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ANALYSIS OF THE COSTS AND BENEFITS OF ELECTRONIC FISHERIES INFORMATION SYSTEMS APPLIED IN FFA COUNTRIES AND IDENTIFICATION OF THE LEGISLATIVE, REGULATORY AND POLICY SUPPORTING REQUIREMENTS

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STUDY FOR
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Acronyms used

AES ..... Advanced Encryption Standard
AIS ..... Automatic Identification System
AFMA..... Australian Fisheries Management Authority
ALB ..... Albacore tuna
CCM..... Members, Cooperating Non-members and participating Territories of WCPFC)
CCTV..... Closed Circuit Television
CDS..... Catch Documentation Scheme
CMM ..... Commission Management Measure (of WCPFC)
CSV ..... Comma Separated Value
DNID..... Data Network Identity
ECDIS..... Electronic Chart Display & Information Systems
EDGE..... Enhanced Data rates for GSM Evolution
EEZ..... Exclusive Economic Zone
EFIS..... Electronic Fishery Information System (FMIS is a comparable term)
eLog..... electronic logbook
EM ..... Electronic Monitoring
ER ..... Electronic Data Reporting
ERO..... E-Reporting Officer
ER&EMWG ..... Electronic Reporting and Electronic Monitoring Working Group
ET..... Electronic Tracking
FAD..... Fisheries Aggregating Device
FFA ..... Forum Fisheries Agreement
FIMS ..... Fisheries Information Management System
FIP..... Fisheries Improvement Project
FMC..... Fisheries Monitoring Centre
FSM ..... Federated States of Micronesia
GEN-3 ..... Regional Observer Vessel Trip Report
GPRS..... General Packet Radio Services
GPS..... Global Positioning System
GRT..... Gross Registered Ton
GSM..... Global System for Mobile Communications
HD ..... High definition
HDD..... Hard Disc Drive
HS..... High Seas
HSP1..... High Seas Pocket
iFIMS ..... Industry Fisheries Information Management System
IMO ..... The International Maritime Organization
IUU ..... Illegal Unreported and Unregulated
JDP..... Joint Deployment Pragramme
JSON ..... JavaScript Object Notation
LRIT..... Long Range Identification and Tracking
MFMR..... Ministry of Fisheries and Forests (Fiji)
MCS..... Monitoring, Control and Surveillance
MSC..... Marine Stewardship Council

MSY ..... Maximum Sustainable Yield
NAF..... North Atlantic Format
NFA..... National Fisheries Authority
NGO..... Non-Governmental Organization
OFD..... Offshore Fisheries Division
OFP ..... Oceanic Fisheries Programme
OVR ..... Online Vessel Register (PNA)
PIC ..... Pacific Island Countries
PICTS ..... Pacific Island Countries and Territories
PIRFO..... Pacific Island Regional Fishery Observer
PNA ..... Parties to the Nauru Agreement
PNG ..... Papua New Guinea
QAC ..... Quick Access Computing
RFSC ..... Regional Fisheries Surveillance Centre
RIMF ..... Regional Information Management Facility
RMI..... Republic of the Marshall Islands
SAR ..... Synthetic Aperture Radar
SC ..... Scientific Committee (of WCPFC)
SKJ ..... Skipjack tuna
SOLAS ..... International Convention for the Safety of Life at Sea
SPC ..... Secretariat of the Pacific Community
SWO ..... Swordfish
t ..... Metric tonne
TEP ..... Threatened, Endangered and Protected species
TCC ..... Technical and Compliance Committee (WCPFC)
TUBS..... TUFMAN Observer Module System
TUFMAN..... Tuna Fisheries Management (database)
VHF..... Very High Frequency
VCI ..... Vessel Compliance Index
VMS..... Vessel Monitoring System
VOGS ..... Vessels of Good Standing (FFA)
VOI..... Vessels of Interest
W1..... Wharf 1 (of GSFPC Complex)
WCPFC..... Western and Central Pacific Fisheries Commission
WCPO ..... Western and Central Pacific
WWF..... World Wide Fund for Nature
XML ..... Extensible Markup Language
XSD ..... XML Schema Definition
YFT..... Yellowfin Tuna

Disclaimer and Report Information

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EXECUTIVE SUMMARY

This report has been prepared by Poseidon Aquatic Resource Management Pty Ltd, and supported by funding from WWF. The purpose of the report is as follows:

1. Identify the electronic fisheries information systems (EFIS) and assess the rationale for their application;
2. Investigate and analyse existing legislation to identify key legal and regulatory considerations relevant to the implementation of Electronic Monitoring (EM) and Electronic Reporting (ER) into national fisheries policy and legislation. This should provide an analysis that governments can use to support and inform the update of national fisheries policy and legislation to incorporate EM and ER;
3. Identify the costs and benefits of each system, with the support of country case studies;
4. Investigate and document potential (and realistic) cost-recovery solutions for ER and EM that could be adopted by FFA member countries (noting that this work may be included/linked to a broader cost-recovery study); and
5. Provide a recommended critical path to the FFA member countries that are considering cost-recovery solutions for ER and EM implementation.

Fish landings and throughput in the Western & Central Pacific Ocean (WCPFO)

The total Western Central Pacific Ocean (WCPO) tuna catch over 2014 was around 2 million tonnes (t), of which around 71% was caught by purse seine, 9% by longline and 7 % by pole-and-line vessels, and the remaining 13% by a collection of other gears.

The key species caught are the pelagic tunas e.g., skipjack tuna (SKJ) (68%), yellow-fin tuna (YFT) (21%), bigeye tuna (BET) (6%) and albacore tuna (ALB) (4%), along with an assortment of bycatch species including sharks, billfish and other pelagic species (e.g. wahoo, mahi mahi, opah and rainbow runners).

The countries and territories encompassed by the WCPO comprise the 17 members of the Forum Fisheries Convention, the French territories (French Polynesia, New Caledonia and Wallis and Fortuna), Indonesia, Philippines and Vietnam. These countries, along with the main participating distant water countries China, Japan, Korea, Taiwan, the USA and an assortment of Latin states (Spain, Ecuador and El Salvador), operate within the Regional Fishery Management Organisation (RFMO), The Western & Central Pacific Fisheries Commission (WCPFC).

Pacific Island countries, excluding the French and US Territories, are responsible for managing 20.8 million sq. nautical miles of ocean. The principal bodies being the 8 Parties to the Nauru Agreement (PNA), with 14.5 million nautical miles, the South Pacific Island countries, excluding Australia and New Zealand, with 6.3 million sq. nautical miles, and the French and US territories, with 2.3 sq. and 1.3 million nautical miles respectively. Indonesia, Philippines and Vietnam collectively account for another 4.8 million sq. nautical miles. The High Seas areas, which are outside national jurisdiction, account for 3.5 million sq. miles.

Amongst Pacific Island countries coordination of regional Monitoring, Control and Surveillance (MCS) EEZ actions comes under the responsibility of the Forum Fisheries Agency secretariat, with each participating nation responsible for coastal state enforcement, and flag states responsible for their vessels when fishing within their EEZ, other country waters and the high seas. MCS functions for the High Seas are under the responsibility of the WCPFC. The WCPFC is also responsible for setting specific regional wide management measures. Compliance with these measures requires annual reporting to and compliance monitoring by the WCPFC Technical and Compliance Committee (TCC).

Fisheries management and fisheries-related data collection systems

Tuna and tuna-like fish species are shared stocks and are managed at a regional oceanic level by the WCPFC, based in Pohnpei; or for specific fisheries, at sub regional level by PNA, based in Majuro; and the Forum Fisheries Agency, based in Honiara. The PNA countries manage two Vessel Day Schemes (VDS), the purse seine and longline VDS. The PNA Office (PNAO) in Majuro coordinates this. Aside from its central enforcement role, FFA coordinates the management of the Tokelau (southern tuna) longline fishery.

EFIS include Electronic Tracking (ET), ER and EM.

FFA's Regional Fisheries Surveillance Centre (RFSC) and WCPFC apply the Vessel Monitoring System (VMS) to track vessel movements (position, course and speed). Since April 2009, the application of VMS has been mandatory across the high seas of the WCPFC Convention Area (it was first implemented through WCPFC CMM 2007-02 which was replaced by CMM 2011-02 and now CMM 2014-02). These systems are described as "***closed systems"*** because they do not accept external or manual input that impacts on its core functionality.

FFA operates a Service Level Agreement (SLA) formalising the "Pacific VMS" which provides the common architecture for the FFA VMS and the WCPFC VMS, but with each VMS system operating as separate and stand-alone entities. In accordance with WCPFC rules, vessels required to report to the WPCFC VMS, report to the WCPFC VMS through two avenues: directly to the WCPFC VMS or through the FFA VMS. Irrespective of the avenue the WCPFC VMS information is only viewable in areas covered by the WCPFC VMS: in high seas waters of the Convention Area as well as in certain national waters that are covered by the WCPFC VMS. The WCPFC has approximately 2,355 additional registered vessels (Table 1) that report to the WCPFC VMS directly. All vessels reporting to the WCPFC VMS would be listed by the responsible flag State on the WCPFC Record of Fishing Vessels which demonstrates it is authorized to operate in the Convention Area beyond the flag States jurisdiction (WCPFC CMM 2013-10). The FFA also operates its own register (The FFA Vessels of Good Standing) and these comprise the 1,213 vessels (November, 2015) fishing inside national EEZs.

VMS requires vessels to install a near real-time satellite position fixing transmitter, known as Mobile Transceiver Units (MTUs). The MTUs identify and locate vessels by electronically exchanging data via global satellite networks. This data transmission is supported by a number of telecommunication companies (Inmarsat, Iridium and Argos). These companies charge the sender for the MTU, and the receiver for Air Time, usually through a third party provider. The MTU transmits the sending location and the MTU ID or Data Network Identity (DNID), to the receiving location. Once received, data is transmitted to Electronic Chart Display & Information Systems (ECDIS) to review vessel positions. Each national organisation has access to the VMS operated by FFA, and can track all vessels fishing and transiting its respective zone using 'Google Track', with vessels' colour coded, identifying individual vessel non compliance risks, scored against a Vessel Compliance Index (VCI). The VCIs are determined by both FFA and by each country based on annual VCI scoring. The FFA Secretariat sees fishing activities in all EEZs and High Seas areas. There is no restriction in the viewing area. Member countries see all vessels within the High Seas areas & High Seas pockets outside their own EEZ. They see their own flag vessels in all areas and licensed vessels in all areas during the validity of the fishing license. They also see into other members' EEZs under data sharing agreements. Only Fiji and Kiribati have selective data sharing while the other countries are all sharing with each other. The WCPFC VMS allows for vessel movements to be monitored primarily in the High Seas waters of the Convention Area, but vessel movements can also be tracked in most, but not all EEZs.

ET also includes the integration of the International Maritime Organization (IMO) Long Range Identification and Tracking (LRIT) system, the Automatic Identification System (AIS). AIS is a designated system designed to collect and disseminate vessel position information received from

IMO member States' ships that are subject to the International Convention for the Safety of Life at Sea (SOLAS). The LRIT is compulsory for all vessels > 300 Gross Tonnes (GT), but may be installed on a number of smaller craft for safety reasons. The RFSC and one national administration (the National Fisheries Authority (NFA) for Papua New Guinea (PNG)) integrates AIS positions into the ECDIS, invariably when the signal may be stronger than the VMS. AIS is also used as a cross checking tool to view potential unauthorised activity, for example for carriers and bunkers, that may not be registered on the WCPFC or FFA authorised lists. AIS is not presently used or accessed by WCPFC Secretariat.

In the event that vessels may be operating without VMS and AIS, Synthetic Aperture Radar (SAR) provides intelligence high-resolution remote sensing imagery, in any type of weather, and can be used to locate any vessel imagery and detect suspicious behavior. Its application is generally used to view activities in potential high fishing intensity hotspots, for example within the High Seas, to identify unauthorised transshipments. The use of this system supports asset deployment such as overflight during operations or directing patrol vessels to any potential unauthorised fishing activity targets. SAR presently has some imagery deficiencies due to speckles and signals returned from rough seas, and cannot be used as evidence to support prosecutions. SAR is not presently used or accessed by WCPFC Secretariat.

Electronic monitoring (EM) largely consists of a closed video or photographic system integrated with a sensor system that can be used to view changes in fishing activity and to trigger or coordinate photographic viewing. These systems, as per ET, are also "***closed systems"***. The camera and sensor systems do not allow external or manual inputs nor manipulation of data. The EM system consists of a control center, connected to an array of peripheral components including: CCTV cameras, Vessel AIS or GPS receiver, winch and engine sensors and a communications transceiver. The sensors transmit real time positions, in much the same way as VMS, but additionally record when there is a change in fishing behaviour when the fishing gear is being used. Vessel positions and activity can also be viewed on ECDIS. The application focuses on identifying a number of activities. Geo-referenced images allows vessel tracking and streaming sensor data. Sensor data transmission requirements are equivalent to VMS (19byte) needs. Cameras may identify interactions with bycatch species, and are especially useful when recording bycatches of protected species. The viewed data can also provide a secondary source of data, for example to validate catch and bycatch logsheets. Cameras can substitute for the observer requirements, largely where it may be impractical to deploy observers, or where there may be a threat to the security of the observers-on-board. The current providers in the Pacific include Archipelago Asia Pacific video (4 cameras) and sensor recording system, currently applied by AFMA for use in the Australian Eastern Tuna and Billfish longline fishery (ETBF) and other Australian Commonwealth fisheries; Satlink Sea Tube Lite, Spain, using a 3 video cameras EM system trialed by SPC/FFA in the Solomon Islands and presently under trial in Fiji in a wider program financed by the GEF and managed by FAO; and Trident's single camera system deployed on 3 domestic vessels, under a specific arrangement with two Fijian based companies. One other provider, but not presently deployed in the Pacific tuna fisheries, is Marine Instruments, who provide the Electronic Eye (Spain). Both the application by AFMA and the trials undertaken with Satlink in the Solomon Islands, demonstrate the view of the project proponents that the system may meet the majority of the minimum data standards of the WCPFC Regional Observer Programme (ROP). The exception (now available under the Satlink system) is an on screen-measuring tool to calculate fish length. Live video footage through satellite transmission is not cost effective at present. Footage is stored in a hard drive and sent monthly, or after each trip, to the provider for analysis. The Marine Instruments e-eye system does provide for an integrated Iridium modem, which allows for real time data transfer. This also allows for less HD space needed for photos and longer periods at sea (6 month in position - linked to HD capacity). The Trident system developed in New Zealand is 3G based and data can be uploaded when the vessel is within cellphone range. Whilst there is provision for this facility, the cost of transmitting still frames, as opposed to live footage is still prohibitively expensive, and quite impractical because of the high volume required for

transmission. That said, health and safety issues may warrant such a facility to be available.

Various **Electronic Reporting (ER)** systems are used as monitoring and database systems, satisfying data-reporting requirements for regionally coordinated work such as the regional stock assessments, regional fisheries management and compliance. The systems are "***open systems"*** because manual inputs are required and accepted, for example from skippers and observers.

The systems provide an integrated collection of modules that relate processes that together support a regional country's NFA and regional management groups (e.g. PNA and FFA), in achieving its business objectives through the provision of comprehensive, timely and quality data. SPC pioneered the initial steps in ER development through its Tuna Fisheries Database Management System (TUFMAN). These contain e-tunalog and e-tubs as well as a number of other modules. Integrated ER systems have now been developed and include the Fisheries Integrated Management System (FIMS) and the Regional Information Management Facility (RIMF). The pace of advancement of FIMS has been rapid, developed over 6 years, responding to demand, largely by PNG NFA, and now offering 11 operational modules to the PNA. The system contains an integrated industry portal, industry Fisheries Integrated Management System (iFIMS). By contrast, the RIMF system is still to be fully activated beyond the VMS capability. This facility operates with a limited 4 core modules, along with integrated access to the SPC e-tunalog and e-tubs. This system is available to all FFA members and can be used as an alternative system to FIMS, albeit, that it has not reached anywhere near the same stage of development.

All systems provide desktop/laptop access through one menu, provide access to databases away from the office (after login/password), produce reports that combine data from different systems (e.g. logsheet, observer, position reports (VMS data), licence and registration details, and observer data), and contain new administration systems to improve work flow (e.g. data registration and document management).

The two available systems include access to VMS/Google track, vessel day management and observer management. The FIMS system modules include Online Vessel registry (OVR) and Electronic Licence Registration (ELR), Asset Tracking System (ATS), e-log (catch logsheets), observer Management and electronic data reporting and near real time GEN 3 reports, port sampling and unloading, VDS monitoring, VDS trading, FAD Tracking, Catch Documentation Scheme (CDS) port monitoring and e-reporting.

Compliance Apps are being developed for each system. These include integration of MCS TUFMAN and the Boarding Officers Job Aid Kit into RIMF. The FIMS provider, Quick Access Computing (QAC) is also in the design stages of a compliance app for NFA, PNG. These systems are used to record vessel inspection details and will contain an interactive link to the other modules in each system.

It should be noted that the e-TUNALOG and FIMS e-log system have not as yet been widely applied. All FFA countries and French Territories (French Polynesia and New Caledonia) presently manually enter catch logsheet data into TUFMAN and observer data into the observer entry module (TUBS). E-logs are now being implemented on a 'port-to-port basis' with PNG and Solomon Islands sharing information, with RMI and Tokelau set to follow.

All the ER systems provide a cloud based recording and transmission system for transmitting information, transmitted through 'fleet broadband internet'. The modules contained within FIMS are interactive, allowing for industry (iFIMS) to feed-into FIMS and specific company access to their own data, and access through reporting to real time data on vessel days, positions, e-catchlog, observer reporting, CDS and registration and licensing, as well as other features. The CDS module produces a full traceability check system, integrating unloading, elog, observer verification and VDS checks with Catch Certificates and traceability balances.

The purse seine industry also uses internet connectivity to support Fish Aggregation Device (FAD) tracking and FAD acoustic readings, the positions of satellite buoys, weather information and sea temperature variations and sea surface heights.

Legislative and regulatory issues associated with ER and EM

The implementation of ER and EM into the Pacific Island Countries' (PICs') fisheries regimes raises a number of legal and regulatory issues and considerations. The main legal and regulatory issues relate to privacy, confidentiality, and data protection.

With respect to privacy, none of the PICs currently have specialised privacy legislation. Instead, privacy, confidentiality and data security considerations are addressed on an *ad hoc* basis across different industries (e.g. telecommunications, finance, or fisheries). Privacy regimes can comprehensively address advances in technological and data or information processes where existing legislation regulates main privacy considerations such as data protection and security. In addition to this, targeted and specific legislation regarding EM and ER processes, requirements, restrictions and governance facilitate the transition and effective integration of such processes into existing regimes.

Of the PICs, PNG has the most comprehensive legislation integrating EM and ER into its fisheries management regime. PNG has achieved this through a recent amendment to its *Fisheries Management Act* in 2015.[1] The remaining PICs are yet to implement specific legislation to facilitate the integration of EM and ER into their fisheries regimes. While this lack of targeted legislative implementation may not necessarily preclude EM and ER being integrated into the respective PICs' fisheries management regimes, potential legal and regulatory issues, liabilities and obstacles may arise without express implementing legislation. In addition, the implementation of express EM and ER legislation and regulations will provide clarity and transparency to both industry and regulatory authorities critical for effective domestic and international fisheries management.

Case studies of other countries[2] indicate that many have enacted privacy legislation that specifically governs how agencies collect, use, disclose, retain, store, and allow access to personal information. Typically, the primary piece of privacy legislation also authorizes the Privacy Commissioner to implement regulations, codes to establish standards regarding particular areas of privacy protection (e.g. on a sectorial basis). PICs could mitigate any potential data protection and privacy legal issues by implementing general privacy legislation governing, among other things, the protection, use and disclosure of personal information. However, even with the implementation of specialised privacy legislation, specific amendments to existing fisheries legislation integrating EM and ER, and addressing potential legal issues or uncertainty proactively, is the most effective approach.[3]

Based on an analysis of the potential legal implications regarding the development and implementation of EFIS systems, PIC legal frameworks will need to clearly address and provide for the following key areas and considerations:

a) clear classifications (including legal definitions) of the types of data or information involved, whether personal, confidential or other information;
b) the purposes, methods and locations for obtaining, collecting, accessing, transmitting, storing and disclosing the data/information, including any relevant exceptions, limitations or restrictions;

[1] See the *Fisheries Management (Amendment) Act 2015*, which amends the *Fisheries Management Act 1998*.

[2] For example, Australia.

[3] Targeted amendments to existing fisheries legislation would be effective at mitigating any potential legal issues arising from the implementation of EM and ER, and would also be the most time effective means of integrating EM and ER into the countries' respective fisheries regimes.

c) the relevant entities who will store, transmit, receive, access and process or use the information or data;
d) legal safeguards to the security of data/information – through confidentiality and data protection / personal data provisions (including relevant compliance and enforcement provisions); and
e) a reasonable estimation of the necessary length of time that a regulatory body must retain the particular data based on the carrying out of the proposed use (including expressly regulating how data can be retained for longer periods – for example, where determined necessary by the particular holding authority).

Electronic fisheries information solutions (EFIS): Opportunities and outline costs and benefits

Efficient, comprehensive, and cost effective EFIS systems can generate significant value to management and compliance, the industry, and science, but only if incentives are aligned, costs and benefits shared, and transparent and rational standards developed.

New technology for EFIS offers the opportunity to increase efficiency and accuracy while dramatically improving data quality. The development of an effective EFIS is often hindered by two main factors:

1. The cost of related data, tracking and communication technologies.
2. An absence of data recording and reporting standards.

This said, there are considerable useful data that can be collected from fishing operations:

1. **Fishing Operation**
    a. Vessel day recording
    b. Target species catch and bycatch
    c. Start and end of trip: Vessel leaving and entering port
    d. Entering and leaving fishing zone
    e. Start single fishing operation (set); fishing: the activity between gear deployment and gear hauling; and end single fishing operation
    f. At sea compliance with management regulations (non discarding, non retention of protected species, using unauthorised gears or illegal setting (e.g. FAD sets during prohibition periods, setting on whale sharks, unauthorised transshipments, use of prohibited gears (e.g. wire traces)
2. Recording of **Non-fishing operation**
    a. Steaming between ports and transiting EEZs
    b. Research and survey
    c. Non-fishing surveys (not include actual catching of fish)
    d. Fishing surveys
    e. Retained and discarded catch
    f. CPUE
3. **Other information to be recorded:**
    a. Marine and vessel environment
    b. GIS data
4. **Traceability**
    a. Chain of custody as fish change hands
    b. What info is required (date/time, species, action taken, temperature, etc.)
    c. What safeguards were in place to ensure chain of custody is not broken
    d. Transshipment issues with respect to vessel flagging

- Such information is required by a wide range of different fisheries stakeholders, including:

1. **Fisheries management authorities**
    - Administration
    - MCS authorities
    - Fisheries managers
    - Fisheries scientists
2. **Commercial sector**
    - Skippers
    - Fleet managers
    - Fishing industry associations
    - Market recipients

There are a number of different functions EFIS can provide:

1. Vessel tracking, via VMS, AIS and SAR. Whilst VMS and AIS can track authorised vessels fitted with these systems, SAR can be used to locate any vessel and detect suspicious behaviour. For example, vessels without VMS may operate in and amongst others operating with the system. The cross-correlation with VMS / AIS will identify potential IUU fishing activities. SAR may also be used prior to any asset deployment, for example in zone Pacific Patrol Boat Deployment, or during coordinated Joint Deployment Programmes (JDPs).
2. Electronic monitoring: can provide views of key vessel areas e.g., gear deployment / retrieval, catch aboard, sorting, processing, storage and can potentially be used to replace or compliment the use of human observers (who are expensive, logistically complex and potentially bribable). One new development is drone-mounted cameras, allowing a potential low-cost solution to the over-flying of suspicious vessels to assist in their identification and recording of evidence.
3. Electronic reporting: use of electronic logbooks to replace paper forms. Potentially time-saving (menu-driven and can derive data automatically form sensors, automatic measuring equipment as well as GIS / map plotters) and can transmit information in an agreed format to fisheries management authorities. The real time entry of data at source eliminates the need for onshore data entry and potentially provides greater flexibility within fisheries administrations to focus more on data analysis. E-logs can also be used by commercial fisheries operators to transmit catch, vessel and quota utilisation data to their own management.

- The use of e-logs and e-obs, in particular raises considerable issues over data standards, data validation, data encryption, access control, and data transmission.
- Data transmission is an issue, but with data coding, most of the costs involved are reduced. Satellite transmission is reasonably cost effective and can be used anywhere, but significant opportunities exist for improved efficiencies in data transmission, which in time will lower the cost, and will make all systems more effective.

The estimated annual costs of EFIS applied to FFA and WCPFC fisheries collectively equate to US$ 9.8 million, of which US$ 2 million would be for VMS and allied satellite tracking systems; US$ 3.8 for ER; and US$ 7 million for EM. Assuming current rates of fishing activity, these could equate to US$ 9,100 per vessel annually, made up of US$ 1,500, US$ 3,400 and US$ 3,800 per vessel respectively. No distinction is made between vessel types since the operating costs (support hardware, software and manpower) are virtually the same. These collective costs would represent, as a proportion of total sales, approximately < 0.05% for purse seine, 0.3% for longline, and 0.2% for pole-and-line. Similar costs would be levied on carriers, bunkers and motherships.

Overall, there are five (5) main areas into which benefits from a more extensive and comprehensive implementation of an EFIS is seen to fall, these being:

1. Improved compliance and reporting
2. Improved fisheries sustainability, including non-target species
3. Improved quality in stock assessment
4. Improved traceability and catch quality
5. Improved industry conditions, including safety

The EFIS systems available at present provide a number of benefits which include:

1. Better quality and more comprehensive data to support management (ET, EM and ER)
2. Improved adequacy, transparency, and integrity of fishery information and management data to support fisheries management – research and monitoring (ET, EM and ER)
3. Providing real time data and intelligence to strengthen awareness of fishing activities for both fisheries managers and industry (ET, EM and ER)
4. The ability to monitor more fishing events (ET, EM and ER)
5. Keep the relative costs of increasing fishery MCS levels to relatively manageable levels (ET, EM and ER)
6. Improved targeting, planning and use of MCS, e.g. the near real time analysis of transmission data (VMS, AIS, EM)
7. The rapid integration of higher resolution catch data across fishing vessels and fleets (ER)
8. Cost effective alternatives to more costly systems, e.g. aerial surveillance (ET, EM and ER) and more effective and efficient deployment of surveillance assets
9. Savings in administrative manpower costs due to the automation of data storage and transfer
10. Available intelligence leading to more efficient deployment of assets (ET, EM and ER)
11. Reduced health and safety risks for both crew and on-board observers (the option of fewer personnel exposed to dangerous working practices) (EM)
12. Improved compliance and stronger focus on targeting higher risk non-compliance activities (ET, EM and ER)
13. The ability to use evidence to support and increase number of prosecutions (ET, EM and ER)
14. Promoting voluntary compliance, especially when reporting effort and catch data (ER and EM)
15. Providing multiple and corresponding outputs that can be overlaid and provide automatic cross checks (alerts) to ensure strong data integrity and rapidly identify non-compliance activities (ET, EM and ER)
16. Capability created for providing better verification of chain of custody and traceability to improved adequacy, transparency, and integrity of information flowing into the seafood marketplace
17. Promoting entrepreneurship and encouraging innovation in data collection and compliance monitoring (ET, EM and ER)
18. Promoting higher levels of collaboration between cooperating nations, thereby strengthening compliance functions
19. The systems are auditable
20. The systems can be cross checked by a number of personnel and transparency to ensure data integrity and reduce the possibility of corruption

In quantifying potential benefits, benefits, unlike costs have not been calculated for each electronic system but rather as a package. The rationale for this has been the challenge of attempting to proscribe specific benefits to ET, EM or ER when these benefits are more likely to accrue from installation and operation EFIS solutions overall. Benefits have thus been calculated by category as described in Table 8 and Table 9, above.

The table below, summarises the total quantifiable benefits that would be realized in the event of wide adoption and installation of EM and ER systems onboard WCPO vessels. For each benefit, an upper (high) and lower (low) estimate has been derived. In some cases such as with efficiency gains in employment and compliance with endangered, threatened and protected (ETP) and by-catch CMMs, a single value has been allocated.

Table: Summary of total annual benefits derived from installation and operation EFIS solutions.

Benefit category/source	Lower	Upper
Validation Non-Fishing Days (NFD) claims [1]	$ 34,710,000	$ 66,750,000
Observer Deployment and Coverage savings [2]	$ 550,550	$ 1,116,830
Efficiency Gains in National Employment	$ 2,312,050	
Non-compliance detection and prosecutory fines [3]	$ 10,750,000	$ 21,250,000
Improved Compliance with ETP/Bycatch CMMs	$ 1,245,000	
Improved Compliance with Transshipment CMMs (IUU) [4]	$ 13,325,165	$ 26,650,330
Improved Occupational Health & Safety [5]	$ 529,700	$ 626,600
TOTAL BENEFITS	**$ 63,422,465**	**$ 119,950,810**

Cost Recovery

As demonstrated earlier, the ET (VMS and other RFSC costs) are presently extracted from the FFA Register. These costs (US$ 1,303 /vessel) are broadly covered with registration fees ranging from US$ 1,423/vessel to US$ 3,410.

However, there is no direct cost recovery system for vessels fishing in WCPFC, and these costs are covered by WCPFC expenditure as a whole. There has been some debate as to whether these costs could be recovered on a per vessel basis, but not solution proposed (Manarangi-Trott, pers comm., February, 2015). More explicitly, however, there are some areas of double counting of resources and costs in terms of the operations of both FFA and WCPFC, which could be streamlined if operating through a single RFSC. There are however, some complexities that relate to the relative roles and responsibilities of each organisation, as well as different membership bases, of FFA and WCPFC that would complicate a collective system.

There would also be some room for increasing PNA costs for ER over and above the existing registration fees. The current registration fee rates are US$ 2,000 for each purse seine vessel, and US$ 500 and US$ 250 for longline vessels <40m, and less than 40 m respectively. The PNA ER cost is estimated at US$ 2,320/vessel. This would suggest that there is almost sufficient cost recovery for the purse seine fleet but not for the longline fleet, where all the functions and servicing is very much the same, irrespective of fishing method.

EM options for user pays and covering hardware and installation costs are more complex for the longline sector, as vessels may opt for fishing in one zone, or may operate trans-boundary and in the

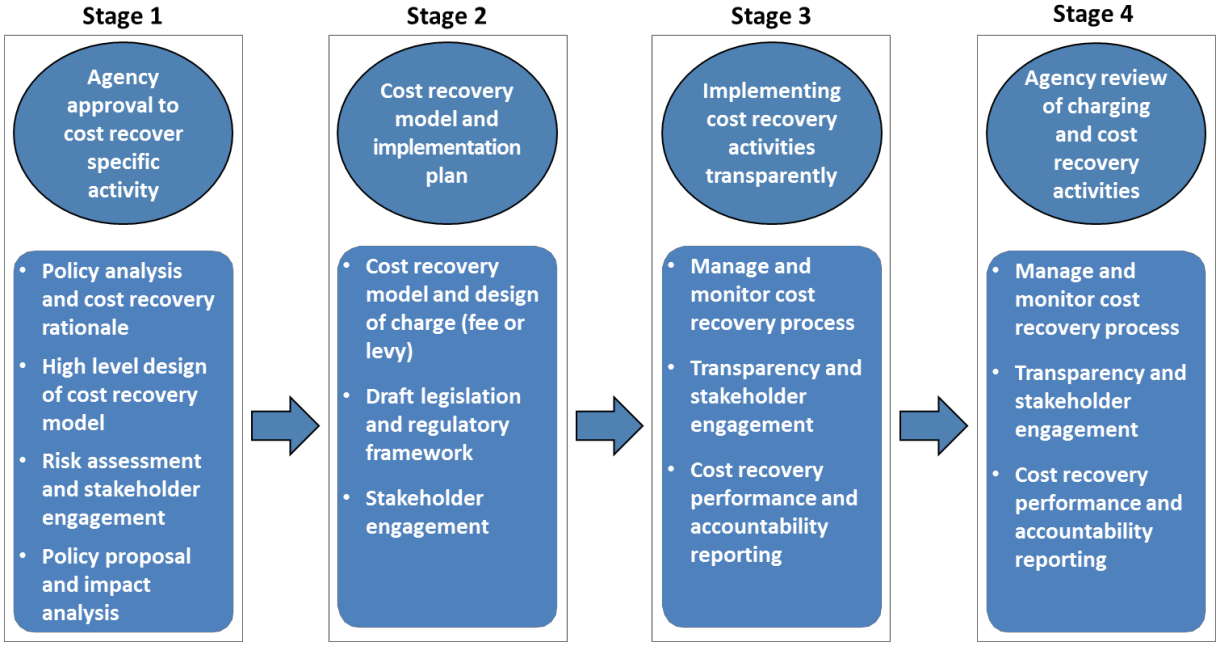
High Seas. This would suggest that it is more practical to explore options for some up-front cost recovery as well as well as an annual contribution. Recovery rates for EM will potentially have to be net of the initial capital investment costs (US$ 10,000), where industry may be asked to pay these costs as a condition of access, or explicitly where they are rated as high risk on the VCI. Annual operating fees are likely to be around US$ 1,000/vessel. Covering part of the initial capital cost could be an area where NGOs could seek to cooperate. However, the scale of activity makes this quite impractical. Various options would have to be discussed between coastal states, flag states, industry and NGOs.

This report has presented a wealth of information on current fees and levies charged to the purse seine and longline fleets across the FFA, WCPFC and PNA nodes and examined the adequacy of these current levies and fees in the context of costs of installing and administering EM and ER solutions. While redressing cost recovery issues in the purse seine fleet is likely to be more straightforward, cost recovery in the longline sector will be more problematical, regardless of the magnitude of cost savings and/or benefits attributable to these EFIS solutions.

As such it will be essential to initiate a systematic and comprehensive review of the existing cost recovery program and options going forward.

This report presents a generic pathway to reviewing existing and implementing a revised cost recovery program as illustrated in the Figure below. The key principles or objectives of this review would be to design a program that i) achieves economic efficiency and effectiveness and promotes equity across the different sectors, ii) is transparent and ensures accountability on roles and responsibilities iii) improves the efficiency and productivity of responsible agencies and iv) is stakeholder engagement driven.

Figure: Pathway to implementing new or upgraded cost recovery systems



Recommendations

This report demonstrates that there is an overwhelming need for EFIS and that the benefits resulting from these significantly outweigh the costs. It is noteworthy that WCPFC (WCPFC, 2014) has already identified a series of operational recommendations, which will compliment the recommendations listed below.

Some specific recommendations relevant to this study are as follows:

Recommendation 1: Consideration should be given to reviewing the rationale of having both WCPFC and FFA operating two Fisheries Surveillance Centres. There appears to be compelling cost efficiency reasons for the operation of one as opposed to two operational centres. However, it is of course understood that roles and membership of WCPFC and FFA do differ.

Recommendation 2: WCPFC should revisit whether cost recovery systems should be considered as a way to supplement existing levels of assessed contributions from members. If agreed the establishment of some form of registry of active vessels could complement this, noting that the WCPFC Record of Fishing Vessels, as a list of authorized vessels, contains both active and inactive vessels.

Recommendation 3: FFA, SPC and PNA need to focus on a practical and more rapid timeline to roll out ER systems and promote and support the agreement of WCPFC ER standards. Every effort should be made to strengthen electronic registration, the monitoring of catch and effort through e-log and e-obs systems and additional components that go towards improving e-CDS.

Recommendation 4: Donor and NGO funds should be channeled into providing support for capacity building of national EFIS officers, and providing support for ER officers to facilitate the more rapid adoption of ER.

Recommendation 5: EM should be rolled out as an acceptable supplement to, or potentially provide a reporting system where existing observer reporting falls below the Commission's ROP standard.

Recommendation 6: The use of EM sensors should be incrementally implemented on purse seine, longline and carrier vessels with an initial emphasis on targeting high risk vessels.

Recommendation 7: It is recommended that national and regional observer programs be responsible for analysis of video and sensor data and that this data and should be made also be accessible in near real time to the RFSC.

Recommendation 8: The PICs should ensure that their fisheries legislation and regulations, at a minimum, detail the following:

a) clear classifications (including legal definitions) of the types of data or information involved, whether personal, confidential or other information;

b) the purposes, methods and locations for obtaining, collecting, accessing, transmitting, storing and disclosing the data/information, including any relevant exceptions, limitations or restrictions;

c) the relevant entities who will store, transmit, receive, access and process or use the information or data;

d) legal safeguards to the security of data/information – through confidentiality and data protection / personal data provisions (including relevant compliance and enforcement provisions); and

e) a reasonable estimation of the necessary length of time that a regulatory body must retain the particular data based on the carrying out of the proposed use (including expressly regulating how data can be retained for longer periods – for example, where determined necessary by the particular holding authority).

Recommendation 9: The PICs could mitigate any potential data protection and privacy legal issues by implementing general privacy legislation governing, among other things, the protection, use and disclosure of personal information. However, even with the implementation of specialised privacy

legislation, specific amendments to existing fisheries legislation integrating EM and ER, and addressing potential legal issues or uncertainty proactively, is the most effective approach.

Recommendation 10: Management organisations (PNA, FFA and WCPFC) and countries should be made aware that despite differences in fleet earning capacity, the costs of ET, EM and ER are broadly the same. Special treatment of the longline sector for example, should not be given for EFIS. ER fees should be set at around US$ 2,000 for all vessels.

Recommendation 11: WCPFC / FFA / SPC, in partnership with national administrations, NGOs and donors, should explore payment guidelines for up front EM capital expenditures, including the application of EM to the high seas. Payments could be integrated as part of a penalty process for offenders.

