; G08C17/02; H04N7/18
Cloud framework based integrated ship management system and communication and rescue methods thereof			
	CN106878430 (A)	UNIV JIMEI	H04L29/08; G08B25/00; G08C17/02; G08G3/00; H04L12/58; H04W4/04; H04W84/18
SYSTEM AND METHOD FOR PROVIDING INTEGRATED UNLOADING AND LOADING PLANS USING CLOUD SERVICE			
	WO2017105069 (A1)	TOTAL SOFT BANK LTD [KR]	G06Q10/08; B65G67/60; G06F15/16; G06Q10/06; G06Q50/10
Cloud management method for ship shore power system, server, and system			
	CN106571950 (A)	SHANGHAI ELECON INTELLIGENT TECH CO LTD	H04L12/24; H04L29/08
LNG ship data acquisition device			
	CN106441489 (A)	ZHONGSHAN LANSHUI ENERGY TECH DEV CO LTD	G01F23/00; G08C17/02
Ship networking fuel gas supply system			
	CN106401745 (A)	ZHONGSHAN LANSHUI ENERGY TECH DEV CO LTD	F02B77/08; F02M21/02
Acquisition and storage system for big data of maritime ships			
	CN106357750 (A)	MENG LING	H04L29/08
Safety monitoring system of Internet of vessels			
	CN106338952 (A)	ZHONGSHAN LANSHUI ENERGY TECH DEV CO LTD	G05B19/042
Cloud monitoring device of ship engine			
	CN106331103 (A)	SMARTGEN TECHNOLOGY CO LTD	H04L29/08
Cloud monitoring system of ship engine			
	Cloud monitoring system of ship engine	Cloud monitoring system of ship engine	Cloud monitoring system of ship engine
Navigation method and system for sailing			
	CN105928521 (A)	UNIV SHANDONG JIAOTONG	G01C21/20
Cloud management platform based on micro-service architecture			
	CN105662432 (A)	WUXI SANGNI'AN SCIENCE & TECH CO LTD	A61B5/1455; A61B5/00
Improved navigation method and system for sailing			
	CN105698800 (A)	UNIV SHANDONG JIAOTONG	G01C21/20

Title			
	Publication number	Applicant(s)	International classification
Bridge anti-collision warning system and realization method			
	CN104916166 (A)	UNIV NANTONG	G08G3/02
NAVIGATION SYSTEM FOR VESSEL, INFORMATION DISPLAY METHOD OF VESSEL NAVIGATION, AND RECORDING MEDIUM THEREOF			
	KR20120108534 (A); KR101280066 (B1)	DONGKANG M TECH LTD [KR]	G08G3/00
System for supervising fishing vessels arriving in and departing from port and positioning of fishing vessels dropping anchor in port and management method thereof			
	CN105868804 (A)	HANGZHOU CHENGAN **IOT** TECH CO LTD	G06K17/00
Internet of things (**IOT**)-based ship dynamic monitoring system			
	CN203300054 (U)	UNIV HOHAI CHANGZHOU	G08G3/00
REAL-TIME PUSH MOBILE SATELLITE COMMUNICATIONS SYSTEM AND METHOD FOR SHIP SMART WORK			
	KR101623896 (B1)	SUNCOMM CO LTD [KR]	H04L29/08; H04B7/185; H04L29/06; H04W4/00; H04W4/14
PLATFORM AND METHOD FOR SAFETY NAVIGATION AND DISASTER RESPONSE OF **IOT** INTELLIGENT SHIP			
	KR20160060798 (A); KR101641787 (B1)	IUCF HYU [KR]	G06Q50/26; G06Q50/30
Ship berthing auxiliary system based on Internet of Things technology			
	CN106875753 (A)	UNIV WUHAN TECH	G08G3/00
Ship conduction system on basis of internet of things			
	CN104887207 (A)	UNIV WUHAN TECH	A61B5/021; A61B5/01; A61B5/0402; H04L29/08
Ocean environment monitoring and early warning system			
	CN102394917 (A)	UNIV SHANGHAI OCEAN	H04L29/08; G08B25/10
Thing networking device of integrated sonar and space environment detection system who is suitable for thereof			
	CN206178139 (U)	ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD	G01S15/88
Internet-of-things equipment integrating sonar and space environment detection system of Internet-of-things equipment			
	CN106199611 (A)	ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD	G01S15/88
Water travel protection system for shipborne unmanned aerial vehicle based on Internet of Things			
	CN106005451 (A)	ANHUI YULONG INFORMATION TECH CO LTD	B64D45/06; G05D1/10
Xijiang river waterway shipping monitoring system based on Beidou satellite			
	CN105336218 (A)	NANNING FENGWEI SCIENCE & TECHNOLOGY CO LTD	G08G3/00
Ship navigation positioning and communicating apparatus			
	CN203299388 (U)	NINGBO TU TENG INTERNET OF THINGS TECHNOLOGY CO LTD	G01S19/33; G01S19/03
Self drive's of accurate positioning ship anchor			