1 BACKGROUND AND PURPOSE OF STUDY

1.1 INTRODUCTION

The World Wide Fund for Nature (WWF) engaged Poseidon Aquatic Resource Management Pty Ltd to prepare a cost and benefit analysis of electronic tracking (ET), electronic monitoring (EM) and electronic reporting (ER) and to outline the regulatory and legislative measures necessary to implement technologies in the several of the select Forum Fisheries Agency (FFA) member states.

OBJECTIVE AND SCOPE

The broad objectives of the analysis includes the following:

1. Identify electronic fisheries information systems (ET, EM and ER) and assess the rationale for their application;
2. Investigate and analyse existing legislation to identify key legal and regulatory considerations relevant to the implementation of EM and ER into national fisheries policy and legislation. This should provide an analysis that governments can use to support and inform the update of national fisheries policy and legislation to incorporate EM and ER;
3. Identify the costs and benefits of each system, with the support of country case studies;
4. Investigate and document potential (and realistic) cost-recovery solutions for ER and EM that could be adopted by FFA member countries (noting that this work may be included/linked to a broader cost-recovery study);
5. Provide a recommended critical path to FFA member countries that are considering cost-recovery solutions for ER and EM implementation.

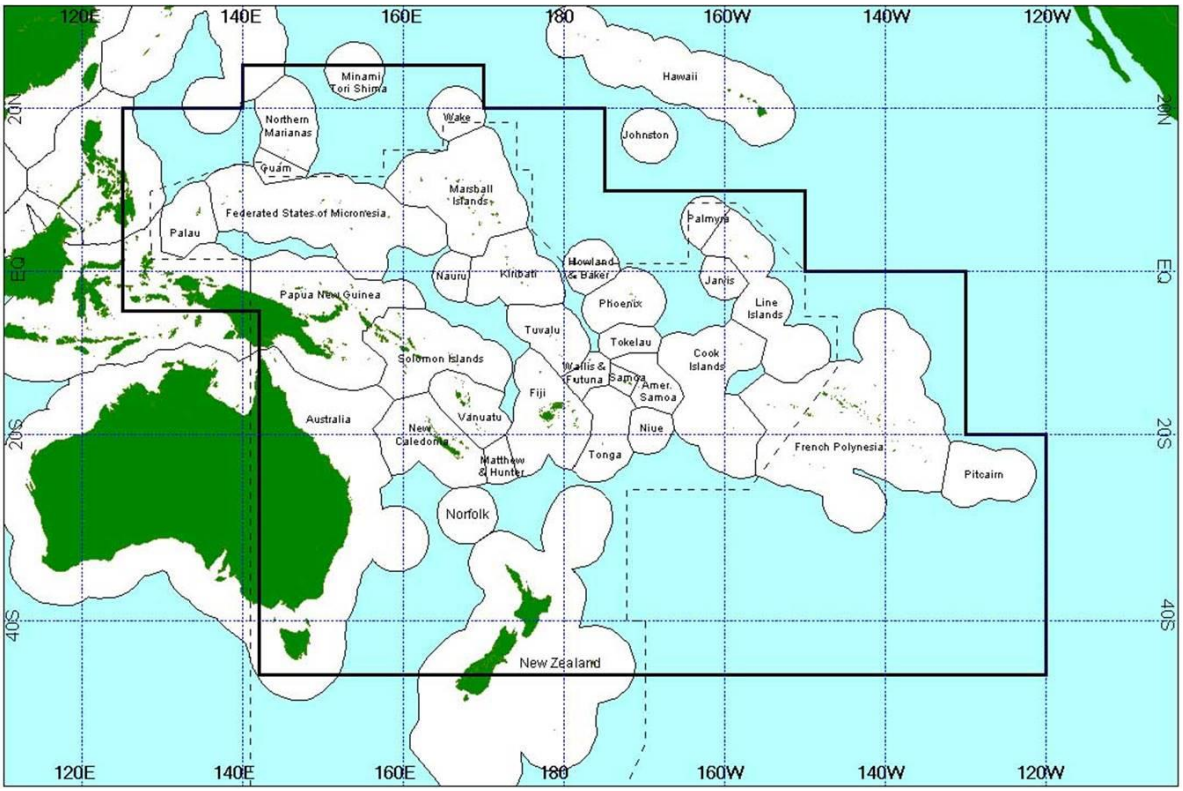
2 OVERVIEW OF WCPO FISHERIES MANAGEMENT AND MONITORING AND REPORTING REQUIREMENTS

2.1 DESCRIPTION OF THE FISH STOCKS AND MAIN FISHERIES IN THE WCPO

2.1.1 Description of the Region

The countries and territories encompassed by the WCPO comprise the 17 members of the Forum Fisheries Convention, the French territories (French Polynesia, New Caledonia and Wallis and Fortuna), Indonesia, Philippines and Vietnam. These countries, along with the main participating distant water countries China, Japan, Korea, Taiwan, the USA and an assortment of Latin states (Spain, Ecuador and El Salvador), operate within the Regional Fishery Management Organisation (RFMO), The Western & Central Pacific Fisheries Commission (WCPFC)

Figure 1: WCPFC EEZs and High Seas areas



Source: Forum Fisheries Agency (FFA)

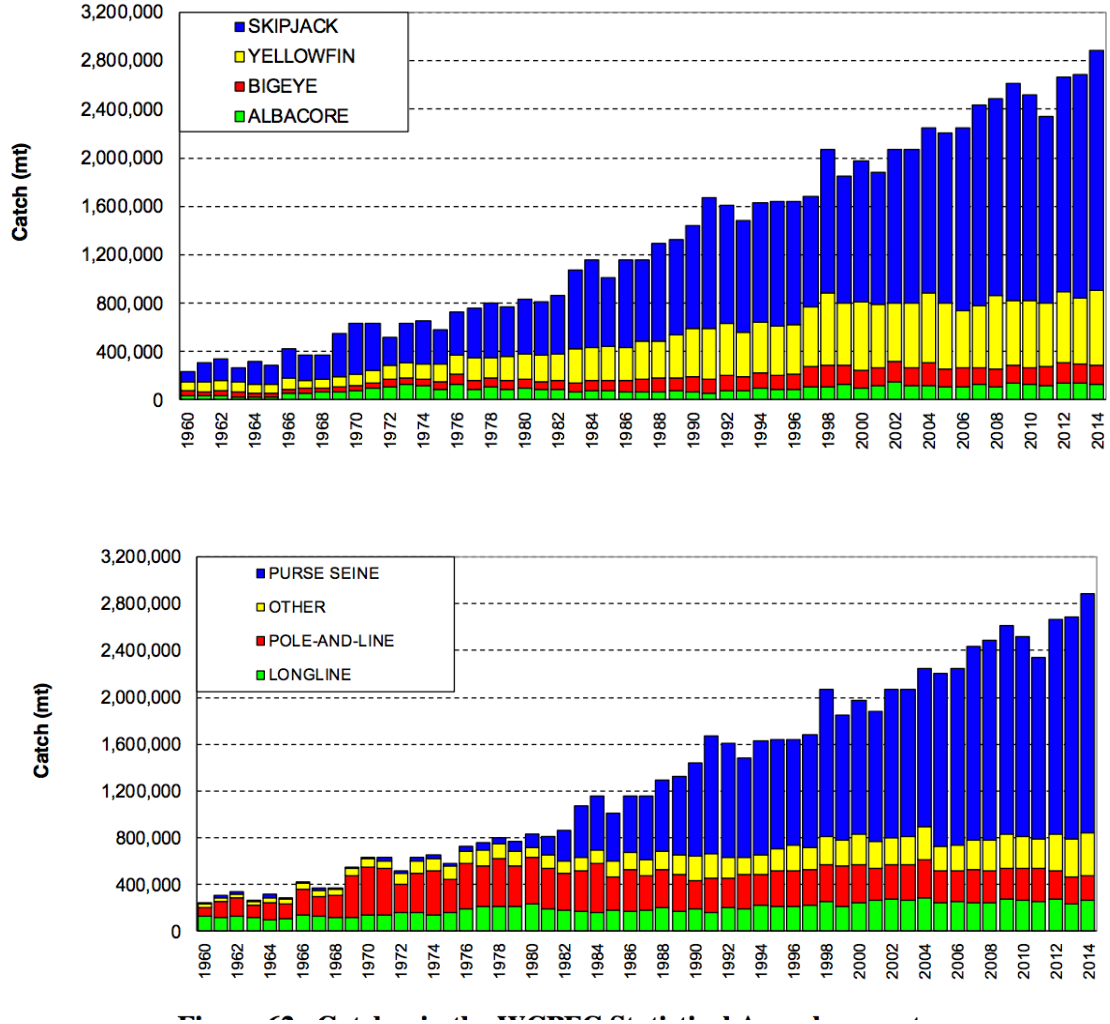
Pacific Island countries, excluding the French and US Territories are responsible for managing 20.8 million sq. nautical miles of ocean. The principal bodies being the 8 Parties to the Nauru Agreement (PNA), with 14.5 million nautical miles, the South Pacific Island countries, excluding Australia and New Zealand, with 6.3 million sq. nautical miles. The French and US territories, account for 2.3 sq. and 1.3 million nautical miles respectively, with Indonesia, Philippines and Vietnam together accounting for 4.8 million sq. nautical miles. The High Seas areas, which fall outside national jurisdiction, account for 3.5 million sq. miles.

2.1.2 Target Species

The total Western Central Pacific Ocean (WCPO) tuna catch during 2014 was around 2.8 million tonnes (t), of which around 71% was caught by purse seine, 9% by Longline and 7 % by pole-and-line vessels, and the remaining 13% by a collection of other gears.

The key species caught comprise the pelagic tunas e.g., skipjack tuna (SKJ), yellow-fin tuna (YFT), albacore tuna (ALB) and bigeye tuna (BET), along with an assortment of bycatch species including sharks, billfish and other pelagic species (e.g. wahoo, mahi mahi, opah and rainbow runners). The 2014 catch breakdown in the WCPFC Statistical Area for skipjack, yellowfin, bigeye and albacore tuna was 1,950,000 t (69%), 593,000 t (21%), 166,000 t (6%) and 129,000 t (4%) respectively.

Figure 2: Historical catches of tuna in the WCPFC statistics area



Source: WCPFC Annual Yearbook

2.1.3 Main Gear Types by Species and Fishing Patterns

The main gear types used in the Pacific tuna fisheries include: purse seine, using an encircling net, and either with the support of a Fish Aggregation Devices (FADs) around which fish congregate, or deployment on mid ocean free swimming schools; longline, with lines deployed with baited hooks attached; and pole-and-line, with fish attracted by dispersing free swimming bait, and then caught by pole and lure. Other methods used would include troll line, handline and gillnet.

The Pacific fleet comprises 344 purse seine, 1,351, longline, and 127 pole-and-line. The operational areas for these vessels vary by zone and jurisdiction. Table 1 below summarises the list of active vessels extracted from FFA and PNA Registries. WCPFC records 2,162 active longline vessels fishing in the high seas, but this has been adjusted downward to 633 to reflect the WCPFC polling rates[4].

Table 1: WCPO Active fleets linked to specific registries

	WCPFC excl FFA & PNA Registered	FFA Vessels of Good Standing	Total WCPO	PNA
Purse seine	77	267	344	(267)
Longline	633	718	1,351	(300)
Pole-and-line	101	26	127	
Carrier	4	167	171	
Mothership	11	5	16	
Bunker		30	30	
Total	**816**	**1,213**	**2,028**	**537**

Source: WCPFC, Tuna Fishery Yearbook, 2014 (https://www.wcpfc.int/doc/wcpfc-tuna-fishery-yearbook-2014); FFA (https://www.ffa.int/node/42) and FIMS Vessel Registry[5].

The purse seine fleet accounts for around 72% of the total catch (Table 2), longline, 10%, pole-and-line 7%, and 11%, others. In value terms, purse seining accounts for purse seine, 59%, longline, 25%, pole-and-line, 6%, and others, 10%. The volume / value differentials largely reflect the differences in product destination, with most purse seine product sold to the high volume, lower value canning market; longline product sold mostly, but not exclusively, as fresh sashimi, with some product (albacore) destined for canning; and pole-and-line product sold either as katsubushi, or for higher value canning.

Table 2: Catch by gear type and species for all vessels, 2014

Gear type	SKJ	YFT	BET	ALB	BILL	Total
Purse seine	1,633,344	374,209	66,560	2,221	1,287	**2,077,621**
Longline	1,266	100,237	69,192	79,163	39,432	**289,290**
Pole-and-line	153,510	22,968	4,827	26	7,130	**188,461**
Others	184,392	113,893	14,791	248		**313,324**
Total	**1,972,512**	**611,307**	**155,370**	**81,658**	**47,849**	**2,868,696**

Source: Secretariat for the Pacific Community

Shark catches are not included in the above table. Lawson (2011)[6], estimated that the purse seine

[4] WCPFC register reportedly contains inactive vessels. WCPFC VMS polls show considerably lower levels of activity, which are reflected in Table 1

[5] Note that the PNA is bracketed since vessels on the PNA are already included on the FFA Register. PNA is presently adding longliners to its Registry. Presently, active vessels include vessels licensed in Solomon Islands, PNG, FSM and Palau. The anticipated number is expected to be around 600 LL vessels in total.

fleet caught an average 53,000 oceanic white tip and silky sharks from 20°S to 20°N and 130°E to 210°W, in the years 1995-2010. These catches are a large part attributed to FAD related fisheries (Pilling, SPC, pers. comm., 2015). The corresponding observed catch by longliners is in the region of 30,000 species (Clarke et al, 2011)[7]. The figure is likely to be an underestimate because of the weaknesses in longline observer coverage.

Fishing patterns and distribution cover the whole of the tuna tropical (0-10 degrees North & South of the Equator); and sub tropical belts (10-20 degrees North and South of the Equator), with purse seining highly concentrated in the tropical belt (Figure 3.1), in an area largely managed by the Parties to the Nauru Agreement; Longlining in both the tropical and sub-tropical areas (Figure 3.2); and pole-and-line, in either tropical areas, or the coastal areas off Japan (Figure 3.3). These fisheries are annual, and more dependent on year on year sea temperature variations. Purse seine fisheries are especially dependent on the ENSO variations.

Figure 3: Fishing patterns and distribution by catch sector

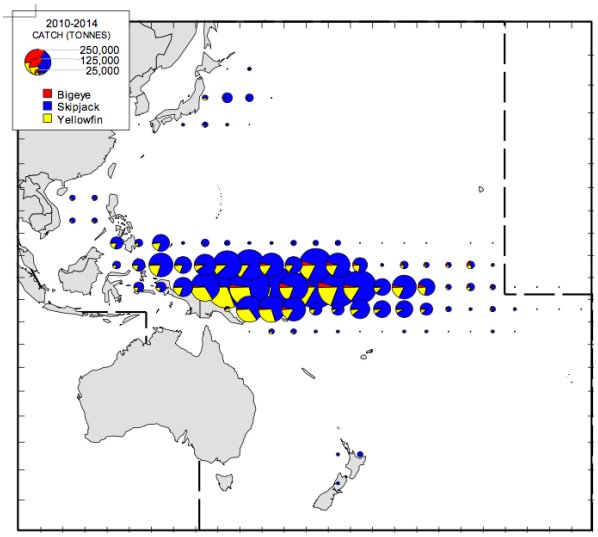


Figure 3.1: Distribution of purse seine tuna catch (2010-2014)

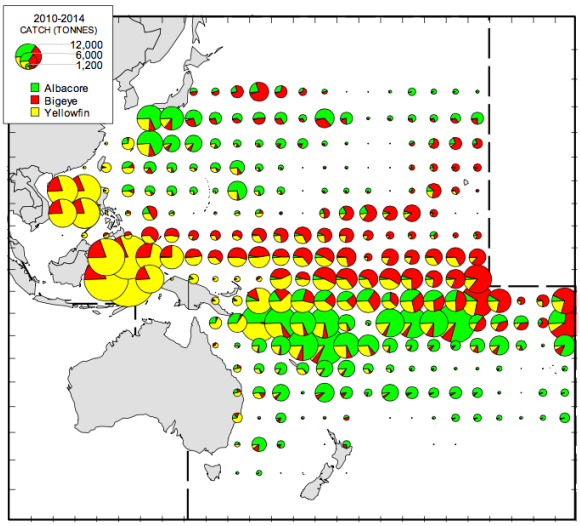


Figure 3.2: Distribution of longline tuna catch (2010-2014)

[6] Lawson, T. (2011), Estimation of Catch Rates and Catches of Key Shark Species in Tuna Fisheries of The Western and Central Pacific Ocean Using Observer Data. https://www.wcpfc.int/system/files/EB-IP-02%20%5BEstimation%20of%20Catch%20Rates%20and%20Catches%20of%20Key%20Shark%20Species%5D.pdf

[7] Clarke, S., Harley, S, Hoyle, S., and Rice, J. An Indicator-based Analysis of Key Shark Species based on Data Held by SPC-OFP, WCPFC-SC7-2011/EB-WP

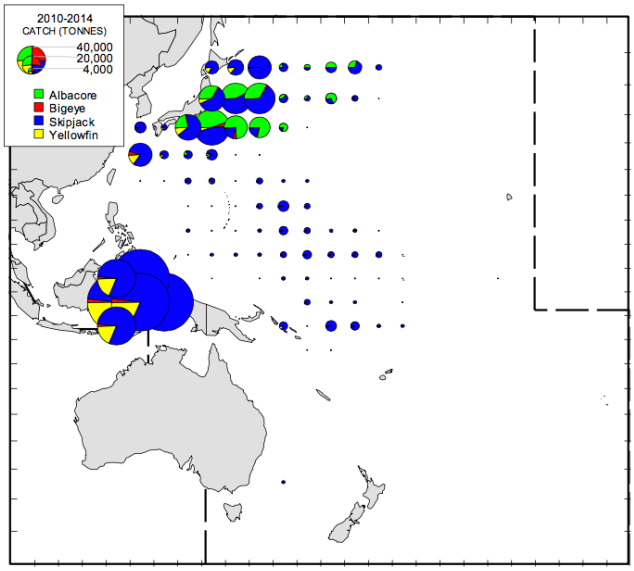


Figure 3.3: Distribution of pole-and-line tuna catch (2010-2014)

Source: WCPFC Annual Yearbook

2.1.4 Fish Landings and Markets

The Purse seine fleet transships around 80% of its product (McCoy, 2012) to carriers in any one of a number of designated Pacific Island ports. The main transshipment ports being Majuro, Republic of the Marshall Islands (RMI), Tarawa and Christmas Island, Kiribati, Rabaul and Lae, Papua New Guinea, Pohnpei, Federated States of Micronesia (FSM), and Honiara, Solomon Islands. The transshipped product is offloaded in Thailand, Vietnam, Philippines, Japan and Ecuador. Product is also offloaded directly from purse seiners into General Santos, Japan and Pago Pago, American Samoa. These collectively account for 154,000, 150,000 and 65,000 t respectively (McCoy, M, 2012[8]). The remaining offloads are into Pacific Island processors in the ports of Lae, Madang and Wewak (PNG) and Noro (Solomon Islands).

There is as yet no designated port structure for longliners. Longline caught product is either transshipped at sea, with the main destination being Japan, or offloaded into a number of Pacific Island ports, for subsequent air or container freight. The proportions of transshipment as against offloads is approximately 226,000t (78%) compared to around 63,000 (22%) (McCoy, 2012), respectively. Major offloading ports include Suva (Fiji), Majuro (RMI), Pohnpei(FSM), Tarawa (Kiribati) and Noro, Solomon Islands.

Pole-and-line product is largely caught by a dedicated Japanese fleet, and either transshipped when working in tropical waters, or landed directly, again when working in tropical areas, or when caught in Japanese coastal waters. The proportion of domestic landings as against transshipments in this sector is estimated as 90,000 t compared to around 100,000 (48%) respectively.

The major market outlets for processed purse seine products are Europe and the USA. The main markets for longline canned product is the USA, and the main market for longline sashimi is Japan, and also Korea, China and Taiwan to a much lesser but growing extent. The predominant market for pole-and-line katsubushi is Japan; and the main market for pole-and-line canned product is Europe.

[8] McCoy, M (2012), A Survey of Tuna Transshipment in Pacific Island Countries: Opportunities for Increasing Benefits and Improving Monitoring, GPA for FFA Devfish.

A notable issue when supplying the European Union (EU) markets is that all product must be accompanied by an EU Catch Certificate. A similar notary issue when selling bigeye tuna to Japan is that all product must be accompanied with an ICCAT Certificate. Product from some fisheries is also sold as Marine Stewardship Council (MSC) certified product, wherein, Chain of Custody authorization is required. In all these cases, sales of such products require a system of and evidence of traceability through the supply chain from vessel to market.

2.2 RESPONSIBLE MANAGEMENT ORGANISATIONS AND THE MEASURES APPLIED

The roles and responsibilities of WCPFC members are clearly described in the Convention, especially Articles 23 and 24, *the Commission Rules of Procedure*, Conservation and Management Measures (CMMs) (Appendix B.1), and other Commission rules and decisions, including i) Rules for Scientific Data to be Provided to the Commission, and ii) Rules and Procedures for Access to and Dissemination of Data Compiled by the Commission.

The PNA countries manage two Vessel Day Schemes (VDS) (Appendix B.2), the purse seine and longline VDS. The PNA Office (PNAO) in Majuro coordinates the application of the VDS, but with each of the 8 Parties (Federated States of Micronesia, Kiribati, Palau, Papua New Guinea, Republic of the Marshall Islands, Solomon Islands, Nauru and Tuvalu) plus Tokelau having responsibility for managing their specific national allocations of vessel days under the Palau Arrangement.

Aside from its central enforcement role (see below), the FFA Secretariat coordinates the management of the Tokelau Arrangement (albacore tuna) longline fishery which applies the implementation of a Total Allowable Catch (TAC) system allocated between FFA member countries; Australia, Cook Islands, Fiji, Vanuatu, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga and Tuvalu.

National administrations are responsible for implementing various national as well as regional and sub-regional measures. These are incorporated into licenses as Minimum Terms and Conditions (MTCs) (Appendix B.3) and bilateral arrangements. The principal actions required are applying National VDS allocations, monitoring catch and bycatch, and monitoring transshipments. The staff in place to undertake these duties comprises inspectors, observers, licensing officers and data clerks, all falling under to the responsibility of each national government. Reporting on the application of these tools takes place through sub regional monitoring (i.e. the PNA and the Tokelau (FFA) Agreements and, at a regional level, by the WCPFC Technical and Compliance Committee.

Coordination of regional Monitoring, Control and Surveillance (MCS) EEZ actions falls under the responsibility of the FFA secretariat, with each participating nation responsible for coastal state enforcement, and flag states responsibility for their vessels when fishing within their EEZ, other country waters and the high seas. Responsibility for the MCS functions for the High Seas falls to the WCPFC who is also responsible for setting specific region-wide management measures, including VMS monitoring. Verifying compliance with these actions requires annual reporting to and compliance monitoring by the WCPFC Technical and Compliance Committee (TCC).

3 OVERVIEW OF ELECTRONIC TRACKING, MONITORING AND REPORTING TECHNOLOGIES AS APPLIED TO FFA COUNRIES

3.1 DATA NEEDS

World fisheries are moving towards having a stronger emphasis on data collection, monitoring and in improving technologies to capture these data and support monitoring. There is now increasing recognition of a need for fast, reliable, and innovative systems for collecting, storing, communicating, and sharing fisheries data. EFIS are being developed both 'top down', as managers and scientists seek to strengthen their data collection and monitoring activities at sea; and 'bottom up' as industry looks for real time and near real time solutions to improve its targeting of resources, assess catch data against market demand and reduce the risks to their vessels by monitoring weather forecasts and wave height. Efficient, comprehensive, and cost effective EFIS systems can generate significant value for the managers, the scientists and the industry, but only if incentives are aligned, costs and benefits shared, and transparent and rational standards developed. New technology for EFIS offers the opportunity to increase efficiency and accuracy while dramatically improving data quality. The development of an effective EFIS is often hindered by two main factors:

- The cost of related data, tracking and communication technologies.
- An absence of data recording and reporting standards.

The cost of the technology (both hardware/software and services) is continuously declining while data quality can be dramatically improved by putting together a comprehensive and practical set of core standards and guidelines. Reduced costs and improved data standards can greatly simplify and expedite the transition to EFIS.

Data collected from fishing operations is used in a variety of management contexts and in different ways such as:

- MCS Authorities using ET technology to support compliance managers to identify the location of vessels. The strength of the systems applied in the WCPO is enhanced by determining a Vessel Compliance Indices (VCI) for each vessel and monitoring via Google track. Unregulated actions can first be identified by viewing unusual activity. Operational efficiencies are achieved with the ability to identify vessels, and these allow for savings in the deployment of compliance assets – overflights and 'at sea' patrols.
- MCS knowledge on each vessel's activity is also enhanced through EM, first through near real time sensor data; and secondly though camera viewing of target species catches, bycatch and gears used.
- ER provides the monitoring framework to ensure compliance with the management measures – authorization to fish, position reports, effort and catch limits, and observer reports. The use of auto alerts or cross checks between the modules is also likely to identify reporting inconsistencies.
- Fisheries management authorities require operational data to be collected and monitored by ER systems to ensure that management actions are implemented. These require data pertaining to vessel registries, vessel positions, effort and quota management tools and permit regulations need to be maintained. Operating several modules provides the basis for cross checking data from several sources. This increases the strength in reporting consistencies and accuracy in the knowledge that these reports are scrutinized more regularly.

- Access to such data is increasingly available to coastal (in zone), flag and port states. PNG has now established an ECDIS FIMS to allow flag states (Korea, Japan, Taiwan, China and the US) to monitor catch and effort for their vessels when fishing in PNA waters. PNA is also in the process if advancing port-to-port data collection and sharing to allow cross party access to ER data.
- Stock assessment models require a significant amount of all the data that are collected by the systems described in this document. The data is generated by the commercial fishing sector and recorded by skippers and ship's officers, by observers, and by port monitors and port samplers. These complement other data collected through more sophisticated sampling, fish surveys and tagging which fall outside the ER spectrum. ER provides catch and effort data, species information, spatial and temporal information, position data, and bycatch information and this information, reduces uncertainty in stock assessment modeling. EM provides additional supporting information in respect to effort, gear deployment (e.g. number of hook deployment, FAD/free school) and target and bycatch data.
- Vessel company owners, fleet managers and skippers are interested in productivity and commercial viability of their vessels. They are also typically interested in obtaining information about fishing patterns that would maximize catch aboard the vessels. Therefore, they are interested in the following information:
    - Operational fishing information including tracking vessel positions from operational HQ, and tracking own FADs from operational HQ and vessel
    - Own fleet catch and effort
    - Weather reports, sea heights and water temperatures
    - Selling information, i.e. catch sold to different buyers

Skippers may also be interested in receiving price information of the various species in the market-place. This information could be forwarded to them from a shore unit if the data is available. Fishing operations can also benefit from the faster relay of information by improving the timing of fleet operations and the supply-chain. For example, carrier vessels can be requested and dispatched to fishing vessels that prefer to stay at sea but need to offload catch. Transport vehicles and processing facilities onshore can be updated with information of the volumes and characteristics of catch that is approaching port, or that has already been landed. Vessel specific catch, location and where processed can also be readily provided to support a full traceability system for consumers.

3.2 AVAILABLE ELECTRONIC INFORMATION SYSTEMS

Today, a number of electronic (e) technologies exist, with three broad groups being the standard for fisheries data collection:

1. Vessel Tracking
2. Electronic Monitoring
3. Electronic Reporting

3.2.1 Vessel Tracking

Vessel-tracking data includes a vessel's identification, location, bearing, speed, and a time-date stamp. Tracking information can be collected in various ways. Four significant examples are vessel monitoring systems (VMS), the automatic identification system (AIS) and synthetic aperture radar (SAR). These systems are "***closed systems"*** because they do not accept external or manual input that impacts on its core functionality.

3.2.1.1 Vessel Monitoring System (VMS)

Vessel Monitoring System (VMS) track vessel position, course and speed of all vessel groups (Table 1) across the EEZs of each country and in the High Seas. VMS includes a GPS device and a narrowband satellite communication modem and antenna. This equipment is packed together in a tamperproof 'black box' with clear view of the satellite (Photo 1a). All vessels are fitted with a near real-time satellite position fixing transmitter, known as Mobile Transceiver Units (MTUs) (Photo 1b).

Photo 1: Technology required to support Electronic Tracking

	
Antenna mounted Source: Bryan Scott, FFA	**MTU's relay positional data to the FFA VMS**

Data transmission is via global satellite network supported by a number of telecommunication companies. The most common satellite networks are Iridium, Inmarsat, Argos and GlobalStar. These companies charge a third party provider, for the sending location, the vessel users of the MTU, to send the receiving location. The MTU transmits to a satellite provider, the Data Network Identity (DNID) to the receiving location. Once received, data are transmitted to Electronic Chart Display & Information Systems (ECDIS) to review vessel positions.

A typical VMS unit tracks and stores a vessel's unique ID, position, speed and bearing and transmits this information to a shore in pre-agreed intervals, known as polling rates. The rates used by FFA are as follows:

- Purse seine – every hour, every 30mins during FAD closure.
- Longline – every 2 hours, every hour for those using Faria/CLS MTUs
- Pole-and-line – every 2 hours, every hour for those using Faria/CLS MTUs
- Carriers - every 2 hours, every hour for those using Faria/CLS MTUs
- Bunkers - every 2 hours, every hour for those using Faria/CLS MTUs

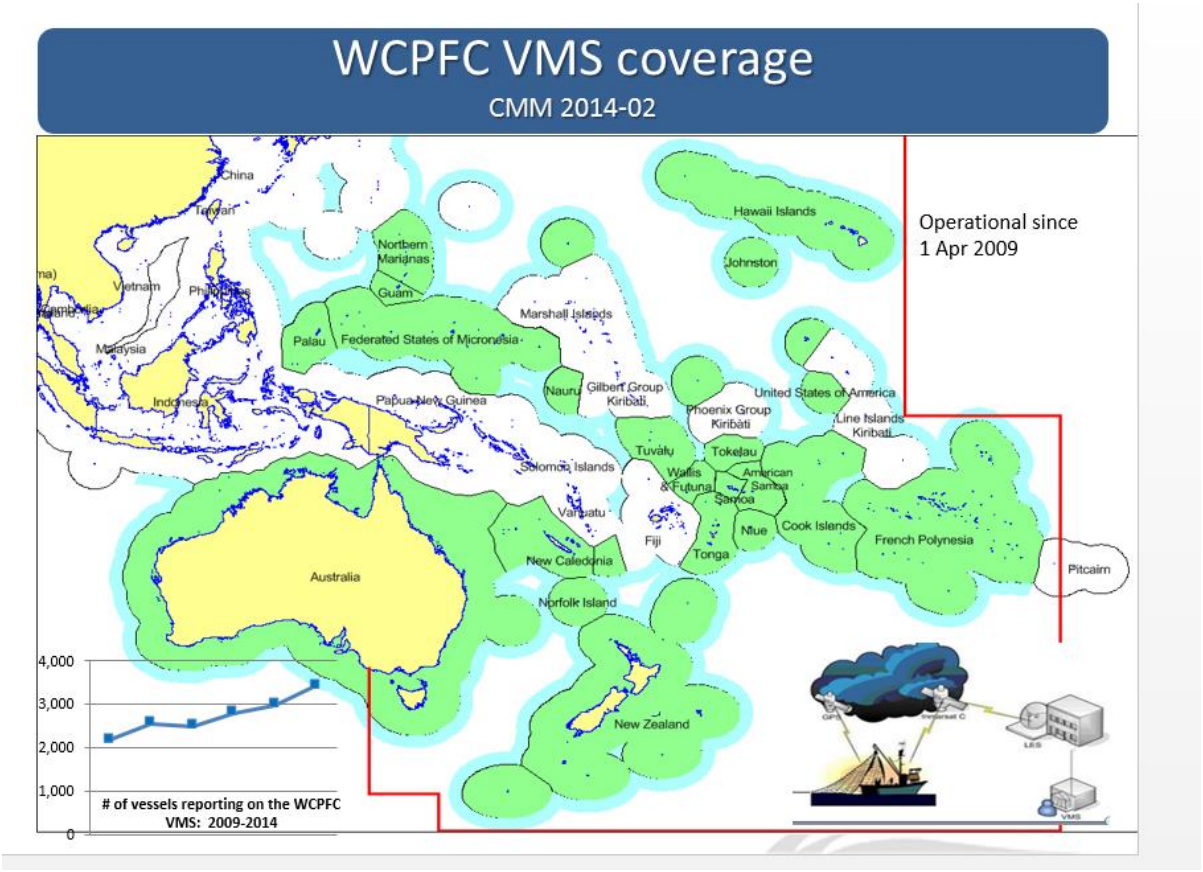
These intervals are mainly determined by transmission costs as the general desire is to have the vessel position known as close to real-time as possible. Modern VMS units can make use of GSM cellular networks (when in range) in order to save transmission costs. It is also possible for the management authority to request a vessel location report manually at any moment, in which case the location is automatically 'pulled' from the VMS unit to the shore.

FFA's Regional Fisheries Surveillance Centre (RFSC) and WCPFC apply VMS to track vessel movements throughout the Convention area on Electronic Chart Display & Information Systems (ECDIS). The RFSC sees fishing activities in all EEZs and High seas areas and High seas pockets within and beyond the convention area. There is no restriction in the viewing area. The application of VMS is a mandatory license condition in all Pacific Island Countries and Territories (PICT). Access to VMS is

also provided to each member country, including both the relevant fisheries departments and maritime police units. FFA member countries see all vessels within their EEZ, in the 100 nautical mile buffer zone adjacent to their EEZs and in the high seas areas and high seas pockets outside own EEZ. They see own flag vessels in all areas and licensed vessels in all areas during the validity of the fishing license. They may also see into other member's EEZ under data sharing agreement. Only Fiji and Kiribati have selective data sharing while all other countries share data.

FFA operates a Service Level Agreement (SLA) formalising the "Pacific VMS" which provides the common architecture for the FFA VMS and the WCPFC VMS, but with each VMS system operating as separate and stand-alone entities. In accordance with WCPFC rules, vessels required to report to the WPCFC VMS, report to the WCPFC VMS through two avenues: directly to the WCPFC VMS or through the FFA VMS. Irrespective of the avenue the WCPFC VMS information is only viewable in areas covered by the WCPFC VMS: in high seas waters of the Convention Area as well as in certain national waters that are covered by the WCPFC VMS. The RFSC as an authorized MCS entity on behalf of certain Pacific Island countries can request to receive WCPFC VMS data, for non FFA Registered vessels, including during MCS operations. Coastal countries may also notify the Commission that they allow the Commission VMS to extend its coverage to include their national waters. Currently of the Pacific Island countries, Fiji, Kiribati, PNG, and RMI have not provided authorization for the Commission VMS to cover their national waters.

Figure 4: WCPFC VMS Coverage as at Dec 2015



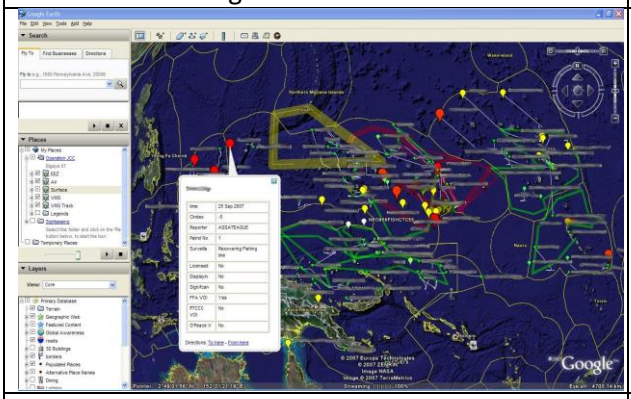
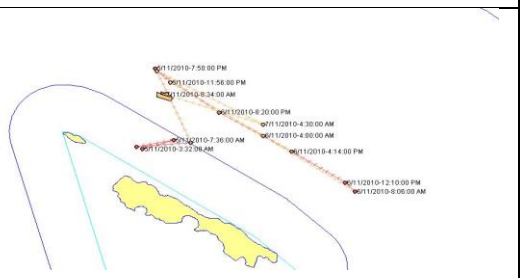
Since April 2009, the application of VMS has been mandatory across the high seas of the WCPFC Convention Area (it was first implemented through WCPFC CMM 2007-02 which was replaced by CMM 2011-02 and now CMM 2014-02). The areas covered by WCPFC only include: HS areas + pockets and the Green areas (CCM in-zone if included in WCPFC VMS). The blue areas are 100nm high seas waters beyond a coastal States waters, which can be requested by the adjacent coastal country through the WCPFC data access rules and procedures adopted in 2009. CCMs see all vessels

in-zone subject to (3) and own flag vessels in other areas covered by WCPFC VMS.

ECDIS tracking is supported using Google Track to monitor vessels by risk category. These risks are determined on the basis of individual compliance records, assessed annually by FFA and countries using risk assessment vessel compliance indices.

Whilst the FFA RFSC and WCPFC track these vessels, PNA also has its own DNID contract with a satellite provider, and uses this information to track vessel activities and fishing vessel day uptake within the FIMS.

Figure 5: **Example of vessel ECDIS viewing and individual vessel tracks record**

Schematic of Google Track as shown on ECDIS	Specific vessel track record
	
Source: Bryan Scott, FFA	

3.2.1.2 Automatic Identification System (AIS)

The International Maritime Organization (IMO) Long Range Identification and Tracking (LRIT) system, using Automatic Identification System (AIS), is a designated system designed to collect and disseminate vessel position information received from IMO member States ships that are subject to the International Convention for the Safety of Life at Sea (SOLAS). The LRIT is compulsory for all vessels > 300 Gross Tonnes (GT), but may be installed on a number of smaller craft for safety reasons. AIS allows for secondary source detection of vessel activity and is used as an overlay to VMS tracking. AIS-capable satellites have been developed and deployed, which are capable of picking up AIS signals from vessels at sea, with a field of view that can be 5000kms in diameter. It is estimated that AIS-capable satellites are able to capture up to 98% of all AIS position reports that are transmitted (WWF, 2014).

The RFSC and one national administration (the National Fisheries Authority (NFA), Papua New Guinea (PNG)) also accesses AIS as a cross checking tool to check on potential unauthorized activity. AIS is not presently used or accessed by WCPFC Secretariat.

3.2.1.3 Synthetic Aperture Radar (SAR)

Synthetic Aperture Radar (SAR) provides intelligence high-resolution remote sensing imagery, in any type of weather, and can be used to locate the presence of a vessel at sea, operating without VMS or AIS, and is usually used to identify IUU fishing activities in and amongst vessels operating with VMS, or within specific EEZs prior to the deployment of assets. Software has been developed to process images taken by SAR satellites, in order to locate recognizable patterns or characteristics in the image, which typically represent the presence of a vessel at sea. Unlike VMS and AIS, processing SAR images are not intended to identify particular vessels, but rather to simply detect where vessels are present (or not) (Baker, pers. comm. November, 2015). A particular problem can be the presence of speckles and strong signals returned from rough seas. The result is that with the current imagery resolutions, SAR can only be used to support asset deployment (overflights or patrol boats). However

new technologies are capable of linking SAR images to a vessel's specific AIS and, if available, its VMS records.

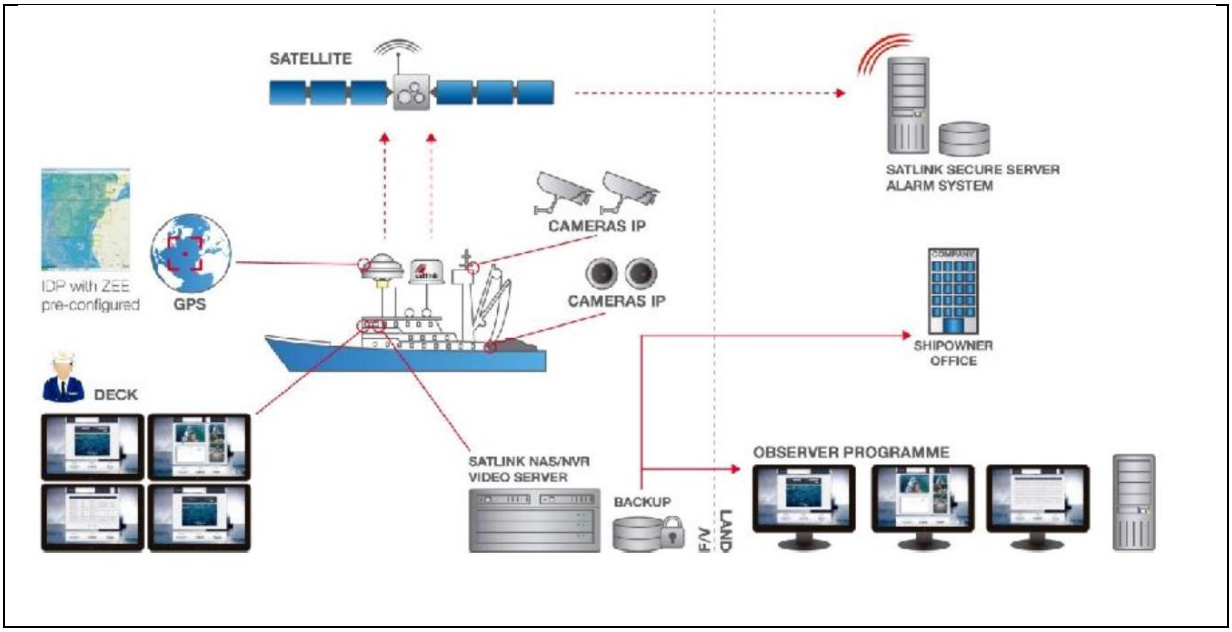
The RFSC has recently signed a contract with a SAR provider for 365 spatial images in 2016. These are to support both the JDPs and separate country marine deployments. SAR is not presently used or accessed by WCPFC Secretariat.

3.2.2 Electronic Monitoring

Electronic monitoring (EM) largely consists of closed video or photographic systems that do not allow external or manual inputs nor manipulation of data.

The EM system consists of a control center, connected to an array of peripheral components including: 3-4 CCTV cameras, Vessel AIS or GPS receiver, winch and engine sensors and a communications transceiver. Videos are recorded at, recording day and night.

Figure 6: Schematic of an Electronic Monitoring System



Source: Satlink

Due to the size requirements of video footage, on-board data storage facilities are required. Cameras film at 5 frames per second (24-30fps is movie standard), and use between 60 and 100 MB per hour of footage. A four-camera setup (Photo 2a) requires 240 to 400 MB per hour (Archipelago, 2015), which results in around 6 to 10 GB for each full day of recording. 1280x720 @ 24FPS on board (HD quality) and minimum recording capacity of the system is 13-14 weeks. Due to these dataset sizes, video surveillance footage cannot feasibly be sent in real-time via a satellite feed. Instead it is usually transferred directly from the hard drive after retrieval. The HDDs are changed very easily on board and can be examined at the control centre. Videos are stored onboard and encrypted. Videos are extracted locally from the encrypted HDD for analysis ashore by the owner or the Observer Program.

The process of hard drive data retrieval and footage review and analysis is currently relatively slow, taking a few days for dispatch, forensic recording, and then data viewing (~ 3-6 hours) depending on the recording requirements (Hosken, pers. comm. November, 2015). Rapid shooter (every 3-5 seconds) still cameras may be better solution for EM as these system use less memory space while offering a far better image resolution, and allows for real time data transmission. The Marine

Instruments e-eye system does provide for an integrated Iridium modem that allows for real time data transfer, but in reality, is rarely used.

The providers EM systems operate a control center, connected to an array of peripheral components including: CCTV cameras, GPS receiver, gear sensors and a communications transceiver. It is also possible to connect the system to a computer on board and see what the cameras are seeing in real time (console).

These systems can also be supported by sensors, which indicate fishing activity. The sensors are attached to equipment (longline drums (Photo 2b), net shooters, power blocks, brails and potentially Fish Aggregation Devices) and transmit real time positions, in much the same way as VMS, and the sensors trigger when the gear is being used. Vessel positions and activity can also be viewed on ECDIS.

Photo 2: Positioning of (a) cameras and (b) motion sensors

Source, AFMA, November, 2015

The application focuses on identifying a number of activities. Cameras may identify interactions with bycatch species, and are especially useful when recording bycatches of protected species. The viewed data can also provide a secondary source of data, for example to validate catch and bycatch logsheets. Cameras can substitute for the observer requirements, largely where it may be impractical to deploy observers, or where there may be a threat to the security of the observers on board. The providers include Archipelago video (4 cameras) and sensor recording system, currently applied by AFMA but use in the Australian Eastern Tuna and Billfish longline fishery (ETBLF) and other Australian Commonwealth fisheries; a 3 video cameras EM system (Satlink Sea Tube Lite, Spain) trailed in the Solomon Islands and under trial in Fiji; the Trident single camera system (New Zealand) is also under trial with two Fiji based longline companies. Another system, yet untrialed in the region is Marine Instrument's Electronic Eye (Spain). This deploys up to 7 cameras.

Within the WCPFC context, there have been dedicated meetings held over the last two years which have considered the application of ER and EM in the WCPO and noted the developments made by both Pacific Island countries and other WCPFC members. A formal working group was established in December 2014, and a meeting held in July 2015. The key risk for WCPFC, as is noted in the Terms of Reference for the working group, is the lack of documented policies and standards for these technologies, resulting in poor data coordination, increased data storage and transmission complexities, higher data security risk and increased long-term costs for the WCPFC. The adoption by WCPFC of ER and EM standards is expected to support and accommodate those CCMs that have commenced implementation of a range of EM and ER technologies in their fisheries and will ensure

that the Commission's databases and systems are ready to exchange electronic data in an orderly and efficient manner. The working group is expected to continue work in 2016 on the development and review of draft ER standards, as well as commence work on draft EM standards. Presently, a decision by the Commission to develop data standards will be separated from a decision by the Commission to require certain data/information to be submitted electronically. A notable omission however is the inability to sex and measure fish (Hosken, *et al*). Georeferenced images (allows vessel tracking) and streaming sensor and VMS data are the same (19bt). This also allows for less HD space needed for photos and longer periods at sea (6 month in position (linked to HD capacity).

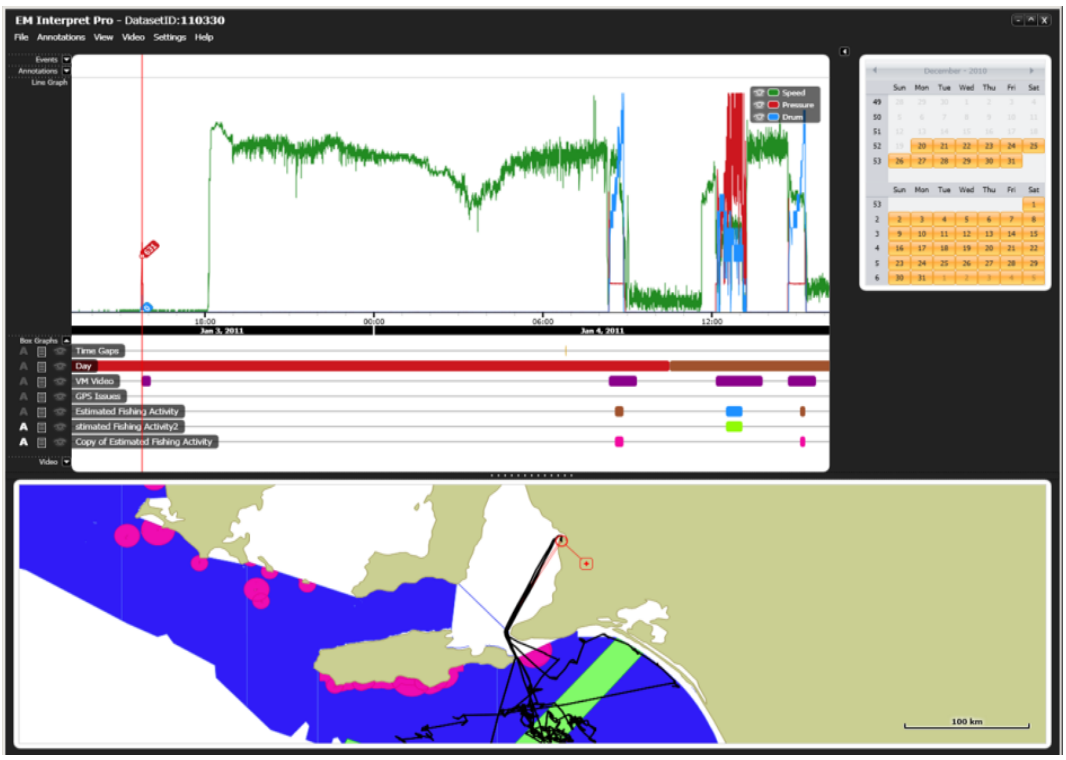
The goal of EM is to provide a cost-effective monitoring solution capable of collecting data for scientific, management, and compliance purposes. Surveillance cameras installed on vessels have proven to be effective at recording crew and fishing activities, which can be checked for compliance with fisheries regulations (AFMA, 2015). As such, camera monitoring that is integrated with EFIS can provide a useful means of validating vessel catch and gear reporting (hook numbers, use of wire tracers on longliners or FAD deployment and setting on FADs during the prohibition period). The sensor data is especially useful in identifying steaming, setting and hauling. Sensors may also be inserted into hooks, or added to brails to weigh the fish on transshipment.

Box 1: Summary of the application of a working Electronic monitoring scheme

<table>
<tr>
<td>Sensor data
• GPS position, vessel speed and direction, fishing activity, time and date
  • Logged every 2s
  • Transmitted every hour
• Health statement also confirms system is operating normally
  • Transmitted every hour
• Replace VMS in medium term
  • Lacks communication ability</td>
<td>Cameras
• Digital full high definition cameras
• 3-5 cameras per boat – most have 4</td>
</tr>
<tr>
<td>E-monitoring process
• Cameras only record fishing activity
• Footage is 24/7
• Connected to a drum/hydraulic sensor
• Cameras triggered when drum/hydraulics turned on
• Camera footage is stored on 2tb hard drives
• Hard Drives must be returned to AFMA after the first trip of the month.
• Drive data is copied and kept for 6 months
• Drives then sent to AAP for analysis
  • Blank drives are returned to boats</td>
<td>Footage Analysis
• Minimum 10% of shots audited
• Minimum of 1 shot per hard drive per boat
• Archipelago Asia Pacific (AAP) carrying out footage analysis
• Footage analysis compared to logbook reports</td>
</tr>
</table>

Source: AFMA, 2015

Figure 7: Schematic of sensor and GPS tracking using E-Monitoring



Cameras can also be an effective tool to monitor Health and Safety issues. A skipper can monitor crew activity from the deck. It may also be possible to detect any possible threat to observers, noting the loss of life of three PNG observers in the past four years.

Onboard or in-port camera monitoring can also be used to contribute to fish traceability, by providing strong evidence that a product was indeed caught, stored, transferred to carrier and then landed at a particular port as specified in the documentation provided by the vessel.

Camera monitoring has certain limitations, and cannot replace the roles of other data gathering techniques entirely. For example, current camera technology does not offer an affordable and reliable means of identifying the sex, age and species composition of a catch sample (NOAA Fisheries, 2013, p. c15; Dunn & Knuckey, 2013). Some observations are difficult to make from camera footage/images, even with human input and specialist knowledge. Furthermore, camera setups (unless extremely elaborate) will generally have 'blind-spots,' where crew could discard bycatch, hide interactions with TEP species, or perform other IUU activities which could then go unreported (NOAA Fisheries, 2013, p. C15). As a result, while some see camera monitoring as a viable alternative to on-board human observers, others feel that on-board observers will remain necessary in the foreseeable future, at minimum in order to perform biological sampling and compliance monitoring where cameras are insufficient. The reality is that EM systems can compliment the role of human observers and enhance overall observer coverage most particularly in the longline fishery.

3.2.3 Electronic Reporting

3.2.3.1 The Definition of Electronic Reporting Systems

The term electronic data reporting (ER) generally refers to a digital version of a paper-based reporting process. In fisheries, electronic reporting is used to record and report vessel activities (uptake of fishing days), catch, catch storage reports (for traceability), observer reports, landing reports, transshipment reports, boarding inspections, in-port inspections, as well departure and arrival reports (hails). The systems are "***open systems***" because manual inputs are required and accepted, for example from skippers and observers. The systems can also be integrated with ET and

EM systems. Integrated ER also provides a cross-checking facility between the different applications or modules available. In addition, ER solutions are used and developed for industry to integrate access to additional data sources such as weather reports, wave heights and sea temperatures. These have practical uses for fishers are sea in terms of when and where to fish, or not to fish in terms of dangerous conditions.

Three distinctive ER systems are used in the WCPO for monitoring and database systems, satisfying data-reporting requirements for regionally coordinated work such as the regional stock assessments, regional fisheries management and compliance.

Fishery ER requires the deployment of a software program specifically developed for fisheries data collection. The nature and properties of module software are directly based on a set of requirements and standards, provided by the user. The term user has a very broad interpretation. User can refer to the regional and national management authorities, who are the appointed official recipient of data and reports. Other "users" are fishing companies, fishing associations or fisheries scientists. The software applied in the WCPO, comprise an collection of modular systems contained therein, that relate processes that together support a regional country's national fisheries authority and regional management groups (e.g. PNA and FFA). Each system can operate independently, or can communicate with each other through a data loader.

All systems provide desktop/laptop access through one menu, provide access to databases away from the office (after login/password), produce reports that combine data from different systems (e.g. vessel activities, e-catch logsheets, observer data and GEN 3 reports.), have new administration systems to improve work flow (e.g. data registration, document management, etc.). Data is inputted either by using a simple PC and keyboard or tabulates, which can be water proof if using on deck.

Data is recorded in plain text, numbers, Boolean (true or false), tabular data, pictures, and videos. The data is stored but then encoded to allow low data encryption into code to reduce the download space, with the report sent to the receiving management organization in various formats such as Extensible Markup Language (XML), JavaScript Object Notation (JSON) and North Atlantic Format (NAF). These reports can be saved and transferred to other databases (such as a shore version, internet or 'cloud', or other third-party databases) either directly, using portable storage devices or in real time using the onboard VMS or other onboard satellite communication systems. Transfers to other systems are facilitated by the data loaders, allowing the encrypted data to be retrieved into readable format.

A good ER system is highly customized and able to be easily adapted to address different data recording and reporting needs. It allows the data managers to configure the software to suit their specific requirements. The users are able to change display labels, field content and look-up values, hide data fields or look-up values, add user-specific fields to the data capture screens, and decide whether or not certain fields are mandatory. This customization is available on every phase of the fishing trip, for example, the trip itself, the start of the trip, and setting the gear. The data definitions are strictly controlled by the management organisation by 'hard' configuring the system and constraining the user's ability to override certain fields. The onboard system consists of the following components:

a. Configuration files defining levels, fields and parameters
b. Database for working data
c. Database for archived data
d. User interface elements: data entry and browsing facilities, a data mapping facility, a data center for maintenance, reporting and querying
e. Input/output modules for the following types of data:
    - Reports to specific agencies and third parties
    - Import/export of operational data

- Backup of the complete system
- Error/exception handling reports to software support

To be accurate and credible, the onboard system makes extensive use of dropdown, predefined, lookup lists whenever possible. The use of dropdown lists to enter data helps to maintain data integrity, thus minimizing typos and saving time.

3.2.3.2 Historic Reporting Formats in the FFA Countries

Historically, all WCPO fisheries information was entered manually into a range of paper reporting forms including logbooks, offloading reporting forms, port sampling and observer modules. These reports are still used in most fisheries, but in at least three Pacific Island countries, there is a rapid evolution towards a composite and integrated modular ER system. The current paper based systems are described below.

Vessel Registration and licensing

Different Registration formats have existed for some time, these include:

- the WCPFC Record of Fishing Vessels[9], which records all vessels, by flag and method operating in the Convention Area
- FFA's Vessels of Good Standing[10], which records the details all vessels, by flag and method operating in FFA PICTs
- The PNA Vessel Register

All systems have historically required the manual submission of vessel details by each applicant, and these details are recorded on a spreadsheet and downloadable via the internet.

PNA Vessel, FFA and WCPFC registrations are automatically required as national licensing requirements.

Applications for licenses are then submitted manually, to each PICT for the zones to be fished by a vessel and to WCPFC, if fishing in the high seas convention areas.

All submitted data for registration and licenses were required to be key punched up until 2015. An Online Vessel Register now exists for PNA, with the facility for auto cross checking with the WCPFC and FFA authorized lists; and Electronic Licensing Registration applications can now be submitted through iFIMS, to the PNA Parties.

Logsheets

The skipper or another ship's officer initially fills out catch and effort logsheets. Most companies like to receive at least daily reports of the catch obtained by their vessels. To achieve this, one of the ship's officers will use a range of media to transfer this information, depending on the vessel capabilities and position relative to transmission networks. Most companies apply fleet broadband, but some may still used VHF / HF radio. The radio communication systems are unsecure and can be intercepted by other vessels in the region. The more sophisticated transfer system applied, pre specific software ER reporting, is where daily catch information is transferred by email with data entered including all of the set by set catch and effort data into the approved SPC Excel spreadsheet. If the paper logsheets are filled out, these may be completed after each set where the company demands it, and then the spreadsheet emailed to the company office. It should however be noted,

[9] https://www.wcpfc.int/record-fishing-vessel-database

[10] https://www.ffa.int/node/42

that whilst this system might apply to some purse seine companies, others might retrospectively complete logbooks on landing, or in respect to some longliners might not complete logbooks at all. The lack of logbook reporting by some fleets, especially those fishing predominantly on the high seas (e.g. China and Taiwan), is a significant cause for concern (WCPFC TCC, 2015).

Depending on the requirements of the vessel's owner, the paper logbooks may then be sent directly to the coastal state's fishery management agency, or more often, are sent back to the company so that they can be checked by company officials before being sent to the fishery management agency. There were numerous reports that this second pathway for the paper logbooks can involve significant delays (often months and up to more than a year) in the logsheets reaching the coastal state's fishery management agency. Most PICT license conditions give up to 48 days for logbook submission, which results in considerable delays in processing.

Data is keypunched once the paper logsheets arrive at the fishery management agency, often after the company has also been keypunched them. Depending on the resources available at the agency, they may be stored for several months. Depending on the coastal state, the logsheets data may be keypunched into an in-house database, or into the country's TUFMAN database. In some cases where there have been significant time delays in national agencies key punching data, arrangements have been made for scanned copies of the logsheets is sent to SPC. If the country's TUFMAN database has been audited, then the digital data is directly loaded into SPC's TUFMAN database. Otherwise, the data are double keypunched into the SPC's TUFMAN database. Thus, depending on the transfer and entry process, keypunching of the same data may occur up to 4 times.

Vessel Day management

Vessel days form the core system to manage the purse seine fishery which commenced in 2008. Vessel Day uptake was then monitored by FFA against the in zone VDS tracks, and spreadsheets submitted to the PNA countries. Claims for Non Fishing Days (NFDs) were submitted to the Parties by the respective associations, and generally accepted without verification, as there were insufficient means to specifically track the assets of each vessel. The facility to track assets was introduced under FIMS in 2010, with an industry e-claims only implemented from 2013, with the introduction of iFIMS.

Observers

Observer programs are administered by most coastal states for fishing in their national waters, the PNA Office for vessels operating under the FSM Arrangement, and the FFA for vessels operating under the US Treaty. There are more than twenty observer programs operating in the Commission's area of competence (Dunn and Knuckey, 2013). Key challenges are therefore consistency of data standards and operating procedures. To address these challenges a Data Collection Committee meets biennially, and an Observers Coordinators Workshop is convened annually.

Currently, it is a requirement that all purse seine vessels carry an observer 100% of the time they are within the Commission's and PNA's area[11] of competence. For other fisheries, coverage is patchy and inadequate to meet the Commission's agreed levels of coverage of 5%. This is the viewing rate applied by AFMA to each of its fisheries and is consistent with the minimum Regional Observer Programme requirement.

Observers enter all of their data into an observer workbook. Different workbooks are required, depending on the fishing method being observed. Observers are required to carry one observer workbook for every 30 days at sea as well as sufficient catch monitoring forms (PS - 4) for the entire trip. They are also required to carry a book containing line pages to be used as their diary during the trip. They are required to fill out numerous forms, whilst conducting their work at sea:

[11] Implemented first as the PNA Third Implementation Arrangement (May, 2008), and thereafter endorsed by WCPFC 2008-01, replaced and updated annually by CMM on the Conservation and Management measure for Bigeye, Yellowfin and Skipjack tuna.

- The PS – 1 form is to record information on the trip details, vessel characteristics, fishing gear comment vessel electronics, well contents, and crew details
- The PS – 2 form is a daily log on which information is recorded about the position of the vessel, the EEZ in which its operating, the activity code, and any association of a set with FADS
- The PS – 3 form is to record information at the set level, including the set sequence times, retained and discarded catch of target species and other species, the fate of the catch and whether any tags were recovered. If tags were recovered or there were interactions with marine mammals or turtles, then a further set of forms is required to be filled out
- The PS – 4 form is used to record the sampling method and length frequencies for the catch of different species
- The PS – 5 form is a vessel logsheet and well loading reconciliation form which allows scientists to match vessel logsheets data to observer data and to improve the port sampling strategy The forms above are specific to purse seine vessels, but a number of generic forms are also filled out by the observers:
- The GEN – 1 form is used to record vessel and aircraft sightings, bunkering, transshipping and fish dumping.
- The GEN – 2 form records information on catches or interactions with species of special interest such as marine mammals, turtles or birds
- The GEN – 3 form must be completed at the end of every trip and is a record of whether the master or crew of the vessel violated any fishing regulations or hindered the work of the observer
- The GEN – 6 form is a record of a pollution incident.

In addition to all of the above, the observer is required to fill out a comprehensive trip report that includes a written summary of all of the above. Once observers return from a trip, which can be up to 120 days duration, they undergo one or more debriefing sessions with trained debriefers. The debriefing session covers a range of issues and includes checking the data sheets for missing fields, incomplete reports, possible incorrect data entries, overall data quality, and any issues that occurred on the vessel. The debriefing procedure will usually take up to 2 days. When debriefing is completed the observer workbook and all additional data forms are sent to the coastal state fisheries management agency for key-punching. Similar to the logsheets, depending on the resources available at the agency, the hard copies of the observer data may be stored for many months prior to keypunching. Again, scans of the hard copies of every datasheet are sent to the SPC.

Offloading, unloading and port sampling

Port samplers record information on transshipments and unloadings, during which vessels transfer their catch to carrier vessels, canneries, or ship or air freight carriers, as well as recording information on the size frequency of the catch unloaded.

Offloading or Unloading data provides an independent estimate of the trip catch, which can be used to verify logsheets and catch totals for vessels as well as record carrier specific transshipments, which can support traceability requirements, e.g. Catch Certificates. The unloading form includes general information about the port and the date, information on the vessel, the number and weight of fish landed and whether that fish is being transshipped for export or retained locally. Unloading data must be identified to the “vessel trip” to ensure useful comparisons to other types of data (e.g. logsheets and observer data).

Length frequency information obtained on the main target species is a crucial input for stock

assessments. It is important that the port sampler collects random samples and the method of sampling varies depending on the vessel type being unloaded. For sampling the length frequency of the catch from purse seiners, the aim is to identify wells which contain fish that were caught with the same school association, caught in the same month, and caught in the same area, and then to randomly sample five fish from every net that is unloaded from the well. Information collected on the port sampling form consists of general data on the port and date, set details (obtained from the vessel's logbooks) and species length data.

CMM and MTC Reporting Requirements

Apart from the logsheets, there are a small number other forms and reports that need to be submitted by vessel operators as part of complying with the Commission's CMMs or national MTCs. Among these are transhipment reports, species of interest interaction reports, port arrival reports, pre port transshipment notices and zone entry and exit reports.[12] These are specified fields required in each of these reports but the method of recording and transmission is varied. Depending on the requirements of the coastal state and the capabilities of the vessel, the content of these forms may be radioed, faxed or emailed from the vessel to the coastal state management agency where it is recorded. For WCPFC reporting transmission can be via the responsible flag CCM. The most relevant CMMs[13] are:

- WCPFC CMM, 2009-06, Conservation and Management Measure on The Regulation of Transhipments and provision of a transhipment declaration[14];
- WCPFC 2013-05, Conservation and Management Measure on Daily Catch and Effort Reporting[15];
- Paragraph 3 and Annex 1 of Scientific Data to be Provided to the Commission;
- WCPFC ROP Minimum Standard Data Fields, as amended by WCPFC12 decisions.

The most relevant MTC requirements are:

- Catchlog submission deadlines
- Exit and entry into zone
- Pre port calls
- Pre transshipment notices
- Pre port departure calls

Catch documentation

A Catch Documentation Scheme is focussed primarily on preventing fish and fish products identified as caught by or originating from IUU activities from moving through the commodity chain and ultimately entering markets.

[12] WCPFC reports are high seas pre- and post-transhipment reports (CMM 2009-06), high seas purse seine discard declarations (CMM 2009-02), and Eastern High Seas Pocket entry and exit reports (CMM 2010-02)

[13] WCPFC, Consultation Document for Developing a Draft WCPFC Electronic Reporting Standard First e-Reporting and e-Monitoring Intersessional Working Group Meeting (erandemwg1), Nadi, Fiji, 8 – 10 July 2015

[14] https://www.wcpfc.int/doc/cmm-2009-06/conservation-and-management-measure-regulation-transhipment-0

[15] https://www.wcpfc.int/system/files/CMM%202013-05%20CMM%20on%20daily%20catch%20and%20effort%20reporting.pdf

CDS requires a process by which documentary checks are made to ensure compliance with national and regional management measures. This requires a documentation cross check process to ensure vessels have conformed to their monitoring and reporting obligations and that their reported catches, effort and offloadings/transhipments are checked by flag, coastal and port states (verification). This also required that CDS certificates are only issued when the vessel has no reported IUU activity. This has traditionally required manual cross checking between inspection and observer reports, compliance with country licensing conditions and elog and offloading information. In addition CDS requires a fully traceable system, such that the catch document accompanies the product throughout the commodity chain, i.e. transport via carrier or freight, as well when processed, and sold as product weight.

Two CDS systems are widely used in the Pacific and include the EU Catch Certificate, for sales to EU markets[16], and sales of bigeye tuna, requiring an ICCAT certificate[17].

WCPFC is currently seeking to establish a CDS standard, which can apply to all species entering the commodity chain (FFA, 2015[18]).

3.3 ER SYSTEMS AVAILABLE AND AVAILABLE OUTPUTS

The e-reporting systems available to PICTs are largely in an evolutionary stage, including the most comprehensive, the Fisheries Integrated Management System (FIMS), designed by Quick Access Computing (QAC) for PNG and PNA. This system contains an integrated industry portal, the Industry Fisheries Integrated Management System (iFIMS). Other softwares include SPC"s TUFMAN and FFA's Regional Integrated Management Facility (RIMF).

SPC's TUFMAN was developed with specific software, to enhance data collection for both national management organisations and to enhance SPC's Oceanic Fisheries Programme access to data to support stock assessment modelling work. Both FIMS and RIMF provide data loaders to enter data into the required SPC data formats, but the TUFMAN system is a standalone programme, and is largely used more for data access as opposed to day-to-day management purposes. However, TUFMAN was in many respects the pioneer of ER systems and was originally designed to include additional modules such licensing, unloading, port sampling, VDS management and administration. Non data elements have largely now been surpassed or integrated into the other available systems.

The first software modules produced for the PICTs were e-TUNALOG and e-TUBS which feed into TUFMAN. E-TUBS is now operational, whilst e-TUNALOG is still under trial, and shown to be effective in producing near real time catch data. Details of these are shown in Box 2 and 3 to SPC's TUFMAN database, which is a central depository for a number of information fields, and the available data source for national management organisations as well as the stock assessment specialists in the Oceanic Fisheries Programme (OFP) at SPC. TUFMAN1 was developed in the early 2000s, and upgraded in 2015 to form TUFMAN2. The summary SPC logsheet is shown below (Figure 7).

Box 2: SPC' eTUNALOG

The **eTUNALOG** product, developed by SPC/OFP, is an application designed to run on any Windows-based laptop/tablet/desk-top installed on-board commercial tuna fishing vessels operating in the WCPFC Area.

The eTUNALOG application is designed to replace the need for skippers to manually complete hard-copy vessel trip LOGSHEETS for submission to national and sub-regional authorities as a licensing condition.

eTUNALOG covers the Purse Seine, as well as the Longline fishery (more recently). Features of eTUNALOG include:

[16] EU Regulation 1005/2008, http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1408984470270&uri=CELEX:02008R1005-20110309

[17] http://www.nmfs.noaa.gov/gpea_forms/national/0040/iccat_bet_rec_2010.pdf

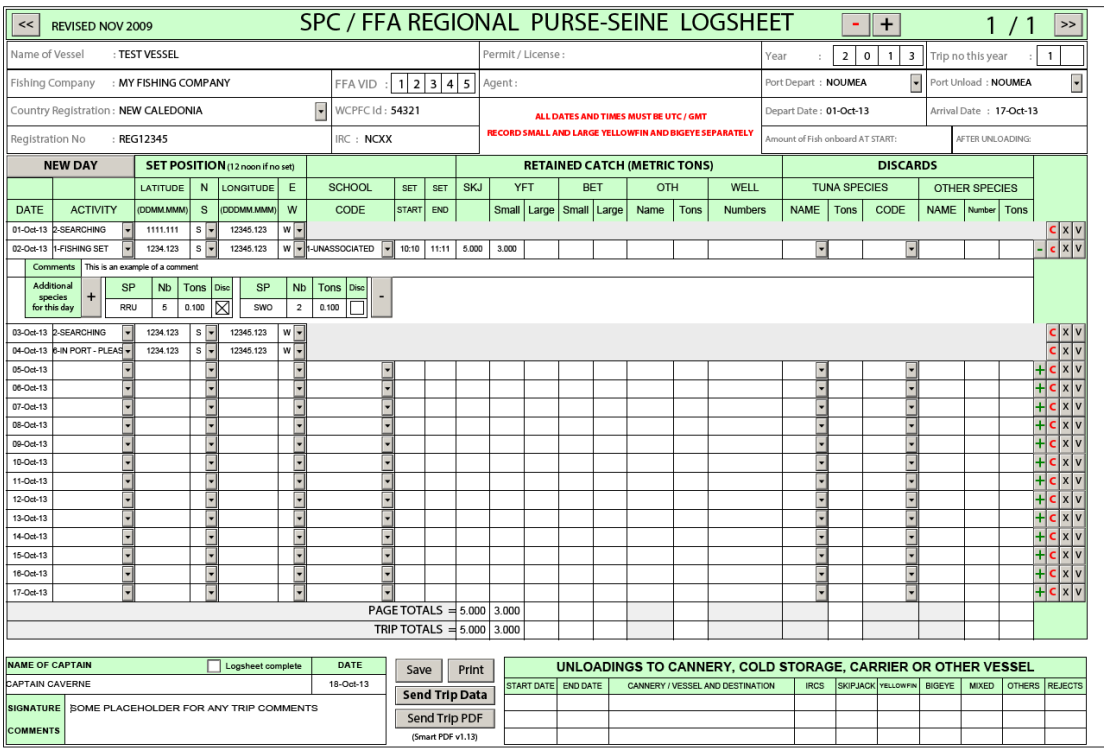
[18] FFA, Development of WCPFC CDS Standards (Version2), Working paper, 2015

- The use of a user-friendly smart PDF form which is identical to the regional standard hard-copy LOGSHEET form, thereby, satisfying licensing conditions, and the vessel skipper is already familiar with the format for recording information, so there is a quick uptake in using the system;
- Extensive on-line error checking built into the PDF form to ensure the data quality;
- Data in concise format (XML file) are encrypted and sent as email attachment to authorised data recipients;
- Data can be transmitted back to shore via email at any time; that is, complete or incomplete trip data can be transmitted to the authorised onshore base(s) at any time;
- System will allow for many authorised recipients to receive the emailed data simultaneously;
- On receipt at the national fisheries authority offices, data is easily uploaded into the TUFMAN database system through a series of prompts which includes an audit of the data;
- The data structures can be made available for import into other database systems, as required;
- An in-built reporting system will allow the vessel and the fishing company to produce reports relevant to their requirements.

Source: http://www.spc.int/oceanfish/en/ofpsection/data-management/spc-members/e-reporting/379-etunalog-smart-pdf-manager

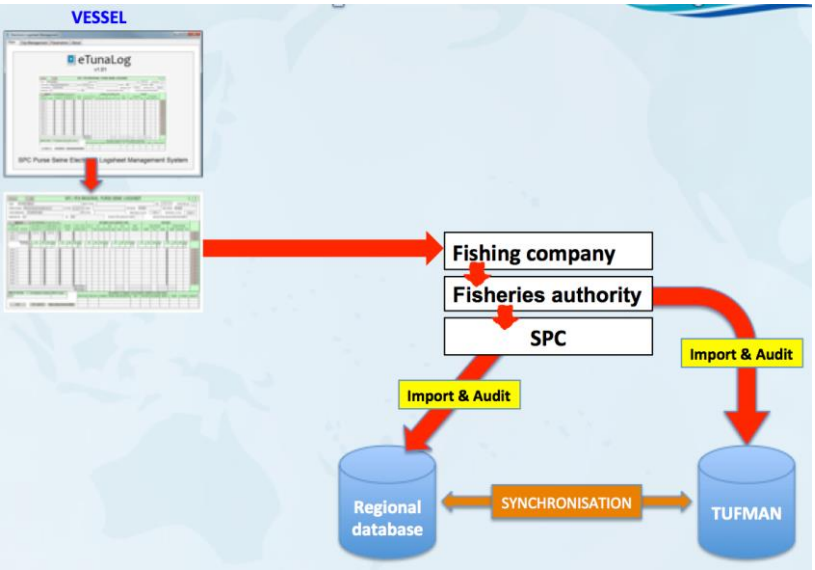
TUFMAN is a database developed by SPC for PICTs to allow them to convert their hard copy tuna data into an electronic format. Previously most tuna data was forwarded to SPC and entered into a regional database, with updates sent to countries every 3 months or so. Entering the data nationally gives countries more immediate access to their data and greater control over their tuna fisheries information should result in improved monitoring of the fishery (SPC, 2012)[19].

Figure 8: SPC/FFA Regional Purse seine logsheet



[19] SPC, MCS TUFMAN Overview (Session 2), https://www.google.com.au/search?client=safari&rls=en&q=MCS+TUFMAN&ie=UTF-8&oe=UTF-8&gfe_rd=cr&ei=JeKGVsnROc3u8wf4t7NA

Figure 9: Schematic for E-TUNALOG



eTUBS is a web-based Observer database management system developed by the SPC/OFP to enter purse seine and longline observer data collected on the SPC/FFA Regional standard observer forms. Previous versions of this system (e.g. TUBS) have been used at SPC for more than 15 years and the current web-based version is installed and operational in the WCPFC and FFA offices (for the US purse seine Treaty observer programme)

Box 3: SPC's e-TUBS

Features of eTUBS include:

- a user-friendly data entry forms that correspond to the regional standard observer data collection forms;
- extensive on-line error checking built into the system to ensure the data quality;
- compatible with common web browsers, maximising the user-friendliness and logical navigation between forms; and
- comprehensive reporting system providing information retrieved from one observer trip to all observer data.

The system places the onus of purchasing and maintaining equipment used by the observer on the vessel, and the establishment of technical support staff in each of the major ports for purse seine unloading/transhipments to oversee the training of observers in using eTUBs, installation of eTUBs and conduct of technical audits of the computer equipment used by observers on-board vessels.