Title			
	Publication number	**Applicant(s)**	**International classification**
	CN206171724 (U)	FENGDU CHANGYUAN MACHINERY PLANT	B63B21/22
Internet of Things technology based ship part sectional logistics monitoring system and method			
	CN104951912 (A)	UNIV WUHAN TECH	G06Q10/08; G06Q50/28
Ship conduction system on basis of internet of things			
	CN104887207 (A)	UNIV WUHAN TECH	A61B5/021; A61B5/01; A61B5/0402; H04L29/08
Internet AIS (automatic identification system)-base ship anti-collision method and system			
	CN105788370 (A)	FUJIAN NORTH STAR GALAXY COMMUNICATION CO LTD	G08G3/02
Ship local and/or remote track tracking method based on maritime satellite			
	CN105185161 (A)	QINGPING WANG	G08G3/00
Maritime search and rescue WSN			
	CN203015128 (U)	UNIV SHANGHAI MARITIME	H04W28/08; H04W40/10; H04W84/18
Ship track positioning system			
	CN102999044 (A)	WANG LIUYAN	G05D1/02
Dynamically monitoring and managing system of offshore ship			
	CN202306258 (U)	UNIV ZHEJIANG OCEAN	G05B19/418; H04L29/08
Ship recognition and locating system			
	CN201936459 (U)	ANXIN WU; WEI FANG	G08G3/00
Marine navigation network shared radar			
	CN106610291 (A)	NANJING INTELLIGENT CUBE ELECTRONIC TECH CO LTD	G01C21/20; G01S13/93
Marine internet system			
	CN105809371 (A)	COMPASS TECH CO LTD	G06Q10/06; G06Q50/26
Automatic system of collecting evidence of boats and ships illegal activities			
	CN205384759 (U)	WUHU MARITIME SAFETY ADMINISTRATION; WUHAN SUPERUS INFORMATION TECH CO LTD	G08G3/00
Mobile-internet-based VTS safety information service system and method			
	CN105261239 (A); CN105261239 (B)	UNIV DALIAN MARITIME	G08G3/00; H04L29/08
MARINE WEATHER DATA PROVIDING SYSTEM FOR OPTIMUM ENEGY AND SAFETY NAVAGATION OF VESSEL			
	KR20150102808 (A); KR101604016 (B1)	NEW WORLD MARITIME CO LTD [KR]	B63B35/00; G06Q50/10; G08G3/00
Ship remote video monitor system based on maritime satellite and base station			
	CN204408529 (U)	SOUTH CHINA SEA FISHERIES RES	H04N7/18

Acuicultura

Publication number	Applicant(s)	International classification
Aquaculture intelligent integrated monitoring system based on **IOT** (Internet of Things)		
CN107179732 (A)	UNIV FUDAN	G05B19/048
Aquaculture heating pipeline monitoring device and system under mixed communication mode		
CN106679731 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	G01D21/02; G01N33/18; G08C17/02
Automatic oxygenation feeding **IOT** (Internet of Things) monitoring system for aquaculture		
CN106647891 (A)	CHONGQING YIDIAN JIUBAO ENTPR MANAGEMETN CONSULTING CO LTD	G05D27/02
Aquaculture and livestock breeding multi-parameter measurement and control system and method based on **IOT** (Internet of Things) and GIS		
CN106603629 (A)	UNIV JIANGSU	H04L29/08; G01D21/02; G06F17/30; H04L12/26; H04L29/06
IoT-based intelligent aquaculture management system		
CN105976256 (A)	XU HONGJUN	G06Q50/02; G05B19/048; G05D11/13; H04L29/08
Automatic aquaculture unmanned aerial vehicle		
CN106719230 (A)	UNIV GUANGDONG TECHNOLOGY	A01K61/80; H04L29/08; H04N7/18
Intelligent feeding device based on real-time cultivation water quality monitoring		
CN106771031 (A)	UNIV JIANGSU	G01N33/18; G05B19/418; G08C17/02; H02J7/35; H04W84/18
Accurate water-transferring operation system for unmanned aerial vehicle aquaculture based on wireless sensor network and method thereof		
CN106227236 (A)	UNIV SOUTH CHINA AGRICULT	G05D1/10
Unmanned aerial vehicle aquaculture precise feeding work system and method based on wireless sensor network		
CN106227075 (A)	UNIV SOUTH CHINA AGRICULT	G05B19/04; G05D1/10
Information service and equipment remote power feeding system are synthesized in aquatic products industry		
CN205983187 (U)	XIAMEN TIANHUA HAOYE ELECTRONIC TECH CO LTD	G05B19/418; H04L29/06
CLOUD GENERAL-PURPOSE ENVIRONMENTAL INFORMATION MONITORING SYSTEM AND MIDDLEWARE THEREOF		
JP2016058084 (A)	NAGOYA INST TECHNOLOGY	G06Q50/10; G08B21/10; G08B25/08; G08B25/10; H04M11/00; H04Q9/00
Shrimp environment intelligence control system that grows seedlings based on multisensor information fusion		
CN204790651 (U)	UNIV GUANGDONG OCEAN	G05D27/02

Title		
Publication number	**Applicant(s)**	**International classification**
Internet-of-things-based on-line litopenaeus vannamei aquaculture water quality monitoring system		
CN203324260 (U)	UNIV GUANGDONG OCEAN	G01N33/18
Lightning protection aquaculture water quality monitoring device		
CN106053747 (A)	JIANGSU ZHONGNONG INTERNET OF THINGS TECH CO LTD	G01N33/18; H01T19/04
Lifting type aquaculture sensing platform		
CN106020242 (A)	SHANGHAI AGRICULTURAL INTERNET OF THINGS ENG RES CENTER	G05D3/12; A01K61/00
Multi -functional aquaculture monitoring facilities		
CN205547021 (U)	ANHUI SMART INTERNET OF THINGS TECH CO LTD	A01K63/04; A01K61/00
Aquaculture intelligence control system		
CN103823415 (A)	WUXI MEIXIN INTERNET OF THINGS TECHNOLOGY CO LTD	G05B19/418
Aquaculture system		
CN203467421 (U)	ANHUI SMART INTERNET OF THINGS TECHNOLOGY CO LTD	A01K61/80; A01K63/04
Intelligence control system for aquaculture oxygenation device		
CN203275991 (U)	BEIJING ZHONGNONG CHENXI SCIENCE & TECHNOLOGY CO LTD; GUANGDONG SHUNDE CHENXI INTERNET OF THINGS TECHNOLOGY CO LTD	G05B19/418; A01K63/04
Industrial aquaculture distribution and control system		
CN203275989 (U)	BEIJING ZHONGNONG CHENXI SCIENCE & TECHNOLOGY CO LTD; GUANGDONG SHUNDE CHENXI INTERNET OF THINGS TECHNOLOGY CO LTD	G05B19/418; A01K63/00; A01K63/04
Water quality online monitoring system for industrial aquaculture		
CN203275396 (U)	BEIJING ZHONGNONG CHENXI SCIENCE & TECHNOLOGY CO LTD; GUANGDONG SHUNDE CHENXI INTERNET OF THINGS TECHNOLOGY CO LTD	G01N33/18
Aquaculture oxygenation device wireless intelligent control system		
CN202583842 (U)	GUANGDONG SHUNDE CHENXI INTERNET OF	G05B19/418; A01K63/04