Regional authorities have set guidelines with the requirement for fishing companies/vessels to support the observer data collection and data processing on-board the vessel. These include:

- Clear specifications for the configuration of computer equipment/software (i.e. Windows-based laptop) to be purchased and maintained by the vessel in sound working order, including backup equipment in the event of failure;
- Requirement for the vessel to cover the costs for purchase, ongoing maintenance and replacement of the "observer" laptop (that remains on-board the vessel) according to specifications;
- Requirement for the observer's laptop to be available for software updates (e.g. latest version of eTUBs) and hardware/software technical audits at any time by the authorised on-shore technical support staff;
- Requirement for the vessel to act on the recommendations from the technical audits prior to embarking on the next trip; and
- An indication of what will happen in the event of non-compliance with these requirements (which would require the observer to fall back to manual recording on the hard-copy forms).

The observer enters non-sensitive ROP observer data on-board the vessel using the eTUBS system, so, potentially, the vessel would be authorised to receive these data. Non-sensitive data make up the most of the data entered by the observer. The observer would continue to record the sensitive observer data (e.g. GEN-3 form) on hard-copy forms and, since the volume of non-sensitive data is very small, these data can be entered during the debriefing session when the observer returns to port.

At the end of the trip, the observer backs-up their data onto their own external hard-drive through an option in the eTUBs system.

As soon as possible following the end of a trip, the observer's data is audited as a part of the debriefing process which involves the observer debriefer. Once the data have been cleared, the debriefer facilitates the import into the national TUBS observer system in place, and facilitates transmission of data to the respective regional agencies (SPC, WCPFC, FFA) according to agreed data protocols.

The system has been trialed in FSM and RMI with the support of SPC Technical E-monitoring support officers.

FIMS and RIMF, are now being extended to the PICTS and both are under continuous development. The FIMS role out is being applied to PNA countries, and its adoption has reached different stages of application for a number of countries and in the application of the different modules. FIMS was originally developed for NFA, PNG to support Asset Tracking (ATS) and additional reporting requirements. It was then adopted by PNA to monitor purse seine vessel day uptake against the VDS scheme. Since then FIMS has evolved by demand to include other modules. NFA's desire for an application of integrated modules within the FIMS system is now being followed by a number of PNA

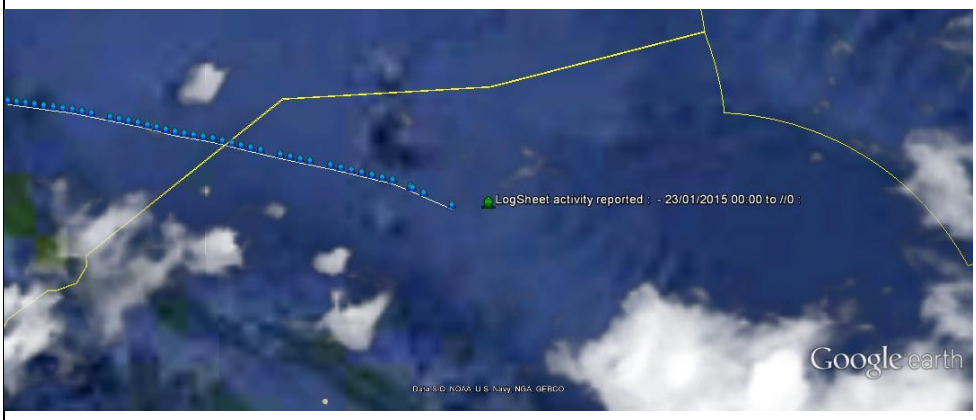
countries, notably, Solomon Islands, Tokelau, Tuvalu and Republic of the Marshall Islands.

Both FIMS and RIMF provide internet and cloud based recording and transmission of information, using the same satellite based systems available for VMS transmission, but transmitted through 'fleet broadband internet'. FIMS near real time reporting, uses email/http and internationally recognised data formats and does not require connectivity during use. Emails are stored and sent when connection becomes available. iFIMS feeds into FIMS in areas such as providing details of vessel for registration and licensing, details of crews, and e-catch log uploads. The iFIMS / FIMS system is also to be adapted to include automated licensing and CMM reporting requirements.

The modules contained within FIMS are interactive, allowing for an industry portal using the industry Fisheries Information Management System (iFIMS) to feed-into FIMS and specific company access to their own data, and access through reporting and ECDIS to real time data on Vessel days, vessel positions, e-catchlog and observer reporting (e-obs). The most prominent FIMS/iFIMS ER reporting modules components are outlined in Box 4 below:

Box 4: FIMS and iFIMS integrated software

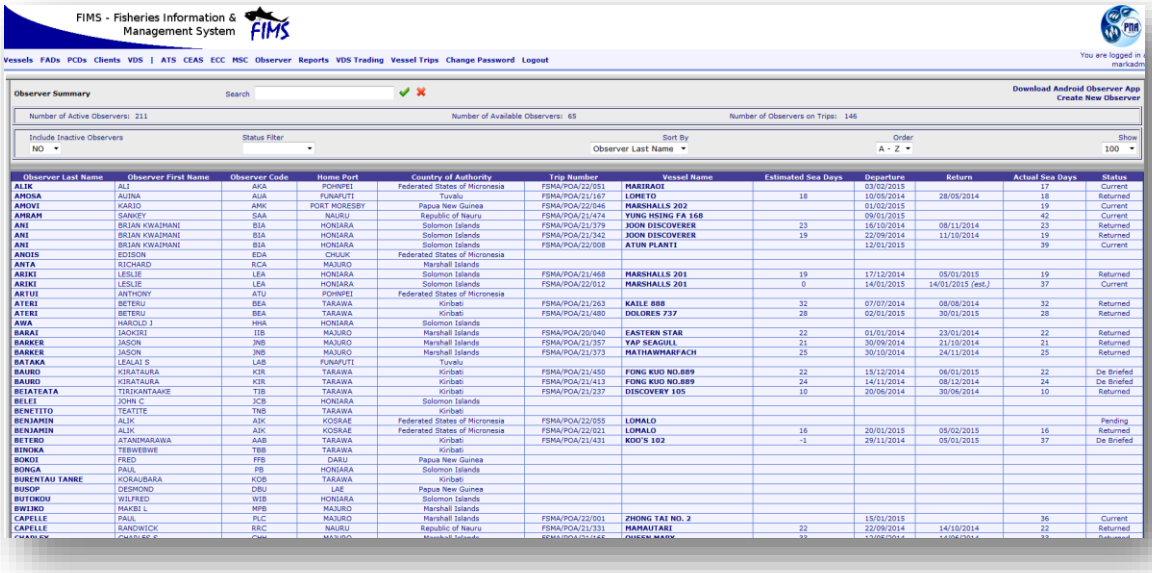
FIMS start up with VDS and ATS (early 2010) allied to iFIMS (March 2013): Covers Vessel Day Scheme (VDS) monitoring, including tracking via ECDIS, with summary vessel by vessel uptake reporting, summarised by participating group (Bilateral country, US Treaty, FSMA and Archipelagic fishery group), also accessible to iFIMS users for company specific information, with provision of NFD applications (iFIMS) and national government FIMS assessment. Auto alert inconsistencies identified from other modules to assist processing.



View || Email	02/02/2015 03:20	28/01/2015 04:45	28/01/2015 19:33	Unlicensed Transit	transit	14.8	-1.066, 155.033	1.121, 155.951	(ifims	ACCEPT / REJECT View eOBS
View || Email	09/02/2015 01:53	06/02/2015 20:05	07/02/2015 07:40	Licensed Fishing - Bad Weather - Rough Seas	rainstorm	0	-0.046, 153.08	-1.079, 155.254	(ifims	ACCEPT / REJECT View eCDS

eReporting (January 2012): Covers e-reporting requirements, submitted manually via email/http from iFIMS to FIMS by the ship's skipper of officer, in accordance with pre notification requirements (entry and exit into national EEZs), and pre port call (24 hours) and transshipment (48 hours), or electronically via VMS tracking, in and out of zone, or when entering territorial waters.

Observer Management (March 2012): Covers Observer Management with details entered manually for each observer (Passport, visas) and their placement.



FIMS - Fisheries Information & Management System

Vessels FADs PCDs Clients VDS | ATS CEAS ECC MSC Observer Reports VDS Trading Vessel Trips Change Password Logout

Observer Summary

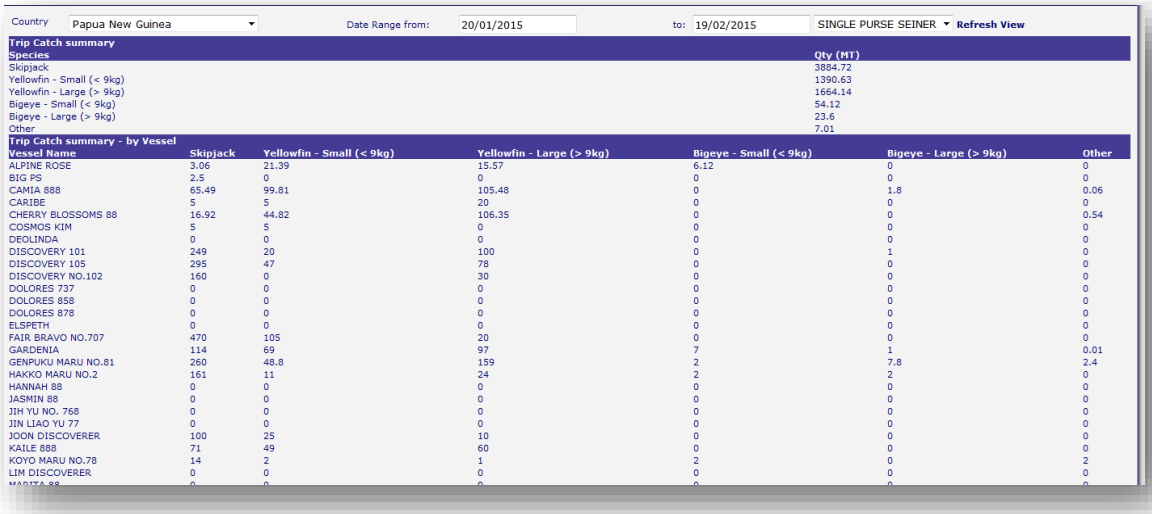
Search

Download Android Observer App
Create New Observer

Number of Active Observers: 211 Number of Available Observers: 65 Number of Observers on Trips: 146

Observer Last Name	Observer First Name	Observer Code	Home Port	Country of Authority	Trip Number	Vessel Name	Estimated Sea Days	Departure	Return	Actual Sea Days	Status
ALIK	ALI	AKA	POHNPEI	Federated States of Micronesia	FSMA/POA/22/051	MARIRAOI		03/02/2015		17	Current
AMOSA	AUINA	AUA	FUNAFUTI	Tuvalu	FSMA/POA/21/167	LOMETO	18	10/05/2014	28/05/2014	18	Returned
AMOVI	KARIO	AMK	PORT MORESBY	Papua New Guinea	FSMA/POA/22/046	MARSHALLS 202		01/02/2015		19	Current
AMRAM	SANKEY	SAA	NAURU	Republic of Nauru	FSMA/POA/21/474	YUNG HSING FA 168		09/01/2015		42	Current
ANI	BRIAN KWAIMANI	BIA	HONIARA	Solomon Islands	FSMA/POA/21/379	JOON DISCOVERER	23	16/10/2014	08/11/2014	23	Returned
ANI	BRIAN KWAIMANI	BIA	HONIARA	Solomon Islands	FSMA/POA/21/342	JOON DISCOVERER	19	22/09/2014	11/10/2014	19	Returned
ANI	BRIAN KWAIMANI	BIA	HONIARA	Solomon Islands	FSMA/POA/22/008	ATUN PLANTI		12/01/2015		39	Current
ANOIS	EDISON	EDA	CHUUK	Federated States of Micronesia							
ANTA	RICHARD	RCA	MAJURO	Marshall Islands							
ARIKI	LESLIE	LEA	HONIARA	Solomon Islands	FSMA/POA/21/468	MARSHALLS 201	19	17/12/2014	05/01/2015	19	Returned
ARIKI	LESLIE	LEA	HONIARA	Solomon Islands	FSMA/POA/22/012	MARSHALLS 201	0	14/01/2015	14/01/2015 (est.)	37	Current
ARTUI	ANTHONY	ATU	POHNPEI	Federated States of Micronesia							
ATERI	BETERU	BEA	TARAWA	Kiribati	FSMA/POA/21/263	KAILE 888	32	07/07/2014	08/08/2014	32	Returned
ATERI	BETERU	BEA	TARAWA	Kiribati	FSMA/POA/21/480	DOLORES 737	28	02/01/2015	30/01/2015	28	Returned
AWA	HAROLD J	HHA	HONIARA	Solomon Islands							
BARAI	IAOKIRI	IIB	MAJURO	Marshall Islands	FSMA/POA/20/040	EASTERN STAR	22	01/01/2014	23/01/2014	22	Returned
BARKER	JASON	JNB	MAJURO	Marshall Islands	FSMA/POA/21/357	YAP SEAGULL	21	30/09/2014	21/10/2014	21	Returned
BARKER	JASON	JNB	MAJURO	Marshall Islands	FSMA/POA/21/373	MATHAWMAWFACH	25	30/10/2014	24/11/2014	25	Returned
BATAKA	LEALAI S	LAB	FUNAFUTI	Tuvalu							
BAURO	KIRATAURA	KIR	TARAWA	Kiribati	FSMA/POA/21/450	FONG KUO NO.889	22	15/12/2014	06/01/2015	22	De Briefed
BAURO	KIRATAURA	KIR	TARAWA	Kiribati	FSMA/POA/21/413	FONG KUO NO.889	24	14/11/2014	08/12/2014	24	De Briefed
BEIATEATA	TIRIKANTAAKE	TIB	TARAWA	Kiribati	FSMA/POA/21/237	DISCOVERY 105	10	20/06/2014	30/06/2014	10	Returned
BELEI	JOHN C	JCB	HONIARA	Solomon Islands							
BENETITO	TEATITE	TNB	TARAWA	Kiribati							
BENJAMIN	ALIK	AJK	KOSRAE	Federated States of Micronesia	FSMA/POA/22/055	LOMALO					Pending
BENJAMIN	ALIK	AJK	KOSRAE	Federated States of Micronesia	FSMA/POA/22/021	LOMALO	16	20/01/2015	05/02/2015	16	Returned
BETERO	ATANIMARAWA	AAB	TARAWA	Kiribati	FSMA/POA/21/431	KOO'S 102	-1	29/11/2014	05/01/2015	37	De Briefed
BINOKA	TEBWEBWE	TBB	TARAWA	Kiribati							
BOKOI	FRED	FFB	DARU	Papua New Guinea							
BONGA	PAUL	PB	HONIARA	Solomon Islands							
BURENTAU TANRE	KORAUBARA	KOB	TARAWA	Kiribati							
BUSOP	DESMOND	DBU	LAE	Papua New Guinea							
BUTOKOU	WILFRED	WIB	HONIARA	Solomon Islands							
BWIJKO	MAKEI L	MPB	MAJURO	Marshall Islands							
CAPELLE	PAUL	PLC	MAJURO	Marshall Islands	FSMA/POA/22/001	ZHONG TAI NO. 2		15/01/2015		36	Current
CAPELLE	RANDWICK	RRC	NAURU	Republic of Nauru	FSMA/POA/21/331	MAMAUTARI	22	22/09/2014	14/10/2014	22	Returned

e-log (October 2013): Catch logs manually entered into an electronic table on iFIMS by purse seine and longline skipper or another ship's officer, with current provision for company verification before submission to management organisations through FIMS and then SPC. E-log data viewing also available on ECDIS. Once received and verified by national data officers, the information is sent via data loader to SPC TUFMAN.



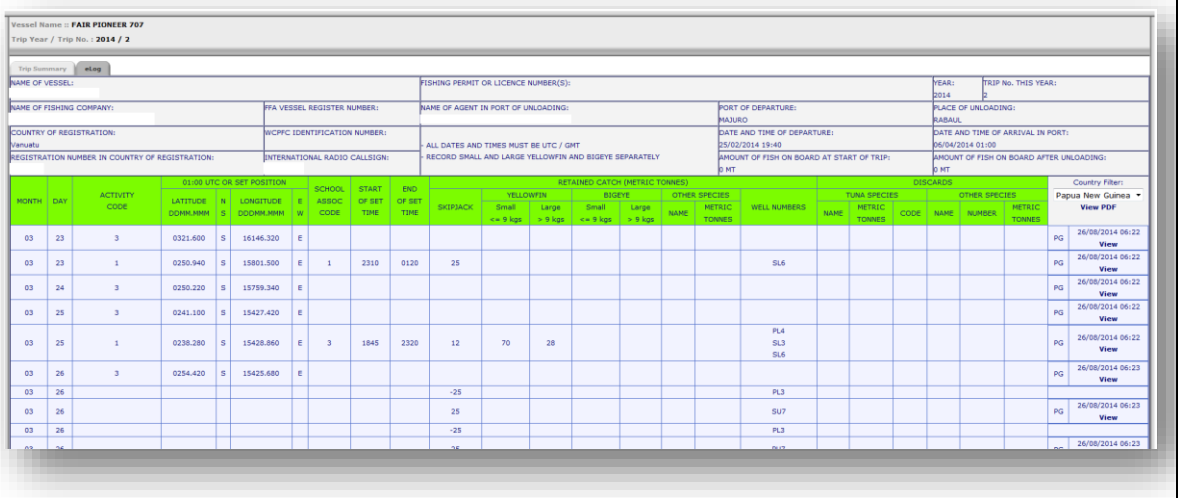
Country: Papua New Guinea Date Range from: 20/01/2015 to: 19/02/2015 SINGLE PURSE SEINER Refresh View

Trip Catch summary

Species	Qty (MT)
Skipjack	3884.72
Yellowfin - Small (< 9kg)	1390.63
Yellowfin - Large (> 9kg)	1664.14
Bigeye - Small (< 9kg)	54.12
Bigeye - Large (> 9kg)	23.6
Other	7.01

Trip Catch summary - by Vessel

Vessel Name	Skipjack	Yellowfin - Small (< 9kg)	Yellowfin - Large (> 9kg)	Bigeye - Small (< 9kg)	Bigeye - Large (> 9kg)	Other
ALPINE ROSE	3.06	21.39	15.57	6.12	0	0
BIG PS	2.5	0	0	0	0	0
CAMIA 888	65.49	99.81	105.48	0	1.8	0.06
CARIBE	5	5	20	0	0	0
CHERRY BLOSSOMS 88	16.92	44.82	106.35	0	0	0.54
COSMOS KIM	5	5	0	0	0	0
DEOLINDA	0	0	0	0	0	0
DISCOVERY 101	249	20	100	0	1	0
DISCOVERY 105	295	47	78	0	0	0
DISCOVERY NO.102	160	0	30	0	0	0
DOLORES 737	0	0	0	0	0	0
DOLORES 858	0	0	0	0	0	0
DOLORES 878	0	0	0	0	0	0
ELSPETH	0	0	0	0	0	0
FAIR BRAVO NO.707	470	105	20	0	0	0
GARDENIA	114	69	97	7	1	0.01
GENPUKU MARU NO.81	260	48.8	159	2	7.8	2.4
HAKKO MARU NO.2	161	11	24	2	2	0
HANNAH 88	0	0	0	0	0	0
JASMIN 88	0	0	0	0	0	0
JIH YU NO. 768	0	0	0	0	0	0
JIN LIAO YU 77	0	0	0	0	0	0
JOON DISCOVERER	100	25	10	0	0	0
KAILE 888	71	49	60	0	0	0
KOYO MARU NO.78	14	2	1	2	0	2
LIM DISCOVERER	0	0	0	0	0	0



Vessel Name :: FAIR PIONEER 707
Trip Year / Trip No. : 2014 / 2

Trip Summary | eLog

NAME OF VESSEL:		FISHING PERMIT OR LICENCE NUMBER(S):	YEAR: 2014 / TRIP No. THIS YEAR: 2
NAME OF FISHING COMPANY:	FFA VESSEL REGISTER NUMBER:	NAME OF AGENT IN PORT OF UNLOADING:	PORT OF DEPARTURE: MAJURO / PLACE OF UNLOADING: KABAUL
COUNTRY OF REGISTRATION: Vanuatu	WCPFC IDENTIFICATION NUMBER:	- ALL DATES AND TIMES MUST BE UTC / GMT	DATE AND TIME OF DEPARTURE: 25/02/2014 19:40 / DATE AND TIME OF ARRIVAL IN PORT: 06/04/2014 01:00
REGISTRATION NUMBER IN COUNTRY OF REGISTRATION:	INTERNATIONAL RADIO CALLSIGN:	- RECORD SMALL AND LARGE YELLOWFIN AND BIGEYE SEPARATELY	AMOUNT OF FISH ON BOARD AT START OF TRIP: 0 MT / AMOUNT OF FISH ON BOARD AFTER UNLOADING: 0 MT

MONTH	DAY	ACTIVITY CODE	01:00 UTC OR SET POSITION				SCHOOL ASSOC CODE	START OF SET TIME	END OF SET TIME	RETAINED CATCH (METRIC TONNES)							DISCARDS						Country Filter: Papua New Guinea / View PDF
			LATITUDE DDMM.MMM	N S	LONGITUDE DDDMM.MMM	E W				SKIPJACK	YELLOWFIN		BIGEYE		OTHER SPECIES		WELL NUMBERS	TUNA SPECIES			OTHER SPECIES			
											Small <= 9 kgs	Large > 9 kgs	Small <= 9 kgs	Large > 9 kgs	NAME	METRIC TONNES		NAME	METRIC TONNES	CODE	NAME	NUMBER	METRIC TONNES	
03	23	3	0321.600	S	16146.320	E																		PG 26/08/2014 06:22 View
03	23	1	0250.940	S	15801.500	E	1	2310	0120	25							SL6							PG 26/08/2014 06:22 View
03	24	3	0250.220	S	15759.340	E																		PG 26/08/2014 06:22 View
03	25	3	0241.100	S	15427.420	E																		PG 26/08/2014 06:22 View
03	25	1	0238.280	S	15428.860	E	3	1845	2320	12	70	28					PL4 SL3 SL6							PG 26/08/2014 06:22 View
03	26	3	0254.420	S	15425.680	E																		PG 26/08/2014 06:23 View
03	26									-25							PL3							
03	26									25							SU7							PG 26/08/2014 06:23 View
03	26									-25							PL3							
																								PG 26/08/2014 06:23

e-obs (September 2014): Covers provision for real time reporting supported by Samsung tablets and Delorme inReach devices.
Observer manual entry required, with near real time delivery (GEN-3 reports) and completed modules, delivered through FIMS and downloadable into pdf format to support debriefing. Competed pdfs transmitted via data loader to e-TUBS.

e-CDS and Port Monitoring eReporting (March 2014): A single system CDS FIMS provides access to pre selected modules (including a provision for flag state access), allowing for access to cross zonal/port to port VDS, e-catchlog, e-obs,and offloading records. Automated cross verification of the data, and specifically the catch total information, allows the Flag State to authorize Catch Certificates, and the coastal state to monitor compliance, for both fishing in its own EEZ, but also to verify if compliant when fishing in surrounding EEZs.

OVR/ELR (November 2015): Vessel owners submit e-applications through iFIMS for registration on the PNA Online Vessel Register. The details are automatically cross checked against the FFA VOGS and the WCOFC Register. Once approval is issues, countries can apply through their online iFIMS portal for a country license.

The **MSC traceability module** (November, 2014): Auto generates an MSC trip number, keeps a register of all MSC trips, allows data in regards to the trip to be entered including the vessels, observer and catch data for the MSC trip, automatically links observer eReporting data for verification (if available), links catcher to carrier and can issue MSC certificates if all boxes ticked, Sends data to Pacifical for linking of the databases, provides an industry portal to view their own MSC trip history and provides an Industry portal to apply for an MSC trip.

FIMS / iFIMS also has incorporated provision for A crew Register, VDS Tender (September 2015), VDS Trading (from January 2014) summary reports Archipelagic VDS (March 2013).

A Port Sampling module is used in PNG and available for others, but requires investment in tablets and country level security. FAD Tracking is in the process of being rolled out on trials and compliance available for PNG and Solomons, but will require country level security before others will be able to use.

Source: QAC

Though not as advanced as FIMS, RIMF contains some of the same or similar modules to some of those in FIMS, e.g. the Vessel Monitoring System, but also draws on other system software, such as SPC's e-TUNALOG, e-TUBS and TUFMAN. This system also provides summary reports for one type of data, and reports integrating/combining data and a unified "portal" and menu system to facilitate access.

As with FIMS, e-reporting data collection has been built into the RIMF. The components in the national IMS systems supported by FFA and SPC are:

- Change Request Manager
- Dashboard
- Data Management
- Licensing
- Observer Programme Management
- Transhipment
- Violations and Prosecutions
- Vessel Day Scheme
- Vessel Monitoring System

These subsequently link directly to:

- WCPFC RFV
- TUFMAN-2 : Logsheets
- TUFMAN-2 : Port Sampling
- TUFMAN-2 : Unloadings/Transhipments
- TUFMAN-2 : Data Loaders
- TUBs : Observer Data Entry
- TUFMAN/TUBs : web reporting service

The following countries, including some from PNA, use national Information Management Systems (IMS) portals to facilitate reporting: Cook Islands, FSM, Fiji, Marshall Islands, Kiribati, Palau, Samoa, Tonga, Tuvalu and Vanuatu. The finding from these countries is that most users access the Vessel Monitoring System fairly regularly to support their management activities, but not so much the other systems. The current body of software development work is focused on scoping out IMS-related needs of all member countries then using that report as the basis to further develop national IMS portals.

Compliance Apps have also been developed, or are in development. These support the recording of basic boarding, patrol and Vessel of Interest (VOI) details. The purpose is to ensure that the compliance organisations have access to strategically important information on the vessel for regular monitoring purposes, as well as a support toll for boarding. As with other ER software, the systems are "***open systems"*** because manual inputs are required. As they evolve however, these are expected to be enhanced by tabulate supported Boarding Officer Job Kit (BOJAK), currently under development by FFA and also under development for NFA as a Compliance App / DeLorme inReach to be introduced as an additional FIMS module.

The systems in use at present is MCS TUFMAN, and is already applied by a number of compliance agencies. The principal contents of MCS TUFMAN:

- History of vessel boardings
- Vessels that have not been boarded
- Vessels that have been boarded, categorized by compliance index rating
- Details of patrols in past years

- Details of boarding inspections in past years
- WCPFC Part 2 Data for boardings and patrols

The BOJAK mobile application will be the first tool in a suite of mobile tools developed with the capability to capture data electronically and to transmit relevant data near real-time either using mobile networks or via satellite in conjunction with the DeLorme inReach device. FFA's expected trial period with selected FFA member countries will commence in the first quarter of 2016. The infrastructure and protocols developed as part of this project will form the basis of FFA's e-reporting infrastructure that will be initially focused on MCS-related activities but will be easily scalable to capture other related datasets. A similar time scale is being proposed for the NFA/FIMS Compliance App.

3.4 THE ROLE OF ELECTRONIC REPORTING AS SUPPORT TO THE REGIONAL AGENCIES

Regional agencies have a role to support E-Reporting. Over the past decade, SPC has been gaining experience in E-Reporting systems, from both a product development point of view and an operational point of view (through the Regional E-Reporting Coordinator's oversight of a number of E-Reporting trials). SPC are now better placed to support our member countries aspirations for E-Reporting.

The PNA Office has established E-Reporting systems aligned to their purse seine vessel days scheme (VDS) and Catch Documentation (eCDS), both of which are fully compatible with the national iFIMS system developed by QAC. The purse seine industry's need for eCDS and the VDS component of the PNA FIMS appears to be the main driver for PNA countries to implement E-Reporting (as a consequence).

FFA are well positioned to provide a complementary service to member countries with respect to E-Reporting, including trials involving MCS data and the provision of advice related to changes to national policy and legislative to better support E-Reporting, and studies into cost-recovery related to E-Reporting.

Member countries will be the drivers of E-Reporting implementation when it is appropriate for them to proceed and regional agencies are better placed to support that move when it happens.

WCPFC remains in somewhat of a vacuum to the extent that whilst it can set reporting standards, it has still to lay out the basis for an ER system to be applied for High Seas fisheries.

Non-governmental organisations (NGOs) also recognise the importance of E-Reporting and E-Monitoring in providing more accurate, complete and timely data for the work of the WCFPC in ensuring the sustainable management of the fishery, and have directly supported a number of trials in E-Reporting and E-Monitoring.

4 LEGISLATIVE AND REGULATORY ISSUES ASSOCIATED WITH ET, EM AND ER

4.1 BACKGROUND

The WCPFC is currently investigating the viability and means for implementing a region-wide standard for EM and ER within the area subject to WCPFC jurisdiction and regulation.[20] The development of regionally agreed EM and ER standards and procedures is consistent with many WCPFC members' international obligations treaties specific to the Western and Central Pacific Ocean.[21] Separate to the WCPFC's investigation, this analysis is focusing on the implementation of EM and ER in PNG, Solomon Islands, Fiji and RMI (together, Pacific Island Countries (PICs)). The analysis will consider a range of different disciplines relevant to ER and EM, including technical needs, costs and benefits, as well as legal, policy and regulatory issues.

This chapter addresses some of the key legal, regulatory and policy considerations that the PICs have taken, or will need to take, into account to effectively transition EM and ER into their existing legal and regulatory regimes. In particular, this chapter analyses potential legal and regulatory issues in relation to privacy, confidentiality and data protection.

EM and ER entails, among other things, data capture and monitoring of vessels, including the transmission, storage, use, disclosure of, and access to these data. Such data or information[22] includes real-time position data on registered vessels, as well as specific technical information in relation to, for example, fishing activity and equipment deployment.

As a starting point, section 4.2 this chapter identifies existing legislation currently in place relevant to EM and ER (to be read in conjunction with the legislative overview table provided at Appendix B-3). Section 4.3 identifies the main legal considerations and restrictions arising from the implementation of EM and ER into fisheries management regimes. Section 4.4 outlines key international obligations for the PICs relevant to EM and ER. Section 4.5 provides a brief case study of existing privacy regimes in non-PIC jurisdictions. This chapter concludes that the PICs can mitigate or address potential legal issues from the implementation of EM and ER into their fisheries management regimes by undertaking targeted amendments to existing fisheries legislation.

4.2 LEGISLATIVE OVERVIEW

Appendix C contains a summary table of each PICs domestic legislation potentially relevant to electronic data. While this is not an exhaustive list of relevant legislative provisions concerning EM and ER, it does provide a foundational overview of the relevant fisheries, confidentiality and privacy legislative provisions in each jurisdiction. In addition, the table outlines relevant constitutional provisions that may form the foundation of a constitutional claim concerning the access, disclosure, storage or other use of electronic fisheries data. However, this legislative overview does not contain an analysis of domestic fisheries regulation.

[20] A map of the WCPFC Convention area can be accessed at https://www.wcpfc.int/convention-area-map.

[21] For example under the *Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region*, entered into force on 20 May 1993 [hereafter the *Niue Treaty*]. Article III(2) of the Niue Treaty provides that the "Parties shall cooperate to develop regionally agreed procedures for the conduct of fisheries surveillance and law enforcement…".

[22] "Data" and "information" are often used interchangeably in this chapter. However, in general, data is a subset of information and refers to factual information such as measurements or statistics.

4.2.1 Laws of Evidence

All PICs have specific evidence laws that establish rules of evidence for court and other legal proceedings (civil and/or criminal).[23] However, these laws have not been analysed in this section as such legislation focuses on the admissibility of evidence in litigation and other administrative proceedings, rather than the regulation of information and data.

4.2.1.1 Constitutional Provisions

Right to privacy

The introduction of EM and ER standards may trigger potential conflicts regarding citizens' constitutional rights. The most notable of these are constitutional claims regarding the right to privacy, as well as freedom of information provisions. The constitution of each of the PIC contains specific privacy provisions that establish a fundamental right to privacy.[24] This contrasts from the position in other jurisdictions where the right to privacy is not expressly enshrined in the constitution and, instead, is derived from case law or specific privacy legislation.[25]

In the context of EM and ER, individuals may potentially rely upon these constitutional provisions for the basis of a constitutional claim concerning the access, disclosure, storage or other use of electronic fisheries data or information. For this reason, two important questions arise in the analysis of any constitutional rights to privacy:

1) Who or what has the benefit of the constitutional right to privacy?; and
2) What is the scope of the constitutional right to privacy?

The constitutions of PNG, Solomon Islands and RMI each contain a right to privacy that appears to be applicable only to natural persons. The constitutions of PNG and RMI both contain a right to privacy provision that applies to all persons.[26] However, neither constitution defines the term "person". Instead, the PNG right to privacy is framed in the context of a "fundamental right and freedom of the individual", and therefore appears to extend only to natural persons.[27] Similarly, the right to privacy in the RMI Constitution also appears to extend only to natural persons.[28] The Solomon Islands' constitutional right to privacy, like PNG, is framed as one of the "fundamental rights and freedoms of the individual", thus indicating that it applies to natural persons only.[29]

In contrast, while Fiji's constitutional right to privacy applies to all "persons", the definition of "persons" extends beyond individuals to mean "a natural or legal person, including a company or

[23] In most jurisdictions, this piece of legislation is entitled the Evidence Act: *Evidence Act 1975* (PNG); *Evidence Act* [CAP 41] (Fiji); *Evidence Act 2009* (Solomon Islands); *Evidence Act 1989* (Marshall Islands).
[24] See the legislative table contained at Attachment C to this memorandum.
[25] For example, the United States and Australia.
[26] The right to privacy provision in the *Constitution of the Republic of the Marshall Islands* (S13) applies to "all persons". The right to privacy provision in the *Constitution of the Independent State of Papua New Guinea* (S49) applies to "every person".
[27] S5 (Basic Rights), *Constitution of the Independent State of Papua New Guinea*.
[28] S13 of the *Constitution of the Republic of the Marshall Islands* provides that "[a]ll persons shall be free from unreasonable interference in personal choices that do not injure others and from unreasonable intrusions into their privacy". The language used in this provision (for example, "personal choices" and "injure") is particularly applicable to individuals, and supports the position that the legislative intent is for this provision to apply to natural persons only.
In addition, S 2 and 5 of the Constitution refer to "person or body" in the context of a provision. This supports the position that the Constitution may categorise unnatural persons (for example, organisations or companies) as a "body" and therefore excluding them from the term "person".
[29] S 3(c) and 9, *The Constitution of Solomon Islands 1978.*

association or body of persons whether corporate or unincorporated".[30] This broader application of the right to privacy - that is, beyond applying only to natural persons - raises potential questions regarding the extent to which corporations, associations or other bodies can rely on this constitutional provision when claiming privacy protections over data and information.

Regarding the scope of each PIC's constitutional right to privacy, the Solomon Islands' constitution contains the only right to privacy that is unlikely to extend to protect data and information, and particularly electronic fisheries data. The Solomon Islands' right to privacy is less general than for the other PICs and specifically relates to the "protection for the privacy of [an individual's] home and other property and from deprivation of property without compensation".[31] The language in S9 of the Solomon Islands' constitution provides further detail of this fundamental right and indicates that it relates to the protection of an individual's home from search and entry. Therefore, it is unlikely that Solomon Islands citizens (for example, vessel operators or owners) can rely upon this constitutional provision as a general privacy right that would be applicable to electronic data and information.

Access to data

As outlined above, countries protect personal and confidential information by way of constitutional provisions, and industry-specific legislation. These protections extend to the regulation of access to such data and information. RMI is the only PIC that does not have an express freedom of information provision in its constitution.

PNG's constitution contains a "right to freedom of information" which gives every citizen the "right of reasonable access to official documents" subject to certain exceptions involving the need for "secrecy".[32] A number of these exceptions may be applicable to fisheries data and information including: matters relating to the international relations of PNG[33]; trade secrets, and privileged or confidential commercial or financial information obtained from a person or body[34]; the prevention, investigation and prosecution of crime[35]; and the maintenance of personal privacy and security of the person[36]. As a result, although this constitutional right may provide citizens with a means to gain access to documents containing fisheries related data and information, the wide scope of exceptions limiting this right may indeed prevent the disclosure of such information where it involves personal or confidential content.

Fiji's Bill of Rights, enshrined in its constitution, establishes a "freedom of speech, expression and publication" that includes a "freedom to seek, receive and impart information…".[37] However, this freedom is qualified to allow a law to limit it in certain circumstances, including: if doing so is in the public interest; to protect a person's reputation, privacy, dignity, rights or freedoms; or to prevent to disclosure of information received in confidence.[38]

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[30] S163(1) *Constitution of the Republic of Fiji*.

[31] S3(c) *The Constitution of Solomon Islands 1978.* Hypothetically, this right to privacy may extend to protect fisheries data and information where those data and information are contained within an individual's home.

[32] S51, *Constitution of the Independent State of Papua New Guinea*.

[33] S51(1)(a). This exception in relation to international relations includes PNG's relations with the Government of any other country or with any international organization.

[34] S51(1)(c).

[35] S51(1)(g).

[36] S51(1)(h).

[37] S17(1)(a), *Constitution of the Republic of Fiji*.

[38] Specifically, S17(3)(a) provides that:

"*[t]o the extent that it is necessary, a law may limit, or may authorise the limitation of, the rights and freedoms mentioned in subsection (1) in the interests of—(a) national security, public safety, public order, public morality, public health or the orderly conduct of elections;*

(b) the protection or maintenance of the reputation, privacy, dignity, rights or freedoms of other persons…

(c) preventing the disclosure, as appropriate, of information received in confidence;"

The Solomon Islands Constitution also contains a freedom of expression constitutional provision which covers the "freedom to receive ideas and information without interference".[39] This provision contains similar exceptions for laws to override this freedom to those in the Fijian Constitution, for example, when done so in the public interest[40], and for protecting personal reputation, privacy or freedoms, or preventing the disclosure of confidential information[41].

4.3 LEGAL CONSIDERATIONS AND RESTRICTIONS

4.3.1 Data classification

Personal data or information

The classification of the type of data involved in EM and ER systems is very important in assessing the efficacy and impact of existing and potential regulation of these new technologies.[42] If the particular data are classified as "personal data" or "personal information", then potentially different - and often more restrictive - data protection rules and regulations may apply, including any potential legal impact. Similarly, data or information classified as confidential will also be subject to greater protection and regulation. The applicable data protection rules and regulations that will apply (if any at all) are dependent on the particular jurisdiction and existing regulations, and the legal definition of key terms within them. However, the more robust a particular jurisdiction's data protection laws are, the greater the importance of data classification – as specific regulations and controls are likely to be in place in such jurisdictions.

In jurisdictions with existing specialised privacy legislation[43], consent is not necessarily required for an entity to collect and distribute information, even when the information is "personal".[44] However, the threshold of whether consent is required will ultimately depend on the type of information involved. For example, if the particular information is classified under legislation or regulations as "sensitive"[45] or "confidential" information, this will generally attract higher protection. In such instances, there will often be a legal requirement for an entity to obtain the consent of the person(s) to which the information relates prior to collecting or distributing this information.

There is international debate regarding whether information from vessel monitoring systems should be classified as personal data. For example, in 2012, the European Data Protection Supervisor[46] ruled that the data obtain from vessel monitoring systems can be categorised as personal data in certain circumstances, thus attracting greater regulatory data protection than for non-personal data. However, PICs' legislation does not contemplate whether vessel monitoring information is "personal data". Instead, the PICs (with the exception of the Marshall Islands) expressly characterise vessel monitoring information as "confidential information".

Therefore, any implementing legislation in relation to EM and ER should clearly classify the nature of the data or information involved (that is, collected, stored, transmitted, accessed, disclosed, or otherwise used) to ensure that such data can be effectively regulated and, where necessary, appropriate safeguards and protections are established. This should include a legal definition of

[39] S12, *The Constitution of Solomon Islands 1978.*
[40] S12(2)(a), *The Constitution of Solomon Islands 1978.*
[41] S12(2)(b), *The Constitution of Solomon Islands 1978.*
[42] Including the collection, storage, transmission, disclosure, or other use of data or information.
[43] For example, Australia (both at a Federal and State/Territory level).
[44] For example, under the *Privacy Act*, Australian Privacy Principle number 6 provides that particular entities must not disclose personal information unless constituent with the states purpose for collecting such information in the first place. See Section 4.5 for a further discussion of the Australian Privacy Principles.
[45] "Sensitive information" is a legally defined term of art in many jurisdictions. For example, in Australia "sensitive information" is defined to include medical information or records.
[46] The European Data Protection Supervisor oversees the use of data and related privacy issues within the European Union.

"personal data" or "personal information" that is consistently applied across its EM or ER-related legislation.[47] Implementing legislation should also include targeted compliance and enforcement provisions prescribing appropriate sanctions to deter non-compliance and facilitate enforcement. For example, regarding disclosure, it is common for privacy laws to classify inappropriate disclosure - that is, disclosure not permitted under the particular legislation - an offence, punishable by fine and/or imprisonment (in certain more serious cases). Comprehensive implementing legislation addressing the above key considerations will assist in assuring that individuals have legally enforceable rights regarding storage, use or disclosure their personal data.

Confidentiality

Data may be characterised as confidential by an express or implied provision of law, or pursuant to a contractual provision between relevant parties (for example, between a data supplier and receiver). In each of the PICs' legislative regimes, data characterised as "confidential" have legal limitations on the extent and manner in which it can be accessed, stored and disclosed. For example, the fisheries legislation of PNG and RMI both expressly characterise vessel monitoring information (that is, any information or other data supplied by a vessel monitoring system) as "confidential information".[48] The fisheries legislation of PNG, Solomon Islands, and Fiji all contain a definition of "confidential information".[49] All of these respective definitions are broad and provide a senior official of each fishery authority[50] with a broad discretion to classify any information as confidential. Contractual provisions of fishing and vessel licenses or permits can also impose confidentiality provisions imposing a duty of confidentiality on one or more parties to the particular contract/agreement. Such provisions often also contain provisions defining/delineating a data suppliers' intellectual property rights.[51]

Similar to the discussion regarding personal information, PICs should expressly indicate what information is "confidential" in its fisheries legislation, including providing a clear definition of "confidential information" and outlining any restrictions or regulations resulting from this classification.[52] Any implementing legislation should also include targeted compliance and enforcement provisions to deter non-compliance with confidentiality regulations, and to facilitate enforcement.

Data retention

Countries and their respective regulatory bodies have various different approaches and justifications regarding the length of time a holding authority should retain or store fisheries data. This is particularly the case with respect to VMS data and information. For example, the European Data

[47] For example, in many jurisdictions, "personal data" are defined with words to the following effect: "information or data, the possession of which can lead to direct or indirect identification of an individual".

[48] See S73B(2) of PNG's *Fisheries Management Act 1998*, as amended by the *Fisheries Management (Amendment) Act 2015*, and S508(2) of Marshall Islands' *Fisheries Enforcement Act 1997*.

[49] PNG: S74(4)), *Fisheries Management Act 1998*; Solomon Islands: S36, *Fisheries Management Act 2015*; Fiji: S107(4), *Offshore Fisheries Management Decree 2012*.

[50] The respective senior official with discretionary power to classify information as confidential are the Managing Director of the National Fisheries Authority (PNG), the Director of Fisheries (Solomon Islands), and the Permanent Secretary responsible for Fisheries (Fiji).

[51] Hodgson S, P van de Velde (2008) Legal aspects of maritime monitoring and surveillance data. Framework Service Contract, No. FISH/2006/09 – LOT2; Submitted to DG Maritime Affairs & Fisheries. See http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/legal_aspects_maritime_monitoring_summary_en.pdf

[52] RMI currently has no clear definition of confidential information.

Protection Supervisor[53] has previously stated that it considers "*3 years to be the basic time for retention, unless it can be demonstrated that they [the data] are needed for longer periods,*".[54]

Regulatory authorities' decisions over the required retention period for monitoring data (for example, vessel monitoring data) must take into account various competing and conflicting interests, in addition to resource and technological capability limitations. Compliance and enforcement bodies[55] are likely to support longer retention periods so that data are available for investigations.[56] Similarly, with respect to synthesized or summary data, scientists generally advocate for greater retention periods so that the data can be used for studies and other scientific purposes, many of which require long-term data - that is, data collected over longer periods. However, scientists mostly do not require raw (or primary) data[57] to be retained for long periods (for example, bulk video footage). Vessel owners and operators are also likely to advocate for more stringent limits on data retention periods to minimise the possibility of personal data being used, disclosed, or accessed. Capability limitations also exist where storage and technical capacity, and limited resources can hamper an entity's ability to retain data for a long period of time.

Data flow systems

In order to accurately identify the legal issues regarding ER and EM, data flow systems must be clearly delineated. This involves a clear understanding of the chain of custody regarding data and information involved in ER and EM processes. For example, the form of data regulation required to effectively regulate EM and ER processes (including any potential legal liability of entities involved in these processes) will change depending on which entity collects, owns, stores, or has control or management over (and whether this control or management is exclusive) the data or information. Further, the purpose for using the data will also shape and inform any regulatory restrictions on its use.

Depending on the particular jurisdiction's proposed data flow system (regarding all aspects of the data and information), different legal considerations will arise in relation to privacy and confidentiality. The extent and impact of such legal considerations will ultimately be dependent on the domestic legislation in place to regulate and protect interests in relation to data and information.

4.4 INTERNATIONAL OBLIGATIONS

The PICs are party to a number of multilateral treaties which provide obligations and governing principles relevant to the implementation and use of EM and ER. In implementing legislation integrating EM and ER into their fisheries management regimes, the PICs need to consider its international obligations arising under existing multilateral treaties to which they are a party.

4.4.1 Niue Treaty and its Subsidiary Agreements

The Niue Treaty is one such multilateral treaty between members of the Pacific Islands Forum Fisheries Agency (FFA) that promotes cooperation in fisheries monitoring, control and surveillance.[58]

[53] The European Data Protection Supervisor is the regulatory body responsible for monitoring data privacy within the European Union.

[54] See http://www.nature.com/news/fisheries-science-falls-foul-of-privacy-rules-1.10788.

[55] Such as domestic fisheries management authorities.

[56] Domestic legislation will often contain a provision extending any regulated data retention period where legal investigations or proceedings are on foot.

[57] Raw or primary data refers to data obtained from a source where those data have not been processed.

[58] *Introduction to the Niue Treaty*, FFA Website, see https://www.ffa.int/taxonomy/term/451.

The Niue Treaty imposes a number of obligations on the PICs[59] relevant to EM and ER including, but not limited to:

a) Article III(2): "Parties shall cooperate to develop regionally agreed procedures for the conduct of fisheries surveillance and law enforcement…".

b) Article V relates to the exchange of information and provides the following:

(1) "Each Party shall, to the extent permitted by its national laws and regulations, provide to the South Pacific Forum Fisheries Agency[60], or to any other Party directly, information relevant to the purposes of this Treaty, including but not limited to information about:

i. the location and movement of foreign fishing vessels;

ii. foreign fishing vessel licensing; and

iii. fisheries surveillance and law enforcement activities.

(2) The Parties shall develop standard forms and procedures for reporting information under paragraph 1 of this Article and effective methods for communicating such information."

None of the above international obligations supersede any party's national laws and regulations. Instead, many of the provisions of the Niue Treaty are qualified by the scope of each party's national laws and regulations.[61]

The Niue Treaty, operating as a head agreement, also provides for the creation of bilateral or multilateral subsidiary agreements regarding regional fisheries surveillance and enforcement.[62] One such subsidiary agreement is the *Agreement on Strengthening Implementation of the Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region*.[63] This agreement has direct relevance to the implementation of EM and ER into the PICs' fisheries regimes, and the development of standards to this effect. The Niue Treaty Subsidiary Agreement provides for access to, and the storage, management and use of information regarding regional fisheries surveillance and enforcement. Specifically, it facilitates region-wide information sharing of fisheries data[64], providing for the exchange of fisheries law enforcement data and other fisheries data.[65] The parties must fulfil their obligations under the Niue Treaty Subsidiary Agreement in a manner consistent, and in compliance, with their respective obligations under "national laws, policies or procedures"[66], as well as international law.[67]

[59] All four of the PICs are FFA members.

[60] This reference to the "South Pacific Forum Fisheries Agency" in the Niue Treaty refers to the Pacific Island Forum Fisheries Agency, which is the working name of the agency established by the *South Pacific Forum Fisheries Agency Convention 1979*.

[61] For example, Article V(1).

[62] Article II(2), Niue Treaty.

[63] *Strengthening Implementation of the Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region,* [hereinafter the *Niue Treaty Subsidiary Agreement*].

[64] Article 19, Niue Treaty Subsidiary Agreement.

[65] Article 20, Niue Treaty Subsidiary Agreement.

[66] Article 11(2), Niue Treaty Subsidiary Agreement.

[67] Article 4(1), Niue Treaty Subsidiary Agreement provides, among other things, that the terms of the agreement shall not affect a Party's rights and obligations arising under existing international agreements. Further, Article 10 provides that surveillance and enforcement activity is authorised to the extent that such activity is carried out in accordance with international laws (art 10(5)) and as authorised under a Party's relevant national law (arts 10(1) and (3)(b)).

4.4.2 WCPFC Convention

The WCPFC Convention imposes obligations on the WCPFC, its subsidiary bodies[68] and member States (which includes all PICs) to maintain confidentiality[69] of fisheries-related information or data collected, received, or stored in connection with the Western and Central Pacific Ocean. The WCPFC has some discretion as to what information or data are considered to be confidential. For example, Article 28(7)(a) of the WCPFC Convention provides the WCPFC the discretion to determine what information or data are confidential in nature. Further, the WCPFC Convention imposes an obligation on the WCPFC to create measures to protect confidential information received through the WCPFC VMS.[70] Additionally, the WCPFC is required to develop procedures and guidelines for the operation of the regional observer programme, ancillary to those expressly outlined in the WCPFC Convention[71], "to ensure the security of non-aggregated data and other information which the Commission deems to be of a confidential nature".[72] This provides the WCPFC with an element of discretion regarding the classification of non-aggregated data and other information as confidential.

Arising from this WCPFC Convention obligation, the WCPFC has implemented the *Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the Commission*.[73] The Data Rules and Procedures regulate data and information held by the WCPFC or Secretariat, as well as any other body acting on their behalf.[74] Specifically, the Data Rules and Procedures outline the WCPFC's policies regarding confidentiality and security with respect to the dissemination of data, and establish two categories of data: public domain data[75] and non-public domain data[76]. These rules and procedures operate in conjunction with the policies of confidentiality and security established in the WCPFC's Information Security Policy[77].

Access to data received or held by the WCPFC is dependent on whether data is considered public or non-public domain data. Any person can access public domain data, whether online or by request to the WCPFC.[78] However, non-public domain data can only be accessed in certain circumstances.[79] Therefore, in implementing domestic legislation for the integration of EM and ER, the PICs should be aware of the current data classification under the WCPFC (confidential, public domain or non-public

[68] For example, the Scientific Committee.
[69] Article 10(1)(e) (Functions of the Commission) "compile and disseminate accurate and complete statistical data to ensure that the best scientific information is available, while maintaining confidentiality, where appropriate"
[70] Article 24(8), WCPFC Convention.
[71] Article 28(6), WCPFC Convention.
[72] Article 28(7)(a), WCPFC Convention.
[73] *Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the Commission,* as refined and adopted at the Fourth Regular Session of the Commission, Tumon, Guam, USA, 2-7 December 2007 [hereinafter *Data Rules and Procedures*].
[74] Preamble, page 1, Data Rules and Procedures.
[75] "Public domain data" is any data that does not reveal "the individual activities of any vessel, company, or person", or contain "private information" (paragraph 9, Data Rules and Procedures). A list of examples of public domain data is provided at Appendix 1, Data Rules and Procedures.
[76] "Non-public domain data" is defined under paragraph 14 of the Data Rules and Procedures as all other types of data that do not fall under the definition of "public domain data". A list of examples of non-public domain data is provided at Appendix 2, Data Rules and Procedures, and includes VMS data and regional observer programme reports.
[77] The WCPFC's Information Security Policy establishes, among other things, a risk classification methodology applicable to data. See https://www.wcpfc.int/system/files/WCPFC%20Information%20Security%20Policy.pdf.
[78] Paragraph 12, Data Rules and Procedures.
[79] For example, WCPFC members can access non-public domain data when access is necessary to "serve the purposes of the Convention" (paragraph 19, Data Rules and Procedures). However, members are responsible for keeping the data confidential and secure in accordance with the Data Rules and Procedures (section 4.4, Data Rules and Procedures).

domain) and consider any inconsistencies with domestic data security objectives that may need to be actively addressed in the implementing legislation.

4.5 PRIVACY LEGISLATIVE FRAMEWORK CASE STUDY

Privacy laws are generally aimed at protecting an individual's personal information, with a country's privacy legislation most commonly regulating the handling of personal information by government agencies and certain private sector organisations. Many countries' privacy legislation governs how agencies collect, use, disclose, retain, store, and allow access to personal information. Typically, the primary piece of privacy legislation also authorizes an appointed Privacy Commissioner to implement regulations or codes that establish standards regarding particular areas of privacy protection. This is often done so on a sectorial basis.

Generally, legal risk and uncertainty may arise in situations where a country lacks robust privacy laws. The most effective method for a country to mitigate or remove this uncertainty is for it to ensure that all EM and ER processes are clearly detailed and integrated into its legislation or regulations. For example, it is important to clearly specify all critical elements and data-related processes of EM and ER such as: the purpose for collecting information or data; the manner of storage, transmission, processing and use of the data; the legal definitions of the types of data involved (for example, confidential or personal information); the relevant entities who will store, transmit, receive, access and process or use the information or data; the duration data are to be retained; where the data are to be stored; disclosure standards, restrictions and procedures - and any exemptions to these procedures or standards.

Australia's privacy laws provide a useful example of an established privacy regime. The international community considers Australia's privacy laws as comprehensive and effective, often just below the European Union and the United Kingdom in terms of efficacy, both of which have arguably the most robust privacy regulations and laws.[80] As mentioned previously, the PICs do not currently have specialised privacy regulatory frameworks. This is particularly relevant with respect to implementing new and emerging technologies that potentially raise new legal and policy data privacy considerations.[81] In many cases, it is likely that EM and ER considerations were not contemplated by the respective PICs' governments when they enacted their existing fisheries legislation. As a result, the Australian privacy regulatory regime is a useful case study, as it provides a comprehensive, and scrutinized, "best practice" legislative framework.

Australian privacy laws are generally not prescriptive. Instead, both its Federal and State privacy laws are largely principle-based.[82] These "information privacy principles" apply to private sector organisations as well as most government agencies[83] and cover the following areas[84]:

- Open and transparent management of personal information;

[80] Dorothee Heisenberg. *Negotiating Privacy: The European Union, The United States and Personal Data Protection*. Boulder, CO: Lynne Rienner Publishers, Inc., 2005.

[81] PNG is an exception to this following the enactment of the *Fisheries Management (Amendment) Act 2015* (amending the *Fisheries Management Act 1998*). This Act specifically facilitates the transition of EM and ER into PNG's fisheries management regime.

[82] At a Federal level, the *Privacy Act 1988* contains 11 "Information Privacy Principles" that apply to Federal (and Australian Capital Territory) government agencies and 10 "National Privacy Principles" that apply to the private sector. Similarly, most States also have a set of information privacy principles enshrined in the respective State privacy legislation (e.g. *Privacy and Personal Information Protection Act 1998 (NSW)*).
Other countries, such as New Zealand in its *Privacy Act 1993*, have also developed their privacy laws based on information privacy principles.

[83] The main privacy provisions contained in the *Privacy Act 1993* apply to Australian government agencies (including Norfolk Island agencies), certain not-for-profit and private sector organisations (with greater than $3 million annual turnover), private health service providers and certain small businesses (together "APP entities" as defined in Section 6, *Privacy Act 1993*).

[84] Schedule 1, *Privacy Act 1993*.

- Anonymity and pseudonymity;
- Collection of solicited personal information;
- Dealing with unsolicited personal information;
- Notification of the collection of personal information;
- Use or disclosure of personal information;
- Direct marketing;
- Cross-border disclosure of personal information;
- Adoption, use or disclosure of government related identifiers;
- Quality of personal information; and
- Security of personal information.

Australian privacy laws do contain a set time limit for how long data must be held or stored. However, there are certain sector-specific regulations (legislative or otherwise) that impose temporal restrictions and obligations regarding data retention[85]. Often, such temporal restrictions are shaped or informed by the stated purpose for which the particular entity collects, holds, uses and discloses personal information.

Based on a review of existing legislation of the PICs in conjunction with other established privacy regimes and regulations[86], the PICs' privacy laws (either specialised privacy laws or amendments to existing fisheries legislation) should address the following issues[87]:

1. the type(s) of personal information that the particular entity (private or public agencies/organizations) collects and holds;
2. how the particular entity collects and holds personal information;
3. the purpose(s) for which the particular entity collects, holds, uses and discloses personal information;
4. how an individual may access its own personal information held by the particular entity (including a process for amending or correcting this information);
5. how an individual may complain about a breach of privacy regulations or laws that binds the particular entity, including how the particular entity will deal with such a complaint; and
6. whether the particular entity is likely to disclose personal information to third parties, agencies, or overseas recipients or organizations (and if so and known, which countries or organizations).

4.6 CONCLUSION AND RECOMMENDATIONS

The PICs would benefit from updating their fisheries legislation to specifically incorporate EM and ER processes into their respective fisheries management regimes.[88] Currently, PNG is the only one of the PICs to have expressly undertaken such legislative amendments. This legislative action is likely to mitigate risk of legal liability arising from privacy, confidentiality and other legal issues connected to the implementation of EM and ER.

[85] For example, with respect to taxation and insurance.

[86] In addition to Australia's privacy legislation, New Zealand's privacy legislation (*Privacy Act 1998*) also contains information privacy principles.

[87] These considerations are generally consistent with the areas identified by the Australian Privacy Principles (APP) Privacy Policy regarding the management of personal information.

[88] For example, any existing fisheries regulations which specifically require manual recording (that is, ink or other non-electronic recording) will need to be amended to allow/contemplate electronic reporting in addition to (or in place of) manual reporting. Section 420 of the Solomon Islands' *Fishing Access and Licensing Act 1997* is one such example. This provision outlines various reporting requirements, including a requirement that vessel operators maintain "in ink a fishing log" with vessel and catch information.

Based on an assessment of the PICs' fisheries legislation in conjunction with existing data protection regimes and corresponding fisheries data regulation, a prudent approach would be for the PICs' to ensure that their fisheries legislation and regulations, at a minimum, detail the following:

a) clear classifications (including legal definitions) of the types of data or information involved, whether personal, confidential or other information;

b) the purposes, methods and locations for obtaining, collecting, accessing, transmitting, storing and disclosing the data/information, including any relevant exceptions, limitations or restrictions;

c) the relevant entities who will store, transmit, receive, access and process or use the information or data;

d) legal safeguards to the security of data/information – through confidentiality and data protection / personal data provisions (including relevant compliance and enforcement provisions);

e) a reasonable estimation of the necessary length of time that a regulatory body must retain the particular data based on the carrying out of the proposed use (including expressly regulating how data can be retained for longer periods – for example, where determined necessary by the particular holding authority).

With respect to privacy law, as stated above, none of the PICs have specialised privacy legislation. If the PICs enact specialised privacy laws and regulations, this will establish a baseline privacy regime within which EM and ER, and all other public and private privacy rights and claims, can be regulated. In this regard, principle-based privacy regimes (rather than solely prescriptive regulations) have been successful in other jurisdictions and may be a useful model within which the PICs can base any new privacy regimes. In turn, this will provide a principle-based framework that can be used to ensure that citizens' constitutional privacy rights are upheld and protected, as well as ensuring that individuals have legally enforceable rights regarding storage, use or disclosure of an individual's personal data.

Therefore, PICs could mitigate any potential data protection and privacy legal issues by implementing general privacy legislation governing, among other things, the protection, use and disclosure of personal information. However, even with the implementation of specialised privacy legislation, specific amendments to existing fisheries legislation integrating EM and ER, and addressing potential legal issues or uncertainty proactively, is the most effective approach.

5 RESOURCING EFIS FUNCTIONALITY, COSTS AND BENEFITS

5.1 RESOURCING EFIS SYSTEMS

This section summarizes the resource needs against existing human and financial capital deployed in the WCPO EFIS systems. When identifying these costs the source of activity is from those institutions where actions have (FFA, PNA, NFA PNG) been implemented, and are in the process of implementation (Solomon Islands). That said, PNG, RMI, Solomon Islands and Tuvalu have introduced the e-obs tabulate. Most of the other PNA countries are only exploring the options for rolling out the FIMS modules in 2016 as a trial basis and for introduction in 2017. PNG and Solomon Islands have implemented e-logs and electronic licensing as part of their 2016 licence conditions for both purse seine and longline fleets. This data is port-to-port allowing for data collection and allows cross party access to ER data.

The costs of EFIS solutions are dependent on a number of factors: software development (including security) and system/modular updates, required support hardware (provider and industry), maintenance, communication, manpower and training. Systems development is in a continually dynamic stage, with technological change and application modules changing or added on a continuous basis. System costs, e.g. airtime may depend on various rates of application, e.g. polling rates and data transmission volume. However, higher volumes of data leads to higher costs which means that managers are faced with critical decisions on whether the systems in place are sufficient to deal with the issues, or whether there are considerable benefits from enhancing performance by a system upgrade or a change in communication systems.

Satellite providers can provide a simple or more 'fixed' product, which involves little or no customization to meet the client's needs. This would apply for both transmission and data capture costs. Other providers charge higher implementation costs, but are then able to reduce ongoing fees, e.g., by limiting annual costs to transmission, or transmission and support. Some EM providers charge low implementation costs, especially where some of the systems are in a test phase. Some of the ER software development costs have been undertaken by regional institutions, FFA and SPC, or by some national authorities, such as NFA, PNG. The NFA's contribution to FIMS has also allowed other PNA users to piggyback on a well established ER initiative.

Where the needs are more substantial, software development will be more sophisticated and require more customization. This requires higher development costs. A critical determinant of the costs of software development is whether or not the supplier has an existing template of the programme code needed. As a consequence of the above, pricing across the range of EFIS solutions is fairly standard, with the possible exception of e-monitoring solutions where the levels of application largely depends on specific differences in the modules offered as well as the security systems required.

5.1.1 Electronic Tracking

ET systems are well established, but are continually being upgraded. SAR is now a feature of the RFSC surveillance at a cost of US$ 500,000[89]. There is some expectation that EM sensor data will be incorporated component to RFSC viewing and alerts. These technologies are expected to use existing ECDIS resources, servers and hard drive. The cost of transmitting sensor and position information through GPS would be considered as part of the GPS package, and could replace VMS. This is the thinking behind AFMA's transition to EM (Trent Timmiss, pers comm. November, 2015).

[89] This allows for provision for 365 images @ US$ 1,500 per image (Geospatial image 2000)).

FFA's Regional Fisheries Surveillance Centre is manned by two Senior officers, the Senior Operations Officer and the Deputy Operations Officer, with a support staff of 3 officers. RFSC's resources are expected to increase by two additional VMS monitoring officers, increasing the staff from 5 to 7. The Centre operates with by a large screen bank, 17 workstations, computer systems and software supported by 2 servers for hosting and hardware and an uninterrupted power supply (UPS).

WCPFC is yet to consider whether to include alongside VMS, monitoring to include sensor data. For this to occur would need a decision by the Commission to do so and consideration of the associated commitments and costs, including additional staff to monitor high levels of monitoring activity, especially for longliners and high seas transhipments and bunkering.

5.1.2 Electronic Monitoring

EM systems have now been introduced into two fisheries within Australia, and the system is being actively explored for the Solomon Islands, PNG and Fiji (a non PNA country). A change in focus to EM will require additional viewing capacity, which may be provided by in country observers, has been the case with the Solomon Island/SPC trials, or by a service provider, not ruling out the option for a centralised observer agency to undertake the role. A third party agency might be considered for example, when vessels are operational in several, as opposed to one EEZ. National viewing might be a preferred option when vessel operations are discrete to one EEZ.

EM viewing is likely to represent a strengthening in the Regional Observer Programme (ROP) standard because, whilst purse seine observer coverage at 100% has been effective, observer deployment on longliners has not. EM will also provide additional opportunities for at sea observers on carriers and bunkers.

EM systems are deployed in the Australian Eastern Tuna and Billfish Fishery (ETBF), and were trialed in the Solomon Islands in 2014 (Hosken *et al*, 2015). Trials have now commenced in Fiji. The AFMA viewing of the ETBF is conducted by a service provider (Archipelago AP), with 4 viewing stations covering 75 vessels. The system comprises up to four (4) cameras per vessel, along sensors to report winch, drum, hydraulic system pressure, and engine activity, as well as transmission hardware (gateway, box and per over Ethernet[90]) and costs can range from US$ 7,200-US$ 11,000 per vessel. Sensor data requires 19 bytes, comparable with the standard VMS transmission requirements, and can be sent for as little as $4/poll. The providers include Satlink, Trident, Archipelago, Marine Instruments and CLS Triton Adv. Sensors can be hydraulic (i.e. detecting change in hydraulic pressure), kinetic (i.e.. a reflector coupled with a receiver) or a combination scenario in case one type of sensor fails. Transmitting live footage from any of the systems available is a significant cost, and not practical. Therefore, all systems require use of a 2 terabyte hard drive with a redundant security system. The e-eye, operated by Marine Instruments, provides for high quality still imagery, and claims to allow release of hard drive space and a downloadable facility, but similarly requires significant bandwidth to transmit. Transmission would of course be an advantage in the event of a serious incident or violation.

The assumption applied to the costings in this exercise is to require all vessels to carry monitoring equipment, i.e. 4 cameras, plus sensors, and to be applied across all vessels groups, including bunkers and carrier; and to maintain the viewing rate at 5%, equivalent to the ROP. Interest from NFA, PNG suggests that it is likely that purse seiners would be included in this EM initiative, because it provides a good basis for secondary information but also strengthen the security for observers, noting three deaths in PNG over the last 4 years. Camera viewing could also provide added scrutiny

[90] Ethernet is a link layer protocol in the TCP/IP stack, describing how networked devices can format data for transmission to other network devices on the same network segment, and how to put that data out on the network connection.

for observers against claims of corruption. The Commission adopted a recommendation that encourages the development of Electronic Monitoring by CCMs in areas where data gaps exist such as longline observer coverage and high seas transhipment (WCPFC12 Summary Report, para 543).

Viewing time is an added cost but this is against the fact that observer deployment is not meeting the provided standard. The AFMA ETBF system requires 3 hours per set (Andrew Fedoric, Archipelago AP, pers comm., November, 2015). Three viewers are used by Archipelago to review 75 vessels, reviewing 10% of the footage. The Solomon Island trials, using the Satlink system, suggested a total viewing time of 4 hours or more (Hosken, *et al*) based on 100% viewing of all fishing operations. It is evident from the work undertaken that the View Manager software could be improved to programme tag instances when the catch comes on board, potentially reducing the viewing, or as was the case with the Archipelago system, to be directly linked to the hauling sensor to trigger the view. A fleet of 2,028 vessels (Table 1) at 5% viewing coverage, would require ~ 101 views, each observer covering 2 viewings per 8 hour day, i.e. 50 viewers. It is more probable that viewer coverage would be used for higher risk fisheries, such as longlining, or as a second eye in support of existing observers. Some scenario here might include the following table (Table 3).

Table 3: Anticipated E-Monitoring views against ROP observer commitments[1]

		Views/observer coverage at 5%	Number of viewers
PNA / national observer viewing			
Purse seine	267	14	6
Longline	600	30	12
Sub total	870	44	18
FFA / national observer viewing			
Longline (Tokelau arrangement)	300	15	6
Carrier	170	9	4
Bunker	20	1	1
Sub total	490	25	11
WCPFC HS			
Purse seine (HS pockets (DWFN Attachment D, Philippines & HSP) Attachment C), CMM 2015-01))	3,100 days (16 boat days @ 230 days) Philippines; 4,659 boat days @ 200 days (23 boat days)	2	1
Longline	633	32	13
Carriers and Bunkers	190	10	5
Sub total	**1,904**	**100**	**28**

[1] Pole-and-line vessels have not been added to the list because of historic low risk ratings on VDIs.

Capital requirements include the onboard cameras and sensors, gateway, box and per over Ethernet installed on all vessels, and server costs, a receiver and viewing stations in the receiving office. Viewing stations and supporting technology would need to be housed in a dedicated building.

5.1.3 Electronic Reporting

The ER software systems available have undergone different evolutionary phases, first with TUFMAN, commencing in the early 2000s, followed by FIMS and RIMF. e-TUNALOG and e-Tubs are pretty well integrated into RIMF through a data loader, and theoretically the same applies to FIMS. FIMS, with industry portal iFIMS, represents the most advanced system available, whereas RIMDF is still in its evolutionary stage.

Software development costs, including provision for security, range from US$ 270,000 for TUFMAN, over a 10 year period (Peter Williams, pers. comm. November, 2015) to US$ 2.4 million for FIMS[91], developed in the last 5 years. All claim to be fully operational, but evidence suggests that FIMS is widely endorsed by PNA as 'fit for business model and ready to apply' (Transform Aqorau, pers. comm., November, 2015). QAC were also able to provide specific module development cost information, which can be used to weight against the assessment of benefits. The average cost, including the iFIMS portal, was around US$ 350,000 per module, with 7 modules fully functional.

Software development costs were provided for RIMF, but not in the form of a total package. Examples quoted related to country specific applications of small and large country specific modules, developed at a cost of US$ 15,000 to US$ 25,000, for 13 countries (Kenneth Katafono, pers com, December 2015). This equates to around US$ 350,000, with a potential total development cost spread across the region of US$ 500,000. TUFMAN's eTUNALOG and e-tubs has been fully integrated as a component of RIMF, which would suggest that this alternative system, could be ready to roll out to non-PNA countries. FFA has additional donor funded provision in place to support the further evolution of the RIMF system, which would suggest that US$ 500,000 may be an under estimate.

Human resource issues relate to the required staffing levels, and training and mentoring resources required to be implemented. Staff resourcing would include the centralised management organisation (PNA, FFA and WCPFC) and the national management organisation.

Evidence from PNA suggests that two to three central officers are needed to both service the core Registry (The PNA Register) and provide support to the countries for support training and mentoring of FIMS and iFIMS. Support can also be drawn from officers in national administrations once their systems are operational. NFA for example, is developing an MoU with Solomon Islands to provide FIMS training support.

Evidence from NFA suggests that for ER systems, the duties of existing staff positions are either changed, or that dedicated positions are being established to adequately support E-Reporting implemented on a medium-large scale. New posts in NFA include:

- An EFIS manager / coordinator, ensuring that the transition to ER is seamless, facilitated by training and ongoing mentoring.
- An E-Reporting officer, to facilitate mentoring staff in the various modules and to provide support training to QAC in industry uptake of iFIMS.

ER officers, sponsored by ISSF through SPC, are also now in place in RMI, Solomon Islands and FSM.

[91] Costs paid for FIMS development reflect the costs paid by NFA and PNA and may not accurately reflect the replacement cost. There has been significant investment by QAC and some other investors in the development up to date, *Mark Oates, QAC*, pers. comm, February, 2015

Evidence from these countries suggests, that there is no additional staffing required to support ER, since dedicated positions are already assigned to licensing, logbook reporting, inspection and observer functions. What is happening, however, is that existing staff are being upskilled, and some of the staff are being trained as trainers to facilitate an understanding of the available systems.

Table 4: : Current positions in the two national organisations

	PNG	Solomon Islands
Licensing officers	3	3
Fishery inspectors	30	18
Catch documentation officers	15	3
VDS validation officers	3	2
Fishery observers	270	80
Data clerks and log book verification	4	8

There is unlikely to be a change to the positions of other staff members, but the value of their outputs is expected to increase considerably. In some cases, the application of ER will require changing roles and functions, and a strengthening of capacity for data analysis and application with real time data. The benefit that will ensue will be more rapid processing of the reports (See Section 5), increased levels of scrutiny, and potentially time to reallocate to other duties. This is also against the background that most PICT National Offices are inherently understaffed, which would this lead to improved functionality of the administration.

Some elements of the ER system require new staff members. This is more a reflection of the need to strengthen countries management obligations. An example of this is dedicating some observer coordination staff to managing the observer data base, and recruiting CDS officers. In the case of PNG, the CDS capacity has been increased from zero to 15, but it is likely that had there been a manual inputting requirement, the capacity would have been twice the current level.

Arguably, for each of the national administrations, dedicated officers require new workstations, and probably over the course of the year all staff – data clerks, licensing officers, observer coordinators and inspectors will require new workstations. However, aside from the dedicated officers, these are investments that should take place with or without ER. Nevertheless, new workstations are assumed for the EFIS Manager and EFIS Reporting Officer.

The cost of the PNA DNID contract with its third party provider allows for 24 polls/day at a cost of US$ 50/vessel/month. The total cost to PNA for its 270 purse seiners is US$ 162,000. The polling rate for the longline fleet would be once every 4 hours, hence 25% of the cost of a purse seiner. The number of operational longliners is on the PNA OVR is around 235 to date, but anticipate to reach 600. Therefore the cost for longline data would be US$ 90,000.

Around 200 observers are in the process of being issued with tabulates and InReach satellite communicators[92]. These have a life expectancy of 2 years. The WWF sponsored 135 PNA InReach at a cost of US$ 1,600 for each device set. The cost of the airtime is US$ 66 per trip, with amortisation of the asset equating to (US$ 90 (communication devices) + US$ 66 (airtime) per trip = US$ 156. Each vessel may operate with around 12-15 trips per year, equivalent to US$ 156 X 270 X 15 = 631,800. It

[92] WWF, in partnership with PNA, sponsored the purchase of 135 tabulates and inReach communicators, and paid for observer training and airtime

is noteworthy that the cost of posting observer workbooks are around US$ 150/book. This is without the added benefit of receiving real time GEN 3 reports and photographic evidence.

Currently SPC enters most of the ROP data, with some regionalisation by placing some data punchers in the countries where great amounts of data are received. SPC has been funding this task from funds received from WCPFC and other donor sources. Currently eleven data entry persons are employed in in Noumea and Pohnpei (Peter Williams, pers comm./WCPFC-TCC7-2011/16). It is anticipated that e-obs data will feed through to SPC, but there will still be a need for post-entry auditing. The challenge will be how to build up the capacity of this on-shore auditing/debriefing so it is adequate to ensure quality data. This will require the Pacific Islands Regional Fishery Observer (PIRFO) programme to standardise and direct the training but there will need for the national EROs to support implementation.

5.1.4 Industry E-Reporting

Aside from its reporting obligations the fishing industry is increasingly applying electronic information aids to improve fleet management, strategic decision making and market related actions. Industry responses indicated a very significant range of communication systems from the non existent (the longline fleet), to more sophisticated levels of connectivity (Kawamoto, pers. comm, December, 2015)

Whilst this report does not focus on these benefits, connectivity is usually through fleet broadband, allowing access to weather reports, water temperatures and market information, or GPS tracking via radio buoys on FADs (Pino, 2012). Subscribers to iFIMS also receive a range of strategically important information including company specific vessel locations (VMS) as well as catch quantities and species. iFIMS also includes reporting on Chain of Custody on board, including verification by the observer, and provision for a CoC link from customer to consignment.

5.2 COSTS

5.2.1 Electronic Tracking

Table 5 provides a brief summary of the annualized costs of operating the RFSC VMS and allied software tracking systems.

The following assumptions are made with respect to the RFSC

- Capital asset value – screen bank, 17 workstations, computer systems and software supported by 2 servers for hosting and hardware and an uninterrupted power supply (UPS) are annualized over 5 years;
- Staffing costs represent 7 dedicated personnel
- Providers include annual VMS third party provider (US$ 200,000), AIS (US$ 5,000) and SAR (US$ 500,000).
- Server costs includes a Centralized server and Replication server
- Software development covers integration of data into ECDIS systems
- A satellite cost overhead for countries without cable.