Title		
Publication number	Applicant(s)	International classification
	THINGS TECHNOLOGY CO LTD	
Aquaculture intelligent feeding system		
CN202565981 (U)	GUANGDONG SHUNDE CHENXI INTERNET OF THINGS TECHNOLOGY CO LTD	A01K61/02
Aquaculture intelligent integrated monitoring system based on **IOT** (Internet of Things)		
CN107179732 (A)	UNIV FUDAN	G05B19/048
Aquaculture water quality monitoring and early warning system based on Internet of Things		
CN107065984 (A)	JIANGSU VOCATIONAL COLLEGE OF FINANCE AND ECONOMICS	G05D27/02
Monitoring data sharing and leasing method of intelligent aquatic product system		
CN106960393 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	G06Q50/02; G06Q30/06
Aquaculture water quality monitoring device based on Internet of things		
CN106896844 (A)	UNIV SHAANXI TECHNOLOGY	G05D27/02
Abalone culturing device integrating disinfection and washing, dead body collection, oxygenation and water quality early warning		
CN106879519 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	A01K61/51; A01K63/00; A01K63/04
Aquaculture water quality monitoring device based on thing networking		
CN206270786 (U)	SHAANXI SCI-TECH UNIV	G05D27/02
Color-changing vest for aquaculture field early warning and implementation method of color-changing vest		
CN106723464 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	A41D13/00; A41D1/04; A41D27/20; G01N33/18; G05B19/042
Aquaculture farming system based on Internet of Things		
CN106774560 (A)	SHANGHAI YUEYANG INFORMATION TECH CO LTD	G05D27/02
Internet of things net cage remote monitoring system		
CN106791589 (A)	HARBIN GETAI TECH CO LTD	H04N7/18; G06Q50/02; H04L29/08; H04N5/225
Internet-based cage aquaculture system		
CN106719213 (A)	PANG QIANMEI	A01K61/60; A01K61/80; G01D21/02
Smart aerator based on narrowband Internet of Things and dissolved oxygen stereoscopic monitoring method		
CN106647835 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	G05D11/13; A01K63/04; G01N27/00
Internet based beach aquaculture pool automatic management system		
CN106614237 (A)	UNIV YANCHENG TEACHERS	A01K63/00; A01K63/04; G05D27/02

Title		
Publication number	**Applicant(s)**	**International classification**
Aquaculture pond inspection sign-in and water quality detection device and system and realization method		
CN106657404 (A)	FUJIAN QIANGMIN INFORMATION TECH CO LTD	H04L29/08; G01N33/18; G06K7/14; G07C1/10
Internet + intelligence disinfection aquaculture pond		
CN205756561 (U)	QINGYUAN YUEYANG YIHAO AGRICULTURE SCIENCE AND TECH CO LTD	A01K63/00; A01K63/04; G05B19/418
Intelligent aquaculture system and method based on LABVIEW remote monitoring and control technology		
CN106371485 (A)	YULIN NORMAL UNIV	G05D27/02; A01K61/80; A01K63/04
Aquaculture quality of water automatic monitoring system		
CN205861115 (U)	JIANG HAISHENG	G01D21/02
Internet + electrolysis aquaculture pond		
CN205794495 (U)	GUANGDONG YUESANPANG AGRICULTURAL TECH CO LTD	A01K63/00; A01K63/04; A01K63/06; G05D27/02; H04L29/08
Pond aquaculture management device based on internet of things		
CN205620801 (U)	ANHUI YIHAI AGRICULTURAL DEV CO LTD	G05B19/418
Novel aquaculture scheme based on Internet of Things technology		
CN105660505 (A)	TIANJIN HUARUI JUYUAN METAL PRODUCTS CO LTD	A01K63/00; G05B19/418
Aquaculture monitored control system based on thing networking		
CN205507466 (U)	UNIV ANHUI SCI & TECHNOLOGY	G05B19/042