The total annual costs of operating the RFSC is US$ 1.58 million, which spread over 1,707 vessels is around US$ 1,303/vessel for FFA registered vessels.

For WCPFC, the costs are taken as a balance between 2015 expenditure and the 2016 budget.

The FFA/WCPFC SLA exceeds the revised charge to FFA. The balance in additional cost is used to reflect the WCPFC components in order to avoid double counting. It is likely that the SLA will be adjusted downwards.

Table 5: Principal costs of the Electronic Tracking

Cost type	US$	FFA fleet numbers	Cost/vessel (US$)
FFA			
Staffing costs incl training	460,000	1,213	379
Software support	60,000	1,213	49
Hardware (RFSC)	50,000	1,213	41
ET Providers	705,000	1,213	581
Server costs	30,000	1,213	25
Added satellite costs	12,000	1,213	10
Admin overhead @ 10%	263,400	1,213	217
Sub total	1,580,400	1,213	1,303
WCPFC			
VMS Capital costs	40,000	2,061	19
VMS SLA Costs	205,000	2,061	99
VMS Air time	100,000	2,061	49
VMS Security audit	7,500	2,061	4
VMS training	40,000	2,061	19
VMS Redundancy provision		2,061	0
Information monitoring system	18,700	2,061	9
Sub total	411,200	2,061	200
Total	**1,991,600**	**2,061**	**1,503**

Source: FFA & WCPFC12-2015-FAC9-15

5.2.2 Electronic Monitoring

The annual operating costs across all national administration or observer agencies (Table 6) is estimated at US$ 7.3 million. This averages US$ 3,528/vessel fishing in the jurisdiction of WCPFC. The costs are estimated on a per vessel basis as opposed any other pro rate adjustment (size, catch or nationality). Details on specific costs are summarized below.

Table 6: Principal costs of Electronic Monitoring systems

Cost item	US$	Number of vessels	Cost/user
Staffing costs incl 10% provision for training	882,797	2,061	428
Software support	50,000	2,061	24
Hardware (Workstations)	195,000	2,061	95
Hardware	4,036,000	2,061	1,958
Installation & servicing	1,014,000	2,061	492
DNID	200,000	2,061	97
Server costs	30,000	2,061	15
Admin overhead @ 10%	862,500	2,061	418
Total	**7,270,297**	**2,061**	**3,528**

The following assumptions are made:

- EM will be rolled out across the whole WCPFC fleet (2,061 (WCPFC + FFA, Table 1) vessels.
- 5% screening coverage (the assigned ROP requirement), would require 50 viewers, with each observer covering 2 viewings per 8 hour day. The assumed observer cost would be US$ 65/day[93]. Viewing would be by sample, most probably linked to VCI scoring. The cost is calculated at 51 observers X 242 (days) X US$ 65/day.
- Observer viewing stations would be at a cost of US$ 2,500 each (70 X 2,500), or US$ 175,000.
- Vessel hardware (cameras and sensors) is US$ 10,000/vessel, i.e. US$ 10,000 X US$ 1,215, amortized over 5 years. These are made up of the support hardware (US$ 1,900), cameras (US$ 400-US$1,280), camera central units (US$ 5,000) and sensors.
- Polling would be at the same rate as applied to ET VMS (US$ 200,000). Hence, the expectation is that there would be no extra cost over and above the ET system.
- Servicing costs including the costs of installation (US$ 2,000/system), camera and sensor replacement would be at US$ 500. Equipment installation is estimated to take approximately 14 person hours, or US$ 2,000. Some additional costs might incurred to replace damaged equipment, e.g. camera flooding; or GPS antenna due to lighting strikes.
- Provider / Agency support would be set at 20% of the total cost, which will include the cost of housing the viewing equipment and viewer work stations

It is noteworthy that the cost of an observer/vessel over 230 fishing days at US$ 110/day[94], would equate to around US$ 25,300 per annum for each vessel per observer deployed. At a rate 5%, this would average US$ 1,265/day[95], as opposed to the US$ 3,440/vessel.

AFMA operates a cost recovery system from the vessels (Trent Timmiss, AFMA, pers. comm, November 2015). Based on a 10% recovery, this equates to US$ 10-12,000/vessel, excluding observer costs. This reflects a viewing rate of between 5-8%.

[93] Observer fee rates in the PICTS range from US$ 20-US$ 65/day.

[94] Includes observer rate (US$ 65/day) Plus travel (US$ 35/day)

[95] LL fishing days @ 230 X US$ 65/day = US$ 14,950; US$ 14,950*5%= US$ 748/day.

5.2.3 Electronic Reporting

The estimated annual operating costs for Pacific ER systems are US$ 3.8 million (Table 7). However, this includes the combined costs of all systems available, when the management organization is likely to only choose one. FIMS, including industry portal, is estimated to account for 84% of these costs, but at present provides the most versatile of the systems available, and delivers more in terms of the required outputs. Allowing for increased utilization of the FIMS system, with the PNA LL VDS, would suggest that the total cost per vessel would be equivalent to US$ 3,847. No provision is made in this table to spreading the costs to include the 850+ vessels that are only registered to fish in the High Seas as WCPFC does not have an ER system.

The equivalent cost of RIMF per vessel, but applied over a smaller group of longliners, would be around US $ 2,000 / vessel in place.

Table 7: Principal costs of Electronic Reporting systems for FIMS (A) and RIMF (B).

A. FIMS	Vessels: 270 purse seine and 600 LL			
	Total 5 year development cost (US$)	**Amortized over 5 years**	**Number of vessels**	**Costs/ vessel (US$)**
Software development costs (1)				
VDS and Asset Tracking System (ATS) = foundation cost)	1,000,000	200,000	837	239
ELR	300,000	60,000	837	72
e-log	200,000	40,000	837	48
e-obs and observer management	400,000	80,000	837	96
e-CDS	500,000	100,000	837	119
MSC (Trip management and communication)	40,000	8,000	837	10
Compliance App	200,000	40,000	837	48
Sub total	2,640,000	528,000	837	631
DNID provider		207,000	837	247
Staffing (EFIS & ER national officers)		405,000	837	484
Training	810,000	162,000	837	194
Tabulated and InReach incl data contract		640,000	837	765
Sub total		**1,414,000**	**837**	**1,689**
iFIMS training & support @ US$ 990/company (210 companies) and US$ 1,910/vessel		1,806,570	837	2,158
Total		**3,220,570**	**837**	**3,847**

B. RIMF	Vessels: 300 longliners (Tokelau arrangement)			
	Total 5 year development cost ($US)	Amortised over 5 years (US$)	Vessel numbers	Costs/ vessel (US$)
RIMF Software	500,000	100,000	300	333
SPC e-TNUALOG / e-obs	165,000	10,000	300	33
Security		6,000	300	20
Hardware	30,000	7,000	300	23
Training		12,000	300	40
Annual survey		138,000	300	460
Staffing (EFIS & ER national officers)		320,000	300	1,067
Total		**593,000**	**300**	**1,977**

The following assumptions have been applied

- All modular development costs and fixed assets are given a life expectancy of 5 years.
- National officers include the costs of 9 national EFIS manager and 9 ER officers for PNA and 8 for FFA/RIMF, each at US$ 20,000 pa, plus two work workstations in each country.
- Third party data provision is secured independently by PNA, but the RIMF cost is an integral part of the VMS provision, and already covered under ET costings.
- The cost of the airtime is US$ 66 per trip, with amortisation of the asset equating to (US$ 90 (communication devices) + US$ 66 (airtime) per trip = US$ 156. Each vessel may operate with around 12-15 trips per year, equivalent to US$ 156 X 270 X 15 = 631,800
- FIMS Training includes 1 week (5 days) in country training @ US$ 1,800/day (QAC), across nine countries for 10 modules. This is likely to be an over estimate, and Pew is currently making provision for QAC to train trainers. RIMF training is as per the budget provided, but with some caution, in the sense that it is a very low budget relative to the training needs.
- IFIMS training costs assumes an average 4 vessels per company (i.e. around 210 companies), with charges per vessel aggregated to US$ 1,910, noting the marginal difference in costs between purse seine and longline.

It should be noted that while the costs of RIMF are significantly higher, the FIMS deliverables are significantly greater, so running a value for money exercise of one against the other would have to reflect these differences (Section 3.3).

5.2.4 Current industry

Industry is rapidly developing its own systems to interrogate strategically important information. From a straw pole of industry costs, the estimated annual costs for purse seiners ranged from US$ 10,000/annum to US$ 90,000. The high cost group included access to sonar buoy data. Use of EFIS systems by longliners is notably more basic (Russel Dunham, September, 2015), with a large number of vessels still operating without any system.

5.3 THE BENEFITS

Overall, there are five (5) main areas into which benefits from a more extensive and comprehensive implementation of an EFIS is seen to fall, these being:

1. Improved compliance and reporting
2. Improved fisheries sustainability, including non-target species
3. Improved quality in stock assessment
4. Improved traceability and catch quality
5. Improved industry conditions, including safety

Each of these is briefly addressed below, with regards ET, EM and ER enhancements.

5.3.1 Overall Benefits

5.3.1.1 Improved Compliance and Management

The availability of enhanced integrated EFIS has the potential to prevent under reporting of effort (VDS), target species, bycatch species, pre port notifications transshipments and entry and exit requirements. ET/ER/EM alerts also provide a strong basis to cross check alternative data sources. However, there will be challenges involved, such as levels of IT competency in some areas, concerns over job losses from efficiency savings as well as cultural barriers to moving to different systems. In reality, EFIS solutions are likely to create additional employment and learning opportunities resulting in net gains in and increased quality of employment. Demonstrating the benefits of EFIS to the member countries and the mandating of the installation of EFIS across the WCPO will take time to roll-out but this should not deter the exploration and take-up of new technologies and tools that can enhance existing ER modules (i.e. e-logsheets, and e-observer data, VDS, CMM reporting, e-CDS) and inter-operability of EFIS activities and systems (e.g. iFIMS feeding into FIMS). Increased efficiencies from near real-time catch and effort reporting, verified across multiple ET EM and ER sources, will improve more timely identification of compliance and management issues and administration.

As with stock assessment, neither ER nor EM replaces the value of data collection by on-board observers for cross-checking purposes but both offer significant benefits; in improving quality and timeliness of fisheries data and supporting CMM compliance, particularly on vessels where current observer deployment is insufficient (i.e. longline, pole and line, and carrier vessels). Both are critical to improving the quality of science and compliance information upon which tuna fisheries rely.

While EFIS can improve accuracy and reliability in catch reporting, effort controls and other reporting requirements, ET and EM technologies supported by ER will also strengthen compliance monitoring (e.g. FAD closures, particularly during times of higher risk of ETM interactions and transshipments) and support more timely and clear identification of illegal and unregulated activities reducing the incidence of IUU fishing, acting as a deterrent and encouraging greater voluntary compliance.

5.3.1.2 Improved Fisheries Sustainability

Many of the challenges facing regional fisheries management are well known. All the main tuna species are being heavily exploited and in some cases (e.g. bigeye), over-exploited. As the demand for seafood relative to supply intensifies there will be an ever increasing need to ensure harvest control systems adapt and allow effective management and conservation measures to be implemented as required, in a timelier manner. There are a number of key WCPO concerns including:

- the need to maintain effort for a number of target tunas at historic levels

- the need to manage FADs deployment by some fleets,
- the need to control illegal transshipments and
- the prevention in targeting of vulnerable shark and other ETP species.

All these areas require a high degree of regulation to ensure that Cooperating Commission Members (CCMs) are compliant and all can be strengthened through EFIS. Both ET and EM technologies supported by ER will ensure improved accuracy and reliability in reporting against the above, including non-target species.

5.3.1.3 Improved Stock Assessment

Data collected both at sea and at first landing all has considerable value for utilization in the regional stock assessment models run by SPC and others as part of the WCPFC fisheries management regime. Current shortcomings in under non reporting, timeliness of data entry, processing and transmission as well data reliability and quality issues restrict their use for stock assessment or ecosystem modelling purposes. EFIS provides significant opportunities to facilitate greater levels of reporting, improve the timeliness, accuracy and reliability of data provision, through adoption of EM and ER systems. The current manual information systems are insufficiently effective for reporting, inefficient in terms double handling of data, contain multiple data entry points (increasing the risk of mis-reporting) and experience considerable time lags between data collection and input into databases for use in stock assessment. These lags lead to uncertainties in the accuracy of the data.

ER improves reliability and consistency in data entry in reporting of target and non-target catches. Furthermore, integration across EM and ER systems allows for cross-checking and verification of fishing activity and other trip data. Accessing these data in “near real time” or “real time” strengthens the quality of stock assessment and reduces uncertainty in modeling of stocks and setting of catch and/or effort limits. Currently, neither ER nor EM replaces the value of collection of robust observer data for scientific purposes (e.g. species, sampling, gear used) nor collection of data in port (e.g. species identification, length –frequency data) or at-sea tagging programs to strengthen modeling, although both can support sampling methodologies.

5.3.1.4 Improved Traceability and Catch Quality

A related approach to ensuring sustainability is to add-value to the catch to improve profitability and market access. One of the emerging uses of fisheries data in the WCPO tuna fisheries is for product traceability and to demonstrate the fisheries meet the criteria expected under various environmental certification schemes such as Marine Stewardship Council (MSC) certification. Catch documentation and traceability are key requirements for meeting MSC’s Chain of Custody (CoC) obligations that permit use of their eco-label. Both ER and EM systems facilitate the strong catch monitoring required with ER in particular able be linked to an electronic Catch Documentation Schemes (eCDS[96]) module with flow on benefits for traceability, chain of custody and fishery certification. Through iFIMS, the PNA is already implementing and improving their eCDS and traceability systems for free-school catches cross-checked against observer data, with VDS oversight.

A corollary of the accessing of markets for certified fish, or fish under an “Improvement Project” is that maintaining that access means sustaining quality with flow-on effects being i) support for increased investment in quality enhancement at the scale of the broader fishery and ii) the capability for sales lots to be sorted and segregated to maximize value.

[96] eCDS and traceability systems are capable of capturing Vessel ID, date, location and species data including through remote data capture options (e.g. bar code scanners or RFID tagging systems)

5.3.1.5 Improved Industry Conditions, Including Safety

Industry efficiencies will be realized as a result of integration across ET, EM and ER systems and modules and access to data in real or near real-time. Availability of accurate and reliable catch and effort data over time will enable fishing vessels to better plan activity and exhaustion/allocation of allotted vessel days to take into account seasonal factors (e.g. weather, markets). Through real-time transmission of FAD sonar data, fishing vessels will be able to make decisions quickly and confidently in terms of steaming and setting gear on specific FADs, improving financial and economic returns. Integrated EM and ER platforms will provide added support to traceability and chain of custody claims via validation of catch certificates (iFIMs) and should reduce costs of verification and auditing. Lastly, time series data on catch and effort, compiled into specific reporting formats, combined with greater security of tenure and access to markets from verifiable sourcing of product will lead to increased confidence in future fishery returns (e.g. resource rents) and reduced capital carrying costs.

5.3.2 Description of Direct Fisheries Benefits

Not all benefits arising from implementation of EFIS technology are easily quantifiable and so while this section tries to identify all major benefits, it should be noted that some benefits such as those leading to improved management outcomes leading to better pursuit of objectives can be difficult to quantify. While efforts have been made to quantify benefits where possible, in some instances the benefit is descriptively as opposed quantifiably identified. Moreover, benefits can be categorized as coming from both savings in costs and increases in revenues

The expected life of the EFIS systems, before replacement, has been assumed to be five (5) years which is pertinent to cost recovery options and is the timeline adopted for this CBA. Where relevant benefits (and costs) have been converted to Net Present Value (NPV)[97]. For the purposes of this NPV accounting exercise, a discount rate of 5-7% has been applied (Boston Consulting Group, 2016)

General benefits of Electronic Fishing Information Solutions (EFIS)

From data considerations alone there are a number of **opportunities** for benefits from the introduction of EFIS technology to commercial fishing fleets. The primary overall benefits stem from having an integrated digital collection of base data that delivers functional improvements in the nature of data gathering and of the storage and management of these data leading to the:

- Earlier availability of critical data in near real or real-time
- Better quality of data from “closed” systems (i.e. ET, EM) by elimination of human errors and “open” ER systems through standardized data entry
- Automation of specific data collection processes; and
- Opportunity and capability to collect a greater variety of data at higher spatial and temporal scale and integrate across fleets and jurisdictions

These factors result in **potential** benefits that can be understood in direct fisheries terms. From the list below, notably a) through g), the introduction of EM and ER in particular underpins overall improvement in data quality through greater reliability and accuracy in its collection, its integration across platforms and fisheries and availability in near-real or real-time, and its higher resolution. Via access to these better data, tangible benefits flow around the management of and participation in the fishery, compliance with various CMMs, enhanced sustainability outcomes through better

[97] Net Present Value is the current day value of an anticipated future stream of net benefits

science, safety in the working environment and improvements in industry efficiency from near real-time access to data and stronger tenure. [98]

[98] This is not an exhaustive list

Table 8: Potential direct fisheries benefits from adoption of EFIS, by benefit category

Potential Direct Fisheries Benefit	Benefit Category				
	Management	Compliance	Science	Safety	Markets
a) **Better quality and more comprehensive data to support management**. Will result in increased capability for more reliable catch monitoring, monitoring of more fishing events, improved capacity for integration of catch and effort data across individual fishing vessels and fishing fleets. This ultimately improves the scientific management process, and the sustainable management of fish stocks.	✓	✓	✓		
b) **Use of data standards for data entry, collection and management:** In the case of ER systems, they require all data types to be standardized in order to prevent data and unit ambiguities**.** Standards will allow data to be used in a consistent manner but for a variety of purposes including fishing vessel and fleet operations, fisheries management, regulatory use, marketing, and science applications. Adoption of eLog systems can provide the means for reducing data entry errors and speeding the flow of data to fishery managers.	✓	✓	✓		✓
c) **Contemporary fishery management requires high quality and (near) real time data**. In addition to the basic need to understand the status of fish stocks, fishermen and managers require access to accurate and timely information in order to participate effectively in modern management systems including monitoring and managing effort and catch uptake, catch sharing and precautionary and ecosystem-based management.	✓	✓	✓	✓	✓
d) The collection and practical **use of a greater variety and higher resolution of data** can be used to enhance a wide range of quantitative measures relevant for fisheries management (e.g. catch per unit effort, catch composition, capacity utilization, discards and/or bycatch, sustainable yields), and also raises new opportunities for management intervention across a range of topics.	✓	✓	✓		
e) The earlier availability of data means that **near real time management actions** become a possibility, e.g. bycatch avoidance systems	✓	✓	✓		
f) **Improved adequacy, transparency, and integrity of fishery information and management data.** "Closed" systems remove the potential for data manipulation. Both "open" and "closed" systems are auditable and can be set up to require multi-personnel signoff improving intra and inter-governmental transparency and reducing incentive for corruption	✓	✓	✓		

Potential Direct Fisheries Benefit	Benefit Category				
	Management	Compliance	Science	Safety	Markets
g) **Promote entrepreneurship and encourage innovation in data collection:** Consistent standards compelling industry to install electronic systems would empower governments to work with industry to further lower costs and help drive implementation of the newest technologies, including wireless communication, low cost tablets, and mobile devices. New and low cost technologies will motivate fishing firms, fleets, and the seafood industry to pursue innovative ways to collect and use their own fishery data. Industry can support development of systems that reduce costs and improve their business decisions.	✓		✓		✓
h) The capability is created for providing **better verification of chain of custody** and traceability and contribute to the reduction in IUU fishing, through the use of vessel tracking systems e.g., increasing the VMS coverage to all vessels landing	✓	✓			✓
i) **Reduce the "relative" and overall costs of fishery monitoring, control and surveillance:** Existing monitoring systems that provide necessary data for state and regional agencies are often inefficient, slow and expensive and restrict data-sharing. Currently available electronic reporting systems are capable of meeting the needs of the fleet while also fulfilling the monitoring requirements of regulators and resource managers, likely at a lower cost.	✓	✓			
j) **Improved targeting, planning and use MCS** as a result of enhanced access to data, some in near real-time (e.g. the near real time analysis of VMS data) and expediting of rapid integration of catch data across fishing vessels and fleets for cross checking purposes.	✓	✓			
k) **More effective and efficient deployment of surveillance assets.** Real time and consolidated data analysis would allow for a stronger focus on targeting higher risk non-compliance activities and areas violations leading to improved compliance at a lower relative cost, particularly for costly MCS systems such as those provide by aerial surveillance.		✓			
l) **Enhancing evidence and increasing success rate of prosecutions:** The ability to use evidence to support prosecutions reducing incentive for IUU and providing increased revenues for supporting MCS.		✓			

Potential Direct Fisheries Benefit	Benefit Category				
	Management	Compliance	Science	Safety	Markets
m) There is the potential for **savings in administrative manpower** costs due to the automation of data storage and transfer. This could help offset the existing lack of in-country regulatory capacity and potentially shift public resources to fill other needs including strengthening and improved M,C & S of these fisheries as well as data collection from under-reported fisheries, (e.g. in coastal fisheries).	✓				
n) **Reducing health and safety risk for both crew and on-board observers:** Through a combination of improved knowledge of weather events and visual safety checks, crew and observer safety will be enhanced while electronic monitoring can both improve observer safety and justify fewer on-board observer trips while maintaining required coverage rates.				✓	
o) **Improved collaboration between cooperating nations**: Compliance functions will be strengthened and voluntary compliance promoted, particularly in relation to catch and effort data as well as observer GEN 3 reporting.	✓	✓	✓		
p) **Automatic cross checks (alerts) to ensure data integrity:** Multiple and corresponding outputs can be overlaid and provide and rapidly identify current and potential future non-compliance activities across single and multiple jurisdictions.	✓	✓			
q) **Improved adequacy, transparency, and integrity of fishery information flowing into the seafood marketplace:** Better and more reliable information can help industry improve the public perception of the impact of seafood products on the environment, by supporting traceability, protecting against fraud and entry of IUU fish into the supply chain, facilitating market transactions through the seafood supply chain, and providing value to all market channel participants. Demand by retailers for "sustainable" sources of seafood is driving change in fishing practices on the water, and requiring improved documentation and traceability of seafood supply.. EFIS standards will help fisheries participate in fishery certification and to credibly market sustainable products		✓			✓
r) **Support fisheries collaboration and self-governance:** With better access to – and ability to use their own data in real time – fishermen may work collectively and in partnership with research institutions or non-governmental organizations to improve the management and performance of the fishery. Improved management that can secure long-term profits in the fishery will offer more certainty to industry and act as an incentive for improved compliance and self-regulation.	✓				✓

A properly designed central digital data store provides a focal point driving the activities of the entire fisheries management function at national and regional levels across administration, MCS, science and management. There are many potential positive internal spin offs including improved functionality within the workplace and better staff moral from new employment opportunities arising out of introduction of ER and EM. External spin offs include improvements in perceptions of the efficacy of fisheries management by, inter alia, international stakeholders. This may result in positive spinoffs such as maintaining access for seafood exports to international markets.

Based on experience in other situations and fisheries, the financial scale of benefits that improve compliance and the sustainability of fisheries, or which provide greater access to export markets, are generally orders of magnitude larger than the costs involved in deploying such solutions.

Table 9: Description of actual benefits (or cost savings) derived from adoption of ET, EM and ER by benefit category and including indicator of value attribution.

Category	Benefits/Costs Saving	ET	EM	ER	Indicator/ Value
Management/ Administration					
Vessel Day Scheme	Under manual reporting and 'tracking' system company's claim for over-proscribed Vessel Days. These have been as high currently as 30%-40%. ET/VMS providing real-time reporting of effort days improves the integrity of the system, providing a stronger basis to validate and verify NFD claims and assessment of days fished for PS VDS[99]. These claims supported by EM sensor data and reviews of visual recordings. High level scrutiny by PNAO of Tokelau claims, using ER, reduced average claim to 5%, when expected NFD claims are around 12%	✓	✓	✓	The expectation is that NFDs can be reduced to as little at 5-12% leading to a more efficient operating system, and generating more value from a day Better utilization of days allocated. "Backstop" days not required leading to improved revenues for national Governments Based on average days fished, reduction in costs to governments of NFD claim
	More efficient vessel day scheme markets improves government understanding of VDS discounts and day utilization rates in relation to catches when cross-checked against EM and ER Historically less efficient vessels have been subsidized as result of falsified vessel day claims. A more effective VDS will reduce possibility for fraudulent reporting, capping revenues and offsetting loss making of inefficient vessels	✓	✓	✓	Efficiencies realized in VDS strengthen long-term outlook and deliver higher market prices for vessel days on back of improved profitability (rents)
Employment Data storage, transfer and review	Increased efficiencies in administrative management systems and reduced manpower costs from automation of data storage and transfer reducing need for secondary data collation, entry and validation. Savings in administration and data review. Reductions in annual clerical support needs of private companies, fishery agencies and research organizations They do sample cross-checks		✓	✓	Minimal additional staffing needs. Reductions in current staffing time for manual data entry and review (cross-checks) with time-savings of between 50-60% allocated to other clerical needs – Data entry (e.g. VDS, catch, e-obs) verification – EVR and ELR and licensing time – eCDS validation Assuming staffing unchanged benefits estimated as time-saving (numbers staff x % time saved x cost/day) that can be allocated to other activities
	Redeployment of data entry staff to data analysis, verification and reporting leading to improved compliance and management outcomes (**see compliance and science below**) including increased revenue from prosecutions		✓	✓	Benefit calculation described under compliance below for inspectors Benefits from redeployment of data entry clerks captured via cost of time allocated to new tasks from time savings

[99] A Longline scheme is to be introduced in 2017 but in general Longline non-fishing days is not an issue as Longline vessels are fishing at all times they are in the region

Category	Benefits/Costs Saving	ET	EM	ER	Indicator/ Value
Observer coverage	Land-based reviewers are able to monitor 2.5 times the number of events than at sea. More efficient use of on land reviewers (monitoring 2.5 more events than at sea). Increase current observer numbers to review EM data. There will be an increase in current observer numbers to review and analyse EM data (based on an average of 5% ROP for LL vessels and equivalent 5% coverage of EM reports). Cost forgone from not having to employ on-board observers to lift Longline observer coverage (Currently 0%) to mandatory 5% ROP based on fact that without EM having on-board observer is only alternative For PS number of on-board observers stays at 100%, but with added 5% EM viewing as a secondary source of information		✓		There will be an increased number of analysts needed to review fishing events. However, these costs need to be offset against costs of meeting 5% on-board observer coverage Benefit is difference between number of on-board observers needed to meet 5% ROP coverage for 1,400 plus LL vessels, bunkers and motherships[100] and number of analysts/reviewers required to analyse EM fishing events based on 5% coverage of vessel totals extracted from Table 1. This is calculated as cost saving by multiplying difference by daily rate
	On-board reporting time by Observers reduced and available for monitoring of other catch and effort and compliance issues.		✓		Benefit calculated as time saved time by observers on on-board monitoring and reporting (% time saved x observer costs). Not quantified for this analysis
	e-Reporting facility for vessels entering EEZ sent to management agency for tracking via VMS	✓	✓	✓	
Compliance					
Deployment of surveillance assets	Improved compliance monitoring from targeting higher risk non- compliance activities and higher risk vessels (i.e. vessels of poor standing) ensuring up-to-date Vessel Compliance Index (VCI) data which leading to a reduction in IUU losses to region	✓	✓	✓	Deployment days/year and costs will not be reduced however integrated EFIS/VMS/AIS will provide efficiency gains, as measured by: – improved retention of economic rents from reduction in IUU – increase in number of successful prosecutions
	Cross-check/"Alert systems" to raise red flags on possible non-compliant vessel operation with cost savings generated from more strategic deployment of aircraft/marine vessel surveillance platforms to non-compliance “hot spots” (reduced fuel usage, fewer days at sea/in air, lower personnel costs)	✓	✓	✓	Deployment days/year and costs will not be reduced however integrated EFIS/VMS/AIS will provide efficiency gains and lowering of surveillance costs. Efficiency gains captured through estimates of retention of economic rent and increases in fine

[100] Transhipment or “Carrier” vessels require 100% observer coverages as per CMM 2009-06. These vessels treated as per PS vessels with no EM associated observer cost savings.

					revenues
Category	**Benefits/Costs Saving**	**ET**	**EM**	**ER**	**Indicator/ Value**
CMM Compliance and national licence conditions101.	Deterrent for non-compliance with CMMs and non-compliance with national license conditions (mainly for longline vessels) Improved verification of compliance/non-compliance with various CMM bycatch provisions and use of illegal gears (mainly for longline vessels)		✓	✓	Compliance benefit is transfer benefit from reduction in catches and sale of shark product (i.e. no wire tracers on LL vessels) as benefit of improved non-voluntary compliance
Transhipment and Bunkering	ER and EM (e.g. sensors) can provide verification of catch volumes and species composition and vessel activity (e.g. fishing days) during transhipment at sea and bunkering.	✓	✓	✓	Reduced occurrence of illegal transhipment at sea (IUU) leading to regional retention of higher economic rents and increases in fine revenues Increased in # of port transhipments would lead to increased employment and port fees, although this is not quantified in this analysis
	EM is a backstop to deter observer corruption and verify observer reliability leading to a reduction in IUU		✓		Using estimate of reduction in observer corruption and estimated value of IUU, allow for a reduction in value of IUU of between 10-30% and associated retention of economic rents (MRAG, 2016)
In-port MCS inspection process	Improved timeliness and quality of EM and ER data – VMS positions – Electronic Vessel Register and Electronic Licensing Register, including other PNA country details – Log-sheets on catch, species composition and days fished (VDS) – Observer reports on catch, vessel activity – Observer Gen 3 report – CMM reports able to be cross-checked against real-time VMS data for vessels before coming into port to identify discrepancies in data sources, improve pre-inspection reporting and identify non-conformity issues for purpose of targeted on-bard inspections Identification of non-compliance with CMM reporting requirements (see CMM	✓	✓	✓	More effective deployment of in-port inspectors targeting "at-risk" vessels leading to increased verification of non-compliance and an increase in number of successful prosecutions (i.e. increased fine revenues)

[101] See section 3.2.3 on CMM and MTC reporting requirements

	compliance below)				
	Cross checking improves verification of "non-fishing day" claims	✓	✓	✓	See above with respect to reductions in costs to government for repayment of NFDs.
Category	**Benefits/Costs Saving**	**ET**	**EM**	**ER**	**Indicator/ Value**
Collaboration and Voluntary compliance	Transparent, auditable and integrated systems will: – enhance the use data as evidence to support prosecutions – reduces the potential for corruption Higher levels of collaboration between cooperating nations will – strengthen trans-boundary compliance functions – Improve evidence to support prosecutions, and – Strengthen pre-inspection and likelihood of securing an offence	✓	✓	✓	Strengthened likelihood of successful prosecutions will lead to increased revenues. Double prosecutions at an average fine of $250,000
Science and Sustainability					
	High quality information from various data sources will now be available[102] in a more timely manner to support annual stock assessment reporting needs specifically through access to: – VMS data on effort – Log sheet catch and effort data – Observer reports – Catch landings and port sampling data (i.e. length/frequency) More reliable data leads to more accurate assessments and improved confidence limits around setting of catch and effort targets and reference points	✓	✓	✓	More reliable setting of TACs (i.e. increases in vessel-days) could lead to improved economic returns to industry (i.e. profit maximization under MEY v MSY) and increased rents to CCMs
	Strengthen data availability in real-time in support of e-logbooks and e-observer data, specifically on IUU, by-catch and ETP		✓		Measurement of improved economic returns to CCMs

[102] Historically with the use of manual data entry and reporting systems, significant portions of log-sheet data and observer reports have not been available in time for annual assessment leading to need to undertake assessments with incomplete data sets

	Significant reduction in manpower needs for verification, validation and checking of data prior to its use in stock assessments. Better quality data improves the scientific management and potentially less conservative precautionary limits on catch (i.e. improved confidence in stock assessment)	✓	✓	✓	Reduction in time spent by scientists for verification, validation and checking of manually entered data to ensure high data quality for use in stock assessment. This will allow for more efficient allocation of labour (i.e. time savings and task redeployment)
	Near real-time and more accurate information such as real time reporting (i.e. track vessel days) providing more reliable data for strengthening management of effort and catch	✓	✓	✓	Increased certainty in long-term allocation of allocated fishing days will strengthen tenure rights potentially leading to an increase in Vessel Day's market values[103] and increased revenues to PNA

Category	Benefits/Costs Saving	ET	EM	ER	Indicator/ Value
Health and Safety					
Crew and Observer safety	Skippers will be able to check on weather conditions to improve crew and observer safety	✓	✓	✓	Reduction in potential loss of life calculated from a review of existing literature on the "value" of a human life
	On-board cameras can increase observer safety (mainly on PS and Transhippment vessels where observer coverage is 100%[104]		✓		Reduction in potential loss of life calculated from a review of existing literature on the "value" of a human life
Markets & Traceability					
	EM and ER verifying set type for Purse-seine (i.e. free-school) for chain of custody supporting traceability and CoC claims through: – e-log-sheet and e-observer data including unloading and transhipment recording – electronic catch certificate to validate catch (iFIMs)		✓	✓	Certified Free-school price per ton is approximately-20% higher than equivalent FAD price. Also some benefit obtained from savings in meeting CoC and traceability requirements using current manual reporting system
	Improved efficiency from real-time transmission of FAD sonar data to inform fishing behaviour in term of FAD setting		✓	✓	Improved CPUE leading to increased industry economic returns, VDS value and CCM returns

[103] At current prices, a 10% increase in Vessel Day values would generate an additional US$44,500,000 in access fees

[104] LL observer coverage is close to zero. Benefits from installation of EM in LL addressed in Administration and Management as a saving on on-board observer coverage of 5-10%

	Sourcing from certificated fisheries or fishery improvement projects will provide greater security of tenure and guarantee of market access thereby reducing costs of capital		✓	✓	Reductions in costs of capital calculated on basis of decrease in rate interest applied to borrowings

5.3.3 Quantification of Direct Fisheries Benefits

In quantifying potential benefits, benefits, unlike costs have not been calculated by electronic system but rather as a package. The rationale for this has been the challenge of attempting to proscribe specific benefits to ET, EM or ER when these benefits are more likely to accrue from installation and operation EFIS solutions overall. Benefits have thus been calculated by category as described in Table 8 and Table 9, above.

Table 10 below, summarizes the total quantifiable benefits that would be realized in the event of wide adoption and installation of EM and ER systems onboard WCPO vessels. For each benefit, an upper (high) and lower (low) estimate has been derived. In some cases such as with efficiency gains in employment and compliance with ETP and by-catch CMMs, a single value has been allocated.

Table 10: Summary of total annual benefits derived from installation and operation EFIS solutions.

Benefit category/source	Lower	Upper
Validation Non-Fishing Days (NFD) claims [1]	$ 34,710,000	$ 66,750,000
Observer Deployment and Coverage savings [2]	$ 639,600	$ 1,294,800
Efficiency Gains in National Employment	$ 2,312,050	
Non-compliance detection and prosecutory fines [3]	$ 10,750,000	$ 21,250,000
Improved Compliance with ETP/Bycatch CMMs	$ 1,245,000	
Improved Compliance with Transshipment CMMs (IUU) [4]	$ 13,325,165	$ 26,650,330
Improved Occupational Health & Safety [5]	$ 529,700	$ 626,600
TOTAL BENEFITS	**$ 63,422,465**	**$ 119,950,810**

[1] Lower and upper benefit levels are based on a reduction in NFD claims 5% and 12% respectively

[2] Lower and upper benefit levels are based on 5% and 10% observer coverage rates respectively

[3] Lower and upper benefit levels are based on increases annual infringements successfully prosecuted of 50% and 100% respectively

[4] Lower and upper benefit levels from retention of economic rents are based on IUU reductions of 10% and 20% respectively

[5] Lower and upper benefit levels are based on a remaining working life of 20 and 30 years respectively

5.3.3.1 Management and Administration

Validation of Vessel Days and Non-Fishing Days

Vessel days form the core system to manage the purse seine fishery. Historically, claims for non-fishing days (NFDs) have partially processed with access to VMS data, but without the levels of accuracy now provided by the ER verification modules. Adoption of ET/VMS, EM and ER will reduce claims for 'validated" NFDs.

Assumptions:

- The total number of fishing days available for sale in 2015 under the PNA VDS for purse seiners was 44,623 days. Archipelagic days are added for PNG and Solomon Islands @ 5,500 and 1,000 respectively (51, 123 days)
- The 267 PNA purse seine vessels fish an average of 191 days per annum. Historically, NFD claims for some vessels have been as high as 30% (51 days) but for purposes of this analysis have been averaged at 20% (34 days)

- Access to near real-time data from EFIS has been estimated to reduce NFD claims to ~12% (21 days) and as little as ~5% (9 days)
- Overall this will potentially deliver and reduction in the number of annual NFD claims by between 3,630 and 6,800 days and a concomitant increase in revenues of national governments (Table 11)

Table 11: Estimate of additional benefits from strengthened verification of NFD claims.

No. PNA Vessels	No. Days Fished	Adjusted NFD Claims/Vessel		Additional Revenues ($M/p.a.)	
		Upper (5%)	Lower (12%)	Upper (5%) (US$)	Lower (12%) (US$)
267	191	25	13	$ 66,750,000	$ 34,710,000

A more effective VDS that reduces the possibility for fraudulent reporting, could result in the retirement of inefficient, potentially loss-making, vessels increasing the number of available days per vessel under the total 'capped' fishing days and potentially reducing NFD claims even further.

Observer Deployment and Coverage

Benefits from the installation of EM will come almost entirely from more effective coverage on ***Longline vessels***. Under the WCPFC *Regional Observer Programme* (*ROP*), 5% observer coverage is considered acceptable for LL vessels; however higher observer coverage targets are noted for Eastern Tuna Billfish Fishery (8.5%) and Small Pelagic Fishery (10%) managed by AFMA. Furthermore, scientific advice recommends coverage of up to 20% as a desirable. For the purposes of this analysis we have examined cost savings under 5%, 10% and 20% scenarios.

Despite ROP recommendation, placement of human observers onto LL vessels is acknowledged as problematic for a variety of reasons (Dunn and Knuckey). Regardless, the quantifiable 'net' benefits from EM would come in the form of cost savings to industry from the replacement of onboard observers with analysts reviewing EM data. The costs of an observer program would typically be borne by industry and in the case outlined here of substituting on-board observers with analysts, it is assumed industry would retain responsibility for these employment costs, likely as part of a full-cost recovery plan[105].

Using current estimated observer coverage of WCPFC LL vessels the "minimum" overall benefit can be calculated as the difference between the numbers of on-board observers that would be needed to meet 5% ROP coverage and the number of analysts needed to review EM fishing events of 5% of vessels in the WCPFC LL fleet.

Assumptions:

- The total number of on-board observers (i.e. number of vessels) required at 5%, 10% and 20% observer coverage rates is calculated based on a total of 1,351 LL vessels (Table 1). Observers are charged out at $65/day
- Numbers of analysts required to review EM footage at 5%, 10% and 20% equivalent observer coverage is derived as follows
    - Vessel numbers per observer coverage target multiplied by an average annual set days (N = 230) gives estimate of total number of sets

[105] AFMAs model is for government to install hardware and software, with costs recovered under annual industry surcharge

- Analysts are employed for 242 days/year at $65/day and are able to review on average 2 sets per day

- Benefits calculated as difference between costs of employing onboard observed and costs of employing sufficient analyst/reviewers to achieve equivalent target vessel observer coverage rates (Table 12)[106]

Table 12: Estimate of additional benefits calculated as difference between on-board observer and on-land reviewer requirements to meet desired observed coverage rates

	Observer Coverage Rates		
	5%	10%	20%
Number on-board Observers	68	136	271
Number Analysts/Reviewers	33	65	129
Total Annual Cost Savings	**$ 550,550**	**$ 1,116,830**	**$ 2,223,660**

Achieving observer coverage targets via EM as opposed on-board observer coverage, results in significant benefits (cost-savings) to industry. Another way of illustrating these benefits is to look at marginal costs associated with increased observer coverage. For on-board observer coverage, the marginal costs of additional percentage point of coverage is approximately $210,750 per year as compared with a marginal cost for EM of around $80,800 per year, resulting in a potential *cost saving* of $129,950 for every one percentage point increase in required observer coverage.

It's important to reiterate that costs savings are being calculated here on the basis that fewer analysts are required to review EM footage than are needed as on-board observers to meet ROP coverage rates. Some critics may posit this as an overly simplistic comparison, and the authors acknowledge that EM cannot entirely replace human observers, and there may be additional on-costs associated with employing analysts which we have not been able to include here (see below under *Efficiency Gains in National Employment and Data Uploads)*. Regardless, when implemented, EM will deliver significant savings, along with vastly improved coverage of LL fishing vessel activities. One final point to make is that of who shoulders the cost burden. Regardless of whether costs are being shifted from vessels to a land-based activity, the assumption endorsed here is that costs are still to be borne by industry, as direct payments to the responsible authority, and thus recognized as costs savings to industry. This issue is revisited below as an example in section 6.4 on Cost Recovery pathways.

For ***Purse Seine vessels***, any analysis must consider only those 267 vessels within the PNA, which are also registered under the FFA Vessels of Good Standing. Of the remaining vessels, some are Indonesian and Philippine vessels and observer coverage requirements for these are excluded. Based on an existing observer pool of 500 persons, and 100% observer coverage on PNA vessels, observer utilization rates are approximately 55%.

While on-board observer coverage for the PS fleet is at 100%, EM coverage of 5%, as per ROP requirements, is still considered desirable as a means of validating observer reporting, enhancing observer security and improving the overall quality of outputs. Based on the following assumptions:

- Overall fishing days comprise total allowable vessel days under the PNA (44,600) plus estimated fishing days in Archipelagic Waters out of Papua New Guinea (5,500 days) and Solomon Islands (1000 days); a total of 51,100 fishing days.

[106] In Benefit Cost Analysis, savings on labour costs from technological advances is an accepted measure of private benefits (Hutton and Haller, 2004; Sugden and Williams, 1978)

- Using a 5% ROP observer coverage, and based on average fishing days per vessel of 190 set days annually and reviewer capacity of 2 sets per day, it is estimated only 5 additional reviewers will be needed to analyze EM data

In practice while it may be possible to recruit from the estimated 45% of observers not being utilized at any given time, there will be a need to maintain the observer compliment at current levels. As such, increased resourcing needs will likely be drawn from the existing administrative pool existing administrative pool through training and upskilling of current staff (see below). .

Efficiency Gains in National Employment and Data Uploads

There are two types of benefits attributable to EM and ER impacts in terms of national employment. The first of these will be efficiency gains in labour bought about by opportunities to reallocate time saved to other management and administration tasks. Second, will be that the adoption of ER will deliver higher quality data and present new opportunities for forensic data analysis and associated investigation. While recruitment of new "compliance" staff represents a cost incurred by national governments and/or industry, this needs to be offset against benefits that may accrue in the form of increased number of non-compliance violations successfully prosecuted and reductions in IUU. Both these benefits have been quantified below (see below).

Evidence suggests there will be minimal additional staffing requirements to support ER, since dedicated positions are already assigned to licensing, logbook reporting, inspection and observer functions and validation of vessel days and catch documentation (see Table 4). The value or benefit will arise from increased efficiencies in administrative and data management systems and through automation of entry, storage and transfer of data. These time savings are valued as a % of wages.

There are challenges in directly quantifying benefits stemming from reductions in current staffing time needed for manual data entry, reviews and cross-checking of different data sources and validation. Benefits may be calculated however from the potential reallocation of existing staff toward other duties through upskilling and training, increasing the value of their outputs overall. In addition to efficiency gains from reallocation of staff time, there will also be savings on office supplies and postage costs associated with manual forwarding of observer modules, which will now be transmitted electronically (i.e. e-observer forms) generating a costs saving. Benefits arising from reallocation of resources that improve compliance monitoring and likelihood of prosecution success are dealt with below.

Assumptions:

- Based on feedback from national organizations in PNG and the Solomon Islands, automation from EM and ER can deliver time savings of between 50-60%. In calculating benefit estimates, a conservative efficiency gain of 50% has been applied
- With overall staff numbers unchanged, time saving estimates based on % of FTEs that can now be allocated to other activities with benefits calculated from *existing numbers staff* x *FTE days saved* x *cost per day*). Staff are assumed to be employed for 240 days/year at $50/day
- Observer numbers (see Table 4) have been excluded from these benefit estimates, having been quantified in Table 11 above.
- Fishery inspectors are included on the basis that EM and ER will augment port inspectors capabilities (i.e. increased vessel inspections, targeting of 'at risk' vessels), while non-compliance benefits from more effective deployment of inspectors (i.e. more prosecutions) addressed below (Table 13).

Table 13: Estimate of additional benefits from reallocation of employment resources

	PNG [1]	Solomon Island [2]	Remaining PICs [3]
FTEs re-allocated	27.5	17.0	120.0
Value of efficiency gains (US$)	$ 332,750	$ 205,700	$ 1,452,000
E-observer administrative cost savings (US$)			$ 321,600[4]
Total Annual benefits/cost Savings			**$ 1,773,600**

[1] Employment information provided by National Fisheries Authority (NFA)

[2] Employment information provided by Ministry of Fisheries and Marine Resources (MFMR)

[3] Fiji, Vanuatu, Kiribati, Federated States of Micronesia and Republic of Marshall Islands assumed to have staffing numbers equivalent to Solomon Island. Remaining ten (10) Pacific Island countries have been assumed to have staffing of between 40-50%, with 40% used for the purposes of this analysis.

[4] Byrom Pers Comm, December 2015. This figure is only slightly higher than the estimate from the Technical and Compliance Committee report of Data Entry costs (WCPFC-TCC7-2011/16)

There are concerns that moving to EM and ER will alleviate the need for manual loading of observer data, as is currently the case, although no estimates on possible job losses from the existing cohort of data-entry staff were available. It is expected that there will be some delays on the adoption and roll out of e-observer modules. Moreover the authors would anticipate there is still a need for some data verifiers. It would be preferred that redundancies occur via natural attrition over a timeline consistent with the adoption and roll-out of the e-observer modules

5.3.3.2 Compliance

Compliance benefits will be realized as a result of

a) Integration of existing VMS/AIS and SAR technology with EM and ER to more efficiently deploy surveillance assets to proactively target known non-compliance “hot-spots” and associated “dark targets”

b) Integrated EFIS solution that increase the effectiveness of in-port inspection activities during vessel offloads and transshipments.

While EFIS solutions will generate cost efficiencies and savings (i.e. benefits) both for air and vessel surveillance through more efficient asset deployment and in-port-inspections these are difficult to quantify without deeper investigation. For the purposes of these analyses, these efficiency-related benefits have been quantified via their contribution to increased fine revenues and retention of economic profits, previously lost to the region through IUU fishing (see below).

In addition to the more straightforward, measurable benefit from increased fine revenues, the strengthened EFIS solutions would have the effect of “deterring” non-compliant behaviour. Measuring this deterrent benefit directly is problematic. One way of quantifying this deterrent effect would be to attach an opportunity cost or “shadow-price” value equivalent to the penalty imposed for violations.

It is expected that ER and EM will strengthen the VCI, which if used appropriately could identify systematic offenders. Acknowledging and valuing the deterrent effect in this way will compensate for possible over-valuing of benefits from more successful prosecutions and justify those estimates in this analysis.

Deployment of Surveillance Assets

FFA is currently the responsible organization for monitoring IUU activity using a combination of QUAD nation aerial surveillance[107], contractor aerial surveillance on a limited basis, vessel-based patrols provided by FFA member nations and Satellite based surveillance monitored by the RFSC to track and analyses vessels AIS and/or VMS transmissions. Current surveillance methods are regarded as being not fully effective in monitoring IUU activity and only identifying a small percentage of the actual IUU activity occurring in the WCPO (MAG, 2016)[108]. As noted in this report, aerial surveillance is conducted during four scheduled, mutually agreed periods at beginning and end of year resulting in a significant gap in aerial coverage. Average EEZ coverage is estimated at 15% with 85% of the FFA EEZs not searched for the presence of 'dark targets' (vessels without AIS or VMS) (MAG, 2016). While seemingly low levels of non-compliance are attributed minimal (~15%) surveillance coverage, this overlooks the fact that IUU risks are confined to specific areas where surveillance craft are directed. In reality, unlicensed fishing itself is not high and benefits will be realized by improving deployment efficiencies.

Specific activities associated with IUU fishing that would benefit from a more effective air and sea surveillance program include, high seas unregulated fishing, estimated to 'cost' FFA members around US$6 million annually, illegal transhipment at sea and catch aggregation estimated to represent an "economic loss" to the region in excess of US$130 million annually and illegal setting on FADs, facilitated by observer corruption (MRAG, 2016) and misreporting inside and out of zone.

While there are emerging technologies (i.e. VMS, AIS, SAR) aerial surveillance will continue to be an essential activity for validating these electronic indicators, for positively identifying IUU vessel activity and for verifying the data for prosecution purposes. These technologies will be enhanced by improved integration with multiple EFIS solutions.

The application of EM and ER will further enhance the capacity for assessing compliance performance of each vessel leading to identification of higher risk vessels and more up-to-date VCI data. Realizing these benefits will require compulsory installation of these systems, particularly on LL vessels. The capability for integration of data from satellite surveillance systems (e.g. VMS, AIS) with EM and ER systems in near real-time reporting will enable cross checks to identify the possible non-compliant vessels and will lead to more strategic and effective deployment of sea and air surveillance assets to non-compliance "hot-spots" and should result in a reduction in IUU and increase in prosecutions.

Assumptions:

- Costs of deployment of aerial and vessel surveillance will remain fixed at levels determined by FFA, and based on structure of surveillance systems (i.e. fly-in-fly-out or regionally based) to achieve recommended EEZ coverage (MAG, 2016).
- Integration of EM and ER with existing surveillance tools (VMS, AIS, Satellite surveillance) will improved reporting and risk assessment and assist in identifying priority areas and at-risk vessels for targeting of available deployment days for air and sea surveillance assets
- With fixed surveillance costs, benefits from more efficient deployment of surveillance assets will be realized in form of
    - A reduction in revenues lost to IUU fishing and improved retention by pacific Island nations of economic profits (see below)

[107] QUAD nations are estimated to be providing in excess of US$10 million of surveillance activity annually

[108] Momentum Aviation Group (2016) Fisheries Surveillance Aerial Patrol Study: Feasibility and Costs and Benefits. Draft report prepared for Forum Fisheries Agency

  - An increase in the number of successful prosecutions, and subsequent fine revenues (see below)
  - An increase in the deterrent effect, valued using an opportunity cost approach to quantify benefits as equivalent to additional fines revenue, were these offences to have occurred.
- This will result in a lowering of the ratio of surveillance costs to benefits

In-port MCS inspection process

Currently, MCS boarding and inspection parties have a limited timeframe on-board a vessel in which to collect information that would form basis of any compliance actions (i.e. roughly 4 hours). Most successful compliance operations require multiple information sources mutually highlighting and supporting non-compliance. Having access to only VMS data, as is currently the case, and a reliance on manual manipulation and analysis of data to highlight non-compliance, presents significant logistical hurdles.

These administrative management systems will be strengthened through integrated EM and ER platforms that provide more timely and accurate data to port inspectors. Access to multiple data sources (e.g. VMS, Electronic Vessel Register and Electronic Licensing Register, e-logsheets, e-observer reports and CMM reporting) will enable near real-time cross-checking to identify potential discrepancies and non-conformity issues prior to port inspections. In-port inspection processes and prosecutions for violations of IUU and CMMs will be assisted by enhanced data collected from improved aerial surveillance program (see above).

Port inspectors will be able to target most 'at-risk' vessels and the higher likelihood of identifying and verifying compliance breaches. Potential benefits will be realised in the form increased prosecutions and fine revenues.

Assumptions:

- The number of offenses detected each year is approximately five (5) per country or around 85 offences across all countries.
- Historically fines range from US$ 50,000 to US$ 1,000,000. For the purposes of estimating additional fine revenues, average fines are assumed to be in the order of US$ 250,000
- More effective surveillance combined with improvements in on-board EFIS solutions will lead an increase in the number of successful prosecutions of between by 50% – 100% in the first 1-2 years after implementation of EM and ER with an attendant increase in fine revenues received by FFA member nations. Increased revenues could go into strengthening MCS activities (Table 14).
- It would be expected that in longer term with improved MCS systems and improved evidence to support prosecutions the incidence non-compliance behaviour would decline along with the number of annual prosecutions and resultant fine revenues.

Table 14: Estimate of additional benefits from increases in detection of non-compliance, successful prosecution of offences delivering additional fine revenues

	Additional annual infringements prosecuted		Additional annual fine revenues (US$)	
	50%	100%	50%	100%
Non-compliance detection [1]	43	85	$ 10,750,000	$ 21,250,000

[1] These estimates are for years 1 and 2, following adoption of EM and ER. The total number of violations/infringements identified would likely decrease over time due to the positive compliance impact of EFIS solutions

Despite a reduced risk of non-detection of non-compliance, there will be no reduction in need for port based inspections, although efficiencies in port-based inspections from existing staff will be realised (i.e. in the form of targeted inspections and an increased number of inspections. These efficiencies have been accounted for above.

Improved Compliance with ETP/Bycatch CMMs

Lawson (2011)[109], estimated that the purse seine fleet caught an average 53,000 oceanic white tip and silky sharks from 20°S to 20°N and 130°E to 210°W, in the years 1995-2010. These catches are a large part attributed to FAD related fisheries (Pilling, SPC, pers. comm., 2015). The corresponding observed catch by long-liners is in the region of 30,000 species (Clarke *et al*., 2011), a total in excess of 83,000 individuals.

Comparisons between observer data and video data has shown that important catch information relating to the presence of large animals such as sharks can be missed where the reliance is on video data alone (Diver 2011)[110], as would likely be the case with longline vessels. Anecdotal evidence suggests observer corruption around misreporting of fishing on FADS in return for a monetary incentive is not uncommon (WCPFC, 2012). A recent report by Clarke et al (2011) noted significant gaps in observer data in terms of reporting rate and identification of sharks. Trials of electronic technologies have indicated that they can resolve some of these issues (McElderry *et al.,* 2010) and will likely positively influence fishing activities to mitigate shark catches, including on longline vessels with no on-board observer coverage.

Habitat, gear technology, gear deployment and handling and post-capture release procedures combined will both influence overall catch rates and can contribute to reduction of shark bycatch where mitigation measures employed. Reductions in Oceanic and Silky shark catch from wider application of shark bycatch mitigation measure in longline fisheries have been estimated to be in the order of 20-40% (Curran, 2014[111] ; Watson, J. and Bigelow, 2014[112]).

Assumptions:

- Benefits are measured by the market value foregone from the sale of shark. Short-fin mako and small requiem sharks such as the Silky and oceanic whitetip sharks are a higher value species and fetch around US$50 per fish in key Asian markets, the destination of most Pacific caught shark;
- EM and ER incentivize increased compliance with CMMs that could lead to a reduction in catch of Oceanic and White Tip shark of approximately 30% (Table 15).

[109] Lawson, T. (2011), Estimation of Catch Rates and Catches of Key Shark Species in Tuna Fisheries of The Western and Central Pacific Ocean Using Observer Data. https://www.wcpfc.int/system/files/EB-IP-02%20%5BEstimation%20of%20Catch%20Rates%20and%20Catches%20of%20Key%20Shark%20Species%5D.pdf

[110] Diver, G. (2009) Development and cost-benefit analysis of an electronic observer system to monitor a remote small vessel commercial fishery. FRCD Report: 2009/048.20

[111] Curran, D. (2014) Shark Catch in Pelagic Longline Fisheries: A Review of Mitigation Measures. WCPFC-SC10-2014/ EB-IP-11

[112] Watson, J. and Bigelow, K. (2014). Trade-offs among catch, bycatch, and landed value in the American Samoa longline fishery. Conservation Biology. 28(4):1012-22

Table 15: Estimate of additional benefits from improved CMM compliance and reduction catch of Oceanic and Silky Sharks[113]

Estimated Catch	Value (US$)	Reductions in Catch	
		Individuals	Value (US$)
83,000	4,150,000.00	24,900	1,245,000.00

Improved Compliance with Transshipment CMMs

Purse seine vessels are subject to 100% observer coverage and transshipments occur in either designated Pacific Island ports, via direct offloads into one of several non-Pacific Island ports or as offloads direct to Pacific Island processors (McCoy, 2012). In contrast, almost 80% of Longline caught product is transshipped at sea with the remainder being offloaded in key designated ports. Despite 100% observer coverage and compulsory in port transshipments, PS vessels account for a significant volume of IUU product related to underreporting and FAD fishing misreporting; not to unlicensed fishing. Current monitoring arrangements (observer coverage, low log-sheet submission, inadequate dockside inspections) are weak, undermining stock assessment and CMM compliance.

Integrated ER and EM (e.g. sensors) can strengthen monitoring throughout the supply chain but critically, in terms of IUU, at the transshipment phase, including monitoring of bunker vessels, and in support port inspections and verification of catch. A corollary to improving in-port inspections is the increased likelihood of identifying non-compliance and subsequent successful prosecutions (see above). Additionally, new technologies are becoming available that are capable of linking SAR images, typically used to support asset deployment (overflights or patrol boats), to a vessel's specific AIS and, if available, its VMS records. This cross-correlation of SAR with VMS / AIS will help identify potential IUU "hot-spots" and fishing activities. This would include reducing occurrence of illegal transhipment at sea.

In terms of quantifying benefits that can be generated from reducing IUU, EFIS provides incentives for the reduction in IUU fishing, linked to the likelihood of greater and more successful prosecutions for non-compliance. Moreover, because EFIS modules (i.e. CDS) have the capability for supporting better chain of custody verification and traceability market benefits can be estimated on the basis of the extent to which IUU is reduced (i.e. more product is flowing through legal market channels).

Simulations undertaken have estimated that the total volume of product illegally harvested and/or transshipped in pacific tuna fisheries is around 257,000t with an estimated value, based on species composition and markets, of approximately US$568 million (MRAG, 2016)[114]. Estimating of revenues foregone simply as the value of IUU is not a good indicator of losses to FFA countries as only a proportion of total revenues will be returned to coastal states and that will be realized under an efficient access fees arrangement (Banks, 2015). Foregone rent or 'economic profit' is better basis on which to estimate benefits from reduced IUU. Banks (2015) has calculated a Net Profit Margin (NPM) for both PS and LL vessels

Assumptions:

- Estimated value of lost revenues from IUU fishing is US$568 million across PS and LL fleets
- Net Profit Margins (Economic Rent) for Purse Seine (of 43%) and Longline (of 14.5%) are used to derive rent foregone (Banks, 2015)

[113] Estimated benefits are derived using known market values, an accepted convention in Benefit-Cost Analysis, precluding the need to use "shadow" pricing. As oceanic species, no additional dive tourism associated benefits have been considered (Dreze and Stern, 1990).

[114] MRAG (2016) Towards Quantification of Illegal, Unreported And Unregulated (IUU) Fishing in the Pacific Islands Region

- A percentage reduction in IUU can be converted to "reclaimed" revenues and to recaptured rents, the latter returned to states as increased access fees;
- Estimates are based on reducing current levels of IUU by 10%, 20% and 30% respectively across both PS and LL sectors as a result of adoption of EM and ER systems (Table 16) that:
  - reduce observer corruption and misreporting
  - Improve in-port inspections and verification

Table 16: Estimate of additional benefits from improved CMM compliance and reduction in IUU

Total IUU Value (US$) (ex-vessel)	Potential Losses (US$) "Economic" Profit	IUU Reduction/Regained "Economic" Rent (US$) [2]		
		10%	20%	30%
$ 568,070,000	$ 133,251,654 [1]	$ 13,325,165	$ 26,650,330	$ 39,975,496

[1] It has been estimated that aerial surveillance alone could help reduce this based on total value lost to IUU by approximately 25% or US142 million, although this estimate is considered quite conservative (MAG, 2016).

[2] An effective aerial surveillance system would cost between US$12 – US$17 million annually (MAG, 2016). On the basis of potential increases in economic rents retained by 20%, this investment would be recovered

The calculations presented here are estimates only of "possible" benefits derived from a reduction in IUU bought about by the adoption of EM and ER. Estimates of impacts from increased throughput of 'legal' and reported catches into designated Pacific ports in form of revenue to national government from port access/unloading fees and increased employment have been excluded. Likewise, indirect or flow-on impacts that would come from increased investment in port infrastructure, and associated job creation and multiplier impacts from increased local expenditures have not been estimated. Such estimates would require further analysis using generalized input-output modelling techniques.

Despite these somewhat "arbitrary" benefit estimates, the key takeaway here is that even a 10% reduction in IUU will recapture a significant amount of economic rent, in comparison to the costs of installing EM and ER systems.

5.3.3.3 Occupational Health & Safety

Fishing remains a very dangerous working environment due to a moving, unpredictable and often wet and slippery work platform, an unpredictable environment, and the use of heavy equipment. Despite extensive safety training likely to be delivered to observers, accidents are likely and occasionally death is a possibility. Furthermore, the observers compliance role can often place them in uncomfortable situations with respect to the skipper and crew if a compliance breach occurs and is to be reported. The need for quick and reliable methods of both emergency and routine communication between the observer and their employer are becoming increasingly relevant.

Electronic monitoring and reporting systems can help lessen health and safety risks for both crew and on-board observers through a combination of improved knowledge of weather events and visual safety checks. Moreover, EM can help improve observer safety by providing a deterrent to the possibility of retributive actions against the observer by ship's crew. Improvements in onboard safety are likely to be specific to Purse Seine vessels, where observer coverage is 100%[115] as opposed to longline vessels with currently less than 3% coverage by on-board observers. In the case of longline vessels, EM, in combination with ER, can negate the need for on-board observer trips, while maintaining required coverage rates (i.e. 5% ROP)

On average, reports indicate one (1) observer has died each year for the past four years, although this number could be higher. A possible way of estimating the benefit of EM, in terms of observer

[115] LL observer coverage is close to zero. Benefits from installation of EM in LL addressed in Administration and Management as a saving on on-board observer coverage of 5-10%

safety would be to attach a value to the loss of an observer life. Despite a considerable body of research, the "valuing" of a human life has proved a challenging and divisive pursuit. Mostly, economic principles such as *wage hedonic approaches* and *stated preference methods* have been used (Viscusi and Aldy, 2003)[116]. While estimates used vary considerably, a number of US-based government agencies proscribe values ranging from $5-$10 million, although these high figures tend to be designed to avoid drawn out legal proceedings. Sadly, legal precedent has clearly decided that the value of a human life is determined by the age and years of working life left as well as income. Theoretically speaking this means that a person whose annual income is $100,000 has a "life value" five times that of a person earning 20,000 p.a. (the average wage of an on-board observer). The most recent study conducted by researchers at Stanford University has calculated the average value of a year of quality human life to be between US$50,000 and US$129,000. Given comparatively lower income levels of on-board observers, the lower estimate would seem more appropriate.

In addition to lessening of safety risks for observers and crew alike, that could ultimately save lives, EM is a potential deterrent against physical abuses inflicted upon, or encountered by foreign crews on internationally flagged vessels (Philip Lens, NFA, pers. comm., November, 2015).

Assumptions:

- The installation of EM and ER on board specifically PS vessels will avoid the loss of at least one life per year
- For the purposes of this report, human life is valued based on average value of a year of quality human life (US$50,000);
- A net present value approach has been adopted using a standard discount rate of 7% to applied to an average working life remaining of either 20 or 30 years (Table 17);

Table 17: Estimate of additional benefits from reduction in loss of human lives

Value of year of human life (US$)	NPV of human life based on average working life remaining (Years)	
	20 Years	30 Years
129,000	$ 529,700	$ 626,600

5.3.3.4 *Traceability and Markets*

As previously acknowledged, EFIS are providing solutions for transforming real time electronic data into near real time knowledge to assist fishery managers and industry to better manage harvests and reduce bycatch and discards, increase vessel performance and improve stock assessments, among others. Improved scientific information and data quality allows for reduction of uncertainty and more accurate setting of total allowable catch and effort levels..

A readily acknowledged benefit of EFIS solutions is improvements in traceability through electronic catch monitoring (i.e. eCDS), that can be used to reinforce sustainability claims and deliver increased benefits through accessing those markets that embrace seafood eco-labels and independent certification schemes such as the Marine Stewardship Council (MSC) that afford price premiums. It may also be possible for cost savings to be generated through simplification and alignment with environmental auditing and chain of custody processes

While not attributing the benefit wholly to EFIS, its contribution would be realized from the role EFIS, including traceability, can play in instilling confidence into the seafood industry and the wider community that sustainability goals are being met. Based on this we identify one tangible benefits,

[116] Viscusi, W.K., and Aldy, J.E., (2003). The Value of A Statistical Life: A Critical Review of Market Estimates Throughout the World. NBER Working Paper 9487

albeit that it may be challenging to quantify the extent that can be attributed to EFIS, associated with price premiums afforded certified product. (Table 18)

Table 18: Estimated "potential premium" benefits on MSC certified from improved traceability and CoC

	SKJ		YFT		
	Volume (t)	Value	Volume (t)	Value [2]	Total
Free School caught[1]	782,890	1,174,335,019	235,752	471,503,340	
FAD Caught	459,793	689,688,821	138,457	276,914,660	
Total Volume /(Average price)	**1,242,683**	**1,864,023,840[2]**	**374,209**	**748,418,000[3]**	
Total (MSC Premium) [4]		2,098,890,844		842,718,668	
Current premium realized (25%)		58,716,751		23,575,167	
Potential premium (50%)		117,433,502		47,150,334	
Potential Benefit		**58,716,750**		**23,575,160**	**82,291,910**

[1] Approximately 63% of all Skipjack and Yellowfin tuna is caught as free-school

[2] Average skipjack tuna price is US$1,500/t

[3] Average Yellowfin tuna price is US$2,000/t

[4] Full chain of custody certified 'free-school' tuna attracts a price premium of 20%t

The rational for the table above is as follows:

PNA MSC certified free-school fisheries attract a premium of 20%. Strong traceability systems underpin that. It is estimated that approximately 63% of the total WCPO caught Skipjack and Yellowfin tuna is free-school caught and of that approximately 25% is fully traceable and attracts an MSC premium. Under improved ER and EM that reinforces and improves traceability, it could expected that up to 50% of Free-school caught Skipjack and Yellowfin tuna will have full Chain of Custody and attract the 20% market premium.

The following benefits attached to improved science and sustainability **have not** been quantified.

5.3.3.5 *Science and Sustainability*

We know that currently there major short-comings in data entry, collection and access and availability that hinder effective management of Tuna stocks in the Pacific. The adoption of EM and ER, combined with existing technologies, will lead to significant data improvements in terms of reliability and accuracy, resolution and quality across a range of quantitative measures, integration across multiple platforms, fleets and fisheries and availability in near-real or real-time. Ultimately access to better data will strengthen compliance and reporting and enhance fisheries management and sustainability outcomes delivering tangible benefits to fishing nations and the fishing industry.

Neither ER nor EM would completely displace the need for a robust port-sampling program to collect valuable species level data (e.g. length–frequency, age-frequency and sex) needed to strengthen stock assessment modeling (Dunn et al., 2013). The "cost" of resourcing a sampling program for the Pacific longline fleet could be estimated by multiplying the number of longline vessels (N =1,351) by the average number trips per annum (N = 10) to derive a total number trips for the fleet annually of 13,500 trips. By applying the recommended ROP of 5%, approximately 680 trips would need to be randomly sampled throughout the year. Assuming a port sampler can sample around 4 vessels per day; this would be amount to 170 FTE days of sampling, less than one full time position. On this basis we have not adjusted the downwards any estimates of employment efficiency gains (Table 13)

More timely access to high quality information from various data sources[117] will strengthen the quality of annual stock assessments and reduce uncertainty in modelling of stocks and setting of catch and/or effort limits. That said quantifying these benefits is not straightforward, but they likely to flow from the as a result of:

i. More reliable data leading to increased certainty and confidence in the accuracy of stock assessments. This will lower precautionary limits around setting of annual catch and effort and could potentially lead to re-setting of higher TACs (i.e. increases in vessel-days) and improved economic returns to industry and increased rents to CCMs[118];

ii. Increased certainty in long-term allocation of allocated fishing days will strengthen tenure rights potentially leading to an increase in Vessel Day's market values[119] and increased revenues to PNA;

iii. Manpower needs for verification, validation and checking of manually entered data prior to its use in stock assessments will be reduced allowing for a more efficient allocation of labour (i.e. time savings and task redeployment);

iv. Strengthening of data availability in real-time, specifically on IUU and by-catch that improves economic returns to CCMs. The benefits of reduced IUU and by-catch of commonly caught shark species have been estimated above (see above)

[117] Historically with the use of manual data entry and reporting systems, significant portions of log-sheet data and observer reports have not been available in time for annual assessment leading to the need for undertaking assessments with incomplete data sets.

[118] It has been estimated that due to better reporting and a stronger observer program, the current TAC in the Southern Bluefin Tuna fishery is 25-50% higher than it may otherwise be.

[119] At current prices, a 10% increase in Vessel Day values would generate an additional US$44,500,000 in access fees

6 ASSESSMENT OF AND RECOMMENDATIONS FOR COST RECOVERY OPTIONS

This section examines the existing fee structure and the ability of the industry to pay for EFIS on a cost recovery basis. Regional fee structures are in place for registration (FFA Vessels of Good Standing) and the PNA VDS. National fees are also set and cover a range of issues including access fees, licensing fees and MCS costs. The report also assesses fleet economics to determine the industry's ability to pay.

6.1 REGIONAL AND NATIONAL POLICIES ON COST RECOVERY AND CURRENT REGISTRATION AND LICENSING FEES

Cost recovery is an explicit requirement for FFA Vessel Register and the PNA VDS. It is not a requirement of WCPFC, where the responsibility for payment is left to the CCM. For WCPFC this means that some US$ 411,200 (Table 5) is absorbed annually by WCPFC as part of their operating cost[120]. Both FFA and PNA's set annual registration fee (Box 5):

These costs are broadly set out to recover the costs of registration, and in the case of FFA are specifically tailored to meet the costs of the VMS, other ET support tools, the cost of managing the FFA registration system (which is not computerized) and other MCS support costs. It is noteworthy that donors provide support funding to the RFSC. The main issue here is that, unlike WCPFC, the ET costs of US$ 1,303/vessel (Table 5) are adequately covered at the registration fee rates of US$ 1,423 / vessel to US$ 3,140/vessel (Box 5). The additional cost of WCPFC monitoring High Seas would be around US$ 200/vessel. This comparatively lower number reflects the costs spread amongst more vessels, single authority monitoring (as opposed to 17 country zones), and that all additional ET costs (SAR and AIS) are attributable to FFA.

As for ER, the costs of FIMS system, which is the most comprehensive ER software available, would equate to US$ 1,690 per vessel, or US$ 3,847, per vessel, when including iFIMS training and support costs. This would suggest some merit in increasing Registration costs from US$ 1,910 (Box 5, PNA ER) to at least US$ 2,500 (US$ PNA ER). iFIMS support costs are directly recovered by the service provider. Note however that around US$ 500 / vessel reflects the additional national ER support costs, which would have to be reimbursed, or extracted as part of the national licensing fee.

Licensing fees payable to national fishery administrations reflect the cost of '*services provided to the industry (and other government departments*)' (NFA, 2015). In the four case study countries these ranged from around US$ 1,000 to US$ 50,000[121], and are usually itemized separately for purse seine, longline, pole-and-line and carrier/bunker vessels. License fees also usually differentiate between domestic, locally based and foreign registered vessels. The intent for all case study countries is to demonstrate that the fees recover primarily administration and management costs. Other additional fees outside these can be itemized (MCS, observers and training), and paid for, or 'recovered' separately. These activities and associated fees are not normally differentiated by nationality of the flag vessel. Fees charged for fishing in each EEZ are termed 'Access Fees' and are a separate cost item not considered part of any cost recovery mechanism. National finance ministries usually absorb access fees as a source of Exchequer funding.

[120] WCPFC12-2015-FAC9-15.

[121] NFA's licensing fees are fairly nominal ranging from US$ 800 to US$ 1,500 / licensed vessel, RMI's costs are US$ 5,000 for longline and US$ 20,000 for purse seine, Fiji's costs re US$ 5,000/licensed vessel. Solomon Islands permit fees are US$ 1,000

Box 5: Sub regional registration costs

FFA RFSC (ET)

FY15/16 Registration Fee **FY15/16 FFA Levy**

	Vessel Registration Fee	FFA Levy	Total Fee
Full Paying Vessels	$ 2,940.00	$ 200.00	$ 3,140.00
Full Paying Vessels - Member LL	$ 2,940.00	$ 100.00	$ 3,040.00
Member Domestic Vessels - Non-LL	$ 1,323.00	$ 200.00	$ 1,523.00
Member Domestic Vessels - LL	$ 1,323.00	$ 100.00	$ 1,423.00

Item Codes required for	
Registration Fee-Full Paying Vessels	$ 2,940.00
FFA Levy-Full Paying Vessels	$ 200.00
FFA Levy-Full Paying - Member LL	$ 100.00
Registration Fee-Member Domestic	$ 1,323.00
FFA Levy-Member Domestic-Non-LL	$ 200.00
FFA Levy-Member Domestic-LL	$ 100.00

PNA (ER)

			Purse Seine		Longline	
	Expense Item	Bi-lateral category	FSMA category	Domestic	Vessels < 40m	Vessels > 40m
FIMS	Registration Fee Conservation Levy	$2,000.00 $6,000.00	$2,000.00 $2,000.00	$2,000.00	250.00	500.00
iFIMS	Company Fee Vessel Fee	$ 900 $1,915.25	$ 900 $1,915.25	$900 $1,915.25	$900 $1,190.25	$900 $1,190.25

This would suggest that where the national fishery departments would incur specific extra EFIS costs, there is a case for specific itemized funding. These could be added to MCS costs. ET and ER costs are largely covered as part of the FFA and PNA registration and third party contractor costs (QAC), the exception being US$ 500 for extra ER national support personnel.

With regards EM costs, these have been identified as a substitute cost for on-board observer fees (mainly for longline vessels), capable of generating a net benefit of approximately US$ 1,930/vessel (Table 12). This lends support to the position that EM costs should be charged direct to the vessel by the respective national fishery departments. The potential sticking point here is that the annualized per user cost for EM US$ 3,444, although this includes the cost of equipment installation of US$ 1,958 (Table 6). Cost recovery issues are potentially more complex since they require a significant investment (US$ 10,000 for equipment plus installation costs) upfront. By way of example AFMA paid US$ 615,000 (AUD 850,000) as an upfront costs for 36 vessels in the ETBF (Timmiss, 2015). The industry was persuaded to endorse the scheme, on the basis that net benefits were significantly

higher than if industry was paying for more costly on-board observers, noting that the cost of an Australian observer (US$ 650/day), is ten times that of a Pacific Island observer. EM costs may have to form a condition of access to EEZs however, installation of EM systems as a condition of high seas access is likely to have much less leverage. The costs of EM to purse seiners, as a proportion of their income, will be substantially lower than these same costs to long-liners and pole-and-line vessels Table 19, For this reason, implementing EM on longline vessels, as an alternative to onboard observer coverage, is more likely to encounter industry resistance, although this could neutralized by the positive net benefits argument. One option would be to introduce EM to all medium/high risk vessels on the VCI, or link EM to vessels that are caught and prosecuted, as an integral part of the sanction process.

6.2 ECONOMICS OF THE FISHERIES

The ability of fleets to pay EFIS contributions is summarized in Table 19 below. These data are taken from the PNAO economics model which reviews prices and cost structures on an annual basis relative to changes in catch volume, price, operating costs (fuel, labour, management fees and other) the cost of capital (depreciation, interest), and the opportunity cost of borrowing. Taken together these costs determine the economic rent. Other costs, including access fees and others referred to above (MCS, training and observers) are extracted from the fishery. Added to these costs would be the costs attributed to ET, ER and EM, which are collectively US$ 8,800/vessel. Assessing industry's ability to pay, first of all suggests that these costs, relative to sales, are extremely low; secondly it also highlights their ability to pay relative to overall profit levels. EFIS fee rates remain standard for all vessel types as the cost of servicing remains the same, irrespective of fishing method. The table shows broadly high levels of profit for the purse seine and longline fleet. However, the pole-and-line fleet has been generally operating at a loss. This said, there remains compelling reasons why ET and ER should be applied to this fishery, but probably not so for EM.

Table 19: Fishing vessel economics, average annual revenue and costs per vessel, 2011-2015

Item	Purse seine		Longline[122]		Pole-and-line	
	US$ '000	% of sales	US$ '000	% of sales	US$ '000	% of sales
Sales revenue	10,474	100%	1,157	100%	2,227	100%
Operating costs	4,831	46%	749	65%	2,223	100%
Cost of Capital	1,200	12%	162	14%	224	10%
Economic rent	4,445	42%	247	21%	(240)	-11%
Access fees	1,325	1%	20	2%	20	1%
Less						
Other government costs	289	0%	5	0.43%	5	0.2%
ET	1.5	0.001%	1.5	0.13%	1.5	0.07%
EM	3.5	0.003%	3.5	0.30%	3.5	0.15%
ER	3.8	0.004%	3.8	0.33%	3.8	0.17%
Balance	2,818	3%	209	18%	(274)	-12%

Source: PNAO

[122] Represents Chinese pocket longline which accounts for > 80% of the current longline fleet

6.3 RECOMMENDED RECOVERY RATES

The issue of cost recovery is very important in the design and longer-term development of these systems, and also the capability to extract theses costs from the management of the fishery.

As demonstrated earlier, the ET (VMS and other RFSC costs) are presently extracted from the FFA Register. These costs (US$ 1,303 /vessel (Table 5)) are broadly covered with registration fees ranging from US$ 1,423/vessel to US$ 3,410 (Box 5). That said, the authors are not aware of the internal cost attribution components to FFA Registration.

However, there is no systematic cost recovery system in the ER development of FFA's RIMF system, which has been entirely donor funded. Furthermore, vessels fishing in WCPFC, and these costs are subsidized by WCPFC expenditure as a whole. This represents a shortfall of around US$ 200 for all vessels fishing in the High Seas. This is an area that required addressing. More explicitly, however, there are some areas of double counting of resources and costs in terms of the operations of both FFA and WCPFC, which could be streamlined if operating through a single RFSC.

There would also be some room for increasing PNA costs for ER over and above the existing registration fees. The current registration fee rates are US$ 2,000 for each purse seine vessel, and US$ 500 and US$ 250 for longline vessels <40m, and less than 40 m respectively (Box 5). The PNA ER cost is estimated at US$ 2,320/vessel. This would suggest that there is cost recovery for the purse seine fleet but not for the longline fleet, where all the functions are very much the same.

EM options for user pays and covering hardware and installation costs are more complex for the longline sector, as vessels may opt for fishing in one zone, or may operate transboundary and in the High Seas. This would suggest that it is more practical to explore options for some up front cost recovery as well as well as an annual contribution. Transboundary activity would represent an additional complexity, suggesting the imperative of specific standards, or even a single provider to specific groups, e.g. PNA. Recovery rates for EM will potentially have to be net of the initial capital investment costs (US$ 10,000), where industry may be asked to pay these costs as a condition of access. Annual operating fees are likely to be around US$ 1,000/vessel. Covering part of the initial capital cost could be an area where NGOs could seek to cooperate. However, the scale of activity makes this quite impractical. Various options would have to be discussed between coastal states, flag states, industry and NGOs.

6.4 COST RECOVERY PATHWAY

There are two types of cost recovery charges; **cost recovery fee** charged when a good, service or regulation) is provided directly to a specific individual or organisation and **cost recovery levies** covering charges imposed when a good, service or regulation is provided to a group of individuals or organisations (i.e. an industry sector) and funds activities provided to, or resources made available to, the group that pays the levy. In general licensing and applicable observer costs are usually regarded as recoverable through fees based on costs of placing an observer on a fishing boat, including administration. Justification for fees can come from costs savings or benefits such as that provided by EM in reducing costs of having on-board observers. Levies (i.e. access fees) are by and large a means by which costs are recovered through revenues and economic profits generated from access to a fishery resource and enhancement of those resources, such as through IT improvements.

A generic pathway to implementing a new or revised cost recovery program is illustrated in Figure 10 below. Specific cost-recovery solutions for ER and EM that could be adopted by FFA member countries would need a more detailed financial analysis. The key principles or objectives of any cost recovery program should be:

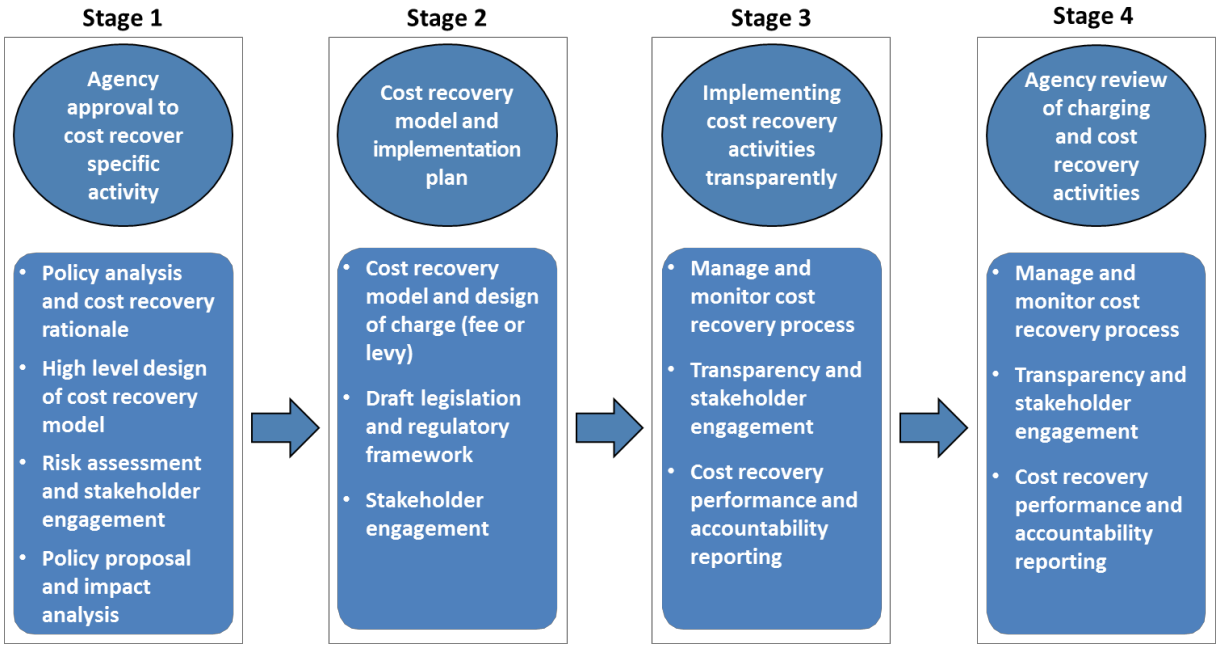
- Economic efficiency and effectiveness in delivery
- Transparency around policy approvals and the cost recovery model to those affected stakeholders

- Accountability on roles and responsibilities and ensuring appropriate governance structures are in place; and
- Stakeholder engagement throughout all stages of the cost recovery process

Moreover, cost recovery in general should:

- promote equity, whereby the cost recovery arrangement accounts for differences in industry structure, profitability and expected benefits[123],
- improve the efficiency, productivity and responsiveness of an agencies activities and accountability for those activities
- increase cost consciousness for all stakeholders by raising awareness of how much a government activity costs

Figure 10: Pathway to implementing new or upgraded cost recovery systems



Source: Adapted from Australian Government Cost Recovery Guidelines

An example of how a cost recovery pathway framework could function is in the case of reallocating costs for payment of on-board observers to that of paying for on-land analysts of EM data. The assumption is that these costs will continue to be borne by industry although the cost recovery mechanism may differ. Also, in the case of EM capital costs (hardware and installation), these are significant and complex (see section 6.3).

Stage 1 of the pathway is mostly focussed on stakeholder engagement to ensure buy-in and iterative, transparent policy development. Stages 2 and 3 of the pathway analysis would entail a detailed quantification of costs for specific activities and development of a financial model for recovery of Initial or upfront capital investment costs which need to be built into the cost recovery

[123] The cost recovery structure includes both fixed and variable components, which means the relative costs for vessels operating for only limited periods or accruing lower economic rents from fishing are higher.

mechanism[124], as well as redirecting ongoing annual data review costs. In the case of the former, where costs are substantial, this would need to include identification of funding sources (e.g. industry, NGO, Donor, coastal and flag states) and in some cases tying these funding commitments to access, as part of a new legislative and/or regulatory agenda, all with the explicit involvement of key stakeholders. As part of the need for transparency, clear accountability reporting of where recovered costs are being expended would be need to be available

[124] The relatively minor capital costs associated with installation of ER and ET systems and that fact that rregistration fees, by and large, cover software development costs simplifies cost recovery of these systems

7 PRELIMINARY OPPORTUNITIES IDENTIFIED / RECOMMENDATIONS

This report demonstrates that there is an overwhelming need for EFIS systems and that the benefits resulting from these significantly outweigh the costs. It is noteworthy that WCPFC (WCPFC, 2014) has already identified a series of operational recommendations, which will compliment the recommendations listed below.

Some specific recommendations relevant to this study are as follows:

Recommendation 1: Consideration should be given to reviewing the rationale of having both WCPFC and FFA operating two Fisheries Surveillance Centres. There appears to be compelling cost efficiency reasons for the operation of one as opposed to two operational centres. However, it is of course understood that roles and membership of WCPFC and FFA do differ.

Recommendation 2: WCPFC should revisit whether cost recovery systems should be considered as a way to supplement existing levels of assessed contributions from members. If agreed the establishment of some form of registry of active vessels could complement this, noting that the WCPFC Record of Fishing Vessels, as a list of authorized vessels, contains both active and inactive vessels.

Recommendation 3: FFA, SPC and PNA need to focus on a practical and more rapid timeline to roll out ER systems and promote and support the agreement of WCPFC ER standards. Every effort should be made to strengthen electronic registration, the monitoring of catch and effort through e-log and e-obs systems and additional components that go towards improving e-CDS.

Recommendation 4: Donor and NGO funds should be channeled into providing support for capacity building of national EFIS officers, and providing support for ER officers to facilitate the more rapid adoption of ER.

Recommendation 5: EM should be rolled out as an acceptable supplement to, or potentially provide a reporting system where existing observer reporting falls below the Commission's ROP standard.

Recommendation 6: The use of E-M sensors should be incrementally implemented on purse seine, longline and carrier vessels with an initial emphasis on targeting high risk vessels.

Recommendation 7: It is recommended that national and regional observer programs be responsible for analysis of video and sensor data and that this data and should be made also be accessible in near real time to the RFSC.

Recommendation 8: The PICs' should ensure that their fisheries legislation and regulations, at a minimum, details the following:

f) clear classifications (including legal definitions) of the types of data or information involved, whether personal, confidential or other information;

g) the purposes, methods and locations for obtaining, collecting, accessing, transmitting, storing and disclosing the data/information, including any relevant exceptions, limitations or restrictions;

h) the relevant entities who will store, transmit, receive, access and process or use the information or data;

i) legal safeguards to the security of data/information – through confidentiality and data protection / personal data provisions (including relevant compliance and enforcement provisions);

j) a reasonable estimation of the necessary length of time that a regulatory body must retain the particular data based on the carrying out of the proposed use (including expressly regulating how data can be retained for longer periods – for example, where determined necessary by the particular holding authority).

Recommendation 9: The PICs could mitigate any potential data protection and privacy legal issues by implementing general privacy legislation governing, among other things, the protection, use and disclosure of personal information. However, even with the implementation of specialised privacy legislation, specific amendments to existing fisheries legislation integrating EM and ER, and addressing potential legal issues or uncertainty proactively, is the most effective approach.

Recommendation 10: Management organisations (PNA, FFA and WCPFC) and countries should be made aware that despite differences in fleet earning capacity, the costs of ET, EM and ER are broadly the same. Special treatment of the longline sector for example, should not be given for EFIS. ER fees should be set at around US$ 2,000 for all vessels.

Recommendation 11: WCPFC / FFA / SPC, in partnership with national administrations, NGOs and donors, should explore payment guidelines for up front EM capital expenditures, including the application of EM to the high seas. Payments could be integrated as part of a penalty process for offenders.

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APPENDIX A: SUMMARY DETAILS OF PERSONNEL ENGAGED

Below are summary details of persons met face-to-face or contacted via email

Persons met/emailed	Affiliation
Tim Adams	FFA
Ramesh Chand	FFA
Ken Katafono	FFA
Bryan Scott	FFA
Hugh Walton	FFA
Gavin Baker	Regional Surveillance Centre, FFA
Lara Manarangi-Trott	Compliance Manager, WCPFC
Transform Aqorau	PNA
Maurice Brownjohn	PNA
Peter Williams	SPC
Malo Hosken	SPC
Mark Oates	Quick Access Computing (QAC)
David Karis	National Fisheries Authority, PNG
Philip Lens	NFA, PNG
Eddie Honiwala	Ministry of Fisheries & Natural Resources, Solomon Islands
Glen Joseph	MIMRA
Trent Timmins	AFMA
Stephanie Martin	AFMA
Dave Power	AFMA
Mike Gerner	AFMA
Andrew Fedoruk	Archipelago AP
Bob Stanley	Archipelago AP
Steve Kennelly	Archipelago AP
Shelley Clarke	Western and Central Pacific Fisheries Commission
Duncan Souter	MRAG Asia Pacific
David Byrom	MRAG Asia Pacific
Taro Kawamoto	Purse seine vessel owner
Russell Dunham	Longline vessel manager

APPENDIX B: REGIONAL AND SUB-REGIONAL MEASURES

APPENDIX B-1: WCPFC CMMS

MEASURE	ACTION
CMM 2004-03 Marking of fishing vessels	• Specifications for the marking of fishing vessels.
CMM 2007-01 Regional Observer Program	• Functions of Regional observers; • Obligations of the CCMs; • Role of the coastal state; • Guiding principles for the operation of the ROP;
CMM 2007-02 VMS in the Convention area	• Application of the Commission VMS (geographical distinction); • Applicable to all vessels > 24 m; • VMS Standards Specifications Procedures (SSPs).
CMM 2008-03 Sea Turtles	• Implement FAO Guidelines; • Comatosed turtles to be brought on board and resuscitation attempted; • Proper handling and release techniques and equipment to be applied as per WCPFC Guidelines; • Purse seine operators to follow specific procedures to avoid and release turtles; • Purse seine operators to report all interactions and provide reports to WCPFC.
CMM 2013-10 Record of fishing vessels and authorisation to fish	• Authorisation to fish;
CMM 2009-06 Transhipment	• Notification of designated ports and ports of transhipment; • Reporting on transhipments in the high seas; • Carriage of observers and definition of their monitoring duties; • Transhipping authorisations (longliners) if applicable.

MEASURE	ACTION
CMM 2010-07: Sharks	• Members comply with reporting systems confirming Implementation of National Plan of Action on Sharks; • Require full utilisation through retention of carcass; • Implement 5% fin to carcass weight ratio, requiring fins and carcasses to be offloaded together at the point of first landing; • Prohibit retention, transhipment or trading in fins caught in contravention; • Encourage live release of sharks in non-target fisheries.
CMM 2011-04 Oceanic white-tip sharks	• Prohibits all CCMs from retaining on board, transhipping, storing on a fishing vessel, or landing any oceanic white-tip shark, in whole or in part, in the fisheries covered by the Convention.
CMM 2011-03 Cetaceans	• Conservation and Management Measure for Protection of Cetaceans From Purse Seine Fishing Operations
CMM 2012-04	• Conservation and Management measure for whale sharks
CMM 2013-01	•
CMM 2013-02: Compliance monitoring	• Monitoring and reporting systems implemented: • Catch and effort limits; • Catch and effort reporting; • Spatial and temporal closures and gear restrictions; • Observer and VMS requirements; and • Scientific data provision, reporting and handling.
CMM 2013-08 Silky sharks	• Prohibits all CCMs from retaining on board, transhipping, storing on a fishing vessel, or landing any silky shark, in whole or in part, in the fisheries covered by the Convention
CMM 2015-01	• Limit high seas purse seine effort to 2004 levels or average 2001-04; • Limit EEZ effort to 2010 levels (PNA) or take compatible measures; • Operating the purse seine Vessel Day Scheme (VDS); • FAD closure – 4 months from 2013 (with a flexibility formula); • Closure of 2 high seas pockets;

MEASURE	ACTION
	• 100% catch retention/no discards (for tuna species); • 100% observer coverage for purse seine

APPENDIX B-2: THE PNA VESSEL DAY SCHEME

The PNA's Vessel Day Scheme sets overall limits on the number of days either purse seine and longline fishing vessels can be licenced to fish in PNA waters. Each Vessel day scheme is separate, with the purse seine VDS implemented from 2008, and the longline vessel day scheme, to be implemented from 2017. Under each scheme, days are allocated to each country and traded between countries, such as when a country uses up all its days while another has days spare. In the below meeting notice and attachments, is current information about the Total Allowable Effort (total allowable days) in the PNA Purse Seine Vessel Day Scheme. - See more at: http://www.pnatuna.com/VDS#sthash.BXSmoYf9.dpuf

The total number of purse seine days allocated (the Total Allowable Effort) is 45,881 days in 2016, allocated across the 8 Parties, plus Tokelau. The total number of longline vessel days to be allocated from 2017 will be 156,000 days

Under the purse seine vessel days scheme, vessels may reclaim Non Fishing Days. These include provision for transiting zones, breakdown and weather restrictions. Each national VDS administrator undertakes assessment of the validity of each claim.

Box 1: Standard Minimum Terms and conditions required of licenses vessels operating in FFA member country waters.

- Common Regional Licence Form to be carried on board at all times.
- Good Standing on the FFA Vessel Register: that vessel and its operator to have good standing on the FFA Vessel Register; and vessel to be registered on the WCPFC Record of Fishing Vessels.
- Transshipment: no purse seine vessel, except for group seiners, to transship at sea; 72 hours notice; submit full reports on transshipping
- Pay all fees required
- Maintain and Submit Catch Logs in Zones and High Seas
- Reporting: each Wednesday; within a reasonable time of entry into and departure from the zone, and entry into a port. Out-turn documentation, and landing and dock receipts to be provided
- Observers to be allowed and assisted to undertake their duties, every effort to be made to achieve twenty per cent coverage
- agent to be appointed to receive and respond to any legal process
- Vessels in Transit to have fishing equipment stowed or secured for fishing.
- Port State Control: FFA members to exercise powers of port State over fishing vessels in their ports,
- Inspection/Enforcement: operators to comply instructions and directions given by an authorised and identified person
- copy of the International Code of Signals (INTERCO) to be accessible at all times;
- Vessels to be identified in accordance with FAO Standards
- Flag States or Fishermen's Associations to be required in agreements to take measures to ensure compliance by their vessels
- Vessel Monitoring System to be implemented
- Fish Aggregating Devices to be clearly marked and identified
- Compulsory pre-fishing inspections to be carried out

APPENDIX B-3: MTC LEGISLATIVE OVERVIEW

Legislation	Key provisions	Enforcement body	Application / Notes
PAPUA NEW GUINEA			
Fisheries Legislation			
Fisheries Management Act 1998	**S58(y)** provides that a person commits an offence who "*knowingly divulges, or tampers with information transmitted in connection with a vessel monitoring system, except in the course of his duty and to a person who is authorized in the course of his duty to receive the information*". **S73** outlines a list of offences for interfering with evidence, including: *"(5) A person who, whether in Papua New Guinea, in fisheries waters or on the high seas, intentionally, recklessly or unintentionally destroys, damages, renders inoperative or otherwise interferes with any part of a vessel monitoring system aboard a vessel, or who intentionally feeds or inputs into that system information or data which is not officially required or is meaningless...";* *(6) A person who intentionally, recklessly or negligently divulges information or data obtained from a vessel monitoring system or a system of reporting or recording required or permitted under this Act, other than in the course of duty and to a person or persons entitled to receive that information or data in the course of duty…";* *(7) A person who allows unauthorised access to premises where a vessel monitoring system is operated or allows unauthorised access to information or data from a vessel* *monitoring system…".*	National Fisheries Authority	The *Fisheries Management Act 1998* is PNG's primary piece of fisheries legislation. This Act has been amended by the *Fisheries Management (Amendment) Act 2015*. The key amendments in relation to EM and ER are outlined below.

	S74 (Duty of Confidentiality) **S74(1)** *Any person carrying out duties or responsibilities in the National Fisheries Authority or otherwise under this Act, including the Minister and members of the Board shall not, unless authorized in accordance with this Act, reveal information or other data of a confidential nature acquired by virtue of their said authority, duties and responsibilities to any person not having such authority or carrying out such duties and responsibilities.* **S74(2)** *The Managing Director may designate any information as confidential, and in doing so may also exempt general summaries of aggregated information from confidentiality requirements.* **S74(3)** *The Managing Director may authorise in writing any person to -* *(a) receive or access confidential information; or* *(b) access or restrict access to such premises holding confidential information as he may designate.* *(4) Notwithstanding Subsection (2), the following information shall be confidential:-* *(a) any information or data of a commercial nature provided in records, returns, or other documents required under this Act;* *(b) any information or other data supplied by a vessel monitoring system in accordance with this Act;* *(c) such other information or data as may be prescribed from time to time."* **S74(5)** provides that confidential information may be disclosed to the extent: "*(a) that disclosure is authorized or required under th[e] Act or any other law; or* *(b) that the person providing the information authorized its disclosure; or* *(c) necessary to enable the Managing Director to publish statistical information relating to the fisheries sector; or* *(d) necessary to enable advice to be given to the Minister*."		

	S74(6) "*The Managing Director may authorise the release of any information supplied by a vessel monitoring system relating to the position of any vessel, upon request, to the* *responsible authority for purposes including surveillance, search and rescue and other emergency, and may authorise the release of such other confidential information for such purposes as may be prescribed*" **S76(1)(m)** provides that the Head of State may make regulations for "*monitoring, control and surveillance of fishing and related activities, including provisions relating to the operation of a vessel monitoring system, the gathering and storing of information regarding a vessel and its fishing activities or related activities, and the use of information, including readings, printouts, displays and pictures of or produced by any vessel monitoring system and the management and use of such information"* **[Note: S76(1)(m) has been amended by the *Fisheries Management (Amendment) Act 2015,* outlined below]**		
Fisheries Management (Amendment) Act 2015	**S73B (Vessel Monitoring System – Information)** **S73B(1)** Ownership of vessel monitoring information "*is vested in the Papua New Guinea government*" **S73B(2)** "*All vessel monitoring information shall be classified as confidential information, and shall be subject to such procedures as may be prescribed by regulation*" **S73B(3)** "*Any person who divulges information from a vessel monitoring system to any person or persons not authorised to receive such information commits an offence*" **S76(1)(m)** provides that the Head of State may make regulations for *"monitoring, control and surveillance of fishing and related activities, including provisions relating to operation of a vessel monitoring system, the collection, storing and transmission of information obtained by electronic means including electronic log books, sensors, cameras or otherwise, regarding a vessel's electronic equipment and its fishing or related activities, and the use of data and other information, including readings, printouts, displays and pictures of or produced by any electronic systems, and the management and use of such information"*	National Fisheries Authority	The *Fisheries Management (Amendment) Act 2015* amends the *Fisheries Management Act 1998*. The provisions of the 2015 Act have been noted in this table separately for clarity regarding the recent EM/ER amendments. However, ultimately these provisions constitute provisions of the *Fisheries Management Act* (as amended). This Act has amended S76(1)(m) specifically to accommodate EM and ER**.**

Fisheries Management Regulation 2000	**S23 (Vessel Reporting Requirements)** This section requires that masters or operators transmit, or otherwise provide, information and data continuously and accurately. **S32 (Electronic Transmission and Storage)** "*(1) For the purpose of this Act, the Managing Director may approve the transmission of accounts, records, returns, transactions, information, notices, objections, requests, applications or other documents required under the Act and this Regulation by means of electronic transmission, and storage in registers by electronic means*" **S33 (Vessel Monitoring System)** This section gives the Managing Director discretion to define the access of any person or class of persons to VMS information and data. *"(1) The Managing Director shall designate officers of the Authority to be authorized to receive and deal with information and data received from a vessel monitoring system, and shall define the access of any person or class of persons to such information and data.* *(2) In any circumstances where the Act requires the installation of and carrying of equipment providing for a vessel monitoring system, it shall be the responsibility of the operator to pay for the cost of such installation and operation.* *(3) No person shall -* *(a) tamper with vessel monitoring system equipment; or* *(b) receive information or dates from a vessel monitoring system that has been received by the Authority unless authorised to do so by the Managing Director.* *(4) Where, in any proceedings for an offence against this Act, the prosecution tenders evidence that has been produced wholly or partly by a machine, device, or technical process, and the machine, device, or technical process is of a kind that ordinarily does what the prosecution asserts the machine, device, or technical process has done, then, in the absence of proof to the contrary, the evidence shall be admissible and sufficient proof*	National Fisheries Authority	The provisions of the *Fisheries Management Regulation 2000* relevant to vessel reporting requirements (electronic or otherwise) generally give the Managing Director wide discretion to determine the type, form of information that must be stored or provided to the authorities (including the frequency within which such information must be provided).

	that, on the relevant occasion, the machine, device, or technical process operated in the way asserted by the prosecution. *(5) The Managing Director may authorise the release of information subject to this section for purposes of judicial proceedings or Summary Administrative Proceedings."*		
Organic Law on Provincial and Local-Level Governments		Various	This piece of legislation gives provincial and local (i.e. non-Federal) governments the responsibility for fisheries and other development activities and the provision of basic services.
National Tuna Fishery Management and Development Plan 2014		National Fisheries Authority (to implement the plan)	This development plan provides for the establishment of an EM and ER programs, to be implemented by the National Fisheries Authority.
Constitution			
Constitution of the Independent State of Papua New Guinea	**S49 – Right to privacy** *"Every person has the right to reasonable privacy in respect of his private and family life, his communications with other persons and his personal papers and effects, except to the extent that the exercise of that right is regulated or restricted by a law that complies with Section 38 (general qualifications on qualified rights)."*	n/a	
	S51 – Right to Freedom of Information *"(1) Every citizen has the right of reasonable access to official documents, subject only to the need for such secrecy as is reasonably justifiable in a democratic society in respect of–* *(a) matters relating to national security, defence or international relations of Papua New Guinea (including Papua New Guinea's relations with the Government of any other country or with any international organization); or* *(c) trade secrets, and privileged or confidential commercial or financial information obtained from a person or body; or*		

	… *(g) the prevention, investigation and prosecution of crime; or* … *(h) the maintenance of personal privacy and security of the person;…"*		
National Information and Communication Technology Act 2009			Not relevant to the implementation of EM/ER into domestic fisheries legislation. No relevant regulations regarding data privacy, confidential information, or related issues.
SOLOMON ISLANDS			
Fisheries Legislation			
Fisheries Act 1998			This Act has been **REPEALED**.
Fisheries Management Act 2015	**S33** - The Director of Fisheries has discretion to require any person regulated under the Act to "*keep, furnish or communicate*" any information, accounts, records, relating to fishing activities. **S36 - Confidential Information** Confidential information is defined to include any commercial information required to be kept, furnished or communicated under S33, any information or data supplied by a mobile transceiver unit, raw scientific research data. The Director can declare any information as confidential, and can authorize any person access to that information. **S33(6)** relates to the disclosure of confidential data, and outlines what circumstances such data can be disclosed. Confidential data can be disclosed for a variety of different purposes (SS33(6) and (7)) and maintains its confidential status for 3 years from the date the Director declares it as such.	Ministry of Fisheries and Marine Resources	
Fisheries (Amendment) Act 2009			The *Fisheries (Amendment) Act 2009* only relates to financial amendments (increasing monetary amounts required to be paid under Fisheries regulations).

Fisheries (Local Fishing Vessels) Regulations			No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Fisheries (Foreign Fishing Vessels) Regulations 1981			No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Fisheries (United States of America) Treaty Act 1988			No regulations regarding data privacy, confidential information, etc.
Constitution			
The Constitution of Solomon Islands 1978	**S3** outlines the "Fundamental Rights and Freedoms of the Individuals", one of which is the "*protection for the privacy of his home and other property and from deprivation of property without compensation*" (S3(c))	n/a	S9 further details this fundamental right (protection for the privacy of home and other property) and makes it clear that it relates to search and entry protection.
	S12 Protection of freedom of expression *(1) Except with his own consent, no person shall be hindered in the enjoyment of his freedom of expression, and for the purposes of this section the said freedom includes the freedom to hold opinions without interference, freedom to receive ideas and information without interference, freedom to communicate ideas and information without interference and freedom from interference with his correspondence.* *(2) Nothing contain in or done under the authority of any law shall be held to be inconsistent with or in contravention of this section to the extent that the law in question makes provision-* *(a) in the interest of defence, public safety, public order, public morality or public health;* *(b) for the purpose of protecting the reputations, rights and freedoms of other persons or the private lives of persons concerned in legal proceedings, preventing the disclosure of information received in confidence, maintaining the authority and independence of the courts, or regulating the administration or the technical operation of telephony, telegraphy, posts, wireless, broadcasting or television; or*		

	(c) that imposes restriction upon public officers, and except so far as that provision or, as the case may be, the thing done under the authority thereof is shown not to be reasonably justifiable in a democratic society.		
FIJI			
Fisheries Legislation			
Fisheries Act CAP 158 ('Fisheries Act' and regulations)		Department of Fisheries	No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Marine Spaces – Chapter 158A ('Marine Space CAP 158A)		Department of Fisheries	No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
General Regulations of the Marine Space Act		Department of Fisheries	No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Offshore Fisheries Management Decree 2012 ('Offshore Decree')	The term "document" is defined under S2(1) as "*in relation to a vessel, means any chart, logbook and other information or record which include electronically stored records or information used in the operation of the vessel or for the purpose of fishing or related activities, or that which relates to fishing vessel and crew activities and fishing vessel operations*". **S107 (Duty of confidentiality)** *(1) Any person carrying out duties or responsibilities under this Decree, shall not unless authorised in accordance with this Decree, reveal information or other data of a confidential nature acquired by virtue of their said authority, duties and responsibilities to any person not having such authority, duties and responsibilities.* *(2) The Permanent Secretary may designate any information as confidential, and in doing so may also exempt general summaries of aggregated information from confidential requirements.* *(3) The Permanent Secretary may authorise in writing any person to—* *(a) receive or access confidential information; or*	Department of Fisheries	As amended by the *Offshore Fisheries Management (Amendment) Decree 2014* (No. 4 of 2014).

	(b) access or restrict access to such premises holding confidential information as he may designate. *(4) Notwithstanding subsection (2) the following information shall be confidential—* *(a) any information or data of a commercial nature provided in records, returns, or other documents required under this Decree;* *(b) any information or other data supplied by a vessel monitoring system in accordance with this Decree;* *(c) such other information or data as may be prescribed from time to time.* *(5) Information may be disclosed to the extent—* *(a) that the disclosure is authorised or required under this Decree or any other law;* *(b) that the person providing the information authorised its disclosure;* *(c) necessary to enable the Permanent Secretary to publish statistical information relating to the fisheries sector; or* *(d) necessary to enable advice to be given to the Minister.* *(6) The Permanent Secretary may authorise the release of any information supplied by a vessel monitoring system relating to the position of any vessel, upon request, to the responsible State agencies for purposes including surveillance, search and rescue and other emergency, and may authorise the release of such other confidential information for such purposes as may be prescribed.* *(7) Any person who violates the requirements of this section commits an offence and, in addition to any penalty, his or her appointment or other authority under this Decree may be reviewed and terminated by the appropriate authority.*		
Marine Act 1986	**S156(4)** *A public officer shall not, otherwise than in the performance of his official duties-* *(a) make available any record; or*		This provision is a restriction on the release of information which has been obtained by the Minister pursuant to the Marine Act.

	(b) divulge or communicate to any person any information, acquired by him or furnished to the Minister under subsection (1) or (2). *Penalty: A fine not exceeding $2,000 or imprisonment for-a term not exceeding 12 months, or both*		
Constitution			
The Constitution of the Republic of Fiji	**Bill of Rights – Chap 2** **S17 - Freedom of speech, expression, and publication** *"(1) Every person has the right to freedom of speech, expression, thought, opinion and publication, which includes—* *(a) freedom to seek, receive and impart information, knowledge and ideas;* *(b) freedom of the press, including print, electronic and other media;* *(c) freedom of imagination and creativity; and* *(d) academic freedom and freedom of scientific research.* *…* *(3) To the extent that it is necessary, a law may limit, or may authorise the limitation of, the rights and freedoms mentioned in subsection (1) in the interests of—* *(a) national security, public safety, public order, public morality, public health or the orderly conduct of elections;* *(b) the protection or maintenance of the reputation, privacy, dignity, rights or freedoms of other persons…* *(c) preventing the disclosure, as appropriate, of information received in confidence;"* **S24 - Right to privacy** *"(1) Every person has the right to personal privacy, which includes the right to—* *(a) confidentiality of their personal information;*	n/a	

	(b) confidentiality of their communications; and *(c) respect for their private and family life.* *(2) To the extent that it is necessary, a law may limit, or may authorise the limitation of the rights set out in subsection (1).”* **S25 - Access to information** “*(1) Every person has the right of access to—* *(a) information held by any public office; and* *(b) information held by another person and required for the exercise or protection of any legal right.* *(2) Every person has the right to the correction or deletion of false or misleading information that affects that person.* *(3) To the extent that it is necessary, a law may limit, or may authorise the limitation of, the rights set out in subsection (1), and may regulate the procedure under which information held by a public office may be made available.*”		
REPUBLIC OF MARSHALL ISLANDS			
Fisheries Legislation			
Marshall Islands Marine Resources Act 1997	**S119** provides that the Marshall Islands Marine Resources Authority has the power to “*coordinate and manage fisheries monitoring, control and surveillance and, in consultation with the Attorney General, enforcement of the Act*”	Marshall Islands Marine Resources Authority	RMI’s fisheries legislation was enacted in 1997 under the *Marshall Islands Marine Resources Act 1997.* In 2004, this Act was codified into five chapters under Title 51 of the *Marshall Islands Revised Code*. The five chapters are: - *Marshall Islands Marine Resources Act 1997* (Ch. 1) - *Fisheries Act 1997* (Ch. 2) - *Management and Development of Local Fisheries Act 1997* (Ch. 3) - *Fish Access & Licensing Act 1997* (Ch. 4) - *Fisheries Enforcement Act 1997* (Ch. 5)

Fisheries Act 1997	**S203(4) (Conservation, management and sustainable use of the fishery resources)** "*The Authority shall as appropriate adopt and apply the following general principles in relation to fisheries management:* … *(g) collect and share, in a timely manner and in accordance with fisheries management agreements and international law, complete and accurate data concerning fishing activities on, inter alia, vessel position, catch of target and non-target species and fishing effort, as well as information from national and international research programs"* **S207(6) -** With respect to fishery management and development plans, "*[i]n order to assess and recommend appropriate management, development and conservation measures for any fishery plan, the Director may reasonably require any person to furnish all relevant data and information, including fishing time and effort, landing, processing, sales and other related transactions*."	Marshall Islands Marine Resources Authority	
Fisheries Enforcement Act 1997	***S508*** *-* ***Vessel Monitoring system: Information.*** *(1) Ownership of all vessel monitoring system information generated by a mobile transmitting device required and operating under this Title is vested in the Marshall Islands.* *(2) All vessel monitoring information shall be classified as confidential information, and shall be subject to such procedures as may be prescribed by regulation.* *(3) Any person who divulges information from a vessel monitoring system, to any person or persons not authorized to receive such information commits an offence and shall be liable on conviction to a fine not less than fifteen thousand dollars ($15,000) and not exceeding one hundred thousand dollars ($100,000).*	Marshall Islands Marine Resources Authority	
Fishing Access and Licensing Act 1997	**S420** outlines various reporting requirements, including a requirement that vessel operators maintain "in ink a fishing log" with vessel and catch information.	Marshall Islands Marine Resources Authority	No relevant provisions with respect to the implementation of EM/ER into domestic legislation.

Maritime Administrations Act			No relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Documentation and Identification of Vessels Act			This Act relates mostly to vessel registration, and contains no relevant provisions with respect to the implementation of EM/ER into domestic legislation.
Constitution			
Constitution of the Republic of the Marshall Islands	**S13 – Personal autonomy and Privacy** "*All persons shall be free from unreasonable interference in personal choices that do not injure others and from unreasonable intrusions into their privacy*"		
INTERNATIONAL AGREEMENTS			
Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific *Region*	**Article III(2)** provides that the "*Parties shall cooperate to develop regionally agreed procedures for the conduct of fisheries surveillance and law enforcement…".* **Article V** relates to the exchange of information and provides the following: (1) "*Each Party shall, to the extent permitted by its national laws and regulations, provide to the South Pacific Forum Fisheries Agency, or to any other Party directly, information relevant to the purposes of this Treaty, including but not limited to information about:* *c) the location and movement of foreign fishing vessels;* *d) foreign fishing vessel licensing; and* *e) fisheries surveillance and law enforcement activities.* *(2) The Parties shall develop standard forms and procedures for reporting information under paragraph 1 of this Article and effective methods for communicating such information*."		The Niue Treaty contains provisions that promote cooperation in fisheries monitoring, control and surveillance. These provisions contain a number of obligations for the PICs relevant to EM and ER